# Alaska Marine Mammal Stock Assessments 1999

by

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# CONTENTS


| SPECIES | STOCK | PAGE |
|---|---|---|
| ***Pinnipeds*** | | |
| Steller Sea Lion | Western U. S. | 1 |
| Steller Sea Lion | Eastern U. S. | 9 |
| Northern Fur Seal | Eastern Pacific | 16 |
| Harbor Seal | Southeast Alaska | 23 |
| Harbor Seal | Gulf of Alaska | 31 |
| Harbor Seal | Bering Sea | 40 |
| Spotted Seal | Alaska | 47 |
| Bearded Seal | Alaska | 52 |
| Ringed Seal | Alaska | 56 |
| Ribbon Seal | Alaska | 60 |
| ***Cetaceans*** | | |
| Beluga Whale | Beaufort Sea | 63 |
| Beluga Whale | Eastern Chukchi Sea | 67 |
| Beluga Whale | Eastern Bering Sea | 71 |
| Beluga Whale | Bristol Bay | 76 |
| Beluga Whale | Cook Inlet | 81 |
| Killer Whale | Eastern North Pacific Northern Resident | 87 |
| Pacific White-Sided Dolphin | Central North Pacific | 94 |
| Harbor Porpoise | Southeast Alaska | 98 |
| Harbor Porpoise | Gulf of Alaska | 103 |
| Harbor Porpoise | Bering Sea | 108 |
| Dall's Porpoise | Alaska | 113 |
| Sperm Whale | North Pacific | 118 |
| Baird's Beaked Whale | Alaska | 122 |
| Cuvier's Beaked Whale | Alaska | 125 |
| Stejneger's Beaked Whale | Alaska | 128 |
| Gray Whale | Eastern North Pacific | 131 |
| Humpback Whale | Western North Pacific | 136 |
| Humpback Whale | Central North Pacific | 141 |
| Fin Whale | Northeast Pacific | 149 |
| Minke Whale | Alaska | 152 |
| Northern Right Whale | North Pacific | 155 |
| Bowhead Whale | Western Arctic | 158 |
| ***Appendices*** | | |
| Appendix Table 1. Summary of changes for the 1999 stock assessments | | 165 |
| Appendix Table 2. Stock summary table | | 166 |
| Appendix Table 3a. Summary table for Alaska category 2 commercial fisheries | | 168 |
| Appendix Table 3b. Interaction table for Alaska category 2 commercial fisheries | | 169 |
| Appendix Table 3c. Interaction table for Alaska category 3 commercial fisheries | | 170 |
| Appendix Table 3d. Observer coverage in Alaska commercial fisheries, 1990-97 | | 173 |
| Appendix 4. Self-reported fisheries information | | 174 |

# PREFACE

On April 30, 1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act (MMPA). Interactions between marine mammals and commercial fisheries are addressed under three new sections. This new regime replaced the interim exemption that has regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaska waters, along the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes a description of the stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence hunters. Under the new regime, these data will be used to evaluate the progress of each fishery towards achieving the MMPA's goal of zero fishery-related mortality and serious injury of marine mammals.

This is a working document. This document represents the third revision since the original development of the stock assessment reports in 1995 (Small and DeMaster 1995). The first and second revisions were labeled the 1996 (Hill et al. 1997) and 1998 (Hill and DeMaster 1998) stock assessment reports, respectively. Each stock assessment report is designed to stand alone and will be updated as new information becomes available. The MMPA requires stock assessment reports to be reviewed annually for stocks designated as strategic, annually for stocks where there are significant new information available, and at least once every 3 years for all other stocks. New information for all strategic stocks (Steller sea lions, northern fur seals, Cook Inlet beluga whales, sperm whales, humpback whales, fin whales, right whales, and bowhead whales), beaked whales, transient killer whales, and beluga whales were reviewed in late 1998. This review led to the revision of the following stock assessments for the 1999 document: Steller sea lions (2 stocks), beluga whales (5 stocks), humpback whales (2 stocks) and beaked whales (3 stocks). The stock assessment reports for all stocks, however, have been included in this document for completeness. Those sections of each stock assessment report containing significant changes are listed in Appendix Table 1. In addition, the assessment for the eastern North Pacific Transient killer whale stock was revised and moved to the Pacific Region document (see Barlow et al. 1999). The authors solicit any new information or comments which would improve future stock assessment reports.

The U. S. Fish and Wildlife Service (USFWS) has management authority for polar bears, sea otters and walrus. Copies of the stock assessments for these species may be obtained through USFWS, Marine Mammals Management, 1011 E. Tudor Road, Anchorage, AK, 99501.

Ideas and comments from the Alaska Scientific Review Group (SRG) have significantly improved this document from its draft form. The authors wish to express their gratitude for the thorough reviews and helpful guidance provided by the Alaska SRG members: Lloyd Lowry (chairman), Milo Adkison, John Gauvin, Carl Hild, Sue Hills, Charlie Johnson (new member), Brendan Kelly, Matt Kookesh, Denby Lloyd, Beth Mathews, Craig Matkin, Jan Straley, and Kate Wynne.

The information contained within the individual stock assessment reports stems from a variety of sources. Where feasible, we have attempted to utilize only published material. When citing information contained in this document, authors are reminded to cite the original publications, when possible.

Revised 6/25/99

# STELLER SEA LION (*Eumetopias jubatus*): Western U. S. Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (NMFS 1995); however, resighting data from branded animals have not yet been analyzed.

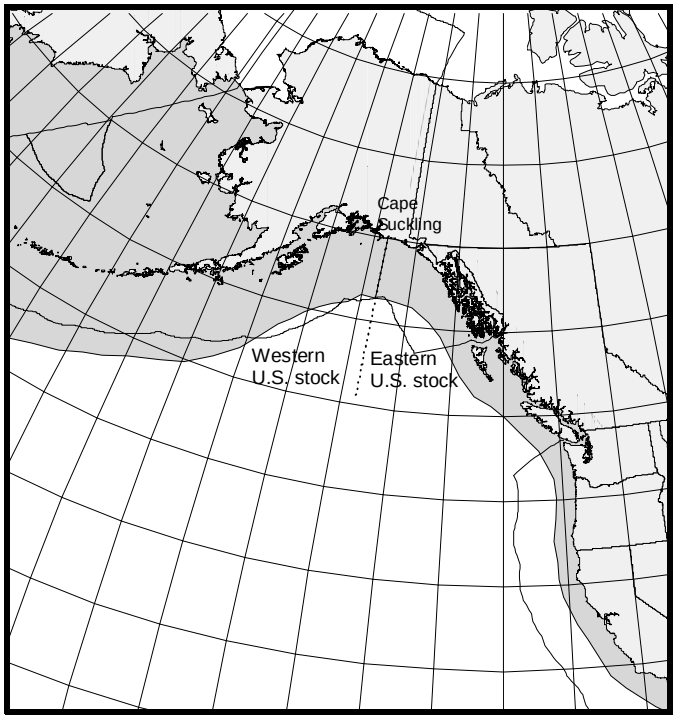


**Figure 1.** Approximate distribution of Steller sea lions in the eastern North Pacific (shaded area).

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: unknown; and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions are now recognized within U. S. waters: an eastern U. S. stock, which includes animals east of Cape Suckling, Alaska (144/W), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 1).

## POPULATION SIZE

The most recent estimate of Steller sea lion abundance in Alaska is based on aerial surveys performed in June and ground based pup counts in June and July 1998 from Southeast Alaska to the western Aleutian Islands (Sease and Loughlin 1999). Data from these surveys represent actual counts of pups and nonpups at all rookeries and major haulout sites in Alaska. During the 1998 survey, a total of 28,658 nonpups were counted in the Gulf of Alaska (12,299) and the Bering Sea/Aleutian Islands (16,359). Note that the 1998 counts for the Gulf of Alaska (12,299) were incomplete because only three of the 25 sites in the eastern Gulf of Alaska were surveyed during 1998. These three sites, however, are major rookeries and included a majority of the animals counted in the eastern Gulf subarea during the 1994 and 1996 surveys (52% and 60%, respectively). It is estimated that 1,000 animals were not counted in the 22 un-surveyed sites (Sease and Loughlin 1999).

The pup counts were conducted at all known rookeries for this stock during 1998. There were 4,058 pups counted in the Gulf of Alaska and 5,315 pups counted in the Bering Sea/Aleutian Islands for a total of 9,373 for the stock. Combining the pup count data (9,373), nonpup count data (28,658), and estimate for un-surveyed sites (1,000) results in a minimum abundance estimate of 39,031 Steller sea lions in the western U. S. stock in 1998.

**Minimum Population Estimate**

The 1998 total count (39,031) will be used as the minimum population estimate ($N_{MIN}$) for the western U. S. stock of Steller sea lion (Wade and Angliss 1997). This count data is considered a minimum estimate because it has not been corrected to account for animals which were at sea during the surveys.

**Current Population Trend**

The first reported trend counts (an index to examine population trends) of Steller sea lions in Alaska were made in 1956-60. Those counts indicated that there were at least 140,000 (no correction factors applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Counts from 1976 to 1979 indicated about 110,000 sea lions (no correction factors applied, Table 1). The decline appears to have spread eastward to the Kodiak Island area during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). The greatest declines occurred in the eastern Aleutian Islands and western Gulf of Alaska, but declines also occurred in the central Gulf of Alaska and central Aleutian Islands. More recently, counts of Steller sea lions at trend sites for the western U. S. stock decreased 27% from 1990 to 1996 (Table 1). Counts at trend sites during 1998 indicate that the number of sea lions in the Bering Sea/Aleutian Island regions has continued to decline (7.8% since 1996, Table 1, Fig. 2).

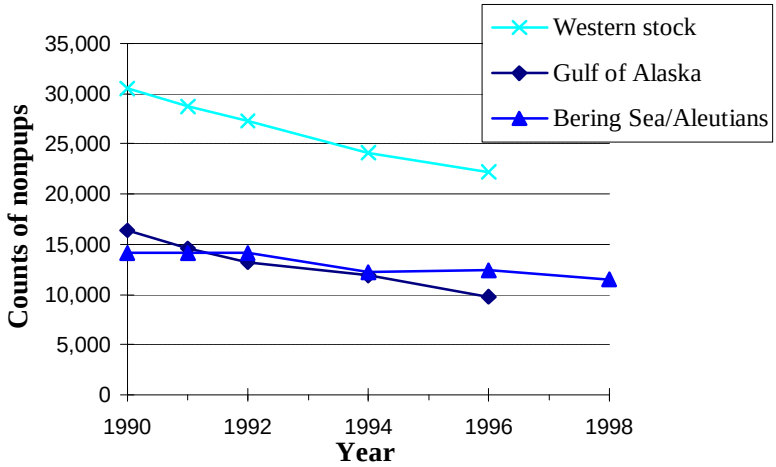


**Figure 2.** Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U. S. stock, 1990-98. Because not all sites in the eastern Gulf of Alaska were surveyed during 1998, those data have not been included in the figure.

**Table 1.** Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the western U. S. stock from the late 1970s through 1998 (NMFS 1995, Strick et al. 1997, Sease et al. 1999, Sease and Loughlin 1999). Counts from 1976-79 (NMFS 1995) were combined to produce complete regional counts which are comparable to the 1990-98 data. n/a indicates that data are not available due to an incomplete survey (see text).

| Area | late 1970s | 1990 | 1991 | 1992 | 1994 | 1996 | 1998 |
|---|---|---|---|---|---|---|---|
| Gulf of Alaska | 65,296 | 16,409 | 14,603 | 13,179 | 11,871 | 9,789 | n/a |
| Bering Sea/ Aleutians | 44,584 | 14,116 | 14,141 | 14,107 | 12,248 | 12,434 | 11,521 |
| Total | 109,880 | 30,525 | 28,744 | 27,286 | 24,119 | 22,223 | n/a |

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rate for Steller sea lions. Hence, until additional data become available, it is recommended that the theoretical maximum net productivity rate ($R_{MAX}$) for pinnipeds of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. However, it should be noted that the PBR management approach was developed with the understanding that human-related mortalities would be the primary reason for observed declines in abundance for marine mammal stocks in U. S. waters. For at least this stock, this assumption seems unwarranted. The recovery factor ($F_R$) for this stock is 0.1, the default value for stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Thus, for the western U. S. stock of Steller sea lions, PBR = 234 animals (39,031 × 0.06 × 0.1).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Six different commercial fisheries operating within the range of the western U. S. stock of Steller sea lions were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No sea lion mortality was observed by fishery observers in either pot fishery. For the fisheries with observed takes, the range of observer coverage over the 8-year period, as well as the annual observed and estimated mortalities, are presented in Table 2a. The mean annual (total) mortality for the most recent 5-year period was 6.8 (CV=0.23) for the Bering Sea groundfish trawl fishery, 1.2 (CV=0.61) for the Gulf of Alaska groundfish trawl fishery, 0.2 (CV=1.0) for the Bering Sea groundfish longline fishery, and 1.0 (CV=0.77) for the Gulf of Alaska groundfish longline fishery. In 1996 (66% observer coverage), only 2 of the 4 observed mortalities in the Bering Sea trawl fishery occurred during monitored hauls, leading to an underestimate (3) of the extrapolated mortality for that fishery. As a result, 4 mortalities were used as both the observed and estimated mortalities for that year (Table 2a). The observed mortality in the 1993 Bering Sea longline fishery (30% observer coverage) also occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1993 for that fishery, and should be considered a minimum estimate.

Observers also monitored the Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording 2 mortalities in 1991, extrapolated to 29 (95% CI 1-108) kills for the entire fishery (Wynne et al. 1992). No mortalities were observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean kill rate of 14.5 (CV=1.0) animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). Fisher self-reports from this fishery detail 12, 5, 1, and 23 Steller sea lion mortalities in 1990, 1991, 1992, and 1993, respectively. The extrapolated (estimated) observer mortality accounts for these self-reported mortalities, so they do not appear in Table 2a. The Alaska Peninsula and Aleutian Islands salmon drift gillnet fishery was also monitored during 1990 (roughly 4% observer coverage) and no Steller sea lion mortalities were observed. Combining the mortality estimates from the Bering Sea and Gulf of Alaska groundfish trawl and longline fisheries presented above (6.8+1.2+0.2+1.0=9.2) with the mortality estimate from the Prince William Sound salmon drift gillnet fishery (14.5) results in an estimated mean annual mortality rate in the observed fisheries of 23.7 (CV=0.62) sea lions per year from this stock.

**Table 2a.** Summary of incidental mortality of Steller sea lions (western U. S. stock) due to commercial fisheries from 1990 through 1997 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1993 to 1997 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSAI) groundfish trawl | 90-97 | obs data | 53-74% | 13, 13, 15, 4, 9, 2, 4, 6 | 13, 19, 21, 6, 11, 3, 4, 10 | 6.8 (CV=0.23) |
| Gulf of Alaska (GOA) groundfish trawl | 90-97 | obs data | 33-55% | 2, 0, 0, 1, 1, 0, 0, 0 | 4, 0, 0, 3, 3, 0, 0, 0 | 1.2 (CV=0.61) |
| BSAI groundfish longline (incl. misc. finfish and sablefish fisheries) | 90-97 | obs data | 27-80% | 0, 0, 0, 1, 0, 0, 0, 0 | 0, 0, 0, 1, 0, 0, 0, 0 | 0.2 (CV=1.0) |
| GOA groundfish longline (incl. misc. finfish and sablefish fisheries) | 90-97 | obs data | 8-21% | 1, 0, 0, 0, 0, 1, 0, 0 | 2, 0, 0, 0, 1, 4, 0, 0 | 1.0 (CV=0.77) |
| Prince William Sound salmon drift gillnet | 90-91 | obs data | 4-5% | 0, 2 | 0, 29 | 14.5 (CV=1.0) |
| Prince William Sound salmon set gillnet | 90 | obs data | 3% | 0 | 0 | 0 |
| Alaska Peninsula/Aleutian Islands salmon drift gillnet | 90 | obs data | 4% | 0 | 0 | 0 |
| Observer program total | | | | | | 23.7 (CV=0.62) |
| | | | | **Reported mortalities** | | |
| Alaska Peninsula/Aleutian Islands salmon set gillnet | 90-97 | self reports | n/a | 0, 1, 1, 1, n/a n/a, n/a, n/a | n/a | [$0.75] |
| Cook Inlet salmon drift gillnet | 90-97 | self reports | n/a | 0, 0, 0, 2, n/a n/a, n/a, n/a | n/a | [$0.5] |
| Bristol Bay salmon drift gillnet | 90-97 | self reports | n/a | 0, 4, 2, 8, n/a n/a, n/a, n/a | n/a | [$3.5] |
| Prince William Sound set gillnet | 90-97 | self reports | n/a | 0, 0, 2, 0, n/a n/a, n/a, n/a | n/a | [$0.5] |
| Alaska miscellaneous finfish set gillnet | 90-97 | self reports | n/a | 0, 1, 0, 0, n/a n/a, n/a, n/a | n/a | [$0.25] |
| Alaska halibut longline (state and federal waters) | 90-97 | self reports | n/a | 0, 0, 0, 0, 1 n/a, n/a, n/a | n/a | [$0.2] |
| Alaska sport salmon troll (non-commercial) | 93-97 | strand | n/a | 0, 0, 0, 0, 1 | n/a | [$0.2] |
| Minimum total annual mortality | | | | | | $29.6 (CV=0.62) |

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishing operations is the self-reported fisheries information required of vessel operators by the MMPA. Some incidental takes of sea lions reported in the Gulf of Alaska fisheries were listed as "unknown species", indicating the animals could have been either Steller or California sea lions. Based on all logbook reports for both species within the Gulf of Alaska, California sea lions represented only 2.2% of all interactions. Thus, the reports of injured and killed "unknown" sea lions were considered to be Steller sea lions. During the period between 1990 and 1997, fisher self-reports from 6 unobserved fisheries (see Table 2a) resulted in an annual mean of 5.7 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reports for Alaska fisheries, except the groundfish trawl and longline fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska, and the Prince William Sound salmon drift gillnet fishery for which observer data were presented above. The Bristol Bay salmon drift gillnet and set gillnet fisheries accounted for the majority of the reported incidental take in unobserved fisheries. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

Strandings of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1993 to 1997 the only fishery-related Steller sea lion stranding was reported in August of 1997 in Prince William Sound. The animal had troll gear in its mouth and down its throat (considered a serious injury; see Angliss and DeMaster 1998). It is likely that this mortality occurred as a result of a sport fishery, not a commercial fishery (Table 2a). Fishery-related strandings during 1993-97 result in an estimated annual mortality of 0.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

NMFS studies using satellite tracking devices attached to Steller sea lions suggest that they rarely go beyond the U.S. Exclusive Economic Zone into international waters. Given that the high-seas gillnet fisheries have been prohibited and other net fisheries in international waters are minimal, the probability that Steller sea lions are taken incidentally in commercial fisheries in international waters is very low. NMFS concludes that the number of Steller sea lions taken incidental to commercial fisheries in international waters is insignificant.

The minimum estimated mortality rate incidental to commercial fisheries is 30 sea lions per year, based on observer data (23.7) and self-reported fisheries information (5.7) or stranding data (0.2) where observer data were not available. No observers have been assigned to several fisheries that are known to interact with this stock (self-reported data from these fisheries are provided in Table 2), making the estimated mortality a minimum estimate.

**Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 2b: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. Between 1992-95 approximately 43 of the interviewed communities lie within the range of the western U. S. stock. The majority (79%) of sea lions were taken by Aleut hunters in the Aleutian and Pribilof Islands. Details concerning the subsistence harvest of Steller sea lions from the western U. S. stock are provided in Table 2b. The great majority (approximately 99%) of the statewide subsistence take was from the western U. S. stock. The mean annual subsistence take from this stock over the 3-year period from 1993 to 1995 was 412 sea lions. The reported average age-specific kill of the harvest across all years was 31% adults, 62% juveniles, 3% pups, and 4% unknown age. The reported average sex-specific kill of the harvest was approximately 64% males, 19% females, and 17% of unknown sex. The 1993-95 subsistence harvest data were used in the mortality rate calculation because 1996 data for Steller sea lion takes for several communities in the Pribilof Islands are in dispute and the 1997 subsistence harvest data are considered preliminary at this time as they have not been reviewed.

**Other Mortality**

Shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the U.S. Endangered Species Act (ESA) in 1990. Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

**Table 2b.** Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions, 1992-97. Brackets indicate that the 1996 data are in dispute and the 1997 data are preliminary.

| Year | Estimated total number taken | 95% confidence interval | Number harvested | Number struck and lost |
|---|---|---|---|---|
| 1992 | 549 | 452-712 | 370 | 179 |
| 1993 | 487 | 390-629 | 348 | 139 |
| 1994 | 416 | 330-554 | 336 | 80 |
| 1995 | 339 | 258-465 | 307 | 32 |
| 1996 | [179] | [158-219] | [149] | [30] |
| 1997 | [164] | [129-227] | [146] | [18] |
| Mean annual take (1993-95) | 412 | | | |

## STATUS OF STOCK

The current annual level of incidental mortality (30) exceeds 10% of the PBR (24) and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. Based on available data, the estimated annual level of total human-caused mortality and serious injury (30 + 412 = 442) is known to exceed the PBR (234) for this stock. The western U. S. stock of Steller sea lion is also currently listed as "endangered" under the ESA, and therefore designated as "depleted" under the MMPA. As a result, the stock is classified as a strategic stock. However, given that the population is declining for unknown reasons that are not explained by the level of direct human-caused mortality, there is no guarantee that limiting those mortalities to the level of the PBR will reverse the decline.

A number of management actions have been implemented since 1990 to safeguard the western U. S. stock of Steller sea lions including 3 nautical mile no-entry zones around rookeries, prohibition of groundfish trawling within 10-20 nautical miles of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock total allowable catch. More recent modifications recommended by the North Pacific Fisheries Management Council include reductions in removals of Atka mackerel within areas designated as critical habitat in the central and western Aleutian Islands.

### Habitat Concerns

The unprecedented decline in the western U. S. stock of Steller sea lion has caused a recent change in the listing status of the stock from "threatened" to" endangered" under the U. S. Endangered Species Act (ESA) of 1973. There is currently no sign that the decline in the population has slowed or stopped. Although many theories have been suggested (overfishing, environmental change, disease, killer whale predation, etc.) it is not clear what factor or factors are most important in causing the decline.

Regarding the possible adverse impacts of commercial groundfish fisheries in Alaska on the western U. S. stock of Steller sea lion, NMFS has completed (September 1998) a draft Supplemental Environmental Impact Statement (SEIS) and has solicited public comment on it. The draft SEIS supplements the original EIS for the initial Fishery Management Plans for groundfish fisheries in the Bering Sea Aleutian Islands (1981) and the Gulf of Alaska (1978). Of the 26 marine mammal species inhabiting Alaskan waters, only a subset have been shown to consume groundfish species as a large part of their diet, and to potentially do so in areas coincident with groundfish harvest operations: Steller sea lion, northern fur seal, and harbor seal. Based on the potential for indirect interactions, NMFS has determined that the current practices involved in the management of the groundfish fishery in Alaska "may have adverse impacts on the western U. S. stock of Steller sea lions, northern fur seals in the Bering Sea, and both the GOA and western stocks of harbor seals" (Draft SEIS September 1998). In addition, in October of 1998 the NMFS developed a draft Biological Opinion, as required under Section 7(2) of the ESA, that describes potential affects on Steller sea lions by three separate actions: 1) authorization of an Atka mackerel fishery under the Bering Sea and Aleutian Islands (BSAI) groundfish

fishery management plan between 1999 and 2002, 2) authorization of a walleye pollock fishery under the BSAI groundfish fishery management plan between 1999 and 2002, and 3) authorization of a walleye pollock fishery under the Gulf of Alaska (GOA) groundfish fishery management plan between 1999 and 2002. The NMFS previously issued biological opinions on the groundfish fisheries off Alaska in 1991 and 1996. Those earlier opinions concluded that the fisheries were not likely to jeopardize the continued existence and recovery of the Steller sea lion. However, the most recent evidence on food habits suggests that the decline of sea lions may be due to lack of available prey. A Biological Opinion was issued December 3, 1998.

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# STELLER SEA LION (*Eumetopias jubatus*): Eastern U. S. Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (NMFS 1995); however, resighting data from branded animals have not yet been analyzed.

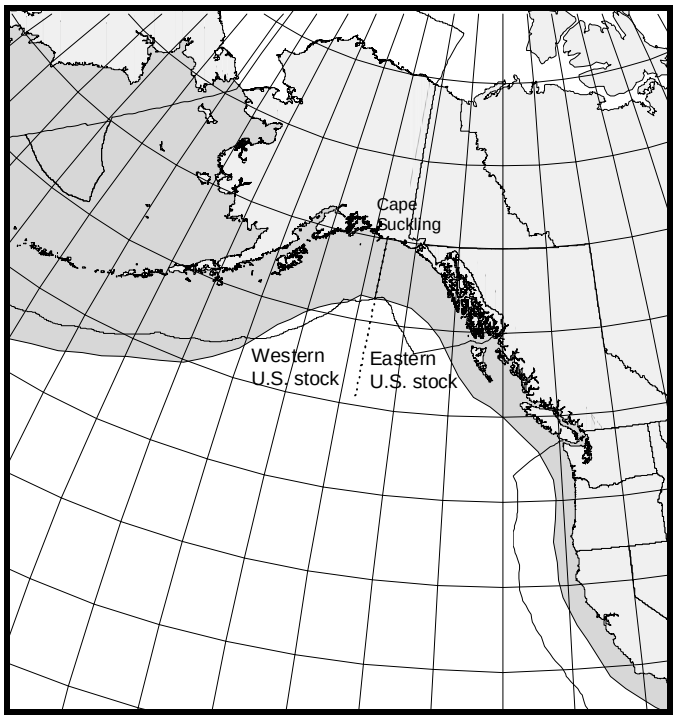


**Figure 3.** Approximate distribution of Steller sea lions in the eastern North Pacific (shaded area).

Loughlin (1997) considered the following information when classifying stock structure based upon the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: unknown; and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions are now recognized within U. S. waters: an eastern U. S. stock, which includes animals east of Cape Suckling, Alaska (144/W), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 3).

## POPULATION SIZE

The most recent estimate of Steller sea lion abundance in Southeast Alaska is based on aerial surveys performed in June 1996 (Sease et al.1999). Data from these surveys represent actual counts of pups and nonpups at all rookeries and major haulout sites in Southeast Alaska. In 1996 a total of 14,571 Steller sea lions were counted in Southeast Alaska, including 10,857 nonpups and 3,714 pups. Aerial surveys and ground counts of California, Oregon, and Washington rookeries and major haulout sites were also conducted during the summer of 1996 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115; Southwest Fisheries Science Center, P. O. Box 271, La Jolla, CA 90238; ODF&W unpubl. data, Marine Science Drive, Newport, OR 97365). In 1996 a total of 6,555 Steller sea lions were counted in California (2,042), Oregon (3,990), and Washington (523), including 5,464 nonpups and 1,091 pups.

The eastern U. S. stock of Steller sea lions is a transboundary stock, including sea lions from British Columbia rookeries (see Wade and Angliss 1997 for discussion of transboundary stocks). Aerial surveys were last conducted in British Columbia during 1994 and produced counts of 8,091 nonpups and 1,186 pups, for a total count of 9,277 (Dept.

Fisheries and Oceans, unpubl. data, Pacific Biological Station, Nanaimo, BC, V9R 5K6). Complete count data are not available for British Columbia in 1996. However, because the number of Steller sea lions in British Columbia is thought

to have increased since 1994 ( P. Olesiuk, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6), the 1994 counts represent a conservative estimate for the 1996 counts. Combining the total counts for the three regions results in a minimum estimated abundance of 30,403 (14,571 + 6,555 + 9,277) Steller sea lions in this stock in 1996.

The abundance estimate for the eastern U. S. stock is based on counts of all animals (pup and nonpup) at all sites and has not corrected for animals missed because they were at sea. A reliable correction factor to account for these animals is currently not available, as it is for the western U. S. stock (J. Sease, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115). As a result, this represents an underestimate for the total abundance of Steller sea lions in this stock.

A range wide survey for Steller sea lions was planned for summer of 1998, but due to unforseen circumstances the survey of Southeast Alaska was incomplete. As a result, the abundance estimate for this stock has not been revised even though data from 1998 surveys are available in the California to British Columbia portion of this stock's range. The 1998 survey data will be used in conjunction with 1999 counts from Southeast Alaska to revise the abundance estimate for this stock.

**Minimum Population Estimate**

The 1996 total count (30,403) will be used as the minimum population estimate ($N_{MIN}$) for the eastern U. S. stock of Steller sea lions (Wade and Angliss 1997). Recall that this count has not been corrected for animals which were at sea, and also utilizes the 1994 data from British Columbia where Steller sea lion numbers are thought to have increased since 1994.

**Current Population Trend**

Trend counts (an index to examine population trends) for Steller sea lions in Oregon were relatively stable in the 1980s, with uncorrected counts in the range of 2,000-3,000 sea lions (NMFS 1992). Counts in Oregon have shown a gradual increase since 1976, as the adult and juvenile state-wide count for that year was 1,486 compared to 3,971 for 1998 (Brown and Reimer 1992; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330). This increase may be an artifact of improved surveys in recent years (NMFS 1995).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 5,000 and 7,000 non-pups with no apparent trend, but have subsequently declined by over 50%, remaining between 1,500 to 2,000 non-pups during 1980-98. Limited information suggests that counts in northern California appear to be stable (NMFS 1995). At Año Nuevo, (central) California, a steady decline in ground counts started around 1970, resulting in an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). In vertical aerial photographic counts conducted at Año Nuevo, pups declined at a rate of 9.9% from 1990 to 1993, while non-pups declined at a rate of 31.5% over the same time period (Westlake et al. 1997). Pup counts at Año Nuevo have been steadily declining at about 5% annually since 1990 (W. Perryman,

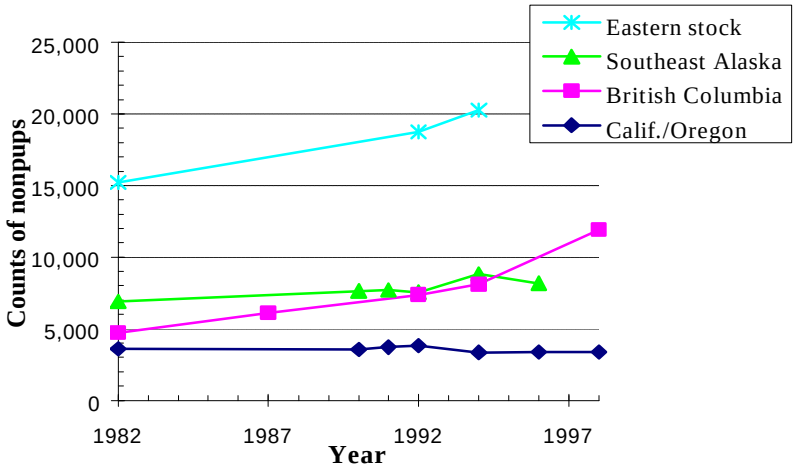


**Figure 4.** Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U. S. stock, 1982-98. Data from British Columbia include all sites.

pers. comm., Southwest Fisheries Science Center, P. O. Box 271, La Jolla, CA, 92038). Overall, counts of nonpups at trend sites in California and Oregon have been relatively stable since the 1980s (Table 3, Fig. 4).

In Southeast Alaska, counts (no correction factors applied) of non-pups at trend sites increased by 28% during 1979-96 from 6,376 to 8,181 (NMFS 1995, Sease et al. 1999). During 1979-97, counts of pups on the three rookeries in Southeast Alaska increased by an average of 5.9% per year. Since 1989 pup counts on the three rookeries increased at a lower rate (+1.7% per year) than for the entire period (Calkins et al. In press). In British Columbia, counts (no correction factors applied) of non-pups throughout the Province increased at a rate of 2.8% annually during 1971-98 (Table 3, Fig. 4; P. Olesiuk, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6). Counts of nonpups at trend sites throughout the range of the eastern U. S. Steller sea lion stock are shown in Figure 4.

**Table 3.** Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the eastern U. S. stock from the 1982 through 1998 (NMFS 1995, Strick et al. 1997, Sease et al. 1999, Sease and Loughlin 1999; P. Olesiuk, unpubl. data, Pacific Biological Station, Nanaimo, BC, V9R 5K6; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970). Central California data include only Año Nuevo and Farallon Island. Trend site counts in northern California/Oregon include St. George, Rogue, and Orford Reefs. British Columbia data include counts from all sites.

| Area | 1982 | 1990 | 1991 | 1992 | 1994 | 1996 | 1998 |
|---|---|---|---|---|---|---|---|
| Central CA | 511[1] | 655 | 537 | 276 | 512 | 385 | 208 |
| Northern CA/OR | 3,094 | 2,922 | 3,180 | 3,544 | 2,834 | 2,988 | 3,175 |
| British Columbia | 4,711 | 6,109[2] | no data | 7,376 | 8,091 | no data | 9,818 |
| Southeast Alaska | 6,898 | 7,629 | 7,715 | 7,558 | 8,826 | 8,181 | no data |
| Total | 15,214 | -- | -- | 18,754 | 20,263 | -- | -- |

[1] This count includes a 1983 count from Año Nuevo. [2] This count was conducted in 1987.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rates for Steller sea lions. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The default recovery factor ($F_R$) for stocks listed as threatened under the Endangered Species Act (ESA) is 0.5 (Wade and Angliss 1997). However, as total population estimates for the eastern U. S. stock have remained stable or increased over the last 20 years, the recovery factor is set at 0.75; midway between 0.5 (recovery factor for a "threatened" stock) and 1.0 (recovery factor for a stock within its optimal sustainable population level). This approach is consistent with recommendations of the Alaska Scientific Review Group. Thus, for the eastern U. S. stock of Steller sea lions, PBR =1,368 animals (30,403 × 0.06 × 0.75).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Fishery observers monitored three commercial fisheries during the period from 1990 to 1997 in which Steller sea lions from this stock were taken incidentally: the California(CA)/Oregon(OR) thresher shark and swordfish drift

gillnet, WA/OR/CA groundfish trawl, and Northern Washington(WA) marine set gillnet fisheries. In 1992 and 1994, 1 Steller sea lion mortality was observed incidental to the CA/OR thresher shark and swordfish drift gillnet fishery. These mortalities extrapolate to estimated total kills of 7 and 6 animals, respectively (Julian 1997, Julian and Beeson 1998). During the most recent 5-year period (1993-97), the mean annual mortality is 1.2 sea lions (CV=1.0) for that fishery (Table 4). One and two Steller sea lion mortalities were observed in the WA/OR/CA groundfish trawl fishery during 1994 (53% observer coverage in 1994) and 1997 (65% observer coverage in 1997), respectively. As these mortalities occurred in unmonitored hauls, they could not be used to calculate the estimated mortality for the fishery. Therefore, the observed mortalities were used as both the observed and estimated mortalities for that fishery, and should be considered minimum estimates (Table 4). These mortalities result in a mean annual mortality of 0.6 (CV=0.67) Steller sea lions for the WA/OR/CA groundfish trawl fishery. During 1996, one Steller sea lion mortality was observed in the Northern Washington marine set gillnet fishery. The mortality was not extrapolated because the coastal portion of the fishery (the portion of the fishery most likely to interact with Steller sea lions) was monitored with 100% observer coverage during 1996. This single observed mortality results in a mean annual mortality of 0.2 (CV=1.0) Steller sea lions for the Northern Washington marine set gillnet fishery. No observer program occurred during 1994 for this fishery. For the fisheries with observed takes, the ranges of observer coverage since 1990, as well as the annual observed and estimated mortalities, are presented in Table 4. Averaging the incidental take data from these three observed fisheries results in an estimated incidental mortality rate of 2.0 (CV=0.64) Steller sea lions per year from this stock. No mortalities were reported by fishery observers monitoring drift gillnet and set gillnet fisheries in Washington and Oregon this decade; though, mortalities have been reported in the past.

**Table 4.** Summary of incidental mortality of Steller sea lions (eastern U. S. stock) due to commercial fisheries from 1990 through 1997 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information or stranding data. Data from 1993 to 1997 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| CA/OR thresher shark and swordfish drift gillnet | 90-97 | obs data | 4-27% | 0, 0, 1, 0, 1, 0, 0, 0 | 0, 0, 7, 0, 6, 0, 0, 0 | 1.2 (CV=1.0) |
| WA/OR/CA groundfish trawl (Pacific whiting component) | 90-97 | obs data | 44-72% | 0, 0, 0, 0, 1, 0, 0, 2 | 0, 0, 0, 0, 1, 0, 0, 2 | 0.6 (CV=0.67) |
| Northern WA marine set gillnet | 90-97 | obs data | 47-98% | 0, 0, 0, 0, n/a, 0, 1, 0 | 0, 0, 0, 0, n/a, 0, 1, 0 | 0.2 (CV=1.0) |
| Observer program total | | | | | | 2.0 (CV=0.64) |
| | | | | **Reported mortalities** | | |
| Southeast Alaska salmon drift gillnet | 90-97 | self reports | n/a | 0, 1, 2, 2, n/a, n/a, n/a, n/a | n/a | [$1.25] |
| Alaska salmon troll | 92-97 | strand data | n/a | 0, 0, 0, 1, 0, 0 | n/a | [$0.2] |
| British Columbia aquaculture predator control program | 91-97 | permit reports | n/a | 14, 8, 10, 11, 6, 13, 22 | n/a | 12.4 |
| Minimum total annual mortality | | | | | | $15.85 (CV=0.64) |

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports from the Southeast Alaska salmon drift gillnet fishery (Table 4) resulted in an annual mean of 1.25 mortalities from interactions with commercial fishing gear. This total is based on all available fisher self-reports for U. S. fisheries within the range of the stock, except the three fisheries for which observer data were presented above. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. During 1990, 11 Steller sea lion injuries incidental to the Alaska salmon troll fishery and 1 Steller sea lion injury incidental to the CA/OR/WA salmon troll fishery were reported. These injuries were not deemed serious (Angliss and DeMaster 1998) and have not been included in the Table 4. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

Strandings of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1993 to 1997 the only fishery-related Steller sea lion stranding was reported in August of 1995 in Southeast Alaska. The mortality has been attributed to the Alaska salmon troll fishery and has been included in Table 4. Fishery-related strandings during 1993-97 result in an estimated annual mortality of 0.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

Steller sea lions are taken in British Columbia incidental to commercial salmon farming operations (Table 4). Preliminary figures from the British Columbia Aquaculture Predator Control Program resulted in a mean annual mortality of 12.4 Steller sea lions from this stock over the period from 1993 to 1997 (P. Olesiuk, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6). Note that the 1995 estimate includes one animal reported as an unidentified sea lion and the 1996 estimate is based upon data from only the first three-quarters of 1996. Due to limited coverage of Canadian observer programs, there are few data concerning the mortality of marine mammals incidental to commercial fisheries in Canadian waters which are analogous to U.S. fisheries that are known to take Steller sea lions. As a result, the number of Steller sea lions taken in Canadian waters is not known.

