NOAA Technical Memorandum NMFS-AFSC-168

Alaska Marine Mammal Stock Assessments, 2006

by
R. P. Angliss and R. B. Outlaw

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

January 2007

NOAA Technical Memorandum NMFS

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This document should be cited as follows:

Angliss, R. P., and R. B. Outlaw. 2007. Alaska marine mammal stock assessments, 2006. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-168, 244 p.

Cover photo: An adult male ribbon seal (*Histriophoca fasciata*) photographed in May 2005 during a NOAA research expedition to the pack ice of the western Bering Sea. Photographer: Michael Cameron (AFSC-NMML).

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January 2007

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PREFACE

On 30 April 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, when available, 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. 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.

The Stock Assessment Reports should be considered working documents, as they are updated as new information becomes available. The Stock Assessment Reports were originally developed in 1995 (Small and DeMaster 1995). Revisions have been published for the following years: 1996 (Hill et al. 1997), 1998 (Hill and DeMaster 1998), 1999 (Hill and DeMaster 1999), 2000 (Ferrero et al. 2000), 2001 (Angliss et al. 2001), 2002 (Angliss and Lodge 2002), 2003 (Angliss and Lodge 2004), and 2005 (Angliss and Outlaw 2005). Each stock assessment report is designed to stand alone and is 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, North Pacific right whales, and bowhead whales), were reviewed in 2005-2006. This review, and a review of other stocks, led to the revision of the following stock assessments for the 2006 document: Steller sea lion (western and eastern U.S. stocks), northern fur seal, beluga whale (Cook Inlet), harbor seal (Southeast Alaska, Gulf of Alaska, Bering Sea/Aleutian Islands), Pacific white-sided dolphin, spotted seal, bearded seal, ringed seal, ribbon seal, Dall's porpoise, harbor porpoise (SE Alaska, Gulf of Alaska, Bering Sea), minke whale, central and western stocks of humpback whales, fin whale, North Pacific right whale, killer whale (eastern North Pacific Gulf of Alaska/Aleutian Islands/Bering Sea Transient, eastern North Pacific Alaska Resident), sperm whale, and bowhead whale. The stock assessment reports for all stocks, however, are included in this document to provide a complete reference. Those sections of each stock assessment report containing significant changes are listed in Appendix Table 1. 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 are included in this NMFS Stock Assessment Report for your convenience.

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 Scientific Review Group members: Brendan Kelly (chair through 2004), Lance Barrett-Lennard, John Gauvin, Sue Hills (chair from 2004 to present), Charlie Johnson, Lloyd Lowry, 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.

CONTENTS

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).

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 were 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).

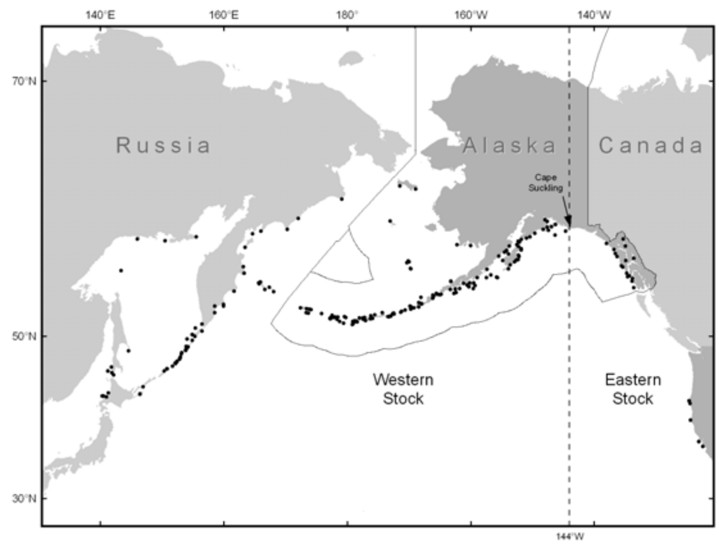

Figure 1. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (V. Burkanov, Natural Resources Consultants, Inc., pers. comm.) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997). Note: Haulouts and rookeries in British Columbia are not shown.

Steller sea lions that breed in Asia have been considered part of the western stock. While Steller sea lions seasonally inhabit coastal waters of Japan in the winter, breeding rookeries are currently only located in Russia (Burkanov and Loughlin, in press). Analyses of genetic data differ in their interpretation of separation between Asian and Alaskan sea lions. Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split that includes Commander Island (Russia) within the western U.S. stock. However, Hoffman et al. (2006) did not support this split based on analysis of nuclear microsatellite markers indicating high rates of male gene flow.

POPULATION SIZE

The most recent comprehensive estimate (pups and non-pups) of abundance of the western stock of Steller sea lions in Alaska is based on aerial surveys of non-pups in June 2004 (Fritz and Stinchcomb 2005) and aerial and ground-based pup counts in June and July of 2004 and 2005 (NMML unpublished data). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites. During the 2004 aerial survey, a total of 29,037 non-pups were counted at 262 rookeries and haulout sites; 13,892 in the Gulf of Alaska and 15,145 in the Bering Sea/Aleutian Islands (Fritz and Stinchcomb 2005). A composite pup count for 2004 and 2005 includes counts from 2 sites in 2004, and 57 sites in 2005. There were 4,518 pups counted in the Gulf of Alaska and 5,433 pups counted in the Bering Sea/Aleutian Islands for a total of 9,951 for the stock. Combining the pup count data from 2004-2005 (9,951) and non-pup count data from 2004 (29,037) results in a minimum abundance estimate of 38,988 Steller sea lions in the western U.S. stock in 2004-2005.

An estimate of the total population size of western Steller sea lion in Alaska may be obtained by multiplying the best estimate of total pup production (9,951) by 4.5 (Calkins and Pitcher 1982), which equals

44,780. This would not be a minimum abundance estimate since it is based on extrapolating total population size from pup counts based on survival and fecundity estimates in a life table. The 4.5 multiplier used for estimating the size of the eastern stock of Steller sea lions may not be appropriate for use in estimating the abundance of the western stock, as it is based on a life history table using age-specific fecundity and survival for the stable, mid-1970s population. The demographics of central Gulf of Alaska populations suggest that these rates have changed considerably since the mid-1970s (Holmes and York 2003).

Methods used to survey Steller sea lions in Russia differ from those used in Alaska, with less use of aerial photography and more use of skiff surveys and ground counts. Burkanov and Loughlin (in press) estimated the current (2005) population (pups and non-pups) of Steller sea lions breeding in Russia at about 16,000. This includes approximately 1,000 animals (674 non-pups and 236 pups counted in 2004) on the Commander Islands that are likely members of the same genetic stock as those breeding west of 144°W in Alaska (Baker et al. 2005).

Minimum Population Estimate

The 2004 count of non-pups (29,037) plus the number of pups in 2004-2005 (9,951) is 38,988, which will be used as the minimum population estimate (N_{MIN}) for the U.S. portion of the western stock of Steller sea lion (Wade and Angliss 1997). This is considered a minimum estimate because it has not been corrected to account for animals that 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 since the 1970s 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. Counts of Steller sea lions at trend sites for the western U. S. stock decreased 40% from 1991 to 2000 (Table 1), an average annual decline of 5.4% (Loughlin and York 2000).

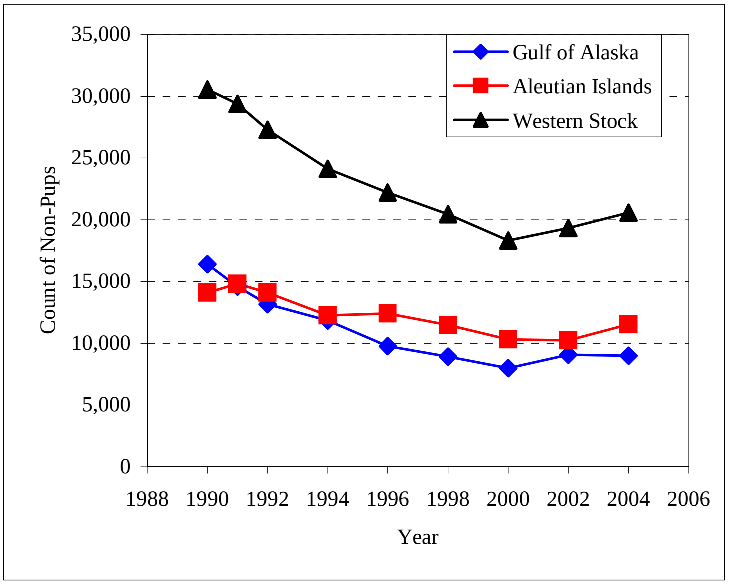

Figure 2. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U.S. stock, 1990-2004. Correction factor applied to 2004 count for film format differences (Fritz and Stinchcomb 2005).

Recently, counts of non-pup Steller sea lions at trend sites for the western U.S. stock increased 5.5% from 2000 to 2002, and at a similar rate between 2002 and 2004 (Table 1, Fig. 2). These were the first region-wide increases for the western stock since standardized surveys began in the 1970s. However, the 2004 count was still 7.4% below the 1996 count and 32.6% below the 1990 count. The long-term, average decline for 1991-04 is 3.1% per year (NMML unpublished data).

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 2004 (NMFS 1995, Sease et al. 2001, NMML unpublished data). Counts from 1976 to 1979 (NMFS 1995) were combined to produce complete regional counts that are comparable to the 1990-2004 data. The asterisk identifies 637 non-pups counted at six trend sites in 1999 in the eastern Gulf of Alaska which were not surveyed in 1998. 2004 data reflect a 3.5% reduction from actual counts to account for differences in survey protocol in 2004 relative to previous years. Actual 2004 trend site counts were: Gulf of Alaska – 9,332; Bering Sea/Aleutian Islands – 11,977; Total – 21,309.

Area	**late 1970s**	**1990**	**1991**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**
Gulf of Alaska	65,296	16,409	14,598	13,193	11,862	9,784	8,937*	7,995	9,087	9,005
Bering Sea/Aleutians	44,584	14,116	14,807	14,106	12,274	12.426	11,501	10,330	10,253	11,558
Total	109,880	30,525	29,405	27,299	24,136	22,210	20,438*	18,325	19,340	20,563

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 reauthorized 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 direct 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 U.S. portion of the western stock of Steller sea lions, PBR = 234 animals ($38{,}988 \times 0.06 \times 0.1$). When Steller sea lions on the Commander Islands are included, PBR = 239 animals ($39{,}898 \times 0.06 \times 0.1$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were six different federally regulated commercial fisheries in Alaska that could have interacted with Steller sea lions. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these 6 fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 1999-2003, there were incidental serious injuries and mortalities of western Steller sea lions in the following fisheries: Bering Sea/Aleutian Islands Atka mackerel trawl, Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Bering Sea/Aleutian Islands pollock trawl, Gulf of Alaska Pacific cod trawl, Gulf of Alaska pollock trawl, and Bering Sea/Aleutian Islands Pacific cod longline (Table 2). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006).

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). 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. It is not known whether these incidental mortality levels are representative of the current incidental mortality levels in these fisheries.

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000 in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and

3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly in review). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly in review). An observer program conducted for a portion of the Kodiak drift gillnet fishery in 2002 did not observe any serious injuries or mortalities of Steller sea lions, although Steller sea lions were frequently observed in the vicinity of the gear (Manly et al. 2003).

Combining the mortality estimates from the Bering Sea and Gulf of Alaska groundfish trawl and Gulf of Alaska longline fisheries presented above (9.7) 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 24.2 (CV = 0.60) sea lions per year from this stock (Table 2).

Table 2. Summary of incidental mortality of Steller sea lions (western U. S. stock) due to fisheries from 1990 through 2004 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2000 to 2004 (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. Details of how percent observer coverage is measured is included in Appendix 6. *Data from the 1999 Cook Inlet observer program are preliminary.

Fishery name	**Years**	**Data type**	**Observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Bering Sea/Aleutian Is. Atka mackerel trawl	2000 2001 2002 2003 2004	obs data	86.3 82.4 98.3 95.3 95.6	1 1 0 1 0	1.1 1.2 0 1.2 0	0.71 (CV = 0.23)
Bering Sea/Aleutian Is. flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	3 4 1 2 2	4.5 6.4 1.6 2.7 3.1	3.67 (CV = 0.17)
Bering Sea/Aleutian Is. Pacific cod trawl	2000 2001 2002 2003 2004	obs data	51.7 57.8 47.4 49.9 50.4	0 0 0 2 0	0 0 0 4.3 0	0.85 (CV = 0.73)
Bering Sea/Aleutian Is. pollock trawl	2000 2001 2002 2003 2004	obs data	76.2 79.0 80.0 82.2 81.2	2 2 3 0 1	3.6 3.3 3.4 0 1	2.26 (CV = 0.14)
Gulf of Alaska Pacific cod trawl	2000 2001 2002 2003 2004	obs data	13.5 20.3 23.2 27.3 27.0	0 1 0 0 0	0 4.7 0 0 0	0.94 (CV = 0.83)
Gulf of Alaska pollock trawl	2000 2001 2002 2003 2004	obs data	27.5 17.6 26.0 31.2 27.4	0 0 0 1 0	0 0 0 2.4 0	0.48 (CV = 0.96)
Bering Sea/Aleutian Is. Pacific cod longline	2000 2001 2002 2003 2004	obs data	35.2 29.5 29.6 29.9 23.8	0 0 1 0 0	0 0 3.7 0 0	0.74 (CV = 0.86)

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Prince William Sound salmon drift gillnet	1990-1991	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
Cook Inlet salmon set gillnet*	1999-2000	obs data	2-5%	0 0	0, 0	0
Cook Inlet salmon drift gillnet*	1999-2000	obs data	2-5%	0 0	0, 0	0
Kodiak Island salmon set gillnet	2002	obs data	6.0%	0	0	0
Observer program total						24.2 (CV = 0.60)
				Reported mortalities		
Alaska sport salmon troll (non-commercial)	93-03	strand	N/A	0, 0, 0, 0, 0, 1, N/A, N/A, N/A, 1, N/A	N/A	[0.2]
Miscellaneous fishing gear	99-03	strand	N/A	N/A, N/A, N/A, N/A, 1	N/A	[0.2]
Minimum total annual mortality						24.6 (CV = 0.60)

Reports from the NMFS stranding database 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 1999 to 2003, there was only one confirmed fishery-related Steller sea lion stranding in the range of the western stock. This sighting involved an animal at Round Island with netting or rope around its neck; no more specific information is available on the type of fishing gear involved. In addition to this incident, a Steller sea lion was entangled in a large flasher/spoon in 1998. It is likely that this injury occurred as a result of a sport fishery, not a commercial fishery (Table 2). There are sport fisheries for both salmon and shark in this area; there is no way to distinguish between them since both fisheries use a similar type of gear (J. Gauvin, Groundfish Forum, Inc., pers. comm.). Fishery-related strandings during 1999-03 result in an estimated annual mortality of 0.4 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 reported in the stranding database as shot are not included in this estimate, as they may result from animals struck and lost in the Alaska Native subsistence harvest.

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 U. S. commercial fisheries is 24.6 sea lions per year, based on observer data (24.2) and stranding data (0.4) where observer data were not available. No observers have been assigned to several fisheries that are known to interact with this stock making the estimated mortality a minimum estimate.

Subsistence/Native Harvest Information

Information on the subsistence harvest of Steller sea lions comes via two sources: the Alaska Department of Fish and Game (ADFG) and the Ecosystem Conservation Office (ECO) of the Aleut Community of St. Paul. The ADFG conducts systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the range of the Steller sea lion in Alaska (Wolfe et al. 2004). The interviews are conducted once per year in the winter (January to March), and cover hunter activities for the previous calendar year. The ECO collects data on the harvest in near real-time on St. Paul Island, and records hunter activities within 36 hours of the harvest (Zavadil et al. 2004). Information on subsistence harvest levels is provided in Table 3; data from ECO (e.g., Zavadil et al. 2004) are relied upon as the source of data for St. Paul Island and all other data are from the ADFG (e.g., Wolfe et al. 2004).

The mean annual subsistence take from this stock over the 5-year period from 2000-2004 was 191 Steller sea lions/year (Table 3).

Table 3. Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions, 2000-2004. Sources: All areas except St. Paul: Wolfe et al. 2002, Wolfe et al. 2003, J. Fall, ADFG, pers comm. St. Paul: Lestenkof et al. 2003, Zavadil et al. 2003, Zavadil et al. 2004, P. Zavadil, Aleut Community of St. Paul Island, Tribal Government, Ecosystem Conservation Office, pers. comm.

Year	Number harvested	Number struck and lost	Total	Number harvested + struck and lost	Total take
2000	127	18.3	145.3	23	168
2001	144.1	30.2	174.3	24	198
2002	118.9	22.9	141.8	36	178
2003	149.7	36.9	186.6	18	205
2004	136.8	49.1	185.9	18	204
Mean annual take (2000-2004)					191

Other Mortality

Illegal 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 for subsistence take by Alaska Natives or where imminently necessary to protect human life). Records from NMFS enforcement indicate that there were two cases of illegal shootings of Steller sea lions in the Kodiak area in 1998, both of which were successfully prosecuted (NMFS, Alaska Enforcement Division). There have been no cases of successfully prosecuted illegal shootings between 1999 and 2003 (NMFS, Alaska Enforcement Division).

STATUS OF STOCK

The current annual level of incidental U. S. commercial fishery-related mortality (24.6) 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 (24.6 + 191 = 215.6) is below the PBR level (234) for this stock. The western U. S. stock of Steller sea lion is 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, if in fact the population is still declining.

A number of management actions were implemented between 1990 and 1998 to promote the recovery of the western U. S. stock of Steller sea lions, including 3 nautical mile (nmi) no-entry zones around rookeries, prohibition of groundfish trawling within 10-20 nmi of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock and Aleutian Island Atka mackerel total allowable catch. Recent modifications finalized in 2002 involve a complex set of regulations that changed the temporal and spatial distribution of the pollock, Pacific cod and Atka mackerel fisheries throughout the range of the western stock in U.S waters. These measures were reviewed by NMFS (2003).

Habitat Concerns

The unprecedented decline in the western U. S. stock of Steller sea lion caused a change in the listing status of the stock from "threatened" to" endangered" under the U. S. Endangered Species Act of 1973. Survey data collected since 2000 suggest that the decline has slowed or stopped in most of the range of the western U. S. stock. Many factors have been suggested as causes of the decline, (e.g., overfishing, environmental change, disease, killer whale predation.) but it is not clear which single or combination of factors are most important in causing the decline. However, nutritional stress related to competition with commercial fisheries is a hypothesis currently receiving serious attention.

NMFS developed a Biological Opinion (BO) on the groundfish fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska regions in 2000. In this BO, NMFS determined that the continued prosecution of the groundfish fisheries as described in the Fishery Management Plan for Bering Sea/Aleutian Islands Groundfish and in the Fishery Management Plan for Gulf of Alaska Groundfish is likely to jeopardize the continued existence of the western population of Steller sea lion and to adversely modify critical habitat. NMFS also identified several other factors that could contribute to the decline of the population, including a shift in a large-scale weather regime and predation. To avoid jeopardy, NMFS identified a Reasonable and Prudent Alternative that included components such as 1) adoption of a more precautionary rule for setting "global" harvest limits, 2) extension of 3 nmi protective zones around rookeries and haulouts not currently protected, 3) closures of many areas around rookeries and haulouts to 20 nmi, 4) establishment of 4 seasonal catch limits inside critical habitat and two seasonal releases outside of critical habitat, and 5) establishment of a procedure for setting limits on removal levels in critical habitat based on the biomass of target species in critical habitat.

NMFS completed a draft Supplemental Environmental Impact Statement (SEIS) in September 2000 for the groundfish fisheries in the Bering Sea Aleutian Islands and the Gulf of Alaska. Based on the potential for indirect interactions between the groundfish fisheries and Steller sea lions, northern fur seals, and harbor seals, NMFS 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". However, the SEIS was determined to be incomplete in a Federal District Court ruling and remanded back to NMFS for further development.

In 2001, NMFS developed another SEIS to consider the impacts on Steller sea lions of different management regimes for the Alaska groundfish fisheries. A committee composed of 21 members from fishing groups, processor groups, Alaska communities, environmental advocacy groups, and NMFS representatives met to recommend conservation measures for Steller sea lions and to develop a "preferred alternative" for the SEIS. Although consensus was not reached, a "preferred alternative" was identified and included in the SEIS. The preferred alternative included complicated, area-specific management measures (e.g., area restrictions and closures) designed to reduce direct and indirect interactions between the groundfish fisheries and Steller sea lions, particularly in waters within 10 nmi of haulouts and rookeries. The suite of conservation measures actually implemented in 2002 were developed after working with the: 1) State of Alaska to explore whether there are potential adverse effects of state fisheries on Steller sea lions, and 2) the North Pacific Fishery Management Council to further minimize overcapitalization of fisheries and concentration of fisheries in time and space. A draft Recovery Plan reviewing current threats to the eastern and western U.S. stocks and proposing actions and guidelines for recovery was released by NMFS in May 2006 (NMFS 2006). Responses to public comments were being considered in late 2006.

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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).

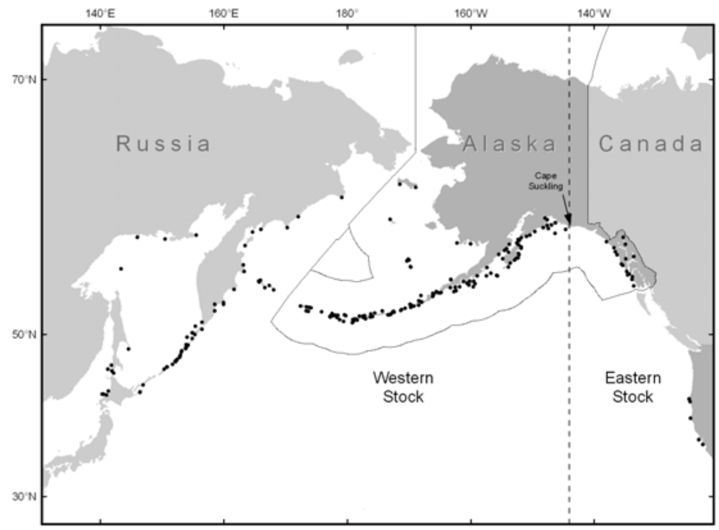

Figure 3. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (V. Burkanov, Natural Resources Consultants, Inc., pers. comm.) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997). Note: Haulouts and rookeries in British Columbia are not shown.

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 were 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).

Steller sea lions that breed in Asia have been considered part of the western stock. While Steller sea lions seasonally inhabit coastal waters of Japan in the winter, breeding rookeries are currently only located in Russia (Burkanov and Loughlin, in press). Analyses of genetic data differ in their interpretation of separation between Asian and Alaska sea lions. Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split that includes Commander Island (Russia) within the western U.S. stock. However, Hoffman et al. (2006) did not support this split based on analysis of nuclear microsatellite markers indicating high rates of male gene flow.

POPULATION SIZE

The eastern stock of Steller sea lions breeds on rookeries located in southeast Alaska, British Columbia, Oregon, and California; there are no rookeries located in Washington. Counts of pups on rookeries conducted near the end of the birthing season are nearly complete counts of pup production. Calkins and Pitcher (1982) concluded that the total Steller sea lion population could be estimated by multiplying the pup counts by a factor of 4.5, which was based on the birth rate, and the sex and age structure of the western Steller sea lion population in the central Gulf of Alaska. Using the most recent 2005 pup counts available by region from aerial surveys across the range of the eastern stock, the total population of the eastern stock of Steller sea lions is estimated to be 47,885. This is based on multiplying the total number of pups counted in southeast Alaska (5,519 in 2005; includes 9 from 3 sites surveyed in 2002; NMFS unpublished data), British Columbia (3,281 in 2002; Pitcher, ADFG, unpublished data), Oregon (1,128 in 2002; Pitcher, ADFG, unpublished data), and California (713 in 2002; Pitcher, ADFG, unpublished data) by 4.5. This is not a minimum population estimate, since it is extrapolated from pup counts from photographs taken in 2002, and demographic parameters of a stable non-pup population that were estimated for the western Steller sea lion in the mid-1970s (Calkins and Pitcher 1982).

Because the eastern stock is increasing within most of its range, using the 4.5 multiplier is a reasonable approach to estimating abundance from pup counts.

Minimum Population Estimate

The minimum population estimate will be calculated by adding non-pup counts from 2005 (not trend counts) from Southeast Alaska (15,283), 1996 from WA/OR/CA (6,555), Canada counts from 2002 (12,121), and pup counts from throughout the range from 2002 and 2005 (10,641), which results in an N_{MIN} for the eastern U. S. stock of Steller sea lions of 44,555. This count has not been corrected for animals which were at sea.

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 3,648 in 2001 (Brown and Reimer 1992; Brown et al. 2002).

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 and 2,000 non-pups during 1980-2001. Limited information suggests that counts in northern California appear to be stable (NMFS 1995). At Año Nuevo Island off 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, NMFS-SWFSC, pers. comm.). The most recent pup counts at Año Nuevo and the Farallones are 349 in 2000 and 287 in 2001 (M. Lowry, NMFS-SWFSC, pers. comm.). Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable since the 1980s (Table 4, Fig. 4).

In Southeast Alaska, counts (no correction factors applied) of non-pups at trend sites increased by 56% from 1979-2002 from 6,376 to 9,951 (Merrick et al. 1992; Sease et al. 2001; K. Pitcher, ADFG, pers. comm.). From 1979-2005, counts of pups on the three largest rookeries in Southeast Alaska more than doubled from 2,219 to 5,235, an increase of 136%. In British Columbia, counts of non-pups throughout the Province increased at a rate of 4.9% annually during 1982-2005 (Table 4, Fig. 4; Olesiuk and Trites 2003). Counts of non-pups at trend sites throughout the range of the eastern Steller sea lion stock are shown in Figure 4.

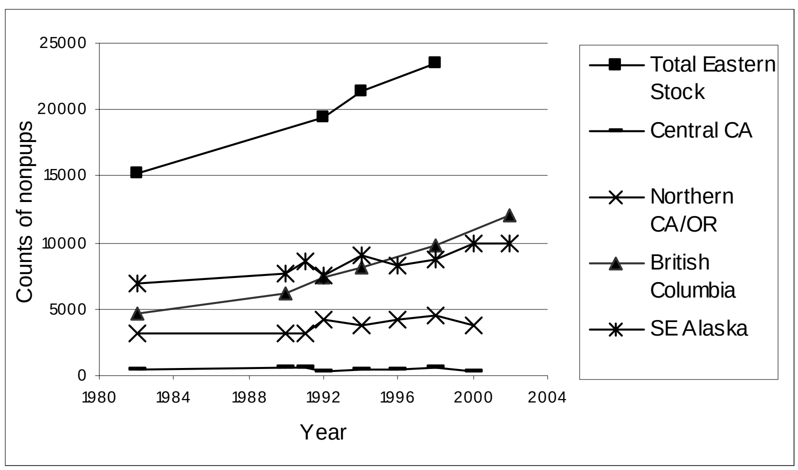

Figure 4. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U.S. stock, 1982-2003. Data from British Columbia include all sites.

Table 4. 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 2002 (NMFS 1995; Strick et al. 1997; Sease et al. 1999; Sease and Loughlin 1999; Sease et al. 2001; Olesiuk 2003; Brown et al. 2002; NMFS unpubl. data; 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 Islands. 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**	**2000**	**2002**
Central CA	511[1]	655	537	276	508	382	564[3]	349	380
Northern CA/OR	3,094	3,088	3,180	4,274	3,831	4,192	4,464	3,793	4,885
British Columbia	4,713	6,109[2]	--	7,376	8,091	--	9,818	--	12,121
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,892	9,951
Total	15,216	17,481	--	19,481	21,431	--	23,539	--	27,337

[1] This count includes a 1983 count from Año Nuevo. [2] This count was conducted in 1987. [3] This count was conducted in 1999.

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 reauthorized 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 = 2,000 animals ($44,555 \times 0.06 \times 0.75$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were six different federally regulated commercial fisheries in Alaska that could have interacted with Steller sea lions and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these 6 fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska.

Fishery observers monitored four commercial fisheries during the period from 1990 to 2003 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, Northern Washington (WA) marine set gillnet, and Gulf of Alaska sablefish longline fisheries. The best data available on the rates of serious injury and mortality incidental to these fisheries is presented in Table 5 (Perez 2006). There have been no observed serious injuries or mortalities incidental to the CA/OR thresher shark and swordfish drift gillnet fishery in recent years (Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). In the WA/OR/CA groundfish trawl (Pacific whiting component only) one Steller sea lion was observed killed in each year in 2001-03; these observed takes in combination with a mortality that occurred in an unmonitored haul resulted in a mean estimated annual mortality level of 0.8 (Table 5). No data are available after 1998 for the northern Washington marine set gillnet fishery. One Steller sea lion mortality was observed in the Gulf of Alaska sablefish longline in 2000. These mortalities result in a mean annual mortality rate of 2.17 (CV = 0.58) Steller sea lions. 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 5. Summary of incidental mortality of Steller sea lions (eastern U. S. stock) due to commercial fisheries from 1992 to 2004 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2000 to 2004 (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. Details of how percent observer coverage is measured is included in Appendix 6. * indicates a mortality seen by an observer, but during an unmonitored haul; because the haul was not monitored, no extrapolation can be done. ** Aquaculture facilities are no longer permitted to shoot Steller sea lions.

Fishery name	**Years**	**Data type**	**Observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Gulf of Alaska sablefish longline	2000 2001 2002 2003 2004	Obs data	6.0 5.9 6.1 4.1 4.9	1 0 0 0 0	6.9 0 0 0 0	1.37 (CV = 0.92)
WA/OR/CA groundfish trawl (Pacific whiting component)	2000 2001 2002 2003 2004	Obs data	80.3 96.2 66.8 85.5 91.5	0 1 1 1 0	1* 1 1 1 0	0.8 (CV = 0.02)
Northern WA marine set gillnet (tribal fishery)	1999-2003	Obs data		0	0	0
Observer program total						2.17 (CV = 0.58)
				Reported mortalities		
Alaska salmon troll	1992-2003	Strand data	N/A	0, 0, 0, 1, 0, 0, N/A, N/A, 1, 1, N/A, N/A	N/A	[0.4]
British Columbia aquaculture predator control program	2000 2001 2002 2003 2004	Permit reports	N/A	50 27 15 N/A** N/A**	N/A	0
Minimum total annual mortality						2.57 (CV = 0.58)

Strandings of Steller sea lions provide additional information on the level of fishery-related mortality. Estimates of fishery-related mortality from stranding data are considered minimum estimates because not all entangled animals strand, and not all stranded animals are found or reported. In Alaska, during the 5-year period from 1999-2003, there were two situations where a flasher was seen in a Steller sea lion's mouth and one situation where line was hanging from an animal's mouth (NMFS Alaska Region, unpublished data). It is not clear whether entanglements with "flashers" involved the recreational or commercial component of the salmon troll fishery. Based on Angliss and DeMaster (1998), it is appropriate to call these entanglements "serious injuries". Based on Alaska stranding records, this information indicates a rate of incidental mortality of at least 0.4/year from the troll fishery. There were no fishery-related strandings of Steller sea lions in Washington, Oregon, or California between 1999 and 2003.

Due to limited observer program coverage, no data exist on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to take Steller sea lions). As a result, the number of Steller sea lions taken in Canadian waters is not known.

The minimum estimated mortality rate incidental to commercial fisheries (both U.S. and Canadian) is 2.6 sea lions per year, based on observer data (2.17) and stranding data (0.4).

Subsistence/Native Harvest Information

The subsistence harvest of Steller sea lions during 2000-2004 is summarized in Wolfe et al. (2004). During 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. Approximately 16 of the interviewed communities lie within the range of the eastern U.S. stock. The average number of animals harvested and struck but lost is 6 animals/year (Table 6).

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.

Table 6. Summary of the subsistence harvest data for the eastern stock of Steller sea lions, 2000-2004 (Wolfe et al. 2004, J. Fall, pers. comm.). The number harvested and number struck and lost do not sum to the estimated number taken due to rounding error.

Year	Estimated total number taken	Number harvested	Number struck and lost
2000	2	2	0
2001	0	0	0
2002	7	7	0
2003	7	2	4
2004	12	5	7
Mean annual take (2000-2004)	6	3	2

Other Mortality

Illegal shooting of sea lions in U.S. waters 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 for subsistence hunting by Alaska Natives or where imminently necessary to protect human life). Records from NMFS enforcement indicate that there were two cases of illegal shootings of Steller sea lions in Southeast Alaska between 1995 and 1999: the cases involved the illegal shooting of one Steller sea lion near Sitka, and three Steller sea lions in Petersburg. Both cases were successfully prosecuted (NMFS, Alaska Enforcement Division). There are no records of illegal shooting of Steller sea lions from the eastern stock listed in the NMFS enforcement records for 1999-2003 (NMFS, unpublished data).

Steller sea lions were taken in British Columbia during commercial salmon farming operations (Table 5). Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 45.75 Steller sea lions from this stock over the period from 1999 to 2003 (Olesiuk 2004). As of 2004, aquaculture facilities are no longer permitted to shoot Steller sea lions (P. Olesiuk, Pacific Biological Station, Canada, pers. comm.).

Strandings of Steller sea lions with gunshot wounds do occur, along with strandings of animals entangled in material that is not fishery-related. During the period from 1999 to 2003 strandings of animals with gunshot wounds from this stock occurred in Oregon and Washington (two animals in 1999) resulting in an estimated annual mortality of 0.4 Steller sea lions from this stock. 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 in the above estimates because it is not possible to tell whether the animal was illegally shot or if the animal was struck and lost by subsistence hunters (in which case the mortality would have been legal and accounted for in the subsistence harvest estimate).

Stranding data may also provide information on additional sources of potential human-related mortality. In 2000, three Steller sea lions were sighted entangled in some kind of rope or line that was not necessarily related to a commercial or recreational fishery and one animal was seen entangled in a tire. All of these animals were alive when sighted; the animal entangled in the tire was successfully released. In 2001, one Steller sea lion was observed with a propeller or head injury. In 2003, one Steller sea lion was observed with a piece of cargo net around its neck. If the number of interactions (6) is averaged over 5 years, the "other" interaction rate would be a minimum of 1.2 animals per year.

STATUS OF STOCK

Based on currently available data, the minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock (2.17 + 0.4 = 2.57) is less than that 10% of the calculated PBR (200) 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 (2.57 + 6+ 0.4 + 1.2 = 10.2) does not exceed the PBR (2000) 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. The eastern U. S. stock is stable or increasing throughout 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; Fig. 4), where habitat concerns include reduced prey availability, contaminants, and disease (Sydeman and Allen 1997). A draft Recovery Plan reviewing current threats to the eastern and western U.S. stocks and proposing actions and guidelines for recovery was released by NMFS in May 2006 (NMFS 2006). Responses to public comments were being considered in late 2006.

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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 summer breeding season, most of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals on rookeries in Russia, on Bogoslof Island in the southern Bering Sea, and on San Miguel Island off southern California (Lander and Kajimura 1982; 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).

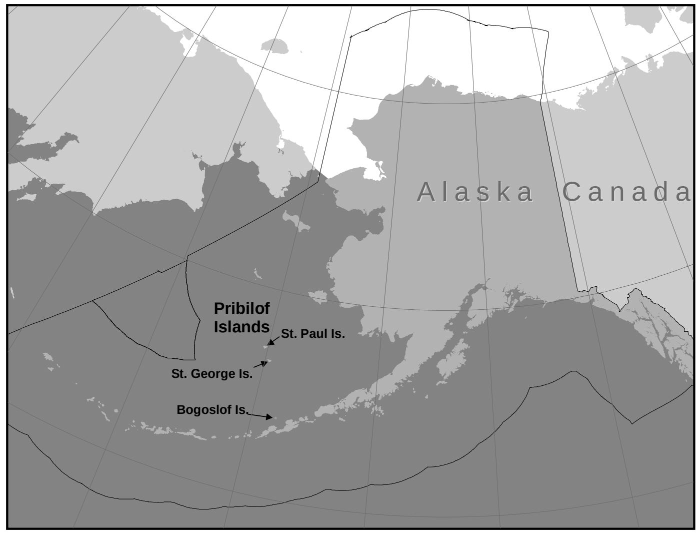

Figure 5. Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

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 (Ream et al. 2005). 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 in the eastern North Pacific (Kajimura 1984) and the Kuril Islands in the western North Pacific (Loughlin et al. 1999). 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 (Baker et al. 1995; 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: little evidence of genetic differentiation among breeding islands in the Bering Sea (Ream 2002). 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 4.5. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. 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 have been made on Bogoslof Island. Since 1990, pup counts have occurred biennially on St. Paul and St. George Islands, although less frequently on Sea Lion Rock and Bogoslof Island (Table 7). The most recent estimate for the number of fur seals in the Eastern Pacific stock, based on pup counts from 2002 on Sea Lion Rock, from 2004 on the Pribilof Islands, and from 2005 on Bogoslof Island, is 721,935 ($4.5 \times 160{,}430$).

Table 7. Estimates and/or counts of northern fur seal pups born on the Pribilof Islands and Bogoslof Island. Standard errors and the CV for haulout locations and the total abundance estimate, respectively, are provided in parentheses.

Year	Haulout location				Total
	St. Paul	Sea Lion Rock	St. George	Bogoslof	
1992*	182,437 (8,919)	10,217 (568)	25,160 (707)	898 (N/A)	218,712 (0.041)
1994	192,104 (8,180)	12,891 (989)	22,244 (410)	1,472 (N/A)	228,711 (0.036)
1996	170,125 (21,244)	"	27,385 (294)	1,272 (N/A)	211,673 (0.10)
1998	179,149 (6,193)	"	22,090 (222)	5,096 (33)	219,226 (0.029)
2000	158,736 (17,284)	"	20,176 (271)	"	196,899 (0.089)
2002	145,716 (1,629)	8,098 (191)	17,593 (527)	"	176,503 (0.01)
2004	122,825 (1,290)	"	16,876 (415)	"	152,895 (0.01)
2005	"	"	"	12,631 (335)	160,430 (0.01)

*Incorporates the 1990 estimate for Sea Lion Rock and the 1993 count for Bogoslof Island

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 721,935 and the default CV (0.2), N_{MIN} for the Eastern Pacific stock of northern fur seals is 709,881. This estimate includes the first pup counts on Bogoslof Island in more than 5 years, and does not indicate an abundance increase.

Current Population Trend

The Alaska population of northern fur seals increased 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 remained relatively stable between 1981 and 1996 (Fig. 6; York and Fowler 1992). There has been a decline in pup production on St. Paul Island since the mid-1990s. Although there was a slight increase in the number of pups born on St. George Island in 1996, the number of pups born declined between 1996 and 1998, and the 1998 counts were similar to those obtained in 1990, 1992, and 1994 (Fig. 7). During 1998-2004, pup production declined 6.2% per year (SE = 0.78%; P = 0.01) on St. Paul Island and 4.5% per year (SE = 0.45%; P = 0.01) on St. George Island (NMML unpublished data). The estimated pup production in 2004 was below the 1919 level on St. Paul Island and below the 1916 level on St. George Island.

The northern fur seal was designated as "depleted" under the Marine Mammal Protection Act (MMPA) in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s (1.8 million animals; 53 FR 17888, 18 May 1988) and there was no compelling evidence that carrying capacity (K) had changed substantially since the late 1950s (NMFS 1993). Under the 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; 1,080,000).

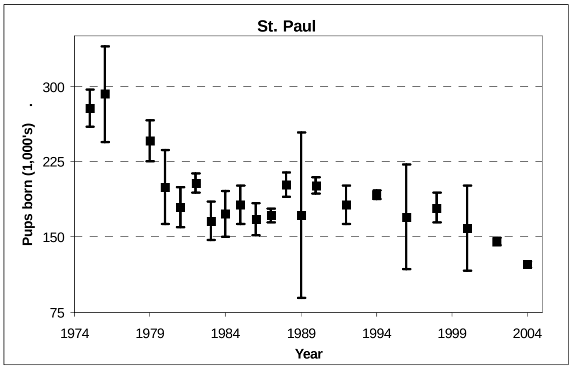

Figure 6. Estimated number of northern fur seal pups born on St. Paul Island, 1970-2004.

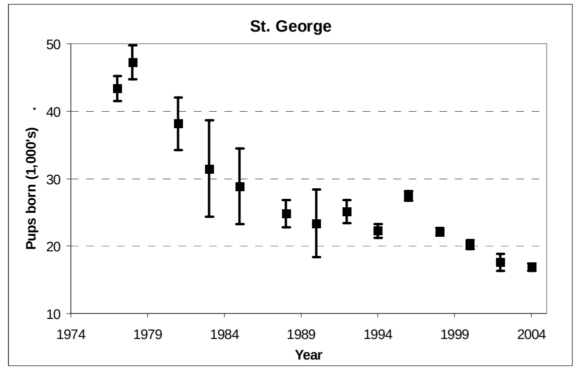

Figure 7. Estimated number of northern fur seal pups born on St. George Island, 1970-2004.

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 reauthorized 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 = 15,262 animals (709,881 × 0.043 × 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, although some low level of illegal fishing may still be occurring. 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, NMFS-NMML, pers. comm.).

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with northern fur seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). The only federally observed fishery in which incidental mortality occurred was the Bering Sea and Aleutian Islands flatfish trawl (Table 8, with a mean annual (total) mortality of 0.48; Perez 2006).

Observer programs for five Alaska commercial fisheries have not documented any takes of fur seals. 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). Observer programs have recently been implemented in the Cook Inlet salmon set and drift gillnet fisheries (Manly in review) and in a portion of the Kodiak drift gillnet fishery (Manly et al. 2003). Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and 3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly in review). Observer coverage in the Kodiak drift gillnet fishery was 7.5% of the fishing permit days. No serious injuries or mortalities of northern fur seals were observed during the course of either observer program.

Table 8. Summary of incidental mortality of northern fur seals (Eastern Pacific stock) due to commercial fisheries from 2000 through 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Islands flatfish trawl	2000	obs data	64.5	0	1	0.48 (CV = 0.53)
	2001		57.6	1	1	
	2002		58.4	0	0	
	2003		64.1	0	0	
	2004		64.3	0	0	
Minimum total annual mortality						0.48 (CV = 0.53)

There are several fisheries which are known to interact with northern fur seals and have not been observed (Appendices 4 and 5). Thus, the estimated mortality rate is likely a minimum estimate. 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 0.5 fur seals per year based on observer data.

Entanglement studies on the Pribilof Islands are another source of information on fishery-specific entanglements. Based on entanglement rates and sample sizes presented in Zavadil et al. (2003), an average of 1.1 fur seals/year on the rookeries were entangled in pieces of trawl netting and an average of 0.1 fur seal/year was entangled in monofilament net.

Anecdotal reports of northern fur 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 1998 to 2002 the only fishery-related northern fur seal stranding was reported in September 2001 near Unalaska as entangled in 8-inch poly trawl web. The animal was cut free and was apparently healthy. The NMFS stranding database includes reports of five fur seals on St. George that were entangled in fishing gear in 2003; including these animals in an annual average will be delayed until comparisons between these data and those from entanglement studies (e.g., Zavadil et al. 2003) can be cross-referenced.

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. Typically, 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. However, occasional harvest of adult males does occur: in 2004, there were two adult male northern fur seals that were struck but lost, and one was killed (Malavansky et al. 2005). A few females were taken in 1996, 1997, and 1998, but no females are known to have been taken since the late 1990s (Alaska Regional Office 2005). 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). Between 2000 and 2004, there was an annual average of 754 seals harvested per year in the subsistence hunt (Table 9).

Table 9. Summary of the Alaska Native subsistence harvest of northern fur seals on St. Paul and St. George Islands St. Paul data provided in Lestenkof and Zavadil 2001, Zavadil et al. 2003, and Malavansky et al. 2005; St. George data provided by NMFS (D. Cormany, NMFS, pers. comm.)

Year	St. Paul	St. George	Total harvested
2000	747	121	868
2001	597	184	781
2002	648	203	851
2003	522	132	654
2004	493	123	616
Mean annual take (2000-2004)			754

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 for subsistence hunting by Alaska Natives or 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, Fowler 2002). 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). Between 1995 and 2000, responsibility for entanglement studies of northern fur seals shifted gradually from NMML to the Tribal Government of St. Paul's Ecosystem Conservation Office (ECO). ECO has managed the entanglement studies under a co-management agreement with NOAA for northern fur seals since 2000. Entanglement rates of male northern fur seals on St. Paul from 1998 to 2002 were 0.2, 0.26, 0.25, 0.3, and 0.37 (Zavadil et al. 2003). The recent rates of entanglements are close to those recorded in the mid-1980s; however, recent changes in methodology (counting juvenile males vs. all males) make direct comparisons between recent and historical data difficult (Zavadil et al. 2003). In 2002, the composition of entangling debris switched from predominantly packing bands to trawl net fragments (Zavadil et al. 2003).

STATUS OF STOCK

Based on currently available data, the minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock (0.5) is less than 10% of the calculated PBR (1526) 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 (0.5 + 754 + 1.2 = 756) is not known to exceed the PBR (15,262) for this 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. The Eastern Pacific stock of northern fur seal is classified as a strategic stock because it is designated as "depleted" under the MMPA.

Habitat Concerns

Northern fur seals forage on a variety of fish species, including pollock (34% of fish species consumed between 1958 and 1974; Perez 1997). As of the 1990s, some prey items, such as capelin, have disappeared entirely from fur seal diet and pollock consumption has tripled (Sinclair et al. 1994, Sinclair et al. 1996, Antonelis et al. 1997). Fishing effort displaced by Steller sea lion protection measures may have moved to areas important to fur seals; recent tagging studies have shown that lactating female fur seals from St. Paul and St. George Islands forage in specific and very different areas (Robson et al. 2004). Relative rates of pollock harvest (catch divided by estimated biomass) by fisheries were approximately five times greater in St. George than St. Paul female foraging areas in summer from 1982 to 2002 (Robson and Fritz in review). At the same time, pup production declined on St. George and St. Paul Islands (Figs. 6 and 7). However, it remains unclear whether the pattern of declines in northern fur seal pup production on the two Pribilof Islands is related to the relative distribution of pollock fishery effort in summer on the eastern Bering Sea shelf.

There is concern that a variety of human activities other than commercial fishing may impact northern fur seals. These activities will be identified in a conservation plan that is currently being developed by NMFS and research projects to address the levels of impact will be recommended in that document.

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

NOTE - January 2006: NMFS has new genetic information on harbor seals in Alaska which indicates that the current division of Alaskan harbor seals into the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks needs to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2006. In the interim, new information on harbor seal abundance, mortality levels, and trends is provided within this report. A complete revision of the harbor seal stock assessments will be postponed until new stocks are defined.

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 (Swain et al. 1996, Lowry et al. 2001, Small et al. 2001). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2001). 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).

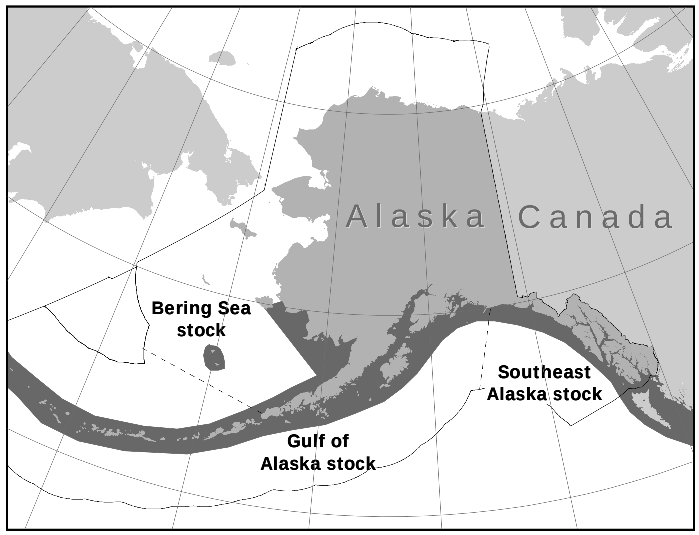

Figure 8. Approximate distribution of harbor seals in Alaska waters (shaded area).

Westlake and O'Corry-Crowe's (2002) analysis of genetic information revealed population subdivisions on a scale of 600-820 km. These results suggest that genetic differences within Alaska, and most likely over their entire North Pacific range, increase with increasing geographic distance. New information revealed substantial genetic differences indicating that female dispersal occurs at region specific spatial scales of 150-540 km. This research identified 12 demographically independent clusters within the range of Alaskan harbor seals; however additional research is required as unsampled areas within the Alaskan harbor seal range remain (O'Corry-Crowe et al. 2003).

The Alaska SRG concluded in 1996 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 what was believed in the early 1990s to be a 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

A comprehensive aerial survey of harbor seals in Southeast Alaska was conducted during the autumn molt in 1993. Eleven separate areas were surveyed 5-9 times each. The sum of all mean counts was 21,523 with a combined CV = 0.026 (Loughlin 1994). 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). Using this correction factor resulted in an abundance estimate of 37,450 (21,523 × 1.74; CV = 0.073) for the Southeast Alaska stock of harbor seals.

Between 1996 and 2000 the National Marine Mammal Laboratory (Alaska Fisheries Science Center) conducted aerial surveys of harbor seals across the entire range of harbor seals in Alaska. Each of five survey regions was surveyed, with one region surveyed per year. To derive an accurate estimate of population size from these surveys, a method was developed to address the influence of external conditions on the number of seals hauled out on shore, and counted, during the surveys. Many factors influence the propensity of seals to haul out, including tides, weather, time of day, and date in the seals' annual life history cycle. A statistical model defining the relationship between these factors and the number of seals hauled out was developed for each survey region. Based on those models, the survey counts for each year were adjusted to the number of seals that would have been ashore during a hypothetical survey conducted under ideal conditions for hauling out (Boveng et al. 2003). In a separate analysis of radio-tagged seals, a similar statistical model was used to estimate the proportion of seals that were hauled out under those ideal conditions (Simpkins et al. 2003). The results from these two analyses were combined for each region to estimate the population size of harbor seals in Alaska.

The current statewide abundance estimate for Alaskan harbor seals is 180,017 (CV = 0.03 NMFS, unpublished data). This estimate is based on 1996-2000 surveys that had incomplete coverage of terrestrial sites in Prince William Sound and of glacial sites in the Gulf of Alaska and the Southeast Alaska regions. Those problems have been addressed in the current survey (2001-2005). Prince William Sound was surveyed completely in 2001, and new methods have been developed and used for surveying glacial sites in 2001-2002. Analyses are currently underway, and a manuscript describing the regional and statewide population estimates is in preparation; the analytical methods are described in Boveng et al. (2003) and Simpkins et al. (2003) and have been presented at the 14th Biennial Conference on the Biology of Marine Mammals. The current abundance estimate for the SE Alaska stock (112,391; CV=0.04) was calculated from northern southeast Alaska surveys (32,454; 27,090 × 1.198; CV = 0.06) in 1997 and southern southeast Alaska surveys (79,937; 66,725 × 1.198; CV = 0.05) in 1998 (NMFS, unpublished data).

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 112,391 and its associated CV(N) of 0.04, N_{MIN} for this stock of harbor seals is 108,670.

