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Alaska Marine Mammal Stock Assessments, 2011~~1~~2

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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), 2005 (Angliss and Outlaw 2005), 2006 (Angliss and Outlaw 2007), 2007 (Angliss and Outlaw 2008), 2008 (Angliss and Allen 2009), 2009 (Allen and Angliss 2010, and 2010 (Allen and Angliss 2011). 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, AT1 transient killer whales, harbor porpoises, sperm whales, humpback whales, fin whales, North Pacific right whales, and bowhead whales), were reviewed in 2008-2009. This review, and a review of other stocks, led to the revision of the following stock assessments for the 2009 document: Steller sea lion (western and eastern U.S. stocks), northern fur seal, harbor seal (southeast Alaska, Gulf of Alaska, Bering Sea stocks), spotted seal, bearded seal, ringed seal, ribbon seal, killer whale (AT1 transient), Pacific white-sided dolphin, harbor porpoise (southeast Alaska, Gulf of Alaska, and Bering Sea stocks), Dall's porpoise, sperm whale, central and western stocks of humpback whales, fin whale, North Pacific right 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: Lance Barrett-Lennard, Karl Haflinger, John Gauvin, Lloyd Lowry, Beth Mathews (chair from 2007 to present), Craig Matkin, George Noongwook, Grey Pendleton, Jan Straley, Robert Suydam, 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

Revised 1~~1~~2/22~~9~~/2011~~0~~

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 (Fig. 3). 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 (Sease and York 2003). 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) is low (NMFS 1995).

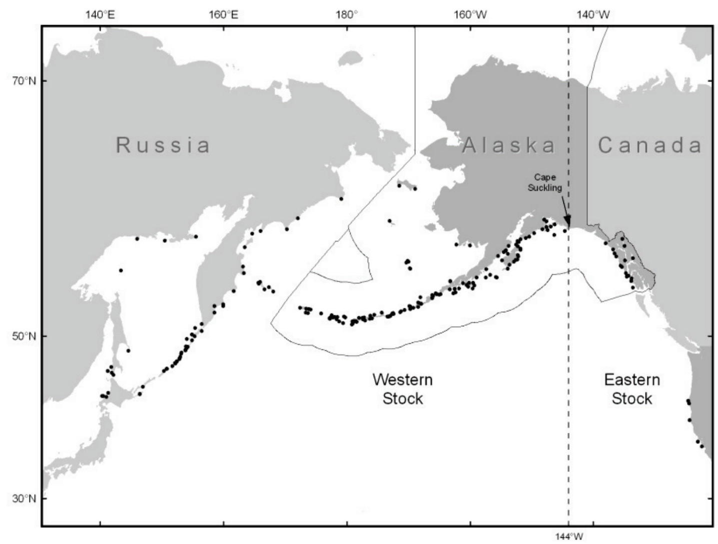

Figure 1. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (Burkanov and Loughlin, 2005) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997). Note: Haulouts and rookeries in British Columbia are not shown.

Loughlin (1997) considered the following information when classifying stock structure based 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).

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 2005). 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 between the Commander Islands (Russia) and Kamchatka that would include Commander Island sea lions within the western U.S. stock and animals west of there in an Asian stock. However, Hoffman et al. (2006) did not support an Asian/western stock split based on their analysis of nuclear microsatellite markers indicating high rates of male gene flow. All genetic analyses (Baker et al. 2005, Harlin-Cognato et al 2006, Hoffman et al. 2006, 2009, O'Corry-Crowe et al, 2006) confirm a strong separation between western and eastern stocks, and there may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009)~~ despite the observation that western stock haplotypes are present at two northern southeast Alaska rookeries (Gelatt et al. 2007)~~. Recent work by Phillips et al. (2011) addressed the effect of climate change in the form of glacial events on the evolution of Steller sea lions and reported that the effective population size at the time of the event determines the outcome. The results suggested that during historic glacial periods dispersal events were correlated with historically low effective population sizes, while range fragmentation type events were correlated with larger effective population sizes. This work again re-inforced the stock delineation concept by noting that ancient population subdivision likely led to the sequestering of most mtDNA haplotypes as DPS, or subspecies-specific (Phillips et al. 2011). Overall, the basis for this distinctiveness is the overwhelming collection of morphological, ecological and behavioral, and genetic evidence for DPS differences. Although the movement of few migrants a year has been documented and that in and of itself may be sufficient to prevent genetic differentiation among populations within a DPS (such as within the entire eastern DPS), there is no evidence to suggest such a rate of exchange is sufficient to merge distinct populations.

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 conducted in June-July 2008-2011 (~~Fritz et al. 2008a~~ DeMaster 2011) and aerial and ground-based pup counts conducted in June~~ and ~~-July ~~of 2009 and 2010~~2009-2011 (DeMaster 20~~09~~11~~; NMML, unpublished data~~). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites. During the 2008-2011 non-pup ~~aerial ~~surveys, a total of ~~31,245~~34,314 non-pups was counted at ~~275~~274 terrestrial rookery~~ies~~ and haulout sites; ~~6,522~~19,593 in the Gulf of Alaska and ~~14,723~~14,721 in the Bering Sea/Aleutian Islands~~ (Fritz et al. 2008b)~~. Most of the data represented in the aggregate 2008-11 non-pup count was collected during the most recent 2011 survey (30,590 non-pups on 127 of the largest sites). Sites that were not surveyed in 2011 contributed less to the aggregate 2008-11 total: 553 non-pups on 54 sites last surveyed in 2008, 644 non-pups on 6 sites last surveyed in 2009, and 2,526 non-pups on 87 sites last surveyed in 2010. The~~A~~ composite pup count ~~for~~from 2009-2011~~0~~ of 11,602 from the western stock in Alaska includes counts from 7 sites in 2009 (274 pups), 7 sites in 2010 (724 pups), and 65 sites in 2011 (10,604 pups). This composite 2009-2011 total of 11,602 pups differs from the 2011 pup production estimate of DeMaster (2011), 11,547 pups, because DeMaster (2011) estimated pup production at sites that were missed in the 2011 survey (estimates were based on recent regional trends). Here, the total of 11,602 pups is based on the most recent counts at each site in the 2009-2011 period.~~ 172 sites in 2009, and 6 sites in 2010.~~ There were ~~5,457~~5,036 pups counted in the Gulf of Alaska and ~~5,584~~5,566 pups counted in the Bering Sea/Aleutian Islands~~ for a total of 11,041 for the stock in Alaska~~. Combining the pup count data from 2009-2011~~0~~ (~~11,041~~11,602) and non-pup count data from 2008-2011 (~~31,245~~34,314) results in a minimum abundance estimate of ~~42,286~~45,916 Steller sea lions in the western U.S. stock in 2008-2011~~0~~.

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 (~~11,041~~11,602) by 4.5 (Calkins and Pitcher 1982), which equals ~~49,685~~52,209. This ~~would not be~~is not a minimum abundance estimate since it is ~~based on extrapolating~~an extrapolated total population size from pup counts based on survival and fecundity estimates in a life table. The 4.5 multiplier 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; Holmes et al. 2007).

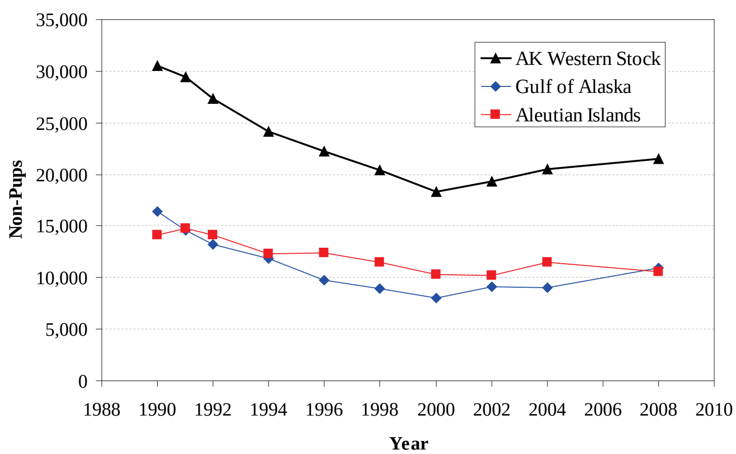

Figure 2. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U.S. stock in Alaska, 1990-2008. Correction factor applied to 2004 and 2008 counts for film format differences (Fritz and Stinchcomb 2005).

Holmes and York (2003) and Holmes et al. (2007) estimated changes in adult and juvenile survival and natality in the female segment of the population that were consistent with time series of pup and non-pup counts, and changes in the juvenile proportion of the population in the central Gulf of Alaska (Kodiak archipelago). They found that the rapid decline of the central Gulf sea lion population in the 1980s was associated with a large drop in juvenile survival and smaller declines in adult survival and natality. As the rate of population decline lessened in the 1990s, rates of juvenile and adult survival increased to pre-decline levels in the 1998-2004 period. Rates of natality, however, continued to decline throughout the 1990s and into the 2000s. Thus, the authors concluded that factors that caused the population decline (those contributing to lower rates of juvenile survival) were likely quite different from those that are now affecting recovery (those contributing to lower reproductive rates of adult females).

In 2006-2009, over 18,000 Steller sea lions were counted in Russia. 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 (2005) estimated that the size of the Steller sea lion population (pups and non-pups) in Russia was 16,000 in 2005. Data collected since then indicate that Steller sea lion numbers in the Kuril Islands and the Sea of Okhotsk increased while those in the western Bering Sea, eastern Kamchatka and Commander Islands have remained stable or declined.

Minimum Population Estimate

The 2008-2011 aggregate total count of non-pups (~~31,245~~34,314) plus the number of pups in 2009-2011~~0~~ (~~11,041~~11,602) is ~~42,286~~45,916, 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).

~~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. Aerial surveys for non-pup Steller sea lions were conducted in 2006 and 2007, but were incomplete due to a court-ordered cessation of research that caused a delay to the start of the survey in 2006, and loss of survey days due to bad weather and aircraft maintenance requirements in both years. Although some trend sites were not surveyed in both 2006 and 2007, available data indicated that the size of the adult and juvenile portion of the western Steller sea lion population throughout much of its range (Cape St. Elias to Tanaga Island, 145°-178° W) in Alaska remained largely unchanged between 2004 (N=23,107) and 2007 (N=23,118) (Fritz et al. 2008a). Results of the aerial survey conducted in 2008 (Fritz et al. 2008b) confirmed that the recent (2004-2008) overall trend in the western population of adult and juvenile Steller sea lions in Alaska is stable. There continues to be considerable regional variability in recent (2004-2008) trends (percentages listed below are % change between years):~~

- ~~the population in the eastern Aleutian Islands is the only one that has consistently increased from 2004-2008 (+7%);~~
- ~~the populations in the central and western Aleutian Islands declined (-30% and -16%, respectively);~~
- ~~the populations in the central and western Gulf of Alaska increased between 2004 and 2007, but declined slightly between 2007 and 2008; and~~
- ~~non-pup counts in the eastern Gulf of Alaska increased by 35%, with some of this increase likely related to timing of the 2008 survey (earlier than usual) and seasonal movement of animals into this area from the central Gulf and Southeast Alaska(eastern stock).~~

~~Counts in the area from the central Gulf of Alaska through the western Aleutian Islands (85% of the 2008 population) declined slightly (-1%) between 2004 and 2008, indicating that the overall increase observed between 2004 and 2008 (3%) was entirely in the eastern Gulf of Alaska. The increase in the eastern Gulf of Alaska may be partially explained by movement of animals from the eastern stock, since counts at index sites in Southeast Alaska were approximately 1,200 lower in 2008 than in 2002, despite the overall 3% per year increase in the Steller sea lion population observed in Southeast Alaska through 2005 (NMFS 2008).~~

~~In 2009 (DeMaster 2009), NMML conducted a non-pup survey in late June ('late' compared with the 'early' 2008 survey to further investigate seasonal movement of sea lions in the northern Gulf of Alaska and how it~~

could affect trend counts in both the eastern and western stocks. In the 'late' 2009 compared to the 'early' 2008 survey, NMFS counted:

- 2,636 more non-pups on all sites in SE Alaska;
- 812 fewer non-pups on all sites in the eastern Gulf of Alaska; and
- 404 more non-pups on 28 of the 33 trend sites surveyed consistently since 1991 in the central Gulf of Alaska.

These results are consistent with the hypothesis proposed in 2008 (Fritz et al. 2008a) that seasonal movement into the eastern Gulf of Alaska may have affected non-pup trend analyses in this area as well as for the western DPS as a whole. DeMaster (2009) estimated the number of sea lions from SE Alaska (eastern stock) and from the central Gulf of Alaska (western stock) that were counted in the eastern Gulf of Alaska (western stock) in 2008 by comparing actual to predicted 2008 sub-area totals based on the 2000-2009 overall trends. These analyses indicated that approximately 570 animals from the eastern stock may have been counted within the range of the western stock in 2008. If 570 non-pups are subtracted from the 2008 total, the overall western stock increase between 2004 and 2008 is reduced from 3% to 1%. The 2009 non-pup survey results in the northern Gulf of Alaska supports the earlier conclusion that the increase observed between 2000 and 2004 in the size of the western stock of Steller sea lion did not continue, and that the population was generally stable between 2004 and 2008.

Counts of non-pup Steller sea lions at trend sites in the AK western stock increased 11% from 2000 to 2004 (Table 1, Fig. 2). These were the first region-wide increases for the western stock since standardized surveys began in the 1970s and were due to increased or stable counts in all regions except the western Aleutian Islands. Between 2004 and 2008, AK western non-pup counts increased only 3%: eastern Gulf of Alaska (Prince William Sound area) counts were higher and Kenai Peninsula through Kiska Island counts were stable, but western Aleutian counts continued to decline. Johnson (2010) analyzed western Steller sea lion population trends in AK and concluded that the overall 2000-2008 trend was 1.5% y^{-1} (with 90% confidence bounds of -0.3% y^{-1} and 3.3% y^{-1}). NMFS has not been able to complete a non-pup survey of the AK western stock since 2008, due largely to weather and closure of the Air Force Base on Shemya in 2009 and 2010. However, the data collected through 2011 indicate the following regional trends in non-pup counts (DeMaster 2011):

- Significant decline in the western Aleutians, 1991-2011: -8.5% y^{-1} (P<0.001)
- Improvement in trend from west to east in the central Aleutians, with counts declining west of Tanaga Pass (Kiska through the Delarof Islands) and either stable or increasing between Tanaga and Samalga Passes:
    - Significant decline from Kiska through Amchitka Islands, 1991-2008: -5.5% y^{-1} (P<0.001)
    - Significant decline in the Delarof Islands, 1991-2010: -3.1% y^{-1} (P<0.001)
    - Stable from Tanaga through Atka Islands, 2000-2011: -0.4% y^{-1} (P=0.756)
    - Significant increase from Amlia Island to Samalga Pass, 2000-2011: 2.2% y^{-1} (P=0.027)
- Significant increase in both the eastern Aleutians (2.6% y^{-1}, P=0.005) and the western Gulf of Alaska (4.8% y^{-1}, P<0.001), 2000-2011
- Stable in the central Gulf of Alaska, 2000-2010: 0.0% y^{-1} (P=0.980), and
- Significant increase in the eastern Gulf of Alaska, 2000-2011: 5.8% y^{-1} (P=0.002).

Pup production at the 31 major western stock rookeries used to estimate trend increased at an average rate of 1.8% y^{-1} (P=0.02) between 2001/02 and 2011. However, the strong regional differences noted in the trends in non-pup counts are also reflected in pup production, which declined in the western (-9.2% y^{-1}; P<0.01) and central Aleutian Islands (-1.5% y^{-1}; P=0.05) between 2001/02 and 2011, but increased in the eastern Aleutian Islands (4.8% y^{-1}; P<0.01) and in the western (3.5% y^{-1}; P=0.02) and eastern Gulf of Alaska (4.7% y^{-1}; P<0.01); pup production in the central Gulf of Alaska has increased in the 2000s (2.2% y^{-1}) but not significantly (P=0.08).

Table 1. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites surveyed consistently since the late 1970s by year and geographical area for the western U. S. stock (NMFS 1995, Sease et al. 2001, Fritz et al. 2008b, NMFS 2008). Counts from 1976 to 1979 (NMFS 1995) were combined to produce complete regional counts that are comparable to the 1990-2008 data. Data from 2004 and 2008 reflect a 3.64% reduction from actual counts to account for improvements in survey protocol in 2004 relative to previous years (Fritz and Stinchcomb 2005).

Area	**late 1970s**	**1990**	**1991**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**	**2008**
Gulf of Alaska	65,296	16,409	14,598	13,193	11,862	9,784	8,937[1]	7,995	9,087	8,993	10,931
Bering Sea/Aleutians	44,584	14,116	14,807	14,106	12,274	12.426	11,501	10,330	10,253	11,507	10,559

Area	late 1970s	1990	1991	1992	1994	1996	1998	2000	2002	2004	2008
Total	109,880	30,525	29,405	27,299	24,136	22,210	20,438[1]	18,325	19,340	20,500	21,489

[1] Identifies 637 non-pups counted at six trend sites in 1999 in the eastern Gulf of Alaska which were not surveyed in 1998.

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. 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 = ~~253~~275 animals (~~42,286~~45,916 × 0.06 × 0.1).

~~The PBR levels for some stocks of marine mammals in the U.S. with an obvious declining trend have been called "undetermined" (e.g., PBR levels for Cook Inlet beluga whales, Hawaiian monk seals); this has not been proposed for the western stock of Steller sea lions. The PBR management approach was developed with the assumption 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. Because direct human-related mortalities are at a low level and are unlikely to either be responsible for the decline or to contribute substantially towards extinction risk, calling the PBR level "undetermined" is unnecessarily conservative for this population of over 40,000 animals.~~

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 2007-2009, 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, Bering Sea/Aleutian Islands Pacific cod longline, and Gulf of Alaska Pacific cod longline (Table 2).

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 2006). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly 2006). 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 (14.6) 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 29.1 (CV = 0.50) 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 2007 through 2009 (or most recent data available) and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. The most recent ~~3~~4 years of available data are used in the mortality 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.

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	2007 2008 2009 2010	obs data	94 100 99 100	0 0 0 1	0 0 0 1	0.25 (CV = 0.23)
Bering Sea/Aleutian Is. flatfish trawl	2007 2008 2009 2010	obs data	72 100 100 100	~~3~~4 11 3 5	~~3.91~~5.5 11.0~~2~~ 3.0~~1~~ 5.0	~~5.98~~6.14 (CV = 0.~~11~~07)
Bering Sea/Aleutian Is. Pacific cod trawl	2007 2008 2009 2010	obs data	5~~2~~3 56~~9~~ 6~~4~~3 66	~~1~~3 0 0 1	~~1.51~~4.0 0 0 1.3	~~0.50~~1.32 (CV = 0.~~58~~29)
Bering Sea/Aleutian Is. pollock trawl	2007 2008 2009 2010	obs data	85 85 86 86	2 8 6 5	2.2~~19~~ 9.2~~1~~ 7.1~~4~~ 6.1	6.1~~8~~6 (CV = 0.1~~5~~1)
Gulf of Alaska pollock trawl	2007 2008 2009 2010	obs data	~~27~~21 ~~34~~24 ~~43~~29 20	0 0 0 0	0 0 0 0	0
Bering Sea/Aleutian Is. Pacific cod longline	2007 2008 2009 2010	obs data	63 63 61 64	0 0 0 0	0 0 0 0	0
Gulf of Alaska Pacific cod longline	2007 2008 2009 2010	obs data	~~45~~20 ~~32~~15 ~~43~~21 28	0 1 0 1	0 2.9~~2~~ 0 14.7	~~0.97~~4.40 (CV = 0.~~81~~67)
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	1990	obs data	3%	0	0	0
Alaska Peninsula/Aleutian Islands salmon drift gillnet	1990	obs data	4%	0	0	0
Cook Inlet salmon set gillnet[1]	1999-2000	obs data	2-5%	0 0	0, 0	0
Cook Inlet salmon drift gillnet[1]	1999-2000	obs data	2-5%	0 0	0, 0	0

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Kodiak Island salmon set gillnet	2002	obs data	6.0%	0	0	0
Observer program total						~~28.13~~32.77 (CV = 0.~~50~~45)
				Reported mortalities		
Alaska sport salmon troll (non-commercial)	200~~5~~6 - 20~~0~~1~~9~~0	strand	N/A	~~0,~~ 0, 0, 0, 1, 1	N/A	[0.~~2~~4]
Miscellaneous fishing gear	200~~5~~6 - 20~~0~~1~~9~~0	strand	N/A	~~0,~~ 0, 0, 0, 1, 2	N/A	[0.~~2~~6]
Minimum total annual mortality						~~28.53~~33.77 (CV = 0.~~50~~45)

[1] Data from the 1999 Cook Inlet observer program are preliminary.

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 200~~5~~6 to 201~~0~~0~~9~~, there were ~~three~~five confirmed fishery-related Steller sea lion strandings in the range of the western stock. ~~One~~Two sightings involved a Steller sea lion that was reported to be in bad body condition and observed with a flasher lure hanging from its mouth; it was believed to have the hooks inside the mouth (Table 2). The other ~~two~~four events involved one animal found on a Bering Sea/ Aleutian Islands pollock trawl vessel while offloading the catch, which is accounted for in the estimated mortality for this fishery, ~~and~~ one animal entangled in unidentified gear on the Pribilof Islands, an animal observed with a band around its neck, and another with a string leader line hanging out its mouth with a hook apparently inside the mouth. Fishery-related strandings during 200~~5~~6-201~~0~~0~~9~~ result in an estimated annual mortality of ~~0.4~~1.0 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 ~~28.5~~33.8 sea lions per year, based on observer data (~~28.1~~32.8) and stranding data (~~0.4~~1.0) where observer data were not available. Observer data on state fisheries dates as far back as 1990; however, these are the best data available to estimate takes in these fisheries. 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 conducted 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. 2005). The interviews were conducted once per year in the winter (January to March), and covered hunter activities for the previous calendar year. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating an annual mortality estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5-year period available. 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. 2010). Information on subsistence harvest levels is provided in Table 3a; data from ECO (e.g., Zavadil et al. 2010) 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. 2005).

The mean annual subsistence take from this stock over the 5-year period from 2004 through 2008, combined with the mean take over the 2005-2009 period from St. Paul, was 198 Steller sea lions/year (Table 3a).

Table 3a. Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating an annual mortality estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5-year period available (2005-2009).

	All areas except St. Paul Island			**St. Paul Island**	
Year	**Number harvested**	**Number struck and lost**	**Total**	**Number harvested + struck and lost**	**Total take**
2004	136.8	49.1	185.9[1]		
2005	153.2	27.6	180.8[2]	22[6]	203
2006	114.3	33.1	147.4[3]	26[7]	173
2007	165.7	45.2	210.9[4]	34[8]	245
2008	114.7	21.6	136.3[5]	22[9]	158
2009	N/A	N/A	N/A	26[10]	N/A
Mean annual take	136.9	35.3	172.3	26	198

[1]Wolfe et al. 2005; [2]Wolfe et al. 2006; [3]Wolfe et al. 2008; [4]Wolfe et al. 2009a; [5]Wolfe et al. 2009b; [6]Lestenkof and Zavadil 2006; [7]Lestenkof et al. 2007; [8]Lestenkof et al. 2008, [9]Jones 2009, [10]Zavidil 2010.

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).

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 200~~3~~6-2010~~7~~, there was a total of ~~3~~0 mortalities resulting from research on the western stock of Steller sea lions~~, which results in an average of 0.6 mortalities per year from this stock~~ (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

The current annual level of incidental U. S. commercial fishery-related mortality (~~28.5~~33.8) exceeds 10% of the PBR (~~25~~28) 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 (~~28.5~~33.8 + 198 ~~+ 0.6~~ = ~~227.1~~231.8) is below the PBR level (~~253~~275) 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 has declined for unknown reasons that are not explained by the level of direct human-caused mortality, there is no reason to believe that limiting those mortalities to the level of the PBR ~~will reverse the decline, if in fact the population is still declining~~significantly improve the likelihood of recovery..

~~The slight increase in the population estimate and PBR level should be interpreted and applied with caution. The increase in number of nonpups in the summer 2008 aerial survey may be attributable to an increase in numbers of eastern Steller sea lions hauled out in the eastern Gulf of Alaska at the time the aerial survey was conducted. A concurrent decrease in numbers in the eastern Steller sea lion stock counts occurred and NMFS is currently investigating the possibility that the increase in counts in the eastern Gulf of Alaska was due to seasonal movements of eastern Steller sea lion stock animals rather than recruitment into the stock.~~

Habitat Concerns

The decline in the western U. S. stock of Steller sea lion caused a change in the listing status of the stock in 1997 from "threatened" to "endangered" under the U. S. Endangered Species Act of 1973. Survey data collected since 2000 ~~suggest~~indicate that the decline ~~has slowed or stopped in some portions of the range of the western U. S. stock, but continues in others~~continues in the central and western Aleutian Islands but that regional populations east of Samalga Pass have increased or are stable. Many factors have been suggested as causes of the steep decline observed in the 1980s, (e.g., competitive effects of fishing, environmental change, disease, killer whale predation, incidental take, illegal and legal shooting). Decreases in rates of survival, particularly for juveniles, were associated with the steep 1980s declines (Holmes et al. 2007). Factors causing direct mortality were likely the most important. The slowing of the decline in the 1990s, and the periods of increase and stability observed between 2000 and 2008 were associated with increases in survival of both adults and juveniles, but also with continuation of a chronic decline in reproductive rate that may have been initiated in the early 1980s (Pitcher et al. 1998, Holmes et al. 2007). Nutritional stress related to competition with commercial fisheries or environmental change, along with predation by killer whales, have been identified as potentially important threats to recovery (NMFS 2008). Additional potential threats to Steller sea lion recovery are shown in Table 3b.

Table 3b. Potential threats and impacts to Steller sea lion recovery and associated references. Threats and impact to recovery as described by the Draft Steller Sea Lion Recovery Plan (NMFS 2008). Reference examples identify research related to corresponding threats and may or may not support the underlying hypotheses.

Threat	**Impact on Recovery**	**Reference Examples**
Environmental variability	Potentially high	Fritz and Hinckley 2005, Trites and Donnelly 2003
Competition with fisheries	Potentially high	Dillingham et al. 2006, Fritz and Brown 2005, Hennen 2004, Fritz and Ferrero 1998
Predation by killer whales	Potentially high	DeMaster et al. 2006, Trites et al. 2007, Williams et al. 2004, Springer et al. 2003
Toxic substances	Medium	Albers and Loughlin 2003, Lee et al. 1996, Calkins et al. 1994
Incidental take by fisheries	Low	Perez 2006, Nikulin and Burkanov 2000, Wynne et al. 1992
Subsistence harvest	Low	Wolfe et al. 2005, Loughlin and York 2000, Haynes and Mishler 1991
Illegal shooting	Low	NMFS 2001, Loughlin and York 2000
Entanglement in marine debris	Low	Calkins 1985
Disease and parasitism	Low	Burek et al. 2005
Disturbance from vessel traffic and tourism	Low	Kucey and Trites 2006
Disturbance or mortality due to research activities	Low	Atkinson et al. 2008, Kucey and Trites 2006, Kucey 2005, Loughlin and York 2000, Calkins and Pitcher 1982

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. In 2000, NMFS issued a Biological Opinion (BO) on effects of the groundfish fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska regions on listed species. 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 was 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 the 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 four seasonal and area catch limits, and 5) establishment of a procedure ("fishing in proportion to biomass") for setting seasonal catch limits on removal levels in critical habitat based on the biomass of the target species residing in critical habitat.

In 2001, NMFS developed a programmatic 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 Atka mackerel, pollock, and Pacific cod fisheries and Steller sea lions, particularly in waters within 10 nmi of haulouts and rookeries. The suite of conservation measures, which were 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 (Council) to further minimize overcapitalization of fisheries and concentration of fisheries in time and space. The 2002 suite of conservation measures also removed the broad prohibition of fishing with trawl gear within 10 (or 20) nmi of rookeries in the western stock in U.S. waters, and did not apply the "fishing in proportion to biomass" procedure for regulating seasonal catch for the three Steller sea lion prey species in the same manner as was initially applied in the 2000 BO. All Steller sea lion-fishery management measures were reviewed in a ~~draft~~ programmatic, status quo ESA Biological Opinion on the effects of groundfish fisheries on listed species released ~~for public review in August 2010~~in December 2010 (NMFS 2010). NMFS concluded that the groundfish fisheries in the Bering Sea/Aleutian Islands area and in the Gulf of Alaska, as currently managed (as of 2010) were likely to jeopardize the continued existence (recovery) and adversely modify the critical habitat of the western stock of Steller sea lion. NMFS ~~has proposed the following new~~implemented interim final measures (reasonable and prudent alternatives to the status quo suite of fishery management regulations) that mitigate jeopardy and adverse modification: closure of the western Aleutian Islands region (170°-177°E) region to directed fishing for Atka mackerel and Pacific cod, and additional measures in the central Aleutian Islands (170°W-177°E) to reduce catches of Atka mackerel and Pacific cod in critical habitat and disperse the fisheries temporally and spatially.