No observers have been assigned to Canadian fisheries and several U.S. fisheries that are known to interact with this stock, making the estimated mortality unreliable. The minimum estimated mortality rate incidental to commercial fisheries is 16 sea lions per year, based on observer data (2.0) and self-reported fisheries information (1.25), stranding data (0.2), or permit reports (12.4) where observer data were not available.

**Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with NMFS (Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. Between 1992-96 approximately 16 of the interviewed communities lie within the range of the eastern U. S. stock. Only a very small percentage (<1%) of the statewide subsistence take was typically from the eastern U. S. stock. The total subsistence take of Steller sea lions from this stock was estimated at 6, 1, 5, 0, 0, and 0 animals in 1992-97, respectively. These values for total take include 1 animal per year during 1992-94 that was reported struck and lost. The mean annual subsistence take from this stock over the 3-year period from 1995 to 1997 was zero sea lions from this stock.

An unknown number of Steller sea lions from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small. Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on the cooperative management process.

**Other Mortality**

Shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the ESA in 1990. Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

Strandings of Steller sea lions with gunshot wounds do still occur, along with strandings of animals entangled in gear that is not fishery-related. During the period from 1990 to 1997 human-related strandings of animals with gunshot wounds from this stock occurred in Oregon, Washington, and Alaska in 1990 (1 animal), 1993 (9 animals), 1996 (2 animals), and 1997 (3 animals), resulting in an estimated annual mortality of 2.8 Steller sea lions from this stock during 1993-97. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). In addition, human-related stranding data are not available for British Columbia. Reports of stranded animals in Alaska with gunshot wounds have not been included because it is not possible to tell if such a report was the result of an animal struck and lost by subsistence hunters (in which case the mortality would have been accounted for in the subsistence harvest estimate). However, one of the two 1996 reports was from Alaska and has been included because there were no subsistence struck and lost reports during that year.

## STATUS OF STOCK

Based on currently available data, the minimum estimated fishery mortality and serious injury for this stock (14) is less that 10% of the calculated PBR (137) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury from fishery interactions, subsistence harvests, and shootings (16 + 0 + 3 = 19) does not exceed the PBR (1,368) for this stock. The eastern U. S. stock of Steller sea lion is currently listed as "threatened" under the ESA, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. Although the stock size has increased in recent years, the status of this stock relative to its Optimum Sustainable Population size is unknown.

### Habitat Concerns

Unlike the observed decline in the western U. S. stock of Steller sea lion there has not been a concomitant decline in the eastern U. S. stock. Concerns regarding the possible impacts of commercial groundfish fisheries in the Gulf of Alaska and Bering Sea have been noted previously (see Habitat Concerns section in assessment report for the western U. S. stock). However, the eastern U. S. stock is stable or increasing in the northern portion of its range (Southeast Alaska and British Columbia). The stock has been declining in the southern end of its range (see Current Population Trend), where habitat concerns include reduced prey availability, contaminants, and disease (Sydeman and Allen 1997).

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# NORTHERN FUR SEAL (*Callorhinus ursinus*): Eastern Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea (Fig. 5) and west to the Okhotsk Sea and Honshu Island, Japan. During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U. S. waters outside of the Pribilof Islands, approximately 1% of the population is found on Bogoslof Island in the southern Bering Sea and on San Miguel Island off southern California (NMFS 1993). Northern fur seals may temporarily haul out onto land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally do so outside of the breeding season (Fiscus 1983).

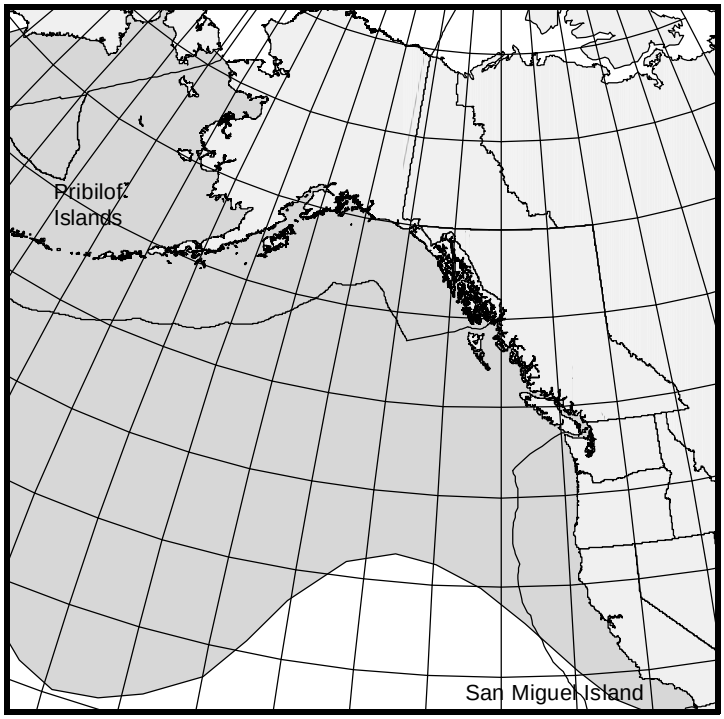


**Figure 5.** Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping times. Adult males usually occur on shore during the 4-month period from May-August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as 6 months (June-November). Following their respective times ashore, seals of both genders then migrate south and spend the next 7-8 months at sea (Roppel 1984). Adult females and pups from the Pribilof Islands migrate through the Aleutian Islands into the North Pacific Ocean, often to the Oregon and California offshore waters. Many pups may remain at sea for 22 months before returning to their rookery of birth. Adult males generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). There is considerable interchange of individuals between rookeries.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution is continuous during feeding, geographic separation during the breeding season, high natal site fidelity (DeLong 1982); 2) Population response data: substantial differences in population dynamics between Pribilof and San Miguel Islands (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this information, two separate stocks of northern fur seals are recognized within U. S. waters: an Eastern Pacific stock and a San Miguel Island stock. The San Miguel Island stock is reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

The population estimate for the Eastern Pacific stock of northern fur seals is calculated as the estimated number of pups at rookeries multiplied by a series of different expansion factors determined from a life table analysis to estimate the number of yearlings, 2 year olds, 3 year olds, and animals at least 4 years old (Lander 1981). The resulting population estimate is equal to the pup count multiplied by 4.475. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. A preliminary analysis indicated that the dynamics of the population have not changed in the last 15 years, so the 4.475 expansion factor remains appropriate (J. Baker, pers. comm., Southwest Fisheries Science Center, 2570 Dole St., Honolulu, HI 96822). Currently, CVs are unavailable for the expansion factor. As the great majority of pups are born on the Pribilof Islands, pup estimates are concentrated on these islands, though additional counts are made on Bogoslof Island. Since 1990, pup counts have occurred biennially. In 1992, 1994, and 1996 pup counts on the Pribilof Islands were 219,151 (CV=0.041), 227,239 (CV=0.036) and 210,401 (CV=0.101), respectively (Antonelis et al. 1994, Antonelis et al. 1996, York et al. 1997). The average mean pup count from these three years of Pribilof Islands data is 218,930 (CV=0.065). In 1997, the number of pups born on Bogoslof Island was 5,096 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). Therefore, the most recent estimate for the number of fur seals in the Eastern Pacific stock is approximately 1,002,516 (4.475×[218,930+5,096]).

### Minimum Population Estimate

A CV(N) that incorporates the variance due to the correction factor is not currently available. Consistent with a recommendation of the Alaska Scientific Review Group (SRG) and recommendations contained in Wade and Angliss (1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate ($N_{MIN}$) for this stock (DeMaster 1998). $N_{MIN}$ is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN}= N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 1,002,516 and the default CV (0.2), $N_{MIN}$ for the Eastern Pacific stock of northern fur seals is 848,539.

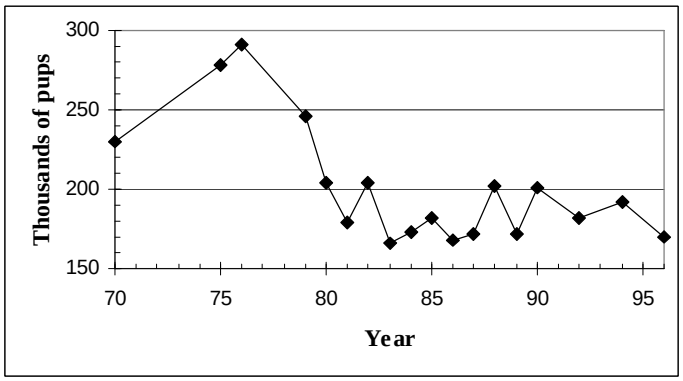


**Figure 6a.** Production of northern fur seal pups on St. Paul Island, Alaska, 1970-96.

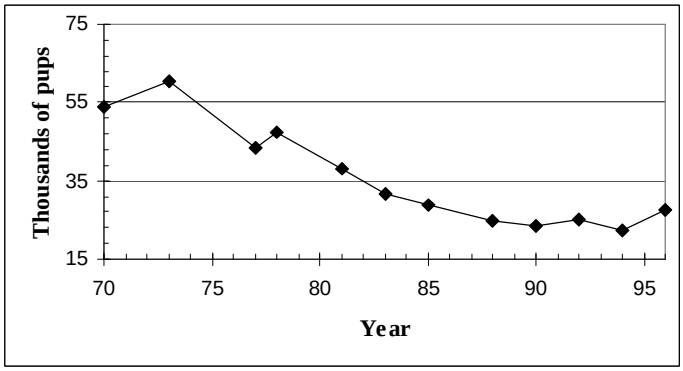


**Figure 6b.** Production of northern fur seal pups on St. George Island, Alaska, 1970-96.

### Current Population Trend

The Alaska population of northern fur seals recovered to approximately 1.25 million in 1974 after the killing of females in the pelagic fur seal harvest was terminated in 1968. The population then began to decrease with pup production declining at a rate of 6.5-7.8% per year into the 1980s (York 1987). By 1983 the total stock estimate was 877,000 (Briggs and Fowler 1984). Annual pup production on St. Paul Island has remained relatively stable since 1981 (Fig. 6a), indicating that stock size has not changed much in recent years (York and Fowler 1992). The 1996 estimate of number of pups born on St. Paul Island is not significantly different from the 1990, 1992, or 1994 estimates (York et al. 1997). The 1996 estimate of number of pups born on St. George Island is the highest since 1985 (Fig. 6b). The northern fur seal was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s and there was no compelling evidence that

carrying capacity (K) had changed substantially since the late 1950s (NMFS 1993). Under the Marine Mammal Protection Act (MMPA), this stock will remain listed as depleted until population levels reach at least the lower limit of its optimum sustainable population (estimated at 60% of K).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population increased steadily during 1912-24 after the commercial harvest no longer included pregnant females. During this period, the rate of population growth was approximately 8.6% (SE=1.47) per year (A. York unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.12% rate of increase (approximate SE=1.29) estimated by Gerrodette et al. (1985). Though not as high as growth rates estimated for other fur seal species, the 8.6% rate of increase is considered a reliable estimate of $R_{MAX}$ given the extremely low density of the population in the early 1900s.

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized MMPA, the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR $= N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for depleted stocks under the MMPA (Wade and Angliss 1997). Thus, for the Eastern Pacific stock of northern fur seals, PBR = 18,244 animals (848,539 x 0.043 x 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

The NMFS estimate of the total number of northern fur seals killed incidental to both the foreign and the joint U. S.-foreign commercial groundfish trawl fisheries in the North Pacific from 1978 to 1988 was 246 (95% CI: 68 - 567), resulting in an estimated mean annual rate of 22 northern fur seals (Perez and Loughlin 1991). The foreign high seas driftnet fisheries also incidentally killed large numbers of northern fur seals, with an estimated 5,200 (95% CI: 4,500 - 6,000) animals taken during 1991 (Larntz and Garrott 1993). These estimates were not included in the mortality rate calculation because the fisheries are no longer operative. Commercial net fisheries in international waters of the North Pacific Ocean have decreased significantly in recent years. The assumed level of incidental catch of northern fur seals in those fisheries, though unknown, is thought to be minimal (T. Loughlin, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115).

Six different commercial fisheries in Alaska that could have interacted with northern fur seals were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only observed fishery in which incidental mortality occurred was the Bering Sea and Aleutian Islands groundfish trawl (Table 5), with a mean annual (total) mortality of 2.2 (CV=0.39). In 1990 and 1991, observers monitored the Prince William Sound salmon drift gillnet fishery and recorded no mortalities of northern fur seals. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). During 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). Although no interaction with northern fur seals was recorded by observers in 1990 and 1991 in these fisheries, due in part to the low level of observer coverage, mortalities did occur as recorded in fisher self-reports (see Table 5).

An additional source of information on the number of northern fur seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA.

During the period between 1990 and 1996, fisher self-reports from 3 unobserved fisheries (see Table 5) resulted in an annual mean of 14.5 mortalities from interactions with commercial fishing gear. While logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), the bias in these estimates are hard to quantify because at least in one area (Prince William Sound), it is unlikely that fur seals occur and reports of fur seal-fishery interactions are likely the result of species misidentification. The great majority of the incidental take in fisher self-reports occurred in the Bristol Bay salmon drift net fishery. In 1990, self-reports from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the northern fur seal mortalities reported in 1990 may have occurred in the set net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

**Table 5.** Summary of incidental mortality of northern fur seals (Eastern Pacific stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Islands groundfish trawl | 90-96 | obs data | 53-74% | 0, 3, 4, 1, 2, 0, 1 | 0, 6, 5, 1, 3, 0, 2 | 2.2 (CV=0.39) |
| Observer program total | | | | | | 2.2 (CV=0.39) |
| | | | | **Reported mortalities** | | |
| Prince William Sound salmon drift gillnet | 90-96 | self reports | n/a | 1, 1, 0, 0, n/a, n/a, n/a | n/a | [$0.5] |
| Alaska Peninsula/Aleutian Islands salmon drift gillnet | 90-96 | self reports | | 2, 0, 0, 0, n/a, n/a, n/a | n/a | [$0.5] |
| Bristol Bay salmon drift gillnet | 90-96 | self reports | n/a | 5, 0, 49, 0, n/a, n/a, n/a | n/a | [$13.5] |
| Minimum total annual mortality | | | | | | $16.7 (CV=0.39) |

No observers have been assigned to several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries is 17 fur seals per year based on observer data (2), and self-reported fisheries information (15) where observer data were not available.

**Subsistence/Native Harvest Information**

Alaska Natives residing on the Pribilof Islands are allowed an annual subsistence harvest of northern fur seals, with a take range determined from annual household surveys. From 1986 to 1996, the annual subsistence harvest level averaged 1,412 and 193 for St. Paul and St. George Islands, respectively, for a total of 1,605. The subsistence harvest in 1994 was 1,616 and 161 on St. Paul and St. George Islands, respectively, for a total of 1,777. The subsistence harvest in 1995 was 1,265 and 260 on St. Paul and St. George, respectively, for a total of 1,525. The subsistence harvest in 1996 was 1,591 (including 3 females accidentally harvested) and 232 on St. Paul and St. George Islands,

respectively, for a total of 1,823. Thus, the mean annual subsistence take of northern fur seals from this stock during the 3-year period from 1994 to 1996 was 1,708 animals. Only juvenile males are taken in the subsistence harvest, which likely results in a much smaller impact on population growth than a harvest of equal proportions of males and females. Subsistence take in areas other than the Pribilof Islands is known to occur, though believed to be minimal (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115).

**Other Mortality**

Intentional killing of northern fur seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown. Such shooting has been illegal since the species was listed as depleted in 1988. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

Mortality resulting from entanglement in marine debris has been implicated as a contributing factor in the decline observed in the northern fur seal population on the Pribilof Islands during the 1970s and early 1980s (Fowler 1987, Swartzman et al. 1990). Surveys conducted from 1995 to 1997 on St. Paul Island indicate a rate of entanglement among subadult males comparable to the 0.2% rate observed from 1988 to 1992 (Fowler and Ragen 1990, Fowler et al. 1994), which is lower than the rate of entanglement (0.4%) observed during 1976-85 (Fowler et al. 1994). During 1995-97, NMFS researchers in conjunction with members of the Aleut communities of St. Paul and St. George Islands captured and removed entangling debris (including trawl net, packing bands, twine, and miscellaneous items) from 88, 146 and 87 northern fur seals, respectively.

**STATUS OF STOCK**

Based on currently available data, the minimum estimated fishery mortality and serious injury for this stock (17) is less than 10% of the calculated PBR (1,824) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury (17 + 1,708 = 1,725) is not known to exceed the PBR (18,244) for this stock. The Eastern Pacific stock of northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA. The Alaska SRG has noted that the multiplier used to convert pup counts to total population size is likely negatively biased and that the estimate of the current population size using the existing multiplier is only marginally less than 60% of the best available estimate of K (DeMaster 1996). Therefore, the Alaska SRG has recommended that the NMFS undertake research to evaluate the degree to which the currently used multiplier may be biased, and if necessary, consider re-evaluating the status of this stock relative to carrying capacity.

**Habitat Concerns**

Recent rapid development on the Pribilof Islands increases the potential for negatively affecting habitat used by northern fur seals. Associated with the development on the islands comes the nearshore discharge of seafood processing waste, oil and contaminant spills, increased direct human disturbance, and increased levels of noise and olfactory pollution. Preliminary data suggest that the development on St. Paul Island may be impacting fur seal rookeries as pup production has declined on two of the three rookeries in closest proximity to human habitation and to the sewer and processor outfalls. Studies designed to assess the potential impact of human and industrial development on the Pribilofs have been planned.

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Revised 12/30/98

# HARBOR SEAL (*Phoca vitulina richardsi*): Southeast Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Frost et al. 1996, Swain et al. 1996). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Frost et al. 1996). Strong fidelity of individuals for haulout sites in June and August also has been reported, although these studies considered only limited areas during a relatively short period of time (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

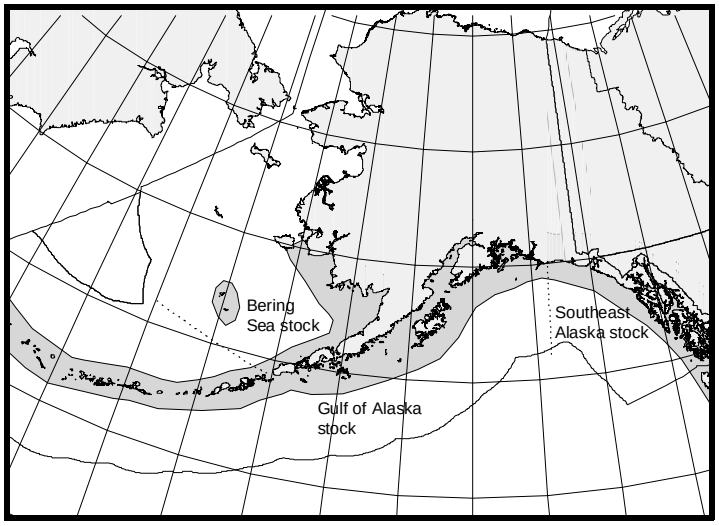


**Figure 8.** Approximate distribution of harbor seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown, breeding dispersal is presumed to be very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); 2) Population response data: substantial differences in population dynamics between Southeast Alaska and the rest of Alaska, and presumed differences between Gulf of Alaska and Bering Sea (Hoover 1988, Hoover-Miller 1994, Withrow and Loughlin 1996); 3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); 4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Preliminary genetic data indicate substantial variation in mtDNA suggesting at least two genetically distinct stocks in Alaska (Westlake and O'Corry-Crowe 1997). However, until additional samples are analyzed the Alaska Scientific Review Group (SRG) recommended using the same stock boundaries as in the Stock Assessment Reports for 1996 (Hill et al. 1997).

The Alaska SRG concluded that the scientific data available to support three distinct biological stocks (i.e., genetically isolated populations) were equivocal. However, the Alaska SRG recommended that the available data were sufficient to justify the establishment of three management units for harbor seals in Alaska (DeMaster 1996). Further, the SRG recommended that, unlike the stock structure reported in Small and DeMaster (1995), animals in the Aleutian Islands should be included in the same management unit as animals in the Gulf of Alaska. As noted above, this recommendation has been adopted by NMFS with the caveat that management units and stocks are equivalent for the purposes of managing incidental take under section 118 of the Marine Mammal Protection Act (Wade and Angliss 1997). Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska, the possible

decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 7). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

**POPULATION SIZE**

The most recent comprehensive aerial survey of harbor seals in Southeast Alaska was conducted during the autumn molt in 1993. Eleven separate areas, with a mean of 39 (21-59) sites each, were surveyed 5-9 times each; the minimum number of surveys for each of the 427 sites was usually 4 or 5. Ten of 11 areas were surveyed during the third week of September; one area was surveyed from 31 August to 6 September. All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). Some of the survey effort was conducted after the molt peak. If it is assumed that harbor seals decrease their amount of time hauled out after the molt, the counts from the 1993 surveys may have underestimated the number of seals. Mathews and Kelly (1996), for instance, suggested more than half of the estimated 6,000 seals found in Glacier Bay in August were not detected in the bay, or within a 60-km radius of the bay, during the September 1993 survey.

The sum of all mean counts was 21,523 with a combined CV=0.026 (Loughlin 1994). This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice, or not at all. Data collected from 36 tagged harbor seals in Southeast Alaska from 1 to 11 September 1994 resulted in a correction factor of 1.74 (CV=0.068) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1995). Although this correction factor (CF) was not derived during the actual survey in 1993, it was considered conservative because the data used to develop the CF were collected during a time period (early September) when seals are assumed to spend more time on haulouts than when the surveys were flown in 1993 (late September). Utilizing this correction factor results in a population estimate of 37,450 (21,523 × 1.74; CV=0.073) for the Southeast Alaska stock of harbor seals.

It should be noted that the CF developed for tidally influenced rocky substrate may not apply to seals hauled on ice from tidewater glaciers (Alaska SRG, see DeMaster 1996). Given the relatively small number of harbor seals counted on glacial haulouts, the magnitude of any bias resulting from using an inappropriate CF is likely small. That is, if no CF were applied to the counts of seals hauled on glacial haulouts during the 1993 surveys, the resulting abundance estimate for Southeast Alaska would be reduced by approximately 3% or 1,000 animals. NMFS will attempt to capture and radio-tag seals that utilize glacial haulouts prior to the next survey in Southeast Alaska. If such efforts are unsuccessful, pending recommendations from the Alaska SRG, NMFS will reconsider the methods used to correct for the number of seals hauled on glacial haulouts.

During August of 1997 aerial surveys of harbor seals in the northern portion of Southeast Alaska were completed. Aerial surveys for harbor seals in the southern portion of Southeast Alaska are scheduled for August of 1998. Results of these two surveys will be available in the Spring of 1999.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 37,450 and its associated CV(N) of 0.073, $N_{MIN}$ for this stock of harbor seals is 35,226.

**Current Population Trend**

Population trend data have been collected in the vicinity of Sitka and Ketchikan since 1983. When counts from 1993 were compared with those made in the early 1980s, mean counts of harbor seals at both locations were lower. However, this is probably explained by the late survey dates in 1993. Mean counts from both trend routes have increased since 1983. The mean count for the Ketchikan trend route was 2,708 in 1996, an increase of 3.8% from the 1995 count. The number of harbor seals at the Ketchikan trend sites has increased 9.3% annually (95% CI: 7.5%-11.0%) from 1983 to 1996 (Small et al. 1997). The mean count for the Sitka trend route decreased 21.5% from the 1995 count of 2,041 to 1,602 in 1996. However, trend estimates based on modeling count data and environmental covariates indicate that the number of harbor seals at the Sitka trend sites has increased 3.0% annually (95% CI: 2.1%-3.9%) from 1983 to 1996 (Small et al. 1997). It should be clear that these data are from selected 'trend' sites and not complete census surveys. Further, both of these trend routes are for terrestrial haul outs, which may not be representative of animals that use glacial haul outs.

Additional information concerning trend counts in Southeast Alaska come from Glacier Bay. The number of harbor seals in Johns Hopkins Inlet (a tidewater glacial fjord in Glacier Bay) increased steeply (30.7% annually) between 1975 and 1978, and then at a slower rate (2.6% annually) for the period from 1983 to 1996 (Mathews and Pendleton 1997). Immigration and reduced mortality may have contributed to the steep growth between 1975 and 1978. During 1992-96, the number of seals in Johns Hopkins Inlet (glacial ice haul out) increased 7.1% annually (95% CI: 1.7%-12.4%), whereas the number of seals using terrestrial haul outs decreased 8.6% annually (95% CI: 5.6%-11.7%) over the same period. The combined effect of the recent divergent trend at glacial ice versus terrestrial haul outs is that numbers in Glacier Bay overall appear to be stable or possibly increasing (Mathews and Pendleton 1997). Results from the Sitka, Ketchikan, and Glacier Bay trend analyses provide a strong indication that the number of harbor seals in Southeast Alaska has been increasing since at least 1983 (Small et al. 1997).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Southeast Alaska harbor seal stock. Population growth rates of 6% and 8% were observed between 1991 and 1992 in Oregon and Washington, respectively. Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997), as population levels have increased or remained stable with a known human take (Pitcher 1990, Small et al. 1997). Thus, for this stock of harbor seals, PBR = 2,114 animals (35,226 × 0.06 × 1.0).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Some fishing effort by vessels participating in the Gulf of Alaska (GOA) groundfish longline fishery occurs in the offshore waters of Southeast Alaska. Effort levels are insignificant for the portion of the GOA groundfish trawl and pot fisheries operating in these waters. During the period from 1990 to 1996, 21-31% of the GOA longline catch occurred within the range of the Southeast Alaska harbor seal stock. This fishery has been monitored for incidental take by fishery observers from 1990 to 1996 (8-21% observer coverage), although observer coverage has been very low in the offshore waters of Southeast Alaska (Table 6a). The only observed harbor seal mortality in this fishery occurred in 1995, resulting in a mean annual (total) mortality of 4 (CV=1.0).

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from 2 unobserved fisheries (see Table 6a) resulted in an annual mean of 31.25 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. As recommended by the Alaska SRG, given that harbor seals are the only common phocid in Southeast Alaska, fisher self-reports of unidentified phocid mortalities have been included as incidental takes of harbor seals in Table 6a (DeMaster 1996: p. 8). The majority of self-reported incidental takes were reported in the Yakutat salmon set gillnet fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

**Table 6a.** Summary of incidental mortality of harbor seals (Southeast Alaska stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Gulf of Alaska groundfish longline (incl. misc. finfish and sablefish fisheries) | 90-96 | obs data | <1-5% | 0, 0, 0, 0, 0, 1, 0 | 0, 0, 0, 0, 0, 20, 0 | 4 (CV=1.0) |
| Observer program total | | | | | | 4 (CV=1.0) |
| | | | | **Reported mortalities** | | |
| Southeast Alaska salmon drift gillnet | 90-96 | self reports | n/a | 8, 1, 4, 2, n/a, n/a, n/a | n/a | [$3.75] |
| Yakutat salmon set gillnet | 90-96 | self reports | n/a | 0, 18, 31, 61, n/a, n/a, n/a | n/a | [$27.5] |
| Minimum total annual mortality | | | | | | $35.25 (CV=1.0) |

The estimated minimum annual mortality rate incidental to commercial fisheries is 36 harbor seals, based on observer data (4) and self-reported fisheries information (rounded to 32). However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the

gillnet fisheries mentioned above. The Yakutat salmon set gillnet fishery is scheduled to be observed in 2000 and 2001. The Southeast Alaska drift gillnet fishery is scheduled to be observed in 2005 and 2006.

**Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with NMFS (Table 6b: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Interviews were conducted in 18 communities in Southeast Alaska. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 6b provides a summary of the subsistence harvest information for the Southeast Alaska stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 1,749 animals. The reported average age-specific kill of the harvest from the Southeast Alaska stock since 1992 was 85% adults, 7% juveniles, 1% pups, and 7% of unknown age. The reported average sex-specific kill of the harvest was 49% males, 24% females, and 27% of unknown sex.

**Table 6b.** Summary of the subsistence harvest data for the Southeast Alaska stock of harbor seals, 1992-96.

| Year | Estimated total number taken | Percentage of statewide total | Number harvested | Number struck and lost |
|---|---|---|---|---|
| 1992 | 1,670 | 58.3% | 1, 481 | 189 |
| 1993 | 1,615 | 59.2% | 1,425 | 190 |
| 1994 | 1,500 | 57.2% | 1,348 | 152 |
| 1995 | 1,890 | 68.9% | 1,719 | 171 |
| 1996 | 1,858 | 67.7% | 1,642 | 216 |
| Mean annual take (1994-96) | 1,749 | | | |

**Other Mortality**

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

**STATUS OF STOCK**

Harbor seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 211 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 1,785 (36 + 1,749) harbor seals. Although considered unlikely due to stable or increasing trends, it is unknown if the

estimated annual level of total human-caused mortality and serious injury exceeds the PBR (2,114) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Southeast Alaska stock of harbor seals is not classified as strategic. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: p. 14). The status of this stock relative to its Optimum Sustainable Population size is unknown.

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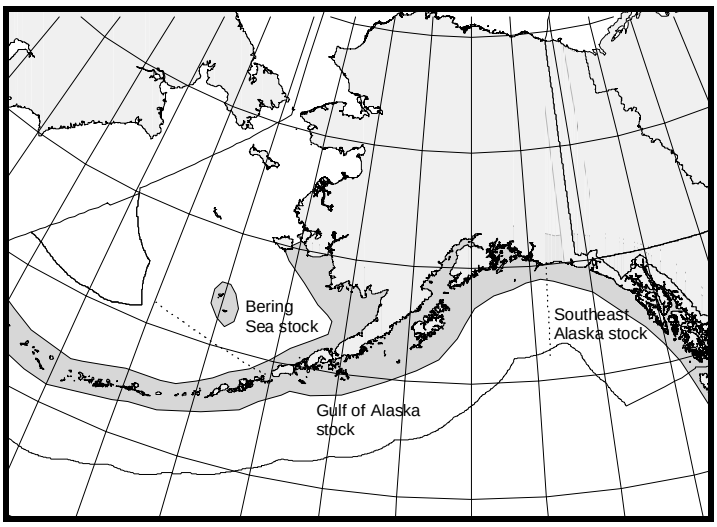


**Figure 9.** Approximate distribution of harbor seals in Alaska waters (shaded area).

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1997). Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska, the possible decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 8). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

**POPULATION SIZE**

Extensive photographic aerial surveys of harbor seals from the Gulf of Alaska stock were conducted during 1994 and 1996. The Aleutian Islands were surveyed from 29 August to 8 September of 1994 (Withrow and Loughlin 1995a). Between 25 August and 3 September of 1996 the south side of the Alaska Peninsula, Cook Inlet, Kenai Peninsula, Kodiak Archipelago, and Copper River Delta were surveyed (Withrow and Loughlin 1997). All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). One to seven repetitive photographic counts were obtained for each major haulout site within each study area. Coefficients of variation (CV) were determined for multiple surveys and found to be <0.19 in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice or not at all.

During summer of 1996, two different aerial surveys covered portions of Prince William Sound. During August 17-26 surveys of trend route A in Prince William Sound resulted in an adjusted mean count of 984 (CV=0.045) seals (Frost et al. 1997). Between August 27 and September 6 surveys of trend route B, excluding Columbia Bay (a tidewater glacial haulout system), in Prince William Sound resulted in a mean count of 1,261 (CV=0.044) seals (unpubl. data, J. Burns, Living Resources Inc., P. O. Box 83570, Fairbanks, AK, 99708). During the route B surveys, the count data from Columbia Bay were considered unreliable due to difficult ice conditions and the widely scattered distribution of seals. Instead, a reasonable minimum estimate for the number of harbor seals using Columbia Bay at the time of the surveys (1,000 seals) will be added below (see Minimum Population Estimate section). Combining the counts from trend routes A and B results in a mean count of 2,245 (CV=0.032) harbor seals in Prince William Sound, excluding Columbia Bay.

Due to the extreme difficulty in censusing harbor seals during the 1994 Aleutian Islands survey, it is recommended that the maximum count of 3,437 be used for an abundance estimate for that region (Withrow and Loughlin 1995a). The coefficient of variation for the mean count (CV=0.059) should be used for the 1994 survey data because an estimate for the CV is not available for the maximum count. The mean count for the 1996 surveys was 16,013 (CV=0.025) harbor seals, with the following mean counts for the major survey areas: Copper River Delta 3,174 (CV=0.078); Prince William Sound 2,245; Kenai Peninsula 713 (CV=0.072); Cook Inlet 2,244 (CV=0.105); Kodiak Archipelago 4,437 (CV=0.035); and the south side of the Alaska Peninsula 3,200 (CV=0.034). Therefore, for the Gulf of Alaska stock of harbor seals, the total combined count from the 1994 and 1996 aerial surveys was 19,450 (CV=0.023) animals.

Data collected from 36 tagged harbor seals in Southeast Alaska during 1994 resulted in a correction factor of 1.74 (CV=0.068) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1995b). In 1995, 25 harbor seals were tagged at a sand bar haulout near Cordova, AK (note: within the Gulf of Alaska). The haulout behavior of these seals was monitored from August 12 to 23, and a correction factor of 1.50 (CV=0.047) was developed for the 1995 aerial survey in this area (Withrow and Loughlin 1996). Although much of

the haulout substrate in the Gulf of Alaska area is rocky, the 1.50 CF (correction factor) from 1995 is considered to be the best available and most conservative CF for the 1996 survey data because the data used to estimate the CF were 1) collected in the survey area, 2) collected during a comparable low-tide survey window, and 3) collected more closely to the peak haul out time period (i.e., CF data collected from 12 August to 23 August versus the survey data from 23 August to 9 September). The Southeast Alaska correction factor of 1.74 was not employed for this stock because the data used to calculate the CF were 1) not collected from the Gulf of Alaska area and 2) collected to some extent after the survey period was completed (i.e., CF data from SE Alaska were collected from 1 September to 11 September)(Alaska SRG, see DeMaster 1996). Therefore, using the Gulf of Alaska correction factor results in an abundance estimate of 29,175 (19,450 × 1.50, CV=0.052) for the Gulf of Alaska stock of harbor seals.

The next round of aerial surveys to assess the abundance of this stock will occur during the summers of 1999 (Aleutian Islands) and 2001 (Gulf of Alaska). Preliminary results of these surveys will be available in autumn of the respective survey year.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 29,175 and its associated CV(N) of 0.052, $N_{MIN}$ for this stock of harbor seals is 27,917. Including the minimum population estimate for Columbia Bay (1,000 animals) results in an $N_{MIN}$ of 28,917 harbor seals for the Gulf of Alaska stock.

**Current Population Trend**

The population trend in the Aleutian Islands is unclear because the 1994 survey was the most complete census to date for that region. Previous harbor seal counts in that area are not comparable to the 1994 data because they were conducted incidental to surveys designed to assess other species (i.e., sea otters or Steller sea lions). However, a subset of the 1994 survey in the eastern Aleutian Islands indicated a count of 1,600 in an area that had counts of approximately 1,000-2,500 seals during 1975-77 (Small 1996).

In Prince William Sound, harbor seal numbers declined by 57% from 1984 to 1992 (Pitcher 1989, Frost and Lowry 1993). The decline began before the 1989 *Exxon Valdez* oil spill, was greatest in the year of the spill, and may have lessened thereafter. Between 1989 and 1995 aerial survey counts of 25 haulout sites in Prince William Sound (trend route A) showed significant declines in the number of seals during the molt (19%) and during pupping (31%) (Frost et al. 1996). Adjusted molt period counts for 1996 were 15% lower than the 1995 counts, indicating that harbor seal numbers in Prince William Sound have not yet recovered from the spill or whatever was causing the decline and that the long-term decline has not ended (Frost et al. 1997).

A steady decrease in numbers of harbor seals has been reported throughout the Kodiak Archipelago from the mid-1970s to the 1990s. On southwestern Tugidak Island, formally one of the largest concentrations of harbor seals in the world, counts declined 85% from 1976 (6,919) to 1988 (1,014) (Pitcher 1990). More recently, the Tugidak Island count has increased from 769 in 1992 to 1,420 in 1996 (Small 1996, Withrow and Loughlin 1997), although this still only represents a fraction of its historical size. The population around Kodiak Island, based on an aerial photographic route established in 1992, is estimated to have increased at 7.2% annually from 1992-96 (Small et al. 1997). Despite some positive signs of growth in certain areas, the overall Gulf of Alaska stock size remains small compared to its size in the 1970s and 1980s.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska or Bering Sea harbor seal stock. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990).

However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown status (Wade and Angliss 1997). Thus, for the Gulf of Alaska stock of harbor seals, PBR = 868 animals (28,917 × 0.06 × 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Gulf of Alaska stock of harbor seals were monitored for incidental take by fishery observers during 1990-96: Gulf of Alaska groundfish trawl, longline, and pot fisheries. For the fisheries with observed takes, the range of observer coverage over the 7-year period, as well as the annual observed and estimated mortalities are presented in Table 7a. The mean annual (total) mortality rate was 0.4 (CV=1.0) for the Gulf of Alaska groundfish trawl fishery and was 0.2 (CV=1.0) Gulf of Alaska pot fishery. The harbor seal taken in the pot fishery in 1995 (7% observer coverage) occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1995 for that fishery, and should be considered a minimum estimate.