Current Population Trend

Population trend data have been collected in the vicinity of Sitka and Ketchikan since 1983. Based on counts near Ketchikan, abundance has increased 7.4% annually (95% CI: 6.1-8.7) from 1983 to 1998, but at a lower rate of 5.6% during the latter portion between 1994 and 1998 (Small et al. 2003). Counts near Sitka failed to show a significant trend either between 1984 and 2001 or 1995 and 2001 (Small et al. 2003). It should be emphasized that these data are from selected 'trend' sites and not complete census surveys. Further, both of these trend routes are for terrestrial haulouts, which may not be representative of animals that use glacial haulouts. Alaska Natives who hunt for seals in Yakutat Bay believe the local harbor seal population has declined over the past 10-15 years, as determined by less successful hunting trips over time (Yakutat Tlingit Tribe, pers. comm., cited in Jansen et al. 2006).

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. New information from Glacier Bay indicates a sharp overall decline of 63-75% in harbor seal abundance from 1992 to 2002; the cause of the decline is unknown (Mathews and Pendleton 2006). Results from the Sitka (stable), Ketchikan (increasing), and Glacier Bay (decreasing) trend analyses, and observations about a possibly declining local population in Yakutat Bay provide an uncertain basis for inferring trends in the Southeast Alaska stock as a whole.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Southeast Alaska harbor seal stock. A population growth rate of 7.4% was observed in Ketchikan between 1983 and 1998 (Small et al. 2003). 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 reauthorized 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 this stock of harbor seals, PBR = 3,260 animals (108,670 $\times$ 0.06 $\times$ 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The previous stock assessment for harbor seals indicated that there were three observed commercial fisheries that operated within the range of the Southeast Alaska stock of harbor seals. As of 2003, changes in how fisheries are defined in the List of Fisheries have resulted in separating these fisheries into nine fisheries based on both gear type and target species (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. During the 5-year period from 2000 to 2004 there were no observed incidental takes in any of these fisheries (Perez 2006).

The estimated minimum annual mortality rate incidental to commercial fisheries is 0. 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 known to interact with this stock. The Southeast Alaska drift gillnet fishery is scheduled to be observed in 2007 and 2008, funds permitting.

Subsistence/Native Harvest Information

The Alaska Native subsistence harvest of harbor seals has been estimated by the Alaska Native Harbor Seal Commission (ANHSC) and the Alaska Department of Fish and Game (ADFG). The previous stock assessment reported that the estimated average harvest of the Southeast Alaska stock of harbor seals for 1994-1996 was 1,749 animals per year (including struck and lost). Recent information from the ANHSC and ADFG indicates the average harvest level from 2000 to 2004, including struck and lost, was 1,092 harbor seals per year (Table 10).

Table 10. Summary of the subsistence harvest data for the Southeast Alaska stock of harbor seals, 2000-2004. Data are from Wolfe et al. 2004; J. Fall, ADFG, pers. comm.

Year	Estimated total number taken	Number harvested	Number struck and lost
2000	1,361	1,210	151
2001	1,176	1,020	156
2002	1,007	877	129
2003	1,069	945	124
2004	845	743	102

Year	Estimated total number taken	Number harvested	Number struck and lost
Mean annual harvest (2000-2004)	1,092	959	132

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). The Alaska Region stranding records from 1998 to 2002 documents five reports of stranded harbor seals that had been shot, for an average of 1 per year over 5 years. It is not known whether these animals were killed illegally or if they were stuck but lost in the subsistence harvest. Because the reason for the shooting is not known, these animals are added to the total number of human-related mortalities.

The Alaska Region stranding records document one Southeast Alaska harbor seal was killed by a vessel collision between 1998 and 2002. One Southeast Alaska harbor seal was entangled in a non-commercial hatchery seine net and released without injury.

STATUS OF STOCK

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. At present, annual U.S. commercial fishery-related mortality levels less than 326 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. 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. Based on the best scientific information available, the estimated annual level of total human-caused mortality (1,092 + 0.2 + 1 = 1,094) is not known to exceed the PBR (3,260) for this stock. Therefore, the Southeast Alaska 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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HARBOR SEAL (*Phoca vitulina richardsi*): Gulf of Alaska Stock

NOTE - January 2006: NMFS has new genetic information on harbor seals in Alaska which indicates that the current division of Alaskan harbor seals into the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks needs to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2006. In the interim, new information on harbor seal abundance, mortality levels, and trends is provided within this report. A complete revision of the harbor seal stock assessments will be postponed until new stocks are defined.

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 northward 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 (Swain et al. 1996, Lowry et al. 2001, Small et al. 2001). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2001). 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).

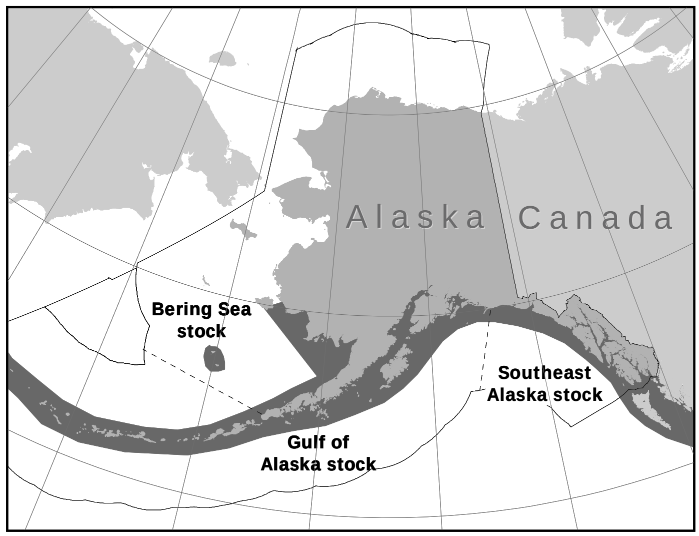

Figure 9. Approximate distribution of harbor seals in Alaska waters (shaded area).

Westlake and O'Corry-Crowe's (2002) analysis of genetic information revealed population subdivisions on a scale of 600-820 km. These results suggest that genetic differences within Alaska, and most likely over their entire North Pacific range, increase with increasing geographic distance. New information revealed substantial genetic differences indicating that female dispersal occurs at region specific spatial scales of 150-540 km. This research identified 12 demographically independent clusters within the range of Alaskan harbor seals; however additional research is required as unsampled areas within the Alaskan harbor seal range remain (O'Corry-Crowe et al. 2003).

The Alaska SRG concluded in 1996 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 what was believed in the early 1990s to be a 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 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 1995). 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). During summer of 1996, two different aerial surveys covered portions of Prince William Sound. The total combined count from the 1994 and 1996 aerial surveys was 19,450 (CV = 0.023) animals. Using the Gulf of Alaska correction factor resulted in an abundance estimate of 29,175 (19,450 $\times$ 1.50, CV = 0.052) for the Gulf of Alaska stock of harbor seals.

Between 1996 and 2000 the National Marine Mammal Laboratory (Alaska Fisheries Science Center) conducted aerial surveys of harbor seals across their entire range in Alaska. Each of five survey regions was surveyed, with one region surveyed per year. To derive an accurate estimate of population size from these surveys, a method was developed to address the influence of external conditions on the number of seals hauled out on shore, and counted, during the surveys. Many factors influence the propensity of seals to haul out, including tides, weather, time of day, and date in the seals' annual life history cycle. A statistical model defining the relationship between these factors and the number of seals hauled out was developed for each survey region. Based on those models, the survey counts for each year were adjusted to the number of seals that would have been ashore during a hypothetical survey conducted under ideal conditions for hauling out (Boveng et al. 2003). In a separate analysis of radio-tagged seals, a similar statistical model was used to estimate the proportion of seals that were hauled out under those ideal conditions (Simpkins et al. 2003). The results from these two analyses were combined for each region to estimate the population size of harbor seals in Alaska.

The current statewide abundance estimate for Alaskan harbor seals based on 1996-2000 surveys is 180,017 (CV = 0.03; NMFS, unpublished data). This estimate is based on 1996-2000 surveys that had incomplete coverage of terrestrial sites in Prince William Sound and of glacial sites in the Gulf of Alaska and the Southeast Alaska regions. Those problems have been addressed in the current survey (2001-2005). Prince William Sound was surveyed completely in 2001, and new methods have been developed and used for surveying glacial sites in 2001-2002. Analyses are currently underway, and a manuscript describing the regional and statewide population estimates is in preparation; the analytical methods are described in Boveng et al. (2003) and Simpkins et al. (2003) and have been presented at the 14th Biennial Conference on the Biology of Marine Mammals. The current abundance estimate for the GOA stock (45,975; CV = 0.04) is calculated from GOA surveys (35,982; 30,035 $\times$ 1.198; CV = 0.05) in 1996 and Aleutian Islands surveys (9,993; 8,341 $\times$ 1.198; CV = 0.06) in 1999 (NMFS unpublished data).

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): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 45,975 and its associated CV(N) of 0.04, results in an N_{MIN} of 44,453 harbor seals for the Gulf of Alaska stock.

Current Population Trend

There are trend counts available from two areas within the Gulf of Alaska stock of harbor seals: Kodiak and Prince William Sound. In Prince William Sound, harbor seal numbers declined by 57% from 1984 to 1992 (Pitcher 1989, Frost and Lowry 1993). Frost et al. (1999) reported a 63% decline in Prince William Sound from 1984-97; more recent information on trends in this area is not available. 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. Trend counts from Kodiak documented a significant increase of 6.6%/year (95% CI:

5.3-8.0; Small et al. 2003) over the period 1993-2001, which was the first documented increase in harbor seals in the Gulf of Alaska. 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 mean count has increased from 769 in 1992 to 2,090 in 2001 (Small 1996, Withrow et al. 2002), although this still only represents a fraction of its historical size. Despite some positive signs of growth in certain areas, the overall Gulf of Alaska stock size likely 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 reauthorized 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 = 1,334 animals ($44{,}453 \times 0.06 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The previous stock assessment for harbor seals indicated that there were five observed commercial fisheries that operated within the range of the Gulf of Alaska stock of harbor seals. As of 2003, changes in how fisheries are defined in the List of Fisheries have resulted in separating these fisheries into 22 fisheries based on both gear type and target species (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. During the 5-year period from 2000 to 2004 there were no observed incidental takes by any of these fisheries (Perez 2006).

In the Prince William Sound salmon drift gillnet fishery, observers recorded two incidental mortalities of harbor seals in 1990 (Wynne et al. 1991), and one 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 11. 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).

Between 1998 and 2002 there were no fishery related standings of Gulf of Alaska harbor seals documented in the Alaska Region stranding records.

The estimated minimum annual mortality rate incidental to commercial fisheries is 24.0, based on observer data (24.0) and stranding data (0) 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 salmon gillnet fisheries known to interact with this stock.

Table 11. Summary of incidental mortality of harbor seals (Gulf of Alaska stock) due to fisheries from 1990 through 2004 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2000 to 2004 (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
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
Cook Inlet salmon drift gillnet	1999 2000	obs data	1.8% 3.7%	0 0	0 0	0
Cook Inlet salmon set gillnet	1999 2000	obs data	7.3% 8.3%	0 0	0 0	0
Kodiak Island salmon set gillnet	2002	obs data	6.0%	0	0	0
Observer program total						24.0 (CV = 0.50)
Minimum total annual mortality						≥24.0 (CV = 0.50)

Subsistence/Native Harvest Information

Table 12 provides a summary of the subsistence harvest information for the Gulf of Alaska stock. The Alaska Native subsistence harvest of harbor seals has been estimated by the Alaska Native Harbor Seal Commission (ANHSC) and the Alaska Department of Fish and Game (ADFG). The previous stock assessment reported that 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. Recent information from the ADFG indicates the average harvest level from 2000 to 2004, including struck and lost, was 795 harbor seals per year.

Table 12. Summary of the subsistence harvest data for the Gulf of Alaska stock of harbor seals, 2000 to 2004. Data are from Wolfe et al. 2004.

Year	Estimated total number taken	Number harvested	Number struck and lost
2000	779	699	80
2001	772	716	56
2002	688	613	75
2003	688	613	75
2004	857	747	110
Mean annual harvest (2000-2004)	795		

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). The Alaska Region stranding records from 1998 to 2002 document up to three reports of stranded harbor seals found shot in the Gulf of Alaska, for an average of 0.6 over 5 years. It is not known whether these animals were killed illegally or if they were struck but lost in the subsistence harvest. Because the reason for the shooting is not known, these animals are added to the total number of human-related mortalities.

The Alaska Region stranding records document one Gulf of Alaska harbor seal was killed by a ship collision, and one was killed by massive blunt trauma between 1998 and 2002.

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; a final agreement was approved in 1999.

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. At present, annual U.S. commercial fishery-related mortality levels less than 133 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. 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. Based on currently available data, the minimum estimated annual level of total human-caused mortality is 820 (24.0 + 0.4 + 795 + 0.6) harbor seals which does not exceed the PBR (1,334) 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. 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

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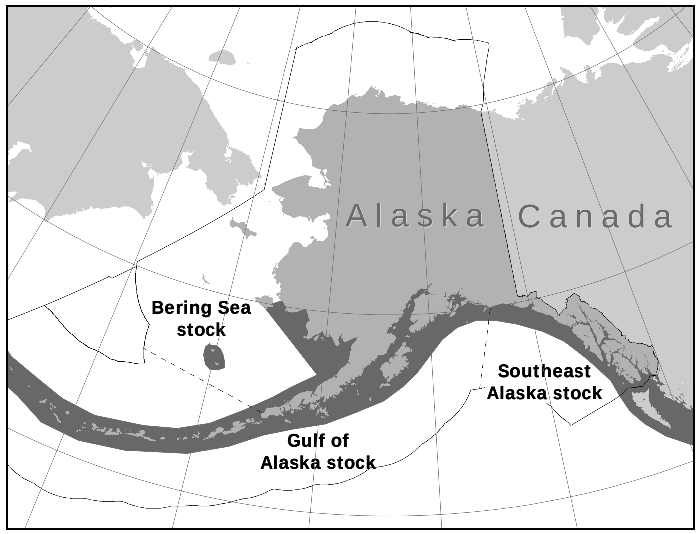

Figure 10. Approximate distribution of harbor seals in Alaska waters (shaded area).

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 (Swain et al. 1996, Lowry et al. 2001, Small et al. 2001). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2001). 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).

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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. 10). 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). At least four replicate photographic counts were obtained for each major rookery and haulout site within each study area. The total mean count for the 1995 surveys was 8,740 (CV = 0.04) harbor seals. 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. Multiplying these aerial survey counts by the correction factor resulted 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 2 July through 8 August. 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.

Between 1996 and 2000 the National Marine Mammal Laboratory (Alaska Fisheries Science Center) conducted aerial surveys of harbor seals across their entire range in Alaska. Each of five survey regions was surveyed, with one region surveyed per year. To derive an accurate estimate of population size from these surveys, a method was developed to address the influence of external conditions on the number of seals hauled out on shore, and counted, during the surveys. Many factors influence the propensity of seals to haul out, including tides, weather, time of day, and date in the seals' annual life history cycle. A statistical model defining the relationship between these factors and the number of seals hauled out was developed for each survey region. Based on those models, the survey counts for each year were adjusted to the number of seals that would have been ashore during a hypothetical survey conducted under ideal conditions for hauling out (Boveng et al. 2003). In a separate analysis of radio-tagged seals, a similar statistical model was used to estimate the proportion of seals that were hauled out under those ideal conditions (Simpkins et al. 2003). The results from these two analyses were combined for each region to estimate the population size of harbor seals in Alaska.

The current statewide abundance estimate for Alaskan harbor seals is 180,017 (CV = 0.03; NMFS, unpublished data), based on data collected during 1996-2000. This estimate, however, is believed to be low because it is based on incomplete coverage of terrestrial sites in Prince William Sound and of glacial sites in the Gulf of Alaska and the Southeast Alaska regions. Those problems have been addressed in the current survey (2001-2005). Prince William Sound was surveyed completely in 2001, and new methods have been developed and used for surveying glacial sites in 2001-2002. Analyses are currently underway, and a manuscript describing the regional and statewide population estimates is in preparation; the analytical methods are described in Boveng et al. (2003) and Simpkins et al. (2003) and have been presented at the 14th Biennial Conference on the Biology of Marine Mammals. The current abundance estimate for the Bering Sea stock (21,651; 18,073 × 1.198; CV = 0.1) is calculated from surveys in 2000 (NMFS, unpublished data).

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 21,651 from the aerial surveys and the associated CV(N) of 0.1, results in an estimate of 19,907 harbor seals. Adding the maximum count of 202 seals from the Otter Island survey results in an N_{MIN} of 20,109 for the Bering Sea harbor seal stock.

Current Population Trend

The number of harbor seals in the Bering Sea stock is thought to have declined between the 1980s and 1990s (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). Trend counts have been conducted in Bristol Bay only between 1998 and 2001. During this period, counts indicated a non-significant trend of -1.3% (95% CI: -5.9 - 3.3; Small et al. 2003). Calculation of trends in abundance in this area is somewhat problematic due to the presence of a sympatric species, spotted seals, which may overlap the range of harbor seals but cannot be identified as a different species by aerial surveys.

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 reauthorized 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 = 603 animals ($20{,}109 \times 0.06 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The previous stock assessment for harbor seals indicated that there were three observed commercial fisheries that operated within the range of the Bering Sea stock of harbor seals. As of 2003, changes in how fisheries are defined in the List of Fisheries have resulted in separating these fisheries into 14 fisheries based on both gear type and target species (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska.

Observer programs in several fisheries have documented mortalities or serious injuries in the Bering Sea/Aleutian Islands flatfish trawl and the Bering Sea/Aleutian Islands Pacific cod trawl (Table 13). Over the last 5 years, there were no observed serious injuries or mortalities of harbor seals in any Bering Sea/Aleutian Islands groundfish longline fisheries, or any Bering Sea/Aleutian Islands finfish pot fisheries (Perez 2006).

The estimated minimum annual mortality rate incidental to commercial fisheries for the period 2000-2004 is 1.3. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in salmon gillnet fisheries known to interact with this stock.

Table 13. Summary of incidental mortality of harbor seals (Bering Sea stock) due to commercial fisheries from 1990 through 2004 and calculation of the mean annual mortality rate.

Fishery name	Years	Data type	Range of observer coverage (%)	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea Pacific cod trawl	2000	obs data	47.3	0	0	0.79 (CV = 0.50)
	2001		53.8	0	0	
	2002		38.3	0	0	
	2003		42.3	1	2.0	
	2004		45.3	1	2.0	

Fishery name	Years	Data type	Range of observer coverage (%)	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	1 0 0 0 0	1.3 0 0 0 1.0	0.46 (CV = 0.49)
Minimum total annual mortality						1.25 (CV = 0.36)

Subsistence/Native Harvest Information

The Alaska Native subsistence harvest of harbor seals has been estimated by the Alaska Native Harbor Seal Commission (ANHSC) and the Alaska Department of Fish and Game (ADFG). The previous stock assessment reported that the estimated average harvest of the Bering Sea stock of harbor seals for 1994-1996 was 161 animals per year (including struck and lost). Recent information from the ADFG indicates the average harvest level from 2000 to 2004, including struck and lost, was 174.3 animals per year. Because surveys did not occur in 1999 an estimate of subsistence harvest in 1999 is unavailable.

Table 14 provides a summary of the subsistence harvest information for the Bering Sea stock. 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.

Table 14. Summary of the subsistence harvest data for the Bering Sea stock of harbor seals, 2000-2004. Data are from Wolfe et al. 2004; J. Fall, ADFG, pers. comm.

Year	Estimated total number taken	Number harvested	Number struck and lost
2000	330.5	272.4	58.0
2001	200.3	158.8	41.6
2002	139.6	95.2	44.2
2003	82.1	65.4	16.7
2004	119.0	76.1	42.9
Mean annual harvest (2000-2004)	174.3		

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). The Alaska Region stranding records from 1998 to 2002 document 2-3 reports of stranded harbor seals found shot in Bristol Bay, for a maximum average of 0.6 harbor seals/year over 5 years. It is not known whether these animals were killed illegally or if they were struck but lost in the subsistence harvest. Because the reason for the shooting is not known, these animals are added to the total number of human-related mortalities.

STATUS OF STOCK

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. At present, U.S. commercial fishery-related annual mortality levels less than 60 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. 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. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (1.25 + 174.3 + 0.6 = 176.2) is not known to exceed the PBR (603). 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

Figure 11. Approximate distribution of spotted seals (shaded area).

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. 11). Satellite tagging studies have provided considerable insight into the seasonal movements of spotted seals (Lowry et al. 1998, Lowry et al. 2000). Those studies indicate that spotted seals migrate south from the Chukchi Sea in October and pass through the Bering Strait in November (Lowry et al. 1998). Seals overwinter in the Bering Sea along the ice edge and make east-west movements along the edge (Lowry et al. 1998). During spring they tend to prefer small floes (i.e., < 20 m in diameter), and 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, Simpkins et al. 2003). In summer and fall, spotted seals use coastal haulouts regularly, and 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 eight known breeding areas, three occur in the Bering Sea, with the remaining five 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 Pacific harbor seals (*Phoca vitulina richardsi*). 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 strongly associated with pack ice (Shaughnessy and Fay 1977). These and other ecological, behavioral, genetic, and morphological differences support their recognition as two separate species (Quakenbush 1988).

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 transmitters on four spotted seals in Kasegaluk Lagoon and estimated the ratio of time hauled out versus time at sea. Preliminary results indicated that the proportion hauled out averaged about 6.8% (CV = 0.85) (Lowry et al. 1994). Using this correction factor with the maximum count of 4,145 from 1992 results in an estimate of 59,214.

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 were relatively stable at Kasegaluk Lagoon from the mid-1970s through 1991. 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.

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 reauthorized 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 = $N_{MIN} \times 0.5 R_{MAX} \times F_R$. 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

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with spotted seals. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Prior to 2004, there were no incidental serious injuries and mortalities of spotted seals in any of the observed fisheries. However, in 2004, the Bering Sea/Aleutian Islands flatfish trawl fishery incurred three mortalities of spotted seals, resulting in a total estimated take of 4.4 spotted seals for that year and an average of 0.88 seals per year for the period 2000-2004 (Table 15; Perez 2006).

The estimated minimum mortality rate incidental to commercial fisheries is 0.88 animals per year. However, serious injury and mortality of harbor seals incidental to commercial fisheries has occurred within the past 5 years, and because it is virtually impossible to distinguish between these two species, some of the reported harbor seal take may actual involve spotted seals. Further, no observers have been assigned to the Bristol Bay drift gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable.

Table 15. Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 2000 through 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Range of Observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	0 0 0 0 3	0 0 0 0 4.4	0.88 (CV = 0.33)
Minimum total annual mortality						0.88 (CV = 0.33)

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.

The Division of Subsistence, Alaska Department of Fish and Game, maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of spotted seals has been compiled for 135 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-98 were used. As of August 2000; the subsistence harvest database indicated that the estimated number of spotted seals harvested for subsistence use per year is 5,265.

At this time, there are no efforts to quantify the current level of harvest of spotted seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of spotted seal harvest in five villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 32 spotted seals were harvested annually in Little Diomede, Gambell, Savoonga, Shishmaref, and Wales from 1998-2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest spotted seals, this level of harvest underestimates the actual harvest level for these years.

A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 5,265 spotted seals estimated by the Division of Subsistence is considerably higher than the previous minimum estimate of 244 per year based on reports from the northern Bristol Bay portion of the spotted seal's range. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 5,265 spotted seals is the best estimate of harvest level currently available.

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. Because the PBR for spotted seals is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. No information is available on the status of spotted seals. Due to a minimal level of interactions between U.S. commercial fisheries and spotted seals, the Alaska stock of spotted seals is not considered a strategic stock.

Habitat Concerns

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Spotted seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska spotted seal stock.

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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 shelf of the Bering, Chukchi, and Beaufort Seas (Ognev 1935, Johnson et al. 1966, Burns 1981, Fig. 12). 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). Recent spring surveys along the Alaskan coast indicate that bearded seals tend to prefer areas of between 70% and 90% sea ice coverage, and are typically more abundant 20-100 nmi from shore than within 20 nmi of shore, with the exception of high concentrations nearshore to the south of Kivalina (Bengtson et al. 2000; Bengtson et al. 2005; Simpkins et al. 2003). 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.

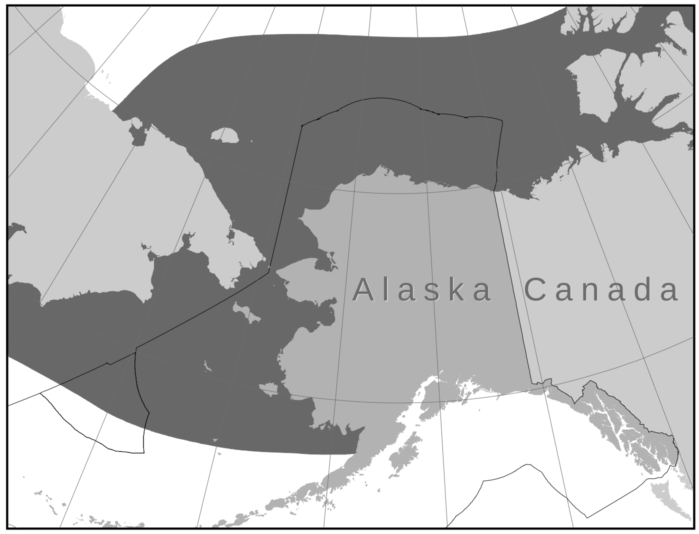

Figure 12. Approximate distribution of bearded seals (shaded area). The combined summer and winter distribution are depicted.

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 bearded seals into more than one stock. Bearded seals range throughout the Arctic into Russian and Canadian waters, however, 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). Surveys flown from Shishmaref to Barrow during May-June 1999 and 2000 resulted in an average density of 0.07 seals/km^2 and 0.14 seals/km^2, respectively, with consistently high densities along the coast to the south of Kivalina (Bengtson et al. 2005). These densities cannot be used to develop an abundance estimate because no correction factor is available. There is no reliable population abundance estimate for the Alaska stock of bearded seals.

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.

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 reauthorized 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

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with bearded seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these 3 fisheries into 12 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2000 and 2004, there were incidental serious injuries and mortalities of bearded seals in the following fisheries: Bering Sea/Aleutian Islands flatfish trawl and Bering Sea/Aleutian Islands pollock trawl (Table 16). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). The estimated minimum mortality rate incidental to commercial fisheries is 0.68 bearded seals per year, based exclusively on observer data.

Table 16. Summary of incidental mortality of bearded seals (Alaska stock) due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	1 1 0 0 0	1.6 1.8 0 0 0	0.68 (CV = 0.46)
Total estimated annual mortality						0.68 (CV = 0.46)

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).

The Division of Subsistence, Alaska Department of Fish and Game maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of bearded seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000; the subsistence harvest database indicated that the estimated number of bearded seals harvested for subsistence use per year is 6,788.

At this time, there are no efforts to quantify the current level of harvest of bearded seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of bearded seal harvest in five villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 273 bearded seals were harvested annually in Little Diomede, Gambell, Savoonga, Shishmaref, and Wales from 1998 to 2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest bearded seals, this level of harvest is known to underestimate the actual harvest level for these years.

A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 6,788 bearded seals estimated by the ADFG Division of Subsistence is considerably higher than the previous minimum estimate of 791 per year from five villages in the Bering Strait. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 6,788 bearded seals is the best estimate of harvest level currently available.

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. Because the PBR for bearded seals is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. No information is available on the status of bearded seals. Due to a very low level of interactions between U.S. commercial fisheries and bearded seals, the Alaska stock of bearded seals is not considered a strategic stock.

Habitat Concerns

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Bearded seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska bearded seal stock.

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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 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 tend to prefer large floes (i.e., > 48 m in diameter) and are often found in the interior ice pack where the sea ice coverage is greater than 90% (Simpkins et al. 2003). 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. 13). 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). Preliminary results from recent surveys conducted in the Chukchi Sea in May-June 1999 and 2000 indicate that ringed seal density is higher in nearshore fast and pack ice, and lower in offshore pack ice (Bengtson et al. 2005). Results of surveys conducted by Frost and Lowry (1999) indicate that, in the Alaskan Beaufort Sea, the density of ringed seals in May-June is higher to the east than to the west of Flaxman Island. 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.

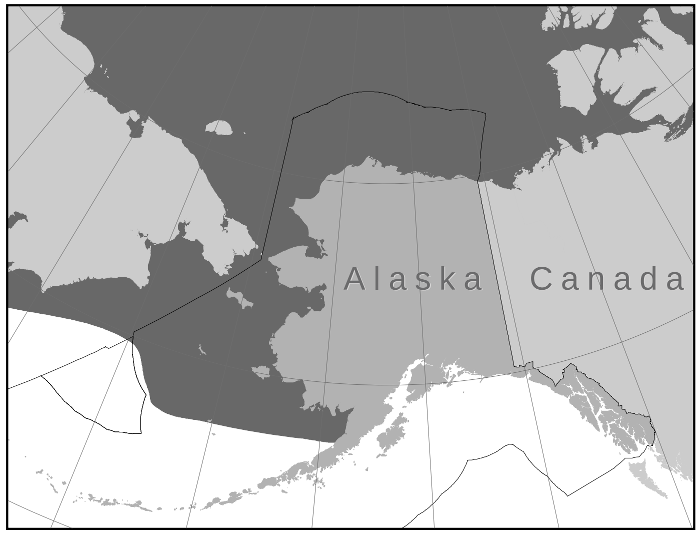

Figure 13. Approximate distribution of ringed seals (shaded area). The combined summer and winter distribution are depicted.

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 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 entire Alaska stock of ringed seals is currently not available. One partial estimate of ringed seal numbers was based on aerial surveys conducted in May-June 1985-1987 in the Chukchi and Beaufort Seas from southern Kotzebue Sound north and east to the U.S.-Canada border (Frost et al. 1988). Effort was directed towards shorefast ice within 20 nmi of shore, though some areas of adjacent pack ice were also surveyed. The estimate of the number of hauled out seals in 1987 was 44,360 ± 9,130 (95% CI). During May-June 1999 and 2000 surveys were flown along lines perpendicular to the eastern Chukchi Sea coast from Shishmaref to Barrow (Bengtson et al. 2005). Bengtson et al. (2005) indicate that the estimated abundance of ringed seals for the study area (corrected for seals not hauled out) in 1999 and 2000 was 252,488 (SE = 47,204) and 208,857 (SE = 25,502), respectively. Similar surveys were flown in 1996-1999 in the Alaska Beaufort Sea from Barrow to Kaktovik. Observed seal densities in that region ranged from 0.81 to 1.17/km^2 (Frost et al. 2002, 2004). Moulton et al. (2002) surveyed some of the same area in the central Beaufort Sea during 1997-99, and reported lower seal densities than Frost et al. (2002). Frost et al. (2002) did not produce a population estimate from their 1990s Beaufort Sea surveys. However, the area they surveyed covered approximately 18,000 km^2 (L. Lowry, University of Alaska Fairbanks, pers. comm.), and the average seal density for all years and ice types was 0.98/km^2 (Frost et al. 2002), which indicates that there were approximately 18,000 seals hauled out in the surveyed portion of the Beaufort Sea. Combining this with the average abundance estimate of 230,673 from Bengtson et al. (2005) for the eastern Chukchi Sea results in a total of approximately 249,000 seals. This is a minimum population estimate because it does not include much of the geographic range of the stock and the estimate for the Alaska Beaufort Sea has not been corrected for the number of ringed seals not hauled out at the time of the surveys. Nonetheless, it provides an update to the estimate from 1987.

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.

Frost et al. (2002) reported that trend analysis based on an ANOVA comparison of observed seal densities in the central Beaufort Sea suggested a marginally significant but substantial decline of 31% from 1980-87 to 1996-99. A Poisson regression model indicated highly significant density declines of 72% on fast ice and 43% on pack ice over the 15-year period. However, the apparent decline between the 1980s and the 1990s may have been due to a difference in the timing of surveys rather than an actual decline in abundance.

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 reauthorized 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

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with ringed seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these three fisheries into 12 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2000 and 2004, there were incidental serious injuries and mortalities of ringed seals in the Bering Sea/Aleutian Islands pollock trawl fishery (Table 17). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). Based on data from 2000 to 2004, there have been an average of 0.71 mortalities of ringed seals incidental to commercial fishing operations.

Table 17. Summary of incidental mortality of ringed seals (Alaska stock) due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. pollock trawl	2000	obs data	76.2	1	1.4	0.71 (CV = 0.24)
	2001		79.0	2	2.1	
	2002		80.0	0	0	
	2003		82.2	0	0	
	2004		81.2	0	0	

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Total estimated annual mortality						0.71 (CV = 0.24)

Subsistence/Native Harvest Information

Ringed seals are an important species for Alaska Native subsistence hunters. The estimated 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).

The Division of Subsistence, Alaska Department of Fish and Game, maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ringed seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000; the subsistence harvest database indicated that the estimated number of ringed seals harvested for subsistence use per year is 9,567.

At this time, there are no efforts to quantify the level of harvest of ringed seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of ringed seal harvest in five villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 47 ringed seals were harvested annually in Little Diomede, Gambell, Savoonga, Shishmaref, and Wales from 1998 to 2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest ringed seals, this level of harvest is known to underestimate the actual harvest level for these years.

A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 9,567 ringed seals estimated by the Division of Subsistence is considerably higher than the previous minimum estimate. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 9,567 ringed seals is the best estimate currently available.

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. Because the PBR for ringed seals is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. No information is available on the status of ringed seals. Due to a very low level of interactions between U.S. commercial fisheries and ringed seals, the Alaska stock of ringed seals is not considered a strategic stock.

Habitat Concerns

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ringed seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ringed seal stock.

Oil and gas exploration and development overlaps with both the summer and winter ranges of ringed seals in the Alaska Beaufort Sea. NMFS has worked with the oil and gas industry to recommend changes to operations to ensure that mortalities of ringed seals are eliminated or minimized, and to ensure that monitoring occurs to verify that population-level changes in distribution are minor. There has been concern that oil and gas exploration, especially seismic exploration, could result in changes in ringed seal distribution. However, aerial surveys conducted for 3 years both before and after industry activities indicate that local seal densities in the spring were not significantly different after the advent of industry activity (Moulton et al. 2002). It is not known to what extent this study can be used to determine likely responses of ringed seals to activity in other parts of the species' range.

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RIBBON SEAL (*Phoca fasciata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Ribbon seals inhabit the North Pacific Ocean and adjacent parts 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. 14). 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 is little known about 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).

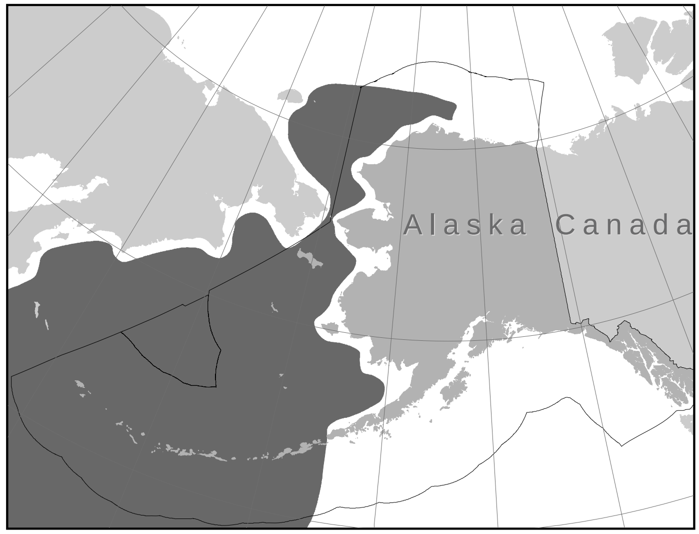

Figure 14 Approximate distribution of ribbon seals (shaded area). The combined summer and winter distribution is depicted.

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.

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 reauthorized 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

Until 2003, there were three different federally regulated commercial fisheries in Alaska that could have interacted with ribbon seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these three fisheries into 13 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2000 and 2004, there were incidental serious injuries and mortalities of ribbon seals in the Bering Sea/Aleutian Islands pollock trawl fishery and the Bering Sea/Aleutian Islands Pacific cod longline fishery (Table 18). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). The estimated minimum mortality rate incidental to commercial fisheries is 0.8 ribbon seal per year, based exclusively on observer data.

Table 18. Summary of incidental mortality of ribbon seals (Alaska stock) due to fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. * Mortality seen by observer, but not during a monitored haul. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. pollock trawl	2000 2001 2002 2003 2004	obs data	76.2 79.0 80.0 82.2 81.2	0 0 0 0 0	0 1* 0 0 0	0.20* (N/A)
Bering Sea/Aleutian Is. Pacific cod longline	2000 2001 2002 2003 2004	obs data	35.2 29.5 29.6 29.9 23.8	0 1 0 0 0	0 3.0 0 0 0	0.60 (0.82)
Total estimated annual mortality						0.8

Subsistence/Native Harvest Information

Ribbon seals are harvested occasionally by Alaska Native subsistence hunters, primarily from villages in the vicinity of 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).

The Division of Subsistence, Alaska Department of Fish and Game maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ribbon seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000; the subsistence harvest database indicated that the estimated number of ribbon seals harvested for subsistence use per year is 193.

At this time, there are no efforts to quantify the level of harvest of ribbon seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of ribbon seal harvest in 5 villages as part of their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 13 ribbon seals were harvested annually in Little Diomede, Gambell, Savoonga, Shishmaref, and Wales from 1999 to 2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest ribbon seals, this level of harvest is known to underestimate the actual harvest level for these years.

A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 193 ribbon seals estimated by the Division of Subsistence is somewhat higher than the previous minimum estimate. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 193 ribbon seals represents a mean estimate rather than a minimum estimate of subsistence harvest.

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. Because the PBR for ribbon seals is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. No information is available on the status of ribbon seals. Due to a very low level of interactions between U.S. commercial fisheries and ribbon seals, the Alaska stock of ribbon seals is not considered a strategic stock.

Habitat Concerns

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ribbon seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ribbon seal stock.

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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).

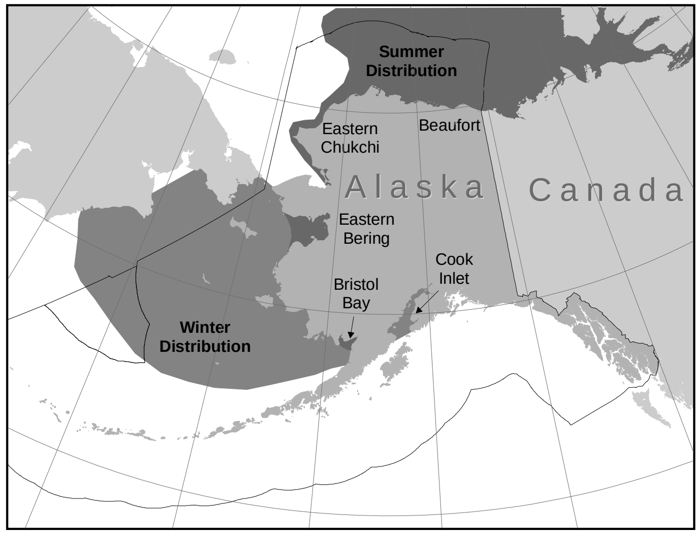

Figure 15. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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. 15).

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, and resulted in an estimate of 19,629 (CV = 0.229) beluga whales in the eastern Beaufort Sea (Harwood et al. 1996). To account for availability bias a correction factor (CF), 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 CF is not available; however, this CF was considered negatively biased by the Alaska SRG considering that aerial survey CFs for this species have been estimated to be 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 current population trend of the Beaufort Sea stock of beluga whales is unknown.

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 reauthorized 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 the stock trend is unknown, the recovery factor (F_R) for this stock is 0.5 (Wade and Angliss 1997). Thus, for the Beaufort Sea stock of beluga whales, PBR = 324 animals ($32{,}453 \times 0.02 \times 0.5$).

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 19 (Frost and Suydam 1995; Frost 1998; K. Frost, University of Alaska, Fairbanks, pers. comm. 2004). Given these data, the annual subsistence take by Alaska Natives averaged 53 belugas during the 5-year period from 1999 to 2003. Recent harvest reports are not considered negatively biased even though they are based on on-site harvest monitoring and harvest reports from well established ABWC representatives. The 1993-95 data are negatively biased because reliable estimates for the number of animals struck and lost are not available prior to 1996.

Table 19. Summary of the Alaska Native subsistence harvest from the Beaufort Sea stock of beluga whales, 1999-2003. 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
1999	45+	N/A	35	10+
2000	117	N/A	66	51
2001	43	N/A	25	18
2002	27	N/A	24	3
2003	34	N/A	34	unknown
Mean annual take (1999-2003)	53			

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 20 (Harwood et al. 2002; data for 2000-2003 from FJMC Beluga Monitor Program, Fisheries Joint Management Committee, Inuvik, NT, Canada). Given these data, the annual subsistence take in Canada averaged 99 belugas during the 5-year period from 1999-2003. Thus, the mean estimated subsistence take in Canadian and U. S. waters from the Beaufort Sea beluga stock during 1999-2003 is 152 (53 + 99) whales.

Table 20. Summary of the Canadian subsistence harvest from the Beaufort Sea stock of beluga whales, 1999-2003. 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
1999	102	N/A	86	16
2000	89	N/A	82	7
2001	92	N/A	86	6
2002	88	N/A	85	3
2003	126	N/A	115	12
Mean annual take (1999-2003)	99			

STATUS OF STOCK

Beaufort Sea 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 U.S. commercial fishery-related mortality (0) is not known to exceed 10% of the PBR (32) 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 (152) is not known to exceed the PBR (324). Therefore, the Beaufort Sea stock of beluga whales is not classified as a strategic stock. 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

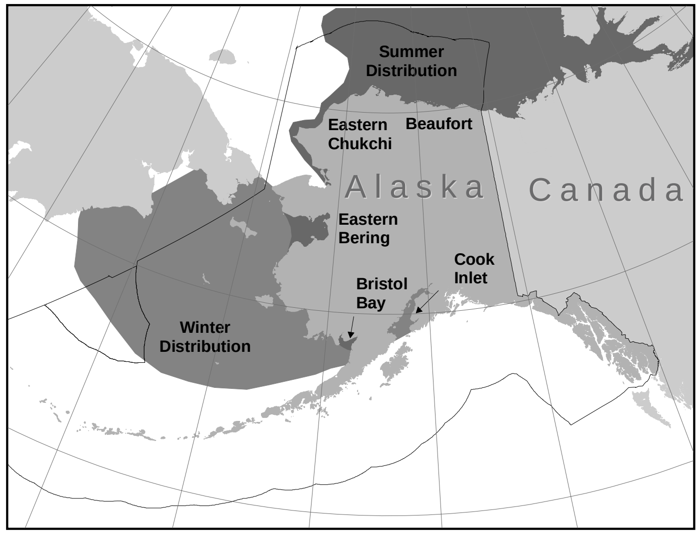

Figure 16. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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). Satellite tagging efforts directed at the eastern Chukchi stock of beluga whales showed that whales tagged in the eastern Chukchi in summer traveled 1,100 km north of the Alaska coastline and to the Canadian Beaufort Sea within 3 months of tagging (Suydam et al. 2001), indicating significant stock overlap with the Beaufort Sea stock of beluga whales. 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).

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. 16).

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 ($1{,}200 \times 2.62 \times 1.18$).

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).

In July 2002, aerial surveys were conducted again in the eastern Chukchi Sea (Lowry and Frost 2002). Those surveys resulted in a peak count of 582 whales. A correction factor for animals that were not available for the count is not available. Offshore sightings during this survey combined with satellite tag data collected in 2001 (Lowry and Frost 2001, Lowry and Frost 2002) indicate that nearshore surveys for beluga will only result in partial counts of this stock.

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 used 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 based on satellite tag results (Suydam et al. 2001, Lowry and Frost 2002), 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 reauthorized 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, 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. In the nearshore waters of the southeastern 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 21 (Frost and Suydam 1995; Frost 1998; K. Frost, University of Alaska, Fairbanks, pers. comm. 2004). Given these data, the annual subsistence take by Alaska Natives averaged 65 belugas during the 5-year period 1999-2003 based on reports from ABWC representatives and on-site harvest monitoring. The 1999-2003 data are for all sites and all years negatively biased because reliable estimates for the number of animals struck and lost are not available prior to 1996.

Table 21. Summary of the Alaska Native subsistence harvest from the eastern Chukchi Sea stock of beluga whales, 1999-2003. 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
1999	52	N/A	52	0
2000	5	N/A	2	3
2001	89	N/A	84	5
2002	99	N/A	93	6
2003	78	N/A	74	4
Mean annual take (1999-2003)	65			

STATUS OF STOCK

The estimated minimum annual mortality rate incidental to U. S. commercial fisheries (0) is not known to exceed 10% of the PBR (7.4) 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 (65) is not known to exceed the PBR (74). Eastern Chukchi Sea 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).

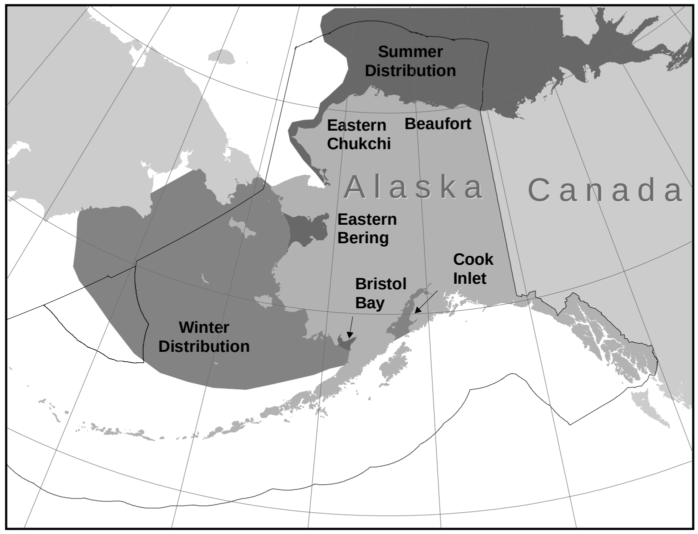

Figure 17. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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. 17).

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 3-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 ($2,583 \times 2.62 \times 1.18$) beluga whales.

Aerial surveys of Norton Sound were also conducted in 2000. Preliminary analyses indicate that the uncorrected estimate was 5,868 animals; when corrected for animals not visible at the surface and for newborn and yearling animals not observed due to their small size and dark coloration, the estimated population size for Norton Sound is 18,142 (CV = 0.24; R. Hobbs, AFSC-NMML, pers. comm.).

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, $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 18,142 and an associated CV(N) of 0.24, N_{MIN} for this stock is 14,898 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 considers the CV derived from the abundance estimate (CV = 0.24) as adequate in calculating a minimum population estimate (DeMaster 1996, 1997; see discussion of N_{MIN} for the eastern Chukchi stock of beluga whales).

Current Population Trend

Surveys to estimate population abundance in Norton Sound were not conducted prior to 1992. Annual estimates of population size from surveys flown in 1992-95 and 1999-2000 have varied widely, due partly to differences in survey coverage and conditions between years. Data currently available do not allow an evaluation of population trend for the Eastern Bering Sea stock.

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 reauthorized 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 = 298 animals (14,898 $\times$ 0.02 $\times$ 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In previous assessments, there were three different federally observed commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of eastern Bering Sea beluga whales. In 2004, the definitions of these commercial fisheries were changed to reflect target species; this new definition has resulted in the identification of several observed fisheries in the Bering Sea that use trawl, longline, or pot gear. There have been no observed serious injuries or mortalities in any of these commercial 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. The estimated mortality is considered a minimum due to a lack of observer programs in fisheries likely to take beluga .

In the nearshore waters of the eastern Bering Sea, substantial effort occurs in gillnet (mostly set nets), herring, and personal-use fisheries. The only reported beluga mortality in this region 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 1996-2000. 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. NMFS assumes that all beluga whales taken for subsistence use, regardless of the method of harvest, are reported to the ABWC and are reflected in the following section on Subsistence/Native Harvest Information; however, some underreporting is known to occur (Unpublished

SRG meeting minutes November 2004, available from Robyn Angliss, NMML, 7600 Sand Point Way NE, Seattle, WA 98115).

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 22 (Frost and Suydam 1995; Frost 1998; Frost 2003; K. Frost, University of Alaska, Fairbanks, pers. comm. 2004). Given these data, the annual subsistence take by Alaska Natives averaged 209 belugas from the eastern Bering Sea stock during the 5-year period 1999-2003 estimates are based on reports from ABWC representatives. The 1993-97 data are 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.

Table 22. Summary of the Alaska Native subsistence harvest from the eastern Bering Sea stock of beluga whales, 1999-2003. 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
1999	159	N/A	134	25
2000	212	N/A	188	24
2001	309	N/A	281	28
2002	255	N/A	234	21
2003	109	N/A	101	8
Mean annual take (1999-2003)	209			

STATUS OF STOCK

The estimated minimum annual mortality rate incidental to U.S. commercial fisheries (0) is not known to exceed 10% of the PBR (30) 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 1999-2003, of human-caused mortality and serious injury (209, including the estimated mortality in non-commercial fisheries) is not known to exceed the PBR (298) for this stock. Eastern Bering Sea 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).

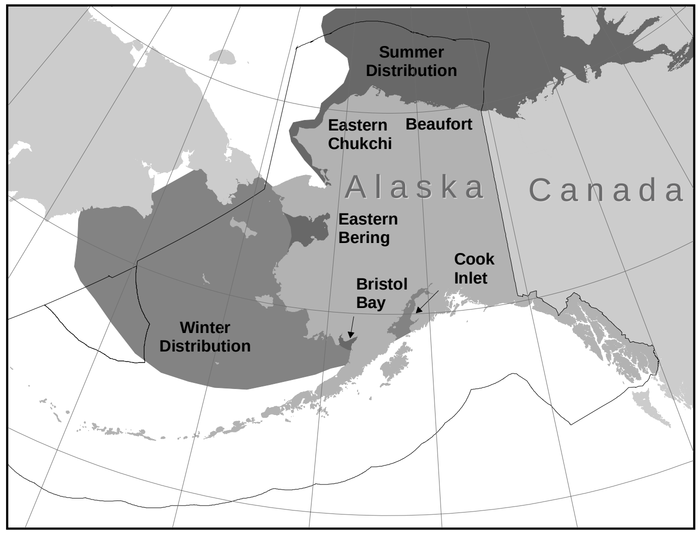

Figure 18. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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

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 maximum 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). Surveys flown by the ADFG in 1999 and 2000 resulted in maximum counts of 690 and 531, which can be extrapolated to provide population estimates of 2,133 and 1,642, respectively (L. Lowry, University of Alaska Fairbanks, pers. comm.). The Alaska Beluga Whale Committee conducted beluga surveys in Bristol Bay in 2004 and will do so again in 2005.

Minimum Population Estimate

The survey technique used for estimating the abundance of beluga whales in this stock is a direct count which incorporates correction factors. Given this survey method, estimates of the variance of abundance are unavailable. 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 average estimate for 1999 and 2000 of (N) of 1,888 and the default CV (0.2), N_{MIN} for the Bristol Bay stock of beluga whales is 1,619.