NMFS reconstituted the Steller Sea Lion Recovery Team in 2002 to write a revised recovery plan for the eastern and western U.S. stocks. The Team's draft plan was reviewed by five independent reviewers in February 2006, prior to its delivery to NMFS, who then released the Plan for public review in May 2006. NMFS addressed the peer and public review comments and released the second draft Plan for another round of public and independent peer (one by the Council of Independent Experts and another commissioned by the Council) review in May 2007. NMFS released the final recovery plan in March 2008 (NMFS 2008). The de-listing criteria approved by NMFS for the western stock of Steller sea lion are:

1. The population for the U.S. region of this [stock] has increased (statistically significant) for 30 years (at an average annual growth rate of 3%), based on counts of non-pups (i.e., juveniles and adults). Based on an estimated population size of about 42,500 animals in 2000, this would represent approximately 103,000 animals in 2030.
2. The trends in non-pups in at least 5 of the 7 sub-regions are stable or increasing, consistent with the trend observed under criterion #1. The population trend in any two adjacent sub-regions can not be declining significantly. The population trend in any subregion cannot have declined by more than 50%. The 7 sub-regions are:
    a. Eastern Gulf of Alaska (US)
    b. Central Gulf of Alaska (US)
    c. Western Gulf of Alaska (US)
    d. Eastern Aleutian Islands (including the eastern Bering Sea) (US)
    e. Central Aleutian Islands (US)
    f. Western Aleutian Islands (US)
    g. Russia/Asia
3. The ESA listing factor criteria are met.

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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 (Fig. 3). 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 (Sease and York 2003). 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) is low, although males have a higher tendency to disperse than females (NMFS 1995, Trujillo et al. 2004, Hoffman et al. 2006). A northward shift in the overall breeding distribution has occurred, with a contraction of the range in southern California and new rookeries established in southeastern Alaska (Pitcher et al. 2007).

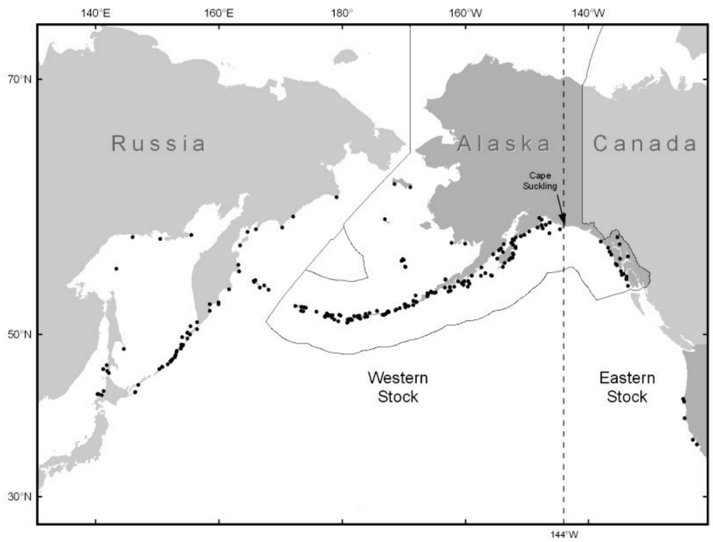

Figure 3. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (Burkanov and Loughlin, 2005) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997). 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 since the two stocks were first delineated in 1997. Since then, analyses of genetic data differ in their interpretation of separation between Asian and Alaskan sea lions. In Asian waters, Steller sea lions seasonally inhabit coastal waters of Japan in the winter, but breeding rookeries are currently only located in Russia (Burkanov and Loughlin 2005). Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split between the Commander Islands (Russia) and Kamchatka that would include Commander Island sea lions within the western U.S. stock and sea lions west of there in an Asian 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. All genetic analyses confirm a strong separation between western and eastern stocks and there may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009) despite the observation that western stock haplotypes are present at two northern southeast Alaska rookeries (Gelatt et al. 2007).

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) and Pitcher et al. (2007) concluded that the total Steller sea lion population could be estimated by multiplying pup counts by a factor based on the birth rate, sex and age structure, and growth rate of the population. The most recent pup counts available by region were 7,462 in 2009 for southeast Alaska (DeMaster 2009), 4,118 in 2006 for British Columbia (Olesiuk 2008), 1,418 in 2009 for Oregon (NMFS, unpublished data), and 891 in 2009 for California (NMFS unpublished data). Using pup multipliers of either 4.2 or 5.2 (Pitcher et al. 2007), the population is estimated to be within the range of 58,334 (13,889 × 4.2) and 72,223 (13,889 × 5.2). These are not minimum population estimates, since they are extrapolated from pup counts from photographs taken in 2006-2009, and demographic parameters estimated for an increasing (at 3.1% per year) population. The extrapolation factor varied depending on the vital rate parameter that resulted in the growth rate: as low as 4.2 if it were due to high fecundity, and as high as 5.2 if it were due to low juvenile mortality.

Minimum Population Estimate

The minimum population estimate was calculated by adding the most recent non-pup and pup counts from all sites surveyed (Table 3c).

Table 3c. Non-pup and pup counts from rookery and haulout sites of eastern U.S. Steller sea lions. The most recent counts for each site were used to calculate the minimum population estimate.

Trend site	Year	Non-pups	Pups	Total count per site
Southeast Alaska	2009	16,985	7,462	24,447
British Columbia	2006	15,700	4,118	19,818
Washington	2001	516	--	516
Oregon Non-Pups	2002	4,169	--	4,169
Oregon Pups	2009		1,418	1,418
California	2009	1,588	891	2,479
Minimum population estimate				52,847

This results in an N_{MIN} for the eastern U. S. stock of Steller sea lions of 52,847 based on counts as old as 2001 for sea lions hauled out in WA (Pitcher et al. 2007) to as recent as 2009 for sites in SE Alaska and California, and all rookeries in Oregon. This count is considered a minimum estimate of population size because it has not been corrected for animals that were at sea and it does not include the extrapolation from pup counts.

Current Population Trend

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 4,169 in 2002 (NMFS 2008).

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 4,000 and 6,000 non-pups with no apparent trend, but have subsequently declined by over 50%, and were between 1,500 and 2,000 non-pups during 1980-2004. At Año Nuevo Island off central California, a steady decline in ground counts started around 1970, and there was an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable or increasing slowly since the 1980s (Table 4, Fig. 4).

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 1982 through 2009 (NMFS 1995; Strick et al. 1997; Sease et al. 1999; Sease and Loughlin 1999; Sease et al. 2001; Olesiuk 2003; 2008; Brown et al. 2002; NMFS 2008; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970; NMFS unpublished data (M. Lowry, SWFSC); DeMaster 2009). 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	2006	2009
Central CA	511[1]	655	537	276	508	382	564[3]	349	380		308
Northern CA/OR	3,094	3,088	3,180	4,274	3,831	4,192	4,464	3,793	4,885		

Area	1982	1990	1991	1992	1994	1996	1998	2000	2002	2006	2009
British Columbia	4,713	6,109[2]	--	7,376	8,091	--	9,818	--	12,121	15,700	
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,892	9,951		11,965
Total	15,216	17,481	--	19,48	21,43	--	23,53	--	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.

In Southeast Alaska, counts of non-pups at trend sites increased by 56% from 1979 to 2002 from 6,376 to 9,951 (Merrick et al. 1992; Sease et al. 2001; NMFS 2008). NMFS conducted an aerial survey of Southeast Alaska in early June 2008 and counted only 8,748 non-pups on trend sites (Fritz et al. 2008). It is thought that the lower than expected count in Southeast Alaska may have been due to movement of animals early in the survey period (early June to early July) north to the Prince William Sound region (since counts of non-pups there were over 1,300 greater in 2008 than 2007) or south to British Columbia. This hypothesis was supported by counts from a late June 2009 non-pup survey in SE Alaska, in which 11,965 non-pups were observed on trend sites, over 3,200 more than were counted in early June 2008. Between 1979 and 2009, counts of pups on the three largest rookeries in Southeast Alaska (Forrester Island complex, Hazy Island and White Sisters) more than tripled (from 2,219 to 6,859). In British Columbia, counts of non-pups throughout the province increased at a rate of 3.9% annually from 1971 through 2006 (Olesiuk and Trites 2003, Olesiuk 2008). Counts of non-pups at trend sites throughout the range of the eastern Steller sea lion stock are shown in Figure 4. Between the 1970s and 2002, the average annual population growth rate of eastern Steller sea lions was 3.1% (Pitcher et al. 2007).

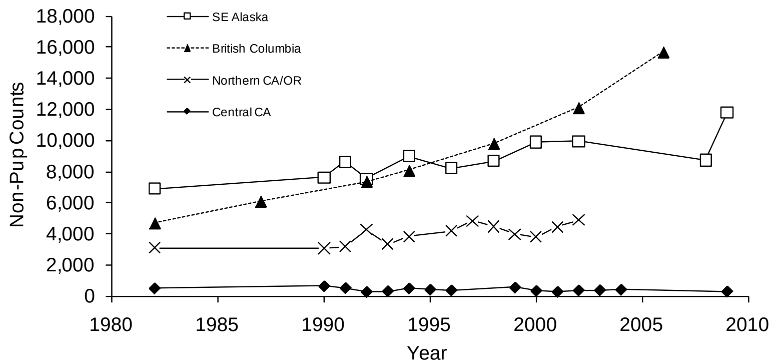

Figure 4. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U.S. stock, 1982-2009. Data from British Columbia include all sites.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rates for Steller sea lions. Pitcher et al. (2007) observed a rate of population increase of 3.1% per year for the eastern stock, but concluded this rate did not represent a maximum rate of increase. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be used 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 = 2,378 animals (52,847 × 0.06 × 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 2005 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. 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 2000~~1~~-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. Between 2005-2009, several Steller sea lion mortalities occurred in WA/OR/CA groundfish fisheries, including the limited trawl sector, California halibut trawl, and the at-sea hake sector, with a mean annual mortality in these fisheries of 5.71 (Jannot et al. 2011). There have been no observer reported mortalities in the Gulf of Alaska sablefish longline since 2000 (Perez unpubl. ms.). During the ~~3~~4-year period from 2007-2010~~9~~, a total of ~~20~~45 Steller sea lions mortalities occurred in fisheries operating south of latitude 49 (2007 = 14 mortalities, 2008 = 6 mortalities, 2009 = 0 mortalities, 2010 = 25 mortalities), with an average annual take of ~~6.67~~11.25 animals. These takes were reported as animals killed by gear; however, they could not be assigned to a particular fishery. ~~These mortalities result in a~~The total mean annual mortality rate from all fisheries is~~of~~ ~~7.47~~17.0 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 2005~~7~~ to 2009 ~~(or most recent data available)~~ and calculation of the mean annual mortality rate. 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. Data for observer coverage, observed mortality and estimated mortality not in parentheses are values from non-breeding season (Aug-Apr), those in parentheses are from breeding season (May-Jul). 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
~~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~~ ~~1~~ ~~0~~	~~0.8~~ ~~(CV = 0.02)~~
WA/OR/CA groundfish (limited entry trawl sector)	2005 2006 2007 2008 2009	Obs data	22 (5) 21 (5) 18 (4) 20 (5) 26 (5)	0 (0) 0 (0) 0 (0) 0 (0) 3 (1)	0 (0) 0 (0) 0 (0) 0 (0) 11.56 (--)	2.51 (CV = 0.47)
WA/OR/CA California halibut trawl	2005 2006 2007 2008 2009	Obs data	10 13 12 37 N/A	0 0 1 1 N/A	0 0 -- 2.68 N/A	0.74 (CV = 0.63)

Fishery name	**Years**	**Data type**	**Observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
WA/OR/CA groundfish (at-sea hake sector)	2005 2006 2007 2008 2009	Obs data	100 98 99 99 100	0 (2) 0 (3) 0 (3) 1 (0) 0 (0)	0 (2.99) 0 (3.78) 0 (4.22) 1.3 (0) 0 (0)	2.46 (CV = 0.17)
Observer program total						~~0.8~~5.71 (CV = ~~0.02~~0.23)

[1] A ~~mortality was seen by an observer, but during an unmonitored haul; because the haul was not monitored, an estimated annual mortality cannot be extrapolated.~~ "—" indicates bycatch estimate not provided due to the high coefficient of variation for that estimate.

Strandings of Steller sea lions provide additional information on 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 2005-2009, there were eleven serious injuries and mortalities of Steller sea lions (6 in 2007, 2 in 2008, and 3 in 2009) due to ingestion of J-hooks attached to a "flasher" (an attractor used in salmon trolling) in which the hook was lodged in the esophagus and penetrating adjacent tissue (NMFS Alaska Region stranding database, unpublished data).~~ A total of 121 observations of Steller sea lions with flashers hanging from their mouth were reported in Southeast Alaska and northern British Columbia between 2003 and 2007 (Raum-Suryan et al. 2009; pers. comm., Lauri Jemison, Steller Sea Lion Program, Alaska Department of Fish and Game, 1255 West 8th Street, P.O. Box 115526, Juneau, AK 99811) indicating an average rate of hook ingestion of 24.2 per year. It is not clear whether entanglements with hooks and flashers involved the recreational or commercial component of the salmon troll fishery. Based on Angliss and DeMaster (1998), it is appropriate to consider these fishery interactions "serious injuries". ~~Mortality records from the Alaska stranding database indicate a rate of incidental mortality of at least 0.6/year from the troll fishery.~~ Entanglements were also reported in the stranding database, with a total of ~~9~~20 cases (1 in 2007, 7 in 2008, and 1 in 2009, 11 in 2010) of serious injury and mortality attributed to entanglement, averaging ~~1.8~~4.0 annually between 200~~5~~6-20~~0~~1~~9~~0. There were ~~no~~3 fishery-related strandings of Steller sea lions in Washington, Oregon, or California between 200~~5~~6 and 20~~0~~1~~9~~0, all occurring in 2010, resulting in a mean annual mortality of 0.6.

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 and recreational fisheries (both U.S. and Canadian) is ~~33.5~~45.8 sea lions per year, based on fisheries observer data (~~7.47~~17.0), opportunistic observations (24.2), and stranding data (~~1.8~~4.6).

Subsistence/Native Harvest Information

The subsistence harvest of Steller sea lions during 2004-2008 is summarized in Wolfe et al. (2009b). 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. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating an annual mortality estimate. The average number of animals harvested and struck but lost is 12 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 management of the stock.

Table 6. Summary of the subsistence harvest data for the eastern stock of Steller sea lions, 2004-2008.

Year	**Estimated total number taken**	**Number harvested**	**Number struck and lost**
2004	12[1]	5	7
2005	19[2]	0	19

Year	Estimated total number taken	Number harvested	Number struck and lost
2006	12.6[3]	2.5	10.1
2007	6.1[4]	0	6.1
2008	9.7[5]	1.7	8.0
Mean annual take (2004-2008)	11.9	1.8	10.0

[1] Wolfe et al. 2005; [2] Wolfe et al. 2006; [3] Wolfe et al. 2008; [4] Wolfe et al. 2009a; [5]Wolfe et al. 2009b.

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). ~~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 45.8 Steller sea lions from this stock over the period from 1999 to 2003 (Olesiuk 2004). Starting in 2004, aquaculture facilities were 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 200~~5~~6 to 2010~~9~~, there were 2 reported strandings of animals from this stock with gunshot wounds ~~occurred~~ in Oregon and Washington, 1 in 2006 and 1 in 2010, ~~(three in 2005)~~ resulting in an estimated annual mortality of 0.~~6~~4 Steller sea lions. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). ~~Two~~Four mortalities from gunshots were reported in Alaska (1 in 2007~~ and~~, 1 in 2009, and 2 in 2010); however, Steller sea lions reported in the Alaska 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. In addition, human-related stranding data are not available for British Columbia. Two Steller sea lion mortalities attributed to vessel collisions were reported to the Alaska stranding network.

~~The total human-related serious injury and mortality of eastern Steller sea lions for the 20056-20109 period based on stranding data is 25 (11 ingested hooks, 9 entanglements, 3 gunshots, and 2 vessel collisions)3 reported in Oregon and Washington region and 11 in Alaska, giving an average annual serious injury and mortality of 5.0.~~

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 200~~3~~6 and 2010~~7~~, there ~~were a total of 9~~was 1 incidental mortality~~ies~~ resulting from research on the eastern stock of Steller sea lions, which results in an annual average of ~~1.8~~0.2 mortalities per year from this stock (Tammy Adams, pers. comm., Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910). Two Steller sea lions died in 2008 in traps at Bonneville Dam, part of the lethal take program targeting California sea lions, averaging 0.4 mortalities per year.

The total non-fishery human-related serious injury and mortality of eastern Steller sea lions for the 200~~5~~6-2010~~9~~ period based on stranding ~~data~~ and other reports is 2~~5~~7 ~~(11 ingested hooks, 9 entanglements, 3 gunshots, and 2 vessel collisions)3 reported in Oregon and Washington region and 11 in Alaska~~ (2 gunshots, 2 vessel collisions, 2 incidentally taken in traps, 1 research mortality), giving an average annual serious injury and mortality of ~~5.0~~1.4.

STATUS OF STOCK

Based on currently available data, the minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock (~~7.47~~17.0) 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 (~~33.5 + 12 + 0.6 + 0.4 + 1.80.2 = 48.3~~45.8 (commercial and recreational fisheries) + 11.9 (subsistence) + 1.4 (other human-caused mortality) = 59.1) does not exceed the PBR (1998) 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. The eastern stock of Steller sea lion is being considered a potential candidate for removal from listing under the ESA by NMFS (NMFS 2008), based in part on its having been increasingsince the mid-1970s. On June 29, 2010, NMFS initiated a review of the eastern Distinct Population Segment population status to reassess the listing classification under the ESA (75 FR 37385). On August 30, 2010, NMFS received a petition to delist the eastern DPS from the States of Washington and Oregon, and on September 1, 2010, the Secretary of Commerce received a petition to delist this DPS from the State of Alaska. NMFS Alaska Region Protected Resources Division is preparing (as of 1 November 2011) a status review to address the petitions to delist the eastern DPS. Although the stock size has increased, the status of this stock relative to its Optimum Sustainable Population size is unknown. The overall annual rate of increase of 3.1% throughout most of the range (Oregon to southeastern Alaska) of the eastern U. S. stock has been consistent and long-term, and may indicate that this stock is reaching OSP size (Pitcher et al. 2007).

Habitat Concerns

Unlike the observed decline in the western U. S. stock of Steller sea lion, there has not been an overall decline in the eastern U. S. stock. The eastern U. S. stock is increasing throughout the northern portion of its range (Southeast Alaska and British Columbia), and is stable or increasing slowly in the central (Oregon through central California). In the southern end of its range (Channel Islands in southern California), it has declined considerably since the late 1930s, and several rookeries and haulouts south of Año Nuevo Island have been abandoned. Changes in the ocean environment, particularly warmer temperatures, may be factors that have favored California sea lions over Steller sea lions in the southern portion of the Steller's range (NMFS 2008). A revised 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 March 2008 (NMFS 2008).

CITATIONS

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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). Non-breeding northern fur seals may occasionally haul out on land at other sites in Alaska, British Columbia, and on islets along the west coast of the United States (Fiscus 1983).

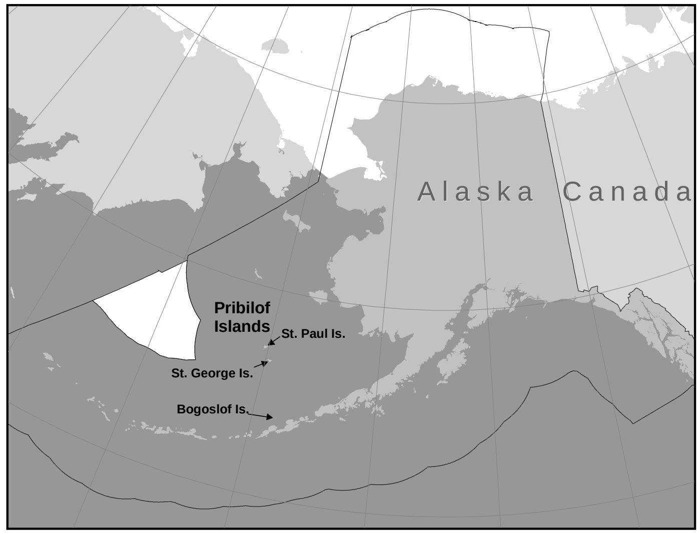

Figure 5. Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

During the reproductive season, adult males usually are 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 ashore during a 6-month period (June-November). Following their respective times ashore, seals of both genders then move south and remain at sea until the next breeding season (Roppel 1984). Adult females and pups from the Pribilof Islands move through the Aleutian Islands into the North Pacific Ocean, often to the waters offshore of Oregon and California. Adult males generally move 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). In Alaska, pups are born during summer months, leave the rookeries in the fall, and generally remain at sea for 22 months before returning to their rookery of birth. There is considerable interchange of individuals between rookeries.

Two separate stocks of northern fur seals are recognized within U. S. waters based on the Dizon et al. (1992) phylogeographic approach: 1) distribution: continuous during non-breeding season and discontinuous during the breeding season, high natal site fidelity (Baker et al. 1995; DeLong 1982); 2) population response: substantial differences in population dynamics between Pribilof Islands and San Miguel Island (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); 3) phenotypic differentiation: unknown and 4) genotypic differentiation: little evidence of genetic differentiation among breeding islands (Dickerson et al. 2010, Ream 2002). Thus, an Eastern Pacific stock and a San Miguel Island stock are recognized. 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 ~~counted~~born at rookeries in the eastern Bering Sea 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 4 or more years old (Lander 1981). The resulting population estimate is equal to the pup production estimate 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 St. Paul and St. George Islands, pup estimates are conducted biennially on these islands. Counts are made less frequently on Sea Lion Rock (adjacent to St. Paul Island) 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 2008 on Sea Lion Rock, from 2010 on St. Paul and St. George Islands, and from 2007 on Bogoslof Island, is ~~653,171~~611,617 (4.5 × ~~145,149~~135,915).

Table 7. Estimates and/or counts of northern fur seal pups born on the Pribilof Islands and Bogoslof Island. Standard errors for pup estimates/ counts at rookery locations and the CV for total pup production estimates are provided in parentheses. The “ symbol indicates that no new data are available for that year, and thus the most recent estimate/ count was used in determining total annual estimates.

	Rookery location				
Year	**St. Paul**	**Sea Lion Rock**	**St. George**	**Bogoslof**	**Total**
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)	8,262(191)	17,593 (527)	“	176,667 (0.01)
2004	122,825 (1,290)	“	16,876 (239)	“	153,059(0.01)
2005	“	“	“	12,631 (335)	160,594 (0.01)
2006	109, 961 (1,520)	“	17,072 (144)	“	147,900 (0.011)
2007	“	“	“	17,574 (843)	152,867 (0.011)
2008	102,674 (1,084)	6,741 (80)	18,160 (288)	“	145,149 (0.009)
2010	93,627 (1,034)	“	17,973 (323)	“	135,915 (0.010)

* 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 ~~653,171~~611,617 and the default CV (0.2), N_{MIN} for the Eastern Pacific stock of northern fur seals is ~~642,265~~517,679.

Current Population Trend

Estimates of the size of the Alaska population of northern fur seals increased to approximately 1.25 million in 1974 after the termination of commercial sealing on St. George in 1972 and pelagic sealing for science in 1974; commercial sealing on St. Paul continued until 1984. 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 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 1998-20~~06~~10, pup production declined ~~6.1~~5.46% per year (SE = 0.~~45~~32%; P < 0.01) on St. Paul Island and ~~3.4~~2.09% per year (SE = 0.~~60~~69%; P = 0.~~01~~03) on St. George Island. The estimated pup production in 20~~06~~10 was below the ~~1918 level on St. Paul Island and below the~~ 1916 level on both St. Paul and St. George Islands (~~Towell et al. 2006;~~ NMFS unpubl. data). The population of northern fur seals at Bogoslof Island has grown at an exponential rate exponential rate since the 1990s. (R. Ream, pers. comm., National Marine Mammal

Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115, 5 February 2009). The increase in counts from 2005 to 2007 at Bogoslof Island result in a slight increase in overall pup counts from 2006 to 2007; however, this slight increase in total counts was similar to the slight increase in total counts from 2004 to 2005 when new counts from Bogoslof were added to counts from the previous years in other areas to obtain the overall estimate. Incorporation of the 20~~08~~10 counts from the Pribilofs suggests that the decline has not stopped, and show that the overall abundance estimate is strongly influenced by the continued rapid decline in pups at St. Paul Island.

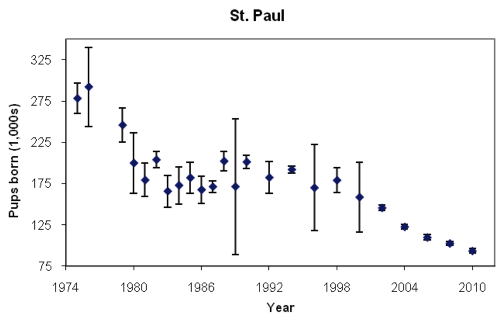

Figure 6. Estimated number of northern fur seal pups born on St. Paul Island, 1970-20~~08~~10 ~~(modified from Towell et al. 2006)~~.

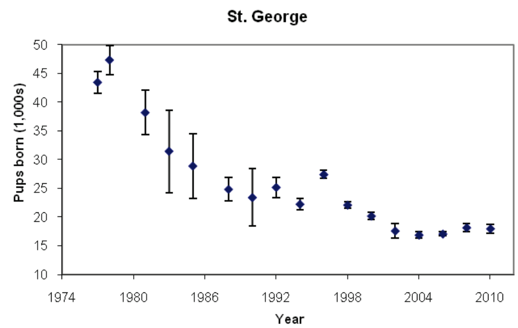

Figure 7. Estimated number of northern fur seal pups born on St. George Island, 1970-20~~08~~10 ~~(modified from Towell et al. 2006)~~.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Pelagic sealing led to a decrease in the fur seal population; however, ~~with~~ a moratorium on fur seal harvesting and termination of pelagic sealing~~,~~ resulted in a steady increase in the northern fur seal population ~~increased steadily~~ during 1912-1924. 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 (retired), 7600 Sand Point Way NE, Seattle, WA 98115), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.1% 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 = ~~13,809~~11,130 animals (~~642,265~~517,679 × 0.043 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Historically, northern fur seals were known to be killed incidentally by both the foreign and the joint U. S.-foreign commercial groundfish trawl fisheries (total estimate of 246 northern fur seals killed between 1978 and 1988), as well as the foreign high seas driftnet fisheries (total take estimate in 1991 was 5,200; 95% CI: 4,500-6,000) (Perez and Loughlin 1991, Larntz and Garrott 1993). These estimates are not included in the mortality rate calculation in this SAR 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, pers. comm., National Marine Mammal Laboratory (retired), 7600 Sand Point Way NE, Seattle, WA 98115).

In 2003, changes in fishery definitions in the List of Fisheries resulted in separating 6 federally-regulated fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change did not represent a change in fishing effort, but provided 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. The total estimated annual fishery-related incidental mortality in these fisheries from 2007-2010~~9~~ is ~~3.01~~2.95 (CV = 0.~~24~~19) (Table 8).

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 were on board 300 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 were on board 531 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 were on board 59 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). More recently, observer programs have been conducted in the Cook Inlet salmon set and drift gillnet fisheries (Manly 2006) and in a portion of the Kodiak set gillnet fishery (Manly 2007). Observer coverage in the Cook Inlet drift gillnet fishery was 1.8% and 3.7% 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 2006). Observer coverage in the Kodiak set gillnet fishery was 6.0% (2002) and 4.9% (2005) of the fishing permit days. No serious injuries or mortalities of northern fur seals were observed during the course of any observer program.

Table 8. Summary of incidental mortality of northern fur seals from the eastern Pacific stock due to commercial fisheries from 2007 through 2010~~9~~ and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured are 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	2007 2008 2009 2010	obs data	72 100 100 100	0 2 1 1	0 2.0~~5~~ 1.0 1.0	~~1.02~~1.01 (CV = 0.~~01~~13)
Bering Sea/Aleutian Islands pollock trawl	2007 2008 2009 2010	obs data	85 85 86 86	3 1 0 2	~~3.94~~4.0 1.0~~3~~ 0 2.6	~~1.66~~1.89 (CV = 0.~~36~~25)
Bering Sea/Aleutian Islands Pacific cod longline	2007 2008 2009 2010	obs data	63 63 61 64	0 0 0 1	0 0 0 1.3	0.31 (CV = 0.67)
Minimum total annual mortality						~~2.68~~3.21 (CV = 0.~~24~~17)

The estimated minimum annual mortality rate incidental to commercial fisheries is ~~2.7~~3.2 fur seals per year based on observer data. There are several fisheries that 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.