**Table 7a.** Summary of incidental mortality of harbor seals (Gulf of Alaska stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information or stranding data. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Gulf of Alaska (GOA) groundfish trawl | 90-96 | obs data | 33-55% | 0, 1, 1, 0, 0, 0, 0 | 0, 3, 2, 0, 0, 0, 0 | 0.4 (CV=1.0) |
| GOA finfish pot | 90-96 | obs data | 5-13% | 0, 0, 0, 0, 0, 1, 0 | 0, 0, 0, 0, 0, 1, 0 | 0.2 (CV=1.0) |
| Prince William Sound salmon drift gillnet | 90-91 | obs data | 4-5% | 2, 1 | 36, 12 | 24 (CV=0.50) |
| Alaska Peninsula/Aleutian Islands salmon drift gillnet | 90 | obs data | 4% | 0 | 0 | 0 |
| Observer program total | | | | | | 24.6 (CV=0.49) |
| | | | | **Reported mortalities** | | |
| Cook Inlet salmon set gillnet | 90-96 | self reports | n/a | 6, 0, 1, 0, n/a, n/a, n/a | n/a | [$1.75] |

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Prince William Sound set gillnet | 90-96 | self reports | n/a | 0, 0, 0, 1, n/a, n/a, n/a | n/a | [$0.25] |
| Kodiak salmon set gillnet | 90-96 | self reports | n/a | 3, 0, 0, 0, n/a, n/a, n/a | n/a | [$0.75] |
| Alaska salmon purse seine (except for Southeast) | 90-96 | self reports | n/a | 0, 0, 0, 2, n/a, n/a, n/a | n/a | [$0.5] |
| Alaska Peninsula/Aleutian Islands salmon drift gillnet | 90-96 | self reports | n/a | 9, 2, 12, 5, n/a, n/a, n/a | n/a | [$7.0] |
| unknown Gulf of Alaska fishery | 92-96 | strand data | n/a | 0, 0, 0, 0, 1 | n/a | [$0.2] |
| Minimum total annual mortality | | | | | | $35.05 (CV=0.49) |

In the Prince William Sound salmon drift gillnet fishery, observers recorded 2 incidental mortalities of harbor seals in 1990 (Wynne et al. 1991), and 1 in 1991 (Wynne et al. 1992). The extrapolated kill estimates were 36 (95% CI 2-74) in 1990 and 12 (95% CI 1-44) in 1991, resulting in a mean kill rate of 24 (CV=0.5) animals per year for this fishery. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet. The estimated mortality rate of harbor seals based on the 1990 and 1991 observed mortalities for this fishery is 0.0002 kills per set. Fisher self-reports of harbor seal mortalities due to this fishery detail 19, 4, 7, 24, and 0 mortalities in 1990, 1991, 1992, 1993, and 1996, respectively. The extrapolated (estimated) mortality from the 1990-91 observer program (24 seals per year) accounts for these mortalities, so they do not appear in Table 7a. Combining the estimates from the groundfish trawl and pot fisheries presented above (0.4 + 0.2 = 0.6) with the estimate from the Prince William Sound salmon drift gillnet fishery (24) results in an estimated annual incidental kill rate in observed fisheries of 24.6 (CV=0.49) harbor seals per year from this stock. It should be noted that in 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). Although no interaction with harbor seals was recorded by observers in 1990, due in part to the low level of observer coverage, mortalities did occur as recorded in fisher self-reports (see Table 7a).

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from 5 unobserved fisheries (see Table 7a) resulted in an annual mean of 10.25 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reported fisheries information for Gulf of Alaska fisheries, except the Prince William Sound salmon drift gillnet fishery and the Gulf of Alaska groundfish trawl and pot fisheries for which observer data were presented above. In 1990, fisher self-reports from the Cook Inlet set and drift gillnet fisheries were combined. As a result, some of the harbor seal mortalities reported in 1990 may have occurred in the drift net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1992 to 1996 the only fishery-related harbor seal stranding was reported in June of 1996 on Middleton Island. The entanglement could not be attributed to a particular fishery and as a result has been included in Table 7a as occurring in an unknown fishery. Fishery-related strandings during 1992-96 result in an estimated annual mortality of 0.2 harbor seals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

The estimated minimum annual mortality rate incidental to commercial fisheries is 36 (rounded up), based on observer data (24.6) and self-reported fisheries information (10.25) or stranding data (0.2) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in several fisheries mentioned above.

**Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 7b: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Between 1992-96, interviews were conducted in approximately 29 communities that lie within the range of the Gulf of Alaska harbor seal stock. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 7b provides a summary of the subsistence harvest information for the Gulf of Alaska stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 791 animals. The reported average age-specific kill of the harvest from the Gulf of Alaska stock since 1992 was 58% adults, 27% juveniles, 2% pups, and 13% of unknown age. The reported average sex-specific kill of the harvest was 44% males, 18% females, and 38% of unknown sex.

**Table 7b.** Summary of the subsistence harvest data for the Gulf of Alaska stock of harbor seals, 1992-96.

| Year | Estimated total number taken | Percentage of statewide total | Number harvested | Number struck and lost |
|---|---|---|---|---|
| 1992 | 967 | 33.7% | 884 | 83 |
| 1993 | 914 | 33.5% | 812 | 102 |
| 1994 | 913 | 34.9% | 819 | 94 |
| 1995 | 724 | 26.4% | 683 | 41 |
| 1996 | 735 | 26.8% | 679 | 56 |
| Mean annual take (1994-96) | 791 | | | |

**Other Mortality**

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

## STATUS OF STOCK

Sustainable harvest levels for this stock will be determined from the analysis of information gathered through the cooperative management process, and will reflect the degree of uncertainty associated with the information obtained for this stock. Efforts were initiated in 1995 and 1996 to develop a cooperative approach for management of this stock; however, a final agreement has not been approved to date.

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant. At present, annual fishery-related mortality levels less than 87 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 827 (36 + 791) harbor seals which does not exceed the PBR (868) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Gulf of Alaska stock of harbor seals is not classified as strategic. This classification is consistent with the recommendations of the Alaska SRG (DeMaster 1998). The status of this stock relative to its Optimum Sustainable Population size is unknown.

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# HARBOR SEAL (*Phoca vitulina richardsi*): Bering Sea Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Frost et al. 1996, Swain et al. 1996). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Frost et al. 1996). Strong fidelity of individuals for haulout sites in June and August also has been reported, although these studies considered only limited areas during a relatively short period of time (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

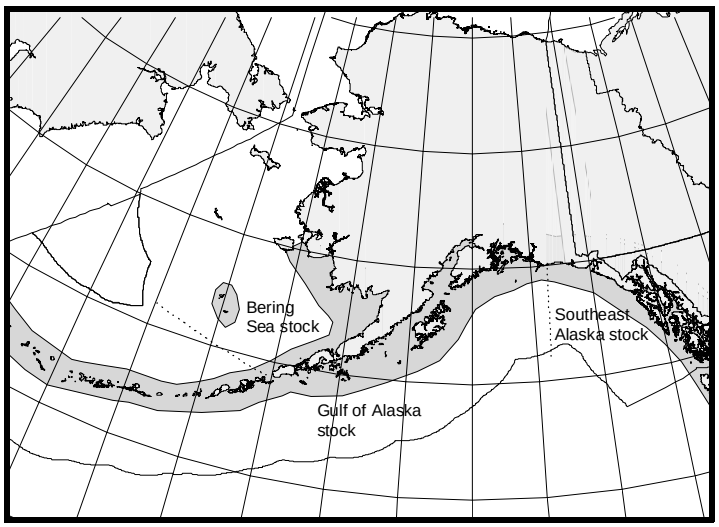


**Figure 10.** Approximate distribution of harbor seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown, breeding dispersal is presumed to be very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); 2) Population response data: substantial differences in population dynamics between Southeast Alaska and the rest of Alaska, and presumed differences between Gulf of Alaska and Bering Sea (Hoover 1988, Hoover-Miller 1994, Withrow and Loughlin 1996b); 3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); 4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Preliminary genetic data indicate substantial variation in mtDNA suggesting at least two genetically distinct stocks in Alaska (Westlake and O'Corry-Crowe 1997). However, until additional samples are analyzed the Alaska Scientific Review Group (SRG) recommended using the same stock boundaries as in the Stock Assessment Reports for 1996 (Hill et al. 1997).

The Alaska SRG concluded that the scientific data available to support three distinct biological stocks (i.e., genetically isolated populations) were equivocal. However, the Alaska SRG recommended that the available data were sufficient to justify the establishment of three management units for harbor seals in Alaska (DeMaster 1996). Further, the SRG recommended that, unlike the stock structure reported in Small and DeMaster (1995), animals in the Aleutian Islands should be included in the same management unit as animals in the Gulf of Alaska. As noted above, this recommendation has been adopted by NMFS with the caveat that management units and stocks are equivalent for the purposes of managing incidental take under section 118 of the Marine Mammal Protection Act (Wade and Angliss 1997). Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska, the possible

decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 9). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

**POPULATION SIZE**

Extensive photographic aerial surveys of harbor seals in the Bering Sea were conducted during the autumn molt in 1995 (28 August - 10 September), throughout northern Bristol Bay and along the north side of the Alaska Peninsula (Withrow and Loughlin 1996a). All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). At least four repetitive photographic counts were obtained for each major rookery and haulout site within each study area. Coefficients of variation were determined for multiple surveys and found to be <0.19 in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice or not at all.

The total mean count for the 1995 surveys was 8,740 (CV=0.040) harbor seals, with mean counts of 955 (CV=0.071) for northern Bristol Bay and 7,785 (CV=0.044) for the north side of the Alaska Peninsula (Withrow and Loughlin 1996a). A correction factor based on data from animals from this stock is currently unavailable. A tagging experiment conducted from 17 to 23 August 1995 collected data from 25 harbor seals using a sand bar haul out near Cordova, Alaska (within the Gulf of Alaska), resulting in a correction factor of 1.50 (CV=0.047) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1996b). This correction factor was used for the Bering Sea stock due to the similarity in haulout habitat type (sand bar) to a majority of harbor seal haulout sites found in the Bering Sea. Further, this CF was considered conservative by the Alaska SRG (DeMaster 1996) because the timing of the aerial survey was later than the timing of the CF study and it is likely that the fraction of seals hauled out during the surveys was smaller. Multiplying these aerial survey counts by the correction factor results in an estimated abundance of 13,110 (8,740 × 1.50; CV=0.062) harbor seals.

In 1995, daily land counts of harbor seals were conducted on Otter Island (one of the Pribilof Islands) from July 2 through August 8. The maximum count during this study was 202 seals (Withrow and Loughlin 1996a). Adding this count to the corrected estimated abundance from the aerial surveys results in an estimated abundance of 13,312 (13,110 + 202) harbor seals for the Bering Sea stock.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 13,110 from the aerial surveys and the associated CV(N) of 0.062, results in an estimate of 12,446 harbor seals. Adding the maximum count of 202 seals from the Otter Island survey results in an $N_{MIN}$ of 12,648 for the Bering Sea harbor seal stock.

**Current Population Trend**

The number of harbor seals in the Bering Sea stock is thought to be declining (Alaska SRG, see DeMaster 1996); however, published data to support this conclusion are unavailable. Specifically, in 1974 there were 1,175 seals reported on Otter Island. The maximum count in 1995 (202 seals) represents an 83% decline (Withrow and Loughlin 1996a). However, as noted by the Alaska SRG (DeMaster 1996), the reason(s) for this decline is(are) confounded by

the recolonization of Otter Island by northern fur seals since 1974, which has caused a loss of available habitat for harbor seals. Further, counts of harbor seals on the north side of the Alaska Peninsula in 1995 were less than 42% of the 1975 counts, representing a decline of 3.5% per year. The number of harbor seals in northern Bristol Bay are also lower, but have remained stable since 1990 (Withrow and Loughlin 1996a).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska or Bering Sea stock of harbor seal. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). Thus, for the Bering Sea harbor seal stock, PBR = 379 animals (12,648 × 0.06 × 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Bering Sea stock of harbor seals were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Harbor seal mortality was observed in all three fisheries at low levels. The range of observer coverage over the period, as well as the annual observed and estimated mortalities are presented in Table 8a. The mean annual (total) mortality rate was 2.2 (CV=0.44) for the Bering Sea groundfish trawl fishery, 0.6 (CV=1.0) for the Bering Sea longline fishery, and 1.2 (CV=0.81) for the Bering Sea pot fishery. The harbor seal taken in the pot fishery in 1992 (34% observer coverage) occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1992 for that fishery, and should be considered a minimum estimate. Combining the estimates from the Bering Sea groundfish trawl, longline, and pot fisheries presented above (2.2 + 0.6 + 1.2 = 4.0) results in an estimated annual incidental kill rate in observed fisheries of 4.0 (CV=0.37) harbor seals per year from the Bering Sea stock.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from the Bristol Bay salmon drift and set gillnet fisheries (see Table 8a) resulted in an annual mean of 26.75 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reported fisheries information for Bering Sea fisheries, except the groundfish trawl, longline and pot fisheries for which observer data were presented above. In 1990, fisher self-reports from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the harbor seal mortalities reported in 1990 may have occurred in the set net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

The estimated minimum annual mortality rate incidental to commercial fisheries is 31, based on observer data (4) and self-reported fisheries information (27) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer

placements in the gillnet fisheries mentioned above. The Bristol Bay salmon set and drift gillnet fisheries are scheduled to be observed in 2005 and 2006.

**Table 8a.** Summary of incidental mortality of harbor seals (Bering Sea stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSAI) groundfish trawl | 90-96 | obs data | 53-74% | 1, 1, 2, 0, 3, 0, 2 | 1, 1, 3, 0, 5, 0, 3 | 2.2 (CV=0.44) |
| BSAI groundfish longline (incl. misc. finfish and sablefish fisheries) | 90-96 | obs data | 27-80% | 0, 0, 0, 1, 0, 0, 0 | 0, 0, 0, 3, 0, 0, 0 | 0.6 (CV=1.0) |
| BSAI finfish pot | 90-96 | obs data | 17-43% | 0, 0, 1, 0, 0, 1, 0 | 0, 0, 1, 0, 0, 5, 0 | 1.2 (CV=0.81) |
| Observer program total | | | | | | 4.0 (CV=0.37) |
| | | | | **Reported mortalities** | | |
| Bristol Bay salmon drift gillnet | 90-96 | self reports | n/a | 38, 23, 2, 42, n/a, n/a, n/a | n/a | [$26.25] |
| Bristol Bay salmon set gillnet | 90-96 | self reports | n/a | 0, 0, 1, 1, n/a, n/a, n/a | n/a | [$0.5] |
| Minimum total annual mortality | | | | | | $30.75 (CV=0.37) |

**Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 8b: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Between 1992-96, interviews were conducted in approximately 14 communities that lie within the range of the Bering Sea harbor seal stock. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 8b provides a summary of the subsistence harvest information for the Bering Sea stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 161 animals. The reported average age-specific kill of the harvest from the Bering Sea stock since 1992 was 69% adults, 14% juveniles, 4% pups, and 13% of unknown age. The reported average sex-specific kill of the harvest was 25% males, 8% females, and 67% of unknown sex.

**Other Mortality**

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

**Table 8b.** Summary of the subsistence harvest data for the Bering Sea stock of harbor seals, 1992-96.

| Year | Estimated total number taken | Percentage of statewide total | Number harvested | Number struck and lost |
|---|---|---|---|---|
| 1992 | 229 | 8.0% | 160 | 59 |
| 1993 | 199 | 7.3% | 122 | 77 |
| 1994 | 208 | 7.9% | 145 | 63 |
| 1995 | 127 | 4.6% | 97 | 30 |
| 1996 | 148 | 5.4% | 94 | 54 |
| Mean annual take (1994-96) | 161 | | | |

**STATUS OF STOCK**

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant. At present, annual mortality levels less than 38 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (31 + 161 = 192) is not known to exceed the PBR (379). Therefore, the Bering Sea stock of harbor seals is not classified as a strategic stock. The status of this stock relative to its Optimum Sustainable Population size is unknown.

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# SPOTTED SEAL (*Phoca largha*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Spotted seals are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977, Fig. 10). Little is known of their winter distribution and migration routes, although satellite tagging studies on a small number of animals in Alaska have been completed. These studies indicate that spotted seals migrate south from the Chukchi Sea utilizing haul outs in both Russia and Alaska and overwinter in the Bering Sea along the ice edge (Lowry et al. 1994). During spring they inhabit mainly the southern margin of the ice, with movement to coastal habitats after the retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977). In summer, spotted seals may be found as far north as 69-72/N in the Chukchi and Beaufort Seas (Porsild 1945, Shaughnessy and Fay 1977). To the south, along the west coast of Alaska, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands. Of 8 known breeding areas, 3 occur in the Bering Sea, with the remaining 5 in the Okhotsk Sea and Sea of Japan. There is little morphological difference between seals from these areas. Spotted seals are closely related to and often mistaken for North Pacific harbor seals (*Phoca vitulina*). The two species are often seen together and are partially sympatric, as their ranges overlap in the southern part of the Bering Sea (Quakenbush 1988). Yet, spotted seals breed earlier and are less social during the breeding season, and only spotted seals are regularly associated with pack ice (Shaughnessy and Fay 1977). These and other ecological, behavioral, and morphological differences support their recognition as two separate species (Quakenbush 1988).

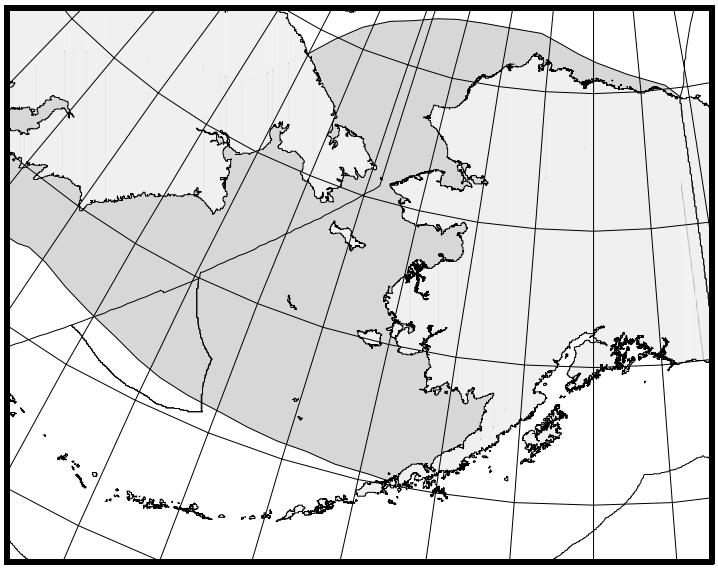

**Figure 11.** Approximate distribution of spotted seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of spotted seals into more than one stock. Therefore, only the Alaska stock is recognized in U. S. waters.

## POPULATION SIZE

A reliable estimate of spotted seal population abundance is currently not available (Rugh et al. 1995). However, early estimates of the world population were in the range of 335,000-450,000 animals (Burns 1973). The population of the Bering Sea, including Russian waters, was estimated to be 200,000-250,000 based on the distribution of family groups on ice during the mating season (Burns 1973). Fedoseev (1971) estimated 168,000 seals in the Okhotsk Sea. Aerial surveys were flown in 1992 and 1993 to examine the distribution and abundance of spotted seals in Alaska. In 1992, survey methods were tested and distributional studies were conducted over the Bering Sea pack ice in spring and along the western Alaska coast during summer (Rugh et al. 1993). In 1993, the survey effort

concentrated on known haul out sites in summer (Rugh et al. 1994). The sum of maximum counts of hauled out animals were 4,145 and 2,951 in 1992 and 1993, respectively. Using mean counts from days with the highest estimates for all sites visited in either 1992 or 1993, there were 3,570 seals seen, of which 3,356 (CV=0.06) were hauled out (Rugh et al. 1995).

Studies to determine a correction factor for the number of spotted seals at sea missed during surveys have been initiated, but only preliminary results are currently available. The Alaska Department of Fish and Game placed satellite radio transmitters on 4 spotted seals in Kasegaluk Lagoon to estimate the ratio of time hauled out vs. time at sea. Preliminary results indicate that the proportion hauled out averages about 6.8% (CV=0.85) (Lowry et al. 1994b). Using this correction factor with the maximum count of 4,145 from 1992 results in an estimate of 59,214. However, the estimate must be considered equivocal because it resulted from a survey which covered only the eastern portion of the spotted seal's geographic range and may have included harbor seals. In addition, the correction factor data have not been stratified by season, tide, and time of day.

**Minimum Population Estimate**

A reliable minimum population estimate ($N_{MIN}$) for this stock can not presently be determined because current reliable estimates of abundance are not available.

**Current Population Trend**

Frost et al. (1993) report that counts of spotted seals have been relatively stable at Kasegaluk Lagoon since the late 1970s. As this represents only a fraction of the stock's range, reliable data on trends in population abundance for the Alaska stock of spotted seals are considered unavailable.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice-associated seals, such as the spotted seal, are particularly sensitive to changes in weather and sea-surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska spotted seal stock.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of spotted seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of $N_{MIN}$ is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries operating within the range of the Alaska stock of spotted seals were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of spotted seals incidental to these groundfish fisheries.

An additional source of information on the number of spotted seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption

program. During the 4-year period between 1990 and 1993, logbook reports from the Bristol Bay salmon drift gillnet and set gillnet fisheries (see Table 9) resulted in an annual mean of 1.5 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for Alaska fisheries through 1993. In 1990, logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the spotted seal mortalities reported in 1990 may have occurred in the set net fishery. Complete logbook data after 1993 are not available.

The estimated minimum mortality rate incidental to commercial fisheries is 2 animals per year (rounded from 1.5), based solely upon logbook data. Yet, it should be noted that most interactions with these fisheries are likely to be harbor seals rather than spotted seals, and that due to the difficulty of distinguishing between spotted and harbor seals, the reliability of such logbook data is questionable. Further, no observers have been assigned the Bristol Bay fisheries that are known to interact with this stock, making the estimated mortality unreliable. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is considered to be insignificant and approaching zero mortality and serious injury rate. However, if there were 50,000 spotted seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 spotted seals in U. S. waters.

**Table 9.** Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

| Fishery name | Years | Data type | Range of observer coverage | Reported mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Observer program total | 90-95 | | | | | 0 |
| Bristol Bay salmon drift gillnet | 90-93 | logbook | n/a | 5, 1, 0, 0 | n/a | [$1.5] |
| Minimum total annual mortality | | | | | | $1.5 |

**Subsistence/Native Harvest Information**

Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions, with estimated annual harvests ranging from 850 to 3,600 seals (averaging about 2,400 annually) taken during 1966-76 (Lowry 1984). From September 1985 to June 1986 the combined harvest from five Alaska villages was 986 (Quakenbush 1988). In a study designed to assess the subsistence harvest of harbor seals and Steller sea lions in Alaska, Wolfe and Mishler (1993, 1994, 1995, 1996) estimated subsistence takes of spotted seals in the northern part of Bristol Bay. The spotted seal take (including struck and lost) was estimated to be 437 in 1992, 265 in 1993, 270 in 1994, and 197 in 1995. Variance estimates for these values are not available. The mean annual subsistence take of spotted seals in this region during the 3-year period from 1993 to 1995 was 244 animals. Reliable information on subsistence harvests from the remainder of Alaska during the 1993-95 period are not available. Therefore, 244 is considered an underestimate for the statewide total of the annual subsistence take.

**STATUS OF STOCK**

Spotted seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. However, due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between spotted seals and any U. S. fishery, the Alaska stock of spotted seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

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# BEARDED SEAL (*Erignathus barbatus*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are circumpolar in their distribution, extending from the Arctic Ocean (85/N) south to Hokkaido (45/N) in the western Pacific. They generally inhabit areas of shallow water (less than 200 m) that are at least seasonally ice covered. During winter they are most common in broken pack ice (Burns 1967) and in some areas also inhabit shorefast ice (Smith and Hammill 1981). In Alaska waters, bearded seals are distributed over the continental shelves of the Bering, Chukchi, and Beaufort Seas (Ognev 1935, Johnson et al. 1966, Burns 1981, Fig. 11). Bearded seals are evidently most concentrated from January to April over the northern part of the Bering Sea shelf (Burns 1981, Braham et al. 1984). Many of the seals that winter in the Bering Sea migrate north through the Bering Strait from late April through June, and spend the summer along the ice edge in the Chukchi Sea (Burns 1967, Burns 1981). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals do not migrate but remain in open-water areas of the Bering and Chukchi Seas (Burns 1981, Nelson 1981, Smith and Hammill 1981). An unknown proportion of the population migrates southward from the Chukchi Sea in late fall and winter, and Burns (1967) noted a movement of bearded seals away from shore during that season as well.

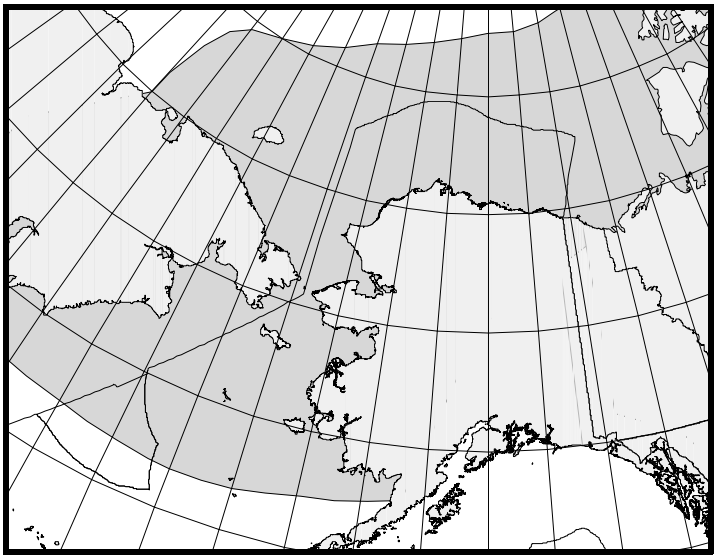

**Figure 12.** Approximate distribution of bearded seals in Alaska waters (shaded area). The combined summer and winter distributions are depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of bearded seals into more than one stock. Therefore, only the Alaska stock is recognized in U. S. waters.

## POPULATION SIZE

Early estimates of the Bering-Chukchi Sea population range from 250,000 to 300,000 (Popov 1976, Burns 1981). Until additional surveys are conducted, reliable estimates of abundance for the Alaska stock of bearded seals are considered unavailable.

### Minimum Population Estimate

A reliable minimum population estimate ($N_{MIN}$) for this stock can not presently be determined because current reliable estimates of abundance are not available.

**Current Population Trend**

At present, reliable data on trends in population abundance for the Alaska stock of bearded seals are unavailable, though there is no evidence that population levels are declining.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice-associated seals, such as the bearded seal, are particularly sensitive to changes in weather and sea-surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska bearded seal stock.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of bearded seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance $N_{MIN}$ is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries operating within the range of the Alaska stock of bearded seals were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 3 mortalities reported in 1991 and 4 mortalities reported in 1994. These mortalities resulted in a mean annual (total) mortality rate of 2 (CV=0.63) bearded seals per year. The range of observer coverage over the 5-year period, as well as the annual observed and estimated mortalities are presented in Table 10. It should be noted that one of the 1991 observed kills was later identified as a juvenile elephant seal (K. Wynne, pers. comm., Univ. AK, 900 Trident Way, Kodiak, AK 99615). Further, only 1 mortality was reported during monitored hauls in 1994, which extrapolated to 2 mortalities for the entire fishery. Because NMFS observers recorded 3 additional bearded seal mortalities in unmonitored hauls, the estimated mortality in 1994 (2 seals) was known to be an underestimate. Accordingly, 4 was used as both the observed and estimated mortality for 1994 (Table 10).

**Table 10.** Summary of incidental mortality of bearded seals (Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 0, 3, 0, 0, 4, 0 | 0, 6, 0, 0, 4, 0 | 2 (CV=.63) |
| Observer program total | | | | | | 2 |
| Total estimated annual mortality | | | | | | 2 |

An additional source of information on the number of bearded seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, the only logbook reports for bearded seals detailed 14 mortalities and 31 injuries in the Bristol Bay salmon drift gillnet fishery in 1991. These reports are suspect because it is highly unlikely that bearded seals would have been in the Bristol Bay vicinity during the summer salmon fishing months. These logbook mortalities have not been included in Table 10. However, because logbook records are most likely negatively biased (Credle et al. 1994), the absence of mortality reports does not assure bearded seal mortality did not occur. These logbook totals (0 animals) are based on all available logbook reports for Alaska fisheries through 1993. Complete logbook data after 1993 are not available.

The estimated minimum mortality rate incidental to commercial fisheries is 2 bearded seals per year, based exclusively on observer data. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant and approaching zero mortality and serious injury rate. However, if there were 50,000 bearded seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 bearded seals in U. S. waters.

**Subsistence/Native Harvest Information**

Bearded seals are an important species for Alaska subsistence hunters, with estimated annual harvests of 1,784 (SD=941) from 1966 to 1977 (Burns 1981). Between August 1985 and June 1986, 791 bearded seals were harvested in five villages in the Bering Strait region based on reports from the Alaska Eskimo Walrus Commission (Kelly 1988). A reliable estimate of the annual number of bearded seals currently taken by Alaska Natives for subsistence is unavailable.

## STATUS OF STOCK

Bearded seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between bearded seals and any U. S. fishery, the Alaska stock of bearded seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

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# RINGED SEAL (*Phoca hispida*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Ringed seals have a circumpolar distribution from approximately 35/N to the North Pole, occurring in all seas of the Arctic Ocean (King 1983). In the eastern North Pacific, they are found in the southern Bering Sea and range as far south as the Seas of Okhotsk and Japan. Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying seasonal and permanent ice. They remain in contact with ice most of the year and pup on the ice in late winter-early spring. Ringed seals are found throughout the Beaufort, Chukchi, and Bering Seas, as far south as Bristol Bay in years of extensive ice coverage (Fig. 12). During late April through June, ringed seals are distributed throughout their range from the southern ice edge northward (Burns and Harbo 1972, Burns et al. 1981, Braham et al. 1984). The overall winter distribution is probably similar, and it is believed there is a net movement of seals northward with the ice edge in late spring and summer (Burns 1970). Thus, ringed seals occupying the Bering and southern Chukchi Seas in winter apparently are migratory, but details of their movements are unknown. The seasonal migrations of seals wintering in the northern Chukchi and Beaufort Seas presumably are less extensive.

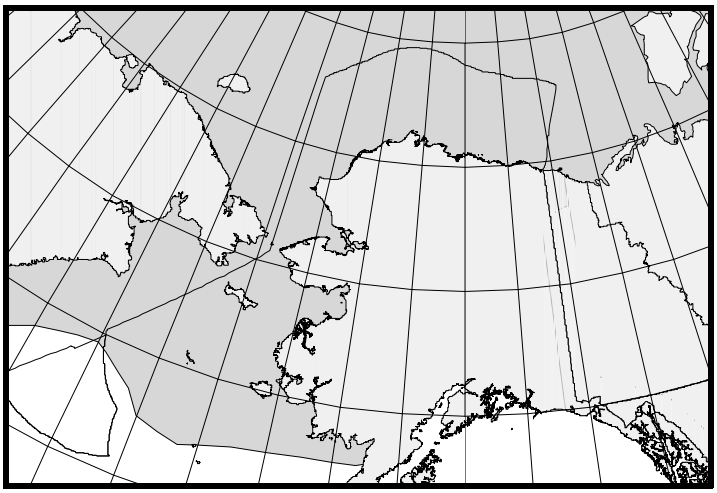

**Figure 13.** Approximate distribution of ringed seals in Alaska waters (shaded area). The combined summer and winter distribution is depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ringed seals into more than one stock. Therefore, only the Alaska ringed seal stock is recognized in U. S. waters.

## POPULATION SIZE

A reliable abundance estimate for the Alaska stock of ringed seals is currently not available. Crude estimates of the world population have ranged from 2.3 to 7 million, with 1 to 1.5 million in Alaska waters (Kelly 1988). The most recent abundance estimates of ringed seals are based on aerial surveys conducted in 1985, 1986, and 1987 by Frost et al. (1988). Survey effort was directed towards shorefast ice, though some areas of adjacent pack ice were also surveyed, in the Chukchi and Beaufort Seas from southern Kotzebue Sound north and east to the U. S. - Canada border. The abundance estimate from 1987 was 44,360±9,130 (95% CI). However, this estimate represents only a portion of the geographic range of the stock, as many ringed seals occur in the pack ice and along the coast of Russia.

### Minimum Population Estimate

A reliable minimum population estimate $N_{MIN}$ for this stock can not presently be determined because current reliable estimates of abundance are not available.

**Current Population Trend**

At present, reliable data on trends in population abundance for the Alaska stock of ringed seals are unavailable, though there is no evidence population levels are declining.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice-associated seals, such as the ringed seal, are particularly sensitive to changes in weather and sea-surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ringed seal stock.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ringed seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance $N_{MIN}$ is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries operating within the range of the Alaska stock of ringed seals were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 2 mortalities reported in 1992. These mortalities resulted in a mean annual (total) mortality rate of .6 (CV=1.0) ringed seals per year. The range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 11.

An additional source of information on the number of ringed seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from all Alaska fisheries indicated no mortalities of ringed seals. Complete logbook data after 1993 are not available.

**Table 11.** Summary of incidental mortality of ringed seals (Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated morality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 0, 0, 2, 0, 0, 0 | 0, 0, 3, 0, 0, 0 | 0.6 (CV=1.0) |
| Total estimated annual mortality | | | | | | 0.6 |

The estimated minimum average mortality rate incidental to commercial fisheries is 1 ringed seal per year (rounded up from 0.6), based exclusively on observer data. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level considered to be insignificant and approaching zero mortality and serious injury rate. However, if there were 50,000 ringed seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 ringed seals in U. S. waters.

**Subsistence/Native Harvest Information**

Ringed seals are an important species for Alaska Native subsistence hunters. The annual subsistence harvest in Alaska dropped from 7,000 to 15,000 in the period from 1962 to 1972 to an estimated 2,000-3,000 in 1979 (Frost unpubl. report). Based on data from two villages on St. Lawrence Island, the annual take in Alaska during the mid-1980s likely exceeded 3,000 seals (Kelly 1988). A reliable estimate of the annual number of ringed seals currently taken by Alaska Natives for subsistence is unavailable.

**STATUS OF STOCK**

Ringed seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ringed seals and any U. S. fishery, the Alaska stock of ringed seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

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# RIBBON SEAL (*Phoca fasciata*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Ribbon seals inhabit the North Pacific Ocean and adjacent fringes of the Arctic Ocean. In Alaska waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice (Kelly 1988). They range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas (Fig. 13). From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970, Burns 1981, Braham et al. 1984). They are most abundant in the northern part of the ice front in the central and western parts of the Bering Sea (Burns 1970, Burns et al. 1981). As the ice recedes in May to mid-July the seals move farther to the north in the Bering Sea, where they haul out on the receding ice edge and remnant ice (Burns 1970, Burns 1981, Burns et al. 1981). There has been little agreement on the range of ribbon seals during the rest of the year. Recent sightings and a review of the literature suggest that many ribbon seals migrate into the Chukchi Sea for the summer (Kelly 1988).

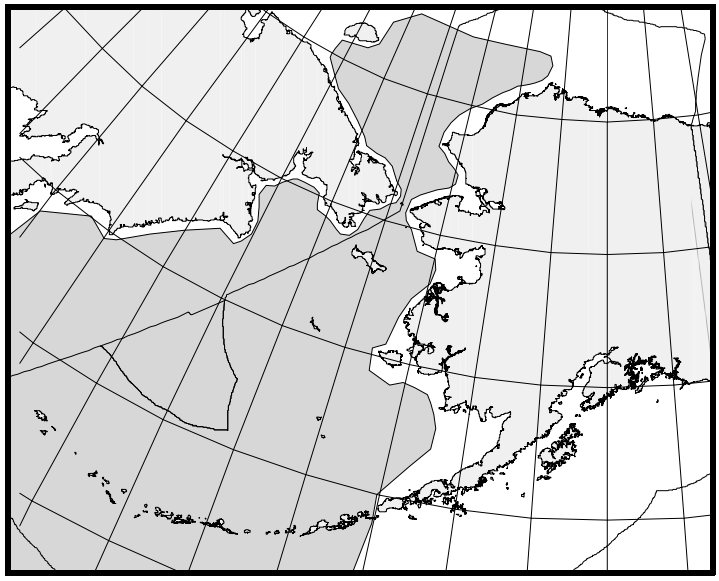

**Figure 14.** Approximate distribution of ribbon seals in Alaska waters (shaded area). The combined summer and winter distribution is depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ribbon seals into more than one stock. Therefore, only the Alaska stock of ribbon seal is recognized in U. S. waters.

## POPULATION SIZE

A reliable abundance estimate for the Alaska stock of ribbon seals is currently not available. Burns (1981) estimated the worldwide population of ribbon seals at 240,000 in the mid-1970s, with an estimate for the Bering Sea at 90,000-100,000.

### Minimum Population Estimate

A reliable minimum population estimate ($N_{MIN}$) for this stock can not presently be determined because current reliable estimates of abundance are not available.

### Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ribbon seals are unavailable, though there is no evidence population levels are declining.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice-associated seals, such as the ribbon seal, are particularly sensitive to changes in weather and sea-surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ribbon seal stock.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ribbon seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ($R_{MAX}$) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance $N_{MIN}$ is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Alaska stock of ribbon seals were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 1 mortality reported both in 1990 and 1991. Averaging the estimated mortalities over the 1991-95 period results in a mean annual (total) mortality rate of 0.2 (CV=1.0) ribbon seals per year. The range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 12.

An additional source of information on the number of ribbon seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from all Alaska fisheries indicated no mortalities of ribbon seals. Complete logbook data after 1993 are not available.

**Table 12.** Summary of incidental mortality of ribbon seals (Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 1, 1, 0, 0, 0, 0 | 1, 1, 0, 0, 0, 0 | 0.2 (CV=1.0) |
| Total estimated annual mortality | | | | | | 0.2 |

The estimated minimum mortality rate incidental to commercial fisheries is 1 ribbon seal per year (rounded up from 0.2), based exclusively on observer data. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is considered to be insignificant and approaching zero mortality and serious injury rate. However, if there were 50,000 ribbon seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 =

1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 ribbon seals in U. S. waters.

**Subsistence/Native Harvest Information**

Ribbon seals are an important species for Alaska Native subsistence hunters, primarily from villages in the vicinity of the Bering Strait and to a lesser extent at villages along the Chukchi Sea coast (Kelly 1988). The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns 1981). In the mid-1980s, the Alaska Eskimo Walrus Commission estimated the subsistence take to still be less than 100 seals annually (Kelly 1988). A reliable estimate of the annual number of ribbon seals currently taken by Alaska Natives for subsistence is unavailable.