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 (Frost and Lowry 1990, 1995a; Lowry and Frost 1998), and the higher counts in 1999 and 2000 suggest that the Bristol Bay stock is at least stable and may be increasing.

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 reauthorized 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 = 32 animals ($1,619 \times 0.02 \times 1.0$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries that could have interacted with beluga whales 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.

Observers have never monitored the Bristol Bay salmon set gillnet and drift gillnet fisheries which combined had over 2,900 active permits in 1996.

The estimated minimum mortality rate incidental to commercial fisheries is 0. 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

Data on 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 23 (Frost and Suydam 1995; Frost 1998; K. Frost, University of Alaska Fairbanks, pers. comm. 2004). Given these data, the annual subsistence take by Alaska Natives averaged 19 belugas from the Bristol Bay stock during the 5-year period 1999-2003. 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 in 2001 and 2002.

Table 23. Summary of the Alaska Native subsistence harvest from the Bristol Bay stock of beluga whales, 1999-2003. 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
1999	15	N/A	13	2

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
2000	25	N/A	24	1
2001	22[1]	N/A	22	N/A
2002	9[1]	N/A	9	N/A
2003	24	N/A	21	3
Mean annual take (1999-2003)	19			

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

There is substantial effort in a subsistence gillnet fishery for salmon in Bristol Bay. There were 6 reported mortalities of beluga in subsistence salmon gillnet fisheries in 2000 and one reported mortality of a beluga whale in a subsistence gillnet in 2002. If this level of mortality is averaged over 5 years, an average of 1.4 belugas per year would be caught in subsistence gillnet fisheries in this area. In addition, records indicate that one and two beluga whales were killed incidental to commercial salmon set nets in 2000 and 2002, respectively and these animals were used for subsistence purposes. Thus, the total subsistence harvest resulting from net entanglements is 2 belugas per year. Note that these mortalities did not occur incidental to a commercial fishery, or did occur incidental to a commercial fishery and were used for subsistence purposes. 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 used by Alaska Native subsistence users. It is not clear whether the mortalities reported in 2000 and 2002 are accounted for in the 2000 and 2002 Alaska Native subsistence harvest report; the subsistence harvest report will be used to document the reported take of beluga whales in Bristol Bay.

STATUS OF STOCK

At present, annual U. S. commercial fishery-related mortality levels less than 3.2 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. Bristol Bay 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 (19) is not known to exceed the PBR (32). 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.

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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). During spring and summer months, beluga whales in Cook Inlet are typically concentrated near river mouths in northern Cook Inlet (Rugh et al. 2000). Although the exact winter distribution of this stock is unknown, there is evidence that some, if not all, of this population may inhabit Cook Inlet year-round (Fig. 19; Hansen and Hubbard 1999, Rugh et al. 2000). Satellite tags have been attached to 17 belugas in late summer in order to determine their distribution through the fall and winter. Ten tags have lasted through the fall and of those, three have lasted through the winter. The three tags that transmitted through the winter stopped working in April and late May (Hobbs et al. 2005). No tagged beluga moved south of Chinitna Bay (Hobbs et al. 2005). A review of all cetacean surveys conducted in the Gulf of Alaska from 1936 to 2000 discovered only 31 sightings of belugas among 23,000 sightings of other cetaceans, indicating that very few belugas occur in the Gulf of Alaska outside of Cook Inlet (Laidre et al. 2000). A small number of beluga whales (fewer than 20 animals) also occur in Yakutat Bay; these are considered part of the Cook Inlet stock (65 FR 34590; 31 May 2000).

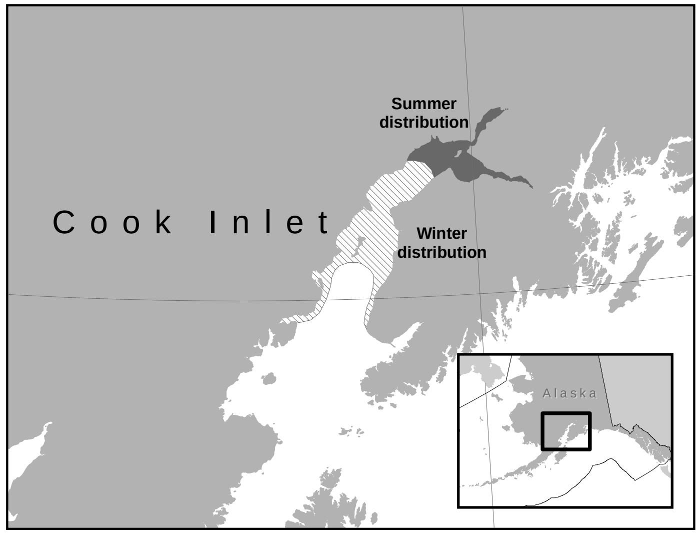

Figure 19. Approximate distribution of beluga whales in Cook Inlet. The dark shading displays the summer distribution. Winter distribution is depicted with dashed shading**.**

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. 2002). 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.

POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet have been conducted by the National Marine Fisheries Service each year since 1993. Starting in 1994, the survey protocol included paired, independent observers so that the number of whale groups missed can be estimated. When groups were seen, a series of aerial passes were made to allow each observer to make independent counts at the same time that a video camera was photographing the whale group (Rugh et al. 2000).

The annual abundances of beluga whales in Cook Inlet are estimated from counts by aerial observers and aerial video group counts. Each group size estimate is corrected for subsurface animals (availability correction) and animals at the surface that were missed (sightability correction) based on an analysis of the video tapes (Hobbs et al. 2000b). When video counts are not available, observer's 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. 2000b). The most recent abundance estimate of beluga whales in Cook Inlet, resulting from the June 2005 aerial survey is 278 (CV = 0.18) animals (NMFS unpubl. data). Although this is not significantly different from the average over the period 1999-2004 (NMML unpublished data), this is the lowest abundance estimate recorded for this stock.

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 278 and its associated CV(N) of 0.18, N_{MIN} for the Cook Inlet stock of beluga whales is 238.

Current Population Trend

The corrected abundance estimates for the period 1994-2005 are shown in Figure 20. A statistically significant trend in abundance was detected between 1994 and 1998 (Hobbs et al. 2000a), although the power was low due to the short time series. However, the 1998 abundance estimate (349) was approximately 50% lower than the 1994 abundance estimate (653). The Cook Inlet beluga population has shown no significant trend since 1998 (NMFS unpublished data).

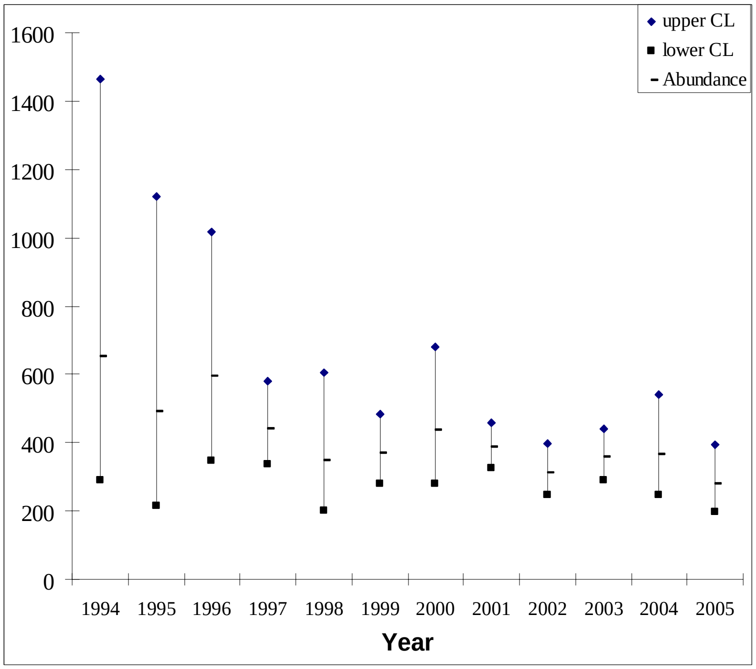

Figure 20. Abundance of beluga whales in Cook Inlet, Alaska 1994-2005 (Rugh et al. 2005, NMFS unpublished data). Error bars depict 95% confidence intervals.

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 reauthorized 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: $PBR = N_{MIN} + 0.5R_{MAX} + F_R$. The F_R and PBR for the Cook Inlet stock of beluga whale were both undetermined in Small and DeMaster (1995). In reports from 1998 through 2005, NMFS calculated a value for PBR. However, given the low abundance relative to historic estimates and low known levels of human caused mortality this stock should have begun to grow at or near its maximum productivity rate, but for unknown reasons the Cook Inlet stock of beluga whale does not appear to be increasing. Because this stock does not meet the assumptions inherent to the use of the PBR, NMFS cannot determine a maximum number that may be removed while allowing the population to achieve OSP. Thus, the PBR is undetermined for the Cook Inlet stock of beluga whale.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In 1999 and 2000, observers were placed on Cook Inlet salmon set and drift gillnet vessels because of the potential for these fisheries to incur incidental mortalities of beluga whales. No mortalities were observed in either year (Manly in review).

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

Subsistence harvest of beluga whales in Cook Inlet has been important to local villages. Between 1993 and 1999, the annual subsistence take ranged from 30 animals to over 100 (Mahoney and Shelden 2000). The most thorough subsistence harvest surveys were completed by the Cook Inlet Marine Mammal Council during 1995-97; while some of the hunters believe the 1996 estimate was positively biased, the 1995-97 CIMMC take estimates are considered reliable. The average annual subsistence harvest between 1995 and 1997 was 87 whales.

Because of the decline in the Cook Inlet beluga whale stock in 1999 Congress imposed a moratorium on beluga harvest in Cook Inlet until NMFS developed a cooperative plan for harvest management with the local Alaska Native organizations. Thus, the best estimate of subsistence take in 1999 and 2000 is zero. Harvest through 2004 was conducted under an interim harvest management plan developed by the Alaska Native organizations and NMFS (69 FR 17973, 6 April 2004). Under that agreement the average take during 2001-05 was one whale/year (see Table 24). In August 2004 a hearing before an administrative law judge was to determine a long-term harvest plan. The resulting ruling was completed in November 2005. The ruling allows a total of 6 whales to be harvested between 2005 and 2009 with harvest in subsequent 5-year periods to depend on the average abundance in the previous 5-year period and the observed growth rate of the population. No harvest would be allowed if the average dropped below 350. An EIS is in preparation for this harvest. The strike limits are as follows: one strike for 2006, two strikes for 2007, one strike for 2008, and two strikes for 2009 (NMFS 2004).

Table 24. Summary of the Alaska Native subsistence harvest from the Cook Inlet stock of beluga whales, 2001-2005.

Year	Reported total number taken	Reported number harvested	Estimated number struck and lost
2001	1	1	0
2002	1	1	0
2003	0	0	0
2004	0	0	0
2005	2	2	0
Mean annual take, 2001-05	1		

OTHER MORTALITY

Mortalities related to stranding events have been reported in Cook Inlet (Table 25). Since detailed recordkeeping was initiated in 1994, there have been mass strandings of beluga almost every year. These mass strandings resulted in mortalities of 4 animals in 1996, 5 animals in 1999, and 6 animals in 2003 (NMFS unpublished data). Many of the strandings occurred in Turnagin Arm. Because Turnagin Arm is a shallow, dangerous waterway, it is not frequented by motorized vessels, and thus, it is highly unlikely that the strandings resulted from human interactions. Another source of mortality in Cook Inlet is killer whale predation. Killer whale sightings were rare in the upper Inlet prior to the 1990s, but have increased to include 18 confirmed sightings from 1985 to 2002 (Shelden et al. 2003). Recently, three predation events occurred in the upper Inlet; one in September 1999 in which the outcome was unknown and one in September 2000 that involved two lactating females which subsequently died (Shelden et al. 2003), and one in 2003 (Vos and Shelden 2005).

Table 25. Cook Inlet beluga strandings investigated by NMFS (Vos and Shelden 2005).

Year	Total Dead (includes subsistence)	Natural or Unknown Cause	Number of Belugas Stranded (mortality known)
1994	10	7	186 (0)
1995	12	1	
1996	19	11	63(0), 60(4), 25(1), 1(0), 15(0)
1997	6	3	
1998	21	7	30(0), 5(0)
1999	13	13	58(5), 13(0)
2000	13	13 (2 killer whale)	8(0), 15-20(0), 2(0)
2001	11	10	
2002	14	13	
2003	21	20 (1 killer whale)	2(0), 46(5), 26(0), 32(0), 9(0)
Total	140	98	580-586 (15)

STATUS OF STOCK

An analysis of available data on the population size and dynamics of the Cook Inlet beluga whale stock led NMFS to conclude that this stock is currently below its Optimum Sustainable Population level. Thus, this stock was designated as "depleted" under the MMPA (65 FR 34590; 31 May 2000). NMFS also made a determination that this stock should not be listed under the ESA at the time (65 FR 38778; 22 June 2000) primarily because the subsistence harvest, which appears to have been responsible for the majority of the decline in this stock, was prohibited in 1999 through an act of Congress. Once the subsistence harvest ceased, the decline in the stock ceased (65 FR 38778; 22 June 2000, Hobbs et al. 2000a). However, the lack of a significant trend since 1998 indicates that recovery has not yet begun. Two fisheries suspected of possibly incurring incidental serious injuries or mortalities of beluga whales were observed in 1999 and 2000, and no takes of beluga whales were observed. At present, annual U. S. commercial fishery-related mortality levels can be considered insignificant and approaching zero mortality and serious injury rate. In addition, based on the level of subsistence harvest in 1999 and the fact that there is currently a moratorium on the harvest, the annual level of human-caused mortality (1.0) is not known to exceed the PBR (undetermined) level for this stock. However, because the Cook Inlet beluga whale stock has been designated as "depleted" under the MMPA, the Cook Inlet beluga whale stock is classified as strategic.

Efforts to develop co-management agreements with Native organizations for several marine mammal stocks harvested by Native subsistence hunters across Alaska, including belugas in Cook Inlet, have been underway for several years. In 1995, development of an umbrella agreement among the Indigenous People's Council for Marine Mammals, U.S. Fish and Wildlife Service, and NMFS was initiated. The agreement was ultimately signed in August 1997. During 1998, efforts were initiated to formalize a specific agreement with local Alaska Native organizations and NMFS regarding the management of Cook Inlet belugas, but without success. In the absence of a co-management agreement, Federal legislation was implemented in May 1999, placing a moratorium on beluga hunting in Cook Inlet until a co-management agreement is completed. Co-management agreements between NMFS and the Cook Inlet Marine Mammal Council have since signed each year since 2000.

Habitat Concerns

Observation and tagging data both indicate that the northernmost parts of upper Cook Inlet, including the Susitna Delta, Knik Arm, and Chickaloon Bay, are the focus of the stock's distribution in both summer (Rugh et al. 2000) and winter (Hobbs et al. 2005). Because of the very restricted range of this stock, Cook Inlet beluga can be assumed to be sensitive to human-induced or natural perturbations. Although the best available information indicated that human activities, including oil and gas development, had not caused the stock to be in danger of extinction as of 2000 (65 FR 38778; 22 June 2000), habitat concerns remain. Contaminants from a variety of sources, sound, onshore or offshore development, and construction have the potential to impact this stock or its habitat.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

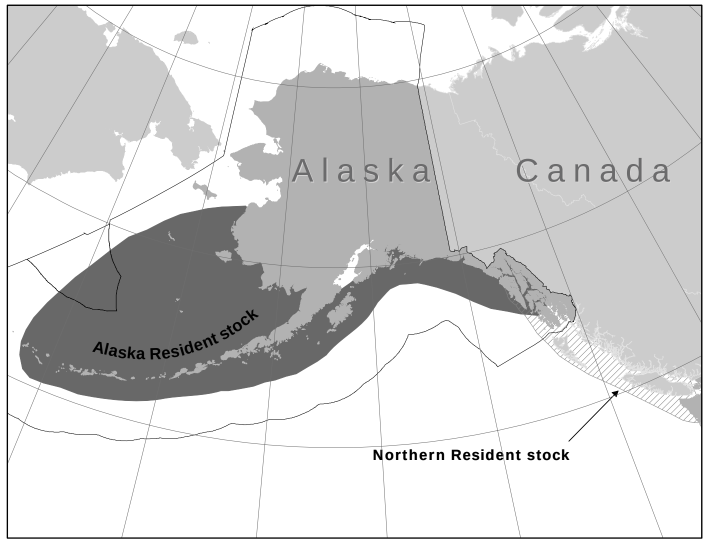

Figure 21. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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 occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, and Forney and Wade, in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; 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, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, acoustics and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). 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 (Matkin et al. 1999) and whales identified in southeastern 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 southeastern Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Separate stock assessment reports have always acknowledged the distinction between resident, offshore, and transient killer whale populations.

Within the resident ecotype, association data were used to describe three separate populations in the North Pacific: Southern Residents, Northern Residents and Alaska Residents (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999; Dahlheim et al. 1997). In previous stock assessment reports, the Alaska and northern resident populations were considered one stock. Acoustic data (Ford 1989, 1991; Yurk et al. 2002) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) have now confirmed that these three units represent discrete populations. The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia and has never been seen to associate with other resident stocks. The Northern Resident population is found in summer primarily in central and northern British Columbia. Members of the Northern Resident population have been documented in southeastern Alaska; however, they have not been seen to intermix with Alaskan residents. Alaskan resident whales are found from southeastern Alaska to the Aleutian Islands and Bering Sea. Intermixing of Alaska residents have been documented among the three areas.

Based on data regarding association patterns, movements, acoustics, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British

Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 21), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

Movement data on Alaska Resident stock members have been documented based on photographic matches. Southeastern Alaska killer whale pods have been seen in Prince William Sound (Matkin et al. 1997) and in the Gulf of Alaska. Prince William Sound pods have been seen near Kodiak Island but never observed in southeastern Alaska (Matkin et al. 2003, Dahlheim et al. 1997). New information on movements of western Alaska killer whales is being analyzed. However, recent studies have documented movements between the Bering Sea and Gulf of Alaska (NMML unpublished data).

POPULATION SIZE

The Alaska Resident stock includes killer whales from southeastern Alaska to the Aleutian Islands and Bering Sea. Preliminary analysis of photographic data resulted in the following minimum counts for 'resident' killer whales belonging to the Alaska Resident stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In southeastern Alaska, 117 'resident' whales have been identified as of 2004 (NMML and North Gulf Oceanic Society unpublished data). In Prince William Sound and Kenai Fjords, another 501 resident whales have been identified as of 2004 (Matkin et al. 2003; C. Matkin, North Gulf Oceanic Society, pers. comm.). In the last stock assessment, a minimum count of 68 western Alaska whales were added to the count because photo-identification data indicated that they associate with Prince William Sound whales. Given that this information is now over 10 years old, we opted to deduct these 68 whales from the current counts because there is no way to know whether these animals are alive.

Beginning in 2001, dedicated killer whale studies were initiated by NMML in Alaska waters west of Kodiak Island, including the Aleutian Islands and Bering Sea. Between 2001 and 2003 (not all data from 2003 have been analyzed), using field assessments based on morphology, association data, and genetic analyses, additional resident whales have now been added to the Alaska resident stock. Internal matches within the NMML data set have been subtracted, resulting in a final count of western Alaska residents for 2001 and 2003 as 464 whales. Studies conducted in western Alaska by the North Gulf Oceanic Society (NGOS) have resulted in the collection of photographs of approximately 600 resident killer whales; however, the NGOS and NMML data sets have not yet been matched so it is unknown how many of these 600 animals are included in the NMML collection. Another 41 whales were identified off Kodiak between 2000 and 2003 by the NGOS. These whales are added to the total of western Alaska residents although they have not been matched to NMML photographs.

NMML conducted killer whale line-transect surveys for 3 years in July and August in 2001-2003. These surveys covered an area from approximately Resurrection Bay in the Kenai Fjords to the central Aleutians. The surveys covered an area from shore to 30-45 nautical miles offshore, with randomly located transects in a zigzag pattern. A total of 9053 km of tracklines were surveyed between the Kenai Peninsula (~150°W) and Amchitka Pass (~179ºW). A total of 41 on-effort sightings of killer whales were recorded, with an additional 16 sightings off-effort. Estimated abundance of resident killer whale from these surveys was 991 (CV = 0.52), with 95% confidence interval of 380-2585 (Zerbini et al. 2006).

The line transect surveys provide an "instantaneous" (across ~40 days) estimate of the number of resident killer whales in the survey area. It should be noted that the photographic catalogue encompasses a larger area, including some data from areas such as Prince William Sound and the Bering Sea that were outside the line-transect survey area. Additionally, the number of whales in the photographic catalogue is a documentation of all whales seen in the area over the time period of the catalogue; movements of some individual whales have been documented between the line-transect survey area and locations outside the survey area. Accordingly, a larger number of resident killer whales may use the line-transect survey area at some point over the 3 years than would necessarily be found at one time in the survey area in July and August in a particular year.

Combining the counts of known 'resident' whales gives a minimum number of 1,123 (Southeast Alaska + Prince William Sound + Western Alaska; 117 + 501 + 505) killer whales belonging to the Alaska Resident stock (Table 26).

Table 26. Numbers of animals in each pod of killer whales belonging to the Alaska Resident stock of killer whales. A number followed by a "+" indicates a minimum count for that pod.

Pod ID	**1999/00 estimate (and source)**	**2001/2004 estimate (and Source)**
Southeast Alaska		
AF	49 (Dahlheim et al. 1997, Matkin et al. 1999)	61 (C. Matkin, NGOS, pers. comm.)
AG	27 (Dahlheim et al. 1997, Matkin et al. 1999)	33 (C. Matkin, NGOS, pers. comm.)
AZ	23+ (Dahlheim, AFSC-NMML, pers. comm.)	23+ (Dahlheim et al. 1997)
Total, Southeast Alaska	**99+**	**117+**
Prince William Sound	**Matkin et al. 1999**	**Matkin et al. 2003 and C. Matkin, NGOS, pers. comm.**
AA	---	8
AB	25	19
AB25	---	10
AD05	---	16
AD16	7	4
AE	16	19
AH01		9
AH20		12
AI	7	7
AJ	38	42
AK	12	13
AN10	20	27
AN20	assume 9	33
AS	assume 20	21
AS30		14
AW		24
AX01	21	20
AX27		24
AX32		15
AX40		14
AX48		20
AY	assume 11	18
Unassigned to pods	138 (C. Matkin, NGOS, pers. comm.)	112
Total, Prince William Sound	**341**	**501**
Western Alaska	**Dahlheim 1997 and NMML unpublished data**	**2001/2003 NMML unpublished data**
Unassigned to pods (NMML)	68+	464
Unassigned to pods (NGOS; Kodiak waters only)		41 (C. Matkin, NGOS, pers. comm.)
Total, Western Alaska	**68+**	**505**
Total, all areas	**507**	**1,123**

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Thus the minimum population estimate (N_{MIN}) for the Alaska Resident stock of killer whales is 1,123 animals. Other estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) are not currently available. 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 resident whales within southeastern Alaska and Prince William Sound is relatively low (NMML unpublished data). Conversely, the rate of discovery of new whales in western Alaska was initially high (i.e., 2001 and 2002 field seasons). However, recent photographic data collected during 2003 and preliminary data from 2004 indicates that the rate of discovering new individual whales has decreased (NMML unpublished data).

Using the line-transect estimate of 991 (CV = 0.52) results in an estimate of N_{MIN} (20th percentile) of 656. This is lower than the minimum number of individuals identified from photographs in recent years, so the photographic catalogue number is used for PBR calculations.

Some overlap of Northern Resident whales occur with the Alaska Resident stock in southeastern Alaska. However, information on the percentage of time that the Northern Resident stock spends in Alaskan 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

Recent data from Matkin et al. (2003) indicate that the component of the Alaska resident stock that summers in the Prince William Sound and Kenai Fjords area is increasing. With the exception of AB pod, which declined drastically after the *Exxon Valdez* oil spill and has not yet recovered, the component of the Alaska resident stock in the Prince William Sound and Kenai Fjords area has increased 3.3% per year from 1984 to 2002. Although the current minimum population count of 1,123 is higher than the last population count of 507, examination of only count data does not provide a direct indication of the net recruitment into the population. At present, reliable data on trends in population abundance for the entire Alaska 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), and 3.3% over the period 1984-2002 (Matkin et al. 2003). Until additional stock-specific 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 reauthorized 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 Alaska Resident killer whale stock, PBR = 11.2 animals ($1{,}123 \times 0.02 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In previous assessments, there were six different commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these commercial fisheries were changed to reflect target species; this new definition has resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were three which incurred serious injuries or mortalities of killer whales (any stock) between 2000 and 2004: the BSAI flatfish trawl, the BSAI pollock trawl, and the BSAI Pacific cod longline. The mean annual (total) mortality rate for all fisheries for 2000-2004 was 1.9 (CV = 0.42). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006).

Over the past few years, observers have collected tissue samples of many of the killer whales which were killed incidental to commercial fisheries. Genetics analyses of samples from the killer whales have indicated that the mortalities incidental to the BSAI flatfish trawl and the BSAI Pacific cod fisheries are of the "resident" type, and mortalities incidental to the BSAI pollock trawl fishery are of the "transient" type (M. Dahlheim, pers. comm.). Thus, the mean annual estimated level of serious injury and mortality of Alaska resident killer whales is 1.48/year (Table 27).

Typically, if serious injury and mortality occurs incidental to commercial fishing, it is due to interactions with the fishing gear. However, reports indicate that observed killer whale mortalities incidental to the BSAI flatfish trawl fishery occur due to contact with the ship's propeller.

Table 27. Summary of incidental mortality of killer whales (Alaska resident stock) due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6. * A second killer whale mortality may have occurred in 2004; genetics results determining whether the samples are from one, or two individuals, are pending.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
BSAI flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	0 1 0 0 1*	0 1.5 0 0 1.8	0.64 (CV = 0.44)
BSAI Pacific cod longline	2000 2001 2002 2003 2004	obs data	35.2 29.5 29.6 29.9 23.8	0 0 0 1 0	0 0 0 4.2 0	0.84 (CV = 0.87)
Estimated total annual mortality						1.48 (CV = 0.53)

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 1.5 animals per year, based exclusively on observer data.

Subsistence/Native Harvest Information

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

Other Mortality

During the 1992 killer whale 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 be related to gunshot wounds or effects of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994). It is unknown what group or groups of individuals are responsible for shooting at killer whales.

There have been no obvious bullet wounds observed on killer whales during recent surveys in the Bering Sea and western Gulf of Alaska (J. Durban, NMML, pers. comm.). However, researchers have reported that killer whale pods in certain areas exhibit vessel avoidance behavior, which may indicate that shootings occur in some places.

Other Issues

Killer whales are known to predate on longline catch in the Bering Sea (Dahlheim 1988; Yano and Dahlheim 1995; Perez 2003; Sigler et al. 2002; Perez 2006) and in the Gulf of Alaska (Sigler et al. 2002, Perez 2006). In addition, there are many reports of killer whales consuming the processing waste of Bering Sea groundfish trawl fishing vessels (Perez 2006). However, the ‘resident’ stock of killer whales is most likely to be involved in such fishery interactions since these whales are known to be fish eaters, while ‘transient’ whales have only been observed feeding on marine mammals.

Recently, several fisheries 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, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115). On some vessels, the waste is discharged in the vicinity of the vessel’s propeller (NMFS unpublished data); consumption of the processing waste in the vicinity of the propeller may be the cause of the propeller-caused mortalities of resident killer whales in the BSAI flatfish trawl fishery.

STATUS OF STOCK

The eastern North Pacific Alaska Resident stock of killer whales is not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The minimum abundance estimate for the Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Gulf of Alaska and western Alaskan waters. Because the population estimate is likely to be conservative, the PBR is also conservative.

Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (1.5) exceeds 10% of the PBR (1.1) 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 (1.5 animals per year) is not known to exceed the PBR (11.2). Therefore, the eastern North Pacific Alaska 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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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 occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, Forney and Wade, in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; 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, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). 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 (Matkin et al. 1999) 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).

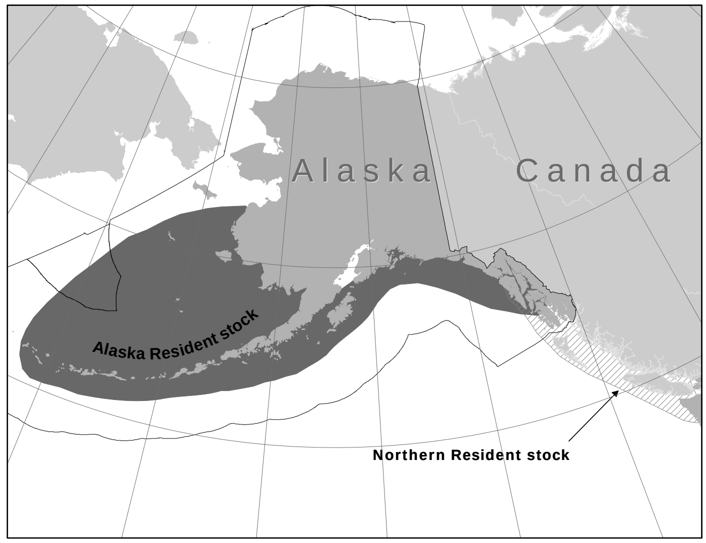

Figure 22. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Within the resident ecotype, association data were initially used to describe three separate communities in the North Pacific (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999). The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia. The Northern Resident population is found in summer primarily in central and northern British Columbia. Resident whales are found throughout Alaska. Acoustic data (Ford 1989, 1991; Yurk et al. 2002) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) have confirmed that these three units represent discrete populations. Separate stock assessment reports have always acknowledged the distinction between residents, offshore, and transient killer whale populations.

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 22), 5) the AT1 transient stock -

occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

The known range of the Northern Resident stock includes Canadian waters from approximately Mid-Vancouver Island and throughout most of southeastern Alaskan waters (Ford et al. 2000, Dahlheim unpublished data). They have been seen infrequently in Washington state waters.

POPULATION SIZE

The Eastern North Pacific Northern Resident stock is a transboundary stock, and includes killer whales that frequent British Columbia, Canada and southeastern Alaska. Photo-identification studies since 1970 (Ford et al. 2000) have catalogued every individual in this population resulting in the following minimum count 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). A count of 216 'resident' whales was made as of 1998 (Ford et al. 2000; Table 28). Births and deaths since 1998 are not accounted for here.

Table 28. Numbers of animals in each pod of killer whales belonging to the Eastern North Pacific Northern Resident stock of killer whales.

British Columbia	**Ford et al. 1994**	**Ford et al. 2000**
A1	15	16
A4	11	11
A5	12	13
B1	9	7
C1	13	14
D1	7	12
H1	8	9
I1	10	8
I2	7	2
I18	19	16
G1	28	29
G12	11	13
I11	18	22
I31	10	12
R1	23	29
W1	3	3
Total	**204**	**216**

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Other estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) are not currently available. Because this population has been studied for such a long time period, each individual is well documented and, except for births, no new individuals are expected to be discovered. Therefore, the estimated population size of 216 animals can also serve as a minimum count of the population.

Thus, the minimum population estimate (N_{MIN}) for the Northern Resident stock of killer whales is 216 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. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

Current Population Trend

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). These rates were for combined northern and southern resident communities. Recent analyses indicate that some pods in the Northern Resident population had increased at approximately 3% per year and were apparently approaching carrying capacity since the rates of increase appeared to be slowing (P. Olesiuk as reported in Dahlheim et al. 2000).

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 British Columbia and Washington waters 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). Until more recent stock-specific 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 reauthorized 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 = 2.16 animals ($216 \times 0.02 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Due to limited Canadian observer program coverage, there are few data on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries 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

The shooting of killer whales in Canadian waters has 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, Pacific Biological Station, Canada, pers. comm.).

Other Issues

In U.S. waters, there is considerable interaction between killer whales and fisheries aside from incidental take. Interactions between killer whales and longline vessels, specifically predation by killer whales on sablefish catch, have been well documented (Dahlheim 1988, Yano and Dahlheim 1995, Sigler et al. 2002). However, it is unknown whether these interactions also occur in Canada.

STATUS OF STOCK

The Northern Resident killer whale stock is not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. In April 1999, the Committee on the Status of Endangered Wildlife in Canada voted to designate all resident killer whales in British Columbia as "threatened", and the designation appears to have been based on the fact that the small size and low growth rate make the northern resident populations at risk from immunotoxic effects of persistent toxic chemicals and a reduction in prey availability (Baird 1999). Baird (1999) also indicates that the commercial and recreational whale watching industry may be having an impact. It is likely that the human-caused mortality level for this stock is underestimated. The human-caused mortality has been underestimated due primarily to a lack of information on Canadian fisheries; however, a review of the status of killer whales in Canada indicates that the available evidence suggests that mortality incidental to commercial fisheries is rare and does not have the potential to cause substantial population reductions in the future (Baird, 1999).

Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level is zero, which does not exceed 10% of the PBR (0.22) and therefore is considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury is not known to exceed the PBR (2.2). 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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KILLER WHALE (*Orcinus orca*): Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

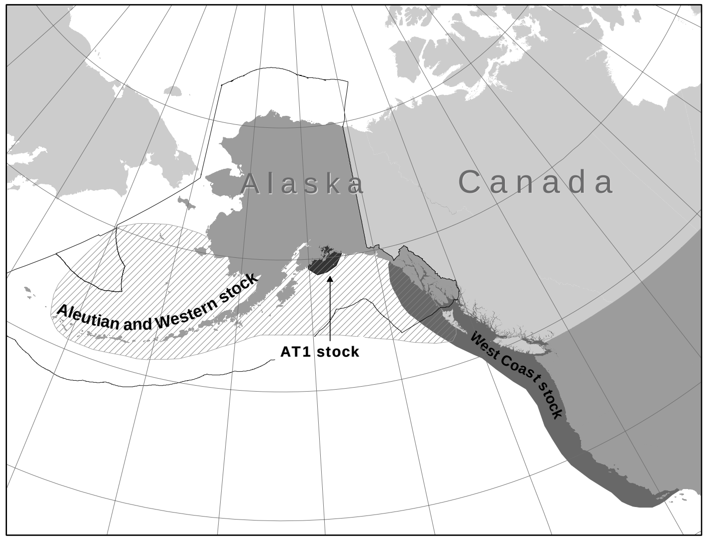

Figure 23. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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 occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade, in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; 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, where pods have been labeled as ‘resident,’ ‘transient,’ and ‘offshore’ (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). 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 (Matkin et al. 1999) 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).

Several studies provide evidence that the ‘resident’, ‘offshore’, and ‘transient’ ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the ‘transient’ and ‘resident’ ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales of Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called ‘Gulf of Alaska’ transients and ‘AT1’ transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the ‘west coast’ community. ‘Gulf of Alaska’ transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with ‘Gulf of Alaska’ transients. Transients that associate with the ‘Gulf of Alaska’ community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the ‘west coast’ community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) described acoustic differences between ‘Gulf of Alaska’ transients and AT1 transients. For these reasons, the ‘Gulf of Alaska’ transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the ‘west coast’ transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, North Gulf Oceanic Society unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. However, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this time, there are insufficient data to further resolve transient population structure in western Alaska. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are also seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales and they are assumed to be part of this stock if they are transient-type whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 23), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

In recent years, a small number of the 'Gulf of Alaska' transients (identified by genetics and association) have been seen in southeastern Alaska; previously only 'west coast' transients had been seen in southeastern Alaska. Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock occupies a range that includes all of the U.S. EEZ in Alaska, though few individuals from this population have been seen in southeastern Alaska.

POPULATION SIZE

In January 2004 the North Gulf Oceanic Society (NGOS) and the National Marine Mammal Laboratory (NMML) held a joint workshop to match identification photographs of transient killer whales from this population. That analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock. In the Gulf of Alaska (east of the Shumagin Islands), 60 whales were identified by NGOS, including whales from Matkin et al. (1999) as well as whales identified in subsequent years (but not including whales identified as part of the AT1 population). NMML identified 43 whales and 10 matches were found between the NGOS and NMML catalogues. Therefore, a total of 93 transients (60 + 43 - 10) have been identified in the Gulf of Alaska. In the Aleutian Islands (west of and including the Shumagin Islands) and Bering Sea, using data from 2001-03, NGOS identified a total of 123 transient killer whales. Over the same time period, NMML identified 124 transient killer whales. Twenty-six matches were found between these two catalogues, leaving a total of 221 transient whales (123+124-26) identified in the Aleutian Islands and Bering Sea (not counting 3 whales previously identified in the eastern area). Combining the counts of catalogued 'transient' whales gives a minimum number of 314 (93 + 221) transient killer whales belonging to the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock.

NMML conducted killer whale line-transect surveys for 3 years in July and August in 2001-2003. These surveys covered an area from approximately Resurrection Bay in the Kenai Fjords to the central Aleutians. The surveys covered an area from shore to 30-45 nautical miles offshore, with randomly located transects in a zigzag pattern. Estimated transient killer whale abundance from these surveys, using post-encounter estimates of group size, was 249 (CV = 0.50), with 95% confidence interval of 99-628 (Zerbini et al. 2006).

The line transect surveys provide an "instantaneous" (across ~40 days) estimate of the number of transient killer whales in the survey area. It should be noted that the photographic catalogue encompasses a larger area, including some data from areas such as Prince William Sound and the Bering Sea that were outside the line-transect survey area. Additionally, the number of whales in the photographic catalogue is a documentation of all whales seen in the area over the time period of the catalogue; movements of some individual whales have been documented between the line-transect survey area and locations outside the survey area. Accordingly, a larger number of transient killer whales may use the line-transect survey area at some point over the 3 years than would necessarily be found at one time in the survey area in July and August in a particular year.

Minimum Population Estimate

The 20^{th} percentile of the line transect survey estimate is 167. The photograph catalogue estimate of transient killer whales is a direct count of individually identifiable animals. However, the number of catalogued whales does not necessarily represent the number of live animals. Some animals may have died, but whales can not be presumed dead if not resighted because long periods of time between sightings are common for some 'transient' animals. The catalogue for the western area used data only from 2001 to 2003, decreasing the potential bias from using whales that may have died prior to the end of the time period. However, given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals catalogued is likely conservative.

Thus, the minimum population estimate (N_{MIN}) for the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is 314 animals based on the count of individuals using photo-identification.

Current Population Trend

At present, reliable data on trends in population abundance for the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient 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). Until stock-specific 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 reauthorized 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 with a mortality rate CV $\geq$ 0.80 (Wade and Angliss 1997). Thus, for the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient killer whale stock, PBR = 3.1 animals ($314 \times 0.02 \times 0.5$). The proportion of time that this trans-boundary stock spends in Canadian waters cannot be determined (G. Ellis, Pacific Biological Station, Canada, pers. comm.)

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In previous assessments, there were six different federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these fisheries were changed to reflect target species; these new definitions have resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were three which incurred serious injury and mortality of killer whales (any stock) between 2000 and 2004: the BSAI flatfish trawl, the BSAI pollock trawl, and the BSAI Pacific cod longline. The mean annual (total) mortality rate for all fisheries for 2000-2004 was 1.9 (CV = 0.42). Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006).

Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). Over the past few years, observers have collected tissue samples of many of the killer whales which were killed incidental to commercial fisheries. Genetics analyses of samples from the killer whales have indicated that the mortalities incidental to the BSAI flatfish trawl and the BSAI Pacific cod fisheries are of the "resident" type, and mortalities incidental to the BSAI pollock trawl fishery are of the "transient" type (M. Dahlheim, NMML-AFSC, pers. comm.). Thus, the mean annual estimated level of serious injury and mortality of the Gulf of Alaska, Aleutian Islands, Bering Sea transient killer whale stock is 0.4/year (Table 29).

Table 29. Summary of incidental mortality of killer whales (Eastern North Pacific Transient stock) due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 2000-2004 data. Details of how percent observer coverage is measured is included in Appendix 6. * Killer whale mortality seen by the observer, but not in a monitored haul.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
BSAI pollock trawl	2000	obs data	76.2	0	0	0.41
	2001		79.0	0	0	(CV = 0.22)
	2002		80.0	1	1	
	2003		82.2	0	1*	
	2004		81.2	0	0	
Estimated total annual takes						0.41 (CV = 0.22)

Subsistence/Native Harvest Information

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

Other Mortality

Collisions with boats are another source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale was struck by a propeller of a vessel in the Bering Sea groundfish trawl fishery.

Other Issues

Killer whales are known to predate on longline catch in the Bering Sea (Dahlheim 1988; Yano and Dahlheim 1995; Perez 2003; Perez 2006; Sigler et al. 2003) and in the Gulf of Alaska (Sigler et al. 2003, Perez 2006). In addition, there are many reports of killer whales consuming the processing waste of Bering Sea groundfish trawl fishing vessels (Perez 2006). However, the 'resident' stock of killer whales is most likely to be involved in such fishery interactions since these whales are known to be fish eaters, while 'transient' whales have only been observed feeding on marine mammals.

STATUS OF STOCK

The Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0.4) exceeds 10% of the PBR (0.3) 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 (0.4 animals per year) is less than the PBR (3.1). Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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KILLER WHALE (*Orcinus orca*):
AT1 Transient 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 occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade, in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; 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, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). 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 (Matkin et al. 1999b) 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).

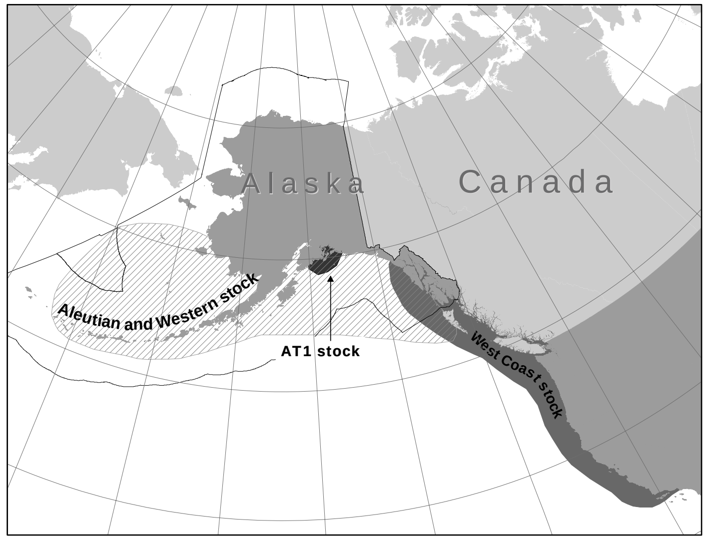

Figure 24. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

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Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, NGOS unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. On the other hand, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this point, there are insufficient data to resolve transient population structure in western Alaska any further. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 24), 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

AT1 killer whales were first identified as a separate, cohesive group in 1984, when 22 transient-type whales were documented in Prince William Sound (Leatherwood et al. 1984, Heise et al. 1991), though individual whales from the group had been photographed as early as 1978. Once the North Gulf Oceanic Society began consistent annual research effort in Prince William Sound, AT1 killer whales were re-sighted frequently. In fact, AT1 killer whales were found to be some of the most frequently sighted killer whales in Prince William Sound (Matkin et al. 1993, 1994). Gulf of Alaska transients are seen less frequently in Prince William Sound, with periods of several years between resightings not uncommon.

AT1 killer whales have never been seen in association with sympatric resident killer whale pods or with Gulf of Alaska transients (Matkin et al. 1999b). As discussed above, the AT1 group were found to be acoustically and genetically different from other transient killer whales in the North Pacific (Saulitis 1993, Barrett-Lennard 2000). AT1 killer whale transients are considered a population that is discrete from 'Gulf of Alaska' transients, which are part of the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock.

The AT1 transients appear to have a more limited geographic range than do other transients. Though seen mostly in Prince William Sound, some AT1s were photographed between Prince William Sound and Resurrection Bay in 1992 (K. Heise, Vancouver Aquarium, pers. comm. in Matkin and Saulitis 1994). It is now known that they can be seen in Prince William Sound and Resurrection and Aialik Bays of the Kenai Fjords year-round (Saulitis et al. 2000). However, they are not known to travel east of Prince William Sound or west of Kenai Fjords, Alaska, an apparent range of at least 200 miles (Matkin et al. 1999b).

POPULATION SIZE

Using photographic identification methods, all 22 individuals in the population were completely censused for the first time in 1984 (Leatherwood et al. 1984). All 22 AT1s were seen annually or biannually from 1984 to 1988 (Matkin et al. 1999a). The *Exxon Valdez* oil spill occurred in spring of 1989. Nine individuals from the AT1 group have been missing since 1990 (last seen in 1989), and 2 have been missing since 1992 (last seen in 1990 and 1991). All 11 are presumed dead (Matkin et al. 2000). Three of the AT1s that presumably died (AT5, AT7, and AT8) were seen near the *Exxon Valdez* (with AT6) shortly after the spill (Matkin et al. 1993, 1994). One of the 11 was confirmed dead – AT19 was found dead on a beach in the spring of 1990 (Matkin et al. 1994). Two other carcasses of killer whales were found in Prince William Sound in 1990, and one was found in 1992. Two of those three were confirmed as transients based on marine mammal parts found in their stomach (Matkin et al. 1994). A fifth killer whale carcass was found on Kayak Island 60 miles southeast of the sound, also with marine mammal parts in its stomach (date not reported) (Matkin et al. 1993). No other killer whale carcasses were found in the Prince William Sound region from 1983 through 1992 (Matkin et al. 1994). In addition, no strandings of killer whales were reported from Prince William Sound from 1975 to 1987 (Zimmerman 1991). In sum, these facts lead to the conclusion that the 11 whales missing since 1991 should be presumed dead, though only one whale was documented to have died.

In the AT1 group, all 11 individuals confirmed as alive after 1989 were seen nearly every year from 1990-92 (Matkin et al. 1994). The number of individuals seen in subsequent years was 8 in 1993, 5 in 1994, 11 in 1995, 9 in 1996, 6 in 1997, 8 in 1998, and 7 in 1999 (Matkin et al. 2000). Since 1993, only in 1995 was every individual whale seen in every year. However, when considering pairs of years, all 11 individuals were seen again in 1996-97, and all 11 individuals were seen again in 1998-99. Therefore, it can be concluded that no mortalities occurred between 1992 and 1998.

Using more current unpublished information, no births have occurred since 1999, and three additional individuals have not been seen in recent years. Therefore, the population size as of the summer of 2004 is thought to be eight whales (C. Matkin, North Gulf Oceanic Society, pers. comm.).

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. Only 11 whales were seen between 1990 and 1999. Since then, 3 of those whales have not been seen in recent years, so the minimum population estimate is 8 whales. Fourteen years of annual effort have failed to discover any whales that had not been seen previously, so there is no reason to believe there are additional whales in the population. Therefore, this minimum population estimate may be the total population size.

Current Population Trend

The population counts have declined from a level of 22 whales in 1989 to 8 whales in 2004, a decline of 64%. The bulk of the decline apparently occurred in 1989-90.

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). Until additional stock-specific 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 reauthorized 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 AT1 killer whale stock, PBR = 0 animals ($8 \times 0.02 \times 0.5$).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The known range of the AT1 stock is limited to waters of Prince William Sound and Kenai Fjords. There are no federally managed commercial fisheries in this area. State managed commercial fisheries prosecuted within the range of this stock, such as the Prince William Sound salmon set and drift gillnet fisheries, and various herring fisheries, are not known to incur incidental serious injuries or mortalities of AT1 killer whales.

Subsistence/Native Harvest Information

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

Other Mortality

Collisions with boats may be an occasional source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery. There have been no known mortalities of AT1 killer whales due to ship strikes.

STATUS OF STOCK

The AT1 Transient stock of killer whales was designated as "depleted" under the MMPA. Therefore, the AT1 Transient stock of killer whales is classified as a strategic stock. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0) does not exceed 10% of the PBR (0) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. At least 11 animals were alive in 1998, but it appears that as of 2004, only 8 individuals may be alive. Therefore, the AT1 group has been reduced to at least 50% (11/22) of its 1984 level, and has likely been reduced to 36% (8/22) of its 1984 level. The AT1 Transient stock of killer whales is not listed as "threatened" or "endangered" under the Endangered Species Act.

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KILLER WHALE (*Orcinus orca*): West Coast Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

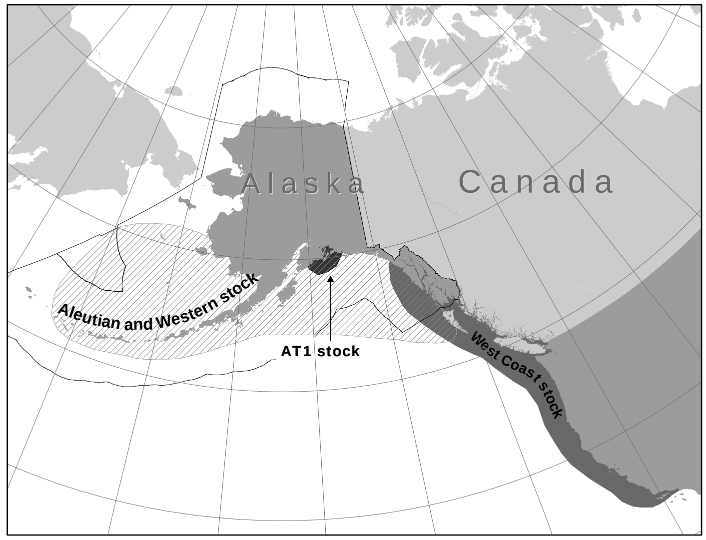

Figure 25. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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 occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade, in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; 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, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). 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 (Matkin et al. 1999) 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).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales in Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the 'west coast' stock. 'Gulf of Alaska' transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients that associate with the 'Gulf of Alaska' community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the 'west coast' community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons, the 'Gulf of Alaska' transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the 'west coast' transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, NGOS unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. On the other hand, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this point, there are insufficient data to resolve transient population structure in western Alaska any further. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 25), 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

The West Coast Transient Stock includes animals that occur in California, Oregon, Washington, British Columbia and southeastern Alaska. On many occasions, transient whales from the inland waters of southeastern Alaska have been seen in association with British Columbia/Washington State transients. On other occasions, some of those same British Columbia whales have been sighted with whales more frequently seen off California thus linking these whales by association.

POPULATION SIZE

The West Coast Transient stock is a trans-boundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the West Coast Transient stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In British Columbia and southeastern Alaska, 219 'transient' whales have been catalogued (Ford and Ellis 1999). Off the coast of California, 105 'transient' whales have been identified (Black et al. 1997): 10 whales were matched to photos of 'transients' in other catalogs and the remaining 95 were linked by association. An additional 14 whales in southeastern Alaska (M. Dahlheim unpubl. data) and 16 whales off the coast of California (N. Black, Monterey Bay Cetacean Project, pers. comm.) have been provisionally classified as 'transient' whales by association. Combining the counts of catalogued 'transient' whales gives a minimum number of 314 (219 + 95) killer whales belonging to the West Coast Transient stock.

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. However, the number of catalogued whales does not necessarily represent the number of live animals. Some animals may have died, but whales can not be presumed dead if not resighted because long periods of time between sightings are common for some 'transient' animals. On the other hand, given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals catalogued is likely conservative. However, the rate of discovering new whales within southeastern Alaska is relatively low. In addition, the abundance estimate does not include 14 whales from southeastern Alaska and 16 whales off the coast of California that have been provisionally classified as 'transients'.