Entanglement studies on the Pribilof Islands are another source of information on fishery-specific interactions with fur seals. 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. Zavadil et al. (2007) determined the juvenile male entanglement rate for 2005-2006 to be between 0.15-0.35%. The mean entanglement rate in this 2-year period for pups on St. George Island was 0.06-0.08%, with a potential maximum rate of up to 0.11% in October prior to weaning. Female entanglement rate on St. George Island increased during the course of the 2005-2006 breeding seasons, reaching a rate of 0.13% in October; this rate increase coincided with the arrival of progressively younger females on the rookery throughout the season (Zavadil et al. 2007).

Stranding reports of northern fur seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. In September 2001 a northern fur seal stranding was reported near Unalaska as entangled in 8-inch poly trawl web. The animal was cut free and was apparently healthy upon release. The NMFS stranding database also includes reports of five fur seals on St. George that were entangled in fishing gear in 2003; there were no strandings reported in 2004 or 2005. Including these stranding data in an annual average mortality estimate 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 3-year take range ~~designed to meet~~based on historic local needs~~ as 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 that includes females. However, ~~occasional~~accidental harvesting of females and adult males does occur: in 2006, one adult male and four females were struck and killed (Lestenkof and Zavadil 2006). No adult males and three females were struck and killed during the harvest on St. Paul Island in 2007 (Lestenkof and Zavadil 2007). Of the 331 fur seals taken for subsistence on St. Paul in 2008, 328 were sub-adult males and 3 were females (Zavadil 2008). A total of 113 sub-adult males and one female were harvested on St. George in 2009 (Lekanof 2009). Only juvenile males were harvested in 2010; no females were reported as accidentally killed. Between 200~~5~~6 and 20109~~9~~, there was an annual average of ~~530~~496 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 for 20~~05~~06-20~~09~~10.

Year	St. Paul	St. George	Total harvested
~~2005~~	~~466[1]~~	~~139[1]~~	~~605~~
2006	396[~~2~~1]	212[~~3~~2]	608
2007	272[~~4~~3]	210[~~5~~4]	482
2008	331[~~6~~5]	170[~~7~~6]	501
2009	341[~~8~~7]	114[~~9~~8]	455
2010	357[9]	78[10]	435
Mean annual take (20~~05~~06-20~~09~~10)			~~530~~496

~~[1]Lestenkof et al. 2006, ~~[~~2~~1]Lestenkof and Zavadil 2006, [~~3~~2]Malavansky and Malavansky 2006,[3~~4~~]Lestenkof and Zavadil 2007; [~~5~~4]Malavansky 2007, [~~6~~5]Zavadil 2008, [~~7~~6]Lekanof 2008, [~~8~~7]Zavadil 2009, [~~9~~8]Lekanof 2009, [9]Zavadil et al. 2011, [10]Merculief 2010.

Other Mortality

Intentional killing of northern fur seals by commercial fishers, sport fishers, and others may occur, but the magnitude of that mortality is unknown. Such shooting has been illegal since the species was listed as "depleted" in 1988.

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) and 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 methods (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).

Two Northern fur seals with circumferential neck entanglements were reported to the stranding network in 2008. One mortality of a Northern fur seal entangled in a large mesh net was reported to the stranding network in 2009. This results in an estimate of annual mortality and serious injury of 0.6 for 200~~5~~6-2010~~9~~.

Mortalities may occasionally occur incidental to marine mammal research activities authorized under Marine Mammal Protection Act (MMPA) permits issued to a variety of government, academic, and other research organizations. Between 200~~3~~6-201~~0~~07, there was a total of 2 mortalities resulting from research on this stock of northern fur seals (1 in 2006, 1 in 2009), an average of ~~1.4~~0.4 mortalities per year (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910). The only fisheries research mortality of a Northern fur seal for the 2006-2010 period occurred in 2009 during a groundfish bottom trawl research survey, resulting in an average of 0.2 mortalities per year. The total combined mortalities of Northern fur seals from marine mammal (0.4) and fisheries (0.2) research activities is 0.6 per year for the 2006-2010 period.

STATUS OF STOCK

Based on currently available data, the minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock (~~2.7~~3.2) is less than 10% of the calculated PBR (~~1,381~~1,113) 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 (~~2.7~~3.2 + ~~530~~496 + ~~1.4~~0.6 + 0.6 = ~~534.7~~500.4) is not known to exceed the PBR (~~13,809~~11,130) for this stock. However, given that the population is declining for unknown reasons, and this decline is not explained by the relatively low level of direct human-caused mortality, there is no reason to believe that limiting mortalities to the level of the PBR will reverse the decline. The northern fur seal was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s (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. The Eastern Pacific stock of northern fur seal is classified as a strategic stock because it is designated as depleted 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).

Habitat Concerns

Northern fur seals forage on a variety of fish species, including pollock. Some historically relevant prey items, such as capelin, have disappeared entirely from fur seal diet and pollock consumption has increased (Sinclair et al. 1994, Sinclair et al. 1996, Antonelis et al. 1997). Analyses of scats collected from Pribilof Island rookeries during 1987-2000 found that pollock (46-75% by frequency of occurrence, FO) and gonatid squids dominated in the diet and that other primary prey (FO>5%) included Pacific sand lance, Pacific herring, northern smoothtongue, Atka mackerel, and Pacific salmon (Zeppelin and Ream 2006). These analyses also found that diets associated with rookery complexes reflected patterns associated with foraging in the specific hydrographic domains identified by Robson et al. (2004). Comparison of ingested prey sizes based on scat and spew analysis indicate a much larger overlap between sizes of pollock consumed by fur seals and those caught by the commercial trawl fishery than was previously known (Gudmundson et al. 2006).

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 and juvenile males from St. Paul and St. George Islands forage in specific and very different areas (Robson et al. 2004, Sterling and Ream 2004). From 1982 to 2002 relative rates of pollock harvest (catch divided by estimated biomass) by fisheries were approximately five times greater where they overlap with summer foraging areas used by females from St. George compared with those from St. Paul (Robson and Fritz in prep); this overlap may result in resource competition between fisheries and foraging fur seals. 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 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. Adult female fur seals spend approximately eight months in varied regions of the north Pacific Ocean during winter, and forage in areas associated with eddies and the subarctic-subtropical transition region (Ream et al. 2005). Thus, environmental changes in the north Pacific Ocean could potentially have an effect on abundance and productivity of fur seals breeding in Alaska.

There is concern that a variety of human activities other than commercial fishing may impact northern fur seals. A Conservation Plan for the eastern Pacific stock was released in December of 2007 (NMFS 2007). This Plan reviews known and potential threats to the recovery of fur seals in Alaska.

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HARBOR SEAL (*Phoca vitulina richardii*)

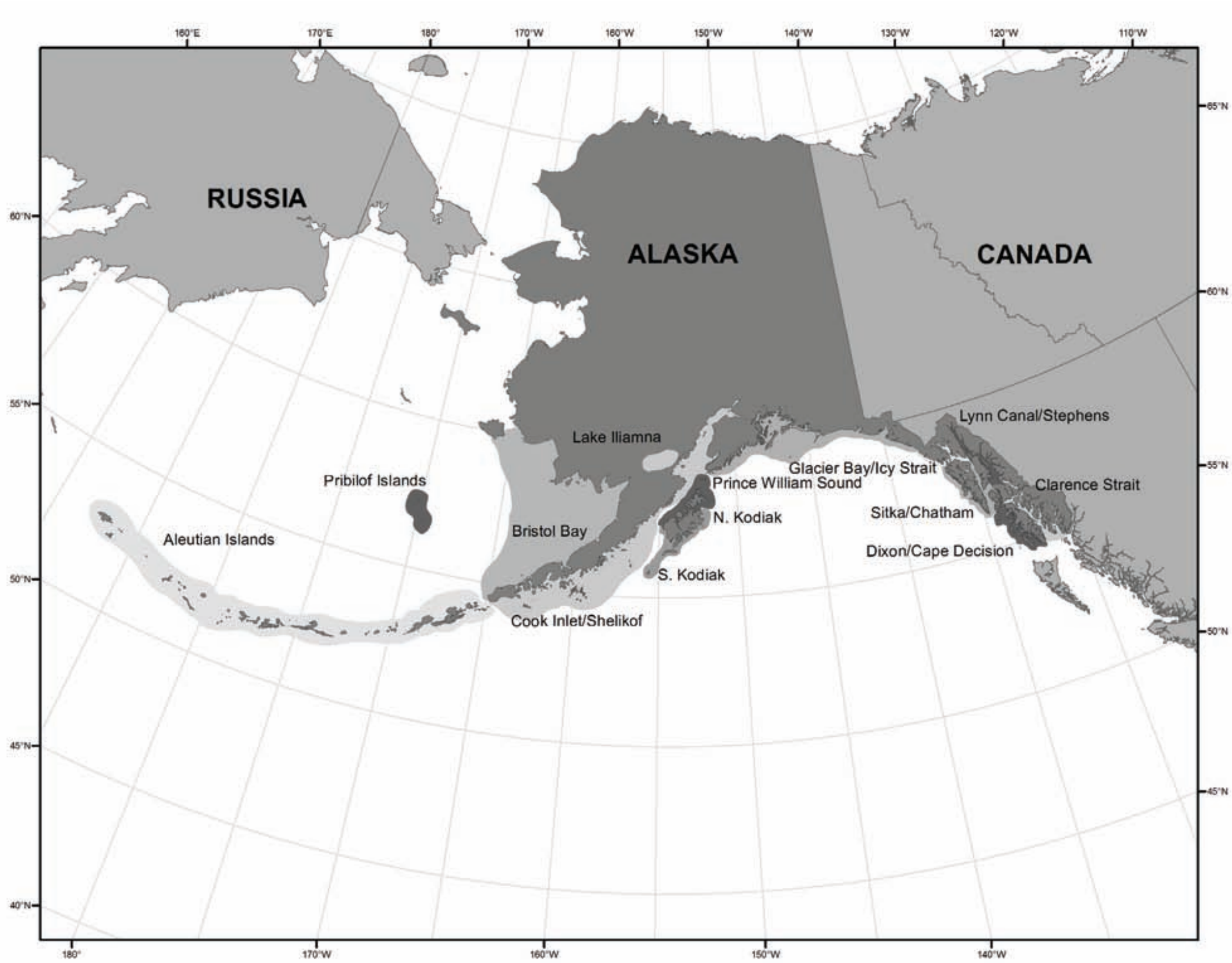


Figure 8. Approximate distribution of harbor seals in Alaska waters (shaded area).

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, Hastings et al. 2004). 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. 2003). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2003). Strong fidelity of individuals for haul-out sites during the breeding season has been documented in several populations (Härkönen and Harding 2001), including in Alaska (Pitcher and McAllister 1981, Small et al. 2005). Harbor seals have declined dramatically in some parts of their Alaska range over the past few decades while in other parts their numbers have increased or remained stable over similar time periods, suggesting areas with independent population dynamics (O'Corry-Crowe et al. 2003).

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 significant geographic areas within the Alaskan harbor seal range remain un-sampled (O'Corry-Crowe et al. 2003).

In 2010, the National Marine Fisheries Service and their co-management partners, the Alaska Native Harbor Seal Commission, decided on 12 separate stocks of harbor seals based largely on the genetic structure. Given the genetic samples were not obtained continuously throughout the range, a total evidence approach was used to consider additional factors such as population trends, observed harbor seal movements and traditional native use areas in the final designation of stock boundaries. This represents a significant increase in the number of harbor seal stocks from the three stocks (Bering Sea, Gulf of Alaska, Southeast Alaska) previously recognized. The twelve stocks of harbor seals identified in Alaska are 1) the Aleutian Islands stock, 2) the Pribilof Islands stock, 3) the Bristol Bay stock, 4) the North Kodiak stock, 5) the South Kodiak stock, 6) the Prince William Sound stock, 7) the Cook Inlet/Shelikof stock, 8) the Glacier Bay/Icy Strait stock, 9) the Lynn Canal/Stephens stock, 10) the Sitka/Chatham stock, 11) the Dixon/Cape Decision stock, and 12) the Clarence Strait stock (Fig. 8). Individual stock distributions can be seen in Fig. 9a-l.

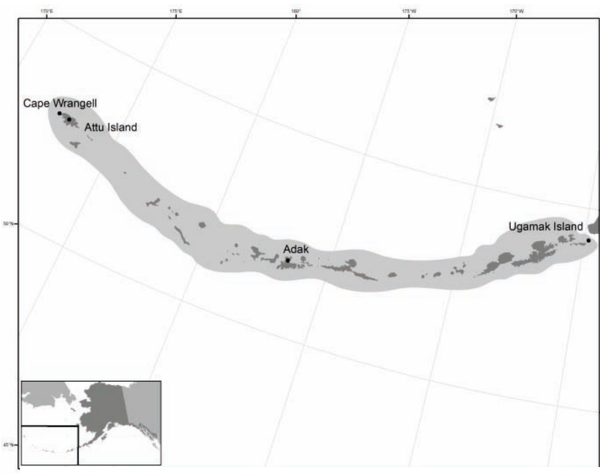


Figure 9a. Approximate distribution of Aleutian Islands harbor seal stock (shaded area).

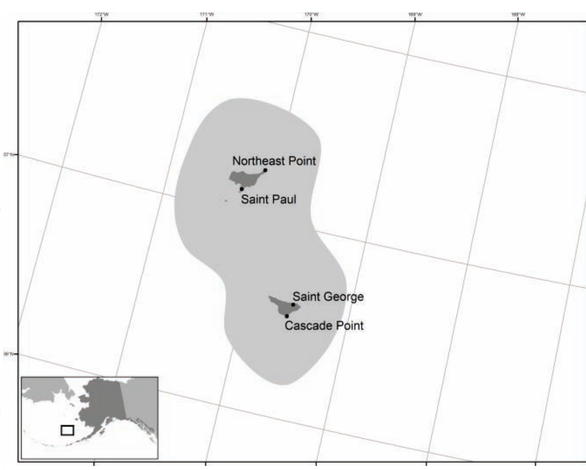


Figure 9b. Approximate distribution of Pribilof Islands harbor seal stock (shaded area).

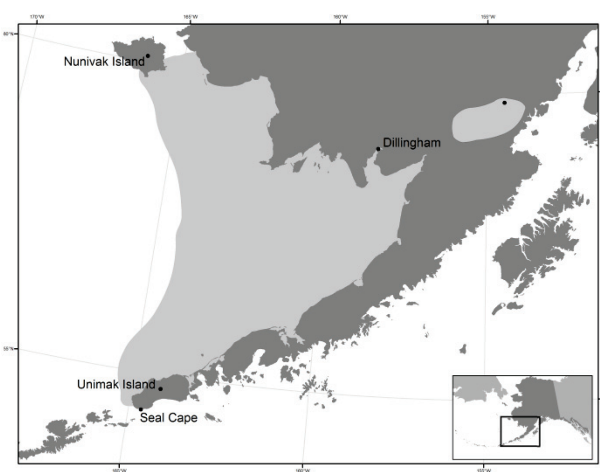


Figure 9c. Approximate distribution of Bristol Bay harbor seal stock (shaded area).

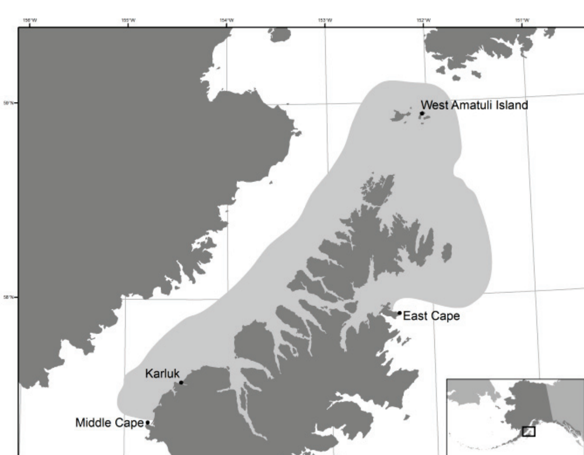
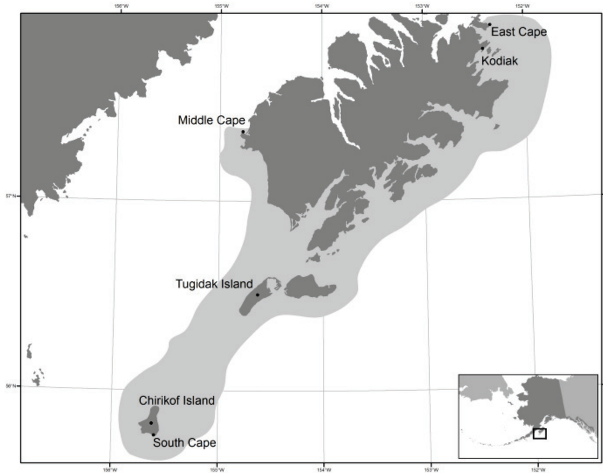


Figure 9d. Approximate distribution of North Kodiak harbor seal stock (shaded area).



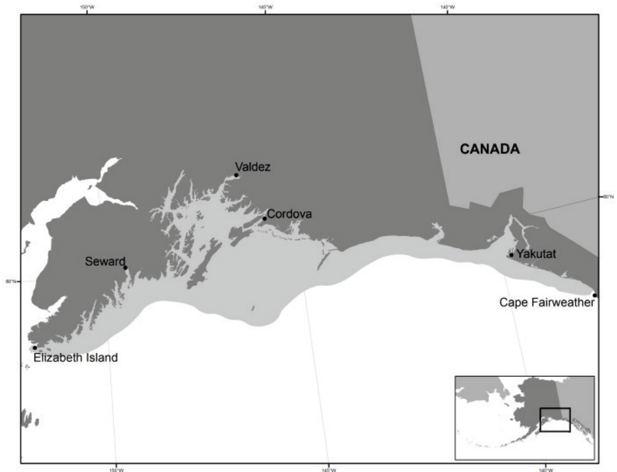
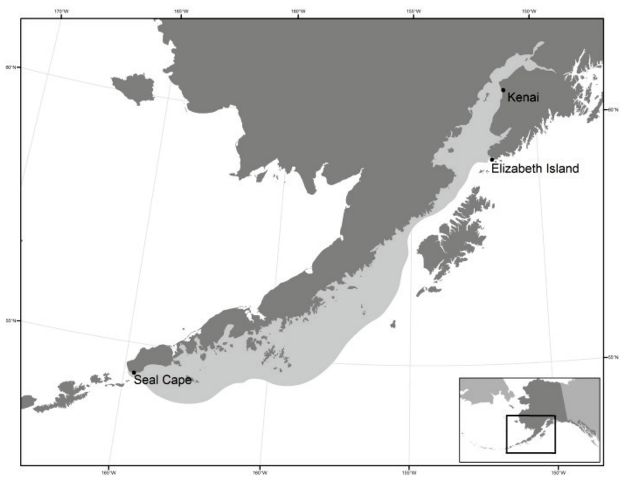


Figure 9e. Approximate distribution of South Kodiak harbor seal stock (shaded area).

Figure 9f. Approximate distribution of Prince William Sound harbor seal stock (shaded area).



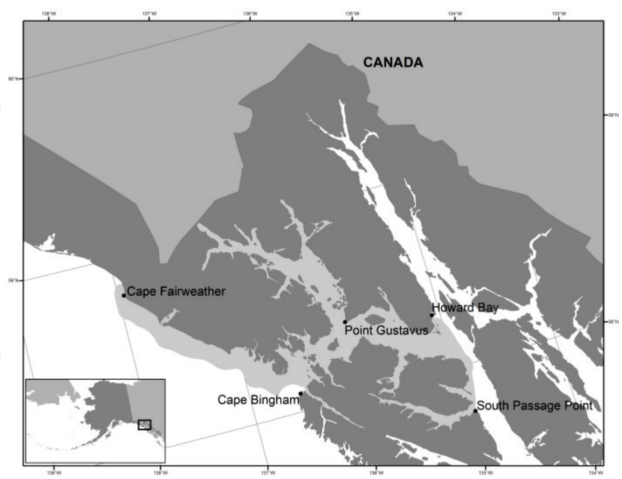
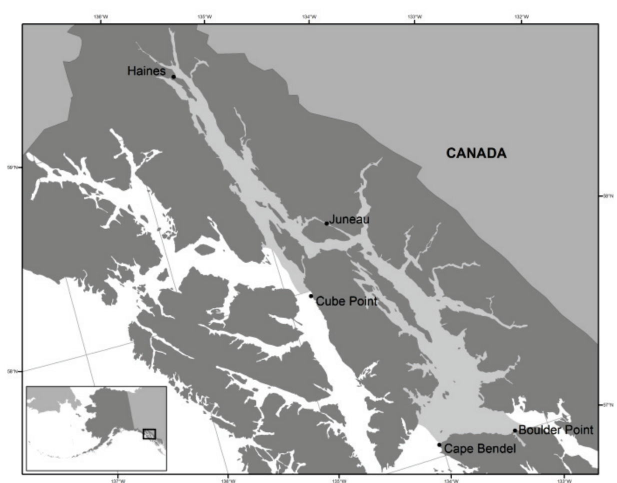


Figure 9g. Approximate distribution of Cook Inlet/Shelikof harbor seal stock (shaded area).

Figure 9h. Approximate distribution of Glacier Bay/Icy Strait harbor seal stock (shaded area).



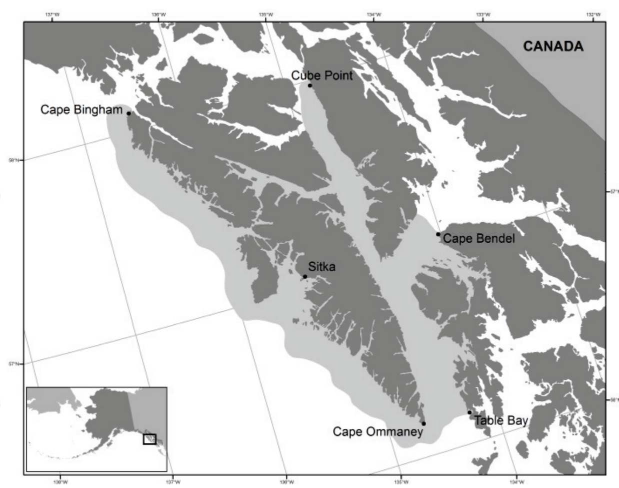


Figure 9i. Approximate distribution of Lynn Canal/Stephens harbor seal stock (shaded area).

Figure 9j. Approximate distribution of Sitka/Chatham harbor seal stock (shaded area).

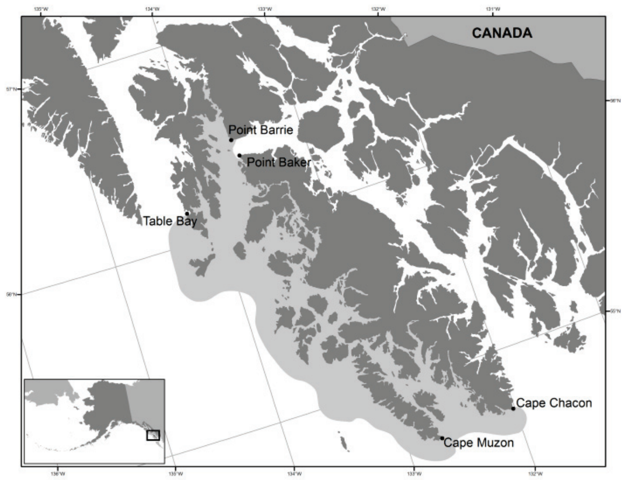


Figure 9k. Approximate distribution of Dixon/Cape Decision harbor seal stock (shaded

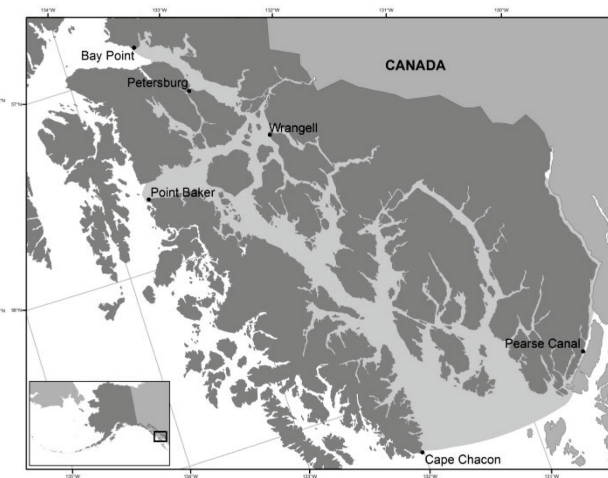


Figure 9l. Approximate distribution of Clarence Strait harbor seal stock (shaded area).

POPULATION SIZE

The National Marine Mammal Laboratory (Alaska Fisheries Science Center) routinely conducts aerial surveys of harbor seals across their entire range in Alaska. Prior to 2008, Alaska was divided into five survey regions, with one region surveyed per year. In 2010, the survey sites were prioritized based on the newly defined harbor seal stock divisions and annual aerial surveys attempt to cover the full geographic range of harbor seals in Alaska. We focused on surveying sites that make up a significant portion of each stock's population every year. Those sites with fewer seals are flown every 3 to 5 years, eventually providing the data necessary to estimate harbor seal population and trends on an annual basis. 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, 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. 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 each stock in Alaska. An additional analysis of abundance and trend for each stock is currently in progress and will be reported in the 2012 stock assessment reports.

Abundance Estimates and Minimum Population Estimates

The current statewide abundance estimate for Alaskan harbor seals is 152,602 (SE: 7,703) (NMFS, unpublished data), based on aerial survey data collected during 1998-2007. See Table ~~1~~9a for abundance estimates of the twelve stocks of harbor seals identified in Alaska. The minimum population estimate (N_{MIN}) for each of the twelve stocks of harbor seals identified in Alaska is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$.

Table ~~1~~9a. Abundance and minimum population size estimates of harbor seals in Alaska by stock.

Stock	Year of Last Survey	Abundance Estimate	SE	Nmin
Aleutian Islands	2004	3,579	329	3,313
Pribilof Islands	2010	232		232
Bristol Bay	2005	18,577	1,080	17,690
N. Kodiak	2006	4,509	290	4,272
S. Kodiak	2006	11,117	573	10,645
Prince William Sound	2006	31,503	5,599	27,157
Cook Inlet/Shelikof	2006	22,900	1,221	21,896
Glacier Bay/Icy Strait	2007	5,042	377	4,735
Lynn Canal/Stephens	2007	8,870	473	8,481
Sitka/Chatham	2007	8,586	443	8,222
Dixon/Cape Decision	2003	14,388	860	13,682
Clarence Strait	2003	23,289	989	22,471

Current Population Trend

Aerial surveys of harbor seal haulout sites throughout Alaska ~~are~~have been conducted annually and provide information on trends in abundance. The following summarizes available information on the population trend for each of the 12 new stocks.

Aleutian Islands: A partial estimate of harbor seal abundance in the Aleutian Islands was conducted from a skiff survey of 106 islands from 1977-1982 (8,601 seals). Small et al. (2008) compared counts from the same islands during a 1999 aerial survey (2,859 seals). Counts decreased at a majority of the islands. Islands with greater than 100 seals decreased by 70%. The overall estimates showed a 67% decline during the approximate 20-year period (Small et al. 2008). The current population trend in the Aleutian Islands is unknown.

Surveying harbor seals in the Aleutian Islands is notoriously difficult. The Aleutian Islands are often blanketed with fog or high winds that limit aerial surveys to narrow windows of time. The logistics of surveying the entire length of the Aleutian Chain are also quite difficult with limited airports and limited access to fuel. Additionally, the haul-out patterns of harbor seals in the Aleutian Islands have not been studied, and there is no stock specific estimate of a survey correction factor. NMFS is committed to conducting surveys on an annual basis within the Aleutian Islands stock and improving our understanding of these behaviors; however, the logistical challenges likely mean longer time periods before adequate assessment of population trends and parameters can be completed.

Pribilof Islands: Counts of harbor seals in the Pribilof Islands ranged from 250 to 1,224 in the 1970s. Counts in the 1980s and 1990s ranged between 119 and 232 harbor seals. Prior to July 2010, the most recent count was in 1995 and reported a total count of 202. In July 2010, approximately 185 adult and 27 pups were observed on Otter Island plus approximately 20 on all the other islands combined for a total of 232 harbor seals. Maximum seal counts (all ages) are nearly identical to the 1995 counts (212 vs. 202), but pup numbers are slightly less (27 vs. 42). The current population trend in the Pribilof Islands is unknown.