## STATUS OF STOCK

Ribbon seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ribbon seals and any U. S. fishery, the Alaska stock of ribbon seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

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# BELUGA WHALE (*Delphinapterus leucas*): Beaufort Sea Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

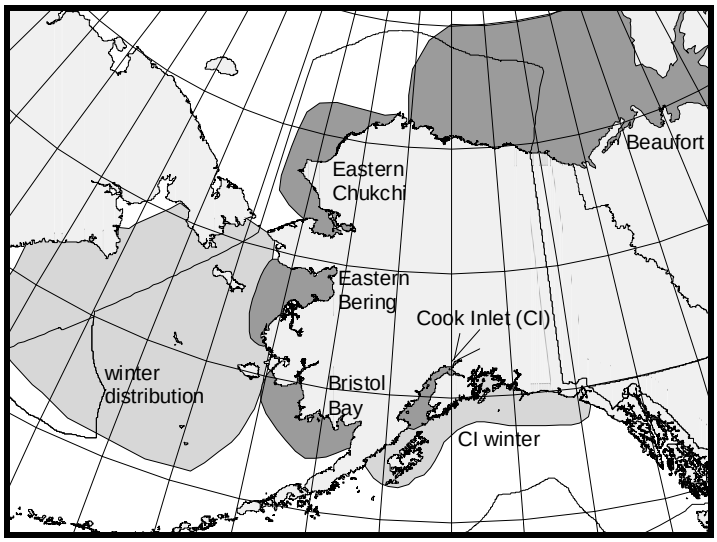


**Figure 15.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (G. O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 14).

## POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of northern Alaska and western Canada have included both opportunistic and systematic observations. Duval (1993) reported an estimate of 21,000 for the Beaufort Sea stock, similar to that reported by Seaman et al. (1985). The most recent aerial survey was conducted in July of 1992, when stock size was estimated to include 19,629 (CV=0.229) beluga whales (Harwood et al. 1996). To account for availability bias a correction factor of 2, which was not data-based, has been recommended for the Beaufort Sea beluga whale stock (Duval 1993), resulting in a population estimate of 39,258 (19,629 × 2) animals. A CV for the correction factor is not available; however, this correction factor (CF) was considered negatively biased by the Alaska SRG considering that CFs for this species typically range between 2.5 and 3.27 (Frost and Lowry 1995).

**Minimum Population Estimate**

For the Beaufort Sea stock of beluga whales, the minimum population estimate ($N_{MIN}$) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Thus, $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 39,258 and an associated CV(N) of 0.229, $N_{MIN}$ for this stock is 32,453.

**Current Population Trend**

The Beaufort Sea stock of beluga whales is considered to be stable or increasing (DeMaster 1995: p. 16).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Beaufort Sea stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is stable or increasing (DeMaster 1995: p. 16), the recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997). Thus, for the Beaufort Sea stock of beluga whales, PBR = 649 animals (32,453 × 0.02 × 1.0).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

The total fishery mortality and serious injury for this stock is estimated to be zero as there are no reports of mortality incidental to commercial fisheries in recent years.

**Subsistence/Native Harvest Information**

The subsistence take of beluga whales from this stock within U. S. waters is reported by the Alaska Beluga Whale Committee (ABWC). The most recent Alaska Native subsistence harvest estimates for the Beaufort Sea beluga stock are provided in Table 13a (Frost and Suydam 1995, Frost 1998). Given these data, the annual subsistence take by Alaska Natives averaged 61 belugas during the 5-year period from 1993 to 1997. Recent harvest reports are not considered negatively biased because they are based on on-site harvest monitoring and harvest reports from well established ABWC representatives. The 1993-97 average is negatively biased because reliable estimates for the number of animals struck and lost are not available prior to 1996.

**Table 13a.** Summary of the Alaska Native subsistence harvest from the Beaufort Sea stock of beluga whales, 1993-97. Canadian subsistence takes are provided in Table 13b. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Estimated number struck and lost |
|---|---|---|---|---|
| 1993 | 85[1,2] | n/a | 85[2] | n/a |
| 1994 | 63[2] | n/a | 62 | 1[2] |
| 1995 | 44[1] | n/a | 44 | n/a |
| 1996 | 42 | n/a | 24 | 18 |
| 1997 | 71 | 69-73 | 43 | 26-30 |
| Mean annual take (1993-97) | 61 | | | |

[1] Does not include the number of struck and lost; [2] Indicates a lower bound.

The subsistence take of beluga whales within Canadian waters of the Beaufort Sea is reported by the Fisheries Joint Management Committee (FJMC). The data are collected by on-site harvest monitoring conducted by the FJMC at Inuvialuit communities in the Mackenzie River delta, Northwest Territories. The most recent Canadian Inuvialuit subsistence harvest estimates for the Beaufort Sea beluga stock are provided in Table 13b (Norton et al. in press; FJMC unpubl. data, FJMC, Box 2120, Inuvik, NT, Canada, X0E 0T0). Given these data, the annual subsistence take in Canada averaged 123 belugas during the 5-year period from 1993 to 1997. Therefore, the mean estimated subsistence take in Canadian and U. S. waters from the Beaufort Sea beluga stock during 1993-97 is 184 (61 + 123) whales.

**Table 13b.** Summary of the Canadian subsistence harvest from the Beaufort Sea stock of beluga whales, 1993-97. Alaska Native subsistence takes are provided in Table 13a. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Reported number struck and lost |
|---|---|---|---|---|
| 1993 | 117 | n/a | 107 | 10 |
| 1994 | 140 | n/a | 133 | 7 |
| 1995 | 132 | n/a | 118 | 14 |
| 1996 | 106 | n/a | 95 | 11 |
| 1997 | 119 | n/a | 114 | 5 |
| Mean annual take (1993-97) | 123 | | | |

## STATUS OF STOCK

Beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on a lack of reported mortalities, the estimated annual fishery-related mortality (0) is not known to exceed 10% of the PBR (65) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of human-caused mortality and serious injury (184) is not known to exceed the PBR (649). Therefore, the Beaufort Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable or increasing, however, at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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# BELUGA WHALE (*Delphinapterus leucas*): Eastern Chukchi Sea Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

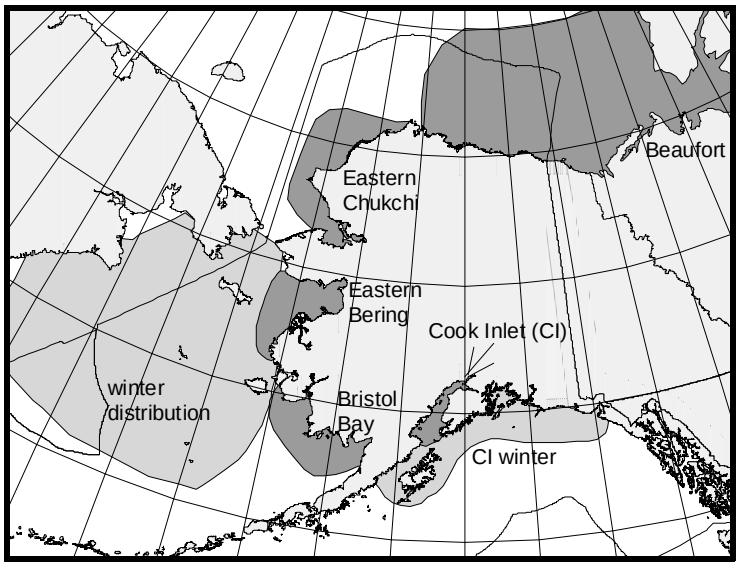


**Figure 16.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (G. O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 15).

## POPULATION SIZE

Frost et al. (1993) estimated the minimum size of the eastern Chukchi stock of belugas at 1,200, based on counts of animals from aerial surveys conducted during 1989-91. Survey effort was concentrated on the 170 km long Kasegaluk Lagoon, an area known to be regularly used by belugas during the open-water season. Other areas that belugas from this stock are known to frequent (e.g., Kotzebue Sound) were not surveyed. Therefore, the survey effort resulted in a minimum count. If this count is corrected, using radio telemetry data, for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995), and for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the eastern Chukchi stock is 3,710 (1,200 × 2.62 × 1.18).

During 25 June to 6 July, 1998, aerial surveys were conducted in the eastern Chukchi Sea (DeMaster et al. 1998). The maximum single day count (1,172 whales) was derived from a photographic count of a large aggregation near Icy Cape (1,018), plus animals (154) counted along an ice edge transect. This count is an underestimate because it was clear to the observers that many more whales were present along and in the ice than they were able to count and

only a small portion of the ice edge habitat was surveyed. Furthermore, only one of five belugas equipped with satellite tags a few days earlier remained within the survey area on the day the peak count occurred (DeMaster et al. 1998).

It is not possible to estimate the abundance for this stock from the 1998 survey. Not only were a large number of whales unavailable for counting, but the large Icy Cape aggregation was in shallow, clear water (DeMaster et al. 1998). Currently, a correction factor (to account for missed whales) does not exist for belugas encountered in such conditions. As a result, the abundance estimate from the 1989-91 surveys (3,710 whales) is still considered to be the most reliable for the eastern Chukchi Sea beluga whale stock.

**Minimum Population Estimate**

The survey technique utilized for estimating the abundance of beluga whales is a direct count which incorporates correction factors. Although CVs of the correction factors are not available, the Alaska Scientific Review Group concluded that the population estimate of 3,710 can serve as an estimate of minimum population size because the survey did not include areas where beluga are known to occur (Small and DeMaster 1995). That is, if the distribution of beluga whales in the eastern Chukchi Sea is similar to the distribution of beluga whales in the Beaufort Sea, which is likely, then a substantial fraction of the population was likely to have been in offshore waters during the survey period (DeMaster 1997).

**Current Population Trend**

The maximum 1998 count (1,172 animals) is similar to counts of beluga whales conducted in the same area during the summers of 1989-91 (1,200 animals) and counts of 1,104 and 1,601 in the summer of 1979 (Frost et al. 1993, DeMaster et al. 1998). Based on these data, there is no evidence that the eastern Chukchi Sea stock of beluga whales is declining.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. This stock is considered relatively stable and not declining in the presence of known take, thus the recovery factor ($F_R$) for this stock is 1.0 (DeMaster 1995: p. 17, Wade and Angliss 1997). For the eastern Chukchi Sea stock of beluga whales, PBR = 74 animals ($3{,}710 \times 0.02 \times 1.0$).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries that could have interacted with beluga whales from this stock were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports did not include any mortality to beluga whales from this stock as a result of interactions with commercial fishing operations. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

In the near shore waters of the eastern Chukchi Sea, substantial effort occurs in gillnet (mostly set nets), and personal-use fisheries. Although a potential source of mortality, there have been no reported takes of beluga whales as a result of these fisheries.

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock.

**Subsistence/Native Harvest Information**

The subsistence take of beluga whales from the eastern Chukchi Sea stock is provided by the Alaska Beluga Whale Committee (ABWC). The most recent subsistence harvest estimates for the stock are provided in Table 14 (Frost and Suydam 1995, Frost 1998). Given these data, the annual subsistence take by Alaska Natives averaged 68 belugas during the 5-year period 1993-97. This estimate is based on reports from ABWC representatives and on-site harvest monitoring. The 1993-97 average is negatively biased because there are not reliable estimates for the number of struck and lost prior to 1995.

**Table 14.** Summary of the Alaska Native subsistence harvest from the eastern Chukchi Sea stock of beluga whales, 1993-97. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Estimated number struck and lost |
|---|---|---|---|---|
| 1993 | 83[1] | n/a | 80-83 | n/a |
| 1994 | 66[2] | n/a | 63 | 3[2] |
| 1995 | 42 | n/a | 36 | 6 |
| 1996 | 126 | n/a | 116 | 10 |
| 1997 | 19 | n/a | 16 | 3 |
| Mean annual take (1993-97) | 68 | | | |

[1] Does not include the number of struck and lost; [2] Indicates a lower bound.

**STATUS OF STOCK**

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (7) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (68) is not known to exceed the PBR (74). Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Therefore, the eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable, however, at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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# BELUGA WHALE (*Delphinapterus leucas*): Eastern Bering Sea Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

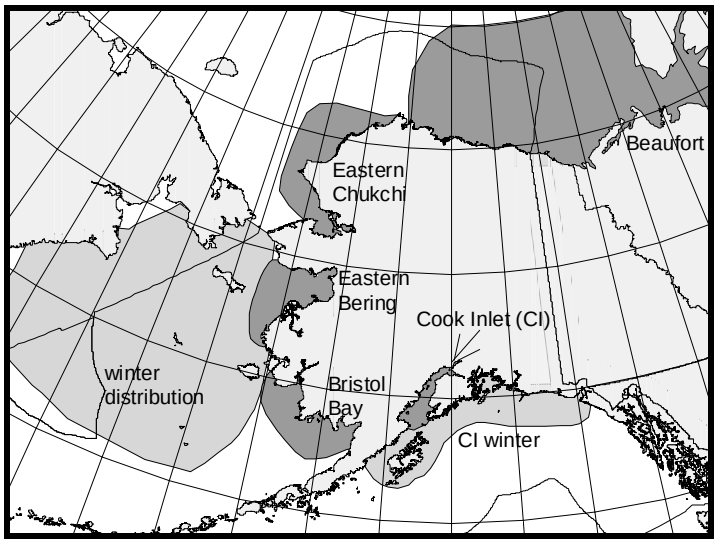


**Figure 17.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (G. O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 16).

## POPULATION SIZE

DeMaster et al. (1994) estimated the minimum abundance (e.g., uncorrected for probability of sighting) of belugas from aerial surveys over Norton Sound in 1992, 1993, and 1994 at 2,095, 620, and 695, respectively (see also Lowry et al. 1995). The variation between years was due, in part, to variability in the timing of the migration and movement of animals into the Sound. As a result the 1993 and 1994 estimates were considered to be negatively biased. Due to the disparity of estimates, the Norton Sound aerial surveys were repeated in June of 1995 leading to the highest abundance estimate of any year, but not significantly different than in 1992. An aerial survey conducted June 22 of 1995 resulted in an uncorrected estimate of 2,583 beluga whales (Lowry and DeMaster 1996). It should be noted that a slightly higher estimate (2,666) occurred during the 1995 survey over three day period from June 6-8. The single day estimate of (2,583), instead of the 3-day estimate was used to minimize the potential for double counting of whales. Correction factors (CF) recommended from studies of belugas range from 2.5 to 3.27 (Frost and Lowry 1995). For Norton Sound, the correction factor of 2.62 (CV[CF] not available) is recommended for the proportion of animals that

were diving and thus not visible at the surface (based on methods of Frost and Lowry 1995), given the particular altitude and speed of the survey aircraft. If this correction factor is applied to the June 22 estimate of 2,583 (CV=0.26) along with the additional correction factor for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the eastern Bering Sea stock is 7,986 (2,583 × 2.62 × 1.18) beluga whales.

An aerial survey of Norton Sound is scheduled to occur during the summer of 1999. Preliminary results from this survey are expected to be available in 2000.

**Minimum Population Estimate**

For the eastern Bering Sea stock of beluga whales, the minimum population estimate ($N_{MIN}$) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Therefore, $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 7,986 and an associated CV(N) of 0.26, $N_{MIN}$ for this stock is 6,439 beluga whales. A CV(N) that incorporates variance due to all of the correction factors is currently not available. However, the Alaska Scientific Review Group (SRG) considers the CV derived from the abundance estimate (CV=0.26) as adequate in calculating a minimum population estimate (DeMaster 1996, 1997; see discussion of $N_{MIN}$ for the eastern Chukchi stock of beluga whales). Due to foggy conditions encountered during the 1995 surveys, it was not possible to survey the entire Norton Sound area occupied by belugas during a continuous time period. As a result, the 1995 abundance estimate is considered to be conservative (Lowry and DeMaster 1996).

The Alaska SRG recommended using the abundance estimate (7,986 whales) as $N_{MIN}$ for this stock. They considered the estimate to be adequately conservative because 1) the June 22 survey covered only the Yukon Delta area, 2) fog precluded surveying the entire area where whales may have been encountered, and 3) the Beaufort sea state during the survey was less than ideal (DeMaster et al. In review). However, pending completion of an analysis on the effects of Beaufort sea state on beluga whale sighting rate, NMFS has decided to continue to use the $N_{MIN}$ as calculated according to the PBR Guidelines above (6,439 whales).

**Current Population Trend**

Surveys to estimate population abundance in Norton Sound were not conducted prior to 1992. However, between 1992 and 1995, survey data indicate that the population is less likely to be declining than it is to be stable or increasing.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the eastern Bering Sea stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for cetacean stocks that are thought to be stable in the presence of a subsistence harvest (Wade and Angliss 1997). The Alaska SRG recommended using a $F_R$ of 1.0 for this stock as the Alaska Beluga Whale Committee (ABWC) intends to continue regular surveys (i.e., 3-5 years) to estimate abundance for this stock and to annually monitor levels of subsistence harvest (DeMaster 1997). For the eastern Bering Sea stock of beluga whales, PBR = 129 animals (6,439 × 0.02 × 1.0).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries that could have interacted with beluga whales in the eastern Bering Sea were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish

trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports did not include any mortality to beluga whales from this stock as a result of interactions with commercial fishing operations. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock. The estimated mortality is considered a minimum due to a lack of observer programs in fisheries likely to take beluga whales and because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

In the near shore waters of the eastern Bering Sea, substantial effort occurs in gillnet (mostly set nets), herring, and personal-use fisheries. The only reported beluga mortality occurred in a personal-use king salmon gillnet near Cape Nome in 1996. This mortality results in an annual estimated mortality of 0.2 whales from this stock during 1993-97. Note that this is not a commercial fishery. As a result, this estimate is considered a minimum because personal-use fishers are not aware of a reporting requirement and there is no established protocol for non-commercial takes to be reported to NMFS. It should also be noted that in this region of western Alaska any whales taken incidentally to the personal-use fishery are utilized by Alaska Native subsistence users. It is not clear whether the 1996 entanglement was accounted for in the 1996 Alaska Native subsistence harvest report. If so, this particular mortality may have been double-counted.

**Subsistence/Native Harvest Information**

The subsistence take of beluga whales from the eastern Bering Sea stock is provided by the ABWC. The most recent subsistence harvest estimates for the stock are provided in Table 15 (Frost and Suydam 1995, Frost 1998). Given these data, the annual subsistence take by Alaska Natives averaged 121 belugas from the eastern Bering Sea stock during the 5-year period 1993-97. These estimates are based on reports from ABWC representatives. The 1993-97 average is considered negatively biased due to a lack of reporting in several villages prior to 1996. In addition, there is not a reliable estimate for the number of struck and lost prior to 1996. Furthermore, an unknown proportion of the animals harvested each year by Alaska Native hunters in this region may belong to other beluga stocks migrating through Norton Sound in both the fall and spring (DeMaster 1995: p. 4).

**Table 15.** Summary of the Alaska Native subsistence harvest from the eastern Bering Sea stock of beluga whales, 1993-97. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Estimated number struck and lost |
|---|---|---|---|---|
| 1993 | 136[1,2] | 121-136[1] | 121-136 | n/a |
| 1994 | 132[2] | 126-132[2] | 116-122 | 10[2] |
| 1995 | 56[2] | 51-61[2] | 45-55[2] | 6[2] |
| 1996 | 120 | 113-126 | 97-108 | 16-18 |
| 1997 | 160 | 146-173 | 127-141 | 19-32 |
| Mean annual take (1993-97) | 121 | | | |

[1] Does not include the number of struck and lost; [2] Indicates a lower bound.

**STATUS OF STOCK**

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (16) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual rate, over the 5-year period from 1993 to 1997, of human-

caused mortality and serious injury (122, including the estimated mortality in non-commercial fisheries) is not known to exceed the PBR (129) for this stock. Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Therefore, the eastern Bering Sea beluga whale stock is not classified as strategic. No decreasing trend has been detected for this stock in the presence of a known harvest, although at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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# BELUGA WHALE (*Delphinapterus leucas*): Bristol Bay Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

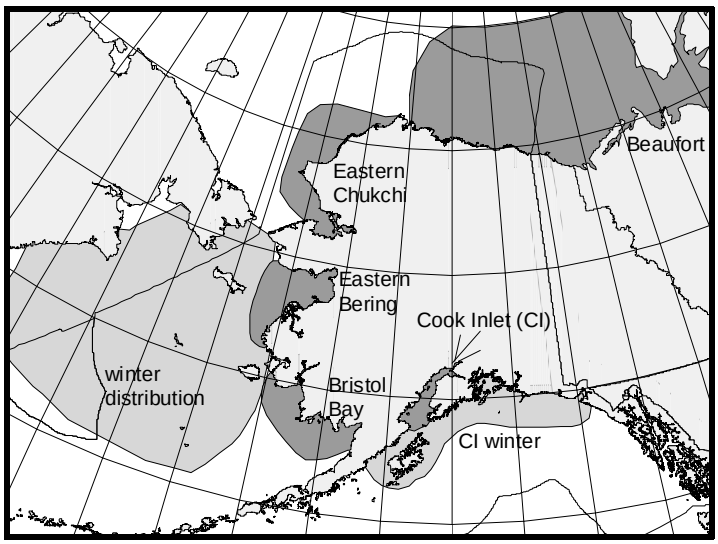


**Figure 18.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (G. O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 17).

## POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of western and northern Alaska have included both opportunistic and systematic observations. Frost and Lowry (1990) compiled data collected from aerial surveys conducted between 1978 and 1987 that were designed to specifically estimate the number of beluga whales. Surveys did not cover the entire habitat of belugas, but were directed to specific areas at the times of year when belugas were expected to concentrate. Frost and Lowry (1990) reported an estimate of 1,000-1,500 for Bristol Bay, similar to that reported by Seaman et al. (1985). Most recently, the number of beluga whales in Bristol Bay was estimated at 1,555 in 1994 (Lowry and Frost 1998). This estimate was based on a count of 503 animals, which was corrected using radio-telemetry data for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995b), and for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971).

An aerial survey of Bristol Bay is scheduled to occur during the summer of 1999. Preliminary results from this survey are expected to be available in 2000.

**Minimum Population Estimate**

The survey technique utilized for estimating the abundance of beluga whales in this stock is a direct count which incorporates correction factors. Given this survey methodology, an estimate of the variance of abundance is unavailable. In addition, the abundance estimate is thought to be conservative because: 1) some whales may have been outside the survey area (i.e., Kuskokwim Bay), 2) no correction has been made for whales that were at the surface but were missed by the observers, and 3) the dive correction factor is probably negatively biased (Lowry and Frost 1998). Consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate ($N_{MIN}$). $N_{MIN}$ for this beluga whale stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN}= N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 1,555 and the default CV (0.2), $N_{MIN}$ for the Bristol Bay stock of beluga whales is 1,316.

**Current Population Trend**

Population estimates from the 1950s (Brooks 1955, Lensink 1961) suggested there were about 1,000-1,500 belugas in Bristol Bay. The first abundance estimate (1,250) from aerial surveys was conducted in 1983. Consistency in count data and abundance estimates between 1993, 1994, and earlier surveys suggests that the Bristol Bay stock is stable, and at or near its historic size (Frost and Lowry 1990, 1995a, Lowry and Frost 1998).

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for the Bristol Bay stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

**POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is considered stable (Frost and Lowry 1990) and because of the regular surveys to estimate abundance and the annual harvest monitoring program supported by the Alaska Beluga Whale Committee (ABWC), the recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997, DeMaster 1997; see discussion under PBR for the eastern Bering Sea stock). Thus, for the Bristol Bay stock of beluga whales, PBR = 26 animals (1,316 × 0.02 × 1.0).

**ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

**Fisheries Information**

Three different commercial fisheries that could have interacted with beluga whales in Bristol Bay were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries (Table 16a).

An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. Observers have never monitored the Bristol Bay salmon set gillnet and drift gillnet fisheries which combined had over 2,900 active permits in 1996. During the period between 1990 and 1997, fisher self-reports included 1 mortality in both 1990 and 1991 from these fisheries (see Table 16a) resulting in an annual mean of 0.5 mortalities from interactions with commercial gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The 1990 logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As a result, the 1990 mortality may have occurred in the drift net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4). Larger fishery-related mortalities resulting from these fisheries have been recorded in

the past. During the summer of 1983 the Alaska Department of Fish and Game documented 12 beluga whale mortalities in Bristol Bay related to drift and set gillnet fishing (Frost et al. 1984).

**Table 16a.** Summary of incidental mortality of beluga whales (Bristol Bay stock) due to commercial fisheries from 1990 through 1997 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1993 to 1997 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Reported mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Observer program total | 90-97 | | | | | 0 |
| Bristol Bay salmon drift gillnet | 90-97 | self reports | n/a | 0, 1, 0, 0, n/a, n/a, n/a, n/a | n/a | [$0.25] |
| Bristol Bay salmon set gillnet | 90-97 | self reports | n/a | 1, 0, 0, 0, n/a, n/a, n/a, n/a | n/a | [$0.25] |
| Minimum total annual mortality | | | | | | $0.5 |

The estimated minimum mortality rate incidental to commercial fisheries is 1 animal per year (rounded up from 0.5), based entirely on logbook data. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the Bristol Bay gillnet fisheries that are known to interact with this stock.

**Subsistence/Native Harvest Information**

The subsistence take of beluga whales from the Bristol Bay stock is provided by the ABWC. The most recent subsistence harvest estimates for the stock are provided in Table 16b (Frost and Suydam 1995, Frost 1998). Given these data, the annual subsistence take by Alaska Natives averaged 19 belugas from the Bristol Bay stock during the 5-year period 1993-97. This estimate is based on reporting by ABWC representatives and is considered negatively biased because there is not a reliable estimate for the number of struck and lost prior to 1994.

**Table 16b.** Summary of the Alaska Native subsistence harvest from the Bristol Bay stock of beluga whales, 1993-97. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Estimated number struck and lost |
|---|---|---|---|---|
| 1993 | 35[1] | 33-35[1] | 33-35 | n/a |
| 1994 | 18 | n/a | 16 | 2 |
| 1995 | 10 | n/a | 6 | 4 |
| 1996 | 19 | n/a | 18 | 1 |
| 1997 | 11 | n/a | 11 | 0 |
| Mean annual take (1993-97) | 19 | | | |

[1] Does not include the number of struck and lost.

**STATUS OF STOCK**

At present, annual mortality levels less than 2.6 per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. However, it is unknown whether the mortality rate is

insignificant because a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable. Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (20, including subsistence harvests and fishery-related mortality) is not known to exceed the PBR (26). Therefore, the Bristol Bay stock of beluga whales is not classified as a strategic stock. However, as noted previously, the estimate of fisheries-related mortality is unreliable and, therefore, likely to be underestimated. The population size is considered stable, however, at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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# BELUGA WHALE (*Delphinapterus leucas*): Cook Inlet Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

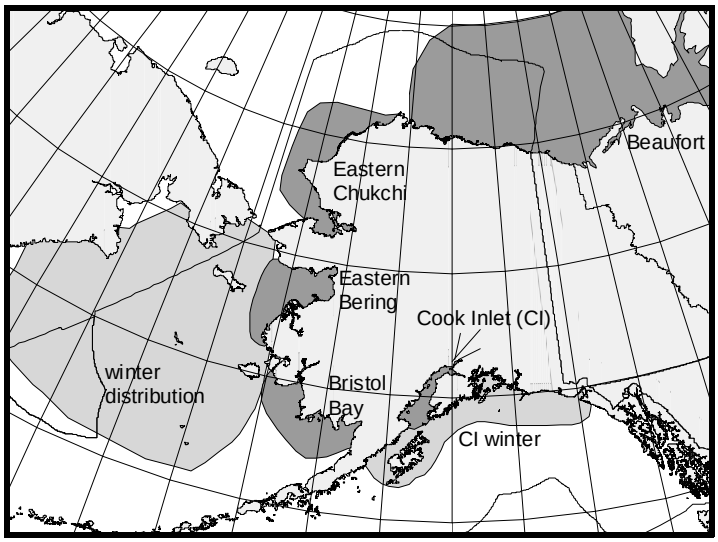


**Figure 19.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 18).

## POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet were conducted annually in June or July during 1994-98 using an 'approach' survey technique that involves repeated circling of observed groups, and videotape recording. The approach technique differs from 'passing mode' surveys performed for belugas in other stocks, in that during passing surveys the aircraft maintains a straight flight path. The approach technique allows each group of whales observed and recorded on video to be corrected for 1) animals that were under the surface, and 2) animals missed by observers yet recorded on video. The sum of median counts for all groups observed in the 1994-98 surveys is 281, 324, 307, 264, and 193 whales, respectively (Rugh et al. In review). The process of using medians instead of maximum counts reduces the effects of outliers (extremes in high or low counts), makes the results more comparable to other surveys which lack multiple passes over whale groups, and is more appropriate than using maximums when the counts will be corrected for missed whales (Rugh et al. 1996).

The abundance of beluga whales in Cook Inlet is estimated from aerial observer counts and aerial video group size estimates. The group size estimates are corrected for subsurface animals (availability) and animals at the surface

that were missed (sightability) based on an analysis of the video tapes. Observer counts are corrected for availability and sightability using a regression of counts and an interaction term of counts with encounter rate against the video group size estimates (Hobbs et al. 1998). The most recent abundance estimate of beluga whales in Cook Inlet resulting from the June 1998 aerial survey is 347 (CV = 0.29) animals (Hobbs et al. 1998).

**Minimum Population Estimate**

The minimum population size ($N_{MIN}$) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 347 and its associated CV(N) of 0.29, $N_{MIN}$ for the Cook Inlet stock of beluga whales is 273.

**Current Population Trend**

In general, uncorrected counts have ranged from 300 to 500 beluga whales within Cook Inlet between 1970 and 1996. However, median counts since 1996 have been below 300 animals (264 in 1997 and 193 in 1998). The abundance estimates for the period 1994-98 are shown in Figure 19 (Hobbs et al. 1998). A statistically significant trend in abundance has not been detected, although the power was low due to the short time series. However, the 1998 abundance estimate (347) is approximately 47% lower than the 1994 abundance estimate (653). In addition, a review of beluga distribution data suggest there has been a reduction in offshore sightings in upper Cook Inlet and a reduction in sightings in lower Cook Inlet (Rugh et al. In review).

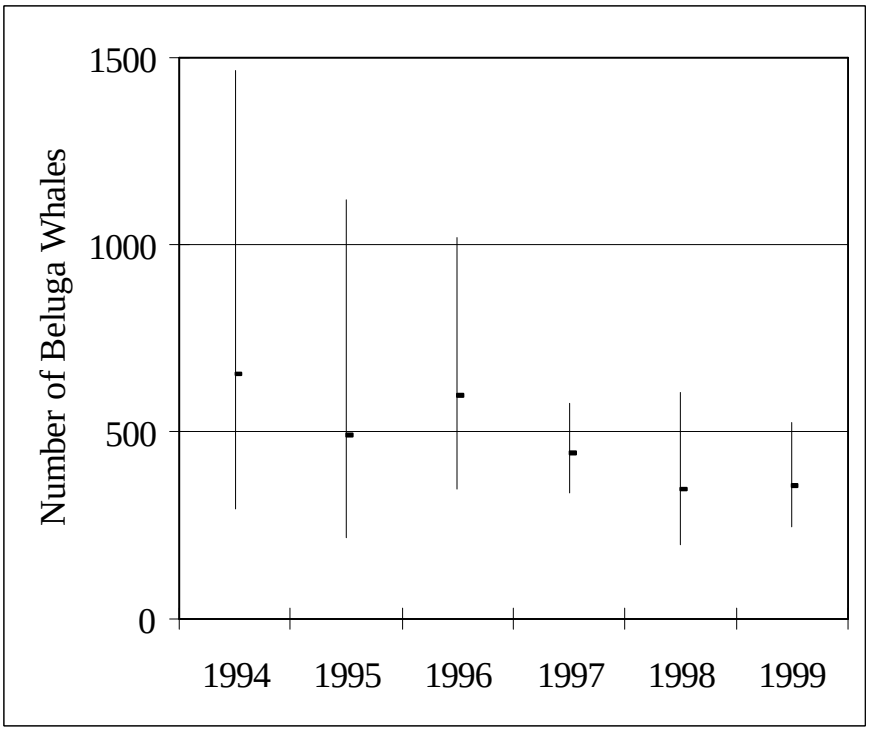


**Figure 19.** Abundance of beluga whales in Cook Inlet 1994-98 (adapted from Hobbs et al. 1998). Error bars depict the 95% confidence intervals

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently not available for the Cook Inlet stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

**POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The $F_R$ and PBR for the Cook Inlet stock of beluga whale in Small and DeMaster (1995), Hill et al. (1997), and Hill and DeMaster (1998) were "undetermined" and "undetermined"; 1.0 and 15; and 1.0 and 14, respectively. However, based on the recent information on stock size, trends in abundance, and level of the subsistence harvest, the Alaska Scientific Review Group (ASRG) (Ferrero 1999) has recommended that NMFS reduce the $F_R$ to the lowest value possible (i.e., 0.1). Further, the ASRG noted the

resulting PBR would be 0.54 (assuming an $N_{min}$ of 273 and an $R_{max}$ of 0.04) and recommended that the agency use this value in managing interactions between Cook Inlet belugas and commercial fisheries in Cook Inlet.

NMFS has chosen not to accept the recommendation of the ASRG at this time. Rather, NMFS has selected an $F_R$ of 0.3 based on the following: 1) this stock has formally been proposed for listing as depleted under the MMPA (which typically is associated with a $F_R$ of 0.5), 2) in March 1999, NMFS was petitioned to list this stock as endangered under the Endangered Species Act, where NMFS has a period of 1 year to make an evaluation as to the merits of the petition (note: a listing of endangered is typically associated with a $F_R$ of 0.1, while a listing of threatened is associated with a $F_R$ of 0.5). Furthermore, the major mortality factor for this stock, subsistence harvest, has been reduced through legislation and cooperative efforts by Alaskan Natives. Thus, the PBR = 1.6 animals (273 x 0.02 x 0.3) for the Cook Inlet stock of beluga whale. Additional data were collected on this stock in 1999; therefore, NMFS anticipates revising this report in 2000 and will evaluate all information and revise all statistics used in the PBR equation as needed.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three types of commercial fishing gear that could possibly interact with beluga whales occur in Cook Inlet (purse seine, drift gillnet, and set gillnet) and are used to catch each of the five species of Pacific salmon, as well as Pacific herring. There are no observer data as fishery observers have not monitored any of these fisheries within Cook Inlet. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports indicated no mortalities of beluga whales from interactions with commercial fishing operations (Table 17a). Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

In the past, beluga mortalities have been attributed to Cook Inlet fisheries with the fishing-related mortality during the 3-year period from 1981 to 1983 estimated at 3-6 animals per year (Burns and Seaman 1986). Accordingly, though there were no self-reported fishery mortalities of beluga whales, the Cook Inlet gillnet fisheries (having a combined total of over 1,325 active permits in 1997) have been included in Table 17a because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the Cook Inlet fisheries mentioned above. The Cook Inlet salmon set and drift gillnet fisheries are scheduled to be observed in 1999 and 2000.

**Table 17a.** Summary of incidental mortality of beluga whales (Cook Inlet stock) due to commercial fisheries from 1990 through 1997 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1993 to 1997 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Reported mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Observer program total | 93-97 | | | | | 0 |
| Cook Inlet salmon drift gillnet | 90-97 | self reports | n/a | 0, 0, 0, 0, n/a n/a, n/a, n/a | n/a | [0] |
| Cook Inlet salmon set gillnet | 90-97 | self reports | n/a | 0, 0, 0, 0, n/a n/a, n/a, n/a | n/a | [0] |
| Minimum total annual mortality | | | | | | 0 |

**Subsistence/Native Harvest Information**

A study conducted by the Alaska Department of Fish and Game (ADF&G), in cooperation with the Alaska Beluga Whale Committee (ABWC) and the Indigenous People's Council for Marine Mammals, estimated the subsistence take in 1993 at 17 whales based on surveys of 16 of 19 households known to have hunted in 1993 (Table 17b: Stanek 1994). This was considered a minimum estimate, and was increased by adding the estimated number of whales taken from households not surveyed (3) and by hunters from areas outside of Cook Inlet (10) resulting in an estimated total take of 30 (17 + 3 + 10) whales. However, in consultation with native elders from the Cook Inlet region, the Cook Inlet Marine Mammal Council (CIMMC) estimated the annual number of belugas taken by subsistence hunters to be greater than 30 animals (DeMaster 1995: p. 5).

There was no systematic Cook Inlet beluga harvest survey in 1994. Instead, Cook Inlet harvest data for 1994 were compiled at the November 1994 ABWC meeting. Representatives of the CIMMC, ADF&G Division of Subsistence, and an active Cook Inlet hunter each presented harvest information they knew about. They discussed the information among themselves to eliminate redundancy, and agreed upon a final 1994 harvest estimate of 19 retrieved and 2 struck and lost. This included 2 belugas taken in Cook Inlet by hunters from Kotzebue Sound. The ADF&G representative estimated that there were 35-50 active beluga hunting households in the Cook Inlet region.

**Table 17b.** Summary of the Alaska Native subsistence harvest from the Cook Inlet stock of beluga whales, 1993-97. n/a indicates the data are not available.

| Year | Reported total number taken | Estimated range of total take | Reported number harvested | Estimated number struck and lost |
|---|---|---|---|---|
| 1993 | 30[1] | n/a | n/a | n/a |
| 1994 | 21[1] | n/a | 19[1] | 2[1] |
| 1995 | 68 | n/a | 42 | 26 |
| 1996 | 123 | 98-147 | 49 | 49-98 |
| 1997 | 70[2] | n/a | 35[2] | 35[2] |
| Mean annual take (1995-97) | 87 | | | |

[1] Estimated value (see text); [2] Represents a minimum value.

The most recent subsistence harvest data concerning the Cook Inlet beluga whale stock is provided in Table 17b (ABWC unpubl. data, ABWC, P.O. Box 69, Barrow, AK, 99723; CIMMC unpubl. data, 26339 Eklutna Village Rd., Chugiak, AK, 99567). The most thorough subsistence harvest surveys to date were completed in Cook Inlet by the CIMMC during 1995-97. Some of the local hunters believe the 1996 estimate of struck and lost is positively biased. The 1995-97 CIMMC take estimates are considered reliable. Given these data, the annual subsistence take by Alaska Natives averaged 87 during the 3-year period from 1995-97. Due to the thoroughness of the 1995-97 harvest reports as compared to earlier years, it is not possible to ascertain the trend in subsistence take. However, as the data from 1995-97 are considered the most reliable, subsistence mortality for the Cook Inlet stock has been averaged over a 3-year period whereas a 5-year period is used for the other four beluga whale stocks occurring in this document.

**OTHER MORTALITY**

Mortalities related to stranding events have been reported in Cook Inlet. For example, in June of 1996, 63 animals stranded in the Susitna Delta (Rugh et al. 1997). Four of these animals are known to have died as a result of the stranding event (B. Smith, pers. comm., NMFS, 222 W 7th Ave., Anchorage, AK, 99513). Such mortalities are not likely to be associated with human-related activities.