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 Transient stock of killer whales is 314 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory trans-boundary 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 previous recommendations of the Alaska Scientific Review Group (DeMaster 1996).

Current Population Trend

At present, reliable data on trends in population abundance for the West Coast Transient 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 reauthorized 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 with a mortality rate CV $\geq$ 0.80 (Wade and Angliss 1997). Thus, for the Eastern North Pacific Transient killer whale stock, PBR = 3.1 animals ($314 \times 0.02 \times 0.5$). The proportion of time that this trans-boundary stock spends in Canadian waters cannot be determined (G. Ellis, Pacific Biological Station, Canada, pers. comm.)

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 1994 to 2003 (Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). The observed mortality in this fishery, in 1995, was a transient whale as determined by genetic testing (S. Chivers, NMFS-SWFSC, pers. comm.). Overall entanglement rates in the California/Oregon thresher shark/swordfish drift gillnet fishery dropped considerably after the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders (Barlow and Cameron 1999). Because the California/Oregon thresher shark/swordfish drift gillnet fishery is observed and has not incurred incidental serious injuries or mortalities of killer whales between 1999-2003, the estimate of fishery-related take for this fishery is zero. Thus, the mean annual mortality rate for this stock is zero. Additional fisheries that could interact with the Eastern North Pacific Transient stock of killer whales are listed in Appendix 3.

The estimated minimum mortality rate incidental to recently monitored U.S. commercial fisheries is zero animals per year.

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 it 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

The shooting of killer whales in Canadian waters has been a concern in the past. However, in recent years there have been no reports of shooting incidents in Canadian waters. In fact, the likelihood of shooting incidents involving 'transient' killer whales is thought to be minimal since commercial fishermen are most likely to observe 'transients' feeding on seals or sea lions instead of interacting with their fishing gear (G. Ellis, Pacific Biological Station, Canada, pers. comm.).

Collisions with boats are another source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery. There have been no reported mortalities of killer whales from this stock due to ship strikes.

STATUS OF STOCK

The West Coast transient killer whale stock is not designated 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, primarily due 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 provisionally classified whales from southeastern Alaska and off the coast of California were not included), resulting in a conservative PBR estimate. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0) does not exceed 10% of the PBR (0.3) and, therefore, can 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 animals per year) does not exceed the PBR (3.1). Therefore, the West Coast Transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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PACIFIC WHITE-SIDED DOLPHIN (*Lagenorhynchus obliquidens*): 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 (Ferrero and Walker 1996)

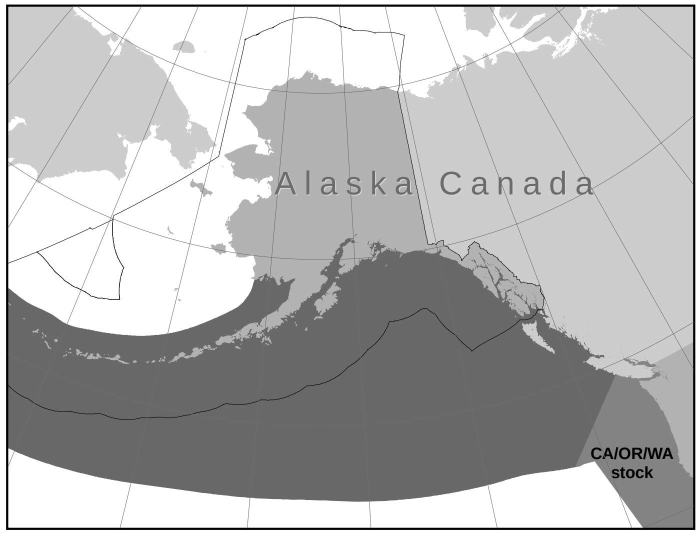

Figure 26. Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (shaded area).

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 et al. 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 U.S. west coast, British Columbia/southeast Alaska, and offshore) were not statistically significant to support phylogeographic partitioning, though they support the hypothesis that animals from the different regions are sufficiently isolated to treat them as separate management units (Lux et al. 1997). Given this limited information, stock structure throughout the North Pacific is poorly defined, but a northern form occurs north of about 33°N from southern California along the coast to Alaska, a southern form ranges from about 36°N southward along the coasts of California and Baja California while the core of the population ranges across the North Pacific to Japan at latitudes south of 45°N. Data are lacking to determine whether this latter group might include animals from one or both of the coastal forms. However, because the California and Oregon thresher shark/swordfish drift gillnet fishery (operating between 33°N and approximately 47°N) and, to a lesser extent, the groundfish and salmon fisheries in Alaska are known to interact with Pacific white-sided dolphins, two management stocks are recognized: 1) the California/Oregon/Washington stock, and 2) the North Pacific stock (Fig. 26). The California/Oregon/ Washington stock is reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

The most complete 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 Buckland et al. (1993) abundance estimate, 931,000 (CV = 0.90) animals, more closely reflects a range-wide estimate rather than one that can be applied to either of the two management stocks off the west coast of North America. Furthermore, Buckland et al. (1993) suggested that Pacific white-sided dolphins show strong vessel attraction but that a correction factor was not available to apply to the estimate. While the Buckland et al. (1993) abundance estimate is not considered appropriate to apply to the management stock in Alaskan waters, the portion of the estimate derived from sightings north of 45°N in the Gulf of Alaska can be used as the population estimate for this area (26,880). For comparison, Hobbs and Lerczak (1993) estimated 15,200 Pacific white-sided dolphins in the Gulf of Alaska based on a single sighting of 20 animals. Small cetacean aerial surveys in the Gulf of Alaska during 1997 sighted one group of 164 Pacific white-sided dolphins off Dixon entrance, while similar surveys in Bristol Bay in 1999 made 18 sightings of a school or parts thereof off Port Moller (R. Hobbs, NMFS-NMML, pers. comm.).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock would be 26,880, based on the sum of abundance estimates for 4 separate 5° × 5° blocks north of 45°N (1,970+6,427+6,101+12,382 = 26,880) reported in Buckland et al. (1993). This is considered a minimum estimate because the abundance of animals in a fifth 5° by 5° block (53,885) which straddled the boundary of the two coastal management stocks were not included in the estimate for the North Pacific stock and because much of the potential habitat for this stock was not surveyed between 1987 - 1990. However, because the abundance estimate used in this calculation is more than 8 years old, the minimum population estimate for this stock is unknown.

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. Recent life history analyses by Ferrero and Walker (1996) suggest a reproductive strategy consistent with the delphinid pattern on which the 4% cetacean maximum net productivity rate (R_{MAX}) was based. 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 reauthorized 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 North Pacific stock of Pacific white-sided dolphin, PBR would be 269 animals (26,880 × 0.02 × 0.5). Wade and Angliss (1997) recommend that abundance estimates older than 8 years no longer be used to calculate a PBR level. In addition, there is no corroborating evidence from recent surveys in Alaska that provide abundance estimates for a portion of the stock's range or any indication of the current status of this stock. Thus, the PBR for this stock is undetermined.

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.

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Pacific white-sided dolphins. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. There were no serious injuries or mortalities incidental to observed commercial fisheries between 2000 and 2004 (Perez 2006).

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).

Note that 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, because the stock size is large, it is unlikely that unreported mortalities from those fisheries would be significant.

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. The level of human-caused mortality and serious injury (0) is not known to exceed the PBR, which is undetermined as the most recent abundance estimate is more than 8 years old. Because the PBR for Pacific white-sided dolphin is undetermined, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The 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 and in the Gulf of Alaska and Southeast Alaska, they occur most frequently in waters less than 100 m in depth (Hobbs and Waite in review). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay, Yakutat Bay, Copper River Delta, and Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite in review). 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 specimens 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.

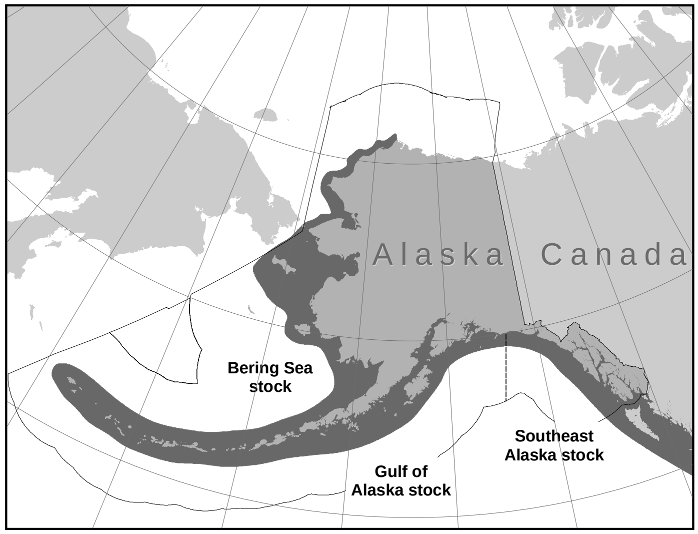

Figure 27. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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 Scientific Review Group (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). Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended, recognizing that the boundaries were set arbitrarily: 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. 27). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental United States (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) is in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

In June and July of 1997, an aerial survey covering the waters of the eastern Gulf of Alaska from Dixon Entrance to Cape Suckling and offshore to the 1,000 fathom depth contour resulted in an uncorrected abundance estimate of 3,698 (CV = 0.162) animals (Hobbs and Waite in review). Included were the inside waters of Southeast Alaska, Yakutat Bay, and Icy Bay were included in addition to the offshore waters. The total area surveyed across inside waters, was 106,087km^2. Only a fraction of the small bays and inlets (< 5.5 km wide) of Southeast Alaska were surveyed and included in this abundance estimate, although the areas omitted represent only a small fraction of the total survey area. The observed abundance estimate was multiplied by correction factors for availability bias (to correct for animals not available to be seen because they were diving and perception bias (to correct for animals not seen because they were missed) to obtain a corrected abundance estimate. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988; Calambokidis et al. 1993) because it is an empirical estimate of perception bias. A second independent observer was used to estimate the average availability bias as 1.56 (CV = 0.108). The estimated corrected abundance from this survey is 17,076 ($3{,}698 \times 2.96 \times 1.56$; CV = 0.265) harbor porpoise for Southeast Alaska.

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 17,076 and its associated CV (0.265), N_{MIN} for this stock is 13,713.

Current Population Trend

The abundance of harbor porpoise in Southeast Alaska was estimated for 1993 and 1997. The 1993 estimate was 10,301 (Dahlheim et al. 2000). The 1997 estimate of 17,076 is higher than the 1993 estimate (Hobbs and Waite in review). However, these estimates are not directly comparable because the area surveyed in 1997 was larger than that in 1993, and because the 1997 abundance estimation involved direct calculation of perception bias, while the 1993 estimate used a correction factor based on some untested assumptions about observer behavior and visibility of harbor porpoise. Thus, while the estimates are not significantly different, 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 reauthorized 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 = 137 animals ($13{,}713 \times 0.02 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with the Southeast Alaska stock of harbor porpoise. As of 2003, changes in fishery definitions in the List of Fisheries resulted in separating the GOA groundfish fisheries into many fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. These fisheries (Pacific cod longline, Pacific halibut longline, rockfish longline, and sablefish longline) were monitored for incidental mortality by fishery observers from 2000 to 2004, although observer coverage has been very low in the offshore waters of Southeast Alaska. No mortalities from this stock of harbor porpoise incidental to commercial groundfish fisheries have been observed.

For this stock of harbor porpoise, the estimated minimum annual mortality rate incidental to commercial fisheries is 0. 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.

Subsistence/Native Harvest Information

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

Other mortality

There was an unconfirmed report of an entanglement of a harbor porpoise in a subsistence drift gillnet near Haines in 2001.

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. At present, U.S. commercial fishery-related annual mortality levels less than 13.7 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 (0) is not known to exceed the PBR (137). However, because the abundance estimates are quite old, long-term survey information suggests a decline in the Southeast Alaska population, and information on incidental harbor porpoise mortality in commercial fisheries is not well known, the Southeast Alaska stock of harbor porpoise is 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, and in the Gulf of Alaska and Southeast Alaska, they occur most frequently in waters less than 100 m in depth (Hobbs and Waite in review). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay, Yakutat Bay, Copper River Delta, and Sitkalidak Strait. 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 four of the six 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 specimens 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.

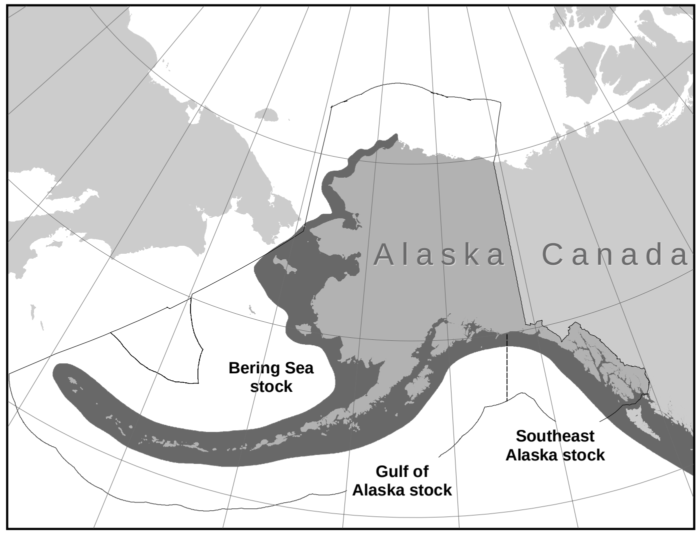

Figure 28. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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 Scientific Review Group (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). Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended, recognizing that the boundaries were set arbitrarily: 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. 28). Information concerning the four harbor porpoise stocks occurring along the west coast of the continental United States (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) is in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

In June and July of 1998 an aerial survey covering the waters of the western Gulf of Alaska from Cape Suckling to Sutwik Island, offshore to the 1,000 fathom depth contour resulted in an uncorrected abundance estimate for the Gulf of Alaska harbor porpoise stock of 10,306 (CV = 0.115) animals (Hobbs and Waite in review). The uncorrected abundance estimate was multiplied by correction factors for availability bias (to correct for animals not available to be seen because they were diving) and perception bias (to correct for animals not seen because they were missed) to obtain a corrected abundance estimate. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988; Calambokidis et al. 1993) because it is an empirical estimate of availability bias. A second independent observer was used to estimate the average perception bias as 1.372 (CV = 0.066). The estimated corrected abundance estimate from this survey is 41,854 ($10{,}306 \times 2.96 \times 1.372 = 41{,}854$; CV = 0.224).

The latest estimate of abundance (41,854; CV = 0.224) is based on surveys conducted in 1998, and is considerably higher than the previous estimate in the 1999 stock assessment (8,271; CV = 0.309). This disparity largely stems from changes in the area covered by the two surveys and differences in harbor porpoise density encountered in areas added to, or dropped from, the 1998 survey, relative to the 1991-93 surveys. The survey area in 1998 (119,183 km^2) was greater than the area covered in the composited portions of the 1991, 1992 and 1993 surveys (106,600 km^2). The 1998 survey included the waters of Prince William Sound, the bays, channels, and inlets of the Kenai Peninsula, the Alaska Peninsula and Kodiak Archipelago whereas the earlier survey included only open water areas. Several of the bays and inlets covered by the 1998 survey had higher harbor porpoise densities than observed in the open waters. In addition, the 1998 estimate provided by Hobbs and Waite (in review) empirically estimates the perception bias, and use this in addition to the correction factor for availability bias. And finally, the 1998 estimate extrapolates available densities to estimate the number of porpoise which would likely be found in unsurveyed inlets within the study area. The 1998 survey result is probably more representative of the size of the Gulf of Alaska harbor porpoise stock since it included more of the inshore habitat commonly used by harbor porpoise.

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 41,854 and its associated CV of 0.224, N_{MIN} for the Gulf of Alaska stock of harbor porpoise is 34,740.

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 reauthorized 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 = 347 animals ($34{,}740 \times 0.02 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Prior to 2003, 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: Gulf of Alaska groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the List of Fisheries resulted in separating these 3 GOA fisheries into 10 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. 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 one mortality in 1990 and three mortalities in 1991. These mortalities extrapolated to eight (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). The Prince William Sound salmon drift gillnet fishery has not been observed since 1991; therefore, no additional data are available for that fishery.

In 1999 and 2000, observers were placed on the Cook Inlet salmon set and drift gillnet vessels because of the potential for these fisheries to incur incidental mortalities of beluga whales. One harbor porpoise mortality was observed in 2000 (Manly in review). This single mortality extrapolates to an estimated mortality level of 31.2 for that year, and an average of 15.6 per year when averaged over the two years of observer data.

In 2002, observers were placed on Kodiak Island set gillnet vessels. Two harbor porpoise mortalities were observed in this fishery. These mortalities extrapolate to an estimated mortality level of 32.2 animals per year (Manly et al. 2003).

Table 30. Summary of incidental mortality of harbor porpoise (Gulf of Alaska stock) due to fisheries from 1990 through 2004 and calculation of the mean annual mortality rate. N/A indicates that data were not available.

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	1990-1991	obs data	4-5%	1, 3	8, 32	20 (CV = 0.60)
Cook Inlet salmon drift gillnet	1999 2000	obs data	1.8% 3.7%	0 1	0 31.2	15.6
Cook Inlet salmon set gillnet	1999 2000	obs data	7.3% 8.3%	0 0	0 0	0
Kodiak Island set gillnet	2002	obs data	6.0%	2	32.2	32.2 (CV = 0.68)
Minimum total annual mortality						67.8

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 30. There were no confirmed reports of strandings of harbor porpoise in this area from 1999-2003.

A reliable estimate of the mortality rate incidental to commercial fisheries is considered unavailable because of the absence of observer placements in several salmon gillnet fisheries. However, the estimated minimum annual mortality rate incidental to U. S. commercial fisheries is 68 (Table 30).

Subsistence/Native Harvest Information

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

Other Mortality

In 1995, two harbor porpoise were taken incidentally in subsistence gillnets, one near Homer Spit and the other near Port Graham.

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. At present, U.S. commercial fishery-related annual mortality levels less than 34.7 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 (70; 68 mortalities in commercial fisheries plus 2 in subsistence gillnets) is not known to exceed the PBR (347). However, because the abundance estimates are quite old and information on incidental harbor porpoise mortality in commercial fisheries is not well understood, the Gulf of Alaska stock of harbor porpoise is classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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Revised 5/15/06

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, and in the Gulf of Alaska and Southeast Alaska, they occur most frequently in waters less than 100 m in depth (Hobbs and Waite in review). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay, Yakutat Bay, Copper River Delta, and Sitkalidak Strait. 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 specimens 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.

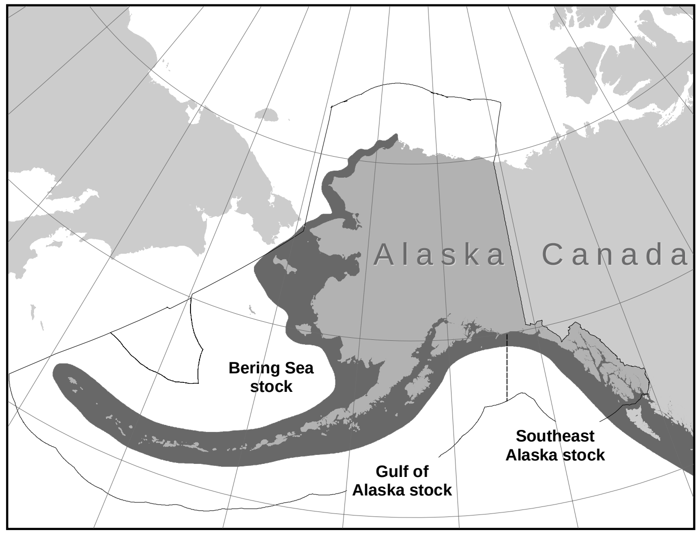

Figure 29. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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 Scientific Review Group (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). Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended, recognizing that the boundaries were set arbitrarily: 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. 29). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental United States (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) is in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

In June and July of 1999, an aerial survey covering the waters of Bristol Bay resulted in an uncorrected abundance estimate for the Bering Sea harbor porpoise stock of 16,271 (CV = 0.132; Hobbs and Waite in review).

The uncorrected abundance estimate was multiplied by correction factors for availability bias (to correct for animals not available to be seen because they were diving) and perception bias (to correct for animals not seen because they were missed) to obtain a corrected abundance estimate. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow 1988; Calambokidis et al. 1993) because it is an empirical estimate of availability bias. A second independent observer was used to estimate the average perception bias as 1.372 (CV = 0.066). The estimated corrected abundance estimate is 66,078 ($16{,}271 \times 2.96 \times 1.372 = 66{,}078$; CV = 0.232). The estimate for 1999 can be considered conservative, as the surveyed areas did not include known harbor porpoise range near either the Pribilof Islands or in the waters north of Cape Newenham (approximately 59°N).

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 66,078 and its associated CV of 0.232), N_{MIN} for the Bering Sea stock of harbor porpoise is 54,492.

Current Population Trend

The abundance of harbor porpoise in Bristol Bay was estimated in 1991 and 1999. The 1991 estimate was 10,946 (Dahlheim et al. 2000). The 1999 estimate of 66,078 is higher than the 1991 estimate (Hobbs and Waite in review). However, there are some key differences between surveys which complicate direct comparisons. Transect lines were substantially more dense in 1999 than in 1991 and large numbers of porpoise were observed in 1999 in an area which was not surveyed intensely in 1991 (compare sightings in northeast Bristol Bay depicted in Figure 5 in Hobbs and Waite (in review) with Figure 4 in Dahlheim et al. 2000). In addition, the use of a second correction factor for the 1999 estimate confounds direct comparison. The density of harbor porpoise resulting from the 1999 surveys was still substantially higher than that reported in Dahlheim et al. (2000), but it is unknown whether the increase in density is a result of a population increase or is a result of survey design. Thus, 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 reauthorized 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 = 545 animals ($54{,}492 \times 0.02 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Prior to 2003, 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 1990-98: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the List of Fisheries resulted in separating these fisheries into twelve fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. One harbor porpoise mortality was observed in 2001 in the Bering Sea/Aleutian Islands flatfish trawl. The mean annual (total) mortality rate resulting from observed mortalities was 0.35 (CV = 0.65).

Table 31. Summary of incidental mortality of harbor porpoise (Bering Sea stock) due to commercial fisheries from 2000 through 2004 and calculation of the mean annual mortality rate.

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) flatfish trawl	2000 2001 2002 2003 2004	obs data	64.5 57.6 58.4 64.1 64.3	0 1 0 0 0	0 1.7 0 0 0	0.35 (CV = 0.65)
Minimum total annual mortality						0.35 (CV = 0.65)

The estimated minimum annual mortality rate incidental to commercial fisheries is 0.35 animals (Table 31). However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in several salmon gillnet fisheries. Therefore, it is unknown whether the kill rate is insignificant.

Subsistence/Native Harvest Information

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

Other Mortality

There have been historic reports of harbor porpoise mortalities in subsistence gillnets in the area from Nome to Unalakleet (Barlow et al. 1994) and near Point Barrow (Suydam and George 1992). The only reports received between 1999 and 2003 were an unconfirmed report of a subsistence entanglement of two animals near Elim, and a third confirmed report of an entangled animal near Emmonak.

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. At present, U.S. commercial fishery-related annual mortality levels less than 54.5 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 (0.35) is not known to exceed the PBR (545). However, because the abundance estimates are quite old and information on incidental mortality in commercial fisheries is not well understood, the Bering Sea stock of harbor porpoise is 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. 30). 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 United States (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).

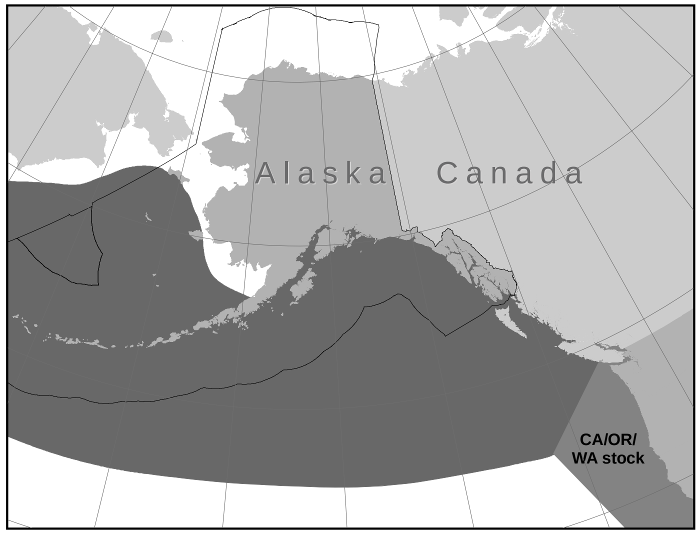

Figure 30. Approximate distribution of Dall's porpoise in Alaska waters (shaded area).

Recent surveys in the central-eastern and southeastern Bering Sea in 1999 and 2000 (see Fig. 40 for locations of surveys) resulted in new information about the distribution and relative abundance of Dall's porpoise in these areas (Moore et al. 2002). Dall's porpoise were abundant in both areas, were consistently found in deeper water (286 m, SE = 23 m) than harbor porpoise (67 m; SE = 3 m; t-test, $P < 0.0001$) and were particularly clustered around the shelf break in the central-eastern Bering Sea (Moore et al. 2002).

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 (Jones et al. 1986) and preliminary genetics analyses Winans and Jones (1988), a delineation between Bering Sea and western North Pacific stocks has been recognized. 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 three 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 $\times$ 0.2) for this stock. No reliable abundance estimates for British Columbia are currently available.

Results of the surveys in 1999 and 2000 in the central-eastern Bering Sea and southeastern Bering Sea provided provisional estimates of 14,312 (CV = 0.26) and 9,807 (CV = 0.20) Dall's porpoise, respectively (Moore et al. 2002). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, and responsive movement. However, because these surveys did not cover the entire range of Dall's porpoise, they cannot be used to determine a minimum population estimate.

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 would be 76,874. However, since the abundance estimate is based on data older than 8 years, the N_{MIN} is considered unknown.

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). However, based on life history analyses in Ferrero and Walker (1999), Dall's porpoise reproductive strategy is not consistent with the delphinid pattern on which the default R_{MAX} for cetaceans is based. In contrast to the delphinids, Dall's porpoise mature earlier and reproduce annually which suggest that a higher R_{MAX} may be warranted, pending further analyses.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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). The PBR reported in the previous stock assessment was 1,537 animals (76,874 $\times$ 0.02 $\times$ 1.0). The estimate of abundance for Dall's porpoise is now more than 8 years old; Wade and Angliss (1997) recommend that abundance estimates older than 8 years no longer be used to calculate a PBR level. Thus, because the abundance estimate for this stock is quite old, the N_{MIN} is unknown and therefore the PBR level is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Steller sea lions and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. For the fisheries with observed takes, the range of observer coverage over the 5-year period (2000-2004), as well as the annual observed and estimated mortalities are presented in Table 32.

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 (5.4 + 0.3 + 0.2 =5.9) 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 33.9 porpoise per year from this stock.

The Prince William Sound salmon drift gillnet 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).

Table 32. Summary of incidental mortality of Dall's porpoise (Alaska stock) due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. * One Dall's porpoise mortality was seen by the observer, but not in a monitored haul.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/ Aleutian Is. (BSAI) pollock trawl	2000 2001 2002 2003 2004	obs data	76.2 79.0 80.0 82.2 81.2	3* 2 1 0 1	4.1 2.9 1.4 0 1.0	1.89 (CV = 0.17)
AK Peninsula/ Aleutian Island salmon drift gillnet	1990	obs data	4%	1	28	28 (CI: 1-81)
Minimum total annual mortality						29.9

Note that 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, due to the large stock size it is unlikely that unreported mortalities from those fisheries are a significant source of mortality.

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. The level of human-caused mortality and serious injury (30) is not known to exceed the PBR, which is undetermined as the most recent abundance estimate is more than 8 years old. Because the PBR is undetermined, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. 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. 31), with the northernmost boundary extending from Cape Navarin (62°N) to the Pribilof Islands (Omura 1955). 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 Mark 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 (CA), none were recovered north of 53° in the Gulf of Alaska despite large takes there (B. Taylor, NMFS-SWFSC, pers. comm.). Therefore, seasonal movement of sperm whales in the North Pacific is unclear at this time.

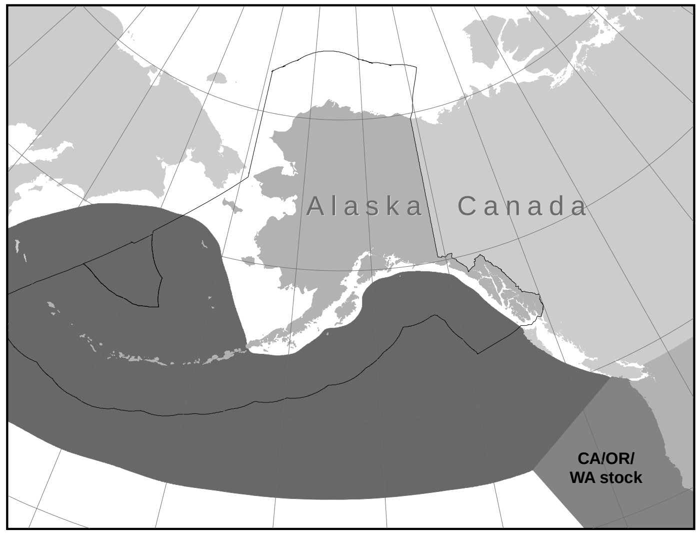

Figure 31. Approximate distribution of sperm whales in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous though data indicate 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, their preliminary analysis indicates 102,112 (CV = 0.155) sperm whales in the western North Pacific. 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 over 8 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 is 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 reauthorized 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

In previous stock assessments, there were six different observed federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of sperm whales. In 2004, the definitions of these commercial fisheries were changed to reflect target species: these new definitions have resulted in the identification of 22 observed fisheries in the Gulf of Alaska and Bering Sea that use trawl, longline, or pot gear (69 FR 70094, 2 December 2004). Of these, there was one fishery that incurred incidental serious injuries or mortalities of sperm whales (Table 33).

Table 33. Summary of incidental mortality of sperm whales due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

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 sablefish longline	2000 2001 2002 2003 2004	obs data	15.2 12.4 13.7 10.0 8.5	1(trailing gear) 0 0 0 0	2.2 0 0 0 0	0.45 (CV = 0.75)
Estimated total annual mortality						0.45 (CV = 0.75)

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 2003, 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 or a minimum estimate after 1996 (see Appendix 7). Therefore, the minimum estimated annual mortality rate incidental to commercial fisheries is 0.45.

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 260,285 sperm whales were reported to have been taken by commercial whalers operating in the North Pacific between 1925 and 1987 of those, 258,829 were taken between 1946 and 1987 (International Whaling Commission, BIWS catch data, February 2003 version, unpublished). 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 1999). The Japanese officially stopped catching sperm whales in the North Pacific in 1988 (Reeves and Whitehead 1997).

Other issues

NMFS observers aboard longline vessels targeting both sablefish and halibut have documented sperm whales feeding off longline gear in the Gulf of Alaska (Hill and Mitchell 1998, Hill et al., 1999; Perez 2006). 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).

Annual longline surveys have been recording sperm whale predation on catch since 1998 (Sigler et al. 2003). Between 1989 and 2003, sperm whale predation on catch has occurred at 38 of the surveyed stations: all events were located in the Gulf of Alaska and none were located in the Bering Sea. The sablefish catch at the stations where predation occurs is lower than at those stations where no predation occurred. Undamaged catches may also occur when sperm whales are present; in these cases, sperm whales apparently feed off the discard. Observer records document that predation on catch is widespread in the Gulf of Alaska (Perez 2006).

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 (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. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. 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 30°N in deep waters over the continental shelf, particularly in regions with submarine escarpments and seamounts (Ohsumi 1983, Kasuya and Ohsumi 1984, Kasuya 2002). The range of the species extends north from Cape Navarin (62° N) and the central Sea of Okhotsk (57° N) to St. Matthew Island, the Pribilof Islands in the Bering Sea, and the northern Gulf of Alaska (Rice 1986, Rice 1998, Kasuya 2002, NMFS unpublished data, Fig. 32). 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, Forney and Brownell 1996, Moore et al. 2002, NMFS unpublished data). In the Sea of Okhotsk and the Bering Sea, Baird's beaked whales arrive in April-May, are numerous during the summer, and decrease in October (Tomilin 1957, Kasuya 2002). During this time they are rarely found in offshore waters and their winter distribution is unknown (Kasuya 2002). 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, making 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).

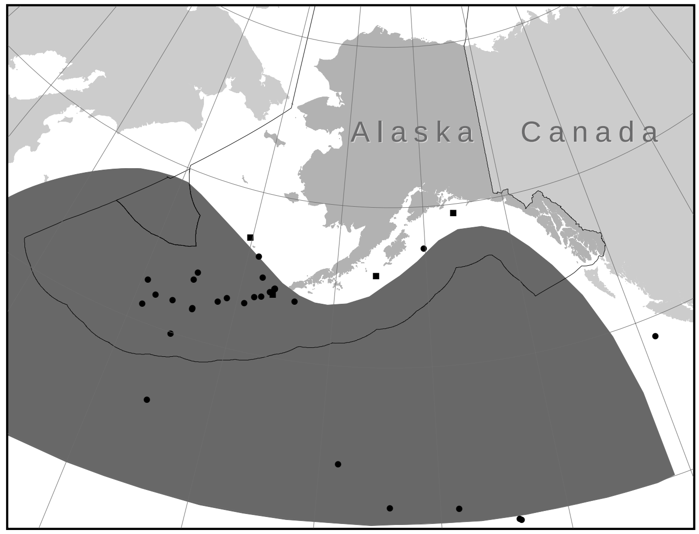

Figure 32. Approximate distribution of Baird's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last ten years are also depicted. (Forney and Brownell 1996, Moore et al. 2002, NMFS unpublished data). Note: Distribution updated based on Kasuya 2002.

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 reauthorized 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 from 1990 to 2002: 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. The estimated annual mortality rate incidental to commercial fisheries is zero.

Subsistence/Native Harvest Information

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

Other Mortality

Between 1925 and 1987, 618 Baird's beaked whales were reported taken throughout the North Pacific (International Whaling Commission, BWIS catch data, February 2003 version, unpublished). Recently, the Japanese have reported taking 54 whales annually off their coasts during the 7-year period between 1992 and 1998 and 62 whales were taken in 1999. There were no reported takes from 2000-02 (IWC 1996, 1997a, 1997b, 1998, 1999, 2000, 2001, 2002). 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. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. 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. 33) 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 the northern Gulf of Alaska, the Aleutian Islands, and the Commander Islands (Rice 1986, 1998). 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).

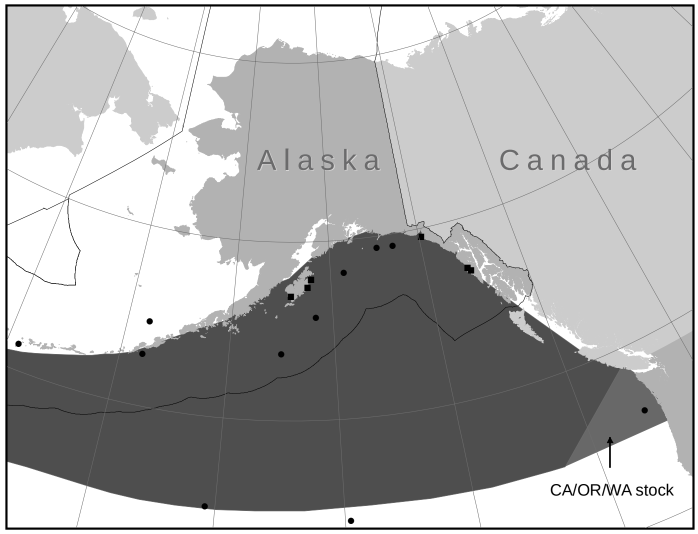

Figure 33. Approximate distribution of Cuvier's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last ten years are also depicted (Forney and Brownell 1996, NMFS unpublished data).

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 reauthorized 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 from 1990 to 2002: 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. The estimated annual mortality rate incidental to commercial fisheries is zero.

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. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. 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, Walker and Hanson 1999). 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. 34). 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).

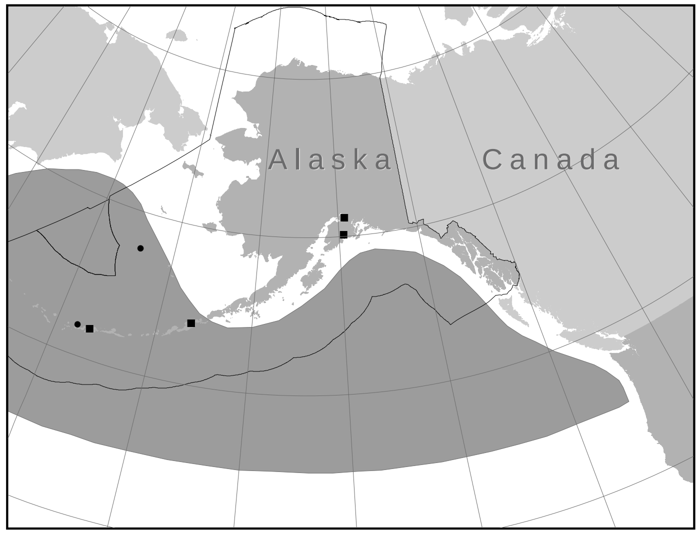

Figure 34. Approximate distribution of Stejneger's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted (Walker and Hanson 1999, NMFS unpublished data).

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 reauthorized 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 from 1990 to 2002: 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. The estimated annual mortality rate incidental to commercial fisheries is zero.

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. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. 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.

CITATIONS

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray whales formerly occurred in the North Atlantic Ocean (Fraser 1970, Mead and Mitchell 1984), but this species is currently found only in the North Pacific (Rice et al. 1984). The following information was considered in classifying stock structure of gray whales based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: two isolated geographic distributions in the North Pacific Ocean; 2) Population response data: the eastern North Pacific population has increased, and no evident increase 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 North Pacific stock, which lives along the west coast of North America (Fig. 35), and the Western North Pacific or "Korean" stock, which lives along the coast of eastern Asia (Rice 1981, Rice et al. 1984). Most of the Eastern North Pacific stock spends the summer feeding in the northern Bering and Chukchi Seas (Rice and Wolman 1971, Berzin 1984, Nerini 1984). However, gray whales have been reported feeding in the summer in waters off of Southeast Alaska, British Columbia, Washington, Oregon, and California (Rice and Wolman 1971, Darling 1984, Nerini 1984, Rice et al. 1984). Each fall, the whales migrate south along the coast of North America from Alaska to Baja California, in Mexico (Rice and Wolman 1971), most of them starting in November or December (Rugh et al. 2001). The Eastern North Pacific stock winters mainly along the west coast of Baja California, using certain shallow, nearly landlocked lagoons and bays, and calves are born from early January to mid-February (Rice et al. 1981). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981, 1984; Poole 1984a), with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast.

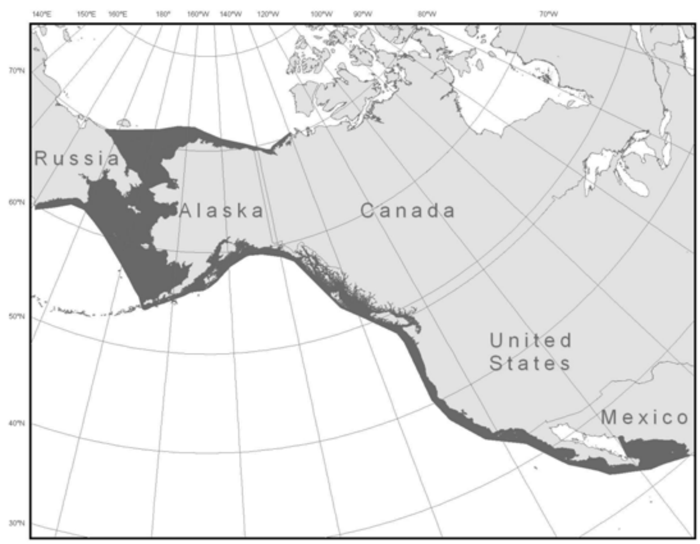

Figure 35. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area).

While most North Pacific gray whales spend the summer in the shallow waters of the northern and western Bering Sea and Arctic Ocean, some animals feed along the Pacific coast. Photo-identification studies of these animals indicate that they move widely within and between areas on the Pacific coast, are not always observed in the same area each year, and may have several year gaps between resightings in studied areas (Calambokidis and Quan 1999, Quan 2000, Calambokidis et al. 2002). The so-called "Pacific coast feeding aggregation" defines one of the areas where feeding groups occur. While some animals in this group demonstrate some site-fidelity, available information from sighting records (Calambokidis and Quan 1999, Quan 2000) and genetics (Ramakrishnan et al. 2001, Steeves 1998) indicates that this group is a component of the eastern North Pacific population and is not an isolated population unit.

POPULATION SIZE

Systematic counts of gray whales migrating south along the central California coast have been conducted by shore-based observers at Granite Canyon most years since 1967 (Fig. 36). The most recent abundance estimates are based on counts made during the 1997/98, 2000/01, and 2001/02 southbound migrations. Analyses of these data resulted in abundance estimates of 29,758 for 1997/98, 19,448 for 2000/01, and 18,178 for 2001/02 (Rugh et al. 2005). Recent estimates were: 22,263 (CV = 9.25%) whales in 1995/96 (Hobbs et al. 2004), 23,109 (CV = 5.42%) whales in 1993/94 (Laake et al. 1994) and 21,296 (CV = 6.05%) whales in 1987/88 (Buckland et al. 1993). Variations in estimates may be due in part to undocumented sampling variation or to differences in the proportion of the gray whale stock migrating as far as the central California coast each year (Hobbs and Rugh 1999). The decline in the 2000/01 and 2001/02 abundance estimates may be an indication that the abundance was responding to environmental limitations as the population approaches the carrying capacity of its environment. Low encounter rates in 2000/01 and 2001/02 may have been due to an unusually high number of whales that did not migrate as far south as Granite Canyon or the abundance may have actually declined following high mortality rates observed in 1999 and 2000 (Gulland et al. 2005, Fig. 37). Visibly emaciated whales (LeBoeuf et al. 2000; Moore et al. 2001) suggest a decline in food resources, perhaps associated with unusually high sea temperatures in 1997 (Minobe 2002). Several factors since this mortality event suggest that the high mortality rate was a short-term, acute event and not a chronic situation or trend: 1) counts of stranded dead gray whales dropped to levels below those seen prior to this event, 2) in 2001 living whales no longer appeared to be emaciated, and 3) calf counts in 2001/02, a year after the event ended, were similar to averages for previous years (W. Perryman, NMFS-SWFSC, pers. comm.; Rugh et al. 2005).

Gray whale calves were counted from Piedras Blancas, a shore site in central California, in 1980-81 (Poole 1984a) and each year since 1994 (Perryman et al. 2002, 2004). In 1980 and 1981, calves passing this site comprised 4.7% to 5.2% of the population (Poole 1984b). From 1994-2000, calf production indices (calf estimate/total population estimate) were 4.2%, 2.7%, 4.8%, 5.8%, 5.5%, 1.7% and 1.1%, respectively (Perryman et al. 2002). Gray whale calves have also been counted from the shore station at Granite Canyon during the southbound migration (Shelden et al. 1995, Shelden and Rugh 2001). Those results have indicated an apparent increase in the percentage of calf sightings from 0.0%-0.2% during 1952-74, 0.1%-0.9% during 1984-95 (Shelden et al. 1995), and 0.3%-1.5% during 1996-2001 (Shelden and Rugh 2001). This increase may be related to a trend toward later migrations over the observation period (Rugh et al. 2001, Buckland and Breiwick 2002), or it may be due to an increase in spatial and temporal distribution of calving as the population increased.

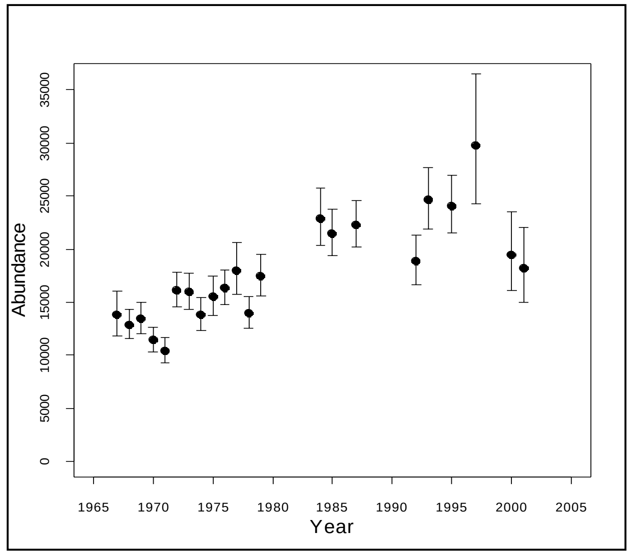

Figure 36. Estimated abundance of Eastern North Pacific gray whales from NMFS counts of migrating whales past Granite Canyon, California. Error bars indicate 95% log-normal CI (after Rugh et al. in press).

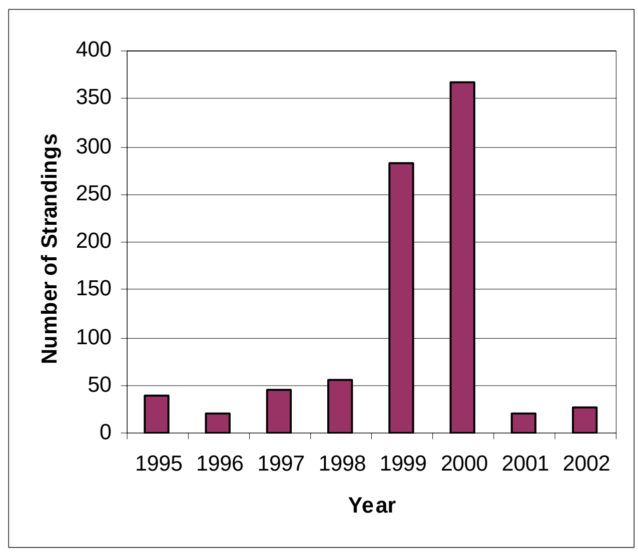

Figure 37. Number of strandings of gray whales along the west coast of North America, 1995-2002. Low levels of strandings in 2001 and 2002 indicate that the stranding event of 1999-2000 was limited to those years.

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): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the mean of the 2000/01 and 2001/02 abundance estimates (not significantly different) of 18,813 and its associated CV of 0.069, N_{MIN} for this stock is 17,752.

Current Population Trend

The population size of the 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 3.3% with a standard error of 0.44% (Buckland et al. 1993). Taking account of the harvest, Wade and DeMaster (1996) estimated an underlying annual rate of increase of 4.4% (95% CI: 3.1%-5.6%) for this same time period. Incorporating the census data through the 1993/94 migration resulted in an annual rate of increase of 2.6% (SE = 0.4%: IWC 1995). Breiwick (1999) estimated the annual rate of increase from 1967/68 to 1997/98 at 2.52% (95% CI: 2.04%-3.12%), and Wade and DeMaster (1996) estimated the annual rate of increase from 1967/68 to 1995/96 at 2.4% (95% CI: 1.6%-3.2%). Rugh et al. (2005) estimated the rate of increase from 1967/69 through 2001/02 at 1.9% (SE = 0.32%). They also fit a discrete logistic model to the abundance estimates resulting in an estimate of K (carrying capacity) of 26,290 (CV = 0.059).

In 1999 and 2000, a large number of gray whale strandings occurred along the west coast of North America between Baja California, Mexico, and the Bering Sea (Norman et al. 2000, Pérez-Cortés et al. 2000, Brownell et al. 2001, Gulland et al. 2005). A total of 273 gray whale strandings was reported in 1999 and 355 in 2000, compared to an average of 38 per year during the previous four years (Fig. 36). Gray whale strandings occurred throughout the year in both 1999 and 2000, but regional peaks of strandings occurred where and when the whales were in their migration cycle. Hypothesized reasons for the increased stranding rate in recent years include starvation, effects of chemical contaminants, natural toxins, disease, direct anthropogenic factors (fishery interactions and ship strikes), increased survey/reporting effort, and effects of wind and currents on carcass deposition (Norman et al. 2000). Since only 16 animals showed conclusive evidence of direct human interaction in 1999-2000, it seems unreasonable that direct anthropogenic factors were responsible for the increase in strandings. In addition, although survey effort has varied considerably in Mexico and Alaska, it has been relatively constant in Washington, Oregon, and California. The other hypotheses indicated have not yet been conclusively eliminated. However, assuming a 5% mortality rate for gray whales (Wade and DeMaster 1996), it would be reasonable to expect that approximately 1,300 gray whales would die annually of natural causes. Thus, while the stranding rate was certainly much higher in 1999 and 2000 than in previous years, it may not indicate a higher mortality rate. Preliminary stranding data indicate that the stranding event in 1999 and 2000 is over, as only 21 gray whale strandings were reported in 2001 (T. Rowles, NMFS-F/PR, pers. comm.). Reports from a portion of the stock's range indicate that only 5 and 6 strandings were reported in 2002 and 2003, respectively (C. Allen, NMFS-National Stranding Database, pers. comm.).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using abundance data through 1996, an analysis of the Eastern North Pacific gray whale population led to an estimate of R_{max} of 0.072, with a 90% probability the value was between 0.039 and 0.126 (Wade 2002). This estimate came from the best fitting age- and sex-structured model, which was a density-dependent Leslie model including an additional variance term, with females and males modeled separately. This estimate was higher than the estimate of R_{max} from a logistic model (0.053, 90% probability 0.031 to 0.113), which was not age- and sex-structured (Wade 2002). The Alaska Scientific Review Group recommended the use of the 0.053 point estimate for R_{max}. The difference in the two estimates of R_{max} is due to the bias in the harvest towards females, which is not accounted for in the logistic model. Therefore, NMFS has decided to use the estimate from the age- and sex-structured model, which had a lower 10th percentile of 0.047. This has the interpretation that there is a 90% probability that the true value of R_{max} is greater than 0.047. This is sufficient evidence that R_{max} for Eastern North Pacific gray whales is greater than the default value of 0.04. Therefore, NMFS will use an R_{max} of 0.047.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 whales, PBR = 417 animals (17,752 $\times$ 0.0235 $\times$ 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In previous stock assessments, there were six different observed federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of gray whales. In 2004, the definitions of these commercial fisheries were changed to reflect target species: these new definitions have resulted in the identification of 22 observed fisheries in the Gulf of Alaska and Bering Sea that use trawl, longline, or pot gear (69 FR 70094, 2 December 2004). There were no observed serious injuries or mortalities of gray whales in any of those fisheries.

NMFS observers monitored the northern Washington marine set gillnet fishery (coastal + inland waters), otherwise known as the Makah tribal fishery for Chinook salmon, during 1990-98 and in 2000. There was no observer coverage in this fishery in 1999; however, the total fishing effort was only 4 net days (in inland waters), and no marine mammals were reported taken. One gray whale was observed taken in 1990 (Gearin et al. 1994) and one in 1995 (P. Gearin, unpubl. data). In July of 1996, one gray whale was entangled in the same tribal set gillnet fishery, but it was released unharmed (P. Gearin, AFSC-NMML, pers. comm.). Data from the most recent 5 years indicates that no gray whales were seriously injured or killed incidental to this fishery.