Bristol Bay: At Nanvak Bay (the largest haul-out in northern Bristol Bay), harbor seals declined in abundance between 1975-1990 and increased from 1990-2000 (Jemison et al. 2006). Land-based harbor seal counts at Nanvak Bay from 1990-2000 increased at 9.2%/year during the pupping period and 2.1%/year during the molting period (Jemison et al. 2006). Data from the NMFS aerial surveys also show an increasing trend for this stock (NMFS unpublished data).

North Kodiak: Population trend information for the North Kodiak harbor seal stock is not available at this time.

South Kodiak: A significant portion of the harbor seal population within the South Kodiak stock is located at and around Tugidak Island off the southwest of Kodiak Island. Sharp declines in the number of seals present on Tugidak were observed between 1976 and 1998. The highest rate of decline was 21% per year between 1976 and 1979 (Pitcher 1990). While the number of seals on Tugidak has stabilized and show some evidence of increase since the decline, the population in 2000 remained reduced by 80% compared to the levels in the 1970s (Jemison et al. 2006). The current population trend for this stock is unknown.

Prince William Sound: The Prince William Sound stock includes harbor seals both within and adjacent to Prince William Sound. Within Prince William Sound proper, harbor seals declined in abundance by 63% between 1984 and 1997 (Frost et al. 1999). More recent analysis of population abundance (ADFG, unpublished) and trend within Prince William Sound proper indicates the population stabilized around 2002 and has likely been increasing since then. Trend information and analysis for the entire Prince William Sound stock is not available at this time.

Cook Inlet/Shelikof: A multi-year study of seasonal movements and abundance of harbor seals in Cook Inlet was conducted between 2004 and 2007. This study involved multiple aerial surveys throughout the year, and data from this study indicates a stable population of harbor seals during the August molting period (Montgomery et al. 2007). Aerial surveys along the Alaska Peninsula present greater logistical challenges and have therefore been conducted less frequently. The current population trend for the entire stock is unknown.

Glacier Bay/Icy Strait: The Glacier Bay/Icy Strait stock shows a negative population trend estimate for harbor seals from 1992-2008 in June and August for glacial (-7.7%/yr; -8.2%/yr) and terrestrial sites (-12.4%/yr, August only) (Womble et al. 2010). Trend estimates by Mathews and Pendleton (2006) were similar for both glacial and terrestrial sites. Long-term monitoring of harbor seals on glacial ice has occurred in Glacier Bay since the 1970's (Hoover 1983, Hoover-Miller 1994, Mathews and Pendleton 2006), and has shown this area to support one of the largest breeding aggregations in Alaska (Steveler 1979, Calambokidis et al. 1987). After a dramatic retreat of Muir Glacier, in the East Arm of Glacier Bay, between 1973 and 1986 (more than 7 km) and the subsequent grounding and cessation of calving in 1993, floating glacial ice was greatly reduced as a haul-out substrate for harbor seals and ultimately resulted in the abandonment of upper Muir Inlet by harbor seals (Calambokidis et al. 1987, Hall et al. 1995, Mathews 1995), Prior to 1993 seal counts were up to 1,347 in the East Arm of Glacier Bay; 2008 counts were fewer than 200 (Streveler 1979, Molnia 2007). The most recent data through 2008 show a decline of harbor seals in Glacier Bay (Womble et al. 2010) with adjusted mean counts from 2004-2008 less than those for 1992-2002 (Mathews and Pendleton 2006).

Lynn Canal/Stepehns: Population trend information for the Lynn Canal/Stephens harbor seal stock is unknown.

Sitka/Chatham: The population trend for the Sitka/Chatham harbor seal stock is unknown.

Dixon/Cape Decision: Population trend information for the Dixon/Cape Decision harbor seal stock is either increasing or stable.

Clarence Strait: The population trend for the Clarence Strait harbor seal stock is either stable or increasing.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the twelve stocks of harbor seals identified in Alaska. 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 these stocks (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

~~**Aleutian Islands:** 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 Aleutian Islands stock harbor seal stock, PBR = 99 animals (3,313 x 0.06 x 0.5).~~

~~**Pribilof Isands:** 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 Pribilof Islands harbor seal stock, PBR = 7 animals (232 × 0.06 × 0.5).~~

~~**Bristol Bay:** 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 = $N_{MIN} \times 1.0R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for pinniped stocks with an increasing or stable population trend (Wade and Angliss 1997). Thus, for the Bristol Bay harbor seal stock, PBR = 1,061 animals (17,690 × 0.06 × 1.0).~~

~~**North Kodiak:** 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 = $N_{MIN} \times 1.0R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for pinniped stocks with an increasing or stable population(Wade and Angliss 1997) . Thus, for the North Kodiak harbor seal stock, PBR = 256 animals (4,272 × 0.06 × 1.0).~~

~~**South Kodiak:** 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 pinniped stocks with an increasing or stable population (Wade and Angliss 1997). Thus, for the South Kodiak harbor seal stock, PBR = 639 animals (10,645 × 0.06 × 1.0).~~

~~**Prince William Sound:** 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 Prince William Sound harbor seal stock, PBR = 815 animals (27,157 × 0.06 × 0.5).~~

~~**Cook Inlet/Shelikof:** 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 = $N_{MIN} \times 1.0R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for pinniped stocks with stable or increasing trends (Wade and Angliss 1997). Thus, for the Cook Inlet/Shelikof harbor seal stock, PBR = 1,314 animals (21,896 × 0.06 × 1.0).~~

~~**Glacier Bay/Icy Strait:** 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 Glacier Bay/Icy Strait harbor seal stock, PBR = 142 animals (4,735× 0.06 × 0.5).~~

~~**Lynn Canal/Stephens:** 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 Lynn Canal/Stephens harbor seal stock, PBR = 254 animals (8,481 × 0.06 × 0.5).~~

Sitka/Chatham: 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 Sitka/Chatham harbor seal stock, PBR = 247 animals (8,222 × 0.06 × 0.5).

Dixon/Cape Decision: 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 pinniped stocks with an increasing or stable population (Wade and Angliss 1997). Thus, for the Dixon/Cape Decision harbor seal stock, PBR = 821 animals (13,682 × 0.06 × 1.0).

Clarence Strait: 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 pinniped stocks with an increasing or stable population (Wade and Angliss 1997). Thus, for the Clarence Strait harbor seal stock, PBR = 1,348 animals (22,471 × 0.06 × 1.0).

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 pinniped stocks with unknown population status is 0.5, whereas a value of 1.0 is used for those stocks with an increasing or stable population trend (Wade and Angliss 1997). Table 9b summarizes the PBR levels for each stock of harbor seals in Alaska based on N_{MIN} estimates and population trend, if known.

Table 9b. PBR levels for each stock of harbor seals in Alaska based on N_{MIN} estimates, $R_{MAX,}$ and population trend. A recovery factor of 1.0 was used for stocks with an increasing or stable population, and 0.5 was used for those stocks with unknown population status.

Stock	**Nmin**	**R_{MAX}**	**Recovery Factor (F_R)**	**PBR Calculation (PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$)**	**PBR**
Aleutian Islands	3,313	0.12	0.5	3,313 x 0.06 x 0.5	99
Pribilof Islands	232	0.12	0.5	232 × 0.06 × 0.5	7
Bristol Bay	17,690	0.12	1.0	17,690 × 0.06 × 1.0	1,061
N. Kodiak	4,272	0.12	1.0	4,272 × 0.06 × 1.0	256
S. Kodiak	10,645	0.12	1.0	10,645 × 0.06 × 1.0	639
Prince William Sound	27,157	0.12	0.5	27,157 × 0.06 × 0.5	815
Cook Inlet/Shelikof	21,896	0.12	1.0	21,896 × 0.06 × 1.0	1,314
Glacier Bay/Icy Strait	4,735	0.12	0.5	4,735× 0.06 × 0.5	142
Lynn Canal/Stephens	8,481	0.12	0.5	8,481 × 0.06 × 0.5	254
Sitka/Chatham	8,222	0.12	0.5	8,222 × 0.06 × 0.5	247
Dixon/Cape Decision	13,682	0.12	1.0	13,682 × 0.06 × 1.0	821
Clarence Strait	22,471	0.12	1.0	22,471 × 0.06 × 1.0	1,348

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Previous stock assessment for harbor seals indicated three observed commercial fisheries operated within the range of the Bering Sea stocks of harbor seals, three within the range of stocks in Southeast Alaska, and five within the range of harbor seal stocks in the Gulf of Alaska. As of 2003, changes in how fisheries are defined in the

List of Fisheries have resulted in separating these fisheries in the Bering Sea into 14 fisheries, those in Southeast Alaska into 9 fisheries, and 22 fisheries in the Gulf of Alaska 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 of harbor seals in the Bering Sea/Aleutian Islands flatfish trawl, the Bering Sea/ Aleutian Islands pollock trawl, and the Bering Sea/Aleutian Islands Pacific cod trawl, as well as in salmon set gillnet (Cook Inlet and Kodiak Island) and salmon drift gillnet (Prince William Sound, Alaska Peninsula/ Aleutian Islands, and Cook Inlet) fisheries. Between 2007-2009, there was one observed mortality of a harbor seal in the Bering Sea/ Aleutian Islands pollock trawl fishery, which is the only observed serious injury or mortality observed in any Alaska groundfish fishery for this 3-year period (NMFS unpubl. data; Table 10).

The estimated minimum annual mortality rate of harbor seals incidental to commercial groundfish fisheries for the period 2007-2010~~9~~ is ~~0.40~~1.03. However, a reliable estimate of the overall mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in salmon gillnet fisheries known to interact with several of these stocks. Additionally, allocating any reported fishery mortalities to any one particular stock is problematic and the methodology for stock assignment is still under development. Therefore, for the purposes of stock assessment, a rate of ~~0.40~~1.03 commercial fisheries mortalities is used for each stock.

Table 10. Summary of incidental mortality of harbor seals due to commercial fisheries from 2007 through 2010~~9~~ 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 Islands pollock trawl	2007 2008 2009 2010	obs data	85 85 86 86	0 1 0 0	0 1.2 0 0	0.~~40~~30 (CV = 0.6~~40~~)
Bering Sea/ Aleutian Islands flatfish trawl	2007 2008 2009 2010	obs data	72 100 100 100	1 0 0 0	1.3 0 0 0	0.31 (CV = 0.67)
Gulf of Alaska Pacific cod trawl	2007 2008 2009 2010	obs data	17 15 29 31	0 0 0 1	0 0 0 2.9	0.73 (CV = 0.82)
Minimum total annual mortality						~~0.40~~1.34 (CV = 0.~~40~~49)

The Prince William Sound salmon drift gillnet fishery is known to interact with harbor seals, although the most recent observer data available for this fishery is from 1990 and 1991. The estimated minimum annual mortality rate incidental to salmon set and drift gillnet commercial fisheries is 24.0 (Table 11). This estimated annual mortality rate in the Prince William Sound salmon drift gillnet fishery (24.0) is added to the overall annual commercial fishery mortality (~~0.4~~1.3) in the overall commercial fisheries mortality estimate (~~24.4~~25.3) for the Prince William Sound stock of harbor seals.

Table 11. Summary of incidental mortality of harbor seals due to commercial salmon drift and set gillnet fisheries from 1990 through 2002 and calculation of the mean annual mortality rate based on the most recent observer program data 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

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). Recent information from the ADFG indicates the average harvest levels for the 12 stocks of harbor seals identified in Alaska from 2002-2008, including struck and lost, as follows (see table 12; average annual take column). As of 2009, data on community subsistence harvests are no longer being collected by ADFG. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating annual mortality estimates for all areas.

Table 12. Summary of the subsistence harvest data for all 12 harbor seal stocks in Alaska, 2003-2008. Data are from (Wolfe et al. 2004, Wolfe et al. 2006, Wolfe et al. 2008, Wolfe et al. 2009a, Wolfe et al. 2009b).

Stock	**Minimum Annual Harvest**	**Maximum Annual Harvest**	**Average Annual Harvest**
Aleutian Islands	50	146	90
Pribilof Islands	0	0	0
Bristol Bay	82	188	141
N. Kodiak	66	260	131
S. Kodiak	46	126	78
Prince William Sound	325	600	439
Cook Inlet/Shelikof	177	288	233
Glacier Bay/Icy Strait	22	108	52
Lynn Canal/Stephens	17	60	30
Sitka/Chatham	97	314	222
Dixon/Cape Decision	100	203	157
Clarence Strait	71	208	164

Other Mortality

The Alaska Region stranding records from 200~~5~~6 to 2010~~9~~ document stranded harbor seals with signs of human interaction. During this 5-year period, ~~5~~6 strandings occurred due to unknown fishery interaction (1 in 2006, 1 in 2007, 2 in 2008, ~~and~~ 1 in 2009, and 1 in 2010) and ~~2~~3 from vessel collision (1 in 2008, ~~and~~ 1 in 2009, and 1 in 2010). The average annual serious injury and mortality estimate based on stranding data is ~~1.4~~1.8 over the 5 year period from 200~~5~~6-2010~~9~~. Stock assignment for these mortalities have not been made; therefore, the conservative approach of applying the ~~1.4~~1.8 average annual mortality will be attributed to all stocks will be used.

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2003-2007, there were no mortalities resulting from research on the Bering Sea stock of harbor seals (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

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 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. The status of all twelve stocks of harbor harbor seals identified in Alaska relative to their Optimum Sustainable Population size is unknown.

Aleutian Islands: 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 9.9 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 (~~0.4~~1.3 + 90 + ~~1.4~~1.8= ~~91.8~~93.1) is not known to exceed the PBR (99). Therefore, the Aleutian Islands stock of harbor seals is not classified as a strategic stock

Pribilof Islands:. 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 0.7 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 (~~0.4~~1.3 + 0 + ~~1.4~~1.8 = ~~1.8~~3.1) is not known to exceed the PBR (7). Therefore, the Pribilof Islands stock of harbor seals is not classified as a strategic stock.

Bristol Bay: 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 106.1 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 (~~0.4~~1.3 + 141 + ~~1.4~~1.8 = ~~142.8~~144.1) is not known to exceed the PBR (1061). Therefore, the Bristol Bay stock of harbor seals is not classified as a strategic stock.

North Kodiak: 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 25.6 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 (~~0.4~~1.3 + 131 + ~~1.4~~1.8 = ~~132.8~~134.1) is not known to exceed the PBR (256). Therefore, the North Kodiak stock of harbor seals is not classified as a strategic stock.

South Kodiak: 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 63.9 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 (~~0.4~~1.3 + 78 + ~~1.4~~1.8 = ~~79.8~~81.1) is not known to exceed the PBR (639). Therefore, the South Kodiak stock of harbor seals is not classified as a strategic stock.

Prince William Sound: 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 81.5 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 (~~24.4~~25.3 + 439 + ~~1.4~~1.8 = ~~464.8~~466.1) is not known to exceed the PBR (815). Therefore, the Prince William Sound stock of harbor seals is not classified as a strategic stock.

Cook Inlet/Shelikof: 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 131.4 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 (~~0.4~~1.3 + 233 + ~~1.4~~1.8 = ~~234.8~~236.1) is not known to exceed the PBR (1314). Therefore, the Bristol Bay stock of harbor seals is not classified as a strategic stock.

Glacier Bay/Icy Strait: 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 14.2 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 (~~0.4~~1.3 + 52 + ~~1.4~~1.8 = ~~97.8~~55.1) is not known to exceed the PBR (142). Therefore, the Glacier Bay/Icy Strait stock of harbor seals is not classified as a strategic stock.

Lynn Canal/Stephens: 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 25.4 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 (~~0.4~~1.3 + 30 + ~~1.4~~1.8 = ~~31.8~~33.1) is not known to exceed the PBR (254). Therefore, the Lynn Canal/Stephens stock of harbor seals is not classified as a strategic stock.

Sitka/Chatham: 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 24.7 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 (~~0.4~~1.3 + 222 + ~~1.4~~1.8 = ~~223.8~~225.1) is not known to exceed the PBR (247). Therefore, the Sitka/Chatham stock of harbor seals is not classified as a strategic stock.

Dixon/Cape Decision: 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 82.1 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

(~~0.4~~1.3 + 157 + ~~1.4~~1.8 = ~~158.8~~160.1) is not known to exceed the PBR (821). Therefore, the Dixon/Cape Decision stock of harbor seals is not classified as a strategic stock.

Clarence Strait: 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 134.8 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 (~~0.4~~1.3 + 164 + ~~1.4~~1.8 = ~~165.8~~167.1) is not known to exceed the PBR (1,348). Therefore, the Clarence Strait stock of harbor seals is not classified as a strategic stock.

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SPOTTED SEAL (*Phoca largha*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spotted seals are distributed along the continental shelf of the Bering, Chukchi, and Beaufort seas, and the Sea of Okhotsk south to the western Sea of Japan and northern Yellow Sea (Fig. 11). Eight main areas of spotted seal breeding have been reported (Shaughnessy and Fay 1977). On the basis of small samples and preliminary analyses of genetic composition, potential geographic barriers, and significance of breeding groups Boveng et al. (2009) grouped those breeding areas into three Distinct Population Segments (DPSs): The Bering DPS, which includes areas in the Beaufort, Chukchi and East Siberian seas; the Okhotsk DPS; and the Southern DPS, which includes spotted seals breeding in the Yellow Sea and Peter the Great Bay in the Sea of Japan. For the purposes of this stock assessment the Bering DPS is considered the Alaska stock of the spotted seal.

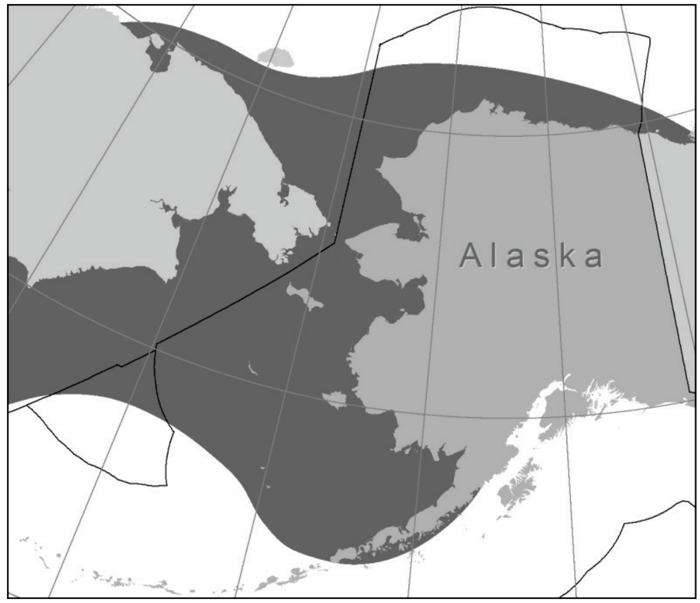

Figure 11. Approximate distribution of spotted seals (shaded area).

Satellite tagging studies showed that seals tagged in the northeastern Chukchi Sea moved south in October and passed through the Bering Strait in November. Seals overwintered in the Bering Sea along the ice edge and made 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 in areas where the water depth does not exceed 200 m, and move to coastal habitats after the retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977, Lowry et al. 2000, Simpkins et al. 2003). In summer and fall, spotted seals use coastal haulouts regularly (Frost et al. 1993, Lowry et al. 1998), 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. 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 the Alaska stock of spotted seal abundance is currently not available (Boveng et al. 2009). A joint U.S.-Soviet effort in 1976 was the most thorough ice seal survey of the southeastern Bering Sea to date (Braham et al. 1984) and produced an unstratified density estimate of spotted seals of 0.37 per nmi^2. Abundance estimates for that region were reported as 10,876 (stratified) and 13,125 (unstratified); however, only seals on the ice were counted, and no adjustment was made for seals in the water. Results were reported primarily in units of seals sighted per unit of surveying time and therefore do not represent abundance estimates.

Based on extensive surveys of the Bering Sea ice in 1987, Fedoseev et al. (1988) reported a minimum estimate of 100,000 spotted seals in the Bering Sea, based on raw counts of 432 spotted seals in April and 179 in May. Four aerial surveys in the western Bering Sea during 1974-1987 produced abundance estimates ranging between 78,000 and 143,000 spotted seals (Fedoseev 2000), with a multi-year average of 140,000 seals. Burkanov et al. (1988) criticized the aerial survey methods used by Fedoseev and others during 1979 and 1987 in the western Bering Sea and argued that significant errors may have resulted from incorrect determinations of the area inhabited by seals.

The Alaska Fisheries Science Center's National Marine Mammal Laboratory (NMML) conducted aerial surveys of the Bering Sea pack ice in 1992 and calculated the density of spotted seals to be 0.28 seals/nmi^2 (Rugh et al. 1995). These surveys were shore based and limited to the areas around Bristol Bay, Nunivak Island, and between Nome and St. Lawrence Island and were not adjusted for seals in the water. More thorough aerial surveys by NMML in 2007 were conducted from U.S. Coast Guard icebreakers that provided greater access to the central and eastern Bering Sea pack ice (Ver Hoef et al. *in review*). Frequencies of sightings data and information on ice distribution and the timings of seal haul-out behavior were analyzed to develop a population estimate of 141,479 (95% CI 92,769-321,882) spotted seals in the areas surveyed within the eastern and central Bering Sea (Ver Hoef et al. *in review*).

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 and the likelihood that these data are outdated, 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. The Bering Sea/Aleutian Islands flatfish trawl fishery is the only known observed commercial fishery to incur mortalities of spotted seals, with an average of 1.00 (CV = 0.01) seals per year for the period 2007-2009 (Table 15a).

The estimated minimum mortality rate incidental to commercial fisheries is 1.0 animals per year. However, serious injury and mortality of harbor seals incidental to commercial fisheries has occurred within the past five years, and because it is virtually impossible to distinguish between these two species, some of the reported harbor seal takes may actually have been spotted seals. Further, no observer programs have been done on nearshore Bristol Bay fisheries that are known to interact with this stock, making the total mortality due to fisheries unknown.

Table 15a. Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 2007 through 2009 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	2007 2008 2009	obs data	72 100 100	0 2 1	0 2.0 1.0	1.00 (CV = 0.01)
Minimum total annual mortality						1.00 (CV = 0.01)

Subsistence/Native Harvest Information

Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions, with historical estimated annual harvests ranging from 850 to 3,600 seals (averaging about 2,400 annually) taken during 1966-76 (Lowry 1984).

Few studies give a statewide estimate of subsistence take. The Division of Subsistence, Alaska Department of Fish and Game and the Alaska Native Harbor Seal Commission has reported subsistence harvest levels of harbor seals and sea lions annually (e.g., Wolfe et al. 2009b). Harvest data were reported from 63 coastal communities, including 6 communities from north Bristol Bay. Due to seasonal geographic overlap in spotted and harbor seal distribution in northern Bristol Bay in combination with the difficulty in distinguishing the two species from external morphology, reports of harvests of spotted seals were differentiated from harbor seals based on ecological features of the kill, primarily degree of association with seasonal ice (Wolfe et al. 2008). As of 2009, data on community subsistence harvests are no longer being collected, so the estimates from 2004-2008 will be used to estimate the annual harvest for the most recent 5-year period. The estimates given in Table 15b represent the best estimate of the subsistence harvest of spotted seals, although species identifications were not confirmed; therefore, the harvest estimates for spotted seals may include some harbor seals, and some spotted seals may have been recorded as harbor seals (Wolfe et al. 2009b).

The mean annual subsistence harvest in north Bristol Bay from this stock over the 5-year period from 2004 through 2008 was 193 spotted seals per year (Table 15b).

Table 15b. Summary of the subsistence harvest data for spotted seals from six coastal villages in northern Bristol Bay, 2002-2006.

Year	Estimated total number taken	Number harvested	Number struck and lost
2004	170[1]	124	46
2005	201[2]	170	31
2006	170[3]	140	30
2007	153[4]	137	16
2008	271[5]	213	58
Mean annual take (2004-2008)	193	157	36

[1] Wolfe et al. 2005; [2] Wolfe et al. 2006; [3] Wolfe et al. 2008; [4] Wolfe et al. 2009a; [5] Wolfe et al. 2009b.

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 total statewide level of harvest of spotted seals by all Alaska communities.

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. 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 in Alaska 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. 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.

On 28 March 2008, NMFS initiated a status review of the spotted seal (73 FR 16617). On 28 May 2008, NMFS received a petition to list spotted seals under the ESA, primarily due to concern about threats to this species' habitat from loss of sea ice and climate change in the Arctic. NMFS found that the petition presented sufficient information to consider listing and proceeded with the status review (73 FR 51615, 4 September 2008). After the status review was complete (Boveng et al. 2009), NMFS determined that listing the Bering and Okhotsk DPSs of spotted seals was not warranted at this time. The Southern DPS, however, was proposed for listing as "threatened" under the ESA (74 FR 53683, 20 October 2009). After fully considering comments from peer reviewers and the public, NMFS issued a final rule listing the Southern DPS as "threatened" on 22 October 2010 (75 FR 65239).

Habitat Concerns

The main concern about the conservation status of spotted seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Boveng et al. 2009). Despite the recent dramatic reductions in Arctic Ocean ice extent during summer, the sea ice in the Bering Sea is expected to continue forming annually in winter for the foreseeable future. There will likely be more frequent years in which ice coverage is reduced, resulting in a decline in the long-term average ice extent, but Bering Sea spotted seals will likely continue to encounter sufficient ice to support adequate vital rates. Even if sea ice were to vanish completely from the Bering Sea, there may be prospects for spotted seals to adjust their breeding grounds to follow the northward shift of the annual ice front into the Chukchi Sea. Laidre et al. (2008) concluded that on a worldwide basis spotted seals were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate.

A second major concern, related by the common driver of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased CO_2 in the atmosphere, may impact spotted seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Because of spotted seals' apparent dietary flexibility, this threat should be of less immediate concern than the direct effects of sea-ice degradation (Boveng et al. 2009).

Additional habitat concerns include the potential effects from oil and gas exploration activities, particularly in the outer continental shelf leasing areas, such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are a boreoarctic species with a circumpolar distribution (Fedoseev 1965, Johnson et al. 1966, Burns 1967, Burns and Frost 1979, Burns 1981, Smith 1981, Kelly 1988). Their normal range extends from the Arctic Ocean (85°N) south to Sakhalin Island (45°N) in the Pacific, and south to Hudson Bay (55°N) in the Atlantic (Allen 1880, Ognev 1935, King 1983). Bearded seals inhabit the seasonally ice-covered seas of the Northern Hemisphere where they whelp and rear their pups, and molt their coats on the ice in the spring and early summer. Bearded seals feed primarily on benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes and so are closely linked to areas where the seafloor is shallow (less than 200 m).

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

Two subspecies have been described: *E. b. barbatus* from the Laptev Sea, Barents Sea, North Atlantic Ocean, and Hudson Bay (Rice 1998); and *E. b. nauticus* from the remaining portions of the Arctic Ocean and the Bering and Okhotsk Seas (Ognev 1935, Scheffer 1958, Manning 1974, Heptner et al. 1976). The geographic distributions of these subspecies are not separated by conspicuous gaps, and there are regions of intergrading generally described as somewhere along the northern Russian and central Canadian coasts. As part of a status review of the bearded seal, Cameron et al. (2010) defined longitude 112° W in the Canadian Arctic Archipelago as the North American delineation between the two subspecies and 145° E as the Eurasian delineation between the two subspecies. Based on evidence for discreteness and ecological uniqueness of bearded seals in the Sea of Okhotsk, the *E. b. nauticus* subspecies was further divided into an Okhotsk Distinct Population Segment (DPS) and a Beringia DPS, so named because the continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian Seas that are the bearded seals range in this region overlie much of the land bridge that was exposed during the last glaciation and that has been referred to as Beringia. For the purposes of this stock assessment the Beringia DPS is considered the Alaska Stock of the bearded seal.

Spring surveys conducted in 1999 and 2000 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 move 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 may not follow the ice northward 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 moves 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.

POPULATION SIZE

A reliable population estimate for this stock is currently considered not available. A few regions have been surveyed by various techniques over the past four decades, although only crude estimates for these areas exist and many assumptions used to derive these estimates are conservative (e.g., seals in the water were often not included, some areas were not surveys or omitted from the analysis). However, based on studies by Ver Hoef et al. (2010), Fedoseev (2000) and Bengtson et al. (2005), Cameron et al. (2010) estimated about 125,000 bearded seals in the

Bering Sea and 27,000 bearded seals in the Chukchi Sea. Cameron et al. (2010) did not present population estimates for the East Siberian and Beaufort Seas, but did estimate that the Beringia DPS contained approximately 155,000 bearded seals. This number is considered a crude estimate based on multiple surveys using various techniques over the past four decades and were based on conservative assumptions. However, given that these numbers are outdated, this estimate cannot necessarily be considered strictly minimum or conservative overall (Cameron et al. 2010).