## STATUS OF STOCK

Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act (ESA). A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate is insignificant. At present, annual commercial fishery-related mortality levels less than 0.16 per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 87 beluga whales (estimated exclusively from subsistence harvest data) exceeds the PBR (1.6) for this stock. Therefore, the Cook Inlet beluga whale stock is classified as a strategic stock. It is not possible to ascertain trends in abundance at this time; however, the current level of human-caused removals is not sustainable.

Sustainable harvest levels for this stock will be determined from the analysis of information gathered through the cooperative management process, and will reflect the degree of uncertainty associated with the information obtained for this stock. Efforts were initiated in 1995 and continued in 1996 to develop an umbrella agreement among the Indigenous People's Council for Marine Mammals, Fish and Wildlife Service (FWS), and NMFS regarding the cooperative management of certain stocks of marine mammals utilized by Native subsistence hunters in Alaska. The final agreement was signed August 27, 1997. During 1998, efforts were initiated to formalize a specific agreement with local Alaska Native Organizations and NMFS regarding the management of this stock. In addition, in October 1998 a formal status review was initiated to assess the potential listing of the Cook Inlet beluga whale stock as "threatened" or "endangered" under the ESA or "depleted" under the MMPA.

### Habitat Concerns

The State of Alaska has held 41 oil and gas lease sales in Cook Inlet since 1959. The planned Cook Inlet Area-wide Sale is scheduled for Feb. 1999, and will offer 4.2 million acres in and around Cook Inlet including tracts at the major river mouths, such as the Beluga River, Susitna River, and Little Susitna River, which are areas of concentrated use by belugas in ice-free seasons. Activities associated with these sales include seismic geophysical exploration, drilling, discharge of drill muds and cuttings, discharge of sanitary wastes and production/formation waters, construction of drill platforms, vessel and aircraft support. It is unknown what effect, if any, the lease sales and associated activities will have on the Cook Inlet beluga whale stock.

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# KILLER WHALE (*Orcinus orca*): Eastern North Pacific Northern Resident Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). In Alaska waters, killer whales occur along the entire Alaska coast from the Chukchi Sea, into the Bering Sea, along the Aleutian Islands, Gulf of Alaska, and into Southeast Alaska (Braham and Dahlheim 1982). Their occurrence has been well documented throughout British Columbia and the inland waterways of Washington State (Bigg et al. 1990), as well as along the outer coasts of Washington, Oregon, and California (Green et al. 1992, Barlow 1995, Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State (Bigg et al. 1990). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Heise et al. 1991) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

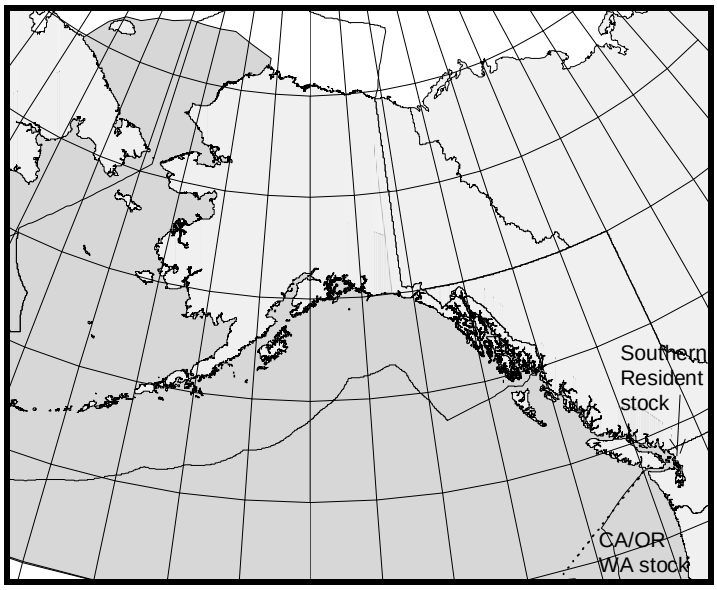


**Figure 21.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the Eastern North Pacific Northern Resident and Transient stocks are largely overlapping (see text).

Killer whales along British Columbia and Washington State have been labeled as ‘resident’, ‘transient’, and ‘offshore’ (Bigg et al. 1990, Ford et al. 1994). Whales of a particular type have not been observed to associate with members of the other group types (Ford et al. 1994). Although less is known about killer whales in Alaska, it appears that all three types occur in Alaska waters (Dahlheim et al. 1997). The ‘resident’ and ‘transient’ types are believed to differ in several aspects of morphology, ecology, and behavior; that is, dorsal fin shape, saddle patch shape, pod size, home range size, diet, travel routes, dive duration, and social integrity of pods. For example, in Pacific Northwest waters, significant differences occur in call repertoires (Ford and Fisher 1982), saddle patch pigmentation (Baird and Stacey 1988), and diet (Baird et al. 1992). Studies on mtDNA restriction patterns provide evidence that the ‘resident’ and ‘transient’ types are genetically distinct (Stevens et al. 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel et al. 1998).

Less is known about the ‘offshore’ type killer whales, which typically travel in pods of 25-75 individuals and have been encountered primarily off the coasts of California, Oregon, British Columbia and, rarely, in Southeast Alaska (Ford et al. 1994, Black et al. 1997, Dahlheim et al. 1997). Studies indicate the ‘offshore’ group type, although distinct from the other types (‘resident’ and ‘transient’), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the ‘resident’ type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers.

comm., Vancouver Aquarium, P. O. Box 3232, Vancouver, B.C. V6B3X8; L. Barrett-Lennard, pers. comm., Univ. of British Columbia, 6270 University Blvd., Vancouver, B.C. V6T1Z4).

Based primarily on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, five killer whale stocks are recognized along the west coast of North America from California to Alaska: 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring within the inland waters of Washington state and southern British Columbia, 3) the Eastern North Pacific Transient stock - occurring from Alaska to Cape Flattery, WA, 4) the California/Oregon/Washington Pacific Coast stock - occurring from Cape Flattery through California (Fig. 20), and 5) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California. Because the stock area for the Eastern North Pacific Northern Resident stock is defined as the waters from British Columbia through Alaska, 'resident' whales in Canadian waters are considered part of the Eastern North Pacific Northern Resident stock. The Stock Assessment Reports for the Pacific Region contain information concerning the Eastern North Pacific Southern Resident stock, the California/Oregon/Washington Pacific Coast stock, the Eastern North Pacific Offshore stock (to be included in the 1999 stock assessment revisions), and a Hawaiian stock. The stock structure recommended in this report should be considered preliminary pending a joint review by the Alaska and Pacific Scientific Review Groups.

**POPULATION SIZE**

The Eastern North Pacific Northern Resident stock is a transboundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'resident' killer whales belonging to the Eastern North Pacific Northern Resident stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In British Columbia, 200 'resident' whales have been identified (Ford et al. 1994). In Southeast Alaska, an additional 89 'resident' whales have been identified (Dahlheim et al. 1997). In Prince William Sound and Kenai Fjords, another 360 'resident' whales have been identified (Matkin et al. 1998). Based on data collected from all Alaska waters west of Seward (Dahlheim and Waite 1993, Dahlheim 1994, Dahlheim 1997), 68 whales are considered 'residents' as they have been linked by association to 'resident' whales from Prince William Sound (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6), and an additional 174 have been provisionally classified as 'residents' and 53 as 'transients.' Provisional classifications were based primarily on morphological differences identified from the photographs. Accordingly, the numbers of 'residents' and 'transients' in Alaska waters west of Seward are considered preliminary at this time. Combining the counts of 'resident' whales gives a minimum number of 717 (200 + 89 + 360 + 68) killer whales belonging to the Eastern North Pacific Northern Resident stock.

**Minimum Population Estimate**

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals known to be alive is likely conservative. However, the rate of discovering new whales within Southeast Alaska and Prince William Sound is relatively low. In addition, the abundance estimate does not include 174 unclassified whales from western Alaska that have been provisionally classified as 'residents'.

Other estimates of the overall population size (i.e., $N_{BEST}$) and associated CV(N) are not currently available. Thus, the minimum population estimate ($N_{MIN}$) for the Eastern North Pacific Northern Resident stock of killer whales is 717 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory transboundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

**Current Population Trend**

Mortality and recruitment rates for six 'resident' killer whale pods in Prince William Sound from 1985 to 1991 and for 16 pods in northern British Columbia from 1981 to 1986 indicate a 2% annual rate of increase for each region over the years examined (Matkin and Saulitis 1994). However, at present, reliable data on trends in population abundance for the entire Eastern North Pacific Northern Resident stock of killer whales are unavailable.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). However, a population increases at the maximum growth rate ($R_{MAX}$) only when the population is at extremely low levels; thus, the estimate of 2.92% is not a reliable estimate of $R_{MAX}$. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Eastern North Pacific Northern Resident killer whale stock, PBR = 7.2 animals (717 × 0.02 × 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Six different commercial fisheries in Alaska that could have interacted with killer whales were monitored for incidental take by fishery observers from 1990 to 1996: Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. Of the 6 observed fisheries, killer whale mortalities occurred only in the Bering Sea groundfish trawl and longline fisheries. For the fisheries with observed takes, the range of observer coverage over the 7-year period, as well as the annual observed and estimated mortalities are presented in Table 15. Both the 1991 and 1995 mortalities in the longline fishery occurred during unmonitored hauls and could not be used to estimate total mortality for the fishery in those years (80% and 28% observer coverage in 1991 and 1995, respectively). For computational purposes, the estimated mortality in 1991 and 1995 was set at 1, because at a minimum, one whale is known to have perished in each of those years. The 1993 mortality in the trawl fishery occurred under similarly circumstances and was treated in the same manner (66% observer coverage in 1993). The mean annual (total) mortality was 0.6 (CV=0.67) for the Bering Sea groundfish trawl fishery and 0.2 (CV=1.0) for the combined Bering Sea longline fishery, resulting in a mean annual mortality rate of 0.8 (CV=0.56) killer whales per year from observed fisheries.

**Table 15.** Summary of incidental mortality of killer whales (Eastern North Pacific Northern Resident stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Data from 1992 to 1996 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSAI) groundfish trawl | 90-96 | obs data | 53-74% | 0, 1, 1, 1, 0, 0, 0 | 1, 2, 2, 1, 0, 0, 0 | 0.6 (CV=0.67) |
| BSAI groundfish longline (incl. misc. finfish and sablefish fisheries) | 90-96 | obs data | 27-80% | 0, 1, 0, 0, 0, 1, 0 | 0, 1, 0, 0, 0, 1, 0 | 0.2 (CV=1.0) |

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Estimated total annual mortality | | | | | | 0.8 (CV=0.56) |

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from all Alaska fisheries indicated only one killer whale mortality, which occurred in the Bering Sea groundfish trawl fishery in 1990. That mortality has been included as an estimated mortality in Table 15 even though an observer program was in operation for that fishery (with 74% observer coverage) and did not report any killer whale mortalities during that year. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 0.8 animals per year, based exclusively on observer data. As the animals which were taken incidental to commercial fisheries have not been identified genetically, it is not possible to determine whether they belonged to the Eastern North Pacific Northern Resident or the Eastern North Pacific Transient killer whale stock. Accordingly, these same mortalities can be found in the stock assessment report for the Transient stock.

Due to a lack of Canadian observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with killer whales. The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994, one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther et al. 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock.

**Subsistence/Native Harvest Information**

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

**Other Mortality**

Since 1986, research efforts have been made to assess the nature and magnitude of killer whale/blackcod (sablefish; *Anoplopoma fimbria*) interactions (Dahlheim 1988; Yano and Dahlheim 1995). Fishery interactions have occurred each year in the Bering Sea and Prince William Sound, with the number of annual reports varying considerably. Data collected from the Japan/U. S. cooperative longline research surveys operating in the Bering Sea indicate that interactions may be increasing and expanding into the Aleutian Islands region (Yano and Dahlheim 1995). During the 1992 surveys conducted in the Bering Sea and western Gulf of Alaska, 9 of 182 (4.9%) individual whales in 7 of the 12 (58%) pods encountered had evidence of bullet wounds (Dahlheim and Waite 1993). The relationship between wounding due to shooting and survival is unknown. In Prince William Sound, the pod responsible for most of the fishery interactions has experienced a high level of mortality: between 1986 and 1991, 22 whales out of a pod of 37 (59%) are missing and considered dead (Matkin et al. 1994). The cause of death for these whales is unknown, but it may related to gunshot wounds or effects of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994).

The shooting of killer whales in Canadian waters has also been a concern in the past. However, in recent years the Canadian portion of the stock has been researched so extensively that evidence of bullet wounds would have been noticed if shooting was prevalent (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6).

**Other Issues**

Although only small numbers of killer whales are taken in the Bering Sea fisheries, there is considerable interaction between the whales and the fisheries. Interactions between killer whales and longline vessels have been well documented (Dahlheim 1988, Yano and Dahlheim 1995). However, less has been documented regarding interactions with the trawl fishery. Recently several observers reported that large groups of killer whales in the Bering Sea have followed vessels for days at a time, actively consuming the processing waste (Fishery Observer Program, unpubl. data, NMFS, AFSC, 7600 Sand Point Way NE, Seattle, WA 98115).

## STATUS OF STOCK

Killer whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Recall, that the human-caused mortality has been underestimated due primarily to a lack of information on Canadian fisheries, and that the minimum abundance estimate is considered conservative (because researchers continue to encounter new whales and unclassified whales from western Alaska were not included), resulting in a conservative PBR estimate. However, based on currently available data, the estimated annual fishery-related mortality level (0.8) exceeds 10% of the PBR, (i.e., 0.72) and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0.8 animals per year) is not known to exceed the PBR (7.2). Therefore, the Eastern North Pacific Northern Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

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# PACIFIC WHITE-SIDED DOLPHIN (*Lagenorhynchus obliquidens*): Central North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The Pacific white-sided dolphin is found throughout the temperate North Pacific Ocean, north of the coasts of Japan and Baja California, Mexico. In the eastern North Pacific the species occurs from the southern Gulf of California, north to the Gulf of Alaska, west to Amchitka in the Aleutian Islands, and is rarely encountered in the southern Bering Sea. The species is common both on the high seas and along the continental margins, and animals are known to enter the inshore passes of Alaska, British Columbia, and Washington (RIWC 1997).

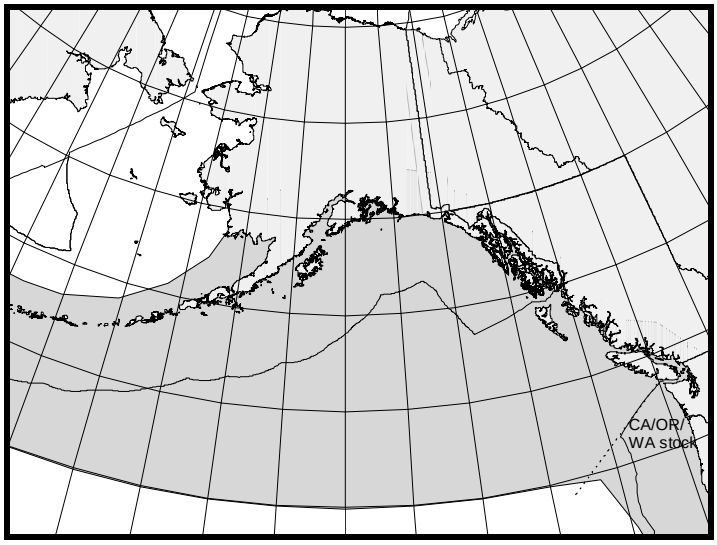


**Figure 22.** Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (shaded area).

The following information was considered in classifying Pacific white-sided dolphin stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution is continuous; 2) Population response data: unknown; 3) Phenotypic data: two morphological forms are recognized (Walker 1986, Chivers et al. 1993); and 4) Genotypic data: preliminary genetic analyses on 116 Pacific white-sided dolphin collected in four areas (Baja California, the west coast of the U. S., British Columbia/southeast Alaska, and offshore) were not statistically significant to support phylogeographic partitioning, though lend credence support the hypothesis that animals from the different regions are sufficiently isolated to treat them as separate management units (RIWC 1997). Based on this limited information, stock structure throughout the North Pacific is poorly defined, yet the northern form occurs north of about 33/N from southern California to Alaska, whereas the southern form ranges from about 36/N southward along the coasts of California and Baja California. The northern and southern forms can not, however, currently be differentiated for abundance and mortality estimation, and are thus managed as a single unit. Because the California and Oregon thresher shark/swordfish drift gillnet fishery operates between 33/N and 45/N and is known to interact with Pacific white-sided dolphins, two stocks are recognized: 1) the California/Oregon/Washington stock, and 2) the Central North Pacific stock (Fig. 21). The California/Oregon/ Washington stock is reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

The most recent population abundance estimate for Pacific white-sided dolphins was calculated from line transect analyses applied to the 1987-90 central North Pacific marine mammal sightings survey data (Buckland et al. 1993). The abundance estimate was 931,000 (CV=0.900; 95% CI 206,000-4,216,000) animals, after a regression adjustment for size-biased sampling of schools. It should be noted, however, that Buckland et al. (1993) suggested that Pacific white-sided dolphins show strong vessel attraction, based on a high concentration of sightings close to the trackline during sampling. A correction factor has not yet been estimated for such vessel attraction behavior for Pacific

white-sided dolphins, yet it may be more extreme than the 0.2 determined for Dall's porpoise (*Phocoenoides dalli*).

In other words, the abundance estimates for Pacific white-sided dolphins may be biased upwards by more than five-fold.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 931,000 and its associated CV of 0.900, $N_{MIN}$ for the Central North Pacific stock of Pacific white-sided dolphin is 486,719.

**Current Population Trend**

At present, there is no reliable information on trends in abundance for this stock of Pacific white-sided dolphin.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is not currently available for the Central North Pacific stock of Pacific white-sided dolphin. Thus, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

**POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks of unknown status (Wade and Angliss 1997). Thus, for the Central North Pacific stock of Pacific white-sided dolphin, PBR = 4,867 animals (486,719 x 0.02 x 0.5).

**ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

**Fisheries Information**

Between 1978 and 1991, thousands of Pacific white-sided dolphins were killed annually incidental to high seas fisheries. However, these fisheries have not operated in the central North Pacific since 1991.

Six different commercial fisheries in Alaska that could have interacted with Pacific white-sided dolphins were monitored for incidental take by NMFS observers from 1990 to 1995: Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. For the fisheries with observed takes, the range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 16. The mean annual (total) mortality was 0.2 (CV=1.0) in the Bering Sea groundfish trawl fishery and 0.8 (CV=1.0) in the Bering Sea groundfish longline fishery. The 1992 mortality in the Bering Sea groundfish trawl fishery occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1992 for that fishery, and should be considered a minimum estimate. Combining the estimates results in a mean annual (total) mortality rate of 1 Pacific white-sided dolphin in observed fisheries.

The Prince William Sound salmon drift gillnet fishery was also monitored by observers in 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels participating in that fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The low level of observer coverage for this fishery apparently missed interaction with Pacific-white sided dolphins which had occurred, as logbook mortalities were reported in both years (see Table 16) which were not recorded by the observer program.

An additional source of information on the number of Pacific white-sided dolphins killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports from 3 unobserved fisheries (see Table 16) resulted in an annual mean of 2.25 mortalities from interactions with commercial fishing gear. It is unclear exactly which Bristol Bay fishery caused the 1990 mortalities because the logbook records from the Bristol Bay set and drift gillnet fisheries were combined. They have been attributed to the Bristol Bay drift gillnet fishery due to the more pelagic nature of the fishery. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for all Alaska fisheries. Complete logbook data after 1993 are not available.

It should be noted that no observers have been assigned several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (4; based on observer data (1) and logbook reports (rounded up to 3) where observer data were not available) is less than 10% of the PBR (487) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

**Table 16.** Summary of incidental mortality of Pacific white-sided dolphins (Central North Pacific stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 0, 0, 1, 0, 0, 0 | 0, 0, 1, 0, 0, 0 | 0.2 (CV=1.0) |
| BSA groundfish longline (incl. misc. finfish and sablefish fisheries | 90-95 | obs data | 27-80% | 0, 0, 0, 0 0, 1 | 0, 0, 0, 0 0, 4 | 0.8 (CV=1.0) |
| Observer program total | | | | | | 1.0 |
| | | | | **Reported mortalities** | | |
| Prince William Sound salmon drift gillnet | 90-93 | logbook | n/a | 1, 4, 0, 0 | n/a | [$1.25] |
| Southeast Alaska salmon drift gillnet | 90-93 | logbook | n/a | 0, 0, 1, 0 | n/a | [$.25] |
| Bristol Bay salmon drift gillnet | 90-93 | logbook | n/a | 3, 0, 0, 0 | n/a | [$.75] |
| Minimum total annual mortality | | | | | | $3.25 |

**Subsistence/Native Harvest Information**

There are no reports of subsistence take of Pacific white-sided dolphins in Alaska.

## STATUS OF STOCK

Pacific white-sided dolphins are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (4) does not exceed the PBR (4,867). Therefore, the Central North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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# HARBOR PORPOISE (*Phocoena phocoena*): Southeast Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

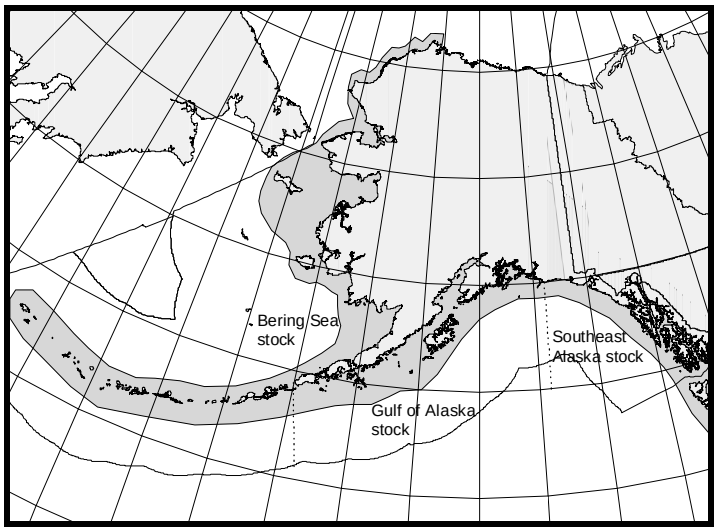


**Figure 23.** Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 22). Information concerning the 4 harbor porpoise stocks occurring

along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

In June of 1993, an aerial survey covering the offshore Alaska waters from Dixon Entrance to Prince William Sound was conducted, resulting in an abundance estimate of 3,982 (CV=0.187) harbor porpoise (Dahlheim et al. submitted). Of the 106 harbor porpoise sightings during the 1993 aerial survey, 71 were encountered east of Cape Suckling (144°W), representing approximately 67% of the sightings. Prorating the abundance estimate to include only the portion of the survey conducted east of Cape Suckling results in an abundance estimate of 2,668 animals from the Southeast Alaska harbor porpoise stock. This estimate is admittedly ad hoc and deemed provisional at this time, pending reanalysis of the 1993 aerial survey data. The coefficient of variation for the entire 1993 survey area (0.187) is considered a reasonable estimate until such reanalysis occurs. Correction factors for aerial surveys of harbor porpoise have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow et al. 1988) from the west coast of the continental U.S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Thus, the estimated corrected abundance from this survey is 8,271 (2,668 x 3.1; CV=0.255) harbor porpoise for the offshore waters from Dixon Entrance to Cape Suckling.

Systematic vessel surveys of harbor porpoise in the inside waters of Southeast Alaska were conducted in 1991 (Dahlheim et al. 1992), 1992 (Dahlheim et al. 1993), and 1993 (Dahlheim et al. 1994). Three vessel surveys in the spring, summer, and fall of each year were performed with abundance estimates relatively similar in each year (Dahlheim et al. 1994). The June 1993 vessel survey of the inside waters occurred simultaneously with the 1993 aerial survey, mentioned above, and resulted in an abundance estimate of 1,586 (CV=0.392) harbor porpoise. Correction factors for vessel surveys of harbor porpoise have been estimated at 1.28 (CV=0.091) in the Pacific Ocean along the west coast of the U. S. (Barlow 1988) and at 1.9 (CV=0.142) from vessel surveys in the Gulf of Maine (D. Palka, pers. comm., Northeast Fisheries Science Center, P. O. Box 314, Woods Hole, MA 02543). The estimated correction factor from the Pacific Ocean surveys (1.28) should be used for the Alaska vessel surveys because it is more conservative and the techniques used in the Barlow study were more similar to the Alaska surveys than those employed in the Gulf of Maine. Therefore, the total corrected abundance estimate for the inside waters of Southeast Alaska is 2,030 (1,586 x 1.28; CV=0.404) harbor porpoise. Accordingly, the corrected abundance estimate for the Southeast Alaska harbor porpoise stock, from aerial surveys in offshore waters and vessel surveys in inside waters, is 10,301 (8,271+2,030) animals.

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

### Minimum Population Estimate

For the Southeast Alaska stock of harbor porpoise, the minimum population estimates ($N_{MIN}$) for the aerial and vessel surveys are calculated separately, using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimates (N) of 8,271 and 2,030 along with their associated CVs (0.255 and 0.404, respectively), $N_{MIN}$ for this stock is 8,156 (6,693+1,463).

### Current Population Trend

At present, there is no reliable information on trends in abundance for the Southeast Alaska stock of harbor porpoise.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate ($R_{MAX}$) is not currently available for the Southeast Alaska stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Southeast Alaska stock of harbor porpoise, PBR = 82 animals (8,156 x 0.02 x 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Some fishing effort by vessels participating in the Gulf of Alaska (GOA) groundfish longline fishery occurs in the offshore waters of Southeast Alaska. Effort levels are insignificant for the portion of the GOA groundfish trawl and pot fisheries operating in these waters. However, during the period from 1990 to 1995, 21-31% of the GOA longline catch occurred within the range of the Southeast Alaska harbor porpoise stock. This fishery has been monitored for incidental take by NMFS observers from 1990 to 1995 (8-21% observer coverage), although observer coverage has been very low in the offshore waters of Southeast Alaska (<1-4% observer coverage). No mortalities from this stock of harbor porpoise incidental to commercial fisheries have been observed.

The only source of information on the number of harbor porpoise killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from the Southeast Alaska salmon drift gillnet fishery (Table 17) resulted in an annual mean of 3.25 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), this is considered to be a minimum estimate. There were no other logbook mortalities for any other fishery within the range of the Southeast Alaska harbor porpoise stock. Complete logbook data after 1993 are not available.

**Table 17.** Summary of incidental mortality of harbor porpoise (Southeast Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

| Fishery name | Years | Data type | Range of observer coverage | Reported mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Observer program total | 90-95 | | | | | 0 |
| Southeast Alaska salmon drift gillnet | 90-93 | logbook | n/a | 2, 2, 7, 2 | n/a | [$3.25] |
| Minimum total annual mortality | | | | | | $3.25 |

For this stock of harbor porpoise, the estimated minimum annual mortality rate incidental to commercial fisheries is 4 animals (rounded up from 3.25), based entirely on logbook data. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in Southeast Alaska fisheries. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 8.2 animals per year (i.e., 10% of PBR) can be considered to be insignificant and approaching zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

## STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental kill. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (4) is not known to exceed the PBR (82). Therefore, the Southeast Alaska stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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# HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

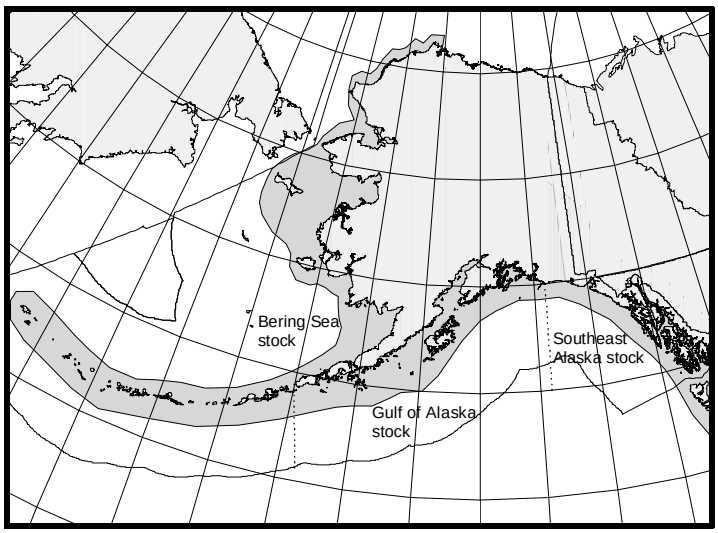


**Figure 24.** Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska

stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 23). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

**POPULATION SIZE**

Systematic aerial surveys of harbor porpoise covering portions of the Gulf of Alaska were conducted in 1991 (Dahlheim et al. 1992), 1992 (Dahlheim et al. 1993), and 1993 (Dahlheim et al. 1994). The 1991 aerial survey covering Cook Inlet waters resulted in an abundance estimate of 136 (CV=0.632) harbor porpoise (Dahlheim et al. submitted). The 1992 aerial survey covered the waters around Kodiak Island and along the south side of the Alaska Peninsula from Shelikof Strait to the Shumagin Islands. Inclement weather during the 1992 survey prohibited covering the portion of the Alaska Peninsula extending from the Shumagin Islands to Unimak Pass, approximately 160-165°W (Dahlheim 1993). The 1992 survey resulted in an abundance estimate of 740 (CV=0.339) harbor porpoise around Kodiak Island and 551 (CV=0.122) harbor porpoise along the southern Alaska Peninsula (Dahlheim et al. submitted). The 1993 aerial survey covered the offshore Alaska waters from Dixon Entrance to Prince William Sound, resulting in an abundance estimate of 3,982 (CV=0.187) harbor porpoise (Dahlheim et al. submitted). Of the 106 harbor porpoise sightings during the 1993 aerial survey, 35 were encountered west of Cape Suckling (144°W), representing approximately 33% of the sightings. Prorating the abundance estimate to include only the portion of the survey conducted west of Cape Suckling results in an abundance estimate of 1,314 animals from the Gulf of Alaska harbor porpoise stock. This estimate is admittedly ad hoc and deemed provisional at this time, pending reanalysis of the 1993 aerial survey data. Until such reanalysis occurs, the coefficient of variation for the 1993 survey area (0.187) is considered a reasonable estimate for the CV of the portion of the survey conducted to the west of Cape Suckling. Adding the abundance estimates for the portions of the 1991-93 surveys within the range of the Gulf of Alaska harbor porpoise stock results in a total estimated abundance of 2,741 (136+740+551+1314; CV=0.134) animals.

Correction factors for harbor porpoise aerial surveys have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow et al. 1988) from the west coast of the continental U. S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Therefore, the total corrected abundance estimate for the Gulf of Alaska stock of harbor porpoise is 8,497 (CV=0.218) animals. This abundance estimate is conservative because several areas within the Gulf of Alaska were not included in the 1991-93 aerial surveys. These areas include the region from 160-165°W along the southern Alaska Peninsula (mentioned above) and the coastal waters from western Prince William Sound to the Kenai Peninsula (approximately 148-152°W).

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 8,497 and its associated CV of 0.218, $N_{MIN}$ for the Gulf of Alaska stock of harbor porpoise is 7,085.

**Current Population Trend**

At present, there is no reliable information on trends in abundance for the Gulf of Alaska stock of harbor porpoise.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate ($R_{MAX}$) is not currently available for the Gulf of Alaska stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Gulf of Alaska stock of harbor porpoise, PBR = 71 animals (7,085 x 0.02 x 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Gulf of Alaska stock of harbor porpoise were monitored for incidental take by NMFS observers during 1990-95: Gulf of Alaska groundfish trawl, longline, and pot fisheries. No incidental mortality of harbor porpoise was observed in these fisheries. Observers also monitored the Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording 1 mortality in 1990 and 3 mortalities in 1991. These mortalities extrapolated to 8 (95% CI 1-23) and 32 (95% CI 3-103) kills for the entire fishery, resulting in a mean kill rate of 20 (CV=0.60) animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). Logbook reports from this fishery detail 6, 5, 6, and 1 harbor porpoise mortalities in 1990, 1991, 1992, and 1993, respectively. The extrapolated (estimated) observer mortality accounts for these mortalities, so they do not appear in Table 18. The Prince William Sound salmon drift gillnet fishery has not been observed since 1991; therefore, no additional data are available for that fishery.

An additional source of information on the number of harbor porpoise mortalities incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from 2 unobserved fisheries (see Table 18) resulted in an annual mean of 4.5 mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Cook Inlet set and drift gillnet fisheries were combined. As it is not possible to determine which fishery was responsible for the harbor porpoise mortalities reported in 1990, both fisheries have been included in Table 18. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for Gulf of Alaska fisheries, except the Prince William Sound salmon drift gillnet fishery for which observer data were presented above. Complete logbook data after 1993 are not available.

**Table 18.** Summary of incidental mortality of harbor porpoise (Gulf of Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports or stranding data.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Prince William Sound salmon drift gillnet | 90-91 | obs data | 4-5% | 1, 3 | 8, 32 | 20 (CV=.60) |
| Observer program total | | | | | | 20 |

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| | | | | **Reported mortalities** | | |
| Cook Inlet salmon drift and set gillnet fisheries | 90-93 | logbook | n/a | 3, 0, 0, 0 | n/a | [$0.75] |
| Kodiak salmon set gillnet | 90-93 | logbook | n/a | 8, 4, 2, 1 | n/a | [$3.75] |
| Minimum total annual mortality | | | | | | $24.5 |

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are a final source of mortality data. In the period from 1990 to 1994, 12 harbor porpoise scarred with gillnet marks were discovered stranded in Prince William Sound (Copper River Delta). These stranding reports were likely the result of operations in the Prince William Sound salmon drift gillnet fishery. The extrapolated (estimated) observer mortality for this fishery accounts for these mortalities, so they do not appear in Table 18.

A reliable estimate of the mortality rate incidental to commercial fisheries is considered unavailable because of the absence of observer placements in several gillnet fisheries mentioned above. However, the estimated minimum annual mortality rate incidental to commercial fisheries is 25, based on observer data (20) and logbook reports (rounded to 5) where observer data were not available. This estimated annual mortality rate is greater than 10% of the PBR (7.1) and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

## STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The lack of surveys in a significant portion of the Gulf of Alaska results in a conservative PBR for this stock. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental mortality. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (25) is not known to exceed the PBR (71). Therefore, the Gulf of Alaska stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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# HARBOR PORPOISE (*Phocoena phocoena*): Bering Sea Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

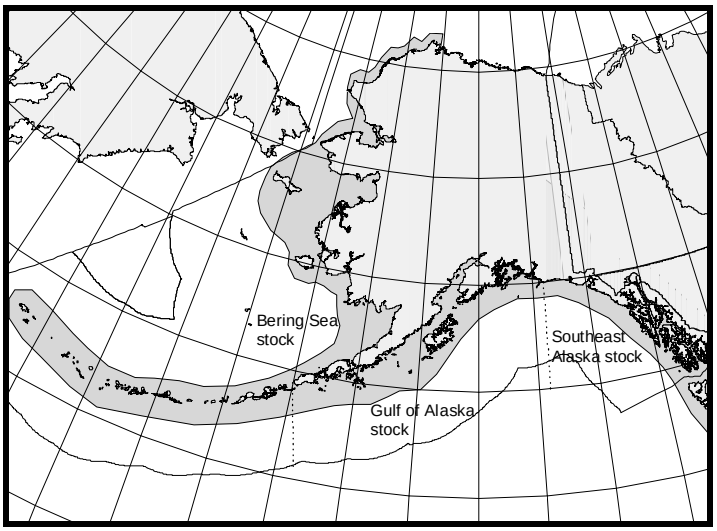


**Figure 25.** Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska

stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 24). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

In the summer of 1991, an aerial survey covering the Bristol Bay region was conducted resulting in an abundance estimate of 3,531 (CV=0.243) harbor porpoise (Dahlheim et al. submitted). No survey effort was conducted in the vicinity of the Pribilof Islands or along the Aleutian Islands because of the lack of commercial fisheries that could potentially affect harbor porpoise in those areas (Dahlheim et al. 1992). In addition, no survey effort was conducted north of Cape Newenham (approximately 59°N), when harbor porpoise are regular visitors as far north as Point Barrow during the summer months (Suydam and George 1992). Clearly, the 1991 survey covered only a fraction of the range occupied by the Bering Sea stock of harbor porpoise.

Correction factors for harbor porpoise aerial surveys have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow et al.1988) from the west coast of the continental U. S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Therefore, the total corrected abundance estimate for the Bering Sea stock of harbor porpoise is 10,946 (3,531 x 3.1; CV=0.300) animals.

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

### Minimum Population Estimate

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 10,946 and its associated CV of 0.300, $N_{MIN}$ for the Bering Sea stock of harbor porpoise is 8,549.

### Current Population Trend

At present, there is no reliable information on trends in abundance for the Bering Sea stock of harbor porpoise.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate ($R_{MAX}$) is not currently available for this stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Bering Sea stock of harbor porpoise, PBR = 86 animals (8,549 x 0.02 x 0.5).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Bering Sea stock of harbor porpoise were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The harbor porpoise mortality was observed only in the Bering Sea groundfish trawl

fishery. The range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 19. The mean annual (total) mortality rate resulting from observed mortalities was 0.60 (CV=.67). In 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). The low level of observer coverage for this fishery apparently missed interactions with harbor porpoise which had occurred, as logbook mortalities were reported in 1990 (see Table 19) which were not recorded by the observer program.

An additional source of information on the number of harbor porpoise mortalities incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports from 2 unobserved fisheries (see Table 19) resulted in an annual mean of 1.25 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for fisheries occurring within the range of the Bering Sea harbor porpoise stock, except the Bering Sea groundfish fisheries for which observer data were presented above. Complete logbook data after 1993 are not available.

Logbook records for three fisheries listed in Table 19 did not report any harbor porpoise mortality over the 1990-93 period. These fisheries have been included above because of the large number of participants and the significant potential for interaction with harbor porpoise. During the period from 1981 to 1987, 7 harbor porpoise mortalities have resulted from gillnet entanglement in the area from Nome to Unalakleet, 3 were reported near Kotzebue from 1989 to 1990, and some take of harbor porpoise is likely in the Bristol Bay gillnet fisheries (Barlow et al. 1994). A similar set gillnet fishery conducted by subsistence fishers incidentally took 6 harbor porpoise in 1991 near Point Barrow, Alaska (Suydam and George 1992).