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 1993 to 2003 (Table 34; Julian 1997; Cameron 1998; Julian and Beeson 1998; Cameron and Forney 1999, 2000; Carretta 2001, 2002; Carretta and Chivers 2003, 2004). One gray whale mortality was observed in this fishery in both 1998 and 1999. Overall entanglement rates in the California/Oregon thresher shark/swordfish drift gillnet fishery dropped considerably after the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders on buoy lines (Barlow and Cameron 1999). Data from the most recent 5 years indicates that no gray whales were seriously injured or killed incidental to this fishery.

Table 34. Summary of incidental mortality of Eastern North Pacific gray whales due to commercial fisheries from 1993-2003 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 1999-2003 (or the most recent 5 years of available data) are used in the mortality calculation. N/A indicates that data are not available.

Fishery name	**Years**	**Data type**	**Observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Unknown west coast fisheries	93-03	strand data	N/A	0, 5, 3, 3, 6, 4, 3, 3, N/A, 2, N/A	N/A	[≥3.6]
AK salmon purse seine	99-03	strand data	N/A	1, N/A, N/A, N/A, N/A	N/A	[≥0.5]
Pot fisheries	99-03	strand data	N/A	1, 2, N/A, N/A, 3	N/A	[≥1.2]
CA yellowtail/ barracuda/white seabass gillnet fishery	99-03	strand data	N/A	N/A, 1, N/A, N/A, N/A	N/A	[≥0.2]
Other entanglements	99-03	strand data	N/A	1, 2, N/A, 2, 1	N/A	[≥1.2]
Minimum total annual mortality						≥6.7

Reports of entangled gray whales found swimming, floating, or stranded with fishing gear attached occur along the U.S. west coast and British Columbia. Details of strandings that occurred in 1993-95 and 1996-98 in the United States and British Columbia are described in Hill and DeMaster (1999) and Angliss et al. (2002), respectively; while Table 35 presents data on strandings that occurred on the U. S. west coast from 1999 to 2003; these data are summarized in Table 34. The strandings resulting from commercial fishing are listed as unknown west coast fisheries in Table 35, unless they could be attributed to particular fisheries. During the 5-year period from 1999 to 2003, stranding network data indicate a minimum annual mean of 6.7 gray whale mortalities resulting from interactions with commercial fishing gear.

Table 35. Human-related gray whale strandings and entanglements, 1999-2003. An asterisk in the "number" column indicates cases that were not considered serious injuries. Note: Due in part to concerns expressed by the Alaska Scientific Review Group, the guidelines for what should constitute a "serious injury" to a large cetacean are to be reviewed and revised, if necessary, by 2006. This review may result in changes to whether the animals identified in this table are considered "seriously injured".

Year	Number	Area	Condition	Description
1999	1	Port Gravina, PWS, AK	Dead	Entangled in AK salmon purse seine net
1999	1	Bristol Bay, AK	Dead	Entangled
1999	1	Offshore North Coronado Is., CA	Non-fatal injury	Ship strike
1999	1	Wreck Creek, WA	Dead	Net wrapped around flukes

1999	1	Twin Harbors State Park, WA (Grayland)	Dead	Rope through mouth
1999	1	1.5 mi. offshore Rancho Palos Verdes, CA	Injury; status unknown	Pink gillnet & attached float wrapped around flukes; swimming w/difficulty; unable to dive
1999	1	10 mi. offshore Port Hueneme, CA	Dead	Wrapped in pot gear & associated floats
1999	1*	2 mi. offshore Crescent City, CA	Non-fatal injury	Crab pot line wrapped around flukes & mouth; disentangled by rescue team
1999	1*	3 mi. offshore Crescent City, CA	Released alive	Crab pot line wrapped around body; released from entangling gear
1999	1	Pt. Loma, CA	Dead	18" harpoon tip embedded in left dorsum
1999	1	Muir Beach, CA	Dead	Ship strike
2000	1	Depoe Bay, OR	Alive	Trailing fish line with longline buoys attached
2000	1	Brookings, OR	Alive	Head entangled in line
2000	1	Offshore Pt. Loma, CA	Status unknown	Trailing lobster pot gear
2000	1	Offshore San Clemente, CA	Status unknown	Yellow polypropylene line wrapped around flukes of free swimming whale
2000	1	Redwood National Park, CA	Dead	Ship strike
2000	1	Offshore Pt. Dume, CA	Status unknown	Line & buoys wrapped around flukes of free swimming whale
2000	1	Vandenberg AFB, CA	Dead	Lobster trap & rope wrapped around flukes
2000	1	Seal Beach, CA	Dead	White sea-bass gillnet wrapped around flukes
2000	1	Offshore Shelter Cove, CA	Injury; status unknown	Free-swimming whale with harpoon in back
2000	1	Offshore Aptos, CA	Status unknown	Fishing gear & floats wrapped around right pectoral flipper of free-swimming whale
2001	1	3 miles offshore Morro Bay	Live, likely mortality	Vessel collision with free-swimming abandoned calf; major injuries to caudal peduncle; flukes completely severed
2002	1*	Offshore Santa Barbara	Live, unknown	Free-swimming animal observed with yellow line wrapped around torso; no disentanglement initiated
2002	1	Offshore Pt. Vicente	Live, unknown	Free-swimming animal observed with yellow line wrapped around caudal peduncle; no disentanglement initiated
2002	1	Grays Harbor, WA	Dead	Yellow fishing gear (lines and net) wrapped around peduncle
2003	1	Offshore Morro Bay	Live, unknown	Free-swimming animal observed with crab pot gear trailing from right side of mouth (crab pot, 75 ft of yellow polypropylene line & 2 buoys); USCG vessel on site; no disentanglement initiated
2003	1	North Island Naval Air Station	Dead	15 foot calf with 3 foot length of yellow polypropylene line lodged in baleen

2003	1	2.5 miles off San Mateo Point	Live	Free-swimming animal observed with 150 ft of crab pot line and associated crab pot wrapped around head, torso & flukes; crew of commercial sportfishing vessel cut most of line and crab pot away; small amount of line remained wrapped around flukes (approximately 4 wraps); animal observed swimming strongly away after disentanglement
2003	1	Lands End Beach	Dead	25 ft calf; probable vessel collision; 2 propeller-like slashes through bone and baleen on right side of rostrum; broken rostrum
2003	1	Tillamook, OR	Dead	Crab pot line and buoy wrapped around flukes and caudal peduncle

It should be noted that no observers have been assigned to most Alaska gillnet fisheries, including those in Bristol Bay that are known to interact with this stock, making the estimated mortality from U.S. fisheries a minimum figure. 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 U. S. commercial fisheries (6.7 whales) is not known to exceed 10% of the PBR (44.2) 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. The only reported takes by subsistence hunters in Alaska during this decade occurred in 1995, with the take of two gray whales by Alaska Natives (IWC 1997). Russian subsistence hunters reported taking 43 whales from this stock in 1996 (IWC 1998a) and 79 in 1997 (IWC 1999). In 1997, the IWC approved a 5-year quota (1998-2002) of 620 gray whales, with an annual cap of 140, for Russian and U.S. (Makah Indian Tribe) aboriginals based on the aboriginal needs statements from each country (IWC 1998b). The U.S. and Russia have agreed that the quota will be shared with an average annual harvest of 120 whales by the Russian Chukotka people and 4 whales by the Makah Indian Tribe. Russian aboriginals harvested 121 (+2 struck and lost) in 1999 (IWC 2001), 113 (+2 struck and lost) in 2000 (Borodin 2001), 112 in 2001 (Borodin et al. 2002), 131 in 2002 (Borodin 2003), and 126 (+2 struck and lost) in 2003 (Borodin 2004), while the Makah Tribe harvested 1 whale in 1999 (IWC 2001). Based on this information, the annual subsistence take averaged 122 whales during the 5-year period from 1999 to 2003.

Other Mortality

The nearshore migration route used by gray whales makes ship strikes another potential source of mortality. Between 1999 and 2003, the California stranding network reported 4 serious injuries or mortalities of gray whales caused by ship strikes: 1 each in 1999, 2000, 2001, and 2003 (J. Cordaro, NMFS-SWR, pers. comm.). One ship strike mortality was reported in Alaska in 1997 (B. Fadely, AFSC-NMML, pers. comm.). 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 1.2 gray whales per year due to collisions with vessels represents a minimum estimate from this source of mortality.

In 1999 and 2000, the California stranding network reported gray whale strandings due to harpoon injuries (Table 35). A Russian harpoon tip was found in a dead whale that stranded in 1999 (R. Brownell, NMFS-SWFSC, pers. comm.), and an injured whale with a harpoon in its back was sighted in 2000. Since, these whales were likely harpooned during the aboriginal hunt in Russian waters, they would have been counted as “struck and lost” whales in the harvest data.

STATUS OF STOCK

The Eastern North Pacific stock of gray whales has been increasing in recent years while being subjected to known harvests. At present, U.S. commercial fishery-related annual mortality levels less than 41.7 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 human-caused mortality and serious injury (130), which includes mortalities from commercial fisheries (6.7), Russian harvest (122), and ship strikes (1.2), does not exceed the PBR (417). Therefore, the Eastern North Pacific stock of gray whales is not classified as a strategic stock. In 1994 this stock was removed from the List of Endangered and Threatened Wildlife (the List), as it was no longer considered endangered or threatened under the Endangered Species Act (ESA). As required by the ESA, NMFS monitored the status of this stock for 5 years following delisting. A workshop convened by NMFS on 16-17 March 1999 at the AFSC's National Marine Mammal Laboratory in Seattle, WA, reviewed the status of the stock based on research conducted during the 5-year period following delisting. Invited workshop participants determined that the stock was neither in danger of extinction, nor likely to become endangered within the foreseeable future, therefore there was no apparent reason to reverse the previous decision to remove this stock from the List (Rugh et al. 1999). This recommendation was subsequently adopted by NMFS.

On 28 March 2001, NMFS received a petition from D. J. Schubert, on behalf of Australians for Animals, The Fund for Animals and several other organizations, to list the Eastern North Pacific stock of gray whales as threatened or endangered under the ESA. On 21 May 2001, NMFS determined that the petition did not present substantial scientific or commercial information sufficient to warrant the listing of this stock (66 FR 32305).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins, though in the North Pacific it does not occur in Arctic waters. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. Humpback whales in the high latitudes of the North Pacific are seasonal migrants that feed on euphausiids and small schooling fishes (NMFS 1991, Clapham and Mead 1999). 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). The Asian wintering area extends from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during the 20th century.

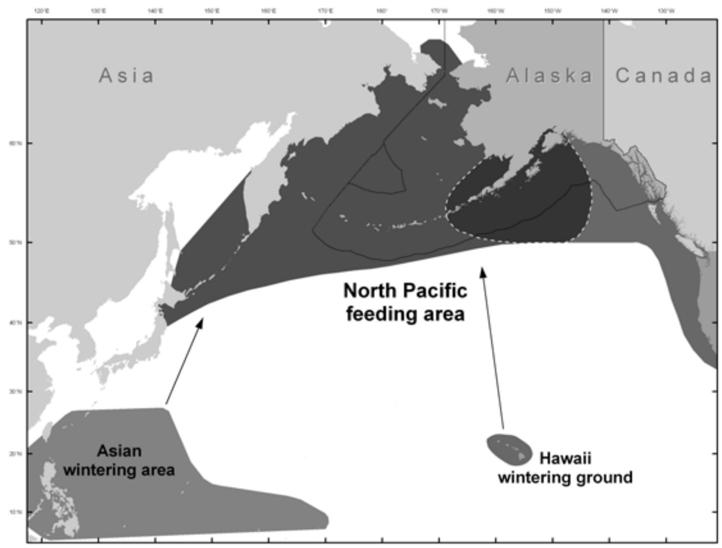

Figure 38. Approximate distribution of humpback whales in the western North Pacific (shaded area). Feeding and wintering grounds are presented above (see text). Area within the dotted line is known to be an area of overlap with the Central North Pacific stock. See Figure 39 for humpback whale distribution in the eastern North Pacific.

Recent surveys in the central-eastern and southeastern Bering Sea in 1999 and 2000 resulted in new information about the distribution of humpback whales in these areas (Moore et al. 2002). The only sightings of humpback whales in the central-eastern Bering Sea occurred southwest of St. Lawrence Island; animals co-occurred with a group of killer whales and a large aggregation of Arctic cod. A few sightings occurred in the southeast Bering Sea, primarily outside Bristol Bay and north of the eastern Aleutian Islands (Moore et al. 2002). However, a survey conducted in 2005 found numerous humpback whales north of the central Aleutian Islands, reinforcing the idea that the Bering Sea is an important feeding area.

Aerial, vessel, and photo-identification surveys and genetic analyses indicate that within the U. S. Exclusive Economic Zone (EEZ) there are at least three 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. 38 and 39): 1) winter/spring populations in coastal Central America and coastal 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 Unimak Pass (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 off Japan which, based on Discovery Mark information, probably migrate primarily to waters west of Unimak Pass (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991), and possibly to the Gulf of Anadyr (NMML unpublished data) - referred to as the Western North Pacific stock. Winter/spring populations of humpback whales also occur near Mexico's offshore islands in the Revillagigedo Archipelago. 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), although recent preliminary data suggest some of these whales summer in the western Gulf of Alaska and Bering Sea. Calambokidis et al. (2001) concludes that there are at least three subpopulations of humpback whales on the wintering grounds (Hawaii, Japan, and Mexico), and possibly as many as six subpopulations, with subdivisions in Mexico, Japan, and Central America.

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, three stocks 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. Data from a large-scale study throughout the North Pacific conducted in 2004-06 (the SPLASH project) are expected to provide a much more comprehensive understanding of humpback whale population structure in the North Pacific in the near future.

Available information about feeding areas in U.S. waters for the western stock of humpback whales indicates that there is considerable overlap between the Western North Pacific and Central North Pacific stocks in the Gulf of Alaska between Kodiak Island and the Shumagin Islands. Over 3 years, Waite et al. (1999) collected photographs of 127 individuals located near Kodiak Island, 22 individuals located near the Shumagin Islands, 8 individuals located offshore to the southeast of the Shumagin Islands, and 7 individuals located near Akutan Island in the eastern Aleutian Islands. Only 7 of these individuals have been documented in Prince William Sound or Southeast Alaska. Witteveen (2003) conducted a photo-identification study in Marmot and Chiniak Bays (on the northeast side of Kodiak Island), documented 103 individual animals, and estimated that the number of humpback whales in that area totaled 157 (95% CI: 114, 241). Witteveen et al. (2004) report matches between whales photographed at the Shumagin Islands between 1999 and 2002 and whales photographed in Hawaii, offshore Mexico Islands, coastal Mexico waters, and Japan. In addition, individuals identified off Japan have been resighted in the eastern North Pacific (Darling et al. 1996, Calambokidis et al. 1997).

In summary, new information from a variety of sources indicates that humpback whales from the Western and Central North Pacific stocks mix on summer feeding grounds in the central Gulf of Alaska and perhaps the Bering Sea.

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.

A vessel survey for cetaceans was conducted in the central Bering Sea in July-August 1999 in cooperation with research on commercial fisheries (Moore et al. 2000). The survey included 6,043 nmi of tracklines, most of which were West of St. Matthew Island, north of the 200 m bathymetric contour, and south of the U.S./Russia Convention Line. Ten on-effort sightings of humpback whales occurred during this survey, the majority of which took place along the eastern Aleutian chain and near the U.S./Russian Convention Line just south of St. Lawrence Island. If these localized sightings are extrapolated to the entire survey area, an estimated abundance of 1,175 humpback whales (95% CI: 197-7,009) occur in the central Bering Sea during the summer. However, Moore et al. (2002) determined that these sightings were too clumped in the central-eastern Bering Sea to be used to provide a reliable estimate for the area and decided to improve upon the method used to stratify the data in the analysis. Sightings of humpback whales also occurred during the survey conducted in the eastern Bering Sea in 2000; these sightings resulted in an estimated abundance of 102 (95% CI = 40-262). It is unknown whether these animals belong to the central or western North Pacific stock of humpback whales.

Photo-identification studies initiated to the west of Kodiak Island from 1999 to 2002 have identified 171 individual humpback whales, which resulted in a mark-recapture estimate of 410 (95% CI: 241-683). It is not known how many animals occurring to the west of Kodiak Island belong to the Western or Central North Pacific stock, but matches between animals photographed west of Kodiak Island and animals photographed in Hawaii, offshore Mexico, coastal Mexico, and Japan clearly indicate that overlap between stocks occurs in this area (Witteveen et al. 2004).

There are no reliable estimates for the abundance of humpback whales at feeding areas for this stock because surveys of the known feeding areas are incomplete, and because not all feeding areas are known.

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. Mobley et al. (2001) estimated a trend of 7% for 1993-00 using data from aerial surveys that were conducted in a consistent manner for several years across all of the Hawaiian Islands and were developed specifically to estimate a trend for the Central North Pacific stock. Although there is no estimate of the maximum net productivity rate for the Western stock, it is reasonable to assume that R_{MAX} for this stock would be at least 7%. Hence, until additional data become available from the Western North Pacific humpback whale stock, it is recommended that 7% be employed as the maximum net productivity rate (R_{MAX}) for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 = 1.3 animals ($367 \times 0.035 \times 0.1$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2004, there were six different federally-regulated commercial fisheries in Alaska that occurred within the range of the Western North Pacific humpback whale stock that were monitored for incidental mortality by fishery observers. As of 2004, changes in fishery definitions in the List of Fisheries have resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Estimates of marine mammal serious injury/mortality in each of these observed fisheries are provided in Perez (2006). Between 2000 and 2004, there were incidental serious injuries and mortalities of Western North Pacific humpback whales in the Bering Sea/Aleutian Islands sablefish pot fishery (Table 36). Average annual mortality from observed fisheries was 0.20 humpbacks from this stock (Table 36). Note, however, that the stock identification is uncertain and the mortality may have involved a whale from the central North Pacific stock of humpback whales. Thus, this mortality is assigned to both the central and western stocks.

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 be for certain (i.e., it may have belonged to the Central North Pacific stock). No strandings or sightings of entangled humpback whales of this stock were reported between 1999 and 2003; however, effort in western Alaska is low.

Table 36. Summary of incidental mortality and serious injury of humpback whales (Western North Pacific stock) due to commercial fisheries from 2000 to 2004 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate. Details of how percent observer coverage is measured is included in Appendix 6. *The humpback whale mortality from 2002 was seen by an observer but not during an "observed set"; thus quantification of effort cannot be accomplished and the single record cannot be extrapolated to provide a total estimated mortality level. ** These mortalities occurred in an area of known overlap with the Central North Pacific stock of humpback whales. Since the stock identification is unknown, the mortalities are reflected in both stock assessments. N/A indicates that data are not available.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea sablefish pot	2000 2001 2002 2003 2004	obs data	62.6 38.7 40.6 21.7 49.1	0 0 0 0 0	0 0 1* 0 0	0.20** (N/A)
Observer program total						0.20
				Reported mortalities		
Unknown fishery (Bering Sea)	2000-2004	Strand data	N/A	0, 0, 0, 0, 0	≥0.0	[≥0.0]
Minimum total annual mortality						[≥0.2]

The estimated annual mortality rate incidental to U. S. commercial fisheries is 0.2 whales per year from this stock based on 0.2 from observed fisheries. 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. Finally, much information on fishery interaction with the Central North Pacific stock is based on information reported to the Alaska Region as stranding data. However, very few stranding reports are received from areas west of Kodiak.

Brownell et al. (2000) compiled records of bycatch in Japanese and Korean commercial fisheries between 1993 and 2000. During the period 1995-99, there were six humpback whales indicated as "bycatch". In addition, two strandings were reported during this period. Furthermore, analysis of four samples from meat found in markets indicated that humpback whales are being sold. At this time, it is not known whether any or all strandings were caused by incidental interactions with commercial fisheries; similarly, it is not known whether the humpback whales identified in market samples were killed as a result of incidental interactions with commercial fisheries. It is also not known which fishery may be responsible for the bycatch. Regardless, these data indicate a minimum mortality level of 1.1/year (using bycatch data only) to 2.4/year (using bycatch, stranding, and market data) in the waters of Japan and Korea.

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). From 1961 to 1971, 6,793 humpback whales were killed illegally by the USSR. Most animals were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000).

STATUS OF STOCK

The estimated human-related annual mortality rate (0.2) is less than the PBR level for this stock (1.3). The estimated human-related mortality rate is based solely on mortalities that occurred incidental to U. S. commercial fisheries therefore, the estimated fishery mortality and serious injury rate exceeds 10% of the PBR (0.1). The rate cannot be considered insignificant and approaching zero. The humpback whale is listed as "endangered" under the Endangered Species Act, and therefore designated as "depleted" under the MMPA. Reliable population trend data and the status of this stock relative to its Optimum Sustainable Population size are currently unknown. Elevated levels of sound from the U. S. Navy's Low Frequency Active Sonar program and other anthropogenic sources (i.e., shipping) is a potential concern for 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 in the North Pacific region it does not occur in Arctic waters. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. Humpback whales in the high latitudes of the North Pacific are seasonal migrants that feed on euphausiids and small schooling fishes (NMFS 1991, Clapham and Mead 1999). 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). A vessel survey in the central Bering Sea in July of 1999 documented 17 humpback whale sightings, most of which were distributed along the eastern Aleutian Island chain and along the U.S.-Russia Convention Line south of St. Lawrence Island (Moore et al. 2000). 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 the 20th century.

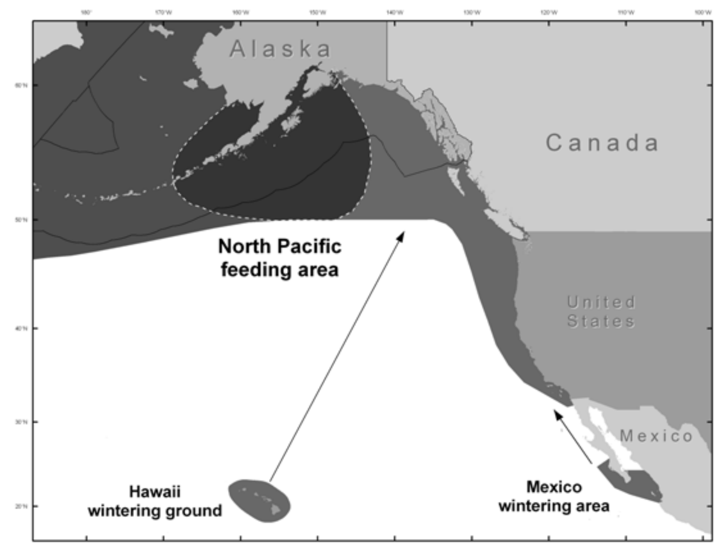

Figure 39. Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). Area within the dotted line is known to be an area of overlap with Western North Pacific stock. See Figure 38 for distribution of humpback whales 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. 38 and 39): 1) winter/spring populations in coastal Central America and coastal 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 Unimak Pass (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 Mark information, probably migrate primarily 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 those whales is not well known (Calambokidis et al. 1993, Calambokidis et al. 1997), although some whales from the Revillagigedo Archipelago have been matched to animals seen west of Kodiak, Alaska (Witteveen et al. 2004). 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), although recent preliminary data suggest some of these whales summer in the western Gulf of Alaska and Bering Sea (Witteveen et al. 2004). Calambokidis et al. (2001) concludes that there are at least three subpopulations of humpback whales on the wintering grounds (Hawaii, Japan, and Mexico), and possibly as many as six subpopulations, with subdivisions in Mexico, Japan, and Central America.

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, three stocks of humpback whales 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. Data from a large-scale study throughout the North Pacific conducted in 2004-06 (the SPLASH project) are expected to provide a much more comprehensive understanding of humpback whale population structure in the North Pacific in the near future.

The Central North Pacific stock of humpback whales consists of feeding aggregations along the northern Pacific Rim, and some humpbacks are present offshore in the Gulf of Alaska (Brueggeman et al. 1989). Humpback whales are also present in the Bering Sea (Moore et al. 2002); it is not conclusively known whether those animals belong to the Western or Central North Pacific stocks, or to a separate, unnamed stock. Three feeding areas for the Central North Pacific stock that have been studied using photo-identification techniques: 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 both Prince William Sound and southeastern Alaska since studies began in 1977 (Perry et al. 1990; von Ziegesar et al. 1994; S. Baker, D. McSweeney, J. Straley, O. von Ziegesar, unpubl. data; Mizroch et al. 2004); nine whales have been sighted between Kodiak Island, including the area adjacent to Kodiak along the Kenai Peninsula, and Prince William Sound; two whales have been sighted between Kodiak and southeastern Alaska (Waite et al. 1999). Calambokidis et al. (2001) reports interchange between Kodiak, Prince William Sound, and Southeast Alaska, although the number of individuals seen in multiple locations is small. Mizroch et al. (2004) examined photographs from 1979 to 1996 and reported that less than 1% of the individual whales photographed in either Southeast Alaska or Prince William Sound moved between areas. Based on sightings across all Alaska feeding areas, fewer than 2% of the individuals were seen in more than one area (Mizroch et al. 2004). Fidelity to feeding areas is 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).

As noted above, there is very little interchange documented between the Southeast Alaska feeding area and the Prince William Sound, Kodiak, and Shumagin Islands feeding areas to the north. Because of the documented lack of interchange, it is possible that a reduction in the population in the Southeast Alaska feeding area would not be augmented by animals that normally use other feeding areas within a timeframe relevant to managers. Thus, NMFS is considering whether the Southeast Alaska feeding area, and possibly other feeding areas in the North Pacific, should be formally designated as separate stocks under the MMPA. In preparation for this decision, a PBR level and annual mortality rates will be calculated for the Southeast Alaska feeding area and included in the report for the entire Central North Pacific humpback whale stock in order to guide managers in prioritizing conservation actions.

POPULATION SIZE

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 uses 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 entire central North Pacific humpback whale stock (Calambokidis et al. 1997).

Photo-identification methods were used to identify 315 individual humpback whales in Prince William Sound from 1977 to 2001 (von Ziegesar 1992, Waite et al. 1999, von Ziegesar et al. 2004). Waite et al. (1999) identified 127 individuals in the Kodiak area between 1991 and 1994, and calculated a total annual abundance estimate of 651 (95% CI: 356-1,523) for the Kodiak region. Witteveen et al. (2004) conducted a mark-recapture study near the Shumagin Islands from 1999-2002 and estimated a total population size of 410 (95% CI: 241-683). It is not known how many animals occurring in the Shumagin Islands belong to the Western or Central North Pacific stock.

This stock of humpback whales winters in Hawaiian waters (Baker et al. 1986). Baker and Herman (1987) used capture-recapture methods in Hawaii 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 methods in conjunction with a small sample size. Further, the data used to produce this estimate were collected between 1980 and 1983. Mobley et al. (2001) conducted aerial surveys throughout the main Hawaiian Islands during 1993, 1995, 1998, and 2000. Abundance during these surveys was estimated as 2,754 (95% CI: 2,044-3,468), 3,776 (95% CI: 2,925-4627), 4,358 (95% CI: 3,261-5,454), and 4,491 (95% CI: 3,146-5,836). These estimates, which are based on line transect methods, are slightly more conservative than the estimates determined using mark-recapture techniques, perhaps due to computational problems associated with the assumption that there is a heterogeneous sighting probability across different regions of Hawaii.

In the Northern British Columbia region (primarily near Langara Island), 275 humpback whales were photo-identified from 1992 to 1998 (G. Ellis, Pacific Biological Station, pers. comm.). As of 2003, approximately 850-1,000 humpback whales have been identified in British Columbia (J. Ford, Department of Fisheries and Oceans, Canada, pers. comm.); it is not known how many of these animals match with animals identified in U.S. waters.

Different studies have used different approaches to estimate the abundance of animals in Southeast Alaska. Baker et al. (1992) estimated an abundance of 547 (95% CI: 504-590) using data collected from 1979 to 1986. Straley (1994) recalculated the estimate using a different analytical approach (Jolly-Seber open model for capture-recapture data) and obtained a mean population estimate of 393 animals (95% CI: 331-455) using the same 1979 to 1986 data set. Using data from 1986 to 1992 and the Jolly-Seber approach, Straley et al. (1995) estimated that the annual abundance of humpback whales in southeastern Alaska was 404 animals (95% CI: 350-458). Straley et al. (2002) examined data for the northern portion of Southeast Alaska from 1994 to 2000 and provided an updated abundance estimate of 961 (95% CI: 657-1,076).

The sum of the available estimates for the known feeding areas is 2,036 (149 in PWS, 651 in Kodiak, 961 in Southeast, and 275 in British Columbia), which is well below the Calambokidis et al. (1997) estimate of 4,005 based on data collected from 1991 to 1993. However, the estimate for Southeast Alaska is known to be a minimum estimate because there is little to no photo-identification effort in the lower half of Southeast Alaska (south of Frederick Sound). In addition, many humpback whales feed seasonally near the Shumagin Islands, where photo-identification studies have only recently been initiated, and humpbacks are seen pelagically in the Gulf of Alaska. Also, Moore et al. (2002) have documented humpback whales in the Bering Sea, and it is not known whether these animals belong to the Central or Western North Pacific humpback whale stock.

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 (estimated in 1993; Calambokidis et al. 1997) and its associated CV(N) of 0.095, N_{MIN} for the entire Central North Pacific humpback whale stock is 3,698. Although the Southeast Alaska feeding aggregation is not being formally considered a stock, the calculation of a PBR for this area may be useful for management purposes. Using the population estimate (N) of 961 and its associated CV(N) of 0.12, N_{MIN} for this aggregation is 868.

Current Population Trend

Comparison of the estimate for the entire stock 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 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. Mizroch et al. (2004) calculate an annual population rate of increase of 10%. This is within the range of 8.8 to 14.4% reported by Best (1993) for humpback whales off South Africa, and is identical to the 10% value reported by Bannister and Hedley (2001) for humpback whales off western Australia. Mobley et al. (2001) estimated an annual increase of 7% for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across the main Hawaiian Islands and were developed specifically to estimate a trend for the Central stock. Zerbini et al. (in press) used line transect data from sequential surveys to estimate a trend of 6.6% (95% CI: 4.7-8.4%).

The estimated number of animals in the Southeast Alaska portion of this stock has increased. The 2000 estimate of 961 (Straley et al. 2002) is substantially higher than estimates from the early and mid-1980s. A trend for the Southeast Alaska portion of this stock cannot be estimated from the data, however, because of differences in methods and areas covered.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using 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. Mobley et al. (2001) conducted annual surveys of the humpback whale breeding grounds in Hawaii and estimated a rate of increase of 7% for the period 1993-2000. Furthermore, it is clear that the abundance has increased in Southeast Alaska in recent years. While 7% is the best available estimate of current rate of increase, and may or may not be the same as the stock's maximum net productivity rate, it seems reasonable to use 0.07 as a new, conservative estimate of the maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 recommended value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). The default value of 0.04 for the maximum net productivity rate will be replaced by 0.07, which is the best estimate of the current rate of increase and is considered a conservative estimate of the maximum net productivity rate. Thus, for the entire Central North Pacific stock of humpback whale, PBR = 12.9 animals ($3{,}698 \times 0.035 \times 0.1$). The PBR level for the Southeast Alaska portion of this stock, PBR = 3.0 animals ($868 \times 0.035 \times 0.1$), and the PBR level for the northern portion of the stock is 9.9 animals (12.9 – 3.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2004, there were four different federally-regulated commercial fisheries in Alaska that occurred within the range of the Central North Pacific humpback whale stock that were monitored for incidental mortality by fishery observers. As of 2004, changes in fishery definitions in the List of Fisheries have resulted in separating these four fisheries into 17 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2000 and 2004, there were incidental serious injuries and mortalities of Central North Pacific humpback whales in the Bering Sea/Aleutian Islands sablefish pot fishery (Table 37). Estimates of marine mammal serious injury/mortality in observed fisheries are provided in Perez (2006).

Table 37. Summary of observer reported incidental mortalities and serious injuries of humpback whales (Central North Pacific stock) due to commercial fisheries from 2000 through 2004 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6. * Mortality seen by observer, but not during a monitored haul. ** These mortalities occurred in an area of known overlap with the Western North Pacific stock of humpback whales. Since the stock identification is unknown, the mortalities are reflected in both stock assessments.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea sablefish pot	2000	obs data	62.6	0	0	0.20**(N/A)
	2001		38.7	0	0	
	2002		40.6	0	0*	
	2003		21.7	0	1	
	2004		49.1	0	0	
Minimum total annual mortality						North: 0.2 SE: 0.0 Total: 0.2

Reports of entangled humpback whales found swimming, floating, or stranded with fishing gear attached occur in both Alaskan and Hawaiian waters. All reports of mortalities or injuries of humpback whales from the Central North Pacific stock from 2001 to 2005 are provided in Appendix 8 and a summary of the information is provided in Table 38. Overall, there were 54 reports of human-related mortalities or injuries during this 5-year period. Of these, there were 40 incidents which involved commercial fishing gear, and 15 of those incidents involved serious injuries or mortalities. 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.

Table 38. Summary of Central North Pacific humpback whale mortalities and serious injuries caused by entanglement and ship strikes from stranding reports, 2001-2005. A summary of information used to determine whether an injury was serious or non-serious is included in Appendix 8. Fisheries with zero average annual mortality indicate historical marine mammal interactions.

Area	**Human activity/fishery**	**Year**	**Mortality**	**Serious**	**Not determinable**	**Average annual serious injury/ mortality rate (2001-2005)**
North	Ship strike	2001	1	0	0	0.4
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	1	0	1	
	Unspecified gear	2001	0	2	0	0.4
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	1	
	Salmon set gillnet	2001	0	0	0	0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Unspecified gillnet	2001	1	0	0	0.4
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	1	0	
	Purse seine	2001	0	0	0	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Unspecified pot gear	2001	0	0	0	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Crab pot gear	2001	0	0	0	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Yakutat salmon set gillnet	2001	1	0	0	0.2
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/ mortality rate (2001-2005)
	Cook Inlet salmon set gillnet	2001	N/A	N/A	N/A	0.2
		2002	N/A	N/A	N/A	
		2003	N/A	N/A	N/A	
		2004	N/A	N/A	N/A	
		2005	0	1	0	
	Kodiak salmon purse seine	2001	N/A	N/A	N/A	0.2
		2002	N/A	N/A	N/A	
		2003	N/A	N/A	N/A	
		2004	N/A	N/A	N/A	
		2005	1	0	0	
	Lower Cook Inlet salmon purse seine	2001	N/A	N/A	N/A	0.2
		2002	N/A	N/A	N/A	
		2003	N/A	N/A	N/A	
		2004	N/A	N/A	N/A	
		2005	1	0	0	
	Average annual serious injury/mortality rate fishery only					1.6
	Average annual serious injury/mortality rate total					2.0
SE	Ship strike	2001	1	0	0	1.4
		2002	0	0	0	
		2003	1	0	0	
		2004	2	1	0	
		2005	1	1	0	
	Unspecified gear	2001	0	0	0	0.4
		2002	0	0	2	
		2003	0	0	0	
		2004	0	2	1	
		2005	0	0	1	
	Salmon set gillnet	2001	0	0	0	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Unspecified gillnet	2001	0	0	0	0.2
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	1	1	
	Purse seine	2001	0	0	0	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/ mortality rate (2001-2005)
	Unspecified pot gear	2001	0	0	1	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Crab pot gear	2001	0	0	0	0.6
		2002	0	0	0	
		2003	0	1	0	
		2004	0	0	1	
		2005	0	2	2	
	SE salmon drift gillnet	2001	N/A	N/A	N/A	0.2
		2002	N/A	N/A	N/A	
		2003	N/A	N/A	N/A	
		2004	N/A	N/A	N/A	
		2005	1	0	0	
	Average annual serious injury/mortality rate fishery only					1.4
	Average annual serious injury/mortality rate total					2.8
Hawaii	Unspecified gear	2001	0	0	1	0.0
		2002	0	0	0	
		2003	0	0	0	
		2004	0	0	0	
		2005	0	0	0	
	Average annual serious injury/mortality rate fishery only					0.0
	Average annual serious injury/mortality rate total					0.0

The overall U. S. commercial fishery-related minimum mortality and serious injury rate for the entire stock is 3.2 humpback whales per year, based on observer data from Alaska (0.20), stranding records from Alaska (3.0), and stranding records from Hawaii (0). The estimated fishery-related minimum mortality and serious injury rate incidental to commercial fisheries for the northern portion of the stock is 1.8 humpback whales per year, based on observer data from Alaska (0.20), stranding records from Alaska (1.6) and stranding data from Hawaii (0) (Table 38). The estimated minimum mortality and serious injury rate incidental to the commercial fisheries in Southeast Alaska is 1.4 humpback whales per year, based on stranding records from Alaska (1.4), and stranding data from Hawaii (0) (Table 38).

As mentioned previously, these estimates of serious injury/mortality levels 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 rate unreliable. Further, due to limited Canadian observer program data, mortality incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to interact with humpback whales) is uncertain. Though interactions are thought to be minimal, data regarding the level of humpback whale mortality related to commercial fisheries in northern British Columbia are not available, again indicating 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 other interactions with vessels unrelated to fisheries have also occurred to humpback whales. Those cases are included in Appendix 8 and summarized in Table 38. Of those, nine ship strikes constitute “other sources” of mortality or serious injury; seven of these ship strikes occurred in Southeast Alaska and two occurred in the northern portion of this stock’s range. It is not known whether the difference in ship strike rates between Southeast Alaska and the northern portion of this stock is due to differences in reporting, amount of vessel traffic, densities of animals, or other factors. Averaged over the year period from 2001 to 2005, these account for an additional 1.8 humpback whale mortalities per year for the entire stock (0.4 ship strikes/year for the northern portion of the stock, and 1.4 strikes/year for the southeast portion).

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 Soviet catches (Yablokov 1994).

STATUS OF STOCK

As the estimated annual mortality and serious injury rate for the entire stock (5.0; 3.2 of which were fishery-related; Table 39) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR level (12.9) for the entire stock. The estimated annual mortality and serious injury rate in Southeast Alaska (2.8, of which 1.4 were fishery-related) is less than the PBR level if calculated only for the Southeast Alaska portion of the population (3.0). The minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock is not less that 10% of the calculated PBR for either the entire stock or the portion of the stock in Southeast Alaska 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. However, the status of the entire stock relative to its Optimum Sustainable Population size is unknown.

Table 39. Summary of serious injury (SI) and mortality (M) levels for the Central North Pacific (CNP) stock of humpback whales. * The average annual SI/M in HI is 0. ** This is the sum of the observed SI/M (0.2), the AK strandings (3.0), and the average HI stranding rate (0). *** This is the sum of 3.2 + 1.8.

Area	Data types for fishery-related information				Ship strikes	Total	"PBR"
	Observer data	AK Strand.	HI Strand.	Total fish.			
Northern	0.2	1.6	0	1.8	0.4	2.2	9.9
Southeast	N/A	1.4	0	1.4	1.4	2.8	3.0
TOTAL	0.2	3.0	0*	3.2**	1.8	5.0***	12.9

Habitat Concerns

This stock is the focus of a large whale watching industry in its wintering grounds (Hawaii) and a growing whale watching 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 whale watching. In 2001, NMFS issued regulations to prohibit most approaches to humpback whales in Alaska within 100 yards (91.4 m; 66 FR 29502; 31 May 2001). The growth of the whale watching industry, however, is a concern as preferred habitats may be abandoned if disturbance levels are too high.

High levels of sound 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 whale watching) in Hawaii waters is of potential 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). Frankel and Clark (2002) indicated that there were also slight shifts in humpback whale distribution in response to ATOC. Efforts are underway to evaluate the relative contribution of sound (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 physalus*): Northeast Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the U.S. waters in the Pacific, fin whales are found seasonally off the coast of North America and Hawaii and in the Bering Sea during the summer (Fig. 40). Recent information on seasonal fin whale distribution has been gleaned from the reception of fin whale calls by bottom-mounted, offshore hydrophone arrays along the U.S. Pacific coast, in the central North Pacific, and in the western Aleutian Islands (Moore et al. 1998, Watkins et al. 2000). Moore et al. (1998) and Watkins et al. (2000) both documented high levels of fin whale call rates along the U.S. Pacific coast beginning in August/September and lasting through February, suggesting that this may be an important feeding area during the winter. While peaks in call rates occurred during fall and winter in the central North Pacific and the Aleutian Islands, there were also a few calls recorded during the summer months. While seasonal differences in recorded call rates are generally consistent with the results of aerial surveys which have documented seasonal whale distribution, it is not known whether these differences in call rates reflect true seasonal differences in whale distribution, differences in calling rates, or differences in oceanographic properties (Moore et al. 1998). Fin whale calls have also been well-documented off of Hawaii during the winter (McDonald and Fox 1999), although aerial and shipboard surveys have found relatively few animals in Hawaiian waters (Mobley et al. 1996).

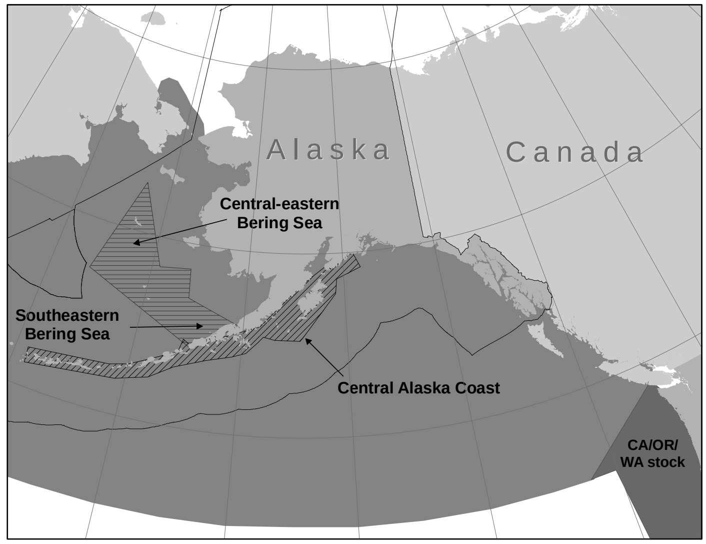

Figure 40. Approximate distribution of fin whales in the eastern North Pacific (shaded area). Enclosed area indicates general location of the pollock surveys from which regional estimates of the fin whale population was made.

Recent surveys in the central-eastern and southeastern Bering Sea in 1999 and 2000 and in the western Gulf of Alaska and the eastern and central Aleutian Islands from 2001 to 2003 resulted in new information about the distribution and relative abundance of fin whales in these areas (Moore et al. 2000, 2002; Zerbini et al., in press). Fin whale abundance estimates were nearly five times higher in the central-eastern Bering Sea than in the southeastern Bering Sea (Moore et al. 2002), and most sightings in the central-eastern Bering Sea occurred in a zone of particularly high productivity along the shelf break (Moore et al. 2000).

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 those authors cited additional evidence that supported the establishment of subpopulations in the North Pacific. Further, Fujino (1960) described an eastern and a western group, which are isolated though may intermingle around the Aleutian Islands. Discovery Mark 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 southern Baja California (Leatherwood et al. 1982). As a result, stock structure of fin whales remains uncertain.

Mizroch et al. (in review) provided a comprehensive summary of whaling catch data, Discovery Mark recoveries, and opportunistic sightings data and found evidence of at least two migratory stocks, similar to Fujino's (1960) eastern and western groups. However, it appears likely that the stocks mingle in the Bering Sea in July and August, rather than in the Aleutian Islands as Fujino (1960) concluded. Mizroch et al. (in review) also found strong evidence of at least one additional non-migratory resident group of fin whales in the Sea of Japan/Sanriku-Hokkaido area, in addition to known resident groups in the Gulf of California and the East China Sea.

For management purposes, however, and until further information becomes available to resolve the uncertainties described above, three stocks of fin whales are currently recognized in U.S. waters: 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 entire 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.

Two recent studies provide some information on presence of fin whales, although they do not provide estimates of population size. A survey conducted in August of 1994 covering 2,050 nautical miles of trackline south of the Aleutian Islands encountered only four 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, thus, no population estimate can be made. Passive acoustics were used off the island of Oahu, Hawaii, to document a minimum density estimate of 0.081 fin whales/1,000km^2 from peak call rates during the winter (McDonald and Fox 1999). This density estimate is well below the population density of 1.1 animals/1,000 km^2 documented off the coast of California (Barlow 1995, Forney et al. 1995) but does indicate that Hawaii is used seasonally by fin whales.

A visual survey for cetaceans was conducted in the central-eastern Bering Sea in July-August 1999 and in the southeastern Bering Sea in June-July 2000 in cooperation with research on commercial fisheries (Moore et al. 2002). The survey included 1,761 km and 2,194 km of effort in 1999 and 2000, respectively. Aggregations of fin whales were often sighted in 1999 in areas where the ship's echosounder identified large aggregations of zooplankton, euphausiids, or fish (Moore et al. 2000). One aggregation of fin whales which occurred during an off-effort period involved greater than 100 animals and occurred in an area of dense fish echosign. Results of the surveys in 1999 and 2000 in the central-eastern Bering Sea and southeastern Bering Sea provided provisional estimates of 3,368 (CV = 0.29) and 683 (CV = 0.32), respectively (Moore et al. 2002). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, and responsive movement. However, the provisional estimate for fin whales in each area is expected to be robust as previous studies have shown that only small correction factors are needed for this species. The Moore et al. (2002) estimate for 1999 is different than that of Moore et al. (2000) because it covers the south-eastern Bering Sea as well as the central-eastern Bering Sea. Additionally, the region covered by Moore et al. (2000) did not have consistent effort and thus could be inaccurate. This estimate cannot be used as an estimate of the entire Northeast Pacific stock of fin whales because it is based on a survey in only part of the stock's range.

Dedicated line transect cruises were conducted in coastal waters of western Alaska and the eastern and central Aleutian Islands in July-August 2001-2003 (Zerbini et al., in press). Over 9,053 km of tracklines were surveyed in coastal waters (as far as 85 km offshore) between the Kenai Peninsula (150^{o}W) and Amchitka Pass (178^{o}W). Fin whale sightings (n = 276) were observed from east of Kodiak Island to Samalga Pass, with high aggregations recorded near the Semidi Islands. Zerbini et al. (in press) estimated that 1,652 (95% CI = 1,142-2,389) whales occurred in the area.

Minimum Population Estimate

Since 1999, information on abundance of fin whales in Alaskan waters has improved considerably. Although the full range of the northeast Pacific stock of fin whales in Alaskan waters has not been surveyed, a rough estimate of the size of the population west of the Kenai Peninsula could include the sums of the estimates from Moore et al. (2002) and Zerbini et al. (in press). Using this approach, an initial estimate of the fin whale population west of the Kenai Peninsula would be 5,703. This is clearly a minimum estimate, as no estimate is available for U.S. waters to the east of the Kenai Peninsula.

Current Population Trend

Zerbini et al. (in press) estimated trends in abundance of fin whales in coastal waters south of the Alaska Peninsula (Kodiak and Shumagin Islands). An annual increase of 4.8% (95% CI = 4.1-5.4%) was observed from 1987-2003. This estimate refers to whales observed in only a fraction of the range of the northeast Pacific stock.

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 reauthorized 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 recommended value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). Thus, the PBR level for this stock is 11.4 ($5{,}703 \times 0.02 \times 0.1$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Prior to 1999, there were no observed or reported mortalities of fin whales incidental to commercial fishing operations within the range of this stock. However, in 1999, one fin whale was killed incidental to the Gulf of Alaska pollock trawl fishery. Because there have been no serious injuries or mortalities in this fishery for the period 2000-2004 (Perez 2006), the mean annual mortality and serious injury rate for fin whales in this fishery is 0. Although there have been a few strandings of fin whales recorded in recent years (2 and 1 in 1998 and 1999, respectively; NMFS unpublished data), none of these have been noted as having evidence of fishery interactions.

The total estimated mortality and serious injury incurred by this stock as a result of interactions with commercial fisheries is 0.

Subsistence/Native Harvest Information

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

Other Mortality

Between 1925 and 1975, 47,645 fin whales were reported killed throughout the North Pacific (International Whaling Commission, BIWS catch data, February 2003 version, unpublished), although newly revealed information about illegal Soviet catches indicates that the Soviets over-reported catches of about 1,200 fin whales, presumably to hide catches of other protected species (Doroshenko 2000). In 2000, a fin whale was struck by a vessel in Uyak Bay. Assuming this was the only ship strike which occurred during the 5-year period from 1997 to 2001, the average number of ship strikes per year is 0.2. There are no other reports of direct human-related injuries or mortalities to fin whales in Alaska waters included in the Alaska Region stranding database for 1998-2003. Thus, the total estimated mortality and serious injury incurred by this stock is 0.2.

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. While reliable estimates of the minimum population size, population trends, and PBR are available for a portion of this stock, much of the North Pacific range has not been surveyed. Therefore the status of the stock relative to its Optimum Sustainable Population size is currently not available. The estimated annual rate of mortality and serious injury incidental to U. S. commercial fisheries for this stock (0) does not exceed the PBR level for the stock (11.4). Thus, fishery-related mortality levels can be determined to have met a zero mortality and serious injury rate. 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 three 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^{o}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).

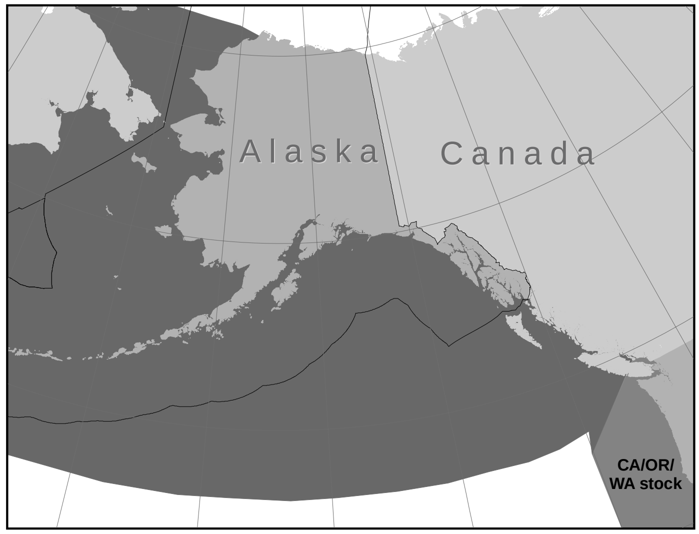

Figure 41. Approximate distribution of minke whales in the eastern North Pacific (shaded area).

Ship surveys in the central-eastern and southeastern Bering Sea in 1999 and 2000 resulted in new information about the distribution and relative abundance of minke whales in these areas (Moore et al. 2000; Moore et al. 2002; see Fig. 40 for location of survey areas). Minke whale abundance estimates were similar in the central-eastern Bering Sea and the southeastern Bering Sea (Moore et al. 2002). Minke whales occurred throughout the area surveyed, but most sightings of minke whales in the central-eastern Bering Sea occurred along the upper slope in waters 100-200 m deep (Moore et al. 2000); sightings in the southeastern Bering Sea occurred along the north side of the Alaska Peninsula and were associated with the 100 m contour near the Pribilof Islands (Moore et al. 2002).