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 2007 and 2009, there were incidental serious injuries and mortalities of bearded seals in the Bering Sea/Aleutian Islands pollock trawl and the Bering Sea/ Aleutian Islands flatfish trawl (Table 16). The estimated minimum mortality rate incidental to commercial fisheries is 2.70 (CV = 0.21) 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 2007 to 2009 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	2007 2008 2009	obs data	85 85 86	1 4 1	1.03 4.65 1.44	2.37 (CV = 0.24)
Bering Sea/ Aleutian Islands flatfish trawl	2007 2008 2009		72 100 100	0 1 0	0 1.0 0	0.33 (CV = 0.04)
Total estimated annual mortality						2.70 (CV = 0.21)

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 maintained 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 was 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. Data on community subsistence harvests are no longer being collected and no new annual harvest estimates exist.

At this time, there are no efforts to quantify the total statewide level of harvest of bearded seals by all Alaska communities.

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.

Other Mortality

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2003-2007, there was 1 mortality resulting from research on the Alaska stock of bearded seals, which results in an average of 0.2 mortalities per year from this stock (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

Bearded seals in Alaska are not currently listed as "depleted" or "strategic" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act (ESA). On 28 March 2008, NMFS initiated a conservation status review of the bearded seal (73 FR 16617). On 28 May 2008, NMFS received a petition to list bearded seals under the ESA, primarily due to concern about threats to the species' habitat from climate warming and loss of sea ice. NMFS found that the petition presented sufficient information to consider listing and proceeded with the status review (73 FR 51615, 4 September 2008). After the status review of the bearded seal was complete (Cameron et al. 2010), NMFS determined that listing the subspecies *E. b. barbatus* was not warranted at this time. However, the Beringia and Okhotsk DPSs were proposed for listing as "threatened" under the ESA (75 FR 77496, 10 December 2010). NMFS will consider comments and information from peer reviewers and the public regarding the proposed listings, and final listing determinations will be made in December 2011.

Habitat Concerns

The main concern about the conservation status of bearded seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Cameron et al. 2010). For bearded seals, the presence of sea ice is considered a requirement for whelping and nursing young. Similarly, the molt is believed to be promoted by elevated skin temperatures that, in polar regions, can only be achieved when seals haul out of the water. Thus, if suitable ice cover is absent from shallow feeding areas during times of peak whelping and nursing (April/May), or molting (May/June and sometimes through August), bearded seals would be forced to seek either sea-ice habitat over deeper waters (perhaps with poor access to food) or coastal regions in the vicinity of haul-out sites on shore (perhaps with increased risks of disturbance, predation, and competition). Both scenarios would require bearded seals to adapt to novel (i.e., suboptimal) conditions, and to exploit habitats to which they may not be well adapted, likely compromising their reproduction and survival rates. A reliable assessment of the future conservation status of each bearded seal species segment requires a focus on projections of specific regional conditions, especially sea ice. End of century projections for the Bering Sea in April-May suggest that there will be sufficient ice only in small zones of the Gulf of Anadyr and in the area between St. Lawrence Island and Bering Strait. In June, suitable ice is predicted to disappear as early as mid-century. To adapt to this regime, bearded seals would likely have to shift their nursing, rearing and molting areas to the ice covered seas north of the Bering Strait. Laidre et al. (2008) also concluded that on a worldwide basis bearded seals were likely to be highly sensitive to climate change based on an analysis of various life history features that could be affected by climate.

A second major concern, driven primarily by the production of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased carbon dioxide in the atmosphere, may impact bearded seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Changes in bearded seal prey, anticipated in response to ocean warming and loss of sea ice, have the potential for negative impacts, but the possibilities are complex. Ecosystem responses may have very long lags as they propagate through trophic webs. Because of bearded seals' apparent dietary flexibility, this threat may be of less immediate concern than the threats from sea-ice degradation.

Additional habitat concerns include the potential effects from oil and gas exploration activities, particularly in the outer continental shelf leasing areas, such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Ringed seals have a circumpolar distribution and are found in all seasonally ice-covered seas of the Northern Hemisphere as well as in certain freshwater lakes (King 1983). Most taxonomists currently recognize five subspecies of ringed seals: *Phoca hispida hispida* in the Arctic Ocean and Bering Sea; *Phoca hispida ochotensis* in the Sea of Okhotsk and northern Sea of Japan; *Phoca hispida botnica* in the northern Baltic Sea; *Phoca hispida lagodensis* in Lake Ladoga, Russia; and *Phoca hispida saimensis* in Lake Saimaa, Finland. The lake-inhabiting subspecies are genetically isolated and those in the Baltic Sea and the Sea of Okhotsk apparently exchange genes with the Arctic subspecies minimally or not at all (Palo et al. 2001, Palo 2003, Kelly et al. 2009). The genetic structuring of *Phoca hispida hispida,* however, remains unresolved, and it may prove to be composed of multiple distinct populations (Kelly et al. 2010a). For the purposes of this stock assessment, the Alaska stock of ringed seals is considered the portion of *Phoca hispida hispida* that occurs within the U.S. Exclusive Economic Zone of the Beaufort, Chukchi, and Bering Seas (Fig. 13).

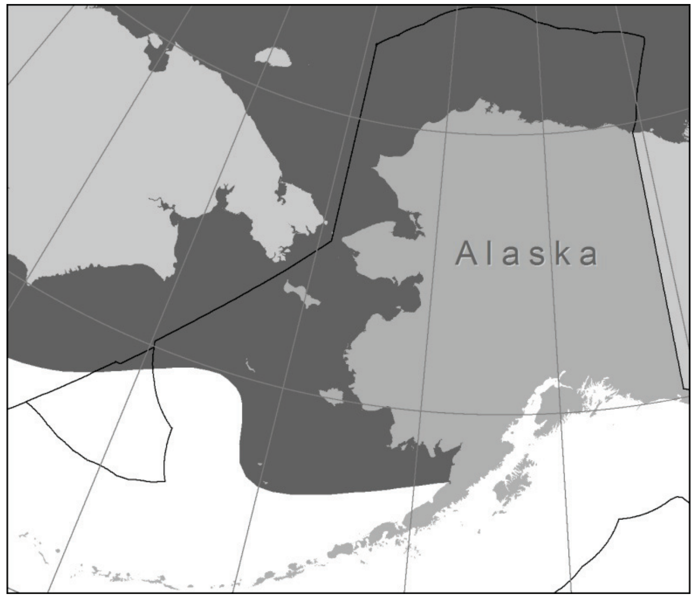

Figure 13. Approximate distribution of ringed seals (shaded area). The combined summer and winter distribution are depicted.

Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying both shorefast and pack ice (Kelly 1988a). They remain in contact with ice most of the year and use it as a platform for pupping and nursing in late winter to early spring, for molting in late spring to early summer, and for resting at other times of the year. In Alaskan waters, during winter and early spring when sea ice is at its maximal extent, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas. They occur as far south as Bristol Bay in years of extensive ice coverage but generally are not abundant south of Norton Sound except in nearshore areas (Frost 1985). Although details of their seasonal movements have not been adequately documented, it is generally considered that most ringed seals that winter in the Bering and Chukchi Seas migrate north in spring as the seasonal ice melts and retreats (Burns 1970) and spend summer in the pack ice of the northern Chukchi and Beaufort Seas, as well as in nearshore ice remnants in the Beaufort Sea (Frost 1985). During summer, ringed seals range hundreds to thousands of kilometers to forage along ice edges or in highly productive open-water areas (Freitas et al. 2008, Kelly et al. 2010b). With the onset of freeze-up in the fall, ringed seal movements become increasingly restricted and seals that have summered in the Beaufort Sea are thought to move west and south with the advancing ice pack, with many seals dispersing throughout the Chukchi and Bering Seas while some remain in the Beaufort Sea (Frost and Lowry 1984). Many adult ringed seals return to the same small home ranges they occupied during the previous winter (Kelly et al. 2010b).

POPULATION SIZE

Ringed seal population surveys in Alaska have used various methods and assumptions, had incomplete coverage of their habitats and range, and were conducted more than a decade ago; therefore, current, comprehensive, and reliable abundance estimates or trends for the Alaska stock are not available. Burns and Harbo (1972) conducted aerial surveys along the North Slope of Alaska (between Point Lay and Kaktovik) during June 1970, and reported a minimal estimate of 11,612 ringed seals in areas of shorefast ice. Frost and Lowry (1984) produced a rough estimate of 40,000 ringed seals in the Alaskan Beaufort Sea during winter and spring by applying an assumed correction factor for availability bias (i.e., for seals not hauled out at the time of the surveys) to the average density observed from 7 years of aerial surveys in the Alaskan and Yukon Beaufort Sea and extrapolating over the entire area of the continental shelf. Their estimate during summer of 80,000 ringed seals was based on the assumption that this population doubles as seals from the Bering and Chukchi Seas move in with the receding ice edge. Based on an analysis of surveys conducted during the 1970s, Frost (1985) estimated 1 to 1.5 million ringed seals in Alaskan waters, of which 250,000 were estimated in shorefast ice. These estimates were considered conservative when compared with polar bear predation rates (Frost 1985); however, details of the analysis were not published. Frost et al. (1988) reported detailed methods and results of surveys conducted in the Alaskan Chukchi and Beaufort Seas during May-June 1985-1987. Survey effort was directed towards shorefast ice within 20 nmi of shore, though some areas of adjacent pack ice were also surveyed, and estimates were based on observed densities extrapolated over estimates of available habitat without correcting for availability bias. In the Chukchi Sea, total numbers of hauled out ringed seals in shorefast ice ranged from 18,400 ± 1,700 in 1985 to 35,000 ± 3,000 in 1986. The 1987 estimate of 20,200 ± 2,300 was similar to 1985. In the Beaufort Sea, the estimated number of ringed seals hauled out within the 20-m depth contour ranged from 9,800 ± 1,800 in 1985 to 13,000 ± 1,600 in 1986. The 1987 estimate (19,400 ± 3,700) was considerably higher but may have included seals that had moved in from other areas as the ice began to break up (Frost et al. 1988). Frost et al. (2002) conducted surveys within 40 km of shore in the Alaskan Beaufort Sea during May-June 1996-1999, and observed ringed seal densities ranging from 0.81 seals/km^2 in 1996 to 1.17 seals/km^2 in 1999. Moulton et al. (2002) conducted similar, concurrent surveys in the Alaskan Beaufort Sea during 1997-1999 but reported substantially lower ringed seal densities than Frost et al. (2002). The reason for this disparity was unclear (Frost et al. 2004). Bengtson et al. (2005) conducted surveys in the Alaskan Chukchi Sea during May-June 1999 and 2000. While the surveys were focused on the coastal zone within 37 km of shore, additional survey lines were flown up to 185 km offshore. Population estimates were derived from observed densities corrected for availability bias using a haul-out model from 6 tagged seals. Ringed seal abundance estimates for the entire survey area were 252,488 (SE = 47,204) in 1999 and 208,857 (SE = 25,502) in 2000. The estimates from 1999 and 2000 in the Chukchi Sea only covered a portion of this stocks range and were conducted over a decade ago.

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. (2002) reported that trend analysis based on an ANOVA comparison of observed seal densities in the central Beaufort Sea suggested marginally significant but substantial declines of 50% on shorefast ice and 31% on all ice types combined from 1985-1987 to 1996-1999. A Poisson regression model indicated highly significant density declines of 72% on shorefast ice and 43% on pack ice over the 15-year period. However, the apparent decline between the mid-1980s and the late 1990s may have been due to a difference in the timing of surveys rather than an actual decline in abundance (Frost et al. 2002, Kelly et al. 2006). As these surveys represent only a fraction of the stock's range and occurred more than a decade ago, current and reliable data on trends in population abundance for the Alaska stock of ringed 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 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 2007 and 2009, there were incidental serious injuries and mortalities of ringed seals in the Bering Sea/Aleutian Islands flatfish trawl fishery and the Bering Sea/ Aleutian Islands pollock trawl (Table 17). Based on data from 2007 to 2009, there have been an average of 1.75 (CV = 0.01) 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 2007 to 2009 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	2007 2008 2009	obs data	72 100 100	0 2 1	0 2.0 1.0	1.00 (CV = 0.01)
Bering Sea/ Aleutian Is. pollock trawl	2007 2008 2009	obs data	85 85 86	0 1 1	0 1.13 1.11	0.75 (CV = 0.23)
Total estimated annual mortality						1.75 (CV = 0.01)

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 1985). 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 1988a).

The Division of Subsistence, Alaska Department of Fish and Game, maintained a database that provided additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ringed seals was 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. Data on community subsistence harvests are no longer being collected and no new annual harvest estimates exist.

At this time, there are no efforts to quantify the total statewide level of harvest of ringed seals by all Alaska communities.

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 in Alaska are not currently listed as "depleted" or "strategic" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act (ESA). On 28 March 2008, NMFS initiated a conservation status review of the ringed seal (73 FR 16617). On 28 May 2008, NMFS received a petition to list ringed seals under the ESA, primarily due to concern about threats to the species' habitat from climate warming and diminishing ice and snow cover. NMFS found that the petition presented sufficient information to consider listing and proceeded with the status review (73 FR 51615, 4 September 2008). After the status review of the ringed seal was complete (Kelly et al. 2010a), NMFS proposed listing four subspecies of ringed seals—including *Phoca hispida hispida*, and; therefore, the Alaska stock of ringed seals—as "threatened" under the ESA (75 FR 77496, 10 December 2010). The fifth subspecies of ringed seals (*Phoca hispida saimensis*) was previously listed as "endangered" under the ESA in 1993, and no change in its listing status was proposed at this time. NMFS will consider comments and information from peer reviewers and the public regarding the proposed listings, and final listing determinations will be made in December 2011.

Habitat Concerns

The main concern about the conservation status of ringed seals stems from the likelihood that their sea-ice and snow habitats have been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Kelly et al. 2010a). Climate models consistently project overall diminishing ice and snow cover through the 21st century with regional variation in the timing and severity of those loses. Increasing atmospheric concentrations of greenhouse gases are driving climate warming and increasing acidification of the ringed seal's habitat. Changes in ocean temperature, acidification, and ice cover threaten prey communities on which ringed seals depend. Laidre et al. (2008) concluded that on a worldwide basis ringed seals were likely to be highly sensitive to climate change based on an analysis of various life history features that could be affected by climate.

The greatest impacts to ringed seals from diminished ice cover will be mediated through diminished snow accumulation. While winter precipitation is forecasted to increase in a warming Arctic (Walsh et al. 2005), the duration of ice cover will be substantially reduced, and the net affect will be lower snow accumulation on the ice. Ringed seals excavate subnivean lairs (snow caves) in drifts over their breathing holes in the ice, in which they rest, give birth, and nurse their pups for 5-9 weeks during late winter and spring (Chapskii 1940, McLaren 1958, Smith and Stirling 1975). Snow depths of at least 50-65 cm are required for functional birth lairs (Smith and Stirling 1975, Lydersen and Gjertz 1986, Kelly 1988b, Lydersen 1998, Lukin et al. 2006), and such depths typically are found only where 20-30 cm or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Lydersen et al. 1990, Hammill and Smith 1991, Lydersen and Ryg 1991, Smith and Lydersen 1991). According to climate model projections, snow cover is forecasted to be inadequate for the formation and occupation of birth lairs within this century over the Alaska stock's entire range (Kelly et al. 2010a). Without the protection of the lairs, ringed seals—especially newborns—are vulnerable to freezing and predation (Kumlien 1879, McLaren 1958, Lukin and Potelov 1978, Smith and Hammill 1980, Lydersen and Smith 1989, Stirling and Smith 2004). Changes in the ringed seal's habitat will be rapid relative to their generation time and, thereby, will limit adaptive responses. As ringed seal populations decline, the significance of currently lower-level threats—such as ocean acidification, increases in human activities, and changes in populations of predators, prey, competitors, and parasites—may increase.

Additional habitat concerns include the potential effects from oil and gas exploration activities, particularly in the outer continental shelf leasing areas, such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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RIBBON SEAL (*Histriophoca 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). Satellite tag data from 2005 and 2007 suggest ribbon seals disperse widely. Ten seals tagged in 2005 near the eastern coast of Kamchatka spent the summer and fall throughout the Bering Sea and Aleutian Islands; eight of the 26 seals tagged in 2007 in the central Bering Sea moved to the Bering Strait, Chukchi Sea, or Arctic Basin as the seasonal ice retreated (Boveng et al. 2008).

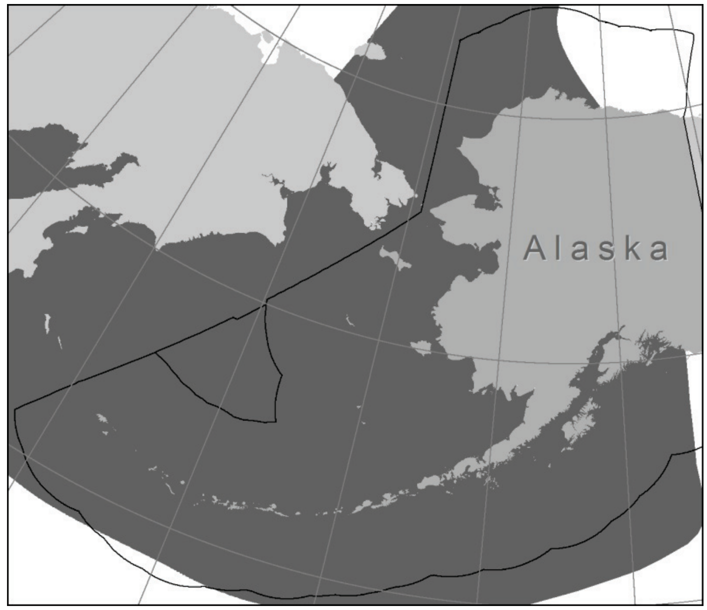

Figure 14 Approximate distribution of ribbon seals (shaded area). The combined summer and winter distribution is depicted.

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 (Boveng et al. 2008). 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.

Aerial surveys were conducted in portions of the eastern Bering Sea in spring of 2003 (Simpkins et al. 2003), 2007 (Cameron and Boveng 2007, Moreland et al. 2008), and 2008 (Peter Boveng, NMML, unpubl. data). The data from these surveys are currently being analyzed to construct estimates of abundance for the eastern Bering Sea from frequencies of sightings, ice distribution, and the timings of seal haul-out behavior. In the interim, NMML researchers have developed a provisional estimate of 49,000 ribbon seals in the eastern and central Bering Sea during the surveys.

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. Although the current population trend is unknown, a recent estimate of 49,000 ribbon seals in the eastern and central Bering Sea is consistent with historical estimates, suggesting suggest that no major or catastrophic change has occurred in recent decades (Boveng et al. 2008). This stock is thought to occupy its entire historically-observed range (Boveng et al. 2008).

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 2007 and 2009, there were incidental serious injuries and mortalities of ribbon seals in the Bering Sea/Aleutian Islands flatfish trawl fishery, the Bering Sea/ Aleutian Islands Atka mackerel trawl, and the Bering Sea/ Aleutian Islands pollock trawl (Table 18). The estimated minimum mortality rate incidental to commercial fisheries is 2.25 (CV = 0.22) ribbon seal per year, based exclusively on observer data.

Table 18. Summary of incidental mortality of ribbon seals (Alaska stock) due to fisheries from 2007 to 2009 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	2007 2008 2009	obs data	72 100 100	0 0 0	0 0 0	0
Bering Sea/ Aleutian Islands Atka mackerel trawl	2007 2008 2009	obs data	94 100 99	1 0 1 + 1[1]	1.05 0 1 + 1[1]	0.68 + 0.33 = 1.01 (CV = 0.01)
Bering Sea/ Aleutian Islands pollock trawl	2007 2008 2009	obs data	85 85 86	0 2 1	0 2.61 1.11	1.24 (CV = 0.34)
Total estimated annual mortality						2.25 (CV = 0.22)

[1] Mortality seen by observer, but not during a monitored haul.

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 maintained a database that provided additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ribbon seals was 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. Data on community subsistence harvests are no longer being collected and no new annual harvest estimates exist.

At this time, there are no efforts to quantify the total statewide level of harvest of ribbon seals by all Alaska communities.

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.

STATUS OF STOCK

Ribbon seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act (ESA). 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. 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.

On 20 December 2007, NMFS received a petition to list ribbon seals under the ESA, primarily due to concern about threats to the species' habitat from climate warming and loss of sea ice. NMFS found that the petition presented sufficient information to consider listing and initiated a conservation status review of ribbon seals (73 FR 16617, 28 March 2008). After the status review of the ribbon seal was complete (Boveng et al. 2008), NMFS determined that listing ribbon seals was not warranted at this time (73 FR 79822, 30 December 2008).

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. The main concern about the conservation status of ribbon seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Boveng et al. 2008). A second major concern, related by the common driver of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased CO_2 in the atmosphere, may impact ribbon seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Although a gradual decline in the ribbon seal population is likely with a decrease in frequency of years with suitable sea ice habitat, ribbon seals are not likely to become an endangered species within the foreseeable future (Boveng et al. 2008). Laidre et al. (2008) concluded that on a worldwide basis ribbon seals were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate. Additional habitat concerns include the potential effects from oil and gas exploration activities, particularly in the outer continental shelf leasing areas, such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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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, the Yukon Delta, 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).

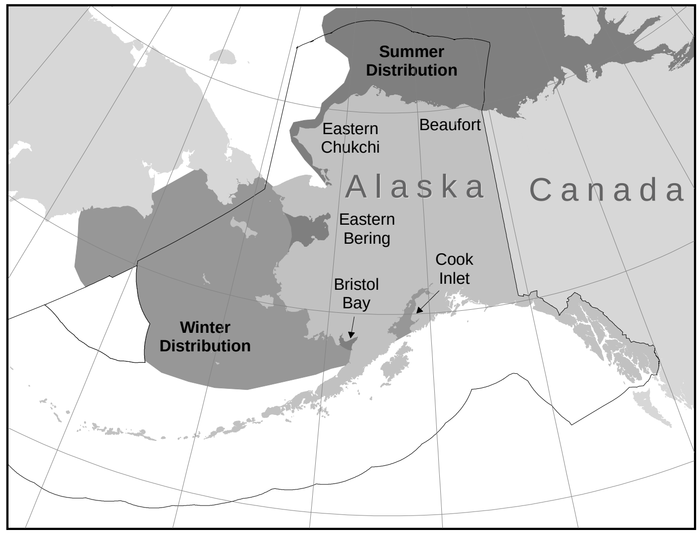

Figure 15. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The general distribution pattern for beluga whales shows major seasonal changes. During the winter, they occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers where they may molt (Finley 1982) and give birth to and care for their calves (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 poorly known 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 undocumented, the recovery factor (F_R) for this stock is 0.5 (Wade and Angliss 1997). Thus, using the abundance estimate calculated from 1992 surveys, the PBR for the Beaufort Sea stock of beluga whales would be calculated to be 324 animals (32,453 × 0.02 × 0.5). However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005).

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 in press, Alaska Beluga Whale Committee, 18 February 2010). Given these data, the annual subsistence take by Alaska Natives averaged 26 belugas during the 5-year period from 2005 to 2009.

Table 19. Summary of the number of beluga whales landed by the Alaska Native subsistence harvest from the Beaufort Sea stock of beluga whales, 2005-2009.

Year	**Reported total number taken**
2005	20
2006	5
2007	40
2008	48
2009	16
Mean annual number of animals landed (2005-2009):	25.8

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 (data for 2005 to 2009 from FJMC Beluga Monitor Program, Fisheries Joint Management Committee, Inuvik, NT, Canada). Given these data, the annual subsistence take in Canada averaged 100 belugas during the 5-year period from 2005 to 2009. Thus, the mean estimated subsistence take in Canadian and U. S. waters from the Beaufort Sea beluga stock during 2005-2009 is 126 (26 + 100) whales. Data on beluga that were struck and lost have not been quantified and are not included in these estimates.

Table 20. Summary of the Canadian subsistence harvest from the Beaufort Sea stock of beluga whales, 2005-2009. N/A indicates the data are not available.

Year	Reported total number taken
2005	108
2006	126
2007	82
2008	81
2009	102
Mean annual landed (2005-2009)	100

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). The total annual human-cause mortality estimate is 126 based on subsitence harvest in the United States (26) and Canada (100). 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. Beaufort Sea beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Although the abundance estimates are greater than 8 years old, the level of incidental mortality in commercial fisheries is considered to be insignificant; therefore the Beaufort Sea stock of beluga whales is classified as a non-strategic stock. At this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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). These changes are likely to affect marine mammal species in the Arctic. Ice-associated animals, such as the beluga whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant effect on prey availability. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on beluga whales, but Laidre et al. (2008) and Heide-Jørgensen (2010) concluded that on a worldwide basis belugas were likely to be less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behavior. Increased human activity in the Arctic, including increasing oil and gas exploration and development, and increased nearshore development, have the potential to impact habitat for beluga whales (Moore et al. 2000, Lowry et al. 2006), but predicting the type and magnitude of the impacts is difficult at this time.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, the Yukon Delta, 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).

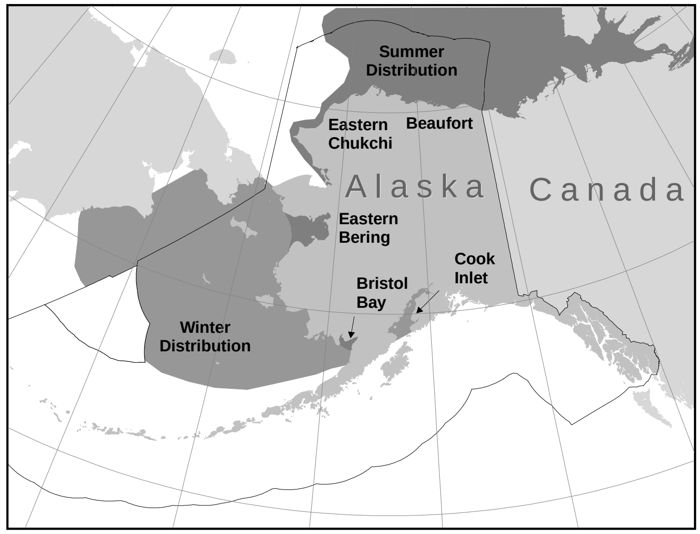

Figure 16. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The general distribution pattern for beluga whales shows major seasonal changes. During the winter, they occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers where they may molt (Finley 1982) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

Eastern Chukchi Sea belugas move into coastal areas along Kasegaluk Lagoon in late June and animals are sighted in the area until about mid-July (Frost and Lowry 1990, Frost et al. 1993). Satellite-linked tags attached in summer to eastern Chukchi belugas occur in Kaseguluk Lagoon showed that whales 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 an overlap in distribution with the Beaufort Sea stock of beluga whales. Satellite telemetry data from 23 whales tagged during 1998-2002 suggest variation in movement patterns for different age and/or sex classes during July – September (Suydam et al. 2005). Adult males used deeper waters and remained there for the duration of the summer; all belugas that moved into the Arctic Ocean (north of 75◦N) were males, and males traveled through 90% pack ice cover to reach deeper waters of the Beaufort Sea and Arctic Ocean (79-80◦N) by late July/early August. Adult and immature females remained at or near the shelf break of the Chukchi Sea. After October, only three tags continued to transmit, and those whales migrated south through the Bering Strait into the northern Bering Sea north of Saint Lawrence Island. Data from a whale tagged in the eastern Chukchi Sea in 2007 overwintered in the waters north of Saint Lawrence Island during 2007/2008 and was still transmitting in this location as of April 2008 (Suydam 2009).

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 × 2.62 × 1.18).

During 25 June to 6 July 1998, aerial surveys were conducted in the eastern Chukchi Sea (DeMaster et al. 1998). The maximum single day count (1,172 whales) was derived from a photographic count of a large aggregation near Icy Cape (1,018), plus animals (154) counted along an ice edge transect. This count is an underestimate because it was clear to the observers that many more whales were present along and in the ice than they were able to count and only a small portion of the ice edge habitat was surveyed. Furthermore, only one of five belugas equipped with satellite tags a few days earlier remained within the survey area on the day the peak count occurred (DeMaster et al. 1998).

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). Using the abundance estimate calculated from 1991 surveys, the PBR for the eastern Chukchi Sea stock of beluga whales would be calculated to be 74 animals (3,710 × 0.02 × 1.0). However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005).

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 in press, Alaska Beluga Whale Committee, 18 February 2010). Given these data, the annual subsistence take by Alaska Natives averaged 94 belugas landed during the 5-year period 2005-2009 based on reports from ABWC representatives and on-site harvest monitoring. Data on beluga that were struck and lost have not been quantified and are not included in these estimates.

Table 21. Summary of the number of beluga whales landed by the Alaska Native subsistence harvest of eastern Chukchi Sea beluga whales, 2005-2009.

2005	43
2006	31
2007	270
2008	74
2009	53
Mean annual number of animals landed (2005-2009):	94.2

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) 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 (94) would exceed the PBR (74) if a PBR were to be calculated based on the most recent abundance estimate of 3,710. Because this estimate is based on surveys from 1989-1991 and is greater than 8 years old, the PBR for this stock is considered undetermined. 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.