**Table 19.** Summary of incidental mortality of harbor porpoise (Bering Sea stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 0, 0, 0, 0, 1, 1 | 0, 0, 0, 0, 2, 1 | 0.6 (CV=.67) |
| Observer program total | | | | | | 0.6 |
| | | | | **Reported mortalities** | | |
| AK Peninsula/Aleutian Island salmon drift gillnet | 90-93 | logbook | n/a | 2, 0, 1, 0 | n/a | [$0.75] |
| AK Peninsula/Aleutian Island salmon set gillnet | 90-93 | logbook | n/a | 0, 0, 2, 0 | n/a | [$0.5] |
| Bristol Bay salmon drift gillnet | 90-93 | logbook | n/a | 0, 0, 0, 0 | n/a | [0] |
| Bristol Bay salmon set gillnet | 90-93 | logbook | n/a | 0, 0, 0, 0 | n/a | [0] |
| AK Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet | 90-93 | logbook | n/a | 0, 0, 0, 0 | n/a | [0] |
| Minimum total annual mortality | | | | | | $1.85 |

The estimated minimum annual mortality rate incidental to commercial fisheries is rounded up to 2 animals, based on observer data (0.60) and logbook reports (1.25) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the gillnet fisheries discussed above. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 8.6 animals per year (i.e., 10% of PBR) can be considered to be insignificant and approaching zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

## STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The lack of surveys in a significant portion of this stock's range results in a conservative PBR for this stock. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental kill. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (2) is not known to exceed the PBR (86). Therefore, the Bering Sea stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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# DALL'S PORPOISE (*Phocoenoides dalli*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoise are widely distributed across the entire North Pacific Ocean (Fig. 25). They are found over the continental shelf adjacent to the slope and over deep (2,500+m) oceanic waters (Hall 1979). They have been sighted throughout the North Pacific as far north as 65/N (Buckland et al. 1993), and as far south as 28/N in the eastern North Pacific (Leatherwood and Fielding 1974). The only apparent distribution gaps in Alaska waters are upper Cook Inlet and the shallow eastern flats of the Bering Sea. Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the west coast of the continental U. S. (Loeb 1972, Leatherwood and Fielding 1974), and winter movements of populations out of Prince William Sound (Hall 1979) and areas in the Gulf of Alaska and Bering Sea (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

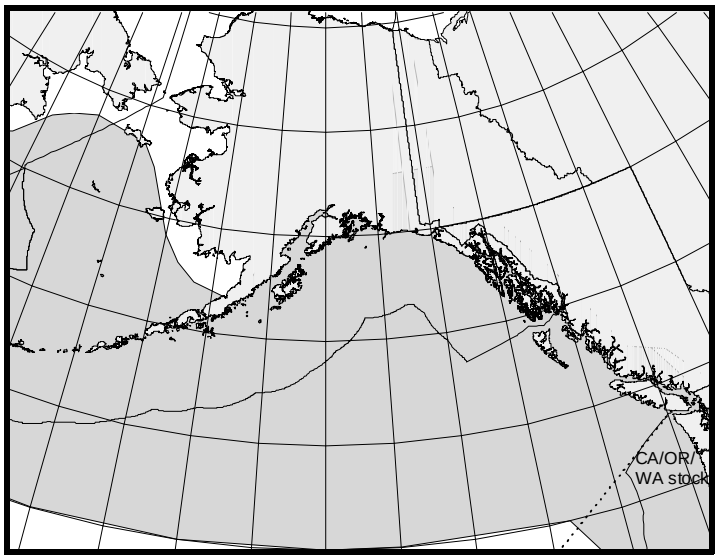


**Figure 26.** Approximate distribution of Dall's porpoise in the eastern North Pacific (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: differential timing of reproduction between the Bering Sea and western North Pacific; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. The stock structure of eastern North Pacific Dall's porpoise is not adequately understood at this time, but based on patterns of stock differentiation in the western North Pacific, where they have been more intensively studied, it is expected that separate stocks will emerge when data become available (Perrin and Brownell 1994). Based primarily on the population response data, a delineation between Bering Sea and western North Pacific stocks has been recognized (Jones et al. 1986). However, similar data are not available for the eastern North Pacific, thus one stock of Dall's porpoise is recognized in Alaska waters. Dall's porpoise along the west coast of the continental U. S. from California to Washington comprise a separate stock and are reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Data collected from vessel surveys, performed by both U. S. fishery observers and U. S. researchers from 1987 to 1991, were analyzed to provide population estimates of Dall's porpoise throughout the North Pacific and the Bering Sea (Hobbs and Lerczak 1993). The quality of data used in analyses was determined by the procedures recommended by Boucher and Boaz (1989). Survey effort was not well distributed throughout the U. S. Exclusive Economic Zone (EEZ) in Alaska, and as a result, Bristol Bay and the north Bering Sea received little survey effort. Only 3 sightings were reported in this area by Hobbs and Lerczak (1993), resulting in an estimate of 9,000 (CV=0.91). In the U. S. EEZ north and south of the Aleutian Islands, Hobbs and Lerczak (1993) reported an estimated abundance of 302,000 (CV=0.11), whereas for the Gulf of Alaska EEZ, they reported 106,000 (CV=0.20) . Combining these three estimates

(9,000 + 302,000 + 106,000) results in a total abundance estimate of 417,000 (CV=0.097) for the Alaska stock of Dall's porpoise. Turnock and Quinn (1991) estimate that abundance estimates of Dall's porpoise are inflated by as much as 5 times because of vessel attraction behavior. Therefore, a corrected population estimate is 83,400 (417,000 x 0.2) for this stock. No reliable abundance estimates for British Columbia are currently available.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 83,400 and its associated CV of 0.097, $N_{MIN}$ for the Alaska stock of Dall's porpoise is 76,874.

**Current Population Trend**

At present, there is no reliable information on trends in abundance for the Alaska stock of Dall's porpoise.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the Alaska stock of Dall's porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for the Alaska stock of Dall's porpoise (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is considered to be within optimum sustainable population (Buckland et al. 1993), the recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997). Thus, for the Alaska stock of Dall's porpoise, PBR = 1,537 animals (76,874 x 0.02 x 1.0).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Six different commercial fisheries operating within the range of the Alaska stock of Dall's porpoise were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No mortalities of Dall's porpoise were observed by NMFS observers in either pot fishery or the Gulf of Alaska longline fishery. For the fisheries with observed takes, the range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 20. The mean annual (total) mortality was 4.6 (CV=0.20) for the Bering Sea groundfish trawl fishery, 0.6 (CV=1.0) for the Gulf of Alaska groundfish trawl fishery, and 1.6 (CV=.61) for the Bering Sea groundfish longline fishery.

The Alaska Peninsula and Aleutian Island salmon driftnet fishery was monitored in 1990. Observers boarded 59 (38.3%) of the 154 vessels participating in the fishery, monitoring a total of 373 sets, or less than 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). One Dall's porpoise mortality was observed which extrapolated to an annual (total) incidental mortality rate of 28 Dall's porpoise. Combining the estimates from the Bering Sea and Gulf of Alaska fisheries presented above (4.6+0.6+1.6=6.8) with the estimate from the Alaska Peninsula and Aleutian Island salmon drift gillnet fishery (28) results in an estimated annual incidental kill rate in observed fisheries of 34.8 porpoise per year from this stock.

The Prince William Sound driftnet fishery was also monitored by observers during 1990 and 1991, with no incidental mortality of Dall's porpoise reported. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne

et al. 1992). The low level of observer coverage for this fishery apparently missed interaction with Dall's porpoise which had occurred, as logbook mortalities were reported in 1991 (see Table 20) which were not recorded by the observer program.

An additional source of information on the number of Dall's porpoise killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from 4 unobserved fisheries (see Table 20) resulted in an estimated annual mean of 6.5 mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Cook Inlet set and drift gillnet fisheries were combined. As a result, the Dall's porpoise mortality reported in 1990 may have occurred in the Cook Inlet set gillnet fishery an not the drift gillnet fishery as reported in Table 20. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These estimates are based on all available logbook reports for Alaska fisheries, except for those fisheries which observer data were presented above. The Southeast Alaska salmon drift gillnet fishery accounted for the majority of the reported incidental take in unobserved fisheries. Complete logbook data after 1993 are not available.

**Table 20.** Summary of incidental mortality of Dall's porpoise (Alaska stock) due to commercial fisheries from 1990 through 1994 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated morality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Bering Sea/Aleutian Is. (BSA) groundfish trawl | 90-95 | obs data | 53-74% | 6, 1, 5, 4, 4, 2 | 7, 2, 6, 5, 7, 3 | 4.6 (CV=.20) |
| Gulf of Alaska (GOA) groundfish trawl | 90-95 | obs data | 33-55% | 0, 0, 0, 1, 0, 0 | 0, 0, 0, 3, 0, 0 | 0.6 (CV=1.0) |
| BSA groundfish longline (incl. misc finfish and sablefish fisheries) | 90-95 | obs data | 27-80% | 0, 0, 0, 0, 1, 1 | 0, 0, 0, 0, 4, 4 | 1.6 (CV=.61) |
| AK Peninsula/ Aleutian Island salmon drift gillnet | 90 | obs data | 4% | 1 | 28 | 28 (CI 1-81) |
| Observer program total | | | | | | 34.8 |
| | | | | **Reported mortalities** | | |
| Prince William Sound salmon drift gillnet | 90-93 | logbook | n/a | 0, 2, 0, 0 | n/a | [$0.5] |
| Southeast Alaska salmon drift gillnet | 90-93 | logbook | n/a | 6, 6, 4, 6 | n/a | [$5.5] |
| Cook Inlet set and drift gillnet fisheries | 90-93 | logbook | n/a | 1, 0, 1, 0 | n/a | [$0.5] |
| Minimum total annual mortality | | | | | | $41.3 |

Note that no observers have been assigned several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (42 animals; based on observer data (35) and logbook reports

(rounded to 7) where observer data were not available) is not known to exceed 10% of the PBR (154) and, therefore can be considered to be insignificant and approaching zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

There are no reports of subsistence take of Dall's porpoise in Alaska.

**STATUS OF STOCK**

Dall's porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (42) does not exceed the PBR (1,537). Therefore, the Alaska stock of Dall's porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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# SPERM WHALE (*Physeter macrocephalus*): North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The sperm whale is one of the most widely distributed of any marine mammal species, perhaps only exceeded by the killer whale (Rice 1989). They feed primarily on medium-sized to large-sized squids but may also feed on large demersal and mesopelagic sharks, skates, and fishes (Gosho et al. 1984). In the North Pacific, sperm whales are distributed widely (Fig. 26), with the northernmost boundary extending from Cape Navarin (62°N) to the Pribilof Islands (Omura 1955). The shallow continental shelf apparently bars their movement into the north-eastern Bering Sea and Arctic Ocean (Rice 1989). Females and young sperm whales usually remain in tropical and temperate waters year-round, while males are thought to move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands. In the winter, sperm whales are typically distributed south of 40/N (Gosho et al. 1984). However, discovery tag data from the days of commercial whaling revealed a great deal of east-west movement between Alaska waters and the western North Pacific (Japan and the Bonin Islands), with little evidence of north-south movement in the eastern North Pacific. For example, of several hundred sperm whales tagged off San Francisco (Calif.), none were recovered north of 53/ in the Gulf of Alaska despite large takes there (B. Taylor, pers. comm., Southwest Fisheries Science Center, P. O. Box 271, La Jolla, CA 92038). Therefore, seasonal movement of sperm whales in the North Pacific is unclear at this time.

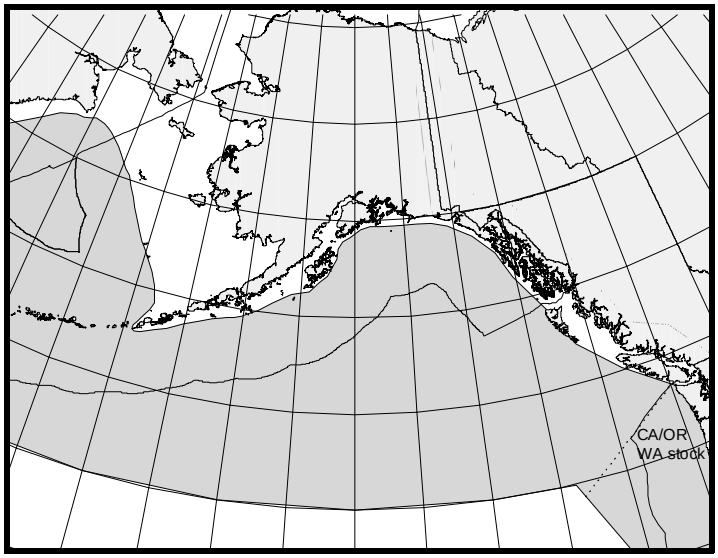


**Figure 27.** Approximate distribution of sperm whales in the eastern North Pacific (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous though indicates three "somewhat" discrete population centers (i.e., Hawaii, west coast of the continental United States, and Alaska); 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. For management purposes, the International Whaling Commission (IWC) recognizes two management units of sperm whales in the North Pacific (eastern and western). However, the IWC has not reviewed its sperm whale stock boundaries in recent years (Donovan 1991). Based on this limited information, and lacking additional data concerning population structure, sperm whales of the eastern North Pacific have been divided into three separate stocks as dictated by the U. S. waters in which they are found: 1) Alaska (North Pacific stock), 2) California/Oregon/Washington, and 3) Hawaii. The California/Oregon/Washington and Hawaii sperm whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Current and historic estimates for the abundance of sperm whales in the North Pacific are considered unreliable. Therefore, caution should be exercised in interpreting published estimates of abundance. The abundance of sperm whales in the North Pacific was reported to be 1,260,000 prior to exploitation, which by the late 1970s was estimated to have been reduced to 930,000 whales (Rice 1989). Confidence intervals for these estimates were not

provided. These estimates include whales from the California/Oregon/Washington stock, for which a separate abundance estimate is currently available (see Stock Assessment Reports for the Pacific Region).

Although Kato and Miyashita (1998) believe their estimate to be upwardly biased, preliminary analysis indicates 102,112 (CV=0.155) sperm whales in the western North Pacific. In the eastern temperate North Pacific a preliminary estimate indicates 39,200 (CV=0.60) sperm whales (Barlow and Taylor, 1998). The number of sperm whales of the North Pacific occurring within Alaska waters is unknown. As the data used in estimating the abundance of sperm whales in the entire North Pacific are well over 5 years old at this time and there are no available estimates for numbers of sperm whales in Alaska waters, a reliable estimate of abundance for the North Pacific stock is not available.

**Minimum Population Estimate**

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as a current estimate of abundance is not available.

**Current Population Trend**

Reliable information on trends in abundance for this stock are currently not available (Braham 1992).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the North Pacific stock of sperm whale. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock at this time (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks which are classified as endangered (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance $N_{MIN}$ is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Six different commercial fisheries operating within the range of the North Pacific stock of sperm whale were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No mortalities of sperm whale were observed by NMFS observers in any observed fishery. However, it appears that sperm whale interactions with longline fisheries operating in the Gulf of Alaska are known to occur and may be increasing in frequency (Hill and Mitchell 1998). NMFS observers aboard longline vessels targeting both sablefish and halibut have documented sperm whales feeding off the longline gear in the Gulf of Alaska. Fishery observers recorded several instances during 1995-97 in which sperm whales were deterred by fishermen (i.e., yelling at the whales or throwing seal bombs in the water). The first entanglement (not classified as a serious injury according to Angliss and DeMaster 1998) of a sperm whale in a Gulf of Alaska longline was documented in June of 1997 (Fishery Observer Program, unpubl. data, NMFS, AFSC, 7600 Sand Point Way NE, Seattle, WA 98115).

An additional source of information on the number of sperm whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from all Alaska fisheries indicated no mortalities of sperm whales from interactions with commercial fishing gear. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Therefore, based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Sperm whales have never been reported to be taken by subsistence hunters (Rice 1989).

**Other Mortality**

The population of sperm whales in the Pacific was likely well below pre-whaling levels before modern whaling for them became especially intense in the late 1940s (Reeves and Whitehead 1997). A total of 258,000 sperm whales were reported to have been taken by commercial whalers operating in the North Pacific between 1947 and 1987 (C. Allison, pers. comm., International Whaling Commission, The Red House, Station Road, Histon, Cambridge, UK). This value underestimates the actual kill in the North Pacific as a result of under-reporting by U.S.S.R. pelagic whaling operations, which are estimated to have under-reported catches during 1949-71 by 60% (Brownell et al. 1998). In addition, new information suggests that Japanese land based whaling operations also under-reported sperm whale catches during the post-World War II era (Kasuya 1998). The Japanese officially stopped catching sperm whales in the North Pacific in 1988 (Reeves and Whitehead 1997).

**STATUS OF STOCK**

Sperm whales are listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. However, on the basis of total abundance, current distribution, and regulatory measures that are currently in place, it is unlikely that this stock is in danger of extinction or threatened with becoming endangered in the foreseeable future (Braham 1992). Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available, although the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. There are no known habitat issues that are of particular concern for this stock.

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# BAIRD'S BEAKED WHALE (*Berardius bairdii*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Baird's beaked, or giant bottlenose, whale inhabits the North Pacific Ocean and adjacent seas (Bering Sea, Okhotsk Sea, Sea of Japan, and the Sea of Cortez in the southern Gulf of California, Mexico), with the best-known populations occurring in the coastal waters around Japan (Balcomb 1989). Within the North Pacific Ocean, Baird's beaked whales have been sighted in virtually all areas north of 35/N, particularly in regions with submarine escarpments and seamounts (Ohsumi 1983, Kasuya and Ohsumi 1984). The range of the species extends north to at least the Pribilof Islands where individuals have been found stranded (Rice 1986, Fig. 27). An apparent break in distribution occurs in the eastern Gulf of Alaska, but from the mid-Gulf to the Aleutian Islands and in the southern Bering Sea there are numerous sighting records (Kasuya and Ohsumi 1984). Tomilin (1957) reported that in the Sea of Okhotsk and the Bering Sea, Baird's beaked whales arrive in April-May and are particularly numerous during the summer. They are the most commonly seen beaked whales within their range, perhaps because they are relatively large and gregarious, traveling in schools of a few to several dozen, which makes them more noticeable to observers than other beaked whale species. Baird's beaked whales are migratory, arriving in continental slope waters during summer and fall months when surface water temperatures are the highest (Dohl et al. 1983, Kasuya 1986).

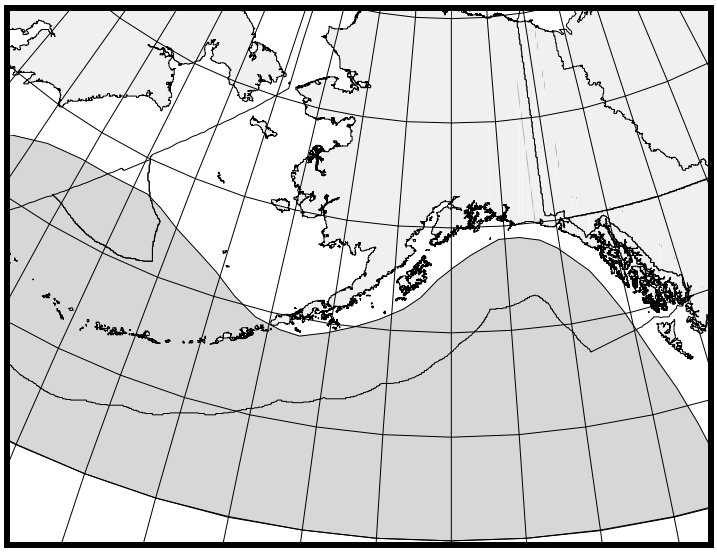

**Figure 28.** Approximate distribution of Baird's beaked whales in the eastern North Pacific (shaded area).

There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Baird's beaked whale. Therefore, Baird's beaked whale stocks are defined as the two non-contiguous areas within Pacific U. S. waters where they are found: 1) Alaska and 2) California/Oregon/Washington. These two stocks were defined in this manner because of: 1) the large distance between the two areas in conjunction with the lack of any information about whether animals move between the two areas, 2) the somewhat different oceanographic habitats found in the two areas, and 3) the different fisheries that operate within portions of those two areas, with bycatch of Baird's beaked whales only reported from the California/Oregon thresher shark and swordfish drift gillnet fishery. The California/Oregon/Washington Baird's beaked whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

### Minimum Population Estimate

At this time, it is not possible to produce a reliable minimum population estimate ($N_{MIN}$) for this stock, as current estimates of abundance are unavailable.

### Current Population Trend

At present, reliable data on trends in population abundance are unavailable.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of Baird's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for these stocks is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Six different commercial fisheries operating within the range of the Alaska stock of Baird's beaked whale were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Baird's beaked whale mortalities were observed by observers in any observed fishery.

An additional source of information on the number of Baird's beaked whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, there were no fisher self-reports of Baird's beaked whale mortalities from any fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4)

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

There is no known subsistence harvest of Baird's beaked whales by Alaska Natives.

### Other Mortality

The Japanese have reported taking 54 Baird's beaked whales annually off their coasts during the 6-year period between 1992 and 1997 (IWC 1996, 1997a, 1997b, 1998). Due to the unknown stock structure and migratory patterns in the North Pacific, it is unclear whether these animals belong to the Alaska stock of Baird's beaked whales.

## STATUS OF STOCK

Baird's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Baird's beaked whale is not classified as strategic.

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# CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked, or goosebeak, whale (Fig. 28) is known primarily from strandings, which indicate that it is the most widespread of the beaked whales and is distributed in all oceans and most seas except in the high polar waters (Moore 1963). In the Pacific, they range north to southeastern Alaska, the Aleutian Islands, and the Commander Islands (Rice 1986). In the northeastern Pacific from Alaska to Baja California, no obvious pattern of seasonality to strandings has been identified (Mitchell 1968). Strandings of Cuvier's beaked whales are the most numerous of all beaked whales, indicating that they are probably not as rare as originally thought (Heyning 1989). Observations reveal that the blow is low, diffuse, and directed forward (Backus and Schevill 1961, Norris and Prescott 1961), making sightings more difficult, and there is some evidence that they avoid vessels by diving (Heyning 1989).

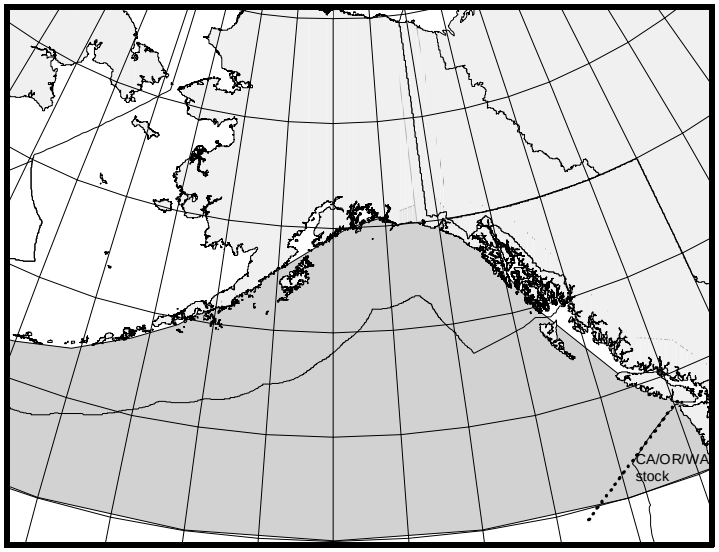


**Figure 29.** Approximate distribution of Cuvier's beaked whales in the eastern North Pacific (shaded area).

Mitchell (1968) examined skulls of stranded whales for geographical differences and thought that there was probably one panmictic population in the northeastern Pacific. Otherwise, there are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for the Cuvier's beaked whale. Therefore, Cuvier's beaked whale stocks are defined as the three non-contiguous areas within Pacific U. S. waters where they are found: 1) Alaska, 2) California/Oregon/Washington, and 3) Hawaii. These three stocks were defined in this way because of: 1) the large distance between the areas in conjunction with the lack of any information about whether animals move between the three areas, 2) the different oceanographic habitats found in the three areas, and 3) the different fisheries that operate within portions of those three areas, with bycatch of Cuvier's beaked whales only reported from the California/Oregon thresher shark and swordfish drift gillnet fishery. The California/Oregon/Washington and Hawaiian Baird's beaked whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

### Minimum Population Estimate

At this time, it is not possible to produce a reliable minimum population estimate ($N_{MIN}$) for this stock, as current estimates of abundance are unavailable.

### Current Population Trend

At present, reliable data on trends in population abundance are unavailable.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of Cuvier's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Six different commercial fisheries operating within the range of the Alaska stock of Cuvier's beaked whale were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Cuvier's beaked whale mortalities were observed by observers in any observed fishery.

An additional source of information on the number of Cuvier's beaked whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, there were no fisher self-reports of Cuvier's beaked whale mortalities from any fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

There is no known subsistence harvest of Cuvier's beaked whales.

## STATUS OF STOCK

Cuvier's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Cuvier's beaked whale is not classified as strategic.

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# STEJNEGER'S BEAKED WHALE (*Mesoplodon stejnegeri*): Alaska Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Stejneger's, or Bering Sea, beaked whale is rarely seen at sea, and its distribution generally has been inferred from stranded specimens (Loughlin and Perez 1985, Mead 1989). It is endemic to the cold-temperate waters of the North Pacific Ocean, Sea of Japan, and deep waters of the southwest Bering Sea (Fig. 29). The range of Stejneger's beaked whale extends along the coast of North America from Cardiff, California, north through the Gulf of Alaska to the Aleutian Islands, into the Bering Sea to the Pribilof Islands and Commander Islands, and, off Asia, south to Akita Beach on Noto Peninsula, Honshu, in the Sea of Japan (Loughlin and Perez 1985). Near the central Aleutian Islands, groups of 3-15 Stejneger's beaked whales have been sighted on a number of occasions (Rice 1986). The species is not known to enter the Arctic Ocean and is the only species of *Mesoplodon* known to occur in Alaska waters. The distribution of *M. stejnegeri* in the North Pacific corresponds closely, in occupying the same cold-temperate niche and position, to that of *M. bidens* in the North Atlantic. It lies principally between 50/and 60/N and extends only to about 45/N in the eastern Pacific, but to about 40/N in the western Pacific (Moore 1963, 1966).

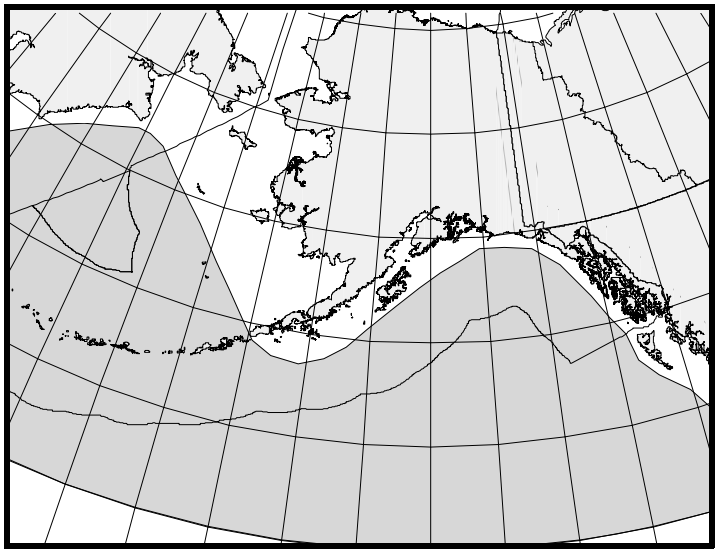

**Figure 30.** Approximate distribution of Stejneger's beaked whales in the eastern North Pacific (shaded area).

There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Stejneger's beaked whale. The Alaska Stejneger's beaked whale stock is recognized separately from *Mesoplodon* spp. off California, Oregon, and Washington because of: 1) the distribution of Stejneger's beaked whale and the different oceanographic habitats found in the two areas, 2) the large distance between the two non-contiguous areas of U.S. waters in conjunction with the lack of any information about whether animals move between the two areas, and 3) the different fisheries that operate within portions of those two areas, with bycatch of *Mesoplodon* spp. only reported from the California/Oregon thresher shark and swordfish drift gillnet fishery. The California/Oregon/Washington stock of all *Mesoplodon* spp. and a *Mesoplodon densirostris* stock in Hawaiian waters are reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

### Minimum Population Estimate

At this time, it is not possible to produce a reliable minimum population estimate ($N_{MIN}$) for this stock, as current estimates of abundance are unavailable.

**Current Population Trend**

At present, reliable data on trends in population abundance are unavailable.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of Stejneger's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Six different commercial fisheries operating within the range of the Alaska stock of Stejneger's beaked whale were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Stejneger's beaked whale mortalities were observed by observers in any observed fishery.

An additional source of information on the number of Stejneger's beaked whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, there were no fisher self-reports of Stejneger's beaked whale mortalities from any fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) were most likely negatively biased (Credle et al. 1994), these were considered to be minimum estimates. Self-reported fisheries data were incomplete for 1994, not available for 1995, and considered unreliable after 1995 (See Appendix 4).

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

There is no known subsistence harvest of Stejneger's beaked whales.

## STATUS OF STOCK

Stejneger's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Stejneger's beaked whale is not classified as strategic.

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# GRAY WHALE (*Eschrichtius robustus*): Eastern North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray whale formerly occurred in the North Atlantic Ocean (Fraser 1970), but is currently only found in the North Pacific (Rice et al. 1984). The following information was considered in classifying stock structure of gray whales based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: isolated geographic distribution in the North Pacific Ocean; 2) Population response data: increasing in the eastern North Pacific, unknown in the western North Pacific; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, two stocks have been recognized in the North Pacific: the Eastern Pacific stock, which breeds along the west coast of North America (Fig. 30), and the Western Pacific or "Korean" stock, which apparently breeds off the coast of eastern Asia (Rice 1981). Most of the Eastern North Pacific stock spends the summer feeding in the northern Bering, Chukchi, and Beaufort Seas (Rice and Wolman 1971). However, gray whales have been reported feeding in the summer in waters off of Southeast Alaska, British Columbia, Oregon, and Washington. The whales migrate near shore along the coast of North America from Alaska to the central California coast (Rice and Wolman 1971) starting in October or November. After passing Point Conception, California, Rice et al. (1984) reported the majority of the animals take a more direct offshore route across the southern California Bight to northern Baja California. The Eastern North Pacific stock winters mainly along the west coast of Baja California. The pregnant females assemble in certain shallow, nearly landlocked lagoons and bays where the calves are born from early January to mid-February (Rice et al. 1981). Interestingly, a small, but increasing proportion of newborn calves have been sighted along the California coast during the southward migration (Shelden et al. 1995). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981) with cows and newborn calves primarily migrating northward between March and June along the U. S. west coast.

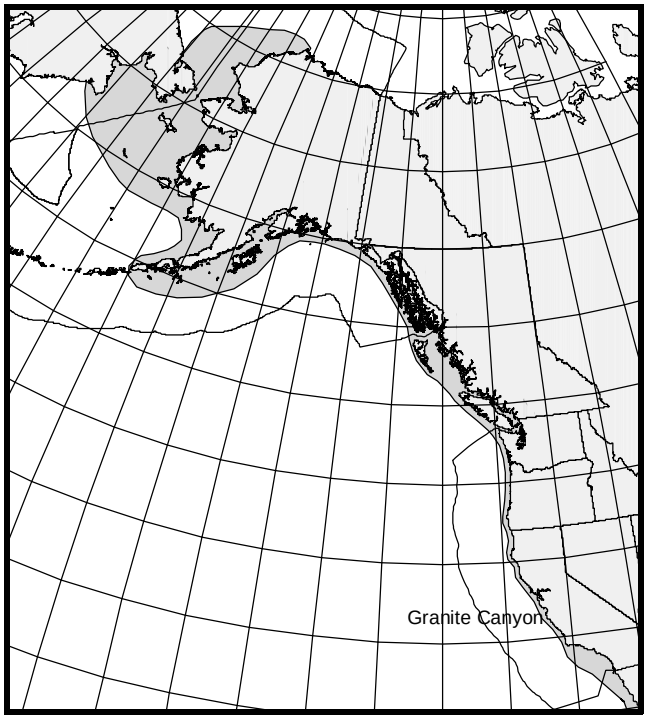


**Figure 31.** Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area). Excluding some Mexican waters, the entire range of this stock is depicted in the figure.

## POPULATION SIZE

Systematic counts of gray whales migrating along the central California coast were conducted by shore-based observers (at Granite Canyon) through the entire duration of the 1995-96 southbound migration (Hobbs et al. 1996). The preliminary abundance estimate resulting from the 1995-96 census is 22,571 (CV=0.0524) whales. This estimate is similar to the 1993/1994 abundance estimate of 23,109 (CV=0.0542) whales (RIWC 1995), slightly higher than the 1987-88 estimate of 21,296 (CV=0.0605) whales (Buckland et al. 1993), and significantly higher than the 1992-93 estimate of 17,674 (CV=0.0587) whales (RIWC 1995). Variations in estimates may be due in part to undocumented

sampling variation due to differences in the proportion of the gray whale stock migrating as far as the central California coast each year (Hobbs et al. 1996). The 1995-96 abundance estimate is the most recent and is considered a reliable estimate of abundance for this stock.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1 +[CV(N)]^2)]^{½})$. Using the 1995-96 population estimate of 22,571 and its associated CV of 0.0524, $N_{MIN}$ for this stock is 21,597.

**Current Population Trend**

The population size of Eastern North Pacific gray whale stock has been increasing over the past several decades. The estimated annual rate of increase, based on shore counts of southward migrating gray whales between 1967 and 1988 is 3.29% with a standard error of 0.44% (Buckland et al. 1993). Incorporating the census data through the 1993-94 migration resulted in an annual rate of increase of 2.57% (SE = 0.4%: RIWC 1995). Most recently, Breiwick (1996) and Wade and DeMaster (1996) estimated the annual rate of increase from 1967-68 to 1995-96 at 2.5% (95% CI: 2.37-2.61%) and 2.4% (95% CI: 1.6%-3.2%), respectively.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Wade (1994) reported that based on a Bayesian analysis of the census data between 1967-68 and 1993-94, the Eastern North Pacific stock of gray whales was between 0.51 and 0.97 of its carrying capacity and that the rate of net production at the maximum net productivity level was 0.033 (95% CI: 0.023-0.044). However, this conclusion was regarded as questionable at the 1994 Scientific Committee meetings of the International Whaling Commission (IWC) because the analysis may have been unduly influenced by the 1992 census and because the variance of the abundance estimate was likely underestimated (i.e., negative biased).

When incorporating the 1995-96 abundance estimate, Wade and DeMaster (1996) estimated $R_{MAX}$ from the period between 1967-68 and 1995-96 at 0.044 (95% CI: 0.031-0.056). This estimate is not significantly different than the cetacean maximum net productivity rate ($R_{MAX}$) of 4% (Wade and Angliss 1997). Therefore, it is recommended that the 4% $R_{MAX}$ be employed for this stock. Because this stock is thought to be midway between the lower limit of its optimum sustainable population (OSP) level and carrying capacity (K), the observed rate of increase is likely to be substantially less than $R_{MAX}$. In addition, it should be noted that the estimated $R_{MAX}$ was calculated during a period in which gray whales from this stock were being harvested by Russian aboriginals.

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the upper limit of the range (0.5-1.0) of values for non-listed stocks which are increasing while undergoing removals due to subsistence hunters (Wade and Angliss 1997). Thus, for the Eastern North Pacific stock of gray whale, PBR = 432 animals (21,597 x 0.02 x 1.0).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Six different commercial fisheries operating in Alaska waters within the range of the Eastern North Pacific gray whale stock were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No gray whale mortalities were observed for any of these Alaska fisheries.

Between 1990 and 1995, NMFS observers also monitored the northern Washington marine set gillnet fishery, otherwise known as the Makah tribal fishery for chinook salmon. No data for 1994 are presented in Table 21 because

no fishery observer program occurred during that year. Accordingly, when calculating the mean annual mortality, the 1994 data omission will be accounted for (e.g., the summed estimated mortality will be divided by 4, not 5). One gray whale was observed taken in 1990 (Gearin et al. 1994) and one observed taken in 1995 (P. Gearin unpubl. data, NMFS, 7600 Sand Point Way NE, Seattle, WA, 98115), resulting in a mean annual mortality of 0.5 gray whales from observed fisheries. In July of 1996, one gray whale was entangled in the same tribal set gillnet fishery though released unharmed (P. Gearin, pers. comm., NMFS, 7600 Sand Point Way NE, Seattle, WA, 98115).

An additional source of information on the number of gray whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports indicated 2 gray whale mortalities related to the Bristol Bay gillnet fisheries in 1990, resulting in an annual mean of 0.5 gray whale mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As it is not possible to determine which fishery was responsible for the gray whale mortalities reported in 1990, both fisheries have been included in Table 21. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Complete logbook data after 1993 are not available.

**Table 21.** Summary of incidental mortality of gray whales (Eastern North Pacific stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Northern Washington marine set gillnet (tribal) | 90-95 | obs data | 47-87% | 1, 0, 0, n/a, 1 | 1, 0, 0, n/a, 1 | 0.5 (CV=.61) |
| Observer program total | | | | | | 0.5 |
| | | | | **Reported mortalities** | | |
| Bristol Bay salmon drift and set gillnet fisheries | 90-93 | logbook | n/a | 2, 0, 0, 0 | n/a | [$0.5] |
| unknown west coast fisheries | 93-95 | strand data | n/a | 0, 5, 2 | n/a | [$2.3] |
| Minimum total annual mortality | | | | | | $3.3 |

Other Alaska fisheries (not included in Table 21) may interact with gray whales as strandings of individuals entangled in gillnets have been reported, including a 1987 stranding along the Alaska Peninsula and a 1988 stranding near Yakutat. These strandings have not been attributed to a particular fishery and have not been included in the annual mortality rate calculation because they occurred prior to 1990.

Reports of entangled gray whales found swimming, floating, or stranded with fishing gear attached also occurs along the west coast of the continental U. S. and British Columbia. In U. S. waters there are confirmed reports of 3 gray whale mortalities in 1994 (2 in San Diego County and 1 in Del Norte County ) and 2 mortalities in 1995 (1 in Santa Barbara county, and 1 in Washington State). There were no confirmed mortalities in 1993 (J. Cordaro, pers. comm., NMFS Southwest Region, 501 West Ocean Blvd. Ste. 4200, Long Beach, CA, 90802). In 1994, two gray whale mortalities related to fisheries were reported in British Columbia (Guenther et al. 1995). Other entangled gray whales were reported, though only confirmed mortalities have been included here. These stranding data are included in Table 21 (listed as unknown west coast fisheries) as they resulted from commercial fishing. However, the mortalities have not been attributed to particular fisheries and their locations suggest that some may have been related to Mexican or Canadian, but not U. S. fisheries. Therefore, during the 3-year period from 1993 to 1995, stranding network data

indicate a minimum annual mean of 2.3 gray whale mortalities resulting from interactions with commercial fishing gear.