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. 41). The California/ Oregon/Washington minke whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. However, some information is now available on the numbers of minke whales in the Bering Sea. A visual survey for cetaceans was conducted in the central-eastern Bering Sea in July-August 1999, and in the southeastern Bering Sea in 2000, in cooperation with research on commercial fisheries (Moore et al. 2000; Moore et al. 2002; see Fig. 40 for locations of survey areas). The survey included 1,761 km and 2,194 km of effort in 1999 and 2000, respectively. Results of the surveys in 1999 and 2000 provide provisional abundance estimates of 810 (CV = 0.36) and 1,003 (CV = 0.26) minke whales in the central-eastern and southeastern Bering Sea, respectively (Moore et al. 2002). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, or responsive movement. These estimates cannot be used as an estimate of the entire Alaska stock of minke whales because only a portion of the stock's range was surveyed.

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

Under the 1994 reauthorized 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: $PBR = N_{MIN} \times 0.5R_{Max} \times F_R$. 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, the PBR for the Alaska minke whale stock is unknown 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 2000-2004: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries (Table 40). In 1989, one minke whale mortality (extrapolated to two mortalities) was observed in the Bering Sea/Gulf of Alaska joint-venture groundfish trawl fishery, the predecessor to the current Alaska groundfish trawl fishery.

Table 40. Summary of incidental mortality and serious injury of minke whales due to commercial fisheries from 2000 to 2004 and calculation of the estimated mean annual mortality rate.

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	2000	obs data	76.2	1	1.6	0.32 (CV = 0.61)
	2001		79.0	0	0	
	2002		80.0	0	0	
	2003		82.2	0	0	
	2004		81.2	0	0	
Estimated total annual mortality						0.32 (CV = 0.61)

The Bering Sea/Aleutian Islands groundfish trawl fishery incurred one mortality of a minke whale in 2000; this extrapolates to an estimated two minke whale mortalities for that year (Table 40). The total estimated mortality and serious injury incurred by this stock as a result of interactions with U. S. commercial fisheries is 0.32 (CV = 0.61).

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, International Whaling Commission, United Kingdom, pers. comm.). The most recent harvest (2 whales) in Alaska occurred in 1989 (Anonymous 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. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

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NORTH PACIFIC RIGHT WHALE (*Eubalaena japonica*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

A comprehensive review of all 20th century sighting, catches, and strandings of North Pacific right whales was conducted by Brownell et al. (2001). Data from this review were subsequently combined with historical whaling records to map the known distribution of the species (Clapham et al. 2004). Whaling records indicate that right whales in the North Pacific ranged across the entire North Pacific north of 35°N and occasionally as far south as 20°N (Rosenbaum et al. 2000; Fig. 42). Before right whales in the North Pacific were heavily exploited by commercial whalers, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1965-99, following illegal catches by the USSR, there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). 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, Brownell et al. 2001).

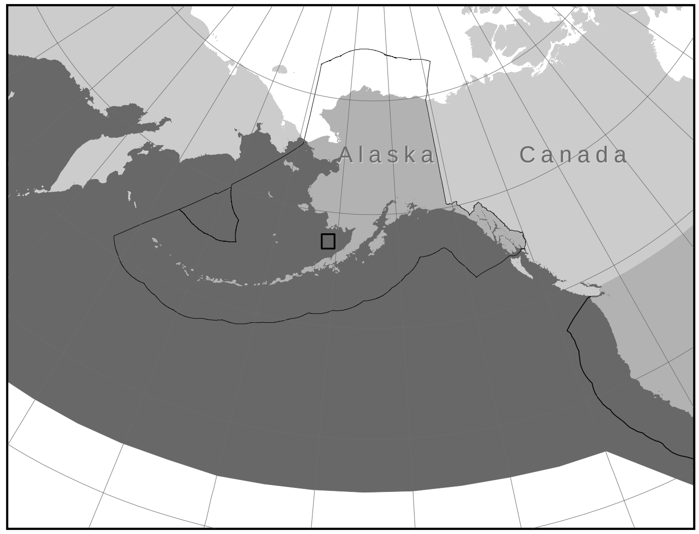

Figure 42. Approximate historical distribution of North Pacific right whales in the eastern North Pacific (shaded area). The box outlines the area in Bristol Bay where intensive aerial and vessel surveys for right whales have occurred from 1999 to 2004.

North Atlantic (*E. glacialis*) and Southern Hemisphere (*E. australis*) right whales calve in coastal waters during the winter months. However, in the eastern North Pacific no such calving grounds have ever been found (Scarff 1986). Migratory patterns of the North Pacific stock are unknown, although it is thought the whales migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly offshore (Braham and Rice 1984, Scarff 1986, Clapham et al. 2004).

Information on the current seasonal distribution of right whales is available from dedicated vessel and aerial surveys, bottom-mounted acoustic recorders, and vessel surveys for fisheries ecology and management which have also included dedicated marine mammal observers. Aerial and vessel surveys for right whales have occurred in recent years in a portion of the southeastern Bering Sea (Fig. 42) where right whales have been observed each summer since 1996 (Goddard and Rugh 1998). North Pacific right whales are observed consistently in this area, although it is clear from historical and Japanese sighting survey data that right whales often range outside this area and occur elsewhere in the Bering Sea (Clapham et al. 2004, Tynan 1999, LeDuc et al. 2001, Moore et al. 2000, Moore et al. 2002, NMFS unpublished data). Bottom-mounted acoustic recorders were deployed in the southeastern Bering Sea and the northern Gulf of Alaska starting in 1999 to document the seasonal distribution of right whale calls (Mellinger et al. 2004). Preliminary analysis of the data from the recorders indicates that right whales remain in the southeastern Bering Sea from May through November with peak call detection in September (Munger and Hildebrand 2004). Right whale calls were rarely detected in the northwestern Gulf of Alaska in the late summer (Mellinger et al. 2004). Right whales have not been observed outside the localized area in the southeastern Bering Sea during surveys conducted for fishery management purposes which covered a broader area of Bristol Bay and the Bering Sea (Moore et al. 2000, 2002; see Fig. 40 for locations of tracklines for these surveys).

In 2004, a right whale was successfully tagged with a satellite-monitored transmitter for 40 days, during which time the animal moved over a large part of the southeastern Bering Sea including the outer shelf area (Wade et al. 2006). In September 2004, information from the tag was used with acoustic detections to find the largest aggregation of right whales observed in the eastern North Pacific since Soviet whaling. A minimum of 17 individuals were identified by photo-id and genotyping from skin biopsies.

There are fewer recent sightings of right whales in the Gulf of Alaska than in the Bering Sea (Brownell et al. 2001), although little survey effort has been conducted in this region. Waite et al. (2003) summarized sightings from the Platforms of Opportunity Program from 1959-97. Seven sightings of right whales were reported, but only one sighting of 4 right whales at the mouth of Yakutat Bay in 1979 could be positively confirmed (Waite et al. 2003). Sightings of a single right whale off eastern Kodiak Island occurred in July 1998 during an aerial survey (Waite et al. 2003), and in August 2004 and 2005 during a NOAA research cruise (NMML unpublished data). Acoustic monitoring at seven sites in the Gulf of Alaska has detected right whale calls at only two: one off eastern Kodiak and the other in deep water south of the Alaska Peninsula.

The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: distinct geographic distribution; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, two stocks of North Pacific right whales are currently recognized: a Sea of Okhotsk stock and an Eastern North Pacific stock (Rosenbaum et al. 2000, Brownell et al. 2001).

POPULATION SIZE

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 the stock was extinct because no sightings of a cow with calf had been confirmed since 1900 (D. Rice, AFSC-NMML-retired, pers. comm.). However, recent confirmed sightings in the Bering Sea have invalidated this view (Wade et al. 2006). Brownell et al. (2001) suggested from a review of sighting records that the abundance of this species in the western North Pacific was likely in the "low hundreds". A reliable estimate of abundance for the North Pacific right whale stock is currently not available.

There were several sightings of North Pacific right whales in the mid-1990s which renewed interest in conducting dedicated surveys for this species. In April 1996 a right whale was sighted off Maui (Salden and Mickelsen 1999). This was the first documented sighting of a right whale in Hawaiian waters since 1979 (Herman et al. 1980, Rowntree et al. 1980), although there is no reason to believe that either Hawaii or tropical Mexico have ever been anything except extralimital habitats for this species (Brownell et al. 2001). A group of 3-4 right whales was sighted in western Bristol Bay, southeastern Bering Sea, in July 1996 which may have included a juvenile animal (Goddard and Rugh 1998). During July 1997, a group of 4-5 individuals was encountered one evening in Bristol Bay, followed by a second sighting of 4-5 whales the following morning in approximately the same location (Tynan 1999). During dedicated surveys in July 1998, July 1999, and July 2000, 5, 6, and 13 right whales, were again found in the same general region of the southeastern Bering Sea (Leduc et al. 2001). Biopsy samples of right whales encountered in the southeastern Bering Sea were taken in 1997 and 1999. Genetics analyses identified three individuals in 1997 and four individuals in 1999; of the animals identified, one was identified in both years, resulting in a total genetic count of six individuals (LeDuc et al. 2001). Genetic analyses on samples from all six whales sampled in 1999 determined that the animals were male (LeDuc et al. 2001). Two right whales were observed during a vessel-based survey in the central Bering Sea in July 1999 (Moore et al. 2000).

Aerial photogrammetric analyses indicated that one of the animals was seen in 1997, 1998, and 1999 (LeDuc et al. 2001). Body lengths of 12 animals ranged from 14.7 to 17.6 m (LeDuc et al. 2001); since body length at sexual maturity has been estimated at about 15 m, LeDuc et al. (2001) suggest that all measured animals may have been sexually mature.

Preliminary information from the Bristol Bay survey in 2002 indicates that there were seven sightings of right whales (LeDuc 2004). One of the sightings in 2002 included a right whale calf; this is the first confirmed sighting of a calf in decades (a possible calf or juvenile sighting was also reported in Goddard and Rugh 1998). The concentration of right whales found in the summer of 2004 (above) included a minimum of 17 individuals, as determined by both photo-identification and genotyping from skin biopsies. Among these, at least one male had been previously photographed and four animals biopsied in other years; the latter included the only female seen prior to this encounter (Wade et al. 2006). This concentration also included two probable calves (Wade et al. 2006).

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. However, it is worth noting that of 13 individual animals photographed during aerial surveys in 1998, 1999, and 2000, two have already been rephotographed (LeDuc et al. 2001). This “mark-recapture” success rate is consistent with a very small population size. This conclusion is supported by a preliminary genotype-based comparison of the 17 individuals biopsied in the Bering Sea in the summer of 2004 which also revealed at least four matches to animals biopsied in previous years (Wade et al. 2006).

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, given the small apparent size and low observed calving rate of this population, this rate may be unrealistically high.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 recommended value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). A reliable estimate of minimum abundance is not available for this stock but it is certainly very small. The PBR level for this stock is considered zero.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Gillnets were implicated in the death of a 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. Entanglement in fishing gear, including lobster pot and sink gillnet gear, is a significant source of mortality for the North Atlantic right whale stock (Waring et al. 2004). An analysis of right whale photographs to estimate entanglement rate from scarring data is currently under way.

Based on the available records, the estimated annual mortality rate incidental to commercial fisheries approaches 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). Best (1987) estimated that between 1835 and 1909 15,374 right whales were taken from the North Pacific by American-registered whaling vessels, with most of those animals taken prior to 1875. Scarff (2001) updated that analysis with adjustments for struck-and-lost whales and whaling conducted by citizens of countries other than the U.S.; he estimated that 26,500-37,000 right whales were killed during the period 1839-1909, with the great majority taken in the single decade of 1840-49. From 1900 to 1999, a total of 742 right whales were killed by whaling; of those, 331 were killed in the western North Pacific and 411 in the eastern North Pacific (Brownell et al. 2001). The latter total includes 372 whales killed illegally by the USSR in the period 1963-67, primarily in the Gulf of Alaska and Bering Sea (Doroshenko 2000, Brownell et al. 2001).

Ship strikes are significant sources of mortality for the North Atlantic stock of right whales, and it is possible that right whales in the North Pacific are also vulnerable to this source of mortality. However, due to their rare occurrence and scattered distribution it is impossible to assess the threat of ship strikes to the North Pacific stock of right whales at this time.

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. Brownell et al. (2001) noted the devastating impact of extensive illegal Soviet catches in the eastern North Pacific in the 1960s, and suggested that the prognosis for right whales in this area was "poor". In its review of the status of right whales worldwide, the International Whaling Commission expressed "considerable concern" over the status of this population (IWC 2001).

On 4 October 2000, NMFS received a petition from the Center for Biological Diversity to designate critical habitat for this stock. Petitioners asserted that the southeast Bering Sea shelf from 55-60° N latitude should be considered critical habitat. On 1 June 2001, NMFS found the petition to have merit (66 FR 29773). On 20 February 2002, NMFS announced a decision to not designate critical habitat for North Pacific right whales (67 FR 7660) at this time. NMFS concluded that the information available did not indicate that the physical or biological features essential to the conservation of the species exist throughout the petitioned area, and that a smaller area may contain essential physical and biological features, but the boundary of this smaller area could not yet be defined. Thus, NMFS determined that critical habitat was undeterminable at that time. In June 2005, a federal judge found this reasoning invalid and directed the agency to publish a proposed rule designating critical habitat. Two areas of critical habitat were proposed: one in the southeastern Bering Sea and another south of Kodiak Island (70 FR 66332, 2 November 2005). In 2006, NMFS issued a final rule designating two areas as northern right whale critical habitat, one in the Gulf of Alaska and one in the Bering Sea (71 FR 38277, 6 July 2006).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Western Arctic bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 60°N and south of 75°N in the western Arctic Basin (Braham 1984, Moore and Reeves 1993). For management purposes, five stocks of bowhead whales have been recognized by the International Whaling Commission (IWC 1992). Small stocks occur in the Sea of Okhotsk, Davis Strait, Hudson Bay, and the offshore waters of Spitsbergen. These small bowhead stocks are comprised of only a few tens to a few hundreds of individuals (Shelden and Rugh 1995, Zeh et al. 1993). The largest population, and the only stock that is found within U. S. waters, is the Western Arctic stock (Figs. 43 and 44), also know as the Bering-Chukchi-Beaufort stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). The majority of 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 (Fig. 43) where they spend much of the summer (mid-May through September) before returning again to the Bering Sea (Fig. 44) in the fall (September through November) to overwinter (Braham et al. 1980, Moore and Reeves 1993). Most of the year, bowhead whales are closely associated with sea ice (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 pack ice. During the summer most of the population is in relatively ice-free waters in the southern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration and extraction (e.g., Richardson et al. 1987, Davies 1997). During the autumn migration, bowheads select shelf waters in all but “heavy ice” conditions, when they select slope habitat (Moore 2000). Sightings of bowhead whales do occur in the summer near Barrow (Moore 1992, Moore and DeMaster 2000) and are consistent with suggestions that certain areas near Barrow are important feeding grounds (Lowry et al. 2004). Some bowheads are found in the

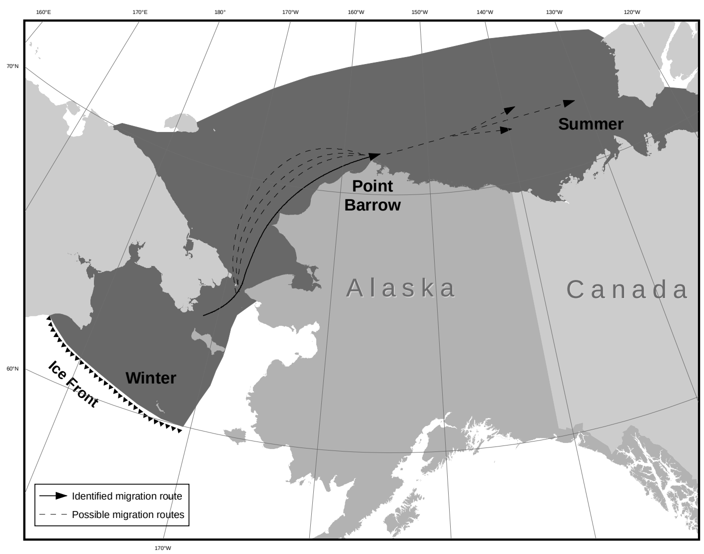

Figure 43. Shaded areas depict the approximate distribution. Spring migration of bowhead whales follows a route from the Bering Sea to the Beaufort Sea, mostly along a coastal tangent that constricts somewhat as it goes east past Point Barrow.

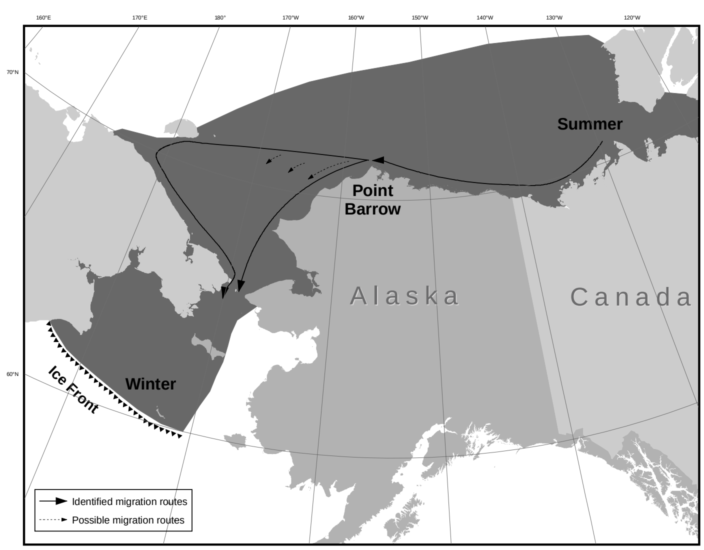

Figure 44. Shaded areas depict the approximate distribution. Fall migration of bowhead whales is represented here by schematic arrows showing generalized routes used to travel from the Beaufort Sea (summering area) to the Bering Sea (wintering area).

Chukchi and Bering Seas in summer, and these are thought to be a part of the expanding Western Arctic stock (Rugh et al. 2003). However, more research needs to be done to determine whether or not there are substocks within the Western Arctic stock (IWC 2004).

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 (Ross 1993) and spreading to the Bering Sea in the mid-19th century (Braham 1984, Bockstoce and Burns 1993). 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, systematic counts of bowhead whales have been conducted from sites on sea ice north of Point Barrow 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. 1993). A summary of the resulting abundance estimates is provided in Table 41 and Figure 45. However, these estimates of abundance have not been corrected for a small portion of the population that may not migrate past Point Barrow during the period when counts are made.

Aerial photo-identification of bowhead whales photographed in 1985 and 1986 and a capture-recapture analytical approach provided estimates of 4,719 (95% CI = 2,382-9,343) to 7,022 (95% CI = 4,701-12,561), depending on the model used (daSilva et al. 2000). These population estimates and their associated error ranges are comparable to the estimates obtained from the combined ice-based visual and acoustic data for 1985 (5,762) and 1986 (8,917). This study does demonstrate that the use of aerial photo-identification to estimate a population size for bowhead whales provides a reasonable alternative to the traditional ice-based census and acoustic techniques.

Table 41. Summary of population abundance estimates for the western Arctic stock of bowhead whales. The historical estimates were made by back-projecting using a simple recruitment model. All other estimates were developed by corrected ice-based census counts. Historical estimates are from Woodby and Botkin (1993); 1978-2001 estimates are from Zeh and Punt (2004).

Year	Abundance estimate (CV)	Year	Abundance estimate (CV)
Historical estimate	10,400-23,000	1985	5,762 (0.253)
End of commercial whaling	1000-3000	1986	8,917 (0215)
1978	4,765 (0.305)	1987	5,298 (0.327)
1980	3,885 (0.343)	1988	6,928 (0.120)
1981	4,467 (0.273)	1993	8,167 (0.017)
1982	7,395 (0.281)	2001	10,545 (0.128)
1983	6,573 (0.345)		

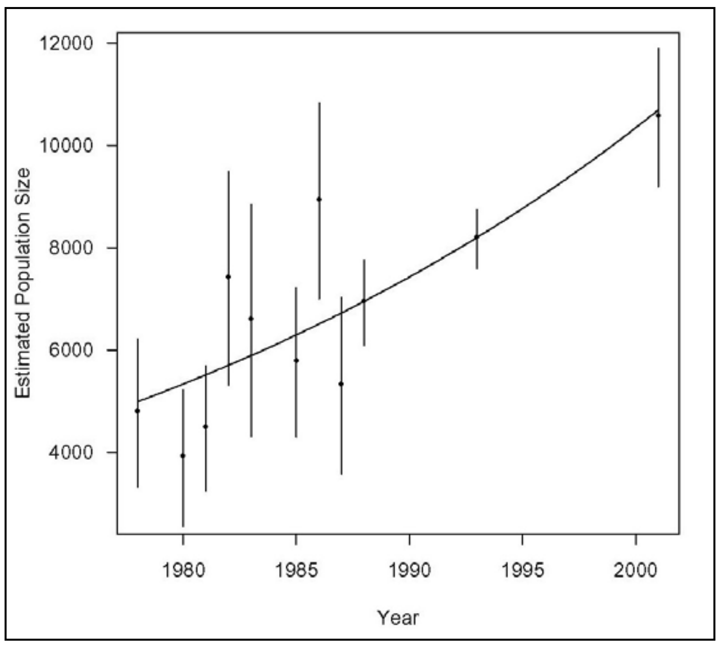

Figure 45. Population abundance estimates for the western Arctic stock of bowhead whales, 1977-2001 (George et al. 2004).

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): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the most recent population estimate (N) of 10,545 and its associated CV(N) of 0.128, N_{MIN} for the Western Arctic stock of bowhead whales is 9,472.

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, during which time abundance increased from approximately 5,000 to approximately 8,000 whales. This rate of increase takes into account whales that passed beyond the viewing range of the ice-based observers. The inclusion of the estimate for 2001 results in a rate of increase of 3.5% (95% CI: 2.2 to 4.9%; Brandon and Wade 2004) or 3.4% (95% CI: 1.7 to 5% George et al. 2004), similar to previous estimates. The count of 121 calves during the 2001 census was the highest yet recorded and, was likely caused by a combination of variable recruitment and the large population size (George et al. 2004). This provides corroborating evidence for a healthy and increasing population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.3%) 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}. 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 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) level 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 = 95 animals ($9{,}472 \times 0.02 \times 0.5$). The development of a PBR level for the Western Arctic bowhead stock is required by the MMPA even though the subsistence harvest 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. For 2002-07, a block quota of 280 bowhead strikes will be allowed, of which 67 (plus up to 15 unharvested in the previous year) could be taken each year. This quota includes an allowance of 5 animals to be taken by Chukotka Natives in Russia.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Several cases of rope or net entanglement have been reported from whales taken in the subsistence hunt, including those summarized in Table 42 (Philo et al. 1993). Further, preliminary counts of similar observations based on reexamination of bowhead harvest records indicate entanglements or scarring attributed to ropes may include over 20 cases (Craig George, Department of Wildlife Management, North Slope Borough, pers. comm.). There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska.

Some bowhead whales have had interactions with crab pot gear (Table 42), one in 1993 and one in 1999. The average rate of entanglement in crab pot gear for 1999-2003 is 0.2.

Table 42. Reported scarring of bowhead whales attributed to entanglement in ropes and ship strikes and description of observations collected during subsistence harvests in Alaska since 1978 (Philo et al. 1993; * D. Rugh, personal communication, National Marine Fisheries Service; ** C. George, personal communication, North Slope Borough).

Year	Number of whales	Location	Description
1978	1	Wainwright	6 scars on caudal peduncle
1986	1	Kaktovik	Scars on caudal peduncle and anterior margin of flukes
1989	1	Barrow	12 scars on ridges of caudal peduncle

Year	Number of whales	Location	Description
1989	1	south of Gambell	Rope wrapped around head, through mouth and baleen
1989*	1	Barrow	Rope ~32m long trailing from mouth
1990	1	Barrow	Scars on caudal peduncle; 2 ropes trailing from mouth.
1991*	1	Barrow	Apparent rope scar from mouth, across back
1993**	1	Barrow	Large female with crab pot line wrapped around flukes
1998**	1	NW of Kotzebue; near Red Dog Mine dock	Stranded - dead with line on it
1999**	1	Barrow	Whale entangled in confirmed crab gear. Line wrapped through gape of mouth, flipper, and peduncle. Severe injuries.
2003**	1	Near Ugashik	Stranded with rope tied around the peduncle; entangled?
2004**	1	Kaktovik	Boat propeller marks

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 nine Alaska communities (Philo et al. 1993). Under this quota, the number of kills has ranged between 14 and 72 per year, depending in part on changes in management strategy and in part on higher abundance estimates in recent years (Stoker and Krupnik 1993). Suydam and George (2004) summarize Alaskan subsistence harvests of bowheads from 1974 to 2003. A total of 832 whales were landed by hunters from 11 villages. Barrow landed the most whales (n = 418) while Little Diomede and Shaktoolik each landed only one. The number of whales landed at each village varies greatly from year to year, as success is greatly influenced by village size and ice and weather conditions. The efficiency of the hunt has increased since the implementation of the bowhead quota in 1978. In 1978 the efficiency was about 50% and is currently about 85%. The size of landed whales differs among villages. Gambell and Savoonga, villages on St. Lawrence Island, and Wainright harvest larger whales than Point Hope and Barrow. These differences are likely due to hunter selectivity and/or whale availability.

The number of bowheads landed by Alaska Natives, was reported to be 35 in 2000, 49 in 2001, 37 in 2002, 35 in 2003, and 36 in 2004 (Suydam et al. 2005). 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 5-year period from 2000 to 2004 is 38.4 bowhead whales. One animal was harvested by Russian subsistence hunters in each of 1999 and 2000 and three in 2003 (Borodin 2004).

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 estimated pre-whaling abundance 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 1848-1919, 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 animals taken by the shore-based operations 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), and the lack of reports on struck and lost animals.

STATUS OF STOCK

Based on currently available data, the estimated annual mortality rate incidental to U. S. commercial fisheries (0.2) is not known to exceed 10% of the PBR (9.4) and, therefore, can be considered to be insignificant. The annual level of human-caused mortality and serious injury (40) is not known to exceed the PBR (95) nor the IWC annual maximum (67). The Western Arctic bowhead whale stock has been increasing in recent years; the current estimate of 10,545 is between 19% and 105% of the pre-exploitation abundance (estimates ranging roughly from 10,000 to 55,000) and this stock may now be approaching its carrying capacity (Brandon and Wade 2004). However, the stock is classified as a strategic stock because the bowhead whale is listed as “endangered” under the Endangered Species Act (ESA) and therefore also designated as “depleted” under the MMPA. Recovery criteria developed for large whales in general (Angliss et al. 2002) and bowhead whales in particular (Shelden et al. 2001) will be used in the next 5-year evaluation of stock status.

Habitat Issues

Increasing oil and gas development in the Arctic has led to an increased risk of various forms of pollution to bowhead whale habitat, including oil spills, and toxic and nontoxic waste. Sound due to higher levels of traffic as well as exploration and drilling operations is also of potential concern. Evidence indicates that bowhead whales are sensitive to sound from offshore drilling platforms and seismic survey operations (Richardson and Malme 1993, Richardson 1995, Davies 1997), and that the presence of an active drill rig (Schick and Urban 2000) or seismic operations (Miller et al. 1999) will cause bowhead whales to avoid the vicinity. Figure 2b in Schick and Urban (2000) demonstrates, however, that the area of disturbance was localized in this instance. Recent studies conducted as part of a monitoring program for the Northstar project (a drilling facility located on an artificial island in the Beaufort Sea) indicate that, in one of the 3 years of monitoring efforts, the southern edge of the bowhead whale fall migration path may have been slightly (2-3 mi) further offshore during periods when higher sound levels were recorded; there was no significant effect of sound detected on the migration path during the other two monitored years (Richardson et al. 2004). Evidence indicated that deflection of the southern portion of the migration in 2001 occurred during periods when there were certain vessels in the area, and did not occur as a result of sound emanating from the Northstar facility itself. Because the bowhead whale population is approaching its pre-exploitation population size and has been documented to be increasing at a roughly constant rate for over 20 years, the impacts of oil and gas industry on individual survival and reproduction have likely been minor.

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, and the concomitant effect on prey availability. There are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales.

On 22 February 2000, NMFS received a petition from the Center for Biological Diversity and Marine Biodiversity Protection Center to designate critical habitat for the Western Arctic bowhead stock. Petitioners asserted that the nearshore areas from the U.S.-Canada border to Barrow, Alaska should be considered critical habitat. On 22 May 2001, NMFS found the petition to have merit (66 FR 28141). On 30 August 2002 (67 FR 55767), NMFS announced the decision to not designate critical habitat for this population. NMFS found that designation of critical habitat was not necessary because the population is known to be approaching its pre-commercial whaling population size, the population is increasing, there are no known habitat issues which are slowing the growth of the population, and because activities which occur in the petitioned area are already managed to minimize impacts to the population.

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APPENDICES

Appendix 1. Summary of changes to the 2006 stock assessments. An 'X' indicates sections where the information presented has been updated since the 2005 stock assessments were released (last revised 11/01/06).

Stock	Stock definition	Population size	PBR	Fishery mortality	Subsistence Mortality	Status
Steller sea lion (western US)		X	X	X	X	
Steller sea lion (eastern US)		X	X	X	X	
Northern fur seal		X	X	X	X	
Harbor seal (SE Alaska)		X	X	X	X	
Harbor seal (GOA)		X	X	X	X	
Harbor seal (Bering Sea)		X	X	X	X	
Spotted seal				X		
Bearded seal				X		
Ringed seal				X		
Ribbon seal				X		
Beluga whale (Beaufort)						
Beluga whale (E. Chukchi)						
Beluga whale (E. Bering Sea)						
Beluga whale (Bristol Bay)						
Beluga whale (Cook Inlet)		X	X	X	X	
Killer whale (Alaska Resident)				X		
Killer whale (Northern Resident)						
Killer whale (AT1 Transient)						
Killer whale (Gulf of Alaska, Bering Sea, Aleutian Islands Transient)				X		
Killer whale (West Coast Transient)						
Pacific white-sided dolphin			X	X		X
Harbor porpoise (SE Alaska)		X	X	X		X
Harbor porpoise (GOA)		X	X	X		X
Harbor porpoise (Bering Sea)		X	X	X		X
Dall's porpoise		X	X	X		
Sperm whale				X		
Baird's beaked whale						
Cuvier's beaked whale						
Stejneger's beaked whale						
Gray whale						
Humpback whale (western)				X		
Humpback whale (central)				X		
Fin whale				X		
Minke whale				X		
North Pacific right whale		X				
Bowhead whale		X	X	X	X	

Appendix 2. Stock summary table (last revised 11/01/06). Stock assessment reports for those stocks in boldface were updated in the 2006 stock assessments. N/A indicates data are unknown. UNDET (undetermined) PBR indicates data are available to calculate a PBR level but a determination has been made that calculating a PBR level using those data is inappropriate (see stock assessment for details).

Species	Stock	N (est)	CV	N(min)	Survey interval/ year of last survey	Rmax	F(r)	PBR	Fishery mort.	Subsist. mort.	Total mort.	Status
Baird's beaked whale	Alaska	N/A		N/A		0.04	0.50	N/A	0	0	0	NS
Bearded seal	**Alaska**	N/A		N/A		0.12	0.50	N/A	0.68	6,788	6,789	NS
Beluga whale	Beaufort Sea	39,258	0.23	32,453	13/1992	0.04	0.50	324	0	152	152	NS
Beluga whale	E. Chukchi Sea	3,710	N/A	3,710	3/2002	0.04	1.00	74	0	65	65	NS
Beluga whale	E. Bering Sea	18,142	0.24	14,898	5/2000	0.04	1.00	298	0	209	209	NS
Beluga whale	Bristol Bay	1,888	0.2	1,619	5/2000	0.04	1.00	32	0	19	19	NS
Beluga whale	**Cook Inlet**	278	0.18	238	1/2005	0.04	0.30	UNDET	0	1	1	S
Bowhead whale	**W. Arctic**	10,545	0.13	9,472	5/2001	0.04	0.50	95	0.2	39	40	S
Cuvier's beaked whale	Alaska	N/A		N/A		0.04	0.50	N/A	0	0	0	NS
Dall's porpoise	**Alaska**	83,400	0.097	N/A	5/2000	0.04	1.00	UNDET	30	0	30	NS
Fin whale	**NE Pacific**	5703	N/A	5703	2/2003	0.04	0.10	11.4	0	0	0.2	S
Gray whale	E. N. Pacific	18,813	0.07	17,752	3/2002	0.047	1.00	417	6.7	122	130	NS
Harbor porpoise	**SE Alaska**	17,076	0.265	13,713	8/1997	0.04	0.50	137	*0	0	0	S
Harbor porpoise	**Gulf of Alaska**	41,854	0.224	34,740	7/1998	0.04	0.50	347	68	0	70	S
Harbor porpoise	**Bering Sea**	66,078	0.232	54,492	6/1999	0.04	0.50	545	0.35	0	0.35	S
Harbor seal	**SE Alaska**	112,391[+]	0.04	108,670	6/1997-1998	0.12	0.5	3,260	0	1,092	1,094	NS
Harbor seal	**Gulf of Alaska**	45,975[+]	0.04	44,453	6/2000	0.12	0.50	1,334	24	795	820	NS

Species	Stock	N (est)	CV	N(min)	Survey interval/ year of last survey	Rmax	F(r)	PBR	Fishery mort.	Subsist. mort.	Total mort.	Status
Harbor seal	Bering Sea	21,651[+]	0.10	20,109	6/1996; 1999	0.12	0.50	603	1.3	174	177	NS
Humpback whale	W. N. Pacific	394	0.08	367	6+/1999	0.07	0.10	1.3	0.2	0	0.2	S
Humpback whale	CNP - entire stock	4,005	0.095	3,698	12/1993	0.07	0.10	12.9	3.2	0	5.0	S
	CNP - SEAK feeding area	961	0.12	868		0.07	0.10	3	1.4	0	2.8	N/A
Killer whale	Alaska Resident	1,123	N/A	1,123	8+/2003	0.04	0.50	11.2	1.5	0	1.5	NS
Killer whale	Northern Resident (British Columbia)	216	N/A	216		0.04	0.5	2.16	0	0	0	NS
Killer whale	AT1 transient	8	N/A	8		0.04	0.50	0	0	0	0	S
Killer whale	GOA, AI, BS Transient	314	N/A	314	8+/2003	0.04	0.5	3.1	0.4	0	0.4	NS
Killer whale	West Coast Transient	314	N/A	314		0.04	0.5	3.1	0	0	0	NS
Minke whale	Alaska	N/A		N/A		0.04	0.50	N/A	0.32	0	0.32	NS
North Pacific right whale	E. N. Pacific	N/A	N/A	N/A	N/A	0.04	0.10	N/A	0	0	0	S
Northern fur seal	E. North Pacific	721,935	N/A	709,881	2/2004	0.086	0.50	15,262	0.5	754	756	S
Pacific white-sided dolphin	Cent. N. Pacific	26,880	N/A	N/A	12+/1990	0.04	0.50	UNDET	0	0	0	NS
Ribbon seal	Alaska	N/A		N/A		0.12	0.50	N/A	0.8	193	194	NS
Ringed seal	Alaska	N/A		N/A		0.12	0.50	N/A	0.71	9,567	9,568	NS
Sperm whale	N. Pacific	N/A		N/A		0.04	0.10	N/A	0.5	0	0.5	S
Spotted seal	Alaska	N/A		N/A		0.12	0.50	N/A	0.88	5,265	5,266	NS
Stejneger's beaked whale	Alaska	N/A		N/A		0.04	0.50	N/A	0	0	0	NS
Steller sea lion	E. U. S.	47,885		44,555	2/2005	0.12	0.75	2,000	2.6	6	10.2	S
Steller sea lion	W.U. S.	38,988		38,988	2/2004	0.12	0.10	234	24.6	191	216	S

C.F. = correction factor; CV C.F. = CV of correction factor; Comb. CV = combined CV; Status: S = Strategic, NS = Not Strategic.

* = No or minimal reported take by fishery observers; however, observer coverage was minimal or nonexistent.
+ = These changes in the abundance estimates do not indicate a major population increase. Instead, these increases are due to new analytical methods that take environmental covariates into account and thus provide an improved estimate of harbor seal abundance.
See txt = see text for details.

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Appendix 3. Summary table for Alaska **Category 2** commercial fisheries. Source: 67 FR 2410; 17 January 2002. Notice of continuing effect of list of fisheries.

Fishery (area and gear type)	**Target species**	**Permits issued or fished (2003)**	**Soak time**	**Landings per day**	**Sets per day**	**Season duration**	**Fishery trends (1990-1997)**
Southeast AK drift gillnet	salmon	478	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	420	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	173	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	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	574	15 min - 3 hrs or continuous; day only	1	6 - 18	June 25 to end of Aug	# vessels stable; catch - variable
Cook Inlet set gillnet	salmon	746	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	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	160	2 -5 hrs; day / night	1	3 - 8	mid - June to mid - Sept	# vessels stable; catch up
AK Peninsula/ Aleutians set gillnet	salmon	115	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	1879	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	1041	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					new fishery

Appendix 4. Interaction table for Alaska **Category 2** commercial fisheries. Source: 71 FR 20941; 24 April 2006 and Perez (2006). Notice of continuing effect of list of fisheries.

Fishery (area and gear type)	**# of permits issued or fished (2003)**	**Observer program**	**Species recorded as taken incidentally in this fishery (records dating back to 1988)**	**Data type**
Southeast AK drift gillnet	478	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	420	never observed	humpback whale	self reports and stranding
Yakutat set gillnet	173	never observed	harbor seal, gray whale (stranding)	logbook and stranding
Prince William Sound drift gillnet	540	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	574	1999	Steller sea lion, harbor seal, harbor porpoise, Dall's porpoise, Cook Inlet beluga Note: observer program in 1999 and 2000 recorded one incidental mortality/serious injury of a harbor porpoise	observer and logbook
Cook Inlet set gillnet	746	1999	harbor seal, harbor porpoise, Dall's porpoise, Cook Inlet beluga Note: observer program in 1999 and 2000 recorded one incidental mortality/serious injury of a harbor porpoise	observer and logbook
Kodiak set gillnet	188	2002	harbor seal, harbor porpoise, sea otter; preliminary results not yet available for 2002 observer program	logbook
Alaska Peninsula/Aleutians drift gillnet	160	1990	northern fur seal, harbor seal, harbor porpoise, Dall's porpoise (obs)	observer and logbook
Alaska Peninsula/Aleutians set gillnet	115	never observed	Steller sea lion, harbor porpoise	logbook
Bristol Bay drift gillnet	1879	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	1041	never observed	northern fur seal, harbor seal, spotted seal, beluga whale, gray whale	logbook
Metkatla/Annette Island drift gillnet	Ask tribal fishery	never observed	none documented	none
AK pair trawl	1	never observed	none documented	none
AK Bering Sea, Aleutian islands flatfish trawl	26	2004	Bearded seal, harbor porpoise (Bering Sea), harbor seal (Bering Sea), killer whale (Alaska Resident), northern fur seal, spotted seal, Steller sea lion (Western U.S.), walrus	observer
AK Bering Sea, Aleutian Islands pollock trawl	120	2004	Dall's porpoise, harbor seal, Humpback whale (Central North Pacific), Humpback whale (Western North Pacific), killer whale (GOA, Aleutian Islands, and Bering Sea Transient), minke whale, ribbon seal, spotted seal, Steller sea lion (western U.S.),	observer
AK Bering Sea, Aleutian Islands Pacific cod longline	114	2004	Killer whale (Alaska Resident), killer whale (GOA, Aleutian Islands, and Bering Sea Transient), ribbon seal, Steller sea lion (western U.S.)	observer

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. Observer program indicates most recent year of observer data included in these reports.

CITATIONS

Perez, M. A. 2006. Analysis of marine mammal bycatch data from the trawl, longline, and pot groundfish fisheries of Alaska, 1998-2004, defined by geographic area, gear type, and target groundfish catch species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-167.

Appendix 5. Interaction table for Alaska **Category 3** commercial fisheries. 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. Source: 71 FR 20941; 24 April 2006 and Perez (2006). Notice of continuing effect of list of fisheries.

Fishery name	**# of permits issued or fished 2003**	**Observer program**	**Species recorded as taken incidentally in this fishery (records dating back to 1990)**	**Data type**
Prince William Sound salmon set gillnet	30	1990	Steller sea lion, harbor seal	logbook
Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet	2055	never observed	harbor porpoise	none
AK roe herring and food/bait herring gillnet	1383	never observed	none documented	none
AK miscellaneous finfish set gillnet	3	never observed	Steller sea lion	logbook
AK salmon purse seine (except for Southeast AK)	956	never observed	harbor seal	logbook
AK salmon beach seine	36	never observed	none documented	none
AK roe herring and food/bait herring purse seine	451	never observed	none documented	none
AK roe herring and food/bait herring beach seine	6	never observed	none documented	none
Metlakatla purse seine	10	never observed	none documented	none
AK octopus/squid purse seine	2	never observed	none documented	none
AK miscellaneous finfish purse seine	1	never observed	none documented	none
AK miscellaneous finfish beach seine	1	never observed	none documented	none
AK salmon troll (includes hand and power troll)	3135	never observed	Steller sea lion	logbook
AK north Pacific halibut/bottom fish troll	175	never observed	none documented	none
AK state waters groundfish longline /set line (incl. sablefish/ rockfish/misc. finfish)	1613	never observed	none documented	none
AK Gulf of Alaska halibut longline	1,302		none documented	
AK Gulf of Alaska rockfish longline	440		none documented	
AK Gulf of Alaska rockfish longline	421		none documented	
AK Gulf of Alaska sablefish longline	412		Steller sea lion, possible sperm whale	
AK Bering Sea, Aleutian Islands Greenland turbot longline	36		Killer whale (Alaska Resident), Killer whale (GOA, Aleutian Islands, and Bering Sea Transient)	
AK Bering Sea, Aleutian islands rockfish longline	17		none documented	
AK Bering Sea, Aleutian Islands sablefish longline	63		none documented	
AK halibut longline/set line (state and federal waters)	2859	never observed	Steller sea lion	self reports
AK octopus/squid longline	4	never observed	none documented	none
AK shrimp otter and beam trawl (statewide and Cook Inlet)	44	never observed	none documented	none
AK Gulf of Alaska flatfish trawl	52		none documented	
AK Gulf of Alaska Pacific cod trawl	101		Steller sea lion	
AK Gulf of Alaska pollock trawl	83		Steller sea lion, fin whale, northern elephant seal, Dall's porpoise	
AK Gulf of Alaska rockfish trawl	45		none documented	
AK Bering Sea, Aleutian Islands Atka mackerel trawl	8		Steller sea lion (Western U.S.)	
AK Bering Sea, Aleutian Islands Pacific cod trawl	87		Harbor seal, Steller sea lion	
AK Bering Sea, Aleutian Islands rockfish trawl	9		none documented	

Fishery name	# of permits issued or fished 2003	Observer program	Species recorded as taken incidentally in this fishery (records dating back to 1990)	Data type
State waters of Kachemak Bay Cook Inlet, Prince William Sound, Southeast AK groundfish trawl	2	never observed	none documented	none
AK miscellaneous finfish otter or beam trawl	303	never observed	none documented	none
AK food/bait herring trawl (Kodiak area only)	4	never observed	none documented	none
AK Bering Sea and Gulf of Alaska finfish pot	308	1990 to present	harbor seal, sea otter	observer
AK Aleutian Islands sablefish pot	8		none documented	
AK Bering Sea sablefish pot	6		Humpback whale (Central North Pacific), Humpback whale (Western North Pacific)	
AK Bering Sea, Aleutian Islands Pacific cod pot	76		possible harbor seal	
AK Bering Sea, Aleutian Islands crab pot	329		none documented	
AK Gulf of Alaska crab pot			none documented	
AK gulf of Alaska Pacific cod pot	154		harbor seal	
AK Southeast Alaska crab pot			none documented	
AK Southeast Alaska shrimp pot			none documented	
AK octopus/squid pot	34	never observed	none documented	none
AK snail pot	1	never observed	none documented	none
AK North Pacific halibut handline and mechanical jig	67	never observed	none documented	none
AK other finfish handline and mechanical jig	485	never observed	none documented	none
AK octopus/squid handline	2 issued # fished N/A	never observed	none documented	none
AK Prince William Sound herring roe/food/bait pound net	449	never observed	none documented	none
Southeast AK herring food/bait pound net	3	never observed	none documented	none
Coastwise scallop dredge	5	never observed	none documented	none
AK dungeness crab (hand pick/dive)	3	never observed	none documented	none
AK herring spawn-on-kelp (hand pick/dive)	289	never observed	none documented	none
AK urchin and other fish/shellfish (hand pick/dive)	500	never observed	none documented	none
AK commercial passenger fishing vessel	2702 (may contain freshwater vessels, will be updated later)	never observed	none documented	none
AK octopus/squid "other"	19	never observed	none documented	none

Note: Observer program indicates most recent year of observer data included in these reports.

CITATIONS

Perez, M. A. 2006. Analysis of marine mammal bycatch data from the trawl, longline, and pot groundfish fisheries of Alaska, 1998-2004, defined by geographic area, gear type, and target groundfish catch species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-167.

Appendix 6. Observer coverage in Alaska commercial fisheries 1990-2004.

Fishery name	Method for calculating observer coverage	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gulf of Alaska (GOA) groundfish trawl		55%	38%	41%	37%	33%	44%	37%	33%							
GOA flatfish trawl	% of observed biomass									39.2%	35.8%	36.8%	40.5%	35.9%	40.6%	76.9%
GOA Pacific cod trawl	% of observed biomass									20.6%	16.4%	13.5%	20.3%	23.2%	27.0%	82.5%
GOA pollock trawl	% of observed biomass									37.5%	31.7%	27.5%	17.6%	26.0%	31.4%	96.1%
GOA rockfish trawl	% of observed biomass									51.4%	49.8%	50.2%	51.0%	37.2%	48.4%	74.1%
GOA longline		21%	15%	13%	13%	8%	18%	16%	15%							
GOA Pacific cod longline	% of observed biomass									3.8%	5.7%	6.1%	4.9%	11.4%	12.6%	21.4%
GOA Pacific halibut longline	% of observed biomass									51.3%	47.1%	51.1%	43.0%	41.4%	9.6%	36.4%
GOA rockfish longline	% of observed biomass									1.0%	1.4%	0.2%	1.3%	4.9%	2.5%	0%
GOA sablefish longline	% of observed biomass									16.9%	14.0%	15.2%	12.4%	13.7%	9.4%	37.7%
GOA finfish pots		13%	9%	9%	7%	7%	7%	5%	4%							
BSAI Pacific cod pot	% of observed biomass									14.6%	16.2%	8.5%	14.7%	12.1%	12.4%	33.1%
BS sablefish pot	% of observed biomass									42.1%	44.1%	62.6%	38.7%	40.6%	21.4%	72.5%
AI sablefish pot	% of observed biomass									100%	50.3%	68.2%	60.6%	69.4%	47.5%	51.2%
GOA Pacific cod pot	% of observed biomass									6.7 %	5.7%	7.0%	5.8%	7.0%	4.0%	40.6%
Bering Sea/Aleutian Islands (BSAI) groundfish trawl		74%	53%	63%	66%	64%	67%	66%	64%							
BSAI Atka mackerel trawl	% of observed biomass									65.0%	77.2%	86.3%	82.4%	98.3%	95.4%	96.6%
BSAI flatfish trawl	% of observed biomass									59.4%	66.3%	64.5%	57.6%	58.4%	63.9%	68.2%
BSAI Pacific cod trawl	% of observed biomass									55.3%	50.6%	51.7%	57.8%	47.4%	49.9%	75.1%
BSAI pollock trawl	% of observed biomass									66.9%	75.2%	76.2%	79.0%	80.0%	82.2%	92.8%
BSAI rockfish trawl	% of observed biomass									85.4%	85.6%	85.1%	65.3%	79.9%	82.6%	94.1%
BSAI longline		80%	54%	35%	30%	27%	28%	29%	33%							
BSAI Greenland turbot longline	% of observed biomass									31.6%	30.8%	52.8%	33.5%	37.3%	40.9%	39.3%
BSAI Pacific cod longline	% of observed biomass									34.4%	31.8%	35.2%	29.5%	29.6%	29.8%	25.7%
BSAI Pacific halibut longline	% of observed biomass									38.9%	48.4%	55.3%	67.2%	57.4%	20.3%	44.5%
BSAI rockfish longline	% of observed biomass									41.5%	21.4%	53.0%	26.9%	36.0%	74.9%	37.9%
BSAI sablefish longline	% of observed biomass									19.5%	28.4%	24.4%	18.9%	30.3%	10.4%	50.9%
BSAI finfish pots	% of observed biomass	43%	36%	34%	41%	27%	20%	17%	18%	15%	17%	9%	15%	14%	13%	?
Prince William Sound salmon drift gillnet	% of estimated sets observed	4%	5%	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Prince William Sound salmon set gillnet	% of estimated sets observed	3%	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Alaska Peninsula/Aleutian Islands salmon drift gillnet (South Unimak area only)	% of estimated sets observed	4%	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.
Cook Inlet salmon drift gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	1.8%	3.7%	not obs.	not obs.	not obs.	not obs.

Fishery name	Method for calculating observer coverage	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Cook Inlet salmon set gillnet	% of fishing days observed	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	7.3%	8.3%	not obs.	not obs.	not obs.	not obs.

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 coverage in the groundfish fisheries varies by statistical area; the pooled percent coverage for all areas is provided here. 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 7. 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). As of the stock assessment reports for 2006, these records are no longer used to estimate annual fishery-related mortalities.