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). These changes are likely to affect marine mammal species in the Arctic. Ice-associated animals, such as the beluga whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant effect on prey availability. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on beluga whales, but Laidre et al. (2008) and Heide-Jørgensen et al. (2010) concluded that on a worldwide basis belugas were likely to be less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behavior. Increased human activity in the Arctic, including increasing oil and gas exploration and development, and increased nearshore development, have the potential to impact habitat for beluga whales (Moore et al. 2000, Lowry et al. 2006), but predicting the type and magnitude of the impacts is difficult at this time.

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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, the Yukon Delta, 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 interactions (Lowry 1985).

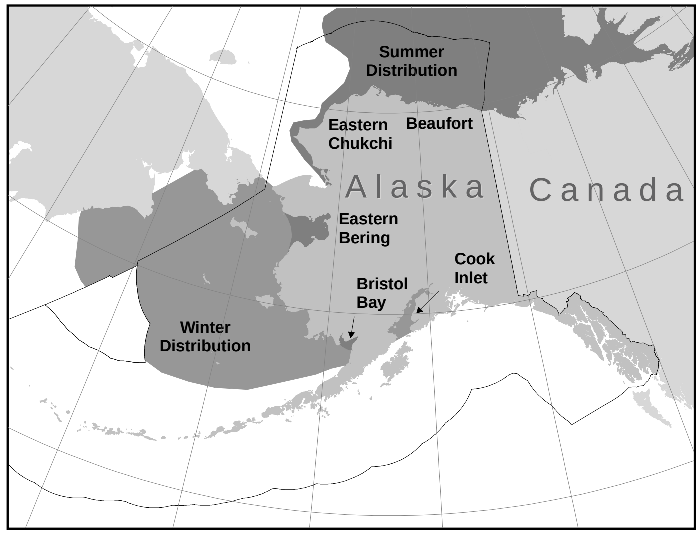

Figure 17. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The general distribution pattern for beluga whales shows major seasonal changes. During the winter, they occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers where they may molt (Finley 1982) and give birth to and care for their calves (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. 17).

POPULATION SIZE

The Alaska Beluga Whale Committee has been working to develop a population estimate for eastern Bering Sea stock beginning with the first systematic aerial surveys of beluga whales in the Norton Sound/Yukon Delta region flown during May, June, and September 1992, and June 1993-1995 (Lowry et al. 1999). Beluga density estimates were calculated for June 1992 surveys using strip transect methods, and for June 1993-1995 using line transect methods. Correction factors were applied to account for animals that were missed during the surveys (those below the surface and not visible, and dark colored neonates). Lowry et al. (1999) concluded that the best estimate of abundance for the eastern Bering Sea beluga stock was 17,675 (95% confidence interval 9,056-34,515 not accounting for variance in correction factors) based on counts made in early June 1995. Additional aerial surveys of the Norton Sound/Yukon Delta region were conducted in June 1999 and 2000 (L. Lowry, pers. comm., 29 January 2011). Unlike previous survey years, in 1999 sea ice persisted in western Norton Sound resulting in a much different distribution of belugas, and the data were not used for population estimation. In 2000 systematic transect lines were flown covering the entire study region, and the data were analyzed using a covariate line transect model. Preliminary results indicate 9,188 belugas (CV=0.42) seen at the surface in the study area (A. Zerbini, AFSC-NMML, pers. comm. 22 December 2010). If the correction factors used previously for this survey region (Lowry et al. 1999) are used (2.62 to correct for the proportion of animals that were diving and thus not visible at the surface and 1.18 to correct for the proportion of newborns and yearlings not observed due to their small size and dark coloration), the total corrected abundance estimate for the eastern Bering Sea stock is 28,406 (9,188 X 2.62 X 1.18) beluga whales. However, while these results confirm that the eastern Bering Sea beluga stock is quite large they are preliminary and are not ready to use for calculation of PBR at this time.

Minimum Population Estimate

For the eastern Bering Sea stock of beluga whales, the minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Therefore, $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 28,406and an associated CV(N) of 0.42, N_{MIN} for this stock is 20,231 beluga whales. However, because the survey data are greater than 8 years old, it is not considered a reliable minimum population estimate for calculating a PBR.

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. Lowry et al. (2008) estimated the rate of increase of the Bristol Bay beluga stock as was 4.8% per year (95% CI = 2.1%-7.5%) over a 12-year period. However, until additional data become available specific to the eastern Bering Sea stock, 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 to estimate abundance for this stock and to annually monitor levels of subsistence harvest (DeMaster 1997). However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for the eastern Bering Sea stock of beluga whales is considered undetermined (NMFS 2005).

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.

In the nearshore waters of the eastern Bering Sea, substantial effort occurs in commercial and subsistence fisheries, mostly for salmon and herring. The salmon fishery uses gillnet gear similar to that used in Bristol Bay where it is known that belugas have been incidentally taken (Frost et al. 1984). However there are no useful data on beluga incidental takes from this stock because there have never been observer programs on the commercial fisheries and there is no reporting requirement for takes in personal use fisheries. The only reported beluga mortality in this region occurred in a personal-use king salmon gillnet in 1996. NMFS assumes that all beluga whales killed are used for subsistence, regardless of the method of harvest, are reported to the ABWC, and included in the following section on Subsistence/Native Harvest Information.

Because there has never been an observer program for nearshore commercial fisheries in the eastern Bering Sea region, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable.

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 in press; Alaska Beluga Whale Committee, pers. comm., 18 February 2010). Belugas harvested in Kuskokwim villages are included in the total harvest for the eastern Bering Sea beluga stock. The annual subsistence take by Alaska Natives averaged 192 belugas landed from the eastern Bering Sea stock during the 5-year period 2005-2009. .

Table 22. Summary of the number of belugas landed by the Alaska Native subsistence harvest from the eastern Bering Sea stock of beluga whales, 2005-2009.

Year	**Reported total number landed**
2005	259
2006	172
2007	232
2008	119
2009	181
Mean annual number of animals landed (2005-2009):	192.6

STATUS OF STOCK

The estimated minimum annual mortality rate incidental to U.S. commercial fisheries is 0. 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 total estimated annual human-caused mortality rate is 193 based on subsistence harvest. Eastern Bering Sea beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Although the abundance estimates are greater than 8 years old and PBR is undetermined, the level of incidental mortality in commercial fisheries is unknown, although it is considered to be insignificant based on no reports. Therefore the Eastern Bering Sea stock of beluga whales is classified as a non-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). These changes are likely to affect marine mammal species in the Arctic. Ice-associated animals, such as the beluga whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant effect on prey availability. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on beluga whales, but Laidre et al. (2008) and Heide-Jørgensen (2010) concluded that on a worldwide basis belugas were likely to be less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behavior. Increased human activity in the Arctic, including increasing oil and gas exploration and development, and increased nearshore development, have the potential to impact habitat for beluga whales (Moore et al. 2000, Lowry et al. 2006), but predicting the type and magnitude of the impacts is difficult at this time.

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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, the Yukon Delta, 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).

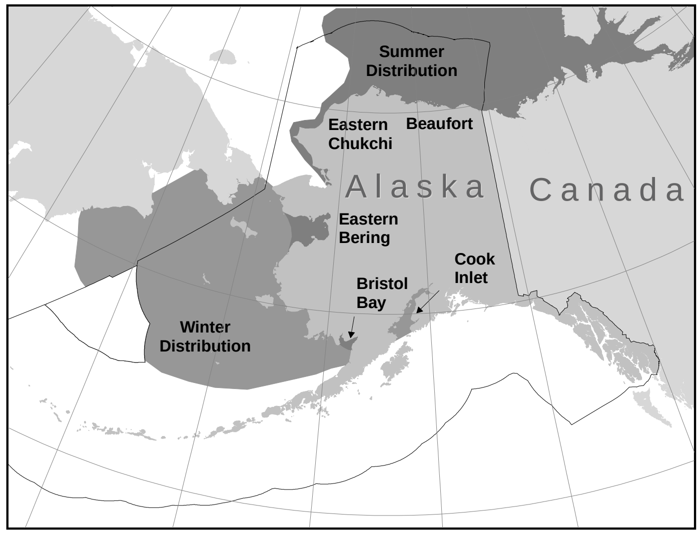

Figure 18. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The general distribution pattern for beluga whales shows major seasonal changes. During the winter, they occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers where they may molt (Finley 1982) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

Summer movement patterns of Bristol Bay belugas were determined from satellite-linked tags deployed on 10 animals in the Kvichak River during 2002 and 2003, and 5 in the Nushagak River in 2006. Those whales used the shallow upper portions of Kvichak and Nushagak bays between May and August (Quakenbush, 2003) and remained in the nearshore waters of Bristol Bay through the months of September and October (Quakenbush and Citta, 2006). Data from two belugas whose tags lasted into December and January showed that they were in Nushagak and Kvichak bays, suggesting that some belugas do not leave the nearshore waters of Bristol Bay during the winter (Lori Quakenbush, Alaska Department of Fish and Game, Fairbanks, AK, pers comm. 31 March 2008).

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 poorly known 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 are known to concentrate during summer. Frost and Lowry (1990) reported an estimate of 1,000-1,500 for Bristol Bay, similar to that reported by Seaman et al. (1985). In 1994, the number of beluga whales in Bristol Bay was estimated at 1,555 (Lowry and Frost 1998). That 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 1995), and for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971). The Alaska Department of Fish and Game and the Alaska Beluga Whale Committee conducted beluga surveys in Bristol Bay in 1999, 2000, 2004 and 2005, with maximum counts of 690, 531, 794, and 1,067 (Lowry et al. 2008). Using the correction factors described above and the maximum counts for 2004 and 2005 gives population estimates of 2,455 and 3,299 (L. Lowry, University of Alaska Fairbanks, pers. comm.).

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 no correction has been made for whales that were at the surface but were missed by the observers, and 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 2004 and 2005 of (N) of 2,877 and the default CV (0.2), N_{MIN} for the Bristol Bay stock of beluga whales is 2,467.

Current Population Trend

Population estimates from the 1950s (Brooks 1955, Lensink 1961) suggested there were about 1,000-1,500 belugas in Bristol Bay. Aerial surveys flown in 1983 produced an abundance estimate of 1,250 which indicated that there had been little change in population size. A survey program involving replicate aerial counts using standardized methods was conducted during 1993-2005. Data from 28 complete counts of Kvichak and Nushagak bays made in good or excellent survey conditions were analyzed, and results showed that the population had increased by 65% over the 12-year period (Lowry et al. 2008).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The estimated rate of increase in abundance of belugas in Bristol Bay during 1993-2005 was 4.8% per year (95% CI = 2.1%-7.5%; Lowry et al. 2008). This estimate exceeds the default cetacean maximum net productivity rate (R_{MAX}) of 4% (Wade and Angliss 1997). It is currently not clear why this stock should be increasing as such a high rate, but possibilities include recovery from research kills in the 1960s, a reduction in subsistence harvests, and a delayed response to increases in salmon stocks (Lowry et al. 2008).

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 known to be increasing (Lowry et al. 2008), the recovery factor (F_R) 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 = 49 animals (2,467 × 0.02 × 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

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

Observers have never monitored the Bristol Bay commercial salmon set gillnet and drift gillnet fisheries which combined had 2,845 active permits in 2010. These fisheries are known to have caused mortality of beluga whales from this stock in the past (Frost et al. 1984). However, they have never been monitored by an observer program so there is no reliable information on the number of animals that have been or are being taken.

There is substantial effort in a subsistence gillnet fishery for salmon in Bristol Bay. Belugas are occasionally entangled and killed in this fishery, but there is no established protocol for non-commercial takes to be reported to NMFS. During 2005-2009, four mortalities of beluga in salmon nets were reported to the stranding network. One entanglement was reported as in a subsistence net, one was in a commercial salmon set net, and two others were in unspecified salmon nets. Based on these stranding reports, the minimum annual mortality estimate due to fishery interactions over the 5-year period from 2005-2009 was 0.8 per year. However, this figure is clearly an underestimate because personal-use fishers are not required to report marine mammal takes, and the commercial fishery has not been observed. Also, it should be noted that in this region of western Alaska, belugas taken incidental to the personal-use or commercial salmon fisheries may be used by Alaska Native for subsistence and may be included in the subsistence harvest data reported below.

A reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable.

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 in press, Alaska Beluga Whale Committee, 18 February 2010) These data show that the annual subsistence take by Alaska Natives averaged 20 belugas from the Bristol Bay stock during the 5-year period 2005-2009.

Table 23. Summary of the Alaska Native subsistence harvest from the Bristol Bay stock of beluga whales, 2005-2009. N/A indicates the data are not available.

Year	**Reported total number landed**
2005	21
2006	20
2007	20
2008	19
2009	20
Mean annual number of animals landed (2005-2009):	20.0

STATUS OF STOCK

It is unknown whether the U. S. commercial fishery-related mortality level is insignificant and approaching zero mortality and serious injury rate (i.e., 10% of PBR; less than 4.9 per year) 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 (20 + 0.8 = 21) is not known to exceed the PBR (49). Because the population size has been increasing at a rate near Rmax, the sum of human impacts on the population are not a problem at this point (Lowry et al. 2008). 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 likely to be underestimated.

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). These changes are likely to affect marine mammal species in the Arctic. Ice-associated animals, such as the beluga whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant effect on prey availability. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on beluga whales, but Laidre et al. (2008) and Heide-Jørgensen (2010) concluded that on a worldwide basis belugas were likely to be less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behavior. Increased human activity in the Arctic, including increasing oil and gas exploration and development, and increased nearshore development, have the potential to impact habitat for beluga whales (Moore et al. 2000, Lowry et al. 2006), but predicting the type and magnitude of the impacts is difficult at this time. Because the population size has been increasing (Lowry et al. 2008), habitat impacts most likely have been minimal during recent years.

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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, ~~the~~ Yukon Delta, Norton Sound, Kasegaluk Lagoon, and ~~the~~ Mackenzie River Delta (Hazard 1988). 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 (Frost and Lowry 1990); 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 stocks are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea.

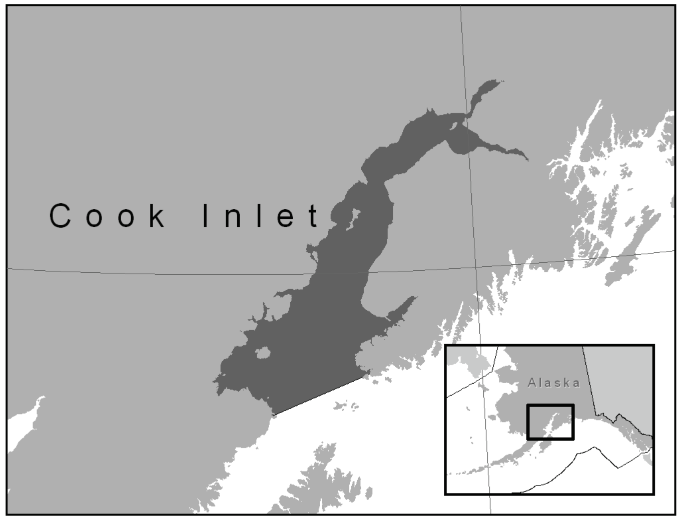

Figure 19. Approximate distribution of beluga whales in Cook Inlet. ~~The dark shading displays the summer distribution.~~

During spring and summer months, beluga whales in Cook Inlet are typically concentrated near river mouths in ~~the~~ northern Cook Inlet (Rugh et al. 20~~00~~10). ~~Although the exact~~The winter distribution of this stock is ~~unknown~~not well known; however, there is evidence that some whales, if not all, ~~of this population~~ may inhabit northern Cook Inlet year-round (Fig. 19; Hansen and Hubbard 1999, Rugh et al. ~~2000~~2004, Hobbs et al. 2005). Satellite tags have been attached to 17 belugas in late summer in order to determine their distribution through the fall and winter (Hobbs et al. 2005). Ten tags lasted through the fall, and of those, three tags lasted through ~~the winter. The three tags that transmitted through the winter~~and ~~stopped working in~~ April and late May. No~~ne of the~~ tagged beluga moved south of Chinitna Bay on the west side of Cook Inlet. A review of all ~~cetacean~~marine mammal surveys conducted in the Gulf of Alaska from 1936 to 2000 discovered only 31 beluga sightings ~~of belugas~~ among 23,000 sightings of ~~other cetacean~~marine mammals, 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; Laidre et al. 2000, O'Corry-Crowe et al. 2006) ~~also occur in~~ are regularly observed in Yakutat Bay.~~; w~~ While not included in the Cook Inlet DPS as listed under the ESA, ~~the Yakutat beluga group is considered part of the Cook Inlet stock (73 FR 62919, 22 October 2008)~~NMFS regulations under the MMPA (50 CFR 216.15) include the beluga whales occupying Yakutat Bay as part of the Cook Inlet stock (75 FR 12498, 16 March 2010), as defined as depleted at 50 CFR 216.15. Notice-and-comment rulemaking procedures would be required to change this regulatory definition. Until such procedures are completed, these animals remain designated as depleted as part of the Cook Inlet stock.

POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet have been conducted by the National Marine Fisheries Service each year since 199~~4~~3. ~~Starting in 1994, t~~The survey protocol included paired, independent observers so that the number of whale groups missed ~~can~~could 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~~ record~~ing~~ed the whales ~~group~~ (Rugh et al. 2000).

The annual abundances of beluga whales in Cook Inlet are estimated ~~from~~based on 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. 2000a). 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. 2000a). The most recent abundance estimate of beluga whales in Cook Inlet, resulting from the 201~~0~~1 aerial survey is ~~340~~284 (CV = 0.1~~1~~6) (~~NMFS unpubl. data 2010~~Hobbs et al. 2011). ~~While t~~This estimate is ~~larger~~less than the estimate~~s~~ of ~~278~~340 for 2010~~5 and 302 for 2006, it fits well with the declining trend for the years 1999-2010~~; however, it falls within the statistical variation around the recent trend line and probably represents variability of the estimation process rather than a substantial decline in the population during the past year. Abundance estimates based on aerial surveys of Cook Inlet beluga over the last 3-year period were ~~375 (2008),~~ 321 (2009), ~~and~~ 340 (2010), and 284 (2011). Based on an average population ~~estimates of the Cook Inlet beluga over the last 3 years~~over the past three years, the abundance estimate for this stock is ~~345~~315 (CV = 0.13).

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 3-year average population estimate (N) of ~~345~~315 and its associated CV(N) of 0.13, N_{MIN} for the Cook Inlet stock of beluga whales is ~~309~~283.

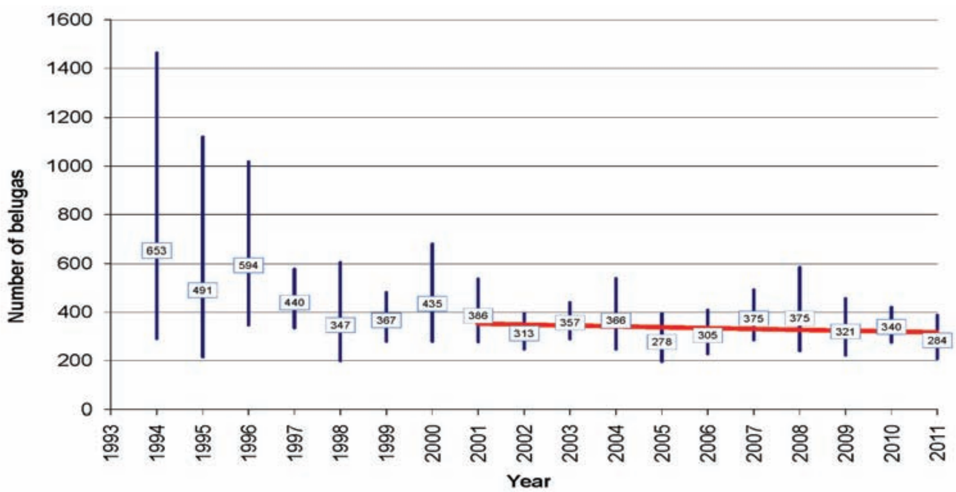

Figure 20a. Abundance of beluga whales in Cook Inlet, Alaska 1994-20~~09~~11 (~~Rugh et al. 2005,~~ Hobbs ~~and Shelden~~et al. 20~~08~~11). ~~Error~~Vertical bars depict ~~95% confidence intervals~~plus and minus one standard error. In the last 10 years (200~~0~~1-201~~0~~1), the rate of decline (red trend line) has been -1.1~~1~~% per year.

Current Population Trend

The corrected abundance estimates for the period 1994-201~~0~~1 are shown in Figure 20a. A statistically significant declining trend in abundance was detected between 1994 and 1998 (Hobbs et al. 2000~~a~~b), although the power of the analysis was low due to the short time series. A Bayesian inference on the population size estimates for 1994-2005 gave a modal estimate of the trend during that period of -1.2% per year, with a 71% probability that the population was declining (Lowry et al. 2006). A trend line fit to the estimates for 2001~~0~~ to 2011~~0~~ estimates an average rate of decline of 1.1~~1~~% (SE = 0.011~~09~~) per year. A recent review of the status of the population indicated that there is an 80% chance that the population will decline further (Hobbs and Shelden 2008).

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). This figure is similar to the 4.8% percent annual increase that has been documented for the Bristol Bay beluga stock (Lowry et al. 2008).

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 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 since 1999 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~~is not ~~appear to be~~ increasing. Because this stock does not meet the assumptions inherent to the use of the PBR, NMFS ~~cannot~~has decided it would not be appropriate to ~~determine~~calculate 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 those fisheries to entangle beluga whales. No mortalities or serious injuries were observed in either year (Manly 2006). No observer data have been collected in these fisheries since 2000.

A photogrammetric study by Kaplan et al. (2009) did not find any instances where Cook Inlet belugas appeared to have been entangled in, or to have otherwise interacted with, fishing gear. However, ~~a recent series of photos of an animal~~in 2010, a beluga with a rope entangled around its girth was observed and photo-documented during the period of ~~June~~May through ~~September~~August. The same whale was photographed in July and August 2011, still entangled in the rope line ~~with no more current photo indicating whether the gear was still present~~ (pers comm. Tamara McGuire, LGL Alaska Research Associates, Inc. 2000 W International Airport Road, Anchorage, AK 99502).

~~Based on a lack of reported mortalities, t~~The estimated minimum mortality rate incidental to commercial fisheries is ~~zero belugas per year from this stock~~unknown, although probably low since no mortalities have been reported.

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 to ~~over~~more than 100 animals (Mahoney and Shelden 2000). The average annual subsistence harvest, including struck and lost, for 1995 and 1996 was 87 whales.

Following a significant decline in Cook Inlet beluga whale abundance estimates between 1994 and 1998, the Federal ~~G~~government ~~took~~attempted actions to prevent further declines in the abundance of these whales. In 1999 and 2000, Public Laws 106-31 and 106-553 established a moratorium on Cook Inlet beluga whale harvests except for subsistence hunts by Alaska Natives conducted under cooperative agreements between NMFS and affected Alaska Native organizations. There were no signed co-management agreements in 1999, 2004, and 2007, so no harvest was authorized. Harvest from 2001 through 2004 was conducted under harvest regulations (69 FR 17973, 6 April 2004) following an interim harvest management plan developed by the Alaska Native organizations and NMFS. Three belugas were harvested in Cook Inlet under the interim harvest plan (2001-2004). In August 2004 an administrative law judge hearing was held to determine a long-term harvest plan. The recommended decision allowed a total of 8 whales to be harvested between 2005 and 2009, followed by the use of a table of allowable harvest levels from 2010 until recovery. This table would set harvest levels dependent on the previous 5-year periods for an average abundance and previous 10-year period to determine the growth rate (increasing, stable, or decreasing). No harvest would be allowed if the 5-year average abundance dropped below 350 belugas. Because the 5–year average abundance was below 350 whales for the 2003-2007 time period, the allowable harvest during the subsequent 5–year period, 2008–2012, was set at zero. (73 FR 60976; 15 October 2008).

~~**Table 24.** Summary of the Alaska Native subsistence harvest from the Cook Inlet stock of beluga whales, 2006~~7~~-2011~~1~~0.~~

~~**Year**~~	~~**Reported total number taken**~~	~~**Reported number harvested**~~	~~**Estimated number struck and lost**~~
~~2006~~	~~0~~	~~0~~	~~0~~
~~2007~~	~~0~~	~~0~~	~~0~~
~~2008~~	~~0~~	~~0~~	~~0~~
~~2009~~	~~0~~	~~0~~	~~0~~
~~2010~~	~~0~~	~~0~~	~~0~~

Year	Reported total number taken	Reported number harvested	Estimated number struck and lost
2011	0	0	0
Mean annual take (20067-20101)	0		

OTHER MORTALITY

Mortalities related to stranding events have been reported in Cook Inlet (Table 25). Since improved record-keeping was initiated in 1994, there are more reports of stranded belugas in Cook Inlet, including live strandings, are reported. These live strandings resulted in suspected mortalities of 5 animals in 1996, 5 animals in 1999, and 5 animals in 2003 (Vos and Shelden 2005) and 1 animal in 2005 (Hobbs and Shelden 2008). Many of the live strandings occurred in Turnagain Arm. Because Turnagain Arm is a shallow, dangerous waterway, it is not frequented by motorized vessels, and thus it is unlikely that the strandings resulted from human interactions on the water. A live stranding of 17-20 animals occurred in Knik Arm in 2009; however, there were no mortalities reported from that event. Two live stranding events occurred in 2010, one consisting of 11 animals and another of 2 animals, during which no mortalities occurred. One live stranding event involving 2 belugas occurred in 2011 in Knik Arm, again no mortalities were reported. Another source of mortality in Cook Inlet is killer whale predation. Killer whale sightings were rare in the upper Inlet prior to the mid-1980s, but have increased and include 18 reported sightings from 1985 to 2002 (Shelden et al. 2003). The threefour most recent predation events that occurred in the upper Inlet were in 1) September 1999 in which the outcome was unknown, 2) in September 2000 that involved two lactating female belugas that subsequently died (Shelden et al. 2003), 3) August 2003 where a male beluga died (Vos and Shelden 2005), and 4) in September 2008 where an adult beluga (sex not yet determined) died (Hobbs and Shelden 2008). Three dead belugas were reported to the NMFS stranding network in 2011, all were floating in Cook Inlet. Necropsies were not conducted on the reported carcasses to rule out any human-related cause of death; however, there was no obvious indication of human interaction.

Year	Total Dead of Natural or Unknown Cause	Number of Belugas per Live Stranding Event* (associated known mortalities)
1994	10	186 (0)
1995	3	0
1996	12	63(0), 60(4), 25(1), 1(0), 15(0)
1997	3	0
1998	10	30(0), 5(0)
1999	12	58(5), 13(0)
2000	13 (2 killer whale)	8(0), 17(0), 2(0)
2001	10	0
2002	13	0
2003	20 (1 killer whale)	2(0), 46(5), 26(0), 32(0), 9(0)
2004	13	N/A
2005	6	7(1)
2006	8	12(0)
2007	15	0
2008	11 (1 killer whale)	28(0), 30(0)
2009	4	17-20 (0)
2010	5	11(0), 2(0)
2011	3	2(0)
Total	173176	690692-698700 (16)

Table 25. Cook Inlet beluga strandings investigated by NMFS (Vos and Shelden 2005; Hobbs and Shelden 2008, NMFS unpublished data). * Harvested beluga are not included in the number dead. ** Many belugas that strand do not die. Although some mortalities may have been missed by observers, and animals may die later of stranding-related injuries, the majority of animals involved in a stranding event often survive.

STATUS OF STOCK

The Cook Inlet beluga whale stock has been designated as “depleted” under the MMPA, and on October 22, 2008, NMFS listed a Distinct Population Segment of beluga whales found in Cook Inlet as endangered under the Endangered Species Act of 1973, as amended (ESA). Therefore, the Cook Inlet beluga whale stock is considered a strategic stock. Current observer data on fisheries within Cook Inlet are lacking; however, no mortalities in U. S. commercial fisheries have been reported for this stock. Thus annual mortality levels are considered insignificant and approaching zero mortality and serious injury rate, although the lack of recent fisheries data is a concern for this small population. NMFS has convened a Recovery Team, consisting of a Scientific Panel and Stakeholder Panel advisory groups, to aide in the development of a Recovery Plan for Cook Inlet beluga whales (http://www.fakr.noaa.gov/protectedresources/whales/beluga/recovery/ci.htm).

Efforts to develop co-management agreements with Alaska 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. An umbrella agreement on co-management among the Indigenous People's Council for Marine Mammals, U.S. Fish and Wildlife Service, and NMFS was signed in August 1997, and an updated co-management agreement was signed in October 2006. During 1998, efforts were initiated to formalize a specific agreement between local Alaska Native organizations and NMFS regarding the management of Cook Inlet belugas, but without success. Federal legislation was implemented in May 1999, placing a moratorium on beluga hunting in Cook Inlet except under cooperative agreements between NMFS and affected Alaska Native organizations. Co-management agreements between NMFS and the Cook Inlet Marine Mammal Council have since been signed for 2000-2003 and 2005-2006.