It should be noted that no observers have been assigned to most Alaska gillnet fisheries, including those in Bristol Bay which are known to interact with this stock, making the estimated mortality from U. S. fisheries unreliable. Further, due to a lack of observer programs there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with gray whales. Data regarding the level of gray whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock. However, the large stock size and observed rate of increase over the past 20 years makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (rounded to 4; based on observer data (0.5) and logbook reports (0.5) or stranding reports (2.3) where observer data were not available) is not known to exceed 10% of the PBR (43) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Subsistence hunters in Alaska and Russia have traditionally harvested whales from this stock. There have been no reported takes by subsistence hunters in Alaska during this decade, with the most recent reported harvest occurring in 1989 (RIWC 1991). Russian subsistence hunters reported taking no whales from this stock during 1993 (RIWC 1995), 44 in 1994 (RIWC 1996), and 85 in 1995 (RIWC 1997). The 1995 harvest consisted of 40 females, 44 males, and 1 whale reported struck and lost. Based on this information, the annual subsistence take averaged 43 whales during the 3-year period from 1993 to 1995. This level of take is well below the 1968-93 average of 159 whales per year (RIWC 1995), during which time the population size increased. The current IWC quota for gray whales taken by aboriginals is 140 animals per year.

In 1995, the Makah Indian Tribe in Washington state officially requested for an annual quota of 5 gray whales per year for subsistence and ceremonial purposes. At the 1996 IWC meetings, the U. S. delegation requested the quota on behalf of the Makah, which was subsequently withdrawn during the same meeting. It is anticipated that the Makah Indian Tribe will seek an annual quota of 5 whales in 1997 and thereafter.

**Other Mortality**

The near shore migration route used by gray whales makes ship strikes another potential source of mortality. There are confirmed reports from the California stranding network of ship strikes causing one gray whale mortality per year over the 3-year period from 1993 to 1995 (J. Cordaro, pers. comm., NMFS Southwest Region, 501 West Ocean Blvd. Ste. 4200, Long Beach, CA, 90802). Additional mortality from ship strikes probably goes unreported because the whales either do not strand or do not have obvious signs of trauma. Therefore, it is not possible to quantify the actual mortality of gray whales from this source and the annual mortality rate of 1 gray whale per year due to collisions with vessels represents a minimum estimate from this source of mortality.

**STATUS OF STOCK**

The eastern North Pacific stock of gray whale has been increasing in recent years while being subjected to known subsistence harvests by Russian subsistence hunters. Based on currently available data, the estimated annual level of human-caused mortality and serious injury (48), which includes mortality from commercial fisheries (4), takes by Russian subsistence hunters (43), and ship strikes (1) does not exceed the PBR (432). Therefore, the Eastern North Pacific stock of gray whale is not classified as a strategic stock. It should be noted that in 1994 this stock was removed from the List of Endangered and Threatened Wildlife (i.e., it is no longer considered endangered or threatened under the Endangered Species Act).

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Revised 6/25/99

# HUMPBACK WHALE (*Megaptera novaeangliae*): Western North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins, though it is less common in Arctic waters. In winter, most humpback whales occur in the temperate and tropical waters of the North and South Hemispheres (from 10/-23/ latitude). Humpback whales in the North Pacific are seasonal migrants that feed on zooplankton and small schooling fishes in the cool, coastal waters of the western United States, western Canada, and the Russian Far East (NMFS 1991). The historic feeding range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Humpback whales have been known to enter the Chukchi Sea (Johnson and Wolman 1984). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during this century.

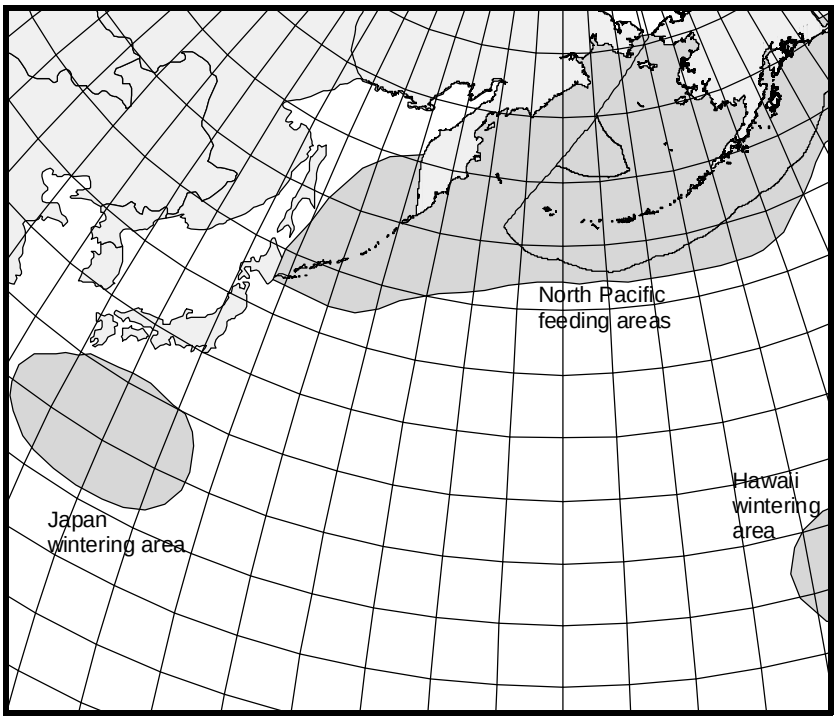


**Figure 32.** Approximate distribution of humpback whales in the western North Pacific (shaded area). Feeding and wintering areas are presented above (see text). See Figure 32 for humpback whale distribution in the eastern North Pacific.

Aerial, vessel, and photo-identification surveys and genetic analyses indicate that within the U. S. Exclusive Economic Zone (EEZ) there are at least three relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Calambokidis et al. 1997, Baker et al. 1998, Figs. 31 and 32): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993) - referred to as the California/Oregon/Washington and Mexico stock; 2) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/Southeast Alaska and Prince William Sound west to Kodiak (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997) - referred to as the Central North Pacific stock; and 3) winter/spring populations of Japan which, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the Western North Pacific stock. Winter/spring populations of humpback whales also occur in Mexico's offshore islands. The migratory destination of these whales is not well known (Calambokidis et al. 1993, Calambokidis et al. 1997). Some recent exchange between winter/spring areas has been documented

(Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993), as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997).

Currently, there are insufficient data to apply the Dizon et al.(1992) phylogeographic approach to classify population structure in humpback whales. Until further information becomes available, 3 management units of humpback whales (as described above) are recognized within the U.S. EEZ of the North Pacific: one in the Eastern North Pacific (the California/Oregon/Washington - Mexico stock), one in the Central North Pacific, and one in the Western North Pacific. The California/Oregon/Washington - Mexico humpback whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

The feeding areas for the Western North Pacific humpback whale stock are largely unknown. There has been little to no effort to photo-identify individual humpback whales in the North Pacific waters west of the Kodiak Archipelago. As a result, none of the whales identified off Japan have been resighted in the historical feeding areas of the stock (Bering Sea and Aleutian Islands). Individuals identified off Japan, however, have been resighted in the eastern North Pacific (Calambokidis et al. 1997). This may indicate that the Western North Pacific humpback whale stock did not exclusively use the feeding areas in the western Pacific, or, perhaps, a shift in the migratory destination of this stock has occurred. Thus, some unknown fraction of whales from the wintering grounds off Japan spend their summers feeding in areas typically utilized by whales from the Central North Pacific stock.

## POPULATION SIZE

The abundance estimate of humpback whales in the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Photographs taken between 1991 and 1993 were used to estimate abundance because samples throughout the entire North Pacific were the largest and most complete during this period. Using Darroch's (1961) method, which utilizes only data from wintering areas (in this case data provided by two Japanese research groups), and averaging the 1991-92, 1992-93, and 1991-93 winter release-recovery information results in an abundance estimate of 394 (CV=0.084) for the Western North Pacific humpback whale stock (Calambokidis et al. 1997).

A vessel survey conducted in August of 1994 covered 2,050 nautical miles of trackline south of the Aleutian Islands encountered humpback whales in scattered aggregations (57 sightings) throughout the study area (Forney and Brownell 1996). It is unknown whether the humpback whales encountered during this survey belonged to the Western or Central North Pacific stock.

There are no reliable estimates for the abundance of humpback whales at feeding areas for this stock because the specific feeding areas are largely unknown.

### Minimum Population Estimate

The minimum population estimate ($N_{MIN}$) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 394 and its associated CV(N) of 0.084, $N_{MIN}$ for this humpback whale stock is 367.

### Current Population Trend

Reliable information on trends in abundance for the Western North Pacific humpback whale stock are currently not available.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE=1.2%) for the well-studied humpback whale population in the Gulf of Maine. However, there are no estimates of the growth rate of humpback whale populations in the North Pacific (Best 1993). Hence, until additional data become available from this or other North Pacific humpback whale stocks, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Thus, for the Western North Pacific stock of humpback whale, PBR = 0.7 animals (367 × 0.02 × 0.1).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Six different commercial fisheries operating in Alaska waters within the range of this stock were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No humpback whale mortalities were observed for any of these fisheries.

An additional source of information on the number of humpback whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, there were no fisher self-reports of humpback whale injuries or mortalities from interactions with commercial fishing gear in any Alaska fishery within the presumed range of the Western North Pacific humpback whale stock. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4).

Strandings of humpback whales entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. The only fishery-related humpback stranding in an area thought to be occupied by animals from this stock was reported by a U. S. Coast Guard vessel in late June 1997 operating near the Bering Strait. The whale was found floating dead entangled in netting and trailing orange buoys (National Marine Mammal Laboratory, Platforms of Opportunity Program, unpubl. data, 7600 Sand Point Way NE, Seattle, WA 98115). With the given data it is not possible to determine which fishery (or even which country) caused the mortality. Note, that this mortality has been attributed the Western North Pacific stock, but without a tissue sample (for genetic analysis) or a photograph (for matching to known Japanese animals) it is not possible to for certain (i.e., it may have belonged to the Central North Pacific stock). Averaging this mortality over the 5-year period 1993-97 results in an estimated annual mortality of 0.2 humpback whales from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found, or reported.

The estimated annual mortality rate incidental to commercial fisheries is 0.2 whales per year from this stock. However, this estimate is considered a minimum because there are no data concerning fishery-related mortalities in Japanese, Russian, or international waters. In addition, there is a small probability that fishery interactions discussed in the assessment for the Central North Pacific stock may have involved animals from this stock because the only known matches to feeding areas come from areas typically used by the Central North Pacific stock.

### Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take humpback whales from this stock.

## HISTORIC WHALING

The number of humpback whales in the North Pacific may have numbered approximately 15,000 individuals prior to exploitation (Rice 1978). Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century (Rice 1978). This mortality estimate likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

## STATUS OF STOCK

As the estimated annual mortality rate (0.2) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR (0.7). Assuming the single mortality occurred in a U. S. fishery, the estimated fishery mortality and serious injury exceeds 10% of the PBR (0.07) and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. The humpback whale is listed as "endangered" under the Endangered Species Act, and therefore designated as "depleted" under the MMPA. As a result, the Western North Pacific humpback whale stock is classified as a strategic stock. Reliable population trend data and the status of this stock relative to its Optimum Sustainable Population size are currently unknown. Noise pollution from the U. S. Navy's Low Frequency Active sonar program and other anthropogenic sources (i.e., shipping) is a potential concern as to the health of this stock.

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# HUMPBACK WHALE (*Megaptera novaeangliae*): Central North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins, though it is less common in Arctic waters. In winter, most humpback whales occur in the temperate and tropical waters of the North and South Hemispheres (from 10/-23/ latitude). Humpback whales in the North Pacific are seasonal migrants that feed on zooplankton and small schooling fishes in the cool, coastal waters of the western United States, western Canada, and the Russian Far East (NMFS 1991). The historic feeding range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Humpback whales have been known to enter the Chukchi Sea (Johnson and Wolman 1984). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during this century.

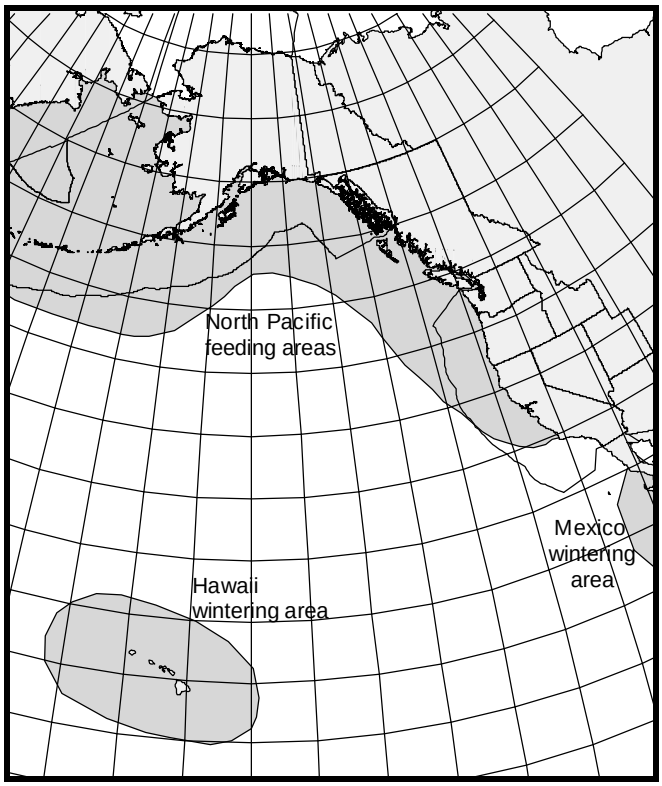


**Figure 33.** Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). See Figure 31 for distribution of humpback whales in the western North Pacific.

Aerial, vessel, and photo-identification surveys and genetic analyses indicate that within the U. S. Exclusive Economic Zone (EEZ) there are at least three relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Calambokidis et al. 1997, Baker et al. 1998, Figs. 31 and 32): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993) - referred to as the California/Oregon/Washington and Mexico stock; 2) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/Southeast Alaska and Prince William Sound west to Kodiak (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997) - referred to as the Central North Pacific stock; and 3) winter/spring populations of Japan which, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the Western North Pacific stock. Winter/spring populations of humpback whales also occur in Mexico's offshore islands. The migratory destination of these whales is not well known (Calambokidis et al. 1993, Calambokidis et al. 1997). Some recent exchange between winter/spring areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993), as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997).

Currently, there are insufficient data to apply the Dizon et al.(1992) phylogeographic approach to classify population structure in humpback whales. Until further information becomes available, 3 management units of humpback whales (as described above) are recognized within the U. S. EEZ of the North Pacific: one in the Eastern North Pacific (the California/Oregon/Washington - Mexico stock), one in the Central North Pacific, and one in the Western North Pacific. The California/Oregon/Washington - Mexico humpback whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

**POPULATION SIZE**

This stock of humpback whales winters in Hawaiian waters (Baker et al. 1986). Baker and Herman (1987) used capture-recapture methodology to estimate the population at 1,407 (95% CI 1,113-1,701), which they considered an estimate for the entire stock (NMFS 1991). However, the robustness of this estimate is questionable due to the opportunistic nature of the survey methodology in conjunction with a small sample size. Further, the data used to produce this estimate were collected between 1980 and 1983.

The current abundance estimate of humpback whales in the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Photographs taken between 1991 and 1993 were used to estimate abundance because samples throughout the entire North Pacific were the largest and most complete during this period. Using Darroch's (1961) method, which utilizes only data from wintering areas, and averaging the 1991-92, 1992-93, and 1991-93 winter release-recovery information results in an abundance estimate of 4,005 (CV=0.095) for the Central North Pacific humpback whale stock (Calambokidis et al. 1997).

The Central North Pacific stock of humpback whales consists of feeding aggregations along the northern Pacific rim. Humpback whale distribution in summer is continuous from British Columbia to the Russian Far East, and humpbacks are present offshore in the Gulf of Alaska (Brueggeman et al. 1989, Forney and Brownell 1996). The three feeding areas for the Central North Pacific stock that have been studied using photographs to identify individual whales are southeastern Alaska, Prince William Sound, and Kodiak Island. There has been some exchange of individual whales between these locations. For example, six whales have been sighted in Prince William Sound and southeastern Alaska since studies began in 1977 (Perry et al. 1990, von Ziegesar et al. 1994; S. Baker, D. McSweeny, J. Straley, and O. von Ziegesar, unpubl. data); nine whales have been sighted between Kodiak Island, including the area adjacent to Kodiak along the Kenai Peninsula, and Prince William Sound; and two whales between Kodiak and southeastern Alaska (Waite et al. 1999). The humpback whales of the Central North Pacific stock show some degree of fidelity to feeding areas, with this fidelity maternally directed; that is, whales return to the feeding areas where their mothers first brought them as calves (Martin et al. 1984, Baker et al. 1987). However, the degree of this fidelity to a specific area is unknown for many whales and given the continuous distribution in the North Pacific, and the known interchange among areas, setting distinct boundaries between feeding areas may not be possible.

Using photographs of the unique markings on the underside of each whales' flukes, there were 149 individual humpback whales identified in Prince William Sound from 1977 to 1993 (von Ziegesar 1992, Waite et al. 1999). The abundance of the Prince William Sound feeding aggregation is thought to be less than 200 whales (Waite et al. 1999). In southeastern Alaska, 648 individual humpback whales were identified from 1985 to 1992, resulting in an annual abundance estimate of 404 whales (95% CI:350-458) (Straley 1994). In the Kodiak Island region, 127 individual humpback whales were identified from 1991 to 1994 (Waite et al. 1999), resulting in an annual abundance estimate of 651 whales (95% CI:356-1,523). In the Northern British Columbia region (primarily near Langara Island), 275 humpback whales were identified from 1992 to 1998 (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6). These estimates represent minimum estimates for these feeding areas because the study areas did not include the entire geographic region (i.e., the southeast Alaska study area did not include waters to the south of Chatham Strait). In addition, little is known regarding humpback whale abundance between feeding areas, south of Chatham Strait, and west of Kodiak Island. As a result, the sum of the estimates from these feeding aggregations (approximately 1,530) is considerably less than 4,005 animals.

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 4,005 and its associated CV(N) of 0.095, $N_{MIN}$ for this humpback whale stock is 3,698.

**Current Population Trend**

Comparison of the estimate provided by Calambokidis et al. (1997) with the 1981 estimate of 1,407 (95% CI 1,113-1,701) from Baker and Herman (1987) suggests that the stock has increased in abundance between the early 1980s and early 1990s. However, the robustness of the Baker and Herman (1987) estimate is questionable due to the small sample size and opportunistic nature of the survey methodology. As a result, although data support an increasing population size for this stock, it is not possible to assess the rate of increase.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE=1.2%) for the well-studied humpback whale population in the Gulf of Maine. However, there are no estimates of the growth rate of humpback whale populations in the North Pacific (Best 1993). Hence, until additional data become available from this or other North Pacific humpback whale stocks, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Thus, for the Central North Pacific stock of humpback whale, PBR = 7.4 animals (3,698 × 0.02 × 0.1).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Three different commercial fisheries operating in Alaska waters within the range of the Central North Pacific humpback whale stock were monitored for incidental take by fishery observers during 1990-97: Gulf of Alaska groundfish trawl, longline, and pot fisheries. No humpback whale mortalities were observed for any of these Alaska fisheries. Fishery observers also monitored the Hawaii swordfish, tuna, billfish, mahi mahi, wahoo, oceanic shark longline/setline fishery during the same period. The range of observer coverage for this fishery, as well as the annual observed and estimated mortalities, are presented in Table 22. The observer program in the Hawaii fishery was voluntary from 1990 through 1993, leading to very low levels of observer coverage during those years (<1%). In 1994, the observer program became mandatory and observer coverage has been approximately 4-5% since that time. Fishery observers recorded one humpback whale entangled in longline gear in 1991. The fate of this animal is unknown, though it is presumed to have died. The mortality rate was not estimated from the 1991 mortality due to the low level of observer coverage in that year (<1%). Therefore, that single mortality also appears as the estimated mortality for 1991 and should be considered a minimum estimate. Note that another humpback whale was reported by fishers and whalewatch operators entangled in longline gear off Maui during 1993 (E. Nitta, pers. comm., Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole St., Honolulu, HI, 96822). This report was never confirmed and the fate of this animal is also unknown. The estimated mean annual mortality rate in observed fisheries during the 5-year period from 1993-97 is zero humpback whales per year from this stock.

An additional source of information on the number of humpback whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the 4-year period between 1990 and 1993, there were no fisher self-reports of humpback whale injuries or mortalities from interactions with commercial fishing gear in any Alaska fishery within the range of the Central North Pacific humpback whale stock. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 4). In 1994, the incidental take of a humpback whale was reported in

the Southeast Alaska salmon purse seine fishery. Another humpback whale is known to have been taken incidentally in this fishery in 1989, but due to its historic nature has not been included in Table 22. In 1996, a humpback whale was reported entangled and trailing gear as a result of interacting with the Southeast Alaska drift gillnet fishery. This whale is presumed to have died. Averaging these two mortalities over the most recent 5 years for which data are available results in an annual mortality of 0.4 humpback whales based on self-reported fisheries information (Table 22). This is considered to be a minimum estimate because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

**Table 22.** Summary of incidental mortality of humpback whales (Central North Pacific stock) due to commercial fisheries from 1990 through 1997 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate. For a particular fishery, the most recent 5 years of available data are used in the mortality calculation when more than 5 years of data are provided. n/a indicates that data are not available.

| Fishery name | Years | Data type | Range of observer coverage | Observed mortality (in given yrs.) | Estimated mortality (in given yrs.) | Mean annual mortality |
|---|---|---|---|---|---|---|
| Hawaii swordfish, tuna, billfish, mahi mahi, oceanic shark longline/setline | 90-97 | obs data | <1-5% | 0, 1, 0, 0, 0, 0, 0, 0 | 0, 1, 0, 0, 0, 0, 0, 0 | 0 |
| Observer program total | | | | | | 0 |
| | | | | **Reported mortalities** | | |
| Southeast Alaska salmon drift gillnet | 90-97 | self reports | n/a | 0, 0, 0, 0, n/a, n/a, 1, n/a | n/a | [$0.2] |
| Southeast Alaska salmon purse seine | 90-97 | self reports | n/a | 0, 0, 0, 0, 1, n/a, n/a, n/a | n/a | [$0.2] |
| Southeast Alaska salmon drift gillnet | 90-97 | strand data | n/a | 0, 0, 1, 0, 1, 0, 0, 0 | n/a | [$0.2] |
| unknown fishery (Hawaii and Gulf of Alaska) | 92-97 | strand data | n/a | 0, 0, 0, 0, 2, 0 | n/a | [$0.4] |
| Minimum total annual mortality | | | | | | [$1.0] |

Strandings of humpback whales entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. Fishery-related humpback strandings have been reported in Hawaii (1992, 1996 and 1997) and in Alaska (1992, 1994, 1996, and 1997). In February 1992, the U. S. Coast Guard successfully disentangled a humpback from set longline gear (ulua fishery) off the island of Hawaii (Mazzuca et al. 1998). In February 1996, a juvenile humpback entangled in fishing gear (thought to be Hawaiian crab gear) was sighted off Oahu, then resighted the following week off Kauai (Mazzuca et al. 1998). This animal is believed to have perished after a disentanglement attempt left pieces of gear around a pectoral fin and through the mouth. In January of 1997 a whale trailing Alaska crab pot floats was successfully disentangled by the U. S. Coast Guard off the island of Hawaii. An entanglement of a humpback whale occurred in the Southeast Alaska salmon drift gillnet fishery in 1992 and was reported as a stranding. In 1994, a humpback whale was reported in a weakened condition entangled in a fishing net with floats attached and is presumed to have died. The 1994 entanglement could not be attributed to a particular fishery. Due to the location of the report (Chatham Strait), the mortality has been included along with the data for the Southeast Alaska salmon drift gillnet fishery (Table 22), when it may have resulted from operations in the Southeast Alaska salmon purse seine fishery. In August 1996, an entangled humpback was released from fishing gear near Sand Point, Alaska. The whale slowly lumbered off, staying near the surface and is thought to have perished. Another humpback entangled in a purse seine off Alitak Beach (Kodiak Island) was successfully released by fishermen in 1996. During 1997 there were three reports of entangled humpbacks in Southeast Alaska. The limited information on the stranding reports (i.e., location, entangling material, nature of entanglement) suggests that the same whale may have

been reported in all three instances. Given the reports, it is not possible to ascertain what fishery was involved or to classify whether any injuries should be classified as serious (i.e., counted as a mortality).

The two 1996 mortalities (one in Hawaii and one in Alaska) have been listed in Table 22 as occurring in unknown fisheries because they can not be attributed to particular fisheries. There have been no reports of fishery-related strandings in northern British Columbia this decade. Fishery-related strandings from Hawaii and Alaska during 1993-97 result in an estimated annual mortality of 0.6 humpback whales from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or cause of death determined.

The estimated minimum mortality rate incidental to commercial fisheries is 1.0 humpback whale per year, based on observer data (0), and self-reported fisheries information (0.4) or stranding data (0.6) where observer data were not available. As mentioned previously, this estimate should be considered a minimum. No observers have been assigned to several fisheries that are known to interact with this stock, making the estimated mortality unreliable. Further, due to limited coverage of Canadian observer programs there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with humpback whales. Though interactions are thought to be minimal, the lack of data regarding the level of humpback whale mortality related to commercial fisheries in northern British Columbia are not available, again reinforcing the point that the estimated mortality incidental to commercial fisheries is underestimated for this stock.

**Subsistence/Native Harvest Information**

Subsistence hunters in Alaska have not been reported to take from this stock of humpback whales.

**Other Mortality**

Ship strikes and interactions with vessels unrelated to fisheries have also occurred to humpback whales. In 1995, a humpback whale was reported in Hawaiian waters trailing line which did not appear to be related to a fishery. This animal then entangled in a mooring line, but was successfully released. However, the whale was subsequently attacked and killed by sharks. The extent to which the entanglement contributed to the shark predation is unknown. In 1996, another humpback was found in Hawaiian waters entangled in a line attached to a sea anchor. This animal appeared in good health after it was successfully released (E. Nitta, pers. comm., Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole St., Honolulu, HI, 96822). During 1993-97, the only reported ship strike mortality of a humpback from this stock occurred in Oahu during February of 1996. Averaging these mortalities over the 5-year period from 1993 to 1997 results in a mortality rate of 0.4 whales per year from this stock resulting from ship strikes or entanglement in line (other than fishing gear).

**HISTORIC WHALING**

The number of humpback whales in the North Pacific may have numbered approximately 15,000 individuals prior to exploitation (Rice 1978). Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century and may have reduced this population to as few as 1,000 before it was placed under international protection after the 1965 hunting season (Rice 1978). This mortality estimate likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

**STATUS OF STOCK**

As the estimated annual mortality rate (1.4; 1.0 of which was fishery-related) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR (7.4). The minimum estimated fishery mortality and serious injury for this stock is not less that 10% of the calculated PBR (0.7) and, therefore, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The humpback whale is listed as “endangered” under the Endangered Species Act, and therefore designated as “depleted” under the MMPA. As a result, the Central North Pacific stock of humpback whale is classified as a strategic stock. The stock appears to have increased in abundance between the early 1980s and early 1990s; however, the status of this stock relative to its Optimum Sustainable Population size is unknown.

**Habitat Concerns**

This stock is the focus of a large whalewatching industry in its wintering grounds (Hawaii) and a growing whalewatching industry in its summering grounds (Alaska). Regulations concerning minimum distance to keep from whales and how to operate vessels when in the vicinity of whales have been developed for Hawaii waters in an attempt to minimize the impact of whalewatching. Similar, although more general, marine mammal viewing guidelines have also been developed for Alaska waters. The growth of the industry, however, is a concern as preferred habitats may be abandoned if disturbance levels are too high.

Noise pollution from the Acoustic Thermometry of Ocean Climate (ATOC) program, the U.S. Navy's Low Frequency Active (LFA) sonar program, and other anthropogenic sources (i.e., shipping and whalewatching) in Hawaii waters is another concern for this stock. Results from experiments in 1996 off Hawaii indicated only subtle responses of humpback whales to ATOC-like transmissions (Frankel and Clark 1998). Efforts are underway to evaluate the relative contribution of noise (e.g., experiments with LFA sound sources) to Hawaii's marine environment, although reports summarizing the results of recent research are not available.

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# FIN WHALE (*Balaenoptera physalis*): Northeast Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

In the North Pacific Ocean, fin whales can be found from above the Arctic Circle to lower latitudes of approximately 20°N (Leatherwood et al. 1982). There are few data concerning the location of the winter grounds of fin whales because migrations from summer feeding areas back to their winter grounds tend to occur in the open ocean rather than near the coast (Mizroch et al. 1984). Within U. S. waters in the Pacific, fin whales are distributed seasonally off the coast of North America (Fig. 33) and occasionally near and around the waters of Hawaii.

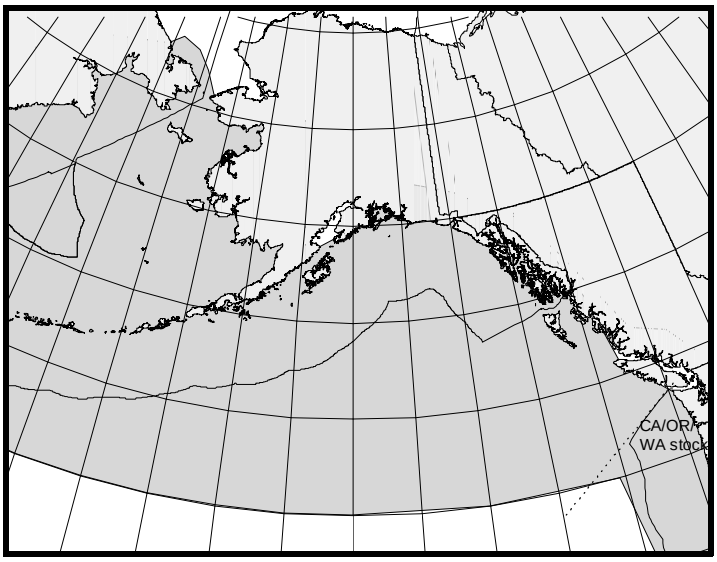


**Figure 34.** Approximate distribution of fin whales in the eastern North Pacific (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous in winter, possibly isolated in summer; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, the International Whaling Commission considers fin whales in the North Pacific to all belong to the same stock (Mizroch et al. 1984), although the authors cited additional evidence that supports the establishment of subpopulations in the North Pacific. Further, Fujino (1960) describes an eastern and a western group, which are isolated though may intermingle around the Aleutian Islands. Tag recoveries reported by Rice (1974) indicate that animals wintering off the coast of southern California range from central California to the Gulf of Alaska during the summer months. Fin whales along the Pacific coast of North America have been reported during the summer months from the Bering Sea to as far south as central Baja California (Leatherwood et al. 1982). As a result, stock structure of fin whales is considered equivocal. Based on a conservative management approach, three stocks are recognized: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. The California/Oregon/Washington and Hawaii fin whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Reliable estimates of current and historical abundance for the Northeast Pacific fin whale stock are currently not available. Ranges of population estimates for the entire North Pacific prior to exploitation and in the early 1970s are 42,000 to 45,000 and 14,620 to 18,630, respectively (Ohsumi and Wada 1974), representing 32% to 44% of the precommercial whaling population size (Braham 1984). These estimates were based on population modeling, which incorporated catch and observation data. These estimates also include whales from the California/Oregon/Washington stock for which a separate abundance estimate is currently available.

A survey conducted in August of 1994 covering 2,050 nautical miles of trackline south of the Aleutian Islands encountered only 4 fin whale groups (Forney and Brownell 1996). However, this survey did not include all of the waters off Alaska where fin whale sightings have been reported.

### Minimum Population Estimate

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as a current estimate of abundance is not available.

### Current Population Trend

Reliable information on trends in abundance for the Northeast Pacific stock of fin whales are currently not available. There are no published reports indicating recovery of this stock has or is taking place (Braham 1992).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Northeast Pacific fin whale stock. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

There have been no reports of incidental mortalities of fin whales related to commercial fishery operations in the North Pacific during this decade, from either observed fisheries or the self-reported fisheries information required of vessel operators by the MMPA. Therefore, based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take fin whales from this stock.

### Other Mortality

In the North Pacific and Bering Sea, catches of fin whales ranged from 1,000 to 1,500 animals annually from the mid-1950s to the mid-1960s. Thereafter, catches declined sharply and ended altogether in 1976 when catches became prohibited (Mizroch et al. 1984). These mortality estimates likely underestimate the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

## STATUS OF STOCK

The fin whale is listed as “endangered” under the Endangered Species Act of 1973, and therefore designated as “depleted” under the MMPA. As a result, the Northeast Pacific stock is classified as a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. There are no known habitat issues that are of particular concern for this stock.

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# MINKE WHALE (*Balaenoptera acutorostrata*): Alaska Stock

**STOCK DEFINITION AND GEOGRAPHIC RANGE:**

In the North Pacific, minke whales occur from the Bering and Chukchi Seas south to near the equator (Leatherwood et al. 1982). The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, the International Whaling Commission (IWC) recognizes 3 stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180°N, and one in the "remainder" of the Pacific (Donovan 1991). The "remainder" stock designation reflects the lack of exploitation in the eastern Pacific and does not indicate that only one population exists in this area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi Seas and in the inshore waters of the Gulf of Alaska (Mizroch 1992), but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982, Brueggeman et al. 1990). Minke whales are known to penetrate loose ice during the summer, and some individuals venture north of the Bering Strait (Leatherwood et al. 1982). In the northern part of their range minke whales are believed to be migratory, whereas they appear to establish home ranges in the inland waters of Washington and along central California (Dorsey et al. 1990). Because the "resident" minke whales from California to Washington appear behaviorally distinct from migratory whales farther north, minke whales in Alaska are considered a separate stock from minke whales in California, Oregon, and Washington. Accordingly, two stocks of minke whales are recognized in U. S. waters: 1) Alaska, and 2) California/Washington/Oregon (Fig. 34). The California/ Oregon/Washington minke whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

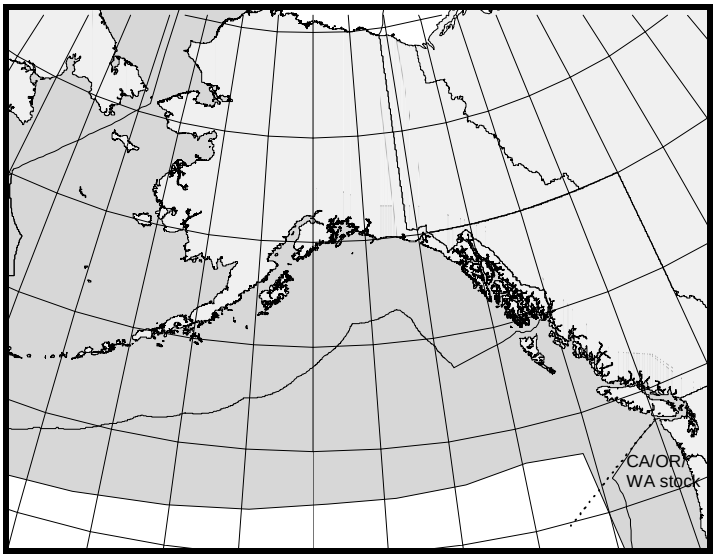


**Figure 35.** Approximate distribution of minke whales in the eastern North Pacific (shaded area).

**POPULATION SIZE**

No estimates have been made for the number of minke whales in the entire North Pacific nor are estimates available for the number of minke whales that occur within the waters of Alaska.

**Minimum Population**

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as current estimates of abundance are not available.

**Current Population Trend**

There are no data on trends in minke whale abundance in Alaska waters.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of minke whale populations in the North Pacific (Best 1993). Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the product of minimum population size, 0.5 maximum net productivity, and a recovery factor. Given the status of this stock is unknown, the appropriate recovery factor is 0.5 (Wade and Angliss 1997). However, because an estimate of minimum abundance is not available, it is not possible to estimate a PBR for the Alaska minke whale stock at this time.

## ANNUAL HUMAN-CAUSED MORTALITY

### Fishery Information

Six different commercial fisheries operating in Alaska waters within the range of the Alaska minke whale stock were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No minke whale mortalities were observed for any of these fisheries. In 1989, one minke whale mortality (extrapolated to 2 mortalities) was observed in the Bering Sea/Gulf of Alaska joint-venture groundfish trawl fishery, the predecessor to the current Alaska groundfish trawl fishery.

In the past, minke whales have been caught in both coastal set gillnets and offshore drift gillnets (Small and DeMaster 1995). However, based on logbook reports maintained by vessel operators required by the MMPA interim exemption program during the 4-year period between 1990 and 1993, no injuries or mortalities of minke whales from interactions with commercial gear were reported for any Alaska fishery. Complete logbook data after 1993 are not available.

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

No minke whales were ever taken by the modern shore-based whale fishery in the eastern North Pacific which lasted from 1905 to 1971 (Rice 1974). Subsistence takes of minke whales by Alaska Natives are rare, but have been known to occur. Only seven minke whales are reported the have been taken for subsistence by Alaska Natives between 1930 and 1987 (C. Allison, pers. comm., International Whaling Commission, The Red House, Station Road, Histon, Cambridge, UK). The most recent harvest (2 whales) in Alaska occurred in 1989 (RIWC 1991). Based on this information, the annual subsistence take averaged zero minke whales during the 3-year period from 1993 to 1995.

## STATUS OF STOCK

Minke whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The greatest uncertainty regarding the status of the Alaska minke whale stock has to do with the uncertainty pertaining to the stock structure of this species in the eastern North Pacific. Because minke whales are considered common in the waters off Alaska and because the number of human-related removals is currently thought to be minimal, this stock is not considered a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to OSP are currently not available.

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# NORTHERN RIGHT WHALE (*Eubalaena glacialis*): North Pacific Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Whaling records indicate that right whales in the North Pacific range across the entire North Pacific north of 35/N and occasionally occur as far south as 20/N (Fig. 35). Before right whales in the North Pacific were heavily exploited by commercial whalers, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, southcentral Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1958-82, there were only 32-36 sightings of right whales in the central North Pacific and Bering Sea (Braham 1986). In the eastern North Pacific, south of 50/N, only 29 reliable sightings were recorded between 1900 and 1994 (Scarff 1986, Scarff 1991, Carretta et al. 1994). Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (Herman et al. 1980, Berzin and Doroshenko 1982, NMFS 1991).