Fishery	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Minimum estimated mortality**
Steller sea lion (Western U.S. stock)																
Alaska Peninsula/Aleutian Islands salmon set gillnet	0	1	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.75
Bristol Bay salmon drift gillnet	0	4	2	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.5
Prince William Sound set gillnet	0	0	2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Alaska miscellaneous finfish set gillnet	0	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Alaska halibut longline (state and federal waters)	0	0	0	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.2
Kodiak salmon set gillnet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2
Steller sea lion (Eastern U. S. stock)																
Southeast Alaska salmon drift gillnet	0	1	2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.25
Northern fur seal (Eastern Pacific stock)																
Prince William Sound salmon drift gillnet	1	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Alaska Peninsula/Aleutian Islands salmon drift gillnet	2	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Bristol Bay salmon drift gillnet	5	0	49	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.5
Alaska misc. finfish pair trawl	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1

Fishery	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Minimum estimated mortality
Harbor seal (Southeast Alaska stock)																
Southeast Alaska salmon drift gillnet	8	1	4	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	N/A	3.2
Yakutat salmon set gillnet	0	18	31	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	27.5
Harbor seal (Gulf of Alaska stock)																
Cook Inlet salmon set gillnet	6	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.75
Prince William Sound set gillnet	0	0	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Kodiak salmon set gillnet	3	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.75
Alaska salmon purse seine (except for Southeast)	0	0	0	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Alaska Peninsula/Aleutian Islands salmon drift gillnet	9	2	12	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7
Harbor seal (Bering Sea stock)																
Bristol Bay salmon drift gillnet	38	23	2	42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	26.25
Bristol Bay salmon set gillnet	0	0	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
AK misc. finfish pair trawl	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	1
Spotted seal (Alaska stock)																
Bristol Bay salmon drift gillnet	5	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.5
Beluga whale (Bristol Bay stock)																
Bristol Bay salmon drift gillnet	0	1	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Bristol Bay salmon set gillnet	1	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Pacific white-sided dolphin (North Pacific stock)																
Prince William Sound salmon drift gillnet	1	4	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.25
Southeast Alaska salmon drift gillnet	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Bristol Bay salmon drift gillnet	3	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.75
Harbor porpoise (Southeast Alaska stock)																
Southeast Alaska salmon drift gillnet	2	2	7	2	N/A	N/A	2	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A	2.7
Harbor porpoise (Gulf of Alaska stock)																
Cook Inlet salmon drift and set gillnet fisheries	3	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	0.8
AK Peninsula/Aleutian Island salmon drift gillnet	2	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.75
Kodiak salmon set gillnet	8	4	2	1	N/A	N/A	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A	3.2
Harbor porpoise (Bering Sea stock)																
AK Peninsula/Aleutian Island salmon set gillnet	0	0	2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Bristol Bay salmon drift gillnet	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Bristol Bay salmon set gillnet	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
AK Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Dall's porpoise (Alaska stock)																
Prince William Sound salmon drift gillnet	0	2	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Southeast Alaska salmon drift gillnet	6	6	4	6	N/A	N/A	N/A	1	N/A	1	N/A	1	N/A	?	N/A	3.6
Cook Inlet set and drift gillnet fisheries	1	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
Eastern North Pacific gray whale																
Bristol Bay salmon drift and set gillnet fisheries	2	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
WA/OR/CA crab pot	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	N/A	N/A	0.5
Humpback whale (Central North Pacific stock)																
Southeast Alaska salmon drift gillnet	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Southeast Alaska salmon purse seine	0	0	0	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.2

CITATIONS

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 - Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Appendix 8: Humpback whale entanglement and other human impact records.

This appendix provides a list of human-related events involving injury or mortality of humpback whales (Central North Pacific stock) from reports provided to the NMFS Alaska Region, 2001-2005. Areas are designated "SE" for Southeast Alaska or "North" for all other feeding areas; it is assumed that the entanglement was reported in the area where the entanglement occurred, and that duplicate sightings have been removed. This table includes summaries of the information on each incident; for detailed reports, contact the NMFS Alaska Region. The determination whether each injury should be considered serious, not serious, or not determinable (ND) was made by a subcommittee of the Alaska Scientific Review Group (SRG) who reviewed the complete record for each incident. A subsequent review was conducted by NMFS Alaska Region staff to ensure consistency with NMFS' existing guidelines for serious injury; this review resulted in three changes from the SRG's recommendations.

Date	Area	Condition	Brief description	Area	Severity of injury
5/28/01	Resurrection Bay	Entangled, released alive	Swimming freely with multiple lines and buoys attached	North	Not serious
6/15/01	Kodiak	Entangled	Attempt to disentangle failed; mother/calf pair	North	Serious*
7/12/01	Yakutat	Found dead	Entangled in Yakutat salmon set gillnet	North	Mortality
7/30/01	Bering Glacier/Yakutaga	Found dead, decomposed	Entangled in salmon set gillnet with floats	North	Mortality
9/18/01	Anchorage	Dead	Ship strike - container ship	North	Mortality
3/13/05	Kenai River	Dead	Fresh stranding; confirmed collision/blunt trauma	North	Mortality
3/16/05	Sadie Cove; Kachemak Bay	Entangled	Fishing gear remnants and buoys attached to flukes; confirmed Pacific cod pot gear, fully disentangled	North	Not serious
6/14/05	Sadie Cove; Kachemak Bay	Entangled	Fishing net remnants and buoys attached to flukes; confirmed Cook Inlet salmon set gillnet	North	Serious
6/17/05	Stevenson Entrance; Kodiak	Entangled	Gillnet on head with three white, pink, orange buoys attached; unknown gillnet	North	Serious
6/21/05	Kachemak Bay	Collision	Whale surfaced by propeller, felt "thump", and saw blood in water	North	Not determinable
6/25/05	Alitak Bay	Dead	Mesh or webbing scars of most of stranded body; confirmed Kodiak salmon purse seine	North	Mortality
7/8/05	Kachemak Bay	Dead	Animal killed in purse seine; confirmed lower Cook Inlet salmon purse seine	North	Mortality
7/26/05	Kodiak Harbor	Partially disentangled	Entangled and immobilized in crab pot gear	North	Not serious
9/14/05	Kodiak	Entangled	Animal entangled in long line gear; partially disentangled	North	Not determinable
6/19/01	Dixon Entrance	Possibly injured	Probable ship strike; whale surfaced immediately in front of large vessel, vessel backed down and stopped, crew heard a "thump" just prior to backing down	SE	Not serious
7/16/01	Glacier Bay	Found dead, decomposed	Ship strike; fractured skull and pre-mortem hemorrhage	SE	Mortality
8/13/01	Hoonah	Entangled, released alive	Shrimp pot gear; wounds on dorsal ridge and tail stock	SE	Not serious

Date	Area	Condition	Brief description	Area	Severity of injury
9/19/01	Lynn Canal	Entangled, release alive, status unknown	Shrimp pot gear	SE	Not determinable
6/22/02	Fern Harbor	Alive, collision	62' recreational charter coasted into whale. Whale surfaced parallel to port side, rolled under, and reappeared with partner on starboard side. Whales continued, moving away from the boat. No visible injury to whale or vessel.	SE	Not serious
7/13/02	Taku Inlet	Entangled	Entangled with fishing gear, unknown condition.	SE	Not determinable
7/21/02	Petersburg	Entangled, released alive	Crab trap in the mouth of whale. Buoy side of line went around top of head and tangled with pot side of line. Coast Guard and NMFS Special Agent removed trap and line from whale.	SE	Not serious
8/15/02	Kupreanof Island	Entangled	Green mesh trawl gear wrapped around the left pectoral fin.	SE	Not determinable
9/7/02	Ketchikan	Entangled, released alive	Whale entangled in shrimp pot gear. Line through mouth and around pectoral fin. Citizen disentangled whale and released.	SE	Not serious
5/03	Icy Bay	Dead	53' female humpback with skull completely disarticulated from the vertebrae	SE	Mortality
8/2/03	Auke Bay	Entangled, self release	Whale disentangled itself from crab pot.	SE	Not serious
8/28/03	Auke Bay	Entangled	Humpback calf entangled in crab pot line. Line across back, wrapped tightly on both sides, forward of pectoral fins, and just behind blowhole.	SE	Serious
8/31/03	Sitka Sound	Entangled	Humpback calf entangled in commercial fishing gear. Confirmed ID, sighted in October with ventral fluke scarring but no other signs of entanglement.	SE	Not serious
5/15/04	Pt. Couverden	Entangled	Humpback reported entangled with 250' of rope, 2 cone-shaped buoys, and 1-2' of wood between buoys.	SE	Serious
5/27/04	Benjamin Island	Collision	Humpback collided with drifting fishing boat. 18-24" piece of whale blubber retrieved from vessel and taken to NOAA enforcement.	SE	Serious
7/8/04	Cape Fanshaw	Entangled, released alive	Humpback calf entangled with ¼" poly pro line around its upper tail fluke and left pectoral fin. Calf was later disentangled.	SE	Not serious
7/30/04	Glacier Bay	Dead	Humpback calf found beached; died due to blunt trauma.	SE	Mortality
8/13/04	Douglas Island	Dead	Humpback calf found beached with severe trauma to right shoulder area.	SE	Mortality
8/17/04	Icy Strait	Entangled	Entangled humpback found floating and not swimming. Line around tail and 100' trailing with red buoy. Multiple sightings/partial disentanglement.	SE	Not determinable
8/31/04	Keku Strait	Entangled	Entangled humpback with crab pot buoys trailing. Unable to relocate whale.	SE	Not determinable
11/11/04	Eckholms Islands	Entangled	Entangled humpback with 5/8" yellow poly line across body forward of dorsal fin, possibly dragging a pot	SE	Serious
5/18/05	Wrangell-Petersberg	Dead	Net entanglement with drift gillnet; confirmed SE salmon drift gillnet	SE	Mortality
5/30/05	George Inlet	Collision	Whale struck by ship	SE	Not serious

Date	Area	Condition	Brief description	Area	Severity of injury
6/6/05	Juneau	Entangled	Green gillnet (approx. 3" mesh) wrapped around head/rostrum area	SE	Not determinable
6/19/05	Portage Bay	Entangled	Adult and calf entangled together in unknown crab pot gear	SE	Serious*
6/29/05	Olga Point	Entangled	Net and buoy wrapped around head and blowhole; unknown gillnet	SE	Serious
7/7/05	Icy Strait	Collision	Calf struck by 26 ft. fiberglass cabin cruiser	SE	Not serious
8/8/05	Juneau	Entangled	Whale swimming slowly, entangled in crab pot gear	SE	Not determinable
8/13/05	Frederick Sound	Collision	Whale struck by 28 ft. aluminum boat at approx 25 knots	SE	Not serious
8/15/05	Eastern Channel	Entangled, self release	Line and buoy wrapped around tail, came free while observer watched	SE	Not serious
8/15/05	N of Auke Bay	Entangled	Section of mooring line entangled around pectoral fin	SE	Not serious
8/16/05	Chatham Strait	Entangled	Entanglement around tail	SE	Not determinable
8/25/05	Stephens Passage	Collision	Vessel passenger reported "pretty hard" impact with animal	SE	Serious
9/8/05	Stephens Passage	Collision	Possible ship strike, ship observed whale off bow and felt pressure wave hit hull	SE	Not serious
9/9/05	Favorite Channel	Entangled	Calf trailing recreational king crab pot gear	SE	Not serious
10/15/05	Peril Strait	Dead	Internal hemorrhaging – see necropsy report; confirmed collision	SE	Mortality
12/6/05	St. Nicholas Bay	Entangled	Two green buoys and one red/white torpedo crab buoy trailing from whale	SE	Not determinable
1/28/01	Hawaii	Injured	Entangled in line/buoy from an AK fishery; released, injured - extent unknown	Unk	Not determinable

* - Two or more animals involved in interaction

Appendix 9. Stock Assessment Reports published by the U.S. Fish and Wildlife Service.

POLAR BEAR (*Ursus maritimus*): Chukchi/Bering Seas Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Polar bears are circumpolar in their distribution in the northern hemisphere. They occur in several largely discrete stocks or populations (Harington 1968). Polar bear movements are extensive and individual activity areas are enormous (Garner *et al.* 1990). The parameters used by Dizon *et al.* (1992) to classify stocks based on the phylogeographic approach were considered in the determination of stock separation in Alaska. Several polar bear stocks are known to be shared between countries (Amstrup *et al.* 1986, Amstrup and DeMaster 1988). Lentfer hypothesized that in Alaska two stocks exist, the Beaufort Sea and the Chukchi/Bering seas, based upon: (a) variations in levels of heavy metal contaminants of organ tissues (Lentfer 1976, Lentfer and Galster 1987); (b) morphological characteristics (Manning 1971, Lentfer 1974, Wilson 1976); (c) physical oceanographic features which segregate the Chukchi Sea and Bering Sea stocks from the Beaufort Sea stock (Lentfer 1974) and; (d) movement information collected from mark and recapture studies of adult female bears (Lentfer 1974, 1983, Amstrup 1995) (Fig. 1).

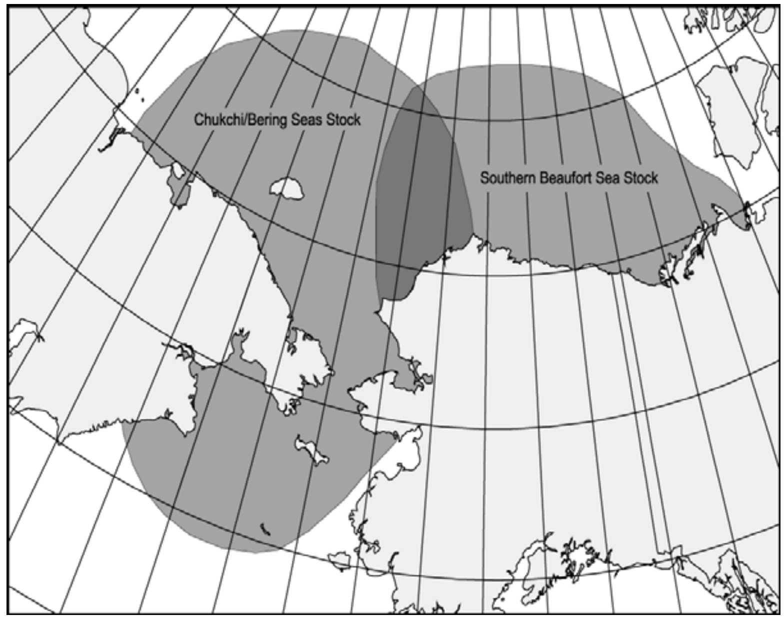

Figure 1. Approximate distribution of the Chukchi/Bering Seas polar bear stock. Dark shaded area represents distribution overlap with the

Past studies (Garner *et al.* 1990, Amstrup 1995) have shown that the eastern boundary of the Chukchi/Bering seas stock is near Point Barrow, and very limited movement occurs sporadically into the Beaufort Sea. The western bound of the stock is near the eastern portion of the Eastern Siberian Sea. The boundary between the Eastern Siberian Sea stock and the Chukchi Sea stock is designated on the basis of movements of adult female polar bears captured in the Bering and Chukchi seas region. Female polar bears initially captured and radio collared on Wrangel Island exhibited no movement into the Eastern Siberian Sea, while female polar bears captured and radio collared in the Eastern Siberian Sea, exhibited only limited short term movement into the western Chukchi Sea. The Chukchi/Bering seas stock extends into the Bering Sea and its southern boundary is determined by the annual extent of pack ice (Garner *et al.* 1990). Adult female polar bears captured in the Beaufort Sea may make seasonal movements into the Chukchi Sea in an area of overlap located between Point Barrow and Point Hope, centered near Point Lay (Garner *et al.* 1990, Garner *et al.* 1994, Amstrup 1995). Telemetry data indicate that these bears, marked in the Beaufort Sea, spend about 25% of their time in the northeastern Chukchi Sea, whereas females captured in the Chukchi Sea spend only 6% of their time in the Beaufort Sea (Amstrup 1995). Activity areas of females in the Chukchi/Bering seas (mean 244,463 km^2, range 144,659 - 351,369 km^2) were more extensive than the Beaufort Sea (mean 162,124 km^2, range 9,739-269,622 km^2) (Garner *et al.* 1990). Radio collared adult females spent a greater proportion of their time in the Russian region than in the American region (Garner *et al.* 1990). Historically polar bears ranged as far south as St. Matthew Island (Hanna 1920) and the Pribilof Islands (Ray 1971) in the Bering Sea.

Analysis of mitochondrial DNA indicates little differentiation of the Alaska polar bear stocks (Cronin *et al.* 1991, Scribner *et al.* 1997). Using 16 highly variable micro satellite loci, Paetkau et al. (1999) determined that polar bears throughout the arctic (16 populations) were very similar genetically. Genetically, polar bears in the Southern Beaufort Sea differed more from polar bears in the Chukchi/Bering Seas than from polar bears in the northern Beaufort Sea (Paetkau et al. 1999).

Past management regimes have consistently distinguished between the Southern Beaufort Sea and the Chukchi/Bering Seas stocks based on the biological evidence presented in the preceding information. The Inuvialuit of the Inuvialuit Game Council (IGC), Northwest Territories, and the Inupiat of the North Slope Borough (NSB), Alaska, polar bear management agreement for the Southern Beaufort Sea stock was delineated on stock boundaries described previously (Brower *et al.* in prep, Nageak 1991, Treseder and Carpenter 1989) and reaffirmed by the information in this stock assessment report.

POPULATION SIZE

Polar bears occur at low densities throughout their circumpolar range (DeMaster and Stirling 1981). They are long lived, mature late, have an extended breeding interval, and have small litters (Lentfer *et al.* 1980, DeMaster and Stirling 1981). Historically polar bear population size in Alaska has been difficult to estimate because of inaccessibility of the habitat, movement of bears across international boundaries, and budget limitations (Amstrup and DeMaster 1988; Garner *et al.* 1992).

Minimum Population Estimate

A reliable population estimate for the Chukchi/Bering seas population currently does not exist. Lentfer in the Administrative Law Judge (ALJ) proceeding to waive the MMPA moratorium on taking and return management to the State of Alaska (ALJ 1977) estimated that the Chukchi/Bering seas population stock (Wrangel Island to western Alaska) was 7,000 and Chapman estimated the Alaska population (both stocks) at 5,550 to 5,700 (ALJ 1977). Lentfer's and Chapman's estimates (ALJ 1977), however, were not based on rigorous statistical analysis of population data and variance estimates could not be calculated. Amstrup *et al.* (1986) estimated densities based on mark and recapture of 266 polar bears near Cape Lisburne on the Chukchi Sea, but a population estimate for the Chukchi Sea was not developed at that time. However, in 1988 Amstrup and DeMaster (1988) estimated the Alaska population (both stocks) at 3,000 to 5,000 animals based on densities calculated by Amstrup *et al.* (1986). The area that the estimate applied and the variance associated with the estimate were not provided for the 1988 population estimate (Amstrup and DeMaster 1988). A crude population estimate for the Chukchi/Bering seas stock of 1,200 to 3,200 animals was derived by subtracting the Beaufort Sea population estimate of 1,800 animals (Amstrup 1995) from the total Alaska statewide estimate, 3,000 to 5,000, (Amstrup and DeMaster 1988). The IUCN Polar Bear Specialist Group (IUCN, 1998) estimated this population to be approximately 2,000 to 5,000 based on extrapolation of multiple years of denning data for Wrangel Island, assuming a known fraction of the population dens annually as adult females. During August 2000, an aerial survey of polar bears in the Eastern Chukchi Sea was conducted by the USFWS from the U.S. Coast Guard icebreaker, Polar Star. Estimates of the density of bears inhabiting this area were develop (0.00748 bear/km^2, or 147 km^2/bear cv. 0.38) (Evans et al. in prep.). A population estimate was not derived from this density since the study area included only a portion of the total area of the population. Future aerial surveys in the Russian and U.S. Chukchi Sea are being planned. Since a reliable estimate for the size of this stock is currently unavailable, a minimum population estimate (N_{min}) was not calculated.

Current Population Trend

Prior to the 20th century, when Alaska's polar bears were hunted primarily by Alaskan Natives, both stocks probably existed near carrying capacity (K). The size of the Beaufort Sea stock appeared to decline substantially in the late 1960's and early 1970's (Amstrup *et al.* 1986) due to excessive harvest rates when sport hunting was legal. Similar declines could reasonably have occurred in the Chukchi Sea, although there are no data with which to test this assumption. Since passage of the Marine Mammal Protection Act (MMPA) in 1972, harvest rates have declined and both stocks seem to have grown --- judging from (a) mark and recapture data, although recapture data are too sparse for the Chukchi stock to quantify its growth; (b) observations by Natives and residents of coastal Alaska and Russia; (c) catch per unit effort indices (Amstrup et al. unpublished reports); (d) reports from Russian scientists (Uspenski and Belikov 1991); (e) aerial survey observations and density estimates (Evans et al. in prep.) and (f) changes in the age composition of the harvest (Schliebe *et al*. 1995). The most recent analysis confirms that the Southern Beaufort Sea population experienced growth during the late 1970's and 1980's and then stabilized during the 1990's (Amstrup et al. 2001). Until 1992 it may have been realistic to infer that the Chukchi/Bering seas stock mimicked the growth pattern and later stability of Beaufort Sea stock, since both stocks experienced similar management and harvest histories. However, the size of the Chukchi/Being seas population has not been accurately determined and the combined effect of the ongoing Alaska harvest and the recent Chukotka harvest of an unknown number of bears can not be accurately assessed. Similarly other potential determinants of population growth or trend, such as disease and prey availability, are not evaluated. Consequently, although there is some evidence to suggest growth for this stock in the past, the lack of current scientific information does not allow for an accurate assessment of trend.

MAXIMUM NET PRODUCTIVITY RATES

Default values for the maximum net productivity rates (R_{MAX}) for Alaska polar bear stocks were not established at the La Jolla PBR workshop (Wade and Angliss 1997). Taylor et al. (1987) estimated the maximum sustainable yield for adult female polar bears from a hunted population to be < 1.6% per annum based upon modeling. However, recent modeling efforts acknowledge that sustainable harvest rates are prone to effects from anthropogenic and natural changes as well as shortcomings in population knowledge. Issues involving global climate change and potential effects of persistent organic pollutants have also highlighted the uncertainty and risks inherent in making management decisions for polar bear populations. Population/stock specific scientific data to estimate R_{MAX} are not available for the Chukchi/Bering seas stock of polar bears. As a default, the R_{MAX} for this stock is assigned to 6.03 percent as reported for the Southern Beaufort Sea polar bear stock.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

Under the 1994 re-authorized MMPA, the potential biological removal (PBR) level is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $(N_{min})(\frac{1}{2} R_{MAX})(F_R)$. Although a recovery factor of 1.0 is probably most accurate, the stock was assigned a recovery rate F_R of 0.5 following the guidelines of the PBR workshop (Wade and Angliss 1997) since the status of the population is unknown (Wade and Angliss 1997). The PBR level cannot be calculated for the Chukchi/Bering seas stock in the absence of a reliable estimate of minimum abundance. Increased efforts are necessary to estimate the size, harvest and life history data for this stock.

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities.

Sport and Native Subsistence Harvest

Historically, polar bears have been killed for subsistence, handicrafts and recreation. Based upon records of skins shipped from Alaska, the estimated annual statewide harvest for 1925-53 averaged 120 bears, taken primarily by Native hunters. Recreational hunting using aircraft was common from 1951-72, increasing statewide annual harvest to 150 during 1951-60 and to 260 during 1960-72 (Amstrup *et al.* 1986; Schliebe *et al.* 1995). Aerial hunting by non-Natives was been prohibited in 1972. This reduced the mean annual harvest for both populations to 105 during 1980-2001 (SD=53; range 41-297) (USFWS unpubl. data). Figure 2 illustrates harvest rates and trend for the Chukchi/Bering seas stock from 1961-2001. From 1980-2001, harvests from the Chukchi/Bering seas stock accounted for 66% (mean=65) of the annual Alaska kill.

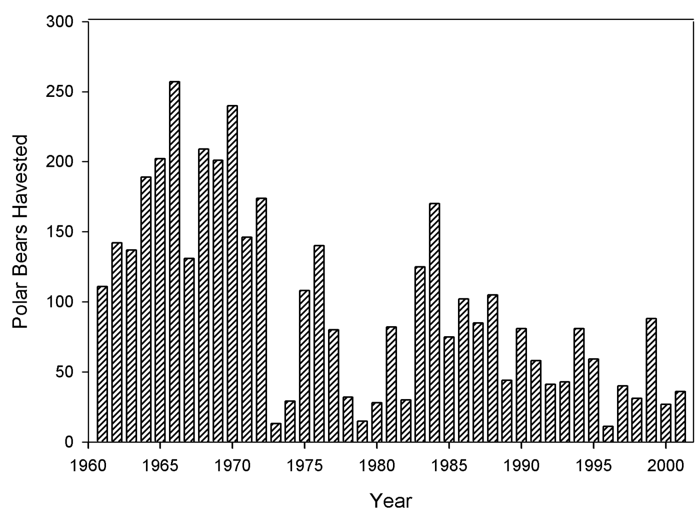

Figure 2. Annual Alaska polar bear harvest from the Chukchi/Bering seas stock, 1961-2001.

Recently, harvest levels by Alaska Natives from this stock have been declining. The 1996-2000 mean U.S. harvest was 44.8 bears and the sex ratio was 64M:36F (Schliebe et al. in prep). The number of unreported kills since 1980 to the present time is thought to be negligible based on: (a) the presence of local assistants contracted to tag parts from harvested bears; (b) active efforts to communicate the requirement for tagging harvest polar bears; (c) frequent interviews with local hunters; and (d) law enforcement investigations. In western Alaska, presently there is no local or government control on the number of bears taken providing the population is not depleted and the taking is not wasteful. On October 16, 2000, a management agreement for this stock between the United States and Russian governments was signed. The Alaska Nanuuq Commission was instrumental in developing this agreement which identifies a central role for Native people in future implementation. Harvest guidelines and quotas are essential elements of this agreement and will be determined in the future when the US-Russia agreement is implemented.

Other Removals

Russia prohibited all hunting of polar bears in 1956 in response to perceived population declines caused by over-harvest. In Russia, only a small number of animals, less than 3-5 per year, were removed for placement in zoos prior to 1986 (Uspenski 1986) and few were taken in defense of life. No bears were taken for zoos or circuses from 1993 to 1995 (Belikov 1997). The occurrence of increased problem bear take in Chukotka was acknowledged in 1992, and Belikov (1993) estimated that up to 10 “problem” bears were killed annually in all of the Russsian Arctic. Increased illegal hunting of polar bears in the Russian Arctic was also recognized to have begun in 1992, primarily in response to decentralization of management authority, entering a free market economy, and increased economic pressures. The magnitude of the illegal harvest in Russia from the Chukchi/Bering seas stock is unquantified, although anecdotal reports indicate that a substantial harvest of up to several hundred bears per year could be taking place.

In Alaska, one orphaned cub from the Chukchi/Bering seas population was placed in a zoo since 1989. In Alaska an illegal harvest, if it occurs, is so small as to be undetectable. The oil and gas industry is not active in this region within Alaska, and have not been responsible for any lethal take of polar bears.

STATUS OF STOCK

Polar bears in the Chukchi/Bering seas stock are not classified as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Reliable estimates of the minimum population, PBR level, and human-caused mortality (Chukotka) or serious injury are currently not available. The status of this stock can not be determined without better basic information on abundance and removal levels. There is a lack of information indicating that subsistence hunting in Alaska is or is not adversely affecting this population stock. No incidental loss due to any U.S. commercial fishery occurs. The status of the Chukchi/Bering seas polar bear stock is designated as uncertain due to the lack of reliable population information.

Management Actions

In the past, the shared Alaska-Chukotka polar bear population has been subject to different management strategies, and coordination of research and studies has been difficult. In the former Soviet Union hunting of polar bears was banned in 1956. Recently that level of protection has diminished due to an inability to enforce a 1956 nationwide ban on hunting polar bears. In Alaska, subsistence hunting by Natives is not restricted provided that the polar bear population is not depleted. In addition while several joint research and management projects have been successfully undertaken in the past comparable efforts are either no longer occurring, or are conducted unilaterally.

An Agreement on the Conservation and Management of the Alaska-Chukotka Polar Bear Population signed by the governments of the United States and the Russian Federation on October 16, 2000, recognizes the needs of Native people to harvest polar bears for subsistence purposes and includes provisions for developing sustainable harvest limits, allocation of the harvest between jurisdictions, and compliance and enforcement. Each jurisdiction is entitled to up to one-half of a harvest limit to be determined in the future by the joint Commission. The Agreement reiterates requirements of the 1973 multi-lateral agreement and includes restrictions on harvesting denning bears, females with cubs, or cubs less than one year old, prohibitions on the use of aircraft, large motorized vessels, and snares or poison for hunting polar bears. The Agreement does not allow hunting for commercial purposes nor commercial uses of polar bears or their parts. It also commitments the Parties to the conservation of ecosystems and important habitats, with a focus on conserving specific polar bear habitats such as feeding, congregating and denning areas.

In the U.S. a number of procedural steps are required in order to give this Agreement the effect of law. The U.S. Congress must enact legislation to provide for new authorities necessary to implement the agreement. Also the U.S. Senate must ratify the agreement. In Russia the need for legislative steps, if any, to provide authorities for implementation are being determined and the mechanism to coordinate management programs with the Chukotka government and with the Chukotka Native organizations are being determined. Once U.S. legislation is enacted, a joint Commission is expected to be named and actual implementation begun.

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Revised: 8/23/2002

POLAR BEAR (*Ursus maritimus*): Southern Beaufort Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Polar bears are circumpolar in their distribution in the northern hemisphere. They occur in several largely discrete stocks or populations (Harington 1968). Polar bear movements are extensive and individual activity areas are enormous (Garner *et al.* 1990, Amstrup 1995). The parameters used by Dizon *et al.* (1992) to classify stocks based on the phylogeographic approach were considered in the determination of stock separation in Alaska. Several polar bear stocks are known to be shared between countries (Amstrup *et al.* 1986, Amstrup and Demaster 1988). Lentfer hypothesized that two Alaska stocks exist, the Southern Beaufort Sea, and the Chukchi/Bering Seas, based upon: (a) variations in levels of heavy metal contaminants of organ tissues (Lentfer 1976, Lentfer and Galster 1987); (b) morphological characteristics (Manning 1971; Lentfer 1974; Wilson 1976); (c) physical oceanographic features which segregate stocks (Lentfer 1974) and; (d) movement information collected from mark and recapture studies of adult female bears (Lentfer, 1983, Amstrup 1995) (Figure 1).

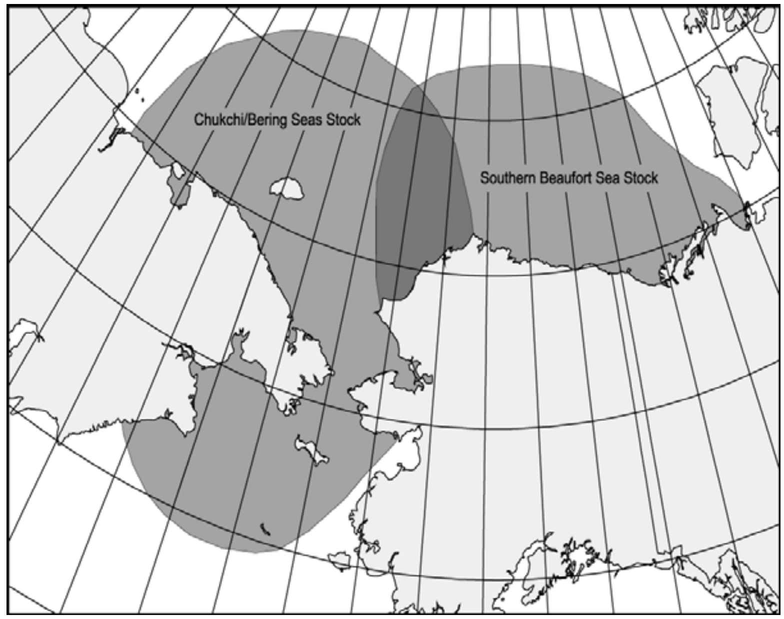

Figure 1. Approximate distribution of the Southern Beaufort Sea polar bear stock. Dark shaded area represents distribution overlap with the Chukchi/Bering seas stock.

Past studies (Amstrup 1995) have shown that the eastern boundary of the Southern Beaufort Sea stock occurs south of Banks Island and east of the Baillie Islands, Canada. The western boundary is near Point Hope. The southern boundary of the northern Beaufort Sea stock in the Canadian Arctic was delineated by Bethke *et al.* (1996). There is minimal overlap between the southern and northern Beaufort Sea populations (Amstrup and Durner In prep). An area of overlap between the Southern Beaufort Sea stock and the Chukchi/Bering seas stock occurs between Point Barrow and Point Hope, centered near Point Lay (Garner *et al.* 1990, Garner *et al.* 1994, Amstrup 1995). Also telemetry data indicates that adult female polar bears marked in the Southern Beaufort Sea spend about 25% of their time in the northeastern Chukchi Sea, whereas females captured in the Chukchi Sea spend only 6% of their time in the Southern Beaufort Sea (Amstrup 1995). Activity areas of Southern Beaufort Sea females averaged 162,124 km^2 (range 12,730 to 596,800 km^2) (Amstrup 1995).

Analysis of mitochondrial DNA indicates little differentiation of the Alaska polar bear stocks (Cronin *et al.* 1991, Scribner *et al.* 1997). Using 16 highly variable micro satellite loci, Paetkau et al. (1999) determined that polar bears throughout the arctic (16 populations) were very similar genetically. Genetically, polar bears in the Southern Beaufort Sea differed more from polar bears in the Chukchi/Bering Seas than from polar bears in the northern Beaufort Sea (Paetkau et al. 1999).

Past management regimes have consistently distinguished between the Southern Beaufort Sea and the Chukchi/Bering Seas stocks based on the biological evidence of the preceding information. The Inuvialuit of the Inuvialuit Game Council (IGC), Northwest Territories, and the Inupiat of the North Slope Borough (NSB), Alaska, polar bear management agreement for the Southern Beaufort Sea stock was delineated on stock boundaries described previously (Brower *et al.* in prep, Nageak 1991, Treseder and Carpenter 1989) and reaffirmed by the information in this stock assessment report.

POPULATION SIZE

Polar bears occur at low densities throughout their circumpolar range (DeMaster and Stirling 1981). They are long lived, mature late, have an extended breeding interval, and have small litters (Lentfer *et al.* 1980, DeMaster and Stirling 1981). Accurate population estimates for the Alaskan populations have been difficult to obtain because of low population densities, inaccessibility of the habitat, movement of bears across international boundaries, and budget limitations (Amstrup and DeMaster 1988, Garner *et al.* 1992).

Minimum Population Estimate

Amstrup *et al.* (1986), Amstrup (1995), Amstrup *et al.* 2001, and McDonald and Amstrup (2001) present population and variance estimates. Amstrup *et al*. (1986) estimated the Southern Beaufort Sea stock at 1,778 (S.D. ± 803; C.V. = 0.45) during the 1972-83 period. Amstrup (1995) estimated the Southern Beaufort Sea stock at around 1,480 animals in 1992.

Amstrup (unpublished data) using data for the 1986-98 period, excluding 4 years when sampling was not conducted, estimated the population size as 2,272 in 2001. This total population estimate was based on as estimate of 1,250 females (C.V. 0.17) and a sex ratio of 55% females from the best model (Amstrup and McDonald 2001). N_{min} is calculated as follows $N/\exp(0.842 * (\ln(1+CV(N)^2))^{½})$ and is 1,973 bears for population size of 2,272 and C.V. of 0.17. The female sex ratio estimate is treated as a constant and does not include an estimate of error. The population estimate applies to an area that extends from Pt. Barrow in the west, east to the Baillie Islands in Canada.

Current Population Trend

Prior to the 20th century, when Alaska's polar bears were hunted primarily by Natives, both stocks probably existed near carrying capacity (K). Once harvest by non-Natives became common in the Southern Beaufort Sea, the size of these stocks declined substantially (Amstrup 1995). Since passage of the Marine Mammal Protection Act (MMPA) in 1972, both stocks seem to have increased based on: (a) mark and recapture data; (b) observations by Natives and residents of coastal Alaska and Russia; (c) catch per unit effort indices (Amstrup et al. unpublished data); (d) reports from Russian scientists (Uspenski and Belikov 1991); and (e) harvest statistics on the age structure of the population. Recapture data on survival and recruitment for females from the Southern Beaufort Sea stock indicates a population growth rate of 2.4% from 1981 to 1992 (Amstrup 1995).

The most recent analysis confirms that the Southern Beaufort Sea stock experienced growth during the late 1970's and 1980's and then stabilized and experienced little or no growth during the 1990's (Amstrup et al. 2001). The indication that the population level appears to have stabilized is noteworthy. This stock has been assigned a recovery rate F_R of 1.0.

MAXIMUM NET PRODUCTIVITY RATES

Default values for R_{MAX} for Alaska polar bear stocks were not established at the La Jolla PBR workshop (Wade and Angliss 1997). Taylor et. al. (1987) estimated the sustainable yield of the female component of the population at < 1.6% per annum. The following information is used to understand the R_{MAX} determination. From 1981-92, vital rates of polar bears in the Southern Beaufort Sea were as follows: average age of sexual maturity (females) was 6 years; average COY litter size was 1.67; average reproductive interval was 3.68 years; and average annual natural mortality (nM), which varies by age class, ranged from 1-3% for adults (Amstrup, 1995). Natural mortality rates for juveniles are not available.

A Leslie type matrix of recapture data, which incorporated the best reproductive rates, and the best survival rates determined by the Kaplan Meir method, projected an annual intrinsic growth rate (including natural mortality but not human-caused mortality) of 6.03% for the Southern Beaufort Sea stock (Amstrup 1995). This calculation did not include human-caused mortalities and therefore represented the “natural” survival rate. This analysis mimics a life history scenario where environmental resistance is low and survival high. The calculation also assumes a 50M:50F population sex ratio which may result in a conservative estimate of R_{max} when populations are biased toward females (Amstrup, pers comm). More recent modeling efforts acknowledge that sustainable harvest rates are prone to effects from anthropogenic and natural changes as well as shortcomings in population knowledge. Issues involving global climate change and potential effects of persistent organic pollutants have also highlighted the uncertainty and risks inherent in making management decisions for polar bear populations.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

In the following calculation: $(N_{MIN})(½\ R_{MAX})(F_r)$ = PBR (Wade and Angliss 1997) the minimum population estimate, N_{MIN} was 1,972; the maximum rate of increase R_{MAX} was 6%; and the recovery factor F_R was 1.0 since the population is believed to be within OSP. Assuming an equal sex ratio in the harvest, the PBR level for the Southern

Beaufort Sea stock is 59 bears per year. In the Southern Beaufort Sea, the sex ratio of the harvest is approximately 2M:1F and thus the PBR level could be adjusted to 88 bears per year to account for male harvest bias. No more than 30 females may be harvested annually at the currently estimated population size.

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities.

Sport and Native Subsistence Harvest

Historically, polar bears have been killed for subsistence, handicrafts, and recreation. Based upon records of skins shipped from Alaska, the estimated annual statewide harvest for 1925-53 averaged 120 bears taken primarily by Native hunters. Recreational hunting using aircraft was common from 1951-72, increasing annual harvest to 150 during 1951-60 and to 260 during 1960-72 (Amstrup *et al.* 1986; Schliebe *et al.*1995). Aerial hunting has been prohibited since 1972. This reduced the mean annual combined harvest for both stocks to 105 during 1980-2001 (SD=53; range 41-297) (FWS unpubl. data). Figure 2 illustrates harvest rates and trend for the Southern Beaufort Sea stock from 1961-2001.

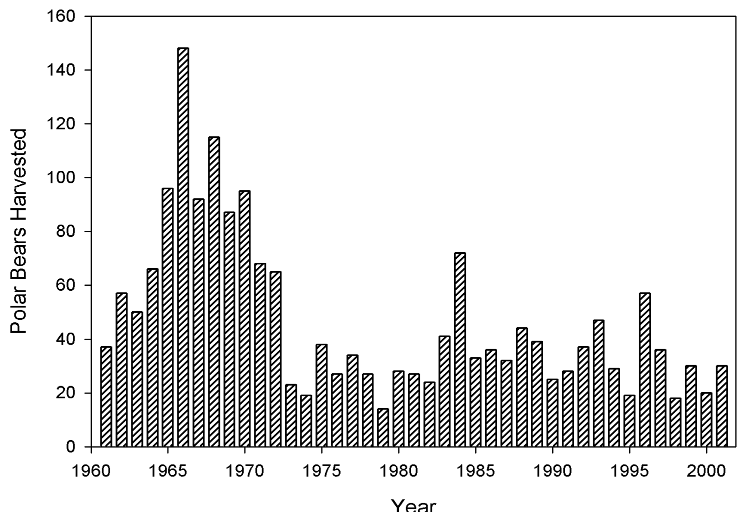

Figure 2. Annual Alaska polar bear harvest from the Southern Beaufort Sea stock, 1961-2001.

During the 1980-2001 period the Alaska harvest from the Southern Beaufort Sea accounted for 34% of the total Alaska kill (annual mean=33 bears). The sex ratio of the harvest from 1980-2001 was 68M:32F.

A management agreement between Canadian Inuit and Alaskan Inupiat of the North Slope has been in place since 1988 (Nageak et al. 1990, Brower et al. in prep). Since initiation of this local user agreement in 1988, the combined Alaska/Canada mean harvest from this stock has been 55.1 bears per year which is less than the previously calculated annual harvest guideline of 81 (Brower et al. in prep.) and a PBR level of 59 bears, or the adjusted PBR level of 88 bears, as reported here. The harvest in Canada is regulated by a quota system. The harvest in Alaska is regulated by voluntary actions of local hunters provided the population is not depleted.

More recently, the 1995-2000 average Alaska harvest for the Southern Beaufort Sea in Alaska was 32.2 and the sex ratio was 71M:29F. During the same time period the average Canadian harvest for the Southern Beaufort Sea was 19.6 and the sex ratio was 62M:38F. The combined average annual Alaska and Canada harvest during the past five years was 51.8.

Other Removals

Orphaned cubs are occasionally removed from the wild and placed in zoos: two cubs were placed into public display facilities during the past five years. Also one research mortality occurred. Activities authorized through "incidental take" regulations, associated with the exploration, development, production, and transportation of oil and gas, may potentially impact polar bears and their habitat. Regulations to authorize incidental take of polar bear by industry may be developed if the effects of the activity result in negligible impact to the population. During the past five years no lethal take of polar bears occurred. Historically, three lethal takes related to industrial activities have been documented in the Southern Beaufort Sea: one at an offshore drilling site in the Canadian Beaufort Sea (1968); one bear at the Stinson site in the Alaska Beaufort Sea (1990); and one bear that ingested ethylene glycol stored at an offshore island in the Alaska Beaufort Sea (1988). Also in 1993, a polar bear was killed at the Oliktok remote radar defense site when it broke into a residence and severely mauled a worker.

STATUS OF STOCK

The Southern Beaufort Sea Stock is not classified as "depleted" under the MMPA or listed as "threatened" or "endangered" under terms of the Endangered Species Act. This stock is assumed to be within optimum sustainable population levels. The calculated PBR levels (59 or 88 adjusted) are greater than the average annual human harvest (55) and greater than the annual harvest guidelines (81) of the user group agreement between the Inuvialuit of Canada and the Inupiat of Alaska. The stock does not experience any incidental loss to commercial fishing. The Southern Beaufort Sea stock appears to be stable and is experiencing little or no growth. The Southern Beaufort Sea stock of polar bears in Alaska is designated a "non-strategic stock."

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PACIFIC WALRUS (*Odobenus rosmarus divergens*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The family *Odobenidae* is represented by a single modern species *Odobenus rosmarus* of which two subspecies are generally recognized: the Atlantic walrus (*O. r. rosmarus*), and the Pacific walrus (*O. r. divergens*). The two subspecies occur in geographically isolated populations. The Pacific walrus is the only form occurring in U.S. waters and considered in this account.

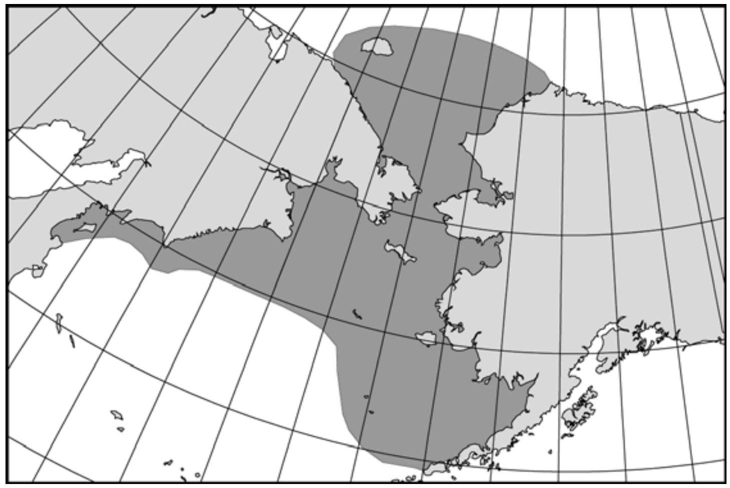

Figure 1. Approximate distribution of Pacific walrus in U.S. and Russian territorial waters. (shaded area). The combined summer

Pacific walrus range throughout the continental shelf waters of the Bering and Chukchi seas, occasionally moving into the East Siberian Sea and the Beaufort Sea (Fig. 1). During the summer months most of the population migrates into the Chukchi Sea, however several thousand animals, primarily adult males, congregate near coastal haulouts in the Gulf of Anadyr and in Bristol Bay. During the late winter breeding season walrus are found in two major concentration areas of the Bering Sea where open leads, polynyas, or thin ice occur (Fay *et al.* 1984). While the specific location of these groups varies annually and seasonally depending upon the extent of the sea ice, generally one group ranges from the Gulf of Anadyr into a region southwest of St. Lawrence Island, and a second group is found in the southeastern Bering Sea from south of Nunivak Island into northwestern Bristol Bay. Currently, animals in these two regions are assumed to represent a single stock. Mitochondrial and nuclear DNA analysis of tissue samples taken from animals in the two areas in April (shortly after breeding season) indicate that either they are not discrete breeding groups, or, that separation took place so recently that it is not genetically detectable (Scribner *et al.* 1997).

POPULATION SIZE

The size of the Pacific walrus population has never been known with certainty. Based on large sustained harvests in the 18th and 19th centuries, Fay (1982) speculated that the pre-exploitation population was represented by a minimum of 200,000 animals. Since that time, population size is believed to have fluctuated markedly in response to varying levels of human exploitation (Fay *et al.* 1989). Large scale commercial harvests reduced the population to an estimated 50,000-100,000 animals in the mid-1950's (Fay *et al.* 1997). The population is believed to have increased rapidly in size during the 1960s and 1970s in response to reductions in hunting pressure (Fay *et al.* 1989).

Between 1975 and 1990, aerial surveys were carried out by the United States and Russia at five year intervals, producing population estimates ranging from 201,039 to 234,020 animals (Table 1). The estimates generated from these surveys are considered conservative population estimates and are not useful for detecting trends (Hills and Gilbert 1994, Gilbert *et al.* 1992). Efforts to survey the Pacific walrus population were suspended after 1990 due to unresolved problems with survey methods which produced population estimates with unacceptably large confidence intervals (Gilbert *et al.* 1992, Gilbert 1999). The current size of the Pacific walrus population is unknown.

In March 2000 the U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey hosted a workshop on walrus survey methods (Garlich-Miller and Jay 2000). Workshop participants reviewed past efforts to survey the Pacific walrus population and discussed various approaches to estimate population size and trend. The amount of survey effort required to achieve a population estimate with an acceptably small variance (CV <= 0.3) is expected to be extensive. Survey effort could be maximized by flying more transects, increasing survey swath width to sample a wider area, or both. Stratification could help focus survey area and reduce the amount of survey effort required, but will require additional research on the relationship between walrus distribution and environmental variables. Workshop participants recommended investing in research on walrus distribution and haulout patterns and exploring new survey tools, including remote sensing systems, prior to conducting another aerial survey.

Table 1. Aerial survey estimates of the Pacific walrus population, 1975-1990. Differences in survey design and methods preclude describing trends in population size.

Year	Population Estimate	References
1975	221,350	Estes and Gilbert 1978, Estes and Gol'tsev 1984
1980	246,360	Johnson *et al.* 1982, Fedoseev 1984
1985	234,020	Gilbert 1986, 1989, Fedoseev and Razlivalov 1986
1990	201,039	Gilbert *et al.* 1992

Minimum Population Estimate

A minimum population estimate (N_{MIN}) for this stock can not be determined because a reliable estimate of current population size is not available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Estimates of net productivity rates for walrus populations have ranged from 3-13% per year with most estimates falling between 5-10% (Chapskii 1936, Mansfield 1959, Krylov 1965, 1968, Fedoseev and Gol'tsev 1969, Sease 1986, DeMaster 1984, Sease and Chapman 1988, Fay *et al.* 1997).

Chivers (1999) developed an individual age based model of the Pacific walrus population using published estimates of survival and reproduction. The model yielded a maximum population growth rate (R_{MAX}) of 8%. This estimate remains theoretical because age-specific survival rates for free ranging walrus are poorly known.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) of a marine mammal stock is defined in the Marine Mammal Protection Act as the product of the minimum population estimate (N_{MIN}), one-half the maximum theoretical net productivity rate (R_{MAX}) and a recovery factor (F_R). Without a reliable estimate of N_{MIN} the PBR for this stock can not be determined.

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There are no data available concerning the incidental catch of walrus in fisheries operating in Russian waters. In the U.S. regulatory zone, walrus occasionally interact with trawl and longline gear of groundfish fisheries operating in the eastern Bering Sea. The USFWS has adopted the average annual fishery mortality rate over the past five years (1996-2000) as a representative estimate of the current rate of fishery related mortality in Alaska. Between 1996 and 2000, sixty-three interactions between commercial fishing gear and walrus were recorded through the National Marine Fisheries Services' fisheries observer program (mean: 12.6, range: 8-20 per year) (Unpublished fisheries observation data, Michael Perez, NMFS, 7600 Sand Pt. Way, NE, Seattle, WA 98115). Most (92%) of the observed interactions were with decomposed walrus carcasses or skeletal remains suggesting that the animals died prior to their interaction with the fishing gear. The only fishery for which incidental kill or injury was observed was the Bering Sea groundfish trawl fishery (non-pelagic). Five dead (not decomposed) walrus and one injured animal (released alive) were recorded over this time period. The range of observer coverage over the five year period (1996-2000), as well as the annual observed and estimated mortalities are presented in Table 2. A complete list of fisheries and marine mammal interactions is published annually by NMFS [67 FR 2410].

Another potential source of information on the number of walrus killed or injured incidental to commercial fisheries operations in Alaska is the NMFS fisher self reporting program. Although there were no walrus mortalities recorded through this program in 1996-2000, this reporting program may be negatively biased (Credle *et al.* 1994), therefore the absence of mortality reports does not necessarily assure that no mortalities occurred.

Table 2. Summary of incidental mortality of Pacific walrus (Alaska stock) due to commercial fisheries from 1996-2000 and estimated mean annual mortality rate. Fisheries observation data provided by NMFS.

Fishery name	Years	Data type	Range of observer coverage[a]	Observed mortality[b] (in given years)	Estimated mortality[c] (in given years)	Estimated mean annual mortality
Bering Sea Groundfish Trawl	1996-2000	Obs data	62.1-76.5%	0, 2, [1], 0,[2]	NE(0),3,NE(1),NE(0),NE(2)	1.2 (CV = 0.42)

[a] Based on total tonnage of the catch monitored by observers.
[b] Brackets indicate that the take was reported to or seen by the observer in an un-monitored haul.
[c] NE = no estimate because either zero take occurred, or, no takes occurred during monitored hauls. The number in parentheses are kills known to have occurred in all hauls on all vessels.

Based on the available fisheries observer data, the estimated mortality rate incidental to commercial fisheries in Alaska is approximately 1.2 walrus per year (CV = 0.42). Because the PBR for this stock is not known, it is not possible to quantify fishery mortalities relative to this standard. However, a fishery mortality level of 1.2 animals per year can be considered insignificant relative to other sources of human caused mortality affecting this stock.