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, 2005, 2010; Goetz et al. 2007) and winter (Hobbs et al. 2005). Because of the very restricted range of this stock, Cook Inlet beluga can be assumed to be vulnerable to human-induced or natural perturbations within their habitat. Although the best available information has 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), potential effects of human activities on recovery remain a concern (73 FR 62919, 22 October 2008). Additional concerns that have the potential to impact this stock or its habitat include changes in prey availability and environmental parameters due to climate changes; competition with fisheries~~ for available prey~~; increased predation by killer whales; contaminants; ~~and sounds~~noise associated with oil and gas exploration; vessel traffic; waste management and urban runoff; construction projects; and physical habitat modifications that may occur as upper Cook Inlet becomes increasingly urbanized (Moore et al. 2000, Lowry et al. 2006). A photogrammetric study by Kaplan et al. (2009) recorded a few instances where belugas had probably been struck by boat propellers or ships. Projects planned that may alter the physical habitat include a highway bridge across Knik Arm, ferry operations in lower Knik Arm, construction and operation of a coal mine near Chulitna, and expansion and improvements to the Port of Anchorage. NMFS released a ~~proposed~~final rule to designate two areas comprising ~~7,809~~7,800 square ~~miles~~kilometers (3,013 square miles) of marine habitat as critical habitat for the Cook Inlet beluga, excluding the Port of Anchorage in consideration of national security interest and military lands determined ineligible for designation (~~74~~76 ~~FR 63080~~20180, ~~2 December 2009~~11 April 2011).

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NARWHAL (*Monodon monoceros*): Unidentified Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Figure 20b. Potential distribution of narwhals in Arctic waters based on extralimital sightings and strandings (George and Suydam, unpubl. ms., Reeves and Tracey 1980, COSEWIC 2004).

Narwhals typically inhabit waters of the Arctic Ocean. They are common in the waters of Nunavut, Canada, west Greenland, and in the European Arctic; however, they rarely occur in the East Siberian, Bering, Chukchi, and Beaufort Seas (COSEWIC 2004). The three recognized populations of narwhals are based on summer distribution: Baffin Bay, Hudson Bay, and east Greenland (DFO 1998a, 1998b; COSEWIC 2004). The Baffin Bay population of narwhals summers in the waters of West Greenland and the Canadian High Arctic and overwinters in Baffin Bay and Davis Strait (Koski and Davis 1994; Dietz et al. 2001; Heide-Jørgensen et al. 2003). Narwhals from the northwest Hudson Bay population are thought to overwinter in eastern Hudson Strait (Richard 1991). The east Greenland population is believed to winter in the pack ice between eastern Greenland and Svalbard (Dietz et al. 1994). The amount of interchange between these populations is unknown; population definition is based on management purposes, and these designated populations may actually consist of several populations (COSEWIC 2004). Population definition based on molecular genetics studies of narwhals remains unresolved (Palsbøll et al. 1997; de March et al. 2001, 2003).

Local observations and traditional ecological knowledge are the primary source for observation data of narwhals in Alaska waters, dating back to the 1800s (Bee and Hall 1956, Geist et al. 1960, Noongwook et al. 2007, George and Suydam unpubl. ms.). The earliest record dates back to 1874, with most records occasional sightings occurring around the area east of Point Barrow (Scammon 1874, Ray and Murdoch 1885, Turner 1886, Nelson and True 1887, Murdoch 1898, MacFarlane 1905, Dufresne 1946, Anderson 1947, Bee and Hall 1956, Geist et al. 1960). Narwhal occurrences are reported in Bee and Hall (1956) from Pt. Barrow to the Colville River Delta. Ljungblad et al. (1983) reported on a sighting of two male narwhals that occurred northwest of King Island in the Bering Sea, just south of the Bering Strait, during a systematic scientific survey. Sightings have occurred in Russian waters of the northern Chukchi Sea in Russian waters (Reeves and Tracey 1980, Yablokov and Bel'kovich 1968). George and Suydam (unpubl. ms.) summarized observations from Alaska Native hunters during eight sighting events of narwhals in the Chukchi and Beaufort Seas between 1989 and 2008. Of these records, seven were sightings of live animals totaling 11-12 individuals; one record was a report of a beach cast narwhal tusk at Cape Sabine. Four of the seven sightings of live animals consisted of mixed groups of beluga and narwhals (George and Suydam unpubl. ms.). It is believed that these incidental sightings of narwhals occurring in the Beaufort, Chukchi, and Bering seas are whales from the Baffin Bay population that are known to move into the Canadian Arctic Archipelago and as far north and west as ice conditions will permit (COSEWIC 2004).

Several specimens of narwhals collected in Alaska have been documented. Huey (1952) reported on a specimen collected near Cape Halkett, Harrison Bay, at the mouth of the Colville River. Three additional specimen records from various locations were documented in Geist et al. (1960); one specimen was found dead on the beach of Kiwalik Bay (Kotzebue Sound), another was initially sighted alive at the mouth of the Caribou River in Nelson Lagoon on the Alaska Peninsula but later died, and a third specimen of a narwhal tusk was found on the beach at Wainwright. Murie (1936) reported on a single tusk that was found on a sandbar at Cape Chibukak, St. Lawrence Island.

Which of the Canadian populations narwhal in Alaska belong is unknown. There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for narwhal.

POPULATION SIZE

Reliable estimates of abundance for narwhal in Alaska 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 narwhals in Alaska. 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

There are no U. S. commercial fisheries operating within the range of the narwhals in Alaska. There are no observer program records of narwhal mortalities incidental to commercial fisheries in Alaska. The estimated annual mortality rate incidental to commercial fisheries is zero.

Subsistence/Native Harvest Information

There is no known subsistence harvest of narwhals by Alaska Natives.

STATUS OF STOCK

Narwhals 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 trend, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. There are no federal or state commercial fisheries operating in the marine waters of the Arctic, and there are no reports of serious injury or mortality of narwhals in Alaska, so the level of serious injury and mortality is considered insignificant and approaching zero. The estimated annual rate of human-caused mortality and serious injury is believed to be zero for this stock. Thus, the Alaska stock of narwhals is not classified as strategic.

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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, 2006). 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.

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, 109 'resident' whales have been identified as of 2009 (NMML and North Gulf Oceanic Society (NGOS), 3430 Main Street, Suite B1, Homer, Alaska; unpublished data). In Prince William Sound and Kenai Fjords, another 675 resident whales have been identified as of 2009 (Matkin et al. 2003; C. Matkin, North Gulf Oceanic Society, pers. comm.).

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 2009, 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 2005 and 2009 as 1,300 whales. Studies conducted in western Alaska by the 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. 2007).

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 2,084 (Southeast Alaska + Prince William Sound + Western Alaska; 109 + 675 + 1,300) 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	**1999/2000 estimate (and source)**	**2001/2004 estimate (and source)**	**2005-2009 estimate (and source)**
Southeast Alaska			
AF	49 (Dahlheim et al. 1997, Matkin et al. 1999)	61 (C. Matkin, NGOS, pers. comm.)	69 (C. Matkin, NGOS, pers. comm.)
AG	27 (Dahlheim et al. 1997, Matkin et al. 1999)	33 (C. Matkin, NGOS, pers. comm.)	40 (C. Matkin, NGOS, pers. comm.)
AZ	23+ (Dahlheim, AFSC-NMML, pers. comm.)	23+ (Dahlheim et al. 1997)	Not seen since prior to 1997
Total, Southeast Alaska	**99+**	**117+**	**109 (excluding AZ)**
Prince William Sound	**Matkin et al. 1999**	**Matkin et al. 2003 and C. Matkin, NGOS, pers. comm.**	**Matkin et al. 2003 and C. Matkin, NGOS, pers. comm.**
AA1	---	8	8
AA30	---	---	28
AB17	25	19	19
AB25	---	10	9
AD05	---	16	17
AD16	7	4	8
AE	16	19	17
AH01		9	9
AH20		12	12
AI	7	7	7
AJ	38	42	50
AK	12	13	16
AL	---	---	23
AN10	20	27	28
AN20	assume 9	33	30
AS	assume 20	21	22
AS30		14	13
AW		24	33+
AX01	21	20	29
AX27		24	25
AX32		15	19
AX40		14	14
AX48		20	23
AY	assume 11	18	17
Unassigned to pods	138 (C. Matkin, NGOS, pers. comm.)	112	199
Total, Prince William Sound/ Kenai Fjord/ Kodiak	**341**	**501**	**675**
Western Alaska	**Dahlheim et al. 1997 and NMML unpublished data[2]**	**2001/2003 NMML unpublished data[2]**	**2000-2009 NMML/NGOS unpublished catalog[2]**
Unassigned to pods (NMML)	68+	464	1,300 (D. Ellifrit pers. comm. Feb. 2010)
Total, Western Alaska	**68+**	**505**	**1,300**
Total, all areas	**507**	**1,123**	**2,084[1]**

[1]Although there is evidence (Matkin et al. 2003) the resident killer whale numbers have been increasing in the Gulf of Alaska, the bulk of the increase from the 2001-2004 counts to the 2005-2009 counts is believed to be due to the discovery of new animals, not recruitment. Animals reported here have been photographed in the 2000-2009 period. [2] Available from M. Dahlheim, National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105.

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~~2,084 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.

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 3.2% (95% CI = 1.94 to 4.36%) per year from 1990 to 2005 (Matkin et al. 2008). 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 = 20.8 animals (2,084 × 0.02 × 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 two which incurred serious injuries or mortalities of killer whales (any stock) between 2007 and 2009: the BSAI flatfish trawl and the BSAI Greenland turbot longline. The mean annual (total) mortality rate for all fisheries for 2007-2009 was 1.49 (CV = 0.19).

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., National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105). A genetics sample was not collected from the single whale killed incidental to the BSAI Greenland turbot longline, so stock identification cannot be confirmed. Thus, the mean annual estimated level of serious injury and mortality of Alaska resident killer whales is 1.49/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 often 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 2007 to 2009 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
BSAI flatfish trawl	2007 2008 2009	obs data	72 100 100	0 1 2	0 1.00 2.01	1.00 (CV = 0.04)
BSAI Pacific cod longline	2007 2008 2009	obs data	63 63 61	0 0 0	0 0 0	0
BSAI Greenland turbot longline	2007 2008 2009	obs data	64 74 74	1[1] 0 0	1.48 0 0	0.49 (CV = 0.57)
Estimated total annual mortality						1.49 (CV = 0.19)

[1] Genetics are not available to confirm whether this observed mortality was of a resident or transient killer whale. Thus, this mortality will be reflected in both SARs.

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 (1.49 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, 2006). 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).

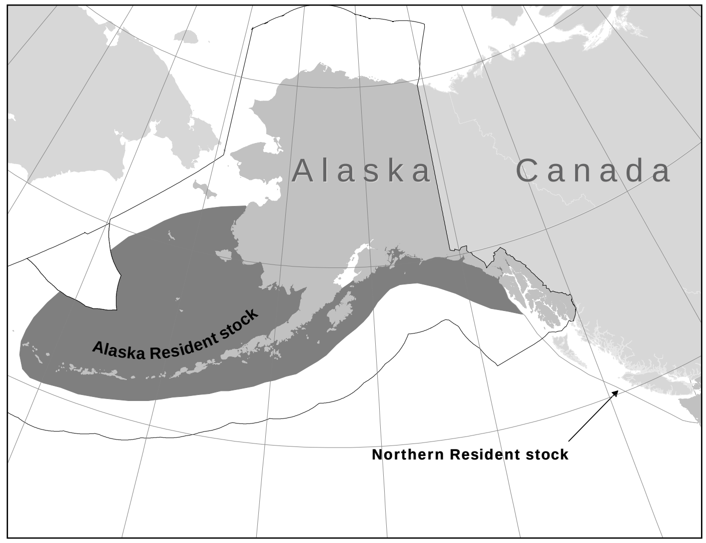

Figure 22. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). Separate stock assessment reports have always acknowledged the distinction between residents, offshore, and transient killer whale populations.

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. Alaska resident whales are found in marine waters of southern and southwestern 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. 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, 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 Eastern North Pacific Northern Resident stock is a transboundary stock, and includes killer whales that frequent British Columbia, Canada and southeastern Alaska (Ford et al. 2000). They have been seen infrequently in Washington state waters.

POPULATION SIZE

Photo-identification studies since 1970 (Ford et al. 2000) have catalogued every individual belonging to the Eastern North Pacific Northern Resident stock (note that individual whales that have been matched between geographical regions and missing animals likely to be dead have been subtracted). The photo catalog included 216 whales 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 technique used for estimating abundance 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, 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 (Wade and Angliss 1997) regarding the status of migratory transboundary stocks). This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown.

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. Their rate of increase appeared to be slowing in the early 1990s, and the population declined from approximately 1997 to 2001; the population increased back to approximately the 1997 level by 2004 (Ford et al. 2005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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). Recent analyses indicate that some pods in the Northern Resident population had increased at approximately 3% per year (P. Olesiuk as reported in Dahlheim et al. 2000). Therefore, the maximum net productivity rate (R_{MAX}) is estimated to be 3%.

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 = 1.62 animals (216 × 0.015 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Due to limited coverage by Canadian observer programs, 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. No killer whale interactions have been reported in the British Columbia halibut longline 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 could result in an underestimate of the annual mortality for this stock.

Subsistence/Native Harvest Information

Killer whales are not harvested for subsistence in Alaska or Canada.

Other Mortality

Collisions of killer whales with vessels occur occasionally. One mortality of a northern resident killer whale (C21) in Prince Rupert, BC was reported in 2006 (Williams and O'Hara 2008). 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 2001, the Committee on the Status of Endangered Wildlife in Canada designated northern resident killer whales in British Columbia as "threatened" and listed in Schedule 1 of the Species at Risk Act (SARA) for Canada. Resident killer whales in British Columbia are considered to be at risk based on their small population size, low reproductive rate, and the existence of a variety of anthropogenic threats that have the potential to prevent recovery or to cause further declines (DFO, 2008). Human-caused mortality has likely been underestimated due primarily to a lack of information on Canadian fisheries;

however, a review of the status of killer whales in Canada indicated 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 (0.16) 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 (1) is not known to exceed the PBR (1.6). 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.

HABITAT CONCERNS

Ford et al. (2005) showed that a sharp drop in coast-wide chinook salmon abundance during the late 1990s was correlated with a significant decline in resident whale survival. They noted that the whales' preference for chinook salmon is likely due to this species' relatively large size, high lipid content and, unlike other salmonids, its year-round presence in the whales' range. They further note that resident killer whales may be especially dependent on chinook during winter, when this species is the primary salmonid available in coastal waters, and the whales may be subject to nutritional stress leading to increased mortality if the quantity and/or quality of this prey resource declines.

Vessel traffic, particularly increased whale-watching activity, is another potential concern for this stock.

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KILLER WHALE (*Orcinus orca*):
Gulf of Alaska, Aleutian Islands, and Bering Sea 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, 2006). 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).

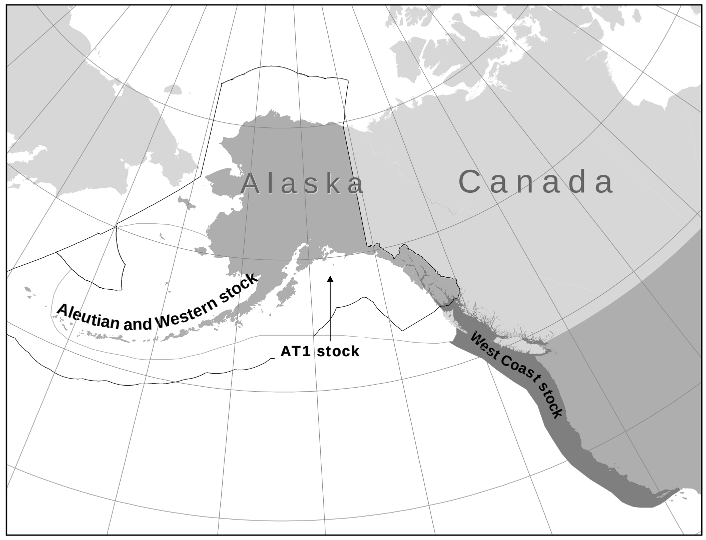

Figure 23. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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), 82 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 11 matches were found between the NGOS and NMML catalogues. Therefore, a total of 114 transients (82 + 43 - 11) have been identified in the Gulf of Alaska. In the Aleutian Islands (west of and including the Shumagin Islands) and Bering Sea, the combined NGOS/NMML catalogue (D Ellifrit, North Gulf Oceanic Society, pers. comm.) now contains 438 whales (not counting two gulf of Alaska transient whales that have been photographed in that region). All have been photographed in the past ten years. Combining the Aleutian Islands and Bering Sea count (438) with the Gulf of Alaska count (114), a total count of 552 individual whales have been identified in catalogs of this 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. 2007).

Mark-recapture methods were used to estimate the number of mammal-eating "transient" killer whales using the coastal waters from the central Gulf of Alaska to the central Aleutian Islands, using photographs collected during the three line-transect surveys (Zerbini et al. 2007), along with photographs collected from a variety of additional surveys during the same time period (Durban et al. in press). A total of 154 individuals were identified from 6,489 photographs collected between July 2001 and August 2003. A Bayesian mixture model estimated seven distinct clusters (95% Probability Interval = 7-10) of individuals that were differentially covered by 14 boat-based surveys exhibiting varying degrees of association in space and time, leading to a total estimate of 345 whales (95% Probability Interval = 255 – 487). This estimate is higher than the line-transect estimate for at least two reasons. First, the line-transect estimate provides an "instantaneous" (across ~40 days) estimate of the average number of transient killer whales in the survey area, whereas the mark-recapture methods provide an estimate of the total number of whales to use the survey area over the three years, which is known to be greater due to the long distance movements documented by satellite tags (J. Durban, Southwest Fisheries Science Center, pers. comm.). Second, the mark-recapture estimate included photographic data from a broader seasonal time period, and therefore includes transient killer whales documented in the False Pass/Unimak Island area in spring where they aggregate to prey on gray whales on migration (Matkin et al. 2007). Many of these whales have not been seen in that region in the summer. However, mark recapture estimates do not include most of the Bering Sea and Pribilof Islands.

It should be noted that the photographic catalogue encompasses a larger area, including some data from areas such as the Bering Sea and Pribilof Islands that were outside the line-transect survey area. The photo catalogue also encompasses a much long time period (through 2008). 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 20^{th} percentile of the mark-recapture estimates of 345 is ~303. A total count of 552 individual whales have been identified in the Gulf of Alaska, Aleutian Islands, and Bering Sea transient killer whale stock.The photograph catalogue estimate of transient killer whales is a direct count of individually identifiable animals. However, the number of cataloged 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 1999 to 2009, 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 cataloged is likely conservative. The catalogue count is slightly higher than the 20^{th} percentile of the mark-recapture estimates, in part because in included data from areas such as Prince William Sound and the Bering Sea that were outside the survey area.

Thus, the minimum population estimate (N_{MIN}) for the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is 552 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 = 5.5

animals (552 × 0.02 × 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 two which incurred serious injury and mortality of killer whales (any stock) between 2007 and 2009: the BSAI flatfish trawl and the BSAI Greenland turbot longline. The mean annual (total) mortality rate for all fisheries for 2007-2009 was 1.5 (CV = 0.19).

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.). A genetics sample was not collected from the single whale killed incidental to the BSAI Greenland turbot longline, so stock identification cannot be confirmed. Thus, the mean annual estimated level of serious injury and mortality of the Gulf of Alaska, Aleutian Islands, Bering Sea transient killer whale stock for 2007-2009 is 1.5/year (Table 29).

Table 29. Summary of incidental mortality of killer whales (Gulf of Alaska, Aleutian Islands, Bering Sea transient stock) due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 2007-2009 data. 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
BSAI flatfish trawl	2007 2008 2009	obs data	72 100 100	0 1 2	0 1.00 2.01	1.00 (CV = 0.04)
BSAI Greenland turbot longline	2007 2008 2009	obs data	64 74 74	1[1] 0 0	1.48 0 0	0.49 (CV = 0.57)
Estimated total annual mortality						1.49 (CV = 0.19)

[1] Genetics are not available to confirm whether this observed mortality was of a resident or transient killer whale. Thus, this mortality will be reflected in both SARs.

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 (1.5) 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 (1.5 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

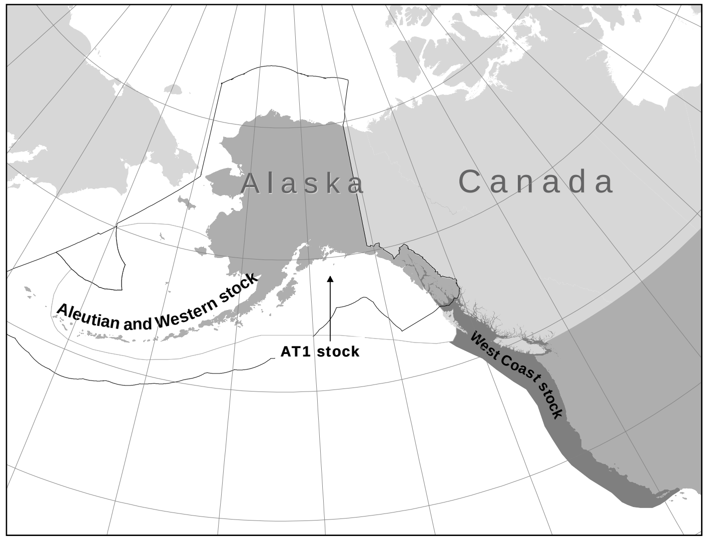

Figure 24. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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 2006). 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, Dahlheim et al. 2009), 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; Dahlheim et al. 2009) 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; Dahlheim et al. 2008). 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; Black et al. 1997; Dahlheim and White 2010).

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, Morin et al. 2010). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

~~Until recently,~~The first studies of transient killer whales in Alaska ~~had only been studied intensively~~were conducted in Southeast 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 genetically distinct 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 regularly associates with transient killer whales that range from California to Southeast 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, and are seen rarely in Southeast Alaska and British Columbia. AT1 transients have only been observed in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients within 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; Saulitis et al. (2005) 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 with mtDNA haplotypes identical with the Gulf of Alaska transients (Zerbini et al. 2007, Matkin et al. 2007), however their connection with Gulf of Alaska transients is equivocal considering there has been little documented interchange between these areas and nuclear DNA analysis has not been completed. AT1 haplotypes are also found in western Alaska, but nuclear DNA assignment tests indicate these whales are part of an Aleutian Islands population rather than part of the AT1 population (Wade 2004). Samples from the central Aleutian Islands and Bering Sea have also identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is at least one additional population in western Alaska (P. Wade, AFSC-NMML, pers comm.). At this point, analyses have not been completed to 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 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) confirm that at least 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, 1999). Gulf of Alaska transients are seen less frequently in Prince William Sound, with periods of several years between resightings.

AT1 killer whales have never been seen in association with sympatric resident killer whale pods or with Gulf of Alaska transients (Matkin et al. 1999). As discussed above, the AT1 group was found to be acoustically and genetically different from other transient killer whales in the North Pacific (Saulitis et al. 2005, Barrett-Lennard 2000). The AT1 transients appear to have a more limited geographic range than do other transients. Though seen mostly in Prince William Sound, they have also been seen in Resurrection and Aialik Bays of the Kenai Fjords year-round (Saulitis et al. 2000). Tagging of a single individual in the summer of 2010 showed movements between Prince William Sound and Kenai Fjords (Craig Matkin, NGOS, pers. comm., 17 November 2010). However, they have never been observed east of Prince William Sound or west of Kenai Fjords, Alaska, resulting in an apparent range of about 200 miles (Matkin et al. 1999).

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. 1999, Matkin el al. 2003). 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). Three of the missing AT1s (AT5, AT7, and AT8) were seen near the *Exxon*

Valdez (with AT6) shortly after the spill (Matkin et al. 1993, 1994, Matkin et al. 2008). Two whales were found stranded in 1989-1990, both genetically assigned to the AT1 population and one visually recognized as AT19 (Heise et al. 2003, Matkin et al. 1994, Matkin et al. 2008). Additional mortalities of four older males include whale AT1 found stranded in 2000, AT13 and AT17 missing in 2002 (one of which was thought to be an AT1 carcass found in 2002), and AT14 missing in 2003. A genetically assigned AT1 stranded whale found in 2003 was probably AT14, but could also have been AT13 (Matkin et al. 2008). No births have occurred in this population since 1984 and none of the missing whales have been seen since 2003 and are presumed dead. There is an extremely small probability (0.4%) that AT1 killer whales that are missing for 3 years or more are still alive (Matkin et al. 2008). No AT1 whale missing for at least 4 years has ever been re-sighted (Matkin et al., 2008). All 15 are presumed dead based on criteria that whales are dead if missing from the population for four or more years (Matkin et al. 2008). Therefore, the population size as of the summer of 2011~~0~~ is seven whales.

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, 4 of those whales have not been seen for four or more consecutive years, so the minimum population estimate is 7 whales (Matkin et al. 2008). 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 7 whales in 2009, a decline of 68%. Most of the mortalities 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 0.1, as the stock is considered depleted under the Marine Mammal Protection Act and there has been no recruitment into the stock since 1984. Thus, for the AT1 killer whale stock, PBR = 0 animals ($7 \times 0.02 \times 0.1$).

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 of killer whales. 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; however, this mortality did not involve a whale from the AT1 stock. There have been no known mortalities of AT1 killer whales due to ship strikes. Most of the mortality occurred from 1989-1991 following the *Exxon Valdez* oil spill.

STATUS OF STOCK

The AT1 Transient stock of killer whales was designated as "depleted" under the MMPA and is therefore 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 insignificant and approaching zero mortality and serious injury rate. At least 11 animals were alive in 1998, but it appears that as of 2009, only 7 individuals remain alive. The AT1 group has been reduced to 32% (7/22) 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

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, 2006). 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, Dahlheim et al., 2008, 2009), 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, Dahlheim et al., 2008, 2009) 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; Dahlheim et al. 2008). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, resident and transient 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). Although uncommon, movements of transient killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994; Black et al., 1997).

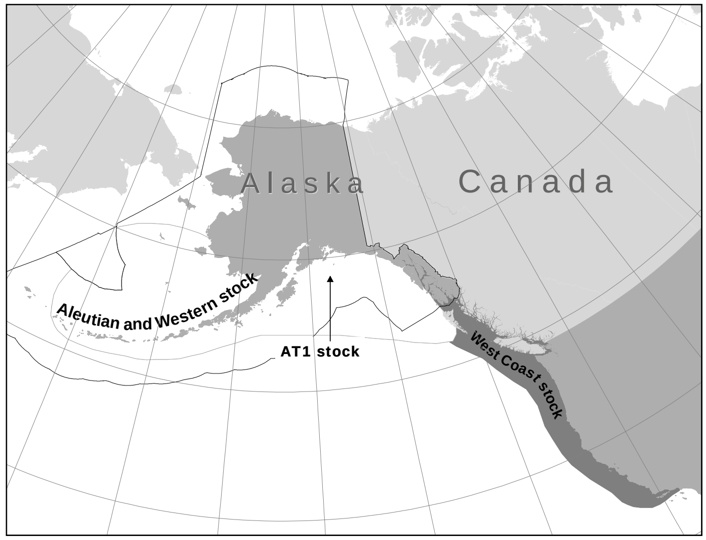

Figure 25. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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).

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.

Until recently, transient killer whales in Alaska had only been studied intensively in Southeast 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 at least 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.

On many occasions, transient whales from the inland waters of Southeast 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, and the West Coast Transient Stock is therefore considered to include transient killer whales from California to southeastern Alaska. However, it should be noted that Fisheries and Oceans Canada recently decided to exclude whales from California from their assessment of the "West Coast Transient (WCT) Population" (DFO, 2007). They noted that 100 or so transient killer whales identified off the central coast of California (Black et al. 1997) were in the past considered to be an extension of this population because of acoustical similarities and occasional mixing with WCT individuals in BC waters (Ford and Ellis 1999), but that a recent reassessment indicated that the available evidence was insufficient to warrant inclusion of those whales in the WCT population (DFO 2010). They noted this was also the case for Gulf of Alaska transients, which are seen occasionally within the range of WCTs (in southeastern Alaska) but have only been observed to travel in association with WCTs on one occasion (DFO 2007). For the purposes of this stock assessment report, the West Coast Transient Stock continues to include animals that occur in California, Oregon, Washington, British Columbia and southeastern Alaska.