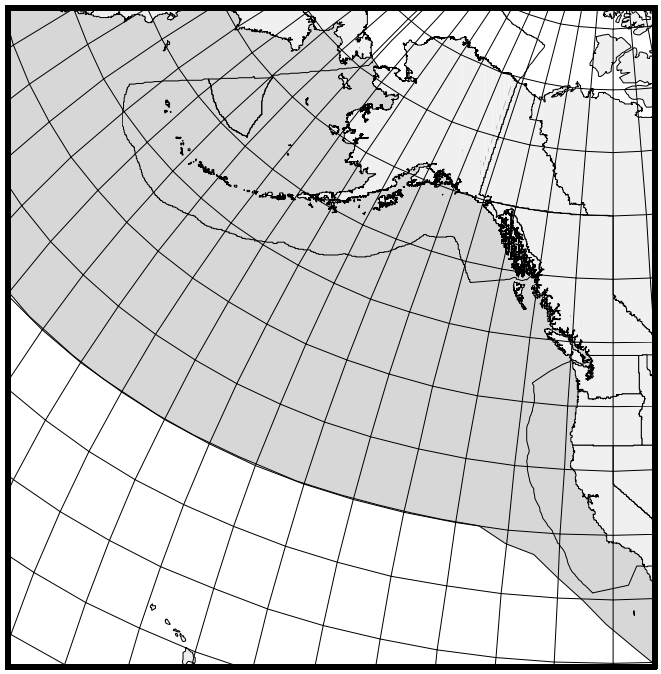

**Figure 36.** Approximate historical distribution of right whales in the eastern North Pacific (shaded area).

Right whales calve in coastal waters during the winter months. However, in the eastern North Pacific no such calving grounds were ever found (Scarff 1986). Migratory patterns of the North Pacific stock are unknown, although it is thought the whales spend the summer on high-latitude feeding grounds and migrate to more temperate waters during the winter (Braham and Rice 1984).

The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, two stocks of northern right whales are currently recognized: a North Atlantic stock and a North Pacific Stock (Scarff 1986, Schevill 1986).

## POPULATION SIZE

The pre-exploitation size of this stock exceeded 11,000 animals (NMFS 1991). Based on sighting data, Wada (1973) estimated a total population of 100-200 in the North Pacific. Rice (1974) stated that only a few individuals remained in the eastern North Pacific stock, and that for all practical purposes was extinct because no sightings of a cow with calf have been confirmed since 1900 (D. Rice, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115). A reliable estimate of abundance for the North Pacific right whale stock is currently not available.

Several notable points concerning right whales in the North Pacific recently occurred. On April 2, 1996 a right whale was sighted off of Maui (D. Salden, pers. comm., Hawaii Whale Research Foundation, P. O. Box 1296, Lahaina, HI 96767). This was the first documented sighting of a right whale in Hawaiian waters since 1979 (Herman et al. 1980, Rowntree et al. 1980). More importantly, a group of 3-4 right whales was sighted in western Bristol Bay (July 30, 1996) which appears to have included a juvenile animal (Goddard and Rugh 1998). During July 1997, a

group of 5-9 individuals was encountered in approximately the same Bristol Bay location (C. Tynan, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115).

**Minimum Population Estimate**

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as a current estimate~~s~~ of abundance is not available.

**Current Population Trend**

A reliable estimate of trend in abundance is currently not available.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Due to insufficient information, it is recommended that the default cetacean maximum net productivity rate ($R_{MAX}$) of 4% be employed for this stock (Wade and Angliss 1997). However, this default rate is likely an underestimate based on the work reported by Best (1993).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

In June of 1983, a right whale was reported to be incidentally killed in a gillnet in Russian waters (NMFS 1991). Gillnets were also implicated in the death of another right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994). No other incidental takes of right whales are known to have occurred in the North Pacific. Any mortality incidental to commercial fisheries would be considered significant.

Based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Subsistence hunters in Alaska and Russia are not reported to take animals from this stock.

**Other Mortality**

Right whales are large, slow-swimming, tend to congregate in coastal areas, and have a thick layer of blubber which enables them to float when killed. These attributes made them an easy and profitable species for early (pre-modern) whalers. By the time the modern (harpoon cannons and steam powered catcher boats) whale fishery began in the late 1800s, right whales were rarely encountered (Braham and Rice 1984). Between 1835 and 1935 over 15,200 right whales were estimated to have been taken from the North Pacific by commercial whalers, with a vast majority of those animals taken prior to 1875 (Brueggeman et al. 1986, IWC 1986). The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

## STATUS OF STOCK

The right whale is listed as “endangered” under the Endangered Species Act of 1973, and therefore designated as “depleted” under the MMPA. As a result, the stock is classified as a strategic stock. Reliable estimates of the minimum population size, population trends, and PBR are currently not available. Though reliable numbers are not known, the abundance of this stock is considered to represent only a small fraction of its precommercial whaling

abundance (i.e., the stock is well below its Optimum Sustainable Population size). The estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. The reason(s) for the apparent lack of recovery for this stock is(are) unknown. There are no known habitat issues that are of particular concern for this stock.

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# BOWHEAD WHALE (*Balaena mysticetus*): Western Arctic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 54/N and south of 75/N in the western Arctic Basin (Braham 1984). For management purposes, five stocks are currently recognized by the International Whaling Commission (IWC 1992). Small stocks occur in the Sea of Okhotsk, Davis Strait, Hudson Bay, and Spitsbergen. These small bowhead stocks are comprised of only a few tens to a few hundreds of individuals (Braham 1984, Shelden and Rugh 1996). The largest remnant population, and only stock that is found within U. S. waters, is the Western Arctic stock (Fig. 36). The Western Arctic stock migrates annually from wintering areas (November to March) in the northern Bering Sea, through the Chukchi Sea in the spring (March through June), to the Beaufort Sea where they spend much of the summer (mid-May through September) before returning again to the Bering Sea in the fall (September through November) to overwinter (Braham et al. 1980; Moore and Reeves 1993). The bowhead spring migration follows fractures in the sea ice around the coast of Alaska, generally in the shear zone between the shorefast ice and the mobile polar pack ice. There is evidence of whales following each other, even when their route does not take advantage of large ice-free areas, such as polynyas (Rugh and Cubbage 1980). As the whales travel east past Point Barrow, Alaska, their migration is somewhat funneled between shore and the polar pack ice, making for an optimal location from which to study this stock (Krogman 1980). Most of the year, bowhead whales are closely associated with sea ice (Moore and DeMaster 1997). Only during the summer is this population in relatively ice-free waters in the southern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration (Richardson et al. 1985).

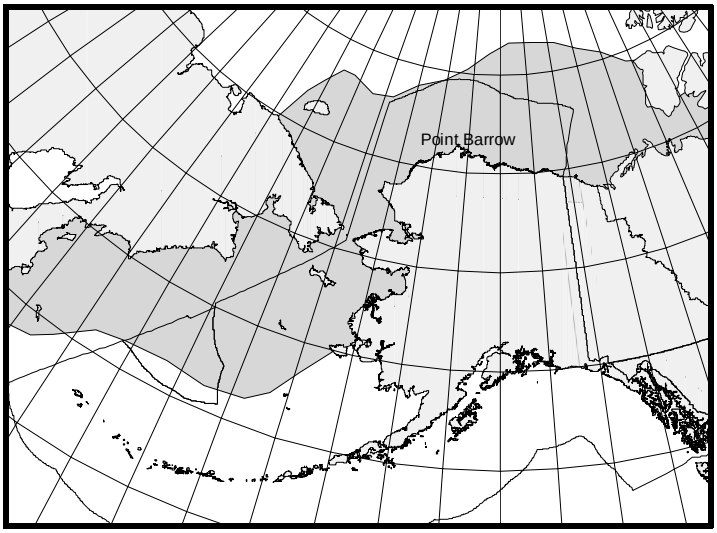


**Figure 37.** Approximate distribution of the Western Arctic stock of bowhead whales. The shaded area includes regions used during both the winter and summer by whales from this stock.

## POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling prior to the 20th century, starting in the early 16th century near Labrador and spreading to the Bering Sea in the mid-19th century (Braham 1984). Woodby and Botkin (1993) summarized previous efforts to approximate how many bowheads there were prior to the onset of commercial whaling. They reported a minimum worldwide population estimate of 50,000, with 10,400-23,000 in the Western Arctic stock (dropping to less than 3,000 at the end of commercial whaling).

Since 1978, counts of bowhead whales have been conducted from sites on sea ice north of Point Barrow, Alaska, during the whales' spring migration (Krogman et al. 1989). These counts have been corrected for whales missed due to distance offshore (through acoustical methods, described in Clark et al. 1994), whales missed when no watch was in effect, and whales missed during a watch (estimated as a function of visibility, number of observers, and distance offshore) (Zeh et al. 1994). However, in some years a small proportion of the population may not migrate past Point Barrow in spring, resulting in estimates which could be negatively biased. In 1993, unusually good counting conditions resulted in a population estimate for this stock of 8,000 (CV = 0.073) animals, with a 95% confidence

interval from 6,900 to 9,200 (Zeh et al. 1994). A refined and larger sample of acoustic data from 1993 has resulted in an estimate of 8,200 animals (95% CI = 7,200-9,400), and is considered a better abundance estimate for the Western Arctic stock (RIWC 1996). The CV for this abundance estimate is 0.069 (Zeh et al. 1995).

**Minimum Population Estimate**

The minimum population estimate ($N_{MIN}$) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 8,200 and its associated CV(N) of 0.069, $N_{MIN}$ for the Western Arctic stock of bowhead whales is 7,738.

**Current Population Trend**

Raftery et al. (1995) reported the Western Arctic stock of bowhead whales increased at a rate of 3.1% (95% CI = 1.4-4.7%) from 1978 to 1993, when abundance increased from approximately 5,000 to 8,000 whales. This rate of increase takes into account whales that passed beyond the viewing range of the ice-based observers. Inclusion of the revised 1993 abundance estimate results in a similar, though slightly higher rate of population increase 3.2% (95% CI = 1.4-5.1%) during the 1978-93 period (IWC 1996).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.2%) should not be used as an estimate of ($R_{MAX}$) because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than $R_{MAX}$. Thus, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% be employed for the Western Arctic stock of bowhead whale (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5 rather than the default value of 0.1 for endangered species because population levels are increasing in the presence of a known take (see guidelines Wade and Angliss 1997). Thus, PBR = 77 animals (7,738 × 0.02 × 0.5) for the Western Arctic stock of bowhead whale. The development of a PBR for the Western Arctic bowhead stock is required by the MMPA even though the Alaska Eskimo subsistence harvest of bowhead whales is managed under the authority of the International Whaling Commission (IWC). Accordingly, the IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. The IWC quotas authorize Alaska Natives to strike up to 67 bowhead whales in 1996, 66 in 1997, and 65 in 1998 (IWC 1995).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

**Fisheries Information**

Rare cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al. 1993), but this species' association with sea ice limits the amount of fisheries activity occurring in bowhead habitat. There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska. In addition, the self-reported fisheries information required of vessel operators by the MMPA during the period between 1990-96 reported no injuries or mortalities of bowhead whales for any Alaska fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

**Subsistence/Native Harvest Information**

Eskimos have been taking bowhead whales for at least 2,000 years (Marquette and Bockstoce 1980, Stoker and Krupnik 1993). Subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters take approximately 0.1-0.5% of the population per annum, primarily from 9 Alaska communities (Philo et al. 1993). Since 1977, the number of kills has ranged between 14-72 per year, depending in part on changes in management strategy and in part to higher estimates of bowhead whale abundance in recent years (Stoker and Krupnik 1993). The following statistics were compiled from animals taken in the subsistence harvest between 1973 and 1992: 1) the sex ratio of bowheads taken in the hunt was equal; 2) the proportion of adult females taken in the hunt increased from 5% in the early 1970s to over 20% in the late 1980s and early 1990s; 3) approximately 80% of the catch was immature animals prior to 1978 and since has been approximately 60%; and 4) modern Native whalers appear to harvest larger bowheads than precontact (prior to 1849) Native whalers (Braham 1995).

The total take by Alaska Natives, including struck and lost, was reported to be 51 whales in 1993 (Suydam et al. 1995), 46 in 1994 (IWC 1996), and 57 in 1995 (IWC 1997), and 44 in 1996 (Alaska Eskimo Whaling Commission, unpubl. data, AEWC, P. O. Box 570, Point Barrow, AK 99723). Canadian Natives are also known to take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik killed one whale in 1991 and one in 1996. The annual average subsistence take (by Natives of Alaska and Canada) during the 3-year period from 1994 to 1996 is approximately 49 bowhead whales.

**Other Mortality**

Pelagic commercial whaling for bowheads principally occurred in the Bering Sea from 1848 to 1919. Within the first two decades of the fishery (1850-1870), over 60% of the stock was harvested although effort remained high into the 20th century (Braham 1984). It is estimated that the pelagic whaling industry harvested 18,684 whales from this stock (Woodby and Botkin 1993). During the same 1848-1919 period, shore-based whaling operations (including landings as well as struck and lost estimates from U. S., Canadian, and Russian shores) took an additional 1,527 animals (Woodby and Botkin 1993). An unknown percentage of the shore-based animals were harvested for subsistence, and not commercial purposes. The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

**STATUS OF STOCK**

Based on currently available data, the estimated annual mortality rate incidental to commercial fisheries (0) not known to exceed 10% of the PBR (8) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The level of human-caused mortality and serious injury (49) is not known to exceed the PBR (77) nor the IWC quota for 1996 (67). The Western Arctic bowhead whale stock has been increasing in recent years. However, the stock is classified as a strategic stock because bowhead whale is listed as “endangered” under the Endangered Species Act (ESA), and therefore designated as “depleted” under the MMPA. The development of criteria for classifying this stock under the ESA is currently underway and will be used in the next 5-year evaluation of stock status (Shelden and Rugh 1996).

**Habitat Issues**

Increasing oil and gas development in the Arctic will lead to an increased risk of various forms of pollution to bowhead whale habitat, including oil spills, toxic and non-toxic waste, and noise due to higher levels of traffic as well as exploration and drilling operations. Evidence indicates that bowhead whales are sensitive to noise from offshore drilling platforms and seismic survey operations (Richardson 1995, Davies 1997).

Another element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1997). Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent. There are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales.

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# APPENDICES

Appendix Table 1.--Summary of changes to the 1999 stock assessments. Sections marked with an 'X' denote significant changes from the last time the stock assessment for that stock was revised (1996 or 1998).

| Stock | Stock definition | Population size | PBR | Fishery mortality | Subsistence mortality | Status |
|---|---|---|---|---|---|---|
| | | | | | | |
| Steller sea lion (western US) | | X | X | X | X | X |
| Steller sea lion (eastern US) | | X | | X | X | X |
| Northern fur seal | | | | | | |
| Harbor seal (SE Alaska) | | | | | | |
| Harbor seal (GOA) | | | | | | |
| Harbor seal (Bering Sea) | | | | | | |
| Spotted seal | | | | | | |
| Bearded seal | | | | | | |
| Ringed seal | | | | | | |
| Ribbon seal | | | | | | |
| | | | | | | |
| Beluga whale (Beaufort) | | | | | X | |
| Beluga whale (E. Chukchi) | | X | | | X | |
| Beluga whale (E. Bering Sea) | | | | X | X | |
| Beluga whale (Bristol Bay) | | | | X | X | |
| Beluga whale (Cook Inlet) | | X | X | | X | |
| Killer whale (resident) | | | | | | |
| Killer whale (transient)* | X | X | X | X | | |
| Pacific white-sided dolphin | | | | | | |
| Harbor porpoise (SE Alaska) | | | | | | |
| Harbor porpoise (GOA) | | | | | | |
| Harbor porpoise (Bering Sea) | | | | | | |
| Dall's porpoise | | | | | | |
| Sperm whale | | | | | | |
| Baird's beaked whale | | | | | | |
| Cuvier's beaked whale | | | | | | |
| Stejneger's beaked whale | | | | | | |
| Gray whale | | | | | | |
| Humpback whale (western) | | | | X | | |
| Humpback whale (central) | | | | X | | |
| Fin whale | | | | | | |
| Minke whale | | | | | | |
| Northern Right whale | | | | | | |
| Bowhead whale | | | | | | |

Note: The transient killer whale stock assessment has been revised in 1999 and was moved to the document containing the U. S. Pacific Marine Mammal Stock Assessment reports.

Appendix Table 2.--Stock summary table.

| Species | Stock | N (est) | CV | C.F. | CV C.F. | Comb. CV | N(min) | 0.5 Rmax | F(r) | PBR | Fishery mort. | Subsist mort. | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baird's beaked whale | Alaska | n/a | | | | | n/a | 0.02 | 0.50 | n/a | 0 | see txt | NS |
| Bearded seal | Alaska | n/a | | | | | n/a | 0.06 | 0.50 | n/a | 2 | n/a | NS |
| Beluga whale | Beaufort Sea | 39,258 | 0.229 | 2.00 | n/a | 0.229 | 32,453 | 0.02 | 1.00 | 649 | 0 | 184 | NS |
| Beluga whale | E. Chukchi Sea | 3,710 | n/a | 3.09 | n/a | n/a | 3,710 | 0.02 | 1.00 | 74 | 0 | 68 | NS |
| Beluga whale | E. Bering Sea | 7,986 | 0.26 | 3.09 | n/a | 0.26 | 6,439 | 0.02 | 1.00 | 129 | 1* | 121 | NS |
| Beluga whale | Bristol Bay | 1,555 | n/a | 3.09 | n/a | 0.20 | 1,316 | 0.02 | 1.00 | 26 | 1* | 19 | NS |
| Beluga whale | Cook Inlet | 347 | 0.29 | | | 0.29 | 273 | 0.02 | 0.50 | 2.7 | 0* | 87 | S |
| Bowhead whale | Western Arctic | 8,200 | 0.069 | | | 0.069 | 7,738 | 0.02 | 0.50 | 77 | 0 | 49 | S |
| Cuvier's beaked whale | Alaska | n/a | | | | | n/a | 0.02 | 0.50 | n/a | 0 | 0 | NS |
| Dall's porpoise | Alaska | 83,400 | 0.097 | | | 0.097 | 76,874 | 0.02 | 1.00 | 1,537 | 42 | 0 | NS |
| Fin whale | Northeast Pacific | n/a | | | | | n/a | 0.02 | 0.10 | n/a | 0 | 0 | S |
| Gray whale | Eastern No Pac. | 22,571 | 0.0524 | | | 0.0524 | 21,597 | 0.02 | 1.00 | 432 | 4 | 43 | NS |
| Harbor porpoise | Southeast Alaska | 10,301 | see txt | see txt | see txt | see txt | 8,156 | 0.02 | 0.50 | 82 | 4* | 0 | NS |
| Harbor porpoise | Gulf of Alaska | 8,497 | 0.134 | 3.10 | 0.171 | 0.218 | 7,085 | 0.02 | 0.50 | 71 | 25 | 0 | NS |
| Harbor porpoise | Bering Sea | 10,946 | 0.243 | 3.10 | 0.171 | 0.300 | 8,549 | 0.02 | 0.50 | 86 | 2 | 0 | NS |
| Harbor seal | Southeast Alaska | 37,450 | 0.026 | 1.74 | 0.068 | 0.073 | 35,226 | 0.06 | 1.00 | 2,114 | 36 | 1,749 | NS |
| Harbor seal | Gulf of Alaska | 29,175 | 0.023 | 1.50 | 0.047 | 0.052 | 28,917 | 0.06 | 0.50 | 868 | 36 | 791 | NS |
| Harbor seal | Bering Sea | 13,312 | 0.062 | 1.50 | 0.047 | see txt | 12,648 | 0.06 | 0.50 | 379 | 31 | 161 | NS |

Appendix Table 2.--(cont.).

| Species | Stock | N (est) | CV | C.F. | CV C.F. | Comb. CV | N(min) | 0.5 Rmax | F(r) | PBR | Fishery mort. | Subsist mort. | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Humpback whale | Western No Pac. | 394 | 0.084 | | | 0.084 | 367 | 0.02 | 0.10 | 0.7 | 0.2 | 0 | S |
| Humpback whale | Central No Pacific | 4,005 | 0.095 | | | 0.095 | 3,698 | 0.02 | 0.10 | 7.4 | 1.0 | 0 | S |
| Killer whale | E. N. Pacific N. resident | 717 | n/a | | | see txt | 717 | 0.02 | 0.50 | 7.2 | 0.8 | 0 | NS |
| Minke whale | Alaska | n/a | | | | | n/a | 0.02 | 0.50 | n/a | 0 | 0 | NS |
| Northern right whale | North Pacific | n/a | | | | | n/a | 0.02 | 0.10 | n/a | 0 | 0 | S |
| Northern fur seal | Eastern No Pacific | 1,002,516 | 0.065 | 4.475 | n/a | 0.2 | 848,539 | 0.043 | 0.50 | 18,244 | 17 | 1,708 | S |
| Pac white-sided dolphin | Central No Pacific | 931,000 | 0.900 | | | 0.900 | 486,719 | 0.02 | 0.50 | 4,867 | 4 | 0 | NS |
| Ribbon seal | Alaska | n/a | | | | | n/a | 0.06 | 0.50 | n/a | 1 | n/a | NS |
| Ringed seal | Alaska | n/a | | | | | n/a | 0.06 | 0.50 | n/a | 1 | n/a | NS |
| Sperm whale | North Pacific | n/a | | | | | n/a | 0.02 | 0.10 | n/a | 0 | 0 | S |
| Spotted seal | Alaska | n/a | | | | | n/a | 0.06 | 0.50 | n/a | 2* | see txt | NS |
| Stejneger's beaked whale | Alaska | n/a | | | | | n/a | 0.02 | 0.50 | n/a | 0 | 0 | NS |
| Steller sea lion | East. U. S. | 30,403 | | | | | 30,403 | 0.06 | 0.75 | 1,368 | 16 | 0 | S |
| Steller sea lion | West. U. S. | 39,031 | | | | | 39,031 | 0.06 | 0.10 | 234 | 30 | 412 | S |

C.F. = correction factor; CV C.F. = CV of correction factor; Comb. CV = combined CV; Status: S=Strategic, NS=Not Strategic, n/a = not available.
* = No reported take by fishery observers; however, observer coverage was minimal or nonexistent.
see txt = see text for details.

Appendix Table 3a.--Summary table for Alaska **category 2** commercial fisheries.

| Fishery (area and gear type) | Target species | # of permits issued/fished 1997 | Soak time | Landings per day | Sets per day | Season duration | Fishery trends (1990-1997) |
|---|---|---|---|---|---|---|---|
| Southeast AK drift gillnet | salmon | 482 issued 423 fished | 20 min - 3 hrs; day / night | 1 | 6 - 20 | June 18 to early Oct | # vessels stable but may vary with price of salmon; catch - high |
| Southeast AK purse seine | salmon | 416 issued 351 fished | 20 min-45 min; mostly daylight fishing, except at peak | 1 | 6 - 20 | end of June to early Sept | # vessel stable but may vary some with price of salmon; catch - high |
| Yakutat set gillnet | salmon | 170 issued 141 fished | continuous soak during opener; day / night | 1 | net picked every 2 - 4hrs/day or continuous during peak | June 4 to mid - Oct | # sites fished stable; catch - variable |
| Prince William Sound drift gillnet | salmon | 540 issued 520 fished | 15 min - 3 hrs; day / night | 1 or 2 | 10 - 14 | mid - May to end of Sept | # vessels stable; catch - stable |
| Cook Inlet drift gillnet | salmon | 581 issued 572 fished | 15 min - 3 hrs or continuous; day only | 1 | 6 - 18 | June 25 to end of Aug | # vessels stable; catch - variable |
| Cook Inlet (CI) set gillnet | salmon | 745 issued 603 fished | continuous soak during opener, but net dry with low tide; upper CI -day / night lower CI -day only except during fishery extensions | 1 | upper CI - picked on slack tide lower CI - picked every 2 - 6 hrs/day | June 2 to mid - Sept | # sites fished stable; catch - up for sockeye and kings, down for pinks |
| Kodiak set gillnet | salmon | 188 issued 174 fished | continuous during opener; day only | 1 or 2 | picked 2 or more times | June 9 to end of Sept | # sites fished stable; catch - variable |
| AK Peninsula/Aleutians drift gillnet | salmon | 164 issued 157 fished | 2 -5 hrs; day / night | 1 | 3 - 8 | mid - June to mid - Sept | # vessels stable; catch up |
| AK Peninsula/Aleutians set gillnet | salmon | 121 issued 111 fished | continuous during opener; day / night | 1 | every 2 hrs | June 18 to mid Aug | # sites fished stable; catch - up since 90; down in 96 |
| Bristol Bay drift gillnet | salmon | 1,899 issued 1,875 fished | continuous soaking of part of net while other parts picked; day / night | 2 | continuous | June 17 to end of Aug or mid - Sept | # vessels stable; catch - variable |
| Bristol Bay set gillnet | salmon | 1,019 issued 921 fished | continuous during opener, but net dry during low tide; day / night | 1 | 2 or continuous | June 17 to end of Aug or mid - Sept | # sites fished stable; catch - variable |
| AK pair trawl | misc finfish | 1 issued # fished n/a | | | | | new fishery |

Appendix Table 3b.--Interaction table for Alaska **category 2** commercial fisheries.

| Fishery (area and gear type) | Observer program | Species recorded as taken incidentally in this fishery (records dating back to 1988) | Data type |
|---|---|---|---|
| Southeast AK drift gillnet | never observed | Steller sea lion, harbor seal, harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, humpback whale (self) | logbook and self reports |
| Southeast AK purse seine | never observed | humpback whale | self reports |
| Yakutat set gillnet | never observed | harbor seal, gray whale (strand) | logbook and stranding |
| Prince William Sound drift gillnet | 1990 1991 | Steller sea lion (obs), northern fur seal, harbor seal (obs), harbor porpoise (obs), Dall's porpoise, Pacific white-sided dolphin, sea otter | observer and logbook |
| Cook Inlet drift gillnet | never observed | Steller sea lion, harbor seal, harbor porpoise, Dall's porpoise | logbook |
| Cook Inlet set gillnet | never observed | harbor seal, harbor porpoise, Dall's porpoise | logbook |
| Kodiak set gillnet | never observed | harbor seal, harbor porpoise, sea otter | logbook |
| Alaska Peninsula/Aleutians drift gillnet | 1990 | northern fur seal, harbor seal, harbor porpoise, Dall's porpoise (obs) | observer and logbook |
| Alaska Peninsula/Aleutians set gillnet | never observed | Steller sea lion, harbor porpoise | logbook |
| Bristol Bay drift gillnet | never observed | Steller sea lion, northern fur seal, harbor seal, spotted seal, Pacific white-sided dolphin, beluga whale, gray whale | logbook |
| Bristol Bay set gillnet | never observed | northern fur seal, harbor seal, spotted seal, beluga whale, gray whale | logbook |
| AK pair trawl | never observed | none documented | none |

Note: Only species with positive records of being taken incidentally in a fishery since 1988 (the first year of the MMPA interim exemption program) have been included in this table. A species' absence from this table does not necessarily mean it is not taken in a particular fishery. Rather, in most fisheries, only logbook or stranding data are available which resulted in many reports of unidentified or misidentified marine mammals.

Appendix Table 3c.--Interaction table for Alaska **category 3** commercial fisheries.

| Fishery name | # of permits issued/fished 1997 | Observer program | Species recorded as taken incidentally in this fishery (records dating back to 1990) | Data type |
|---|---|---|---|---|
| Prince William Sound salmon set gillnet | 30 issued<br>27 fished | 1990 | Steller sea lion, harbor seal | logbook |
| Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet | 2,014 issued<br>1,533 fished | never observed | harbor porpoise | none |
| AK roe herring and food/bait herring gillnet | 2,595 issued<br>1,519 fished | never observed | none documented | none |
| AK miscellaneous finfish set gillnet | 3 issued<br># fished n/a | never observed | Steller sea lion | logbook |
| AK salmon purse seine (except for Southeast AK) | 960 issued<br>578 fished | never observed | harbor seal | logbook |
| AK salmon beach seine | 34 issued<br>5 fished | never observed | none documented | none |
| AK roe herring and food/bait herring purse seine | 832 issued<br>540 fished | never observed | none documented | none |
| AK roe herring and food/bait herring beach seine | 10 issued<br>6 fished | never observed | none documented | none |
| Metlakatla purse seine and drift gillnet (tribal) | 10 fished (purse)<br>60 fished (drift) | never observed | none documented | none |
| AK octopus/squid purse seine | 2 issued<br># fished n/a | never observed | none documented | none |
| AK miscellaneous finfish purse seine | 10 issued<br># fished n/a | never observed | none documented | none |
| AK miscellaneous finfish beach seine | 1 issued<br># fished n/a | never observed | none documented | none |
| AK salmon troll (includes hand and power troll) | 2,427 issued<br>1,127 fished | never observed | Steller sea lion | logbook |
| AK north Pacific halibut/bottom fish troll | 367 issued<br>168 fished | never observed | none documented | none |
| AK state waters groundfish longline /set line (incl. sablefish/ rockfish/misc.finfish) | 2,637 issued<br>1,392 fished | never observed | none documented | none |
| Gulf of AK groundfish longline/set line (incl. misc. finfish/sablefish) | # issued n/a<br>975 fished | 1989-present | Steller sea lion, harbor seal, northern elephant seal, Dall's porpoise | observer |
| BSAI groundfish longline/set line (incl. misc. finfish/sablefish) | # issued n/a<br>137 fished | 1989-present | Steller sea lion (SR), killer whale (obs), Pacific white sided dolphin (obs), Dall's porpoise (obs) , northern elephant seal (log) | observer, logbook, and self reports (SR) |
| AK halibut longline/set line (state and federal waters) | # issued n/a<br>2,180 fished | never observed | Steller sea lion | self reports |

Note: Only species with positive records of being taken incidentally in a fishery since 1990 (the first year of the MMPA interim exemption logbook program) have been included in this table. A species' absence from this table does not necessarily mean it is not taken in a particular fishery. Rather, in most fisheries, only logbook or stranding data are available which resulted in many reports of unidentified or misidentified marine mammals.

Appendix Table 3c.--(cont.).

| Fishery name | # of permits issued/fished 1997 | Observer program | Species recorded as taken incidentally in this fishery (records dating back to 1990) | Data type |
|---|---|---|---|---|
| AK octopus/squid longline | 2 issued<br>1 fished | never observed | none documented | none |
| AK shrimp otter and beam trawl (statewide and Cook Inlet) | 91 issued<br>42 fished | never observed | none documented | none |
| Gulf of Alaska groundfish trawl | # issued n/a<br>203 fished | 1989 to present | Steller sea lion, harbor seal, northern elephant seal, Dall's porpoise | observer |
| Bering Sea and Aleutian Island groundfish trawl | # issued n/a<br>167 fished | 1989 to present | Steller sea lion, northern fur seal, harbor seal, spotted seal, bearded seal, ribbon seal, ringed seal, northern elephant seal, Dall's porpoise, harbor porpoise, Pacific white-sided dolphin, killer whale, walrus | observer |
| State waters of Kachemak Bay Cook Inlet, Prince William Sound, Southeast AK groundfish trawl | 26 issued<br>3 fished | never observed | none documented | none |
| AK miscellaneous finfish otter or beam trawl | 382 issued<br>309 fished | never observed | none documented | none |
| AK food/bait herring trawl (Kodiak area only) | 4 issued<br>4 fished | never observed | none documented | none |
| AK crustacean pot | 1,963 issued<br>1,406 fished | 1988 to present | harbor porpoise | stranding |
| AK Bering Sea and Gulf of Alaska finfish pot | # issued n/a<br>202 fished | 1990 to present | harbor seal, sea otter | observer |
| AK octopus/squid pot | 70 issued<br>16 fished | never observed | none documented | none |
| AK snail pot | 18 issued<br>5 fished | never observed | none documented | none |
| AK North Pacific halibut handline and mechanical jig | 66 issued<br>37 fished | never observed | none documented | none |
| AK other finfish handline and mechanical jig | 934 issued<br>283 fished | never observed | none documented | none |
| AK octopus/squid handline | 2 issued<br># fished n/a | never observed | none documented | none |
| AK Prince William Sound herring roe/food/bait pound net | 128 issued<br>90 fished | never observed | none documented | none |
| Southeast AK herring food/bait pound net | 337 issued<br>269 fished | never observed | none documented | none |
| Coastwise scallop dredge | 30 issued<br>22 fished | never observed | none documented | none |

Note: Only species with positive records of being taken incidentally in a fishery since 1990 (the first year of the MMPA interim exemption logbook program) have been included in this table. A species' absence from this table does not necessarily mean it is not taken in a particular fishery. Rather, in most fisheries, only logbook or stranding data are available which resulted in many reports of unidentified or misidentified marine mammals.

Appendix Table 3c.--(cont.).

| Fishery name | # of permits issued/fished 1997 | Observer program | Species recorded as taken incidentally in this fishery (records dating back to 1990) | Data type |
|---|---|---|---|---|
| AK abalone (hand pick/dive) | 13 issued<br>0 fished | never observed | none documented | none |
| AK clam (hand pick/dive) | 62 issued<br>53 fished | never observed | none documented | none |
| AK dungeness crab (hand pick/dive) | 3 issued<br>0 fished | never observed | none documented | none |
| AK herring spawn-on-kelp (hand pick/dive) | 492 issued<br>44 fished | never observed | none documented | none |
| AK urchin and other fish/shellfish (hand pick/dive) | 788 issued<br>432 fished | never observed | none documented | none |
| AK commercial passenger fishing vessel | 3,173 issued<br># fished n/a | never observed | none documented | none |

Note: Only species with positive records of being taken incidentally in a fishery since 1990 (the first year of the MMPA interim exemption logbook program) have been included in this table. A species' absence from this table does not necessarily mean it is not taken in a particular fishery. Rather, in most fisheries, only logbook or stranding data are available which resulted in many reports of unidentified or misidentified marine mammals.

Appendix Table 3d.--Observer coverage in Alaska commercial fisheries 1990-97.

| Fishery name | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Gulf of Alaska (GOA) groundfish trawl | 55% | 38% | 41% | 37% | 33% | 44% | 37% | 33% |
| GOA longline | 21% | 15% | 13% | 13% | 8% | 18% | 16% | 15% |
| GOA finfish pots | 13% | 9% | 9% | 7% | 7% | 7% | 5% | 4% |
| Bering Sea/Aleutian Islands (BSAI) groundfish trawl | 74% | 53% | 63% | 66% | 64% | 67% | 66% | 64% |
| BSAI longline | 80% | 54% | 35% | 30% | 27% | 28% | 29% | 33% |
| BSAI finfish pots | 43% | 36% | 34% | 41% | 27% | 20% | 17% | 18% |
| Prince William Sound salmon drift gillnet | 4% | 5% | not observed | not observed | not observed | not observed | not observed | not observed |
| Prince William Sound salmon set gillnet | 3% | not observed | not observed | not observed | not observed | not observed | not observed | not observed |
| Alaska Peninsula/Aleutian Islands salmon drift gillnet (South Unimak area only) | 4% | not observed | not observed | not observed | not observed | not observed | not observed | not observed |

Note: Observer coverages in the groundfish fisheries (trawl, longline, and pots) were determined by the percentage of tons caught which were observed. Observer coverage in the groundfish fisheries is assigned according to vessel length; where vessels greater then 125' have 100% coverage, vessels 60-125' have 30% coverage, and vessels less than 60' are not observed. Observer coverages in the drift gillnet fisheries were calculated as the percentage of the estimated sets that were observed. Observer coverages in the set gillnet fishery was calculated as the percentage of estimated setnet hours (determined by number of permit holders and the available fishing time) that were observed.

Appendix 4.--Self-reported fisheries information.

The Marine Mammal Exemption Program (MMEP) was initiated in mid-1989 as a result of the 1988 amendments to the Marine Mammal Protection Act (MMPA). The MMEP required fishers involved in Category I and II fisheries to register with NMFS and to complete annual logbooks detailing each day's fishing activity, including: date fished, hours fished, area fished, marine mammal species involved, injured and killed due to gear interactions, and marine mammal species harassed, injured and killed due to deterrence from gear or catch. If the marine mammal was deterred, the method of deterrence was required, as well as indication of its effectiveness. Fishers were also required to report whether there were any losses of catch or gear due to marine mammals. These logbooks were submitted to NMFS on an annual basis, as a prerequisite to renewing their registration. Fishers participating in Category III fisheries were not required to submit complete logbooks, but only to report mortalities of marine mammals incidental to fishing operations. Logbook data are available for part of 1989 and for the period covering 1990-1993. Logbook data received during the period covering part of 1994 and all of 1995 was not entered into the MMEP logbook database in order for NMFS personnel to focus their efforts on implementing the 1994 amendments to the MMPA. Thus, aside from a few scattered reports from the Alaska Region, self-reported fisheries information is not available for 1994 and 1995.

In 1994, the MMPA was amended again to implement a long-term regime for managing mammal interactions with commercial fisheries (the Marine Mammal Authorization Program, or MMAP). Logbooks are no longer required. Instead, vessel owners/operators in any commercial fishery (Category I, II, or III) are required to submit one-page pre-printed reports for all interactions resulting in an injury or mortality to a marine mammal. The report must include the owner/operator's name and address, vessel name and ID, where and when the interaction occurred, the fishery, species involved, and type of injury (if animal was released alive). These postage-paid report forms are mailed to all Category I and II fishery participants that have registered with NMFS, and must be completed and returned to NMFS within 48 hours of returning to port for trips in which a marine mammal injury or mortality occurred. This reporting requirement was implemented in April 1996. During 1996, only 5 mortality/injury reports were received by fishers participating in all of Alaska's commercial fisheries. This level of reporting was a drastic drop in the number of reports compared to the numbers of interactions reported in the annual logbooks. As a result, the Alaska Scientific Review Group (SRG) considers the MMAP reports unreliable and has recommended that NMFS not utilize the reports to estimate marine mammal mortality (see June 1998 Alaska SRG meeting minutes; DeMaster 1998).

Self-reported fisheries information, where available, have been included into the stock assessment reports contained in this document. Refer to the individual stock assessment reports for summaries of self-reported fisheries information on a stock-specific basis.

**REFERENCES**

DeMaster, D. P. 1998. Minutes from sixth meeting of the Alaska Scientific Review Group, 21-23 October 1997, Seattle, Washington. 40 pp. (available upon request - D. P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).