Subsistence/Commercial Harvest

Over the past forty years the Pacific walrus population has sustained estimated annual harvest mortalities ranging from 3,200 to 16,100 animals per year (mean: 6,993) (Fig. 2). Recent harvest levels are lower than historic highs. It is not known whether lower harvest levels reflect changes in walrus abundance or hunting effort. Factors affecting harvest levels include the cessation of Russian commercial walrus harvests after 1991, changes in political, economic, and social conditions of subsistence hunters in Alaska and Chukotka, and the effects of variable weather and ice conditions on hunting success.

In 1997, a Cooperative Agreement was developed between the USFWS and the Alaska Eskimo Walrus Commission to facilitate the participation of subsistence hunters in activities related to the conservation and management of walrus stocks in Alaska. Specific activities carried out under this agreement have included the strengthening and expansion of harvest monitoring programs in Alaska and Chukotka as well as efforts to develop locally based subsistence harvest regulations.

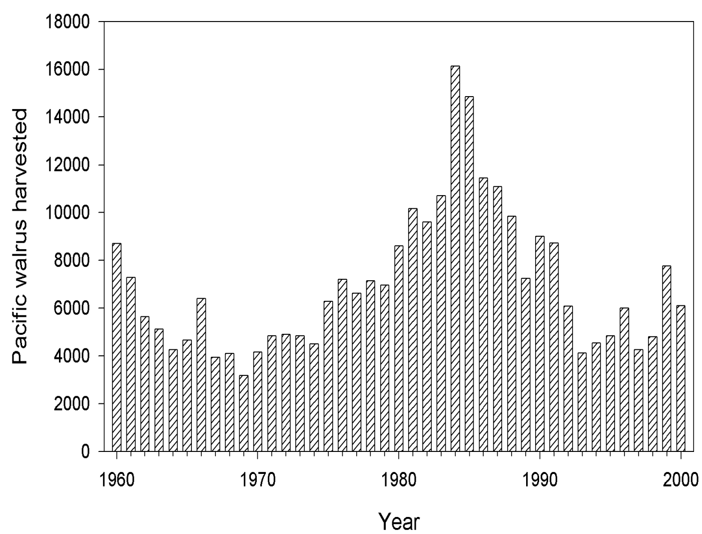

Figure 2. Harvest of Pacific walrus, 1960-2000. Data includes a 42% struck and lost rate applied to subsistence harvest totals (Fay *et al.* 1994).

The USFWS has adopted the average annual harvest over the past five years as a representative estimate of current harvest levels in Alaska and Chukotka. Based on 1996-2000 harvest statistics, adjusted for animals mortally wounded but not retrieved, harvest mortality levels are estimated at 5,789 animals per year (Table 3). Based on data collected through the USFWS Marking Tagging and Reporting Program, the sex-ratio of the reported U.S. walrus harvest over this time period was approximately equal. The sex-ratio of the reported Russian walrus harvest was approximately 0.5 female:male (based on harvest information collected Chukotka TINRO in 1999 and 2000 only).

Table 3. Estimated harvest of Pacific walrus, 1996-2000. Russian harvest information provided by Chukotka TINRO. U.S. harvest information collected by the U.S. Fish and Wildlife Service and are adjusted for unreported walrus (Garlich-Miller and Burn 1997). Corrected harvest incorporates a 42% struck and lost rate from Fay *et al.* (1994).

Year	Reported Russia Harvest	Reported U.S. Harvest	Total Reported Harvest	Total Corrected Harvest
1996	941	2,541	3,482	6,003
1997	731	1,739	2,470	4,259
1998	950	1,840	2,790	4,810
1999	1,670	2,829	4,499	7,757
2000	1,212	2,334	3,546	6,114
Mean	**1,101**	**2,257**	**3,357**	**5,789**

Other Removals

Between 1996 and 2000 there were 15 mortalities associated with research activities and 5 orphaned walrus calves collected for public display. Based on this information, an estimated 4 walrus per year were taken due to other human activities

Total Estimated Human Caused Mortality

The total estimated annual human caused mortality or removal is calculated to be 5,794 walrus per year (1 attributed to fisheries interactions, 5,789 due to harvest, and 4 due to other human activities).

STATUS OF STOCK

Pacific walrus are not listed as “depleted” under the Marine Mammal Protection Act, or as “threatened” or “endangered” under the Endangered Species act. Because of minimal interactions between walrus and any U.S. fishery the Pacific walrus population is not classified as a “strategic” stock with respect to managing incidental take under section 118 of the Marine Mammal Protection Act. The status of this stock relative to its Optimum Sustainable Population size is unknown.

Conservation Issues and Habitat Concerns

While recent harvest levels are lower than historical highs, a lack of information on population size or trend precludes any meaningful assessment of the impact of current harvest levels. Ensuring that harvest levels remain sustainable is a goal shared by subsistence hunters and resource managers in the U.S. and Russia. Achieving this management goal will require continued investments in population research, harvest monitoring programs, international coordination and co-management relationships.

Another element of concern is the potential for global climate change and associated changes in the distribution and extent of pack ice in the Bering and Chukchi Seas. The distribution of walrus is closely linked with the seasonal distribution of the pack ice because walrus rely on sea ice as a substrate for resting and giving birth. There are no data to make reliable predictions of the net impacts that changing climate conditions would have on the status and trend of the Pacific walrus population.

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Revised: 08/20/2002

SEA OTTER (*Enhydra lutris*): Southeast Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sea otters occur in nearshore coastal waters of the U.S. along the North Pacific Rim from the Aleutian Islands to California. The species is most commonly observed within the 40 m depth contour since animals require frequent access to foraging habitat in subtidal and intertidal zones (Reidman and Estes 1990). Sea otters in Alaska are not migratory and generally do not disperse over long distances, although movements of tens of kilometers are normal (Garshelis and Garshelis 1984). Individuals are capable of long distance movements of >100 km (Garshelis *et al.* 1984), however movements of sea otters are likely limited by geographic barriers, high energy requirements of animals, and social behavior.

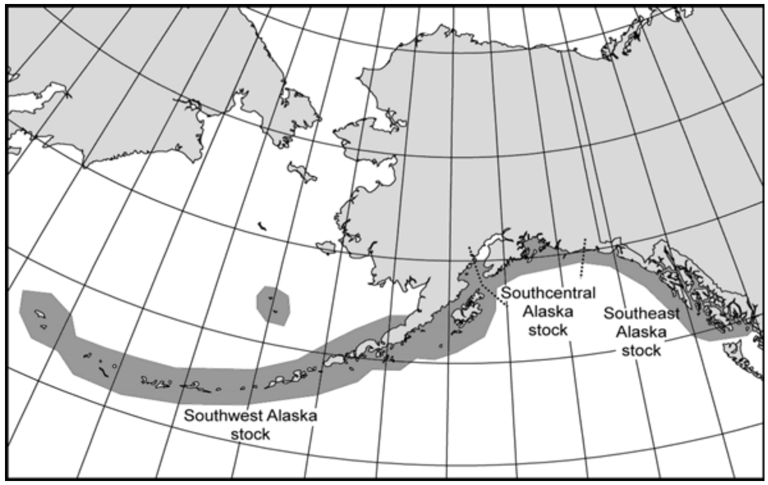

Figure 1. Approximate distribution of sea otters in Alaska waters (shaded area).

Applying the phylogeographic approach of Dizon *et al.* (1992), Gorbics and Bodkin (2001) identified three sea otter stocks in Alaska: southeast, southcentral,and southwest. The ranges of these stocks are defined as follows: (1) south stock extends from Dixon Entrance to Cape Yakataga; (2) southcentral stock extends from Cape Yakataga to Cook Inlet including Prince William Sound, the Kenai peninsula coast, and Kachemak Bay; and (3) southwest stock which includes Alaska Peninsula and Bristol Bay coasts, the Aleutian, Barren, Kodiak, and Pribilof Islands (Fig. 1). The phylogeographic approach of stock identification, which considers four types of data, is presented in greater detail below.

1) Distributional data: geographic distribution is continuous from Kachemak Bay to Cape Suckling, at which point 125 miles of vacant coastal habitat between Cape Suckling and Yakutat Bay separates the southeast and southcentral Alaska stocks (Doroff and Gorbics 1998). Sea otters in Yakutat Bay and southeast Alaska are the result of a translocation of 412 animals from Prince William Sound and Amchitka in the late 1960s (Pitcher 1989; Reidman and Estes 1990). Prior to translocation, sea otters had been absent from these habitats since the beginning of the 20th century. Distribution is nearly continuous from Attu Island in the western Aleutians to the Alaska Peninsula, although distances of >200 km between island groups in the Aleutians may effectively limit exchange of individuals. Sea otters do not occur in upper Cook Inlet, and population densities are currently low between the Kenai peninsula and the Alaska Peninsula, which suggests discontinuity in distribution at the stock boundary. Physical features that may limit movements of otters between the Kenai and Alaska peninsulas include approximately 100 km of open water across Cook Inlet with a maximum water depth of 100 m, and 70 km of open water between the Kenai Peninsula and the Kodiak Archipelago with a maximum water depth of 200 m. However, the open water between Kenai and Kodiak is interrupted mid-way by the Barren Islands (Gorbics and Bodkin 2001).

Contaminant levels may also indicate geographic isolation of stocks. In general, tissues from sea otters in Alaska contain relatively low levels of contaminants; however, higher levels of heavy metals and trace elements were found in animals from southcentral Alaska, with the general trend among groups being southcentral>southwest>southeast (Comerci *et al.*, in prep.). Patterns of contamination are consistent with distribution of pollutants from anthropogenic sources in populated areas. High levels of PCBs in some otters from the Aleutian Islands (southwest Alaska) likely reflect local "point sources," such as military installations (Estes *et al.* 1997; Bacon *et al.* 1999).

2) Population response data: variation in growth rates and reproductive characteristics among populations likely reflect local differences in habitat and resource availability rather than intrinsic differences between geographically distinct units (Gorbics and Bodkin 2001) .

3) Phenotypic data: significant differences in sea otter skull sizes exist between southwest and southcentral Alaska (Gorbics and Bodkin, 2001).

4) Genotypic data: the three stocks exhibit substantial differences in both mitochondrial and nuclear DNA (Cronin *et al.* 1996; Bodkin *et al.* 1992, 1999, Larson *et al.* in prep.). Significant differences in frequencies of mtDNA haplotypes and genetic differences among geographic areas show sufficient variation to indicate restricted gene flow (Gorbics and Bodkin 2001). A recent analyses of mitochondrial and nuclear DNA by Cronin *et al.* (2002) corroborates the stock structure proposed by Gorbics and Bodkin (2001).

POPULATION SIZE

Historically, sea otters occurred across the North Pacific Rim, ranging from Hokkaido Japan through the Kuril Islands, the Kamchatka Peninsula, the Commander Islands, the Aleutian islands, peninsular and south coastal Alaska and south to Baja, California, Mexico (Kenyon 1969). In the early 1700s, the worldwide population was estimated to be between 150,000 (Kenyon 1969) and 300,000 individuals (Johnson 1982). Prior to large-scale commercial exploitation, indigenous people of the North Pacific hunted sea otters. Although it appears that harvests periodically led to local reductions of sea otters (Simenstad *et al.* 1978), the species remained abundant throughout its range until the mid-1700s. Following the arrival in Alaska of Russian explorers in 1741, extensive commercial harvest of sea otters over the next 150 years resulted in the near extirpation of the species. When sea otters were afforded protection by the International Fur Seal Treaty in 1911, probably fewer than 2,000 animals remained in 13 remnant colonies (Kenyon, 1969). Population regrowth began following legal protection, and sea otters have since recolonized much of their historic range in Alaska.

The most recent population estimates for the southeast Alaska stock are presented in Table 1.

Table 1. Population estimates for the southeast Alaska stock of sea otters.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{MIN}	Reference
Southeast Alaska	1994	8,180	11,697	0.398	8,467	Agler *et al.* (1995)
Yakutat Bay	1995		404	0.339	306	Doroff and Gorbics (1998)
North Gulf of Alaska	1996	223	531	0.087	493	Doroff and Gorbics (1998)
Total			12,632		9,266	

The survey of the southeast Archipelago conducted in 1994 ranged from Cape Spencer south to the Dixon Entrance. A ratio estimator was used to estimate a population size of 8,180 (CV = 0.392) sea otters. Applying a correction factor of 1.43 (CV = 0.071) for this type of boat survey (Udevitz *et al.* 1995) for sea otters not detected by observers produces an adjusted estimate of 11,697 (CV = 0.398).

An aerial survey of Yakutat Bay conducted in 1995 resulted in an adjusted population estimate of 404 (CV = 0.339) sea otters. The Yakutat Bay survey followed methodology described in Bodkin and Udevitz (1999) and included a survey-specific correction factor to account for undetected animals. A distribution survey of the Gulf Coast from Cape Yakataga to Cape Spencer excluding Yakutat Bay provided a minimum uncorrected count of 223 animals. Applying a correction factor of 2.38 (CV = 0.087) for sea otter aerial surveys using a twin-engine aircraft (Evans *et al.* 1997) produces an adjusted estimate of 531 (CV = 0.87). Combining the adjusted estimates for these three areas results in a total estimate of 12,632 sea otters for the southeast Alaska 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): $N_{MIN} = N/\exp(0.842 *[\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1; the estimated N_{MIN} for the southeast Alaska stock is 9,266 sea otters.

Current Population Trend

Although rates of population growth may vary among locations, the trend for this stock of sea otters has been one of growth (Pitcher 1989, Agler 1995). Sea otters inhabiting Yakutat Bay and southeast Alaska are the result of a translocation of 412 animals from Prince William Sound and Amchitka Island in the late 1960s. High rates of population growth reported for the southeast stock of sea otters are characteristic of translocated sea otter populations in Alaska (Bodkin *et al.* 1999). Regular aerial surveys of the Cross Sound/Icy Straight area and Glacier Bay have been conducted since 1994 (USGS unpublished data). Sea otter counts from these surveys suggest an average annual population growth rate of 12%, and indicate that animals in this portion of southeast are continuing to expand their range into Icy Strait and Glacier Bay, however this growth rate may not be representative of the entire stock. Preliminary information from recent aerial surveys recorded fewer sea otters than were previously expected. Therefore, the current population trend for the southeast Alaska stock is uncertain.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. Pitcher (1989) estimated that annual rates of increase for the southeast Alaska sea otter stock ranged from 15.7 to 23.3% between 1966 (the time of re-establishment of the southeast stock) and 1988. However, the multiple surveys on which these growth rates were based were all attempts at total counts using varying techniques. Furthermore, no attempt was made to account for availability and sightability biases or for weather conditions. Consequently, the rate of 20% calculated by Estes (1990) was used to estimate R_{MAX} for this stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 = $N_{MIN} \times 0.5 R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0 (Wade and Anglis 1997) as population levels have increased or remained stable with a known human take. Thus for the southeast stock of sea otters, PBR = 927 animals (9,266 x 0.5(0.2) x 1.0).

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Each year, fishery observers monitor a percentage of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to these operations. Although no fisheries operating in the region of the southeast Alaska sea otter stock have been included in the NMFS observer programs to date, there are plans to conduct an observer program in southeast Alaska in 2004.

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska are fisher self-reports required of vessel-owners by NMFS. From 1990 to 1993, self-reported fisheries data reflected no sea otter kills or injuries in the southeast Alaska region. Self-reports were incomplete for 1994 and not available for 1995 or 1996. Between 1997 and 2000, there were no records of incidental take of sea otters by commercial fisheries in this region; thus, the estimated mean annual mortality reported is zero. Credle *et al.* (1994) considered this to be a minimum estimate as fisher self-reports and logbook records (self-reports required during 1990-1994) are most likely negatively biased.

Data available from other areas of the state suggest that rates of lethal interactions between sea otters and commercial fisheries are insignificant. Thus it is probably reasonable to assume that the southeast stock of sea otters is not likely to be significantly affected by fisheries at the present. The total fishery mortality and serious injury is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate. A complete list of fisheries and marine mammal interactions is published annually by NMFS [67 FR 2410].

Oil and Gas Development

Exploration, development, and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (< 10% of body surface), but that greater levels (>25%) will lead to death (Costa and Kooyman 1981, Siniff *et al.* 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Total estimates of mortality for the Prince William Sound area vary from 750 (range 600-1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) (Garrot *et al.* 1993) otters. Statewide, it is estimated that 3,905 sea otters (range 1,904 - 11,257) died in Alaska as a result of the spill (DeGange *et al.* 1994). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the spill (Bodkin *et al.*, in press, Stephensen *et al.* 2001).

There is currently no oil and gas development in southeast Alaska. In addition, tankers carrying oil south from the Trans-Alaska Pipeline typically travel offshore and therefore pose a minimal risk to sea otters in southeast Alaska. As a result, no mortalities due to oil and gas development have been documented within the range of the southeast Alaska sea otter stock.

Subsistence/Native Harvest Information

The Marine Mammal Protection Act of 1972 exempted Native Alaskans from the prohibition on hunting marine mammals. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. Data for subsistence harvest of sea otters in southeast Alaska were collected by a mandatory Marking, Tagging and Reporting Program implemented by USFWS since 1988. Fig. 2 provides a summary of harvest information for the southeast stock from 1989-2000. The mean annual subsistence take during the past five years (1996-2000) was 301 animals. Reported age composition across during this period was 80% adults, 17% subadults, and 3% pups. Sex composition during the past five years was 65% males, 25% females and 10% of unknown sex.

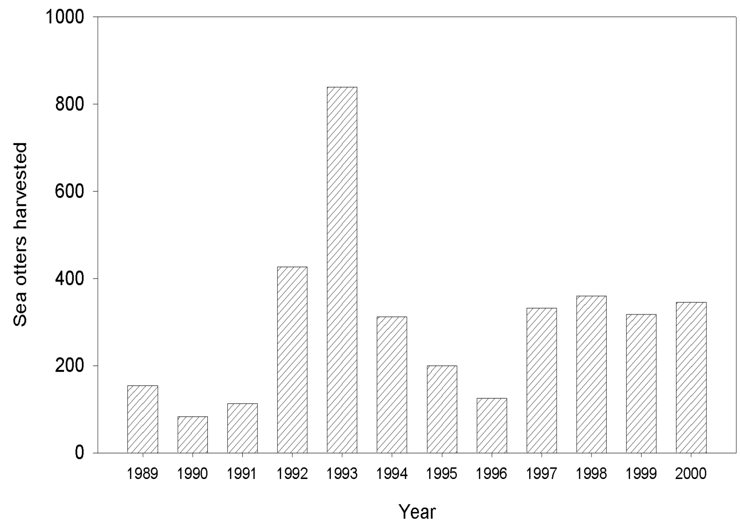

Figure 2. Estimated subsistence harvest of sea otters from the southeast Alaska stock, 1989-2000.

Since 1997, the USFWS and the Alaska Sea Otter and Steller Sea Lion Commission (TASSC) have signed cooperative agreements authorized under Section 119 of the MMPA for the conservation and co-management of sea otters in Alaska. Each of the six TASSC regions has a regional management plan that includes harvest guidelines. Several villages have also developed local management plans that address sea otter harvests.

Research and Public Display

In the past five years, no sea otters have been removed from the southeast Alaska stock for public display. Since 1996, a total of 64 sea otters have been captured and released for scientific research in Glacier Bay National Park. There have been no observed effects on sea otter populations in the southeast Alaska stock from these activities.

STATUS OF STOCK

Sea otters in the southeast Alaska stock 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 minimum mortality and injury incidental to commercial fisheries (0) is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury over the 5-year period from 1996 through 2000 (301) does not exceed the PBR (927). As a result, the southeast Alaska sea otter stock is classified as non-strategic. This classification is consistent with the recommendations of the Alaska Regional Scientific Review Group (DeMaster 1995). The status of this stock relative to its Optimum Sustainable Population levels is unknown.

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Revised: 08/20/2002

SEA OTTER (*Enhydra lutris*): Southcentral Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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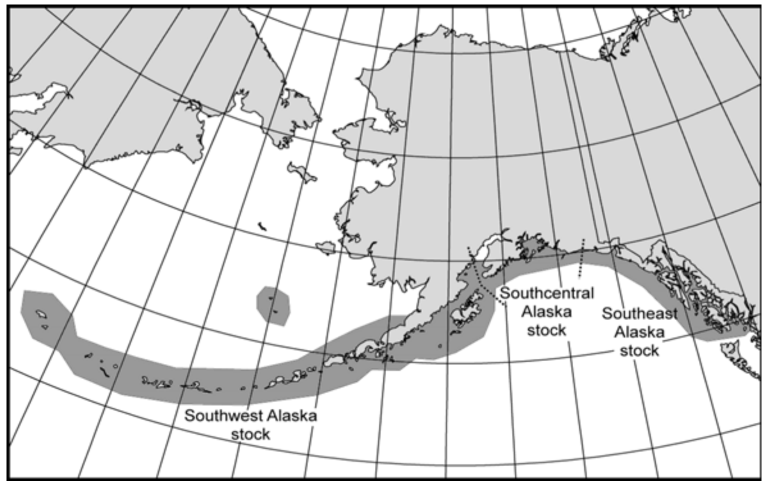

Figure 1. Approximate distribution of sea otters in Alaska waters (shaded area).

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POPULATION SIZE

Historically, sea otters occurred across the North Pacific Rim, ranging from Hokkaido Japan through the Kuril Islands, the Kamchatka Peninsula, the Commander Islands, the Aleutian islands, peninsular and south coastal Alaska and south to Baja, California, Mexico (Kenyon 1969). In the early 1700s, the worldwide population was estimated to be between 150,000 (Kenyon 1969) and 300,000 individuals (Johnson 1982). Prior to large-scale commercial exploitation, indigenous people of the North Pacific hunted sea otters. Although it appears that harvests periodically led to local reductions of sea otters (Simenstad *et al.* 1978), the species remained abundant throughout its range until the mid 1700s. Following the arrival in Alaska of Russian explorers in 1741, extensive commercial harvest of sea otters over the next 150 years resulted in the near extirpation of the species. When sea otters were afforded protection by the International Fur Seal Treaty in 1911, probably fewer than 2,000 animals remained in thirteen remnant colonies (Kenyon, 1969). Population regrowth began following legal protection, and sea otters have since recolonized much of their historic range in Alaska.

The most recent population estimates for the southcentral Alaska stock are presented in Table 1.

Table 1. Population estimates for the southcentral Alaska stock of sea otters.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{min}	Reference
North Gulf of Alaska	1996	271	645	0.087	600	Doroff and Gorbics (1998)
Prince William Sound	1999		13,234	0.198	11,220	USGS Unpublished data
Cook Inlet/Kenai Fiords	2002		2,673	0.271	2,136	USGS Unpublished data
Total			16,552		13,955	

In 1999, a survey of Prince William Sound resulted in an abundance estimate of 13,234 (CV = 0.198) animals (USGS unpublished data). This survey followed methodology described in Bodkin and Udevitz (1999) and included a survey-specific correction factor to account for undetected animals.

The survey of lower Cook Inlet and the Kenai Fiords area conducted in June and August 2002 also followed the methodology of Bodkin and Udevitz (1999) with an abundance estimate of 2,673 (CV = 0.271) (USGS unpublished data).

Finally, two aerial surveys of the northern Gulf of Alaska coastline flown in 1995 and 1996 provided a minimum uncorrected count of 271 sea otters between Cape Hinchinbrook and Cape Yakataga (Doroff and Gorbics 1998). Applying a correction factor of 2.38 (CV = 0.087) for sea otter aerial surveys using a twin-engine aircraft (Evans *et al.* 1997) produces an adjusted estimate of 645 (CV = 0.087). Combining the adjusted estimates for these three areas results in a total estimate of 16,552 sea otters for the southcentral Alaska 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): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1; the estimated N_{MIN} for the southcentral Alaska stock is 13,955 sea otters.

Current Population Trend

Although rates of population growth may vary among locations, the trend for this stock of sea otters is generally one of growth (Irons *et al.* 1988, Bodkin and Udevitz 1999). Since 1911, when sea otters were protected from commercial hunting, remnant populations in southcentral Alaska have recolonized much of their former range. Persisting populations in Alaska have generally exhibited trends of growth, with declines occurring only when populations exceed available resources (Estes 1990, Bodkin *et al.* 1995). The 1989 *Exxon Valdez* oil spill resulted in an estimated sea otter mortality in Prince William Sound ranging from 750 (range 600-1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) otters (Garrot *et al.* 1993). Since the spill, sea otters in western Prince William Sound have increased by approximately 750 animals (Bodkin *et al.*, in press). However, overall sea otter abundance in Prince William Sound has not increased appreciably since 1994. The current population estimate for Kenai Fiords and eastern Cook Inlet is slightly higher than the previous estimate from 1989 (2,673 vs. 2,330), which suggests slight growth in this area. The overall trend for this stock appears to be either stable or slightly increasing.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. However, in areas where resources are limiting or where populations are approaching equilibrium density, slower rates of growth are expected (Estes, 1990, Bodkin *et al.* 1995). Maximum productivity rates have not been measured through much of the sea otter's range in Alaska. In the absence of more detailed information for maximum productivity rates throughout southcentral Alaska, the rate of 20% calculated by Estes (1990) is considered a reliable estimate of R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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} x 0.5 R_{MAX} x F_R. The recovery factor (F_R) for this stock is 1.0 (Wade and Anglis 1997) as population levels have increased or remained stable with a known human take. Thus for the southcentral stock of sea otters, PBR = 1,396 animals (13,955 x 0.5 (0.2) x1.0)

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Each year, fishery observers monitor a percentage of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to these operations. Fisheries observers monitored the Cook Inlet set gillnet and drift gillnet fisheries from 1999-2000. The observer coverage during both years was approximately 2-5%. No mortalities or injuries of sea otters were reported by fisheries observers for the Cook Inlet set gillnet and drift gillnet fisheries for this period. On several occasions, sea otters were observed within 10 meters of the gillnet gear, but did not become entangled. No other fisheries operating in the region of the southcentral stock were monitored by observer programs from 1992 through 2000. From 1990 to 1991, fisheries observers in the southcentral Alaska region reported no mortalities or injuries of sea otters. Prior to the implementation of the NMFS observer program, studies were conducted on sea otter interactions with the drift net fisheries in western Prince William Sound from 1988 to1990 and no mortalities were observed (Wynne 1990, 1991).

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska are fisher self-reports required of vessel owners by NMFS. In 1990, fisher self-report records show 1 kill and 4 injuries due to gear interaction and 3 injuries due to deterrence in the Prince William Sound drift gillnet fishery. Self-reports were not available for 1994 and 1995. Between 1996 and 2000, there were no records of incidental take of sea otters by commercial fisheries in this region; thus, the estimated mean annual mortality reported for the 5-year period from 1996-2000 is zero. Credle *et al.* (1994) considered this to be a minimum estimate as fisher self-reports and logbook records (self-reports required during 1990-1994) are most likely negatively biased.

Based on the available data, sea otter abundance in the southcentral Alaska stock is not likely to be significantly affected by commercial fishery interaction at present. The total fishery mortality and serious injury is less than 10% of the calculated PBR (1,951) and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate (Wade and Angliss 1997). A complete list of fisheries and marine mammal interactions is published annually by NMFS [67 FR 2410].

Oil and Gas Development

Exploration, development and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (< 10% of body surface), but that greater levels (>25%) will lead to death (Costa and Kooyman 1981, Siniff *et al.* 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Total estimates of mortality for the Prince William Sound area vary from 750 (range 600-1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) otters (Garrot *et al.* 1993). Statewide, it is estimated that 3,905 sea otters (range 1,904 - 11,257) died in Alaska as a result of the spill (DeGange *et al.*1994b). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the 1989 oil spill (Bodkin *et al.*, in press, Stephensen *et al.* 2001).

In addition to tanker traffic in Prince William Sound, oil and gas development occurs in Cook Inlet. While the catastrophic release of oil has the potential to take large numbers of sea otters, there is no evidence that routine oil and gas development and transport have a direct impact on the southcentral Alaska sea otter stock.

Subsistence/Native Harvest Information

The Marine Mammal Protection Act of 1972 exempted Native Alaskans from the prohibition on hunting marine mammals. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. Data for subsistence harvest of sea otters in southcentral Alaska were collected by a mandatory Marking, Tagging and Reporting Program implemented by USFWS since 1988. Fig. 2 provides a summary of harvest information for the southcentral stock from 1989-2000. The mean annual subsistence take during the past five years (1996-2000) was 297 animals. Age composition during this period was 93% adults,6% subadults, and 1% pups. Sex composition during the past five years was 81% males, 17% females and 2% of unknown sex.

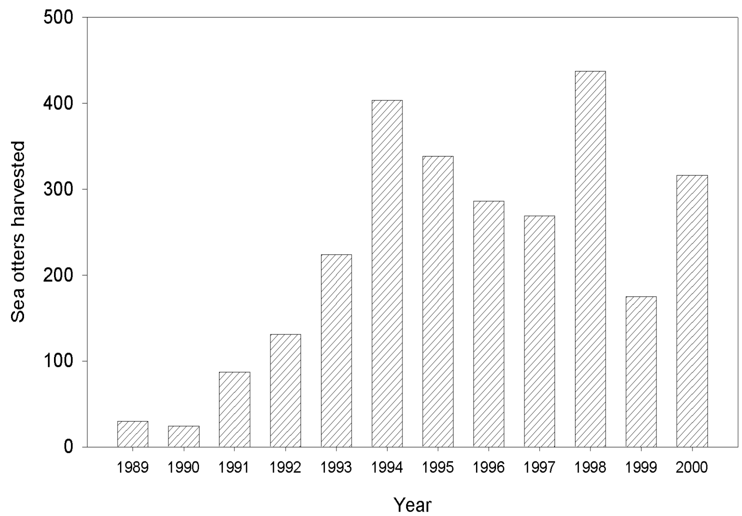

Figure 2. Estimated subsistence harvest of sea otters from the southcentral Alaska stock, 1989-2000.

Since 1997, the USFWS and the Alaska Sea Otter and Steller Sea Lion Commission (TASSC) have signed cooperative agreements authorized under Section 119 of the MMPA for the conservation and co-management of sea otters in Alaska. Each of the six TASSC regions has a regional management plan that includes harvest guidelines. Several villages have also developed local management plans that address sea otter harvests.

Research and Public Display

During the past five years there have been no live captures of sea otters for public display from the southcentral Alaska stock. Since 1996, 253 sea otters have been captured and released for scientific research in Prince William Sound. There have been no observed effects on sea otter populations in the southcentral Alaska stock from these activities.

STATUS OF STOCK

Sea otters in the southcentral Alaska stock 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 minimum mortality and serious injury incidental to commercial fisheries (0) is less than 10% of the calculated PBR, and therefore can be considered insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury over the 5-year period from 1996 through 2000 (297) does not exceed the PBR (1,396). As a result, the southcentral sea otter stock is classified as non-strategic. This classification is consistent with the recommendations of the Alaska Regional Scientific Review Group (DeMaster 1995). The status of this stock relative to its Optimum Sustainable Population size is unknown.

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SEA OTTER (*Enhydra lutris*): Southwest Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sea otters occur in nearshore coastal waters of the U.S. along the North Pacific Rim from the Aleutian Islands to California. The species is most commonly observed within the 40 m depth contour since animals require frequent access to foraging habitat in subtidal and intertidal zones (Reidman and Estes 1990). Sea otters in Alaska are not migratory and generally do not disperse over long distances, although movements of tens of kilometers are normal (Garshelis and Garshelis 1984). Individuals are capable of long distance movements of >100 km (Garshelis *et al.* 1984), however movements of sea otters are likely limited by geographic barriers, high energy requirements of animals, and social behavior.

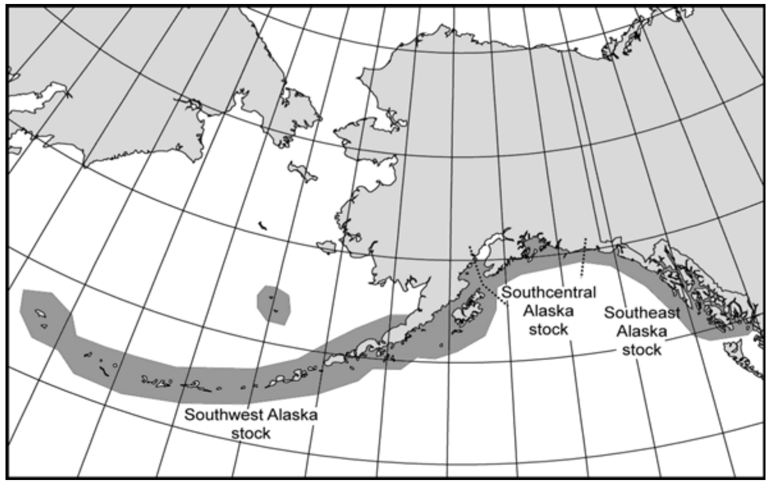

Figure 1. Approximate distribution of sea otters in Alaska waters (shaded area).

Applying the phylogeographic approach of Dizon *et al.* (1992), Gorbics and Bodkin (2001) identified three sea otter stocks in Alaska: southeast, southcentral,and southwest. The ranges of these stocks are defined as follows: (1) Southeast stock extends from Dixon Entrance to Cape Yakataga; (2) Southcentral stock extends from Cape Yakataga to Cook Inlet including Prince William Sound, the Kenai peninsula coast, and Kachemak Bay; and (3) Southwest stock which includes Alaska Peninsula and Bristol Bay coasts, the Aleutian, Barren, Kodiak, and Pribilof Islands (Fig. 1). The phylogeographic approach of stock identification, which considers four types of data, is presented in greater detail below.

1) Distributional data: geographic distribution is continuous from Kachemak Bay to Cape Suckling, at which point 125 miles of vacant coastal habitat between Cape Suckling and Yakutat Bay separates the southeast and southcentral Alaska stocks (Doroff and Gorbics 1998). Sea otters in Yakutat Bay and southeast Alaska are the result of a translocation of 412 animals from Prince William Sound and Amchitka in the late 1960s (Pitcher 1989; Reidman and Estes 1990). Prior to translocation, sea otters had been absent from these habitats since the beginning of the 20th century. Distribution is nearly continuous from Attu Island in the western Aleutians to the Alaska Peninsula, although distances of >200 km between island groups in the Aleutians may effectively limit exchange of individuals. Sea otters do not occur in upper Cook Inlet, and population densities are currently low between the Kenai peninsula and the Alaska Peninsula, which suggests discontinuity in distribution at the stock boundary. Physical features that may limit movements of otters between the Kenai and Alaska peninsulas include approximately 100 km of open water across Cook Inlet with a maximum water depth of 100 m, and 70 km of open water between the Kenai Peninsula and the Kodiak Archipelago with a maximum water depth of 200 m. However, the open water between Kenai and Kodiak is interrupted mid-way by the Barren Islands (Gorbics and Bodkin 2001).

Contaminant levels may also indicate geographic isolation of stocks. In general, tissues from sea otters in Alaska contain relatively low levels of contaminants; however, higher levels of heavy metals and trace elements were found in animals from southcentral Alaska, with the general trend among groups being southcentral>southwest>southeast (Comerci *et al.*, in prep.). Patterns of contamination are consistent with distribution of pollutants from anthropogenic sources in populated areas. High levels of PCBs in some otters from the Aleutian Islands (southwest Alaska) likely reflect local "point sources," such as military installations (Estes *et al.* 1997; Bacon *et al.* 1999).

2) Population response data: variation in growth rates and reproductive characteristics among populations likely reflect local differences in habitat and resource availability rather than intrinsic differences between geographically distinct units (Gorbics and Bodkin 2001) .

3) Phenotypic data: significant differences in sea otter skull sizes exist between Southwest and Southcentral Alaska (Gorbics and Bodkin, 2001).

4) Genotypic data: the three stocks exhibit substantial differences in both mitochondrial and nuclear DNA (Cronin *et al.* 1996; Bodkin *et al.* 1992, 1999, Larson *et al.* in prep.). Significant differences in frequencies of mtDNA haplotypes and genetic differences among geographic areas show sufficient variation to indicate restricted gene flow (Gorbics and Bodkin 2001). A recent analyses of mitochondrial and nuclear DNA by Cronin *et al.* (2002) corroborates the stock structure proposed by Gorbics and Bodkin (2001).

POPULATION SIZE

Historically, sea otters occurred across the North Pacific Rim, ranging from Hokkaido Japan through the Kuril Islands, the Kamchatka Peninsula, the Commander Islands, the Aleutian islands, peninsular and south coastal Alaska and south to Baja, California, Mexico (Kenyon 1969). In the early 1700s, the worldwide population was estimated to be between 150,000 (Kenyon 1969) and 300,000 individuals (Johnson 1982). Prior to large-scale commercial exploitation, indigenous people of the North Pacific hunted sea otters. Although it appears that harvests periodically led to local reductions of sea otters (Simenstad *et al.* 1978), the species remained abundant throughout its range until the mid 1700s. Following the arrival in Alaska of Russian explorers in 1741, extensive commercial harvest of sea otters over the next 150 years resulted in the near extirpation of the species. When sea otters were afforded protection by the International Fur Seal Treaty in 1911, probably fewer than 2,000 animals remained in thirteen remnant colonies (Kenyon, 1969). Population regrowth began following legal protection and sea otters have since recolonized much of their historic range in Alaska.

The most recent population estimates for the Southwest Alaska stock are presented in Table 1.

Table 1. Population estimates for the Southwest Alaska stock of sea otters.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{min}	Reference
Aleutian Islands	2000	2,442	8,742	0.215	7,309	Doroff *et al.* (in press)
North Alaska Peninsula	2000	4,728	11,253	0.337	8,535	USFWS Unpublished data
South Alaska Peninsula - Offshore	2001	1,005	2,392	0.816	1,311	USFWS Unpublished data
South Alaska Peninsula - Shoreline	2001	2,190	5,212	0.087	4,845	USFWS Unpublished data
South Alaska Peninsula - Islands	2001	405	964	0.087	896	FWS Unpublished data
Unimak Island	2001	42	100	0.087	93	FWS Unpublished data
Kodiak Archipelago	2001		5,893	0.228	4,875	USFWS Unpublished data
Kamishak Bay	2002		6,918	0.315	5,340	USGS Unpublished data
Total			41,474		33,203	

Surveys of the Aleutian Islands in summer 2000 included the Near, Rat, Andreanof, Delarof, Four Mountain and Fox Island groups, and resulted in a population estimate of 8,742 (CV= 0.215) sea otters (Doroff *et al.*, in press). In the Aleutian Islands, aerial surveys consisted of shoreline counts that used a correction factor to account for sightability.

A survey of offshore area of the North Alaska Peninsula from Unimak Island to Cape Seniavin flown in summer 2000 produced an abundance estimate of 4,728 (CV= 0.326) sea otters (USFWS unpublished data). A similar survey of offshore areas of the south Alaska Peninsula from False Pass to Pavlov Bay conducted in summer 2001 resulted in a population estimate of 1,005 (CV= 0.811) animals. Applying a correction factor of 2.38 (CV =

0.087) for sea otter aerial surveys using a twin-engine aircraft (Evans *et al.* 1997) produces adjusted estimates of 11,253 (CV = 0.337) and 2,392 (CV = 0.816) for the north and south Alaska Peninsula offshore areas, respectively.

In 2001, aerial surveys along the shoreline of the South Alaska Peninsula from Seal Cape to Cape Douglas recorded 2,190 sea otters (USFWS unpublished data). Additional aerial surveys of the South Alaska Peninsula island groups (Sanak, Caton, and Deer Islands, and the Shumagin and Pavlov island groups) and a survey of Unimak Island, recorded 405 otters for the South Alaska Peninsula island groups and 42 animals for Unimak Island. Applying the same correction factor of 2.38 (CV = 0.087) for sea otter aerial surveys using a twin-engin aircraft produces adjusted estimates of 5,212 (CV = 0.087), 964 (CV = 0.087) and 100 (CV = 0.087) for the south Alaska Peninsula shoreline, south Alaska Peninsula islands, and Unimak Island, respectively.

An aerial survey of the Kodiak Archipelago conducted in 2001 provided a population estimate of 5,893 (CV = 0.228) sea otters (USFWS unpublished data). The population estimate was calculated by applying a ratio estimate of density to the entire study area, and a correction factor was applied to account for group size bias and undetected diving animals.

Finally, an aerial survey of Kamishak Bay conducted in June 2002 produced a population estimate of 6,918 (CV = 0.315) sea otters. This population estimate was also calculated by applying a ratio estimate of density to the entire study area, and a correction factor was applied to account for group size bias and undetected diving animals.

Combining the adjusted estimates for these study areas areas results in a total estimate of 41,474 sea otters for the southwest Alaska 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): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1; the estimated N_{MIN} for the southwest Alaska stock is 33,203.

Current Population Trend

The first systematic aerial surveys of sea otters in southwest Alaska were conducted from 1957 to 1965. These surveys indicated that sea otter populations were growing and that animals were recolonizing much of their former range. Additionally, surveys showed that the greatest concentration of sea otters in the world was located in the Aleutian Islands (Kenyon 1969). By the 1980s, sea otters were present in all the island groups in the Aleutians (Estes 1990), and the total population in the Aleutian Islands was estimated as 55,100 to 73,700 individuals (Calkins and Schneider 1985). In 1992, nearly three decades after the original aerial surveys, USFWS conducted another systematic aerial survey of the Aleutian Islands. The total uncorrected count for the entire area was 8,042 sea otters. Survey results showed that sea otter abundance had declined since 1965 by more than 50% in several island groups in the central Aleutians (Evans *et al.* 1997). Boat-based surveys conducted during the 1990s independently documented severe declines in sea otter abundance within portions of the central Aleutians (Estes *et al.* 1998). In spring 2000, USFWS repeated the 1992 aerial survey and observed widespread declines throughout the Aleutian Islands, with the greatest decreases occurring in the central Aleutians. The total uncorrected count for the area in 2000 was 2,442 animals, indicating that sea otter populations had declined 70% between 1992 and 2000. In August 2000, USFWS designated the northern sea otter in the Aleutian Islands (from Unimak Pass to Attu) as a candidate species under the Endangered Species Act.

As part of a continued effort to determine the full range of the sea otter decline in Western Alaska, USFWS conducted aerial surveys along the Alaska Peninsula and the Kodiak Archipelago in 2000 and 2001. Surveys of the Alaska Peninsula repeated methods used in a 1986 aerial survey by Brueggeman *et al.* (1988). When current results were compared with those from the previous study, declines of 93-94% were documented for the South Alaska Peninsula and declines of 27-49% were documented for the North Alaska Peninsula (USFWS unpublished data). In the Kodiak Archipelago, data from 2001 aerial surveys indicates that sea otter populations have decreased as much as 40% since 1994 (USFWS unpublished data).

A recent aerial survey of Kamishak Bay indicates nearly 7,000 sea otters inhabit this area. Kamishak Bay was previously surveyed as part of a boat-based survey of lower Cook Inlet (Agler *et al.* 1995). An estimate for just Kamishak Bay is not available, therefore the population trend for that area is unknown. Although large portions of the southwest Alaska stock appears to have undergone dramatic population declines, several areas do not appear to have been affected. Estimates from the Port Moller/Nelson Lagoon area and the Alaska Peninsula from Castle Cape to Cape Douglas show evidence of population increases. The magnitude of these increases however, does not offset the declines observed in the last 10-15 years.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. However, in areas where resources are limiting or where populations are approaching equilibrium density, slower rates of growth are expected (Estes 1990, Bodkin *et al.* 1995). Maximum productivity rates have not been measured through much of the sea otter's range in Alaska. In the absence of more detailed information regarding maximum productivity rates throughout the state, the rate of 20% calculated by Estes (1990) is considered a reliable estimate of R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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} x 0.5 R_{MAX} x F_R. Since 1992, sea otter counts in the Aleutians have declined by an average of 70%. In August 2000 sea otters in the Aleutian Islands were designated as a Candidate Species under the Endangered Species Act. Candidate species designation was expanded to encompass the entire southwest Alaska stock of sea otters in June 2002. Given the geographic extent and overall magnitude of the decline, along with the uncertainty regarding the cause, we have set the recovery factor (F_R) for this stock at 0.25. Thus, for the Southwest stock of sea otters, PBR = 830 animals (33,203 x 0.5 (0.2) x 0.25).

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Each year, fishery observers monitor a percentage of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to these operations. In 1992, fisheries observers reported eight sea otters taken incidentally by the Aleutian Island Black Cod Pot Fishery. During that year, 33.8% of the Bering Sea area groundfish fisheries were observed, resulting in a total estimate of 24 ± 3 sea otter mortalities for the Bering Sea groundfish fisheries in 1992. No other sea otter kills were reported by observer programs operating in the region of the Southwest stock from 1993 through 2000 (Perez et al, 1999). The NMFS is currently conducting a marine mammal observer program for the Kodiak salmon set net fishery that will operate during the 2002 and 2003 fishing seasons.

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska are fisher self-reports required of vessel-owners by NMFS. In 1997, fisher self-reports indicated one sea otter kill in the Bering Sea and Aleutian Island groundfish trawl. Self-report records were incomplete for 1994, not available for 1995 and reported no kills or injuries in 1996. From 1998 through 2000, there were no further records of incidental take of sea otters by commercial fisheries in this region. Thus, during the period between 1996 and 2000, fisher self-reports resulted in an annual mean of 0.2 sea otter mortalities from interactions with commercial fishing gear. Credle *et al.* (1994), considered this to be a minimum estimate as fisher self-reports and logbook records (self-reports required during 1990-1994) are most likely negatively biased.

Based on the available data, sea otter abundance in the Southwest stock is not likely to be significantly affected by commercial fishery interactions at present. The total fishery mortality and serious injury (0.2) is less than 10% of the calculated PBR (830) and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate (Wade and Angliss 1997). A complete list of fisheries and marine mammal interactions is published annually by NMFS [67 FR 2410].

Oil and Gas Development

Exploration, development and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (< 10% of body surface), but that greater levels (>25%) will lead to death (Costa and Kooyman 1981, Siniff *et al.* 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Total estimates of mortality for the Prince William Sound area vary from 750 (range 600-1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) (Garrot *et al.* 1993) otters. Statewide, it is estimated that 3,905 sea otters (range 1,904 - 11,257) died in Alaska as a result of the spill (DeGange *et al.* 1994). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the 1989 oil spill (Bodkin *et al.*, in press, Stephensen *et al.* 2001). Other areas outside of Prince William Sound that were affected by the spill have not been intensively studied for long-term impacts.

Within the range of the Southwest Alaska sea otter stock, oil and gas development occurs only in Cook Inlet. Although the amount of oil transport in southwest Alaska is small, the *Exxon Valdez* oil spill demonstrated that spilled oil can travel long distances and take large numbers of sea otters far from the point of initial release. Annual mortality due to oil and gas development activities has not been estimated for the Southwest sea otter stock. While the catastrophic release of oil has the potential to take large numbers of sea otters, there is no evidence that routine oil and gas development and transport have a direct impact on the Southwest Alaska sea otter stock.

Subsistence/Native Harvest Information

The Marine Mammal Protection Act of 1972 exempted Native Alaskans from the prohibition on hunting marine mammals. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. Data for subsistence harvest of sea otters in Southwest Alaska were collected by a mandatory Marking, Tagging and Reporting Program implemented by USFWS since 1988. Fig. 2 provides a summary of harvest information for the Southwest stock from 1989 through 2000. The mean annual subsistence take during the past five years (1996-2000) was 97 animals. Age composition during this period was 87% adults, 10.5% subadults, and 2.5% pups. Sex composition during the past five years was 62% males, 20% females and 18% unknown sex.

Since 1997, the USFWS and the Alaska Sea Otter and Steller Sea Lion Commission (TASSC) have signed cooperative agreements authorized under Section 119 of the MMPA for the conservation and co-management of sea otters in Alaska. Each of the six TASSC regions has a regional management plan that includes harvest guidelines. Several villages have also developed local management plans that address sea otter harvests.

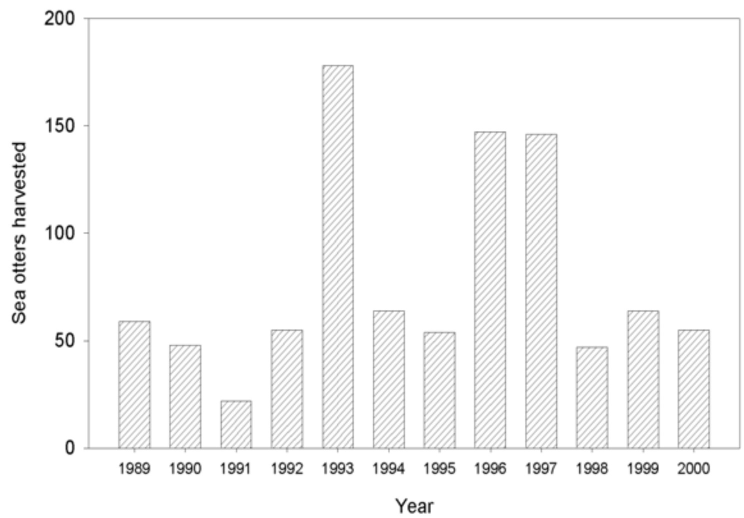

Figure 2. Estimated subsistence harvest of sea otters from the southwest Alaska stock, 1989-2000.

Research and Public Display

In the past five years, 11 sea otters have been removed from the southwest Alaska stock for public display. A limited amount of live capture for scientific research has been conducted in the Aleutian Islands. There have been no observed effects on sea otter populations in the Southwest Alaska stock from these activities.

STATUS OF STOCK

Sea otters in southwest Alaska are not presently listed as "depleted" under the MMPA. However, based on the best available scientific information that indicates sea otter numbers across southwest Alaska are declining, USFWS designated the southwest Alaska Distinct Population Segment of the northern sea otter as a candidate species under the Endangered Species Act in June 2002. As a result, the southwest Alaska stock is classified as strategic.

In the Aleutians and the Alaska Peninsula, subsistence hunting of sea otters occurs at low levels and does not appear to be a major factor in the decline. Additionally, current levels of incidental take of sea otters by commercial fisheries in southwest Alaska can be considered insignificant and approaching a zero mortality rate. Thus, these populations are declining for unknown reasons that are not explained by the level of direct human-caused mortality.

Habitat Concerns

Potential threats to sea otter populations include natural fluctuations, such as disease or predation, and indirect effects of human activities. Population studies in the Aleutian Islands indicate that observed declines are the result of increased adult mortality. A current theory proposes that predation by transient killer whales may be a leading cause of the population decline (Estes *et al.* 1998). Studies show that disease, starvation and contaminants are not presently implicated in the Aleutians; however, further evaluation of these factors is warranted along with additional investigation of the predation hypothesis to better elucidate the cause of the decline.

Sea otters play an important role in maintaining the coastal ecosystems they inhabit. In near-shore kelp beds, sea otters function as keystone species, strongly influencing ecosystem functions. In the Aleutian archipelago, sea urchins are a dominant herbivore and an important food source for sea otters (Estes *et al.* 1978). If sea otters disappear from these areas, sea urchin populations will be released from the control of sea otter predation, and may soon overgraze the attachments of bull kelp. Detached kelp is swept away, exposing remaining fish, crustaceans and bivalves. A secondary consequence of the decline in sea otter populations in southwestern Alaska is that kelp forests in many areas may also be in decline (Estes *et al.* 1998).

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