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 Southeast Alaska, 219 'transient' whales have been cataloged (Ford and Ellis 1999; Dahlheim et al., 1997). 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, AFSC-NMML, 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 cataloged 'transient' whales gives a minimum number of 354 (219 + 95 + 10 + 14 + 16) killer whales belonging to the West Coast Transient stock. A recent mark-recapture estimate for the West Coast Transient population, excluding whales from California, resulted in an estimate of 243 (95% probability interval = 180-339) in 2006 (DFO 2009). This estimate applies to the population of West Coast Transient whales that occur in southeastern Alaska, British Columbia, and northern Washington.

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. However, the number of cataloged 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 cataloged is likely conservative. However, the rate of discovering new adult whales within Southeast Alaska is relatively low (Marilyn Dahlheim, AFSC-NMML, pers. comm., 20 November 2009). 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 West Coast Transient stock of killer whales is 354 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

Recent analyses indicate that the West Coast Transient population grew rapidly from the mid-1970s to mid-1990s as a result of a combination of high birth rate, survival, as well as greater immigration of animals into the nearshore study area (DFO 2009). The rapid growth of the WCT population in the mid-1970s to mid-1990s coincided with a dramatic increase in the abundance of the whales’ primary prey, harbor seals, in nearshore waters. Population growth began slowing in the mid-1990s and has continued to slow in recent years (DFO 2009).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Analyses in DFO (2009) estimated a rate of increase of about 6% per year in this population from 1975 to 2006, but this included recruitment of non-calf whales into the population, at least in the first half of the time period, interpreted as either a movement of some whales into nearshore waters from elsewhere, or from better spatial sampling coverage. The population increased at a rate of approximately 2% for the second half of the time period, when recruitment of new individuals was nearly exclusively from new-born individuals (DFO 2009). 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 $<$ 0.80 (Wade and Angliss 1997). Thus, for the West Coast Transient killer whale stock, PBR = 3.5 animals ($354 \times 0.02 \times 0.5$). 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. In 2001, the Committee on the Status of Endangered Wildlife in Canada designated west coast transient killer whales in British Columbia as "threatened" under the Species at Risk Act (SARA) for Canada. Recall that the human-caused mortality may have 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 Southeast 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 (0.4) 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 (3.5). 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).

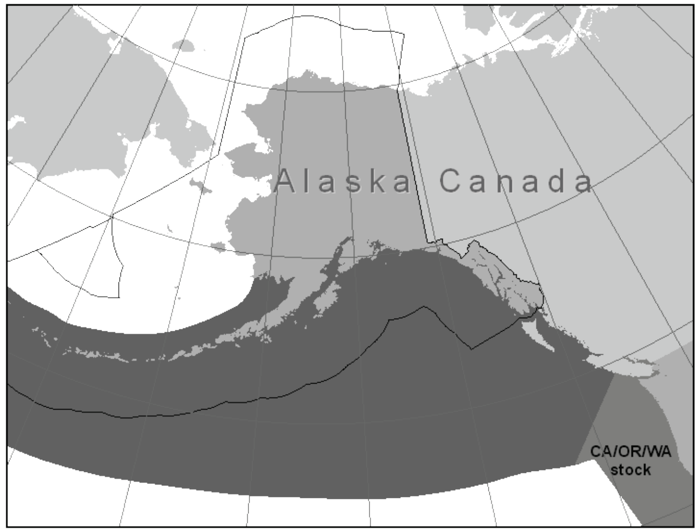

Figure 26. Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (shaded area).

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) do not support phylogeographic partitioning, though they are sufficiently differentiated to be treated as separate management units (Lux et al. 1997). This limited information is not sufficient to define stock structure throughout the North Pacific beyond the generalization that 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. Although the genetic data are unclear, management issues support the designation of two stocks.~~ 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° × 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). ~~Using the abundance estimate of 26,880, the North Pacific stock of Pacific white-sided dolphin PBR has been reported in previous stock assessments as 269 animals (26,880 × 0.02 × 0.5).~~ The estimate of abundance for Pacific white-sided dolphins 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. 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 (NMFS 2005).

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 reported between 2002 and 2006 (Perez 2006, Perez unpubl. ms).

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). No incidental takes of Pacific white-sided dolphins were recorded in the Cook Inlet salmon driftnet and setnet fisheries (1999-2000), the Kodiak Island salmon set gillnet fishery (2002 and 2005), and Yakutat salmon setnet fishery (2007 and 2008) by the Alaska Marine Mammal Observer Program, and Pacific white-sided dolphins were not among the species spotted in the area of operations (Manly et al. 2003; Manly 2006, 2007).

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.

Other mortality

From 2006-2010, there were no human-caused mortalities or serious injuies reported to the Alaska Region Stranding Program (NMFS Alaska Regional Office, unpublished data).

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

NOTE – March 2008: In areas outside of Alaska, studies of harbor porpoise distribution have shown that stock structure is more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to ~~reflect~~define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, smaller stocks are likely. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

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). Harbor porpoise primarily frequent coastal waters and in the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), they occur most frequently in waters less than 100 m deep (Hobbs and Waite 2010). Within the inland waters of Southeast Alaska harbor porpoise distribution is clumped with greatest densities observed in the Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and the adjacent waters of Sumner Strait (Dahlheim et al. 2009). 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 and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, and Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the West Coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia and the single sample from 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); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including 8 more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic, and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from Copper River Delta, 5 from Barrow, 5 from southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

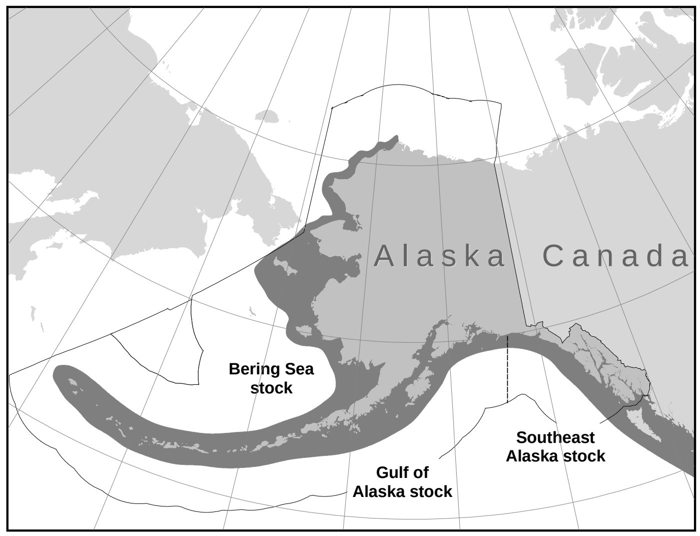

Figure 27. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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). For example, the porpoise concentrations found in Glacier Bay/Icy Strait and around the Zarembo/Wrangell Islands may represent different subpopulations (M. Dahlheim, pers comm. AFSC-NMML, 7600 Sand Point Way, NE, Seattle, WA 98115). The Alaska Scientific Review Group 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 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 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).

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 observed abundance estimate of 3,766 (CV = 0.162) animals (Hobbs and Waite 2010). 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 106,087 km^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. Two types of corrections were needed for these aerial surveys: one for observer perception bias and one to correct for porpoise availability/visibility at the surface. The observed abundance estimate includes a correction factor (1.56) for perception bias to correct for animals not counted because they were not observed. 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. The estimated corrected abundance from this survey is 11,146 (3,766 × 2.96; CV = 0.242) harbor porpoise for both the coastal and inside waters of Southeast Alaska (Hobbs and Waite, 2010). ~~Recent survey data are currently being analyzed, and a new abundance estimate and PBR for this stock will be available and incorporated into the 2012 SARs.~~

In 1991, researchers from the National Marine Mammal Laboratory (NMML) initiated harbor porpoise studies aboard the NOAA *R/V John N. Cobb* with survey coverage throughout the inland waters of Southeast Alaska. Between 1991 and 1993, line-transect methodology was used to: 1) obtain population estimates of harbor porpoise, 2) establish a baseline for detecting trends in abundance, and 3) define overall distributional patterns and seasonality of harbor porpoise. Three surveys were carried out each year spanning spring, summer, and fall. Annual surveys were continued between 1994 and 2005; however, only two trips per year were conducted, one either in spring or summer and the other in fall. Although standard line-transect methodology was not used, all cetaceans observed were recorded. During this 12-year period, observers reported fewer overall encounters with harbor porpoise. To fully assess abundance and population trends for harbor porpoise, line-transect methodology was used during the survey cruises in 2006 and 2007 (Dahlheim et al., 2009) and again in 2010. Methods were comparable to those employed during the early 1990s. Within each year, greater densities of harbor porpoise were observed in Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and adjacent waters of Sumner Strait. Total abundance in the entire study area was highest in 1991 (N = 1293, CV=0.15) and lowest in 2006 (N=485, CV=0.17) with 2010 values at N= 809, CV=0.19 (Dahlheim et al., in prep.). The overall abundance estimation assumes g(0) = 1.

Minimum Population Estimate

For the Southeast Alaska stock of harbor porpoise, the minimum population estimate (N_{MIN}) for the aerial surveys 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 estimates (N) of 11,146 and its associated CV (0.242), N_{MIN} for this stock is 9,116 (Hobbs and Waite~~, unpubl. ms~~ 2010). However, because the survey data are now ~~12~~15 years old, it is not considered a reliable minimum population estimate for calculating a PBR.

Current Population Trend

The abundance of harbor porpoise in Southeast Alaska was estimated for 1993 and 1997. Abundance estimates were determined from coastal aerial surveys from Prince William Sound to Dixon entrance, and from aerial surveys in Southeast Alaska (Dahlheim et al. 2000). These surveys produced abundance estimates of 3,982 and 1,586 for the two areas, respectively, giving a combined estimate for the range of the Southeast Alaska harbor porpoise stock of 5,568. The 1997 estimate of 11,146 is double the 1993 estimate (Hobbs and Waite 2010); however, the 1997 surveys included inside waters of Southeast Alaska while the 1993 survey covered only coastal waters. These estimates are not directly comparable because the area surveyed in 1997 was larger than that in 1993, including inside waters, 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. Dahlheim et al. (2009) found only a slight annual increase (0.2%) in harbor porpoise populations based on survey data from 1991-1993, 2006, and 2007, which is not considered a significant increase.

Population trends (*r*) for Southeast Alaska inland waters from Icy Strait/Glacier Bay to Clarence Strait were assessed from line-transect vessel survey estimates from 1991-93, 2006, 2007 and 2010 surveys with a Bayesian exponential population dynamics model. Results indicate high probability (65-99%) that the population declined between 1991 and 2010, with an overall estimated decline of nearly 3%/year. Regional trend estimates varied with greater declines in Frederick Sound (~6%/year) and Wrangell/Zarembo (~4%/year) than in Glacier Bay/Icy Strait (1%/year) (Zerbini et al., 2011). The reasons for the declines are not well understood and could include bycatch, changes in prey distribution, decrease in survival or shifts in distribution due to habitat degradation, predation, disease, or a combination of these factors. It is noteworthy that a greater decline was observed in areas where gillnet and purse-seine fisheries exist (e.g., near Wrangell where the Stikine and Prince of Wales gillnet fisheries operate (see Davidson et al., 2011).

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, using the abundance estimate calculated from 1997 surveys, the PBR for the Southeast Alaska stock of harbor porpoise would be calculated to be 91 animals (9,116× 0.02 × 0.5).~~ However, the ~~2005 revisions to the~~ SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005). ~~Recent survey data are currently being analyzed, and a new abundance estimate and PBR for this stock will be available and incorporated into the 2012 SARs.~~

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 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 2007 to 2009, 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. There is no observer coverage for inside waters of Southeast Alaska. 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.

In 2007 and 2008, the Alaska Marine Mammal Observer Program (AMMOP) placed observers in four regions where the Yakutat salmon set gillnet fishery operates. These regions included the Alsek River area, the Situk area, the Yakutat Bay area, and the Kaliakh River and Tsiu River areas. Overall observer coverage was 5.3% in 2007 and 7.6% in 2008. Based on observed mortalities during these two years, the estimated mean annual mortality of harbor porpoise in the Yakutat salmon set gillnet fishery was 21.8.

Table ##. Summary of incidental mortality of harbor porpoise from the Southeast Alaska stock due to commercial fisheries from 2007 and 2008 and calculation of the mean annual mortality rate (Manly 2009). Details of how percent observer coverage is measured are included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Yakutat salmon set gillnet	2007- 2008	obs data	5.3% 7.6%	1 3	16.1 27.5	21.8 (CV = 0.54)
Minimum total annual mortality						21.8 (CV = 0.54)

Subsistence/Native Harvest Information

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

Other Mortality

Stranding data may also provide information on additional sources of potential human-related mortality. ~~Between 2004 and~~ In 2008, there was one report to NMFS Enforcement of a harbor porpoise that had been found floating dead with approximately 91 stab wounds and chaffing on fins suggesting possible net entanglement. There were 3 mortalities of harbor porpoises due to entanglement in fishing gear near Yakutat in 2009 reported to the NMFS stranding network. One mortality occurred in a gill net and the other 2 occurred in subsistence salmon gillnets. One mortality due to gillnet entanglement was reported to the stranding network in 2010. The estimated minimum mean annual mortality of harbor porpoises in Southeast Alaska based on stranding data is 1.0 for the 5-year period from 2006-2010.

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. 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. The estimated level of human-caused mortality and serious injury based on observer data (21.8) and stranding data (1) is 22.8. Because the abundance estimates are 12 years old and the frequency of incidental mortality in commercial fisheries is not 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.

HABITAT CONCERNS

Most harbor porpoise are found in waters less than 100m in depth and often concentrate in near-shore areas and inland waters, including bays, tidal areas and river mouths (Dahlheim et al. 2009). As a result, harbor porpoise are more vulnerable to nearshore physical habitat modifications resulting from urban and industrial development, including waste management, nonpoint source runoff; and physical habitat modifications including construction of docks and other over water structures, filling of shallow areas and dredging.

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Revised 1~~2~~/~~28~~20/201~~0~~2

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

NOTE – March 2008: In areas outside of Alaska, studies of harbor porpoise distribution have shown that stock structure is more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to ~~reflect~~define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, smaller stocks are likely. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

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). Harbor porpoise primarily frequent coastal waters and in the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), they occur most frequently in waters less than 100 m deep (Hobbs and Waite 2010). 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 and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, and Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the West Coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia and the single sample from 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); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including 8 more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic, and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from Copper River Delta, 5 from Barrow, 5 from southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

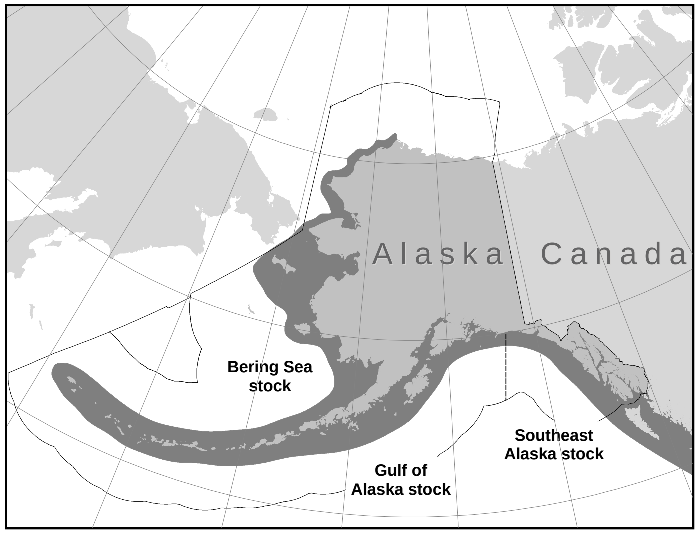

Figure 28. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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 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 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 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).

POPULATION SIZE

In June and July of 1998 an aerial survey cover~~ing~~ed the waters of the western Gulf of Alaska from Cape Suckling to Sutwik Island, offshore to the 1,000 fathom depth contour. Two types of corrections were needed for these aerial surveys: one for observer perception bias and one to correct for porpoise availability/visibility at the surface. The 1998 survey resulted in an ~~uncorrected~~ abundance estimate for the Gulf of Alaska harbor porpoise stock of 10,489 (CV = 0.115) animals (Hobbs and Waite 2010)~~. This abundance estimate~~, which includes a correction factor (1.372; CV = 0.066) for perception bias to correct for animals that were present but not counted because they were not detected by observers. 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. The estimated corrected abundance estimate from this survey is 31,046 (10,489 × 2.96 = 31,046; CV = 0.214) (Hobbs and Waite 2010).

This latest estimate of abundance (31,046) is considerably higher than the estimate reported in the 1999 stock assessment (8,271; CV = 0.309), which was based on surveys in 1991-1993. 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 combined 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 (2010) empirically estimates the perception bias, and uses this in addition to the correction factor for availability bias. 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. For these reasons, the 1998 survey result is probably more representative of the size of the Gulf of Alaska harbor porpoise 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): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 31,046 and its associated CV of 0.214, N_{MIN} for the Gulf of Alaska stock of harbor porpoise is 25,987 (Hobbs and Waite 2010). However, because the survey data are now ~~11~~14 years old, it is not considered a reliable minimum population estimate for calculating a PBR.

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, using the abundance estimate calculated from 1998 surveys, the PBR for the Gulf of Alaska stock of harbor porpoise would be calculated~~

~~as 260 animals (25,987 × 0.02 × 0.5).~~ However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Prior to 2003, three different federally-managed commercial fisheries operating within the range of the Gulf of Alaska stock of harbor porpoise were monitored by NMFS observers for incidental take: 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 State of Alaska-managed 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 8 (95% CI: 1-23) and 32 (95% CI: 3-103) kills for the entire fishery, resulting in a mean kill rate of 20 (CV = 0.60) animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). 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 state-managed Cook Inlet salmon set and drift gillnet vessels primarily because of the potential for these fisheries to cause incidental mortalities of beluga whales. One harbor porpoise mortality was observed in 2000 (Manly 2006). 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 2 years of observer data.

In 2002 and 2005, observers were placed on state-managed Kodiak Island set gillnet vessels. Two harbor porpoise mortalities were observed in both 2002 and 2005 in this fishery. These mortalities extrapolate to an estimated mortality level of 35.8 animals per year (Manly 2007).

Table 30a. Summary of incidental mortality of harbor porpoise (Gulf of Alaska stock) due to fisheries from 1990 through 2005, 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
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~~6[1]% 3.~~7~~6[1]%	0 1	0 31.2	15.6
Cook Inlet salmon set gillnet	1999 2000	obs data	~~7.3~~0.16-1.1[1]% ~~8.3~~2.7[1]%	0 0	0 0	0
Kodiak Island set gillnet	2002 2005	obs data	6.0% 4.9%	2 2	32.2 39.4	35.8 (CV = 0.68)
Minimum total annual mortality						71.4

[1] Manley, 2006.

In 2008, there was one self-report by a fisher of a mortality that occurred in a commercial silver salmon fishing net off Kalgin Island, an average annual mortality of 0.2 between 2006-2010.

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are another 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; NMFS Alaska Regional Office, Marine Mammal Stranding Database). ~~T~~Based on scar patterns, temporal-spatial analysis, and necropsy findings, these strandings were likely the result of 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 30a. There were no confirmed reports of strandings of fishery-related mortalities of harbor porpoise in this area during 1999-2003.

A reliable estimate of the total number of mortalities incidental to commercial fisheries is 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 71.4 (Table 30) + ~~1~~0.2 = ~~72~~71.6.

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. Between 200~~5~~6-2010~~9~~, the NMFS stranding network received two reports of harbor porpoise mortalities from entanglement in Cook Inlet. One mortality occurred in 2006 and another in 2008, resulting in an estimated annual mortality for this 5-year period of 0.4.

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. 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. The estimated level of human-caused mortality and serious injury is ~~74~~72 (~~72~~71.6 mortalities in commercial fisheries~~, 2 in subsistence gillnets,~~ and 0.4 strandings determined to be mortalities due to entanglement). Because the most recent abundance estimate is 11 years 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.

HABITAT CONCERNS

Most harbor porpoise are found in waters less than 100 m in depth and they often concentrate in near-shore areas, bays, tidal areas, and river mouths. As a result, harbor porpoise are vulnerable to physical modifications of nearshore habitats resulting from urban and industrial development (including waste management and nonpoint source runoff) and activities such as construction of docks and other over water structures, filling of shallow areas and dredging.

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Revised ~~12~~04/~~28~~20/201~~0~~2

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

NOTE – March 2008: In areas outside of Alaska, studies of harbor porpoise distribution have shown that stock structure is more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to ~~reflect~~define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, smaller stocks are likely. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

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). Harbor porpoise primarily frequent coastal waters and in the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), they occur most frequently in waters less than 100 m deep (Hobbs and Waite 2010). 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 and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, and Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the West Coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia and the single sample from 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); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including 8 more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic, and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from Copper River Delta, 5 from Barrow, 5 from southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

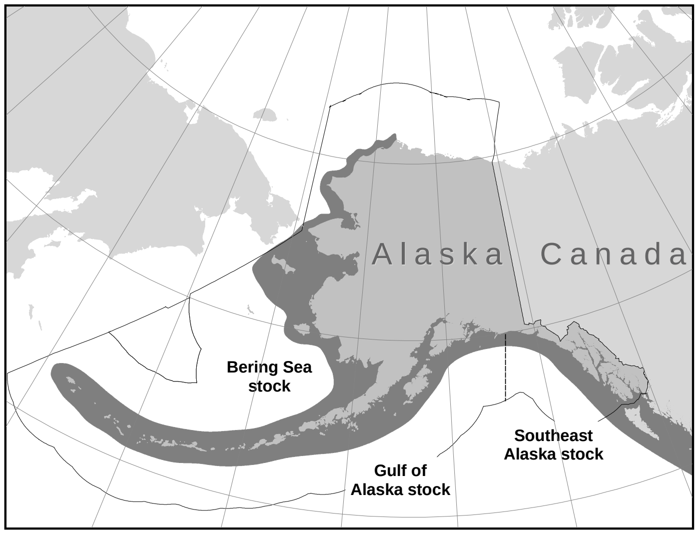

Figure 29. Approximate distribution of harbor porpoise in Alaska waters (shaded area).

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 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 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 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).

Harbor porpoises have been sighted during seismic surveys of the Chukchi Sea conducted in the nearshore and offshore waters by the oil and gas industry between July - November from 2006-2010 (Aerts et al. 2011, Funk et al. 2010, Funk et al. 2011, Reiser et al. 2011). Harbor porpoises were the third most frequently sighted cetacean species in the Chukchi Sea, after gray and bowhead whales, with most sightings occurring during the Sept.- Oct. monitoring period (Funk et al. 2011, Reiser et al. 2011). Over the 2006-2010 industry-sponsored monitoring period, six sightings of 11 harbor porpoises were reported in the Beaufort Sea, suggesting harbor porpoises are occurring more regularly in small numbers in both the Chukchi and Beaufort seas (Funk et al. 2011).

POPULATION SIZE

In June and July of 1999, an aerial survey cover~~ing~~ed the waters of Bristol Bay. Two types of corrections were needed for these aerial surveys: one for observer perception bias and one to correct for porpoise availability/visibility at the surface. The 1999 survey resulted in an observed abundance estimate for the Bering Sea harbor porpoise stock of 16,289 (CV = 0.132; Hobbs and Waite 2010). The observed abundance estimate includes a correction factor (1.337; CV = 0.062) for perception bias to correct for animals not counted because they were not observed. 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. The estimated corrected abundance estimate is 48,215 (16,289 × 2.96 = 48,215; CV = 0.223). 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). However, because the survey data are now ~~10~~12 years old, it is not considered a reliable minimum population estimate for calculating a PBR.

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 48,215 and its associated CV of 0.223, N_{MIN} for the Bering Sea stock of harbor porpoise is 40,039 (Hobbs and Waite 2010).

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 48,215 is higher than the 1991 estimate (Hobbs and Waite 2010). 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 (2010) 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 from 1991 (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, using the abundance estimate calculated from 1999 surveys, the PBR for the Bering Sea stock of harbor porpoise would be calculated to be 400 animals (40,039 × 0.02 × 0.5).~~ However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Prior to 2003, three different Federally-managed 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 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. One harbor porpoise mortality was observed in 2007 in the Bering Sea/Aleutian Islands flatfish trawl, which is the only harbor porpoise mortality observed during the 2007-2010~~9~~ period. Therefore, the mean annual (total) mortality rate resulting from observed mortalities was 0.~~71~~53.

Table 30b. Summary of incidental mortality of harbor porpoise (Bering Sea stock) due to commercial fisheries from 2007 to 2010~~9~~. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	**Years**	**Data type**	**Percent observer coverage**	**Observed mortality**	**Estimated mortality**	**Mean annual takes (CV in parentheses)**
BSAI flatfish trawl	2007 2008 2009 2010	obs data	72 100 100 100	1 0 0 0	2.1~~3~~ 0 0 0	0.~~71~~53 (CV = 0.~~72~~85)
Estimated total annual takes						0.~~71~~53 (CV = 0.~~72~~85)

The estimated minimum annual mortality rate incidental to commercial fisheries is 0.~~71~~53 animals. 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 are known to occasionally take from this stock of harbor porpoise.~~There have been historic reports of harbor porpoise mortalities from bycatch in subsistence gillnets in the area from Nome to Unalakleet (Barlow et al. 1994) and near Point Barrow (Suydam and George 1992). Bee and Hall (1956) reported on two entanglements in subsistence nets in Elson Lagoon, near Barrow, in 1952. ~~S~~More recently, subsistence fishermen in Barrow state that it is not uncommon for one or two porpoises to be caught each summer (Suydam and George 1992). In 1991, pack ice may have contributed to the relatively high number (4) of porpoises caught in subsistence nets (Suydam and George 1992). One confirmed report of an entangled animal near Emmonak occurred between 1999 and 2003. In 2007, 2 harbor porpoises were found dead in a subsistence net in Nome, AK (NMFS, Alaska Regional Office, Marine Mammal Stranding Database), resulting in an average annual mortality of 0.4 for the 2006-2010 period.

~~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). One confirmed report of an entangled animal near Emmonak occurred between 1999 and 2003. In 2007, 2 harbor porpoises were found dead in a subsistence net in Nome, AK.~~

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.~~ 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. The estimated level of human-caused mortality and serious injury relative to PBR is unknown. Because the abundance estimates are ~~10~~13 years old and information on incidental mortality in commercial fisheries is sparse, 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.

HABITAT CONCERNS

Most harbor porpoise are found in waters less than 100 m in depth and often concentrate in near-shore areas, bays, tidal areas and river mouths. As a result, harbor porpoise are more vulnerable to nearshore physical habitat modifications resulting from urban and industrial development, including waste management, nonpoint source runoff; and physical habitat modifications including construction of docks and other over water structures, filling of shallow areas and dredging. Climate change and changes to sea ice coverage may be opening up new habitats, or resulting in shifts in habitat, as evident by an increase in the number of reported sightings of harbor porpoises in the Chukchi Sea (Funk et al. 2010). Shipping and noise from oil and gas activities may also be a habitat concern for harbor porpoises, particularly in the Chukchi Sea.

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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).

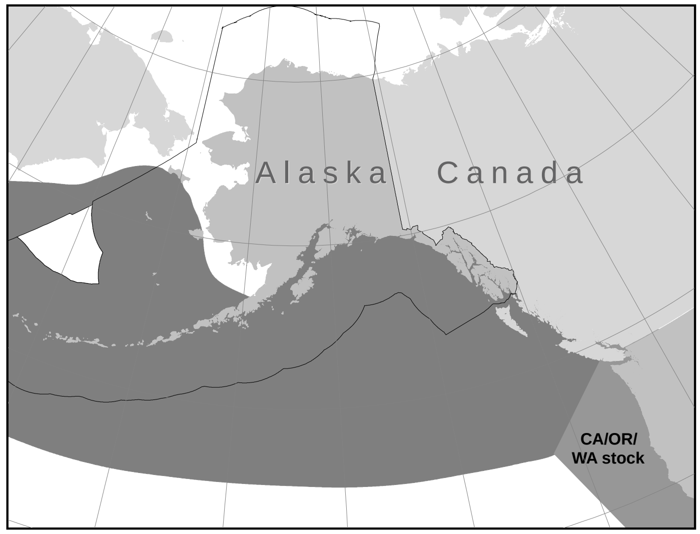

Figure 30. Approximate distribution of Dall's porpoise in Alaska waters (shaded area).

~~Recent s~~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 Alaskan 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 northern Bering Sea received little survey effort. Only 3 sightings were reported between 1987 to 1991 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 from 1987-1991 is 83,400 (417,000 × 0.2) for this stock. Surveys for this stock are greater than 21 years old, consequently there is no reliable abundance data for the Alaska stock of Dall's porpoise. No reliable abundance estimates for British Columbia are currently available.

Sighting surveys for cetaceans were conducted during a NMFS pollock acoustic survey in 1999, 2000, 2002 and 2004 on the eastern Bering Sea shelf. The area was stratified into northern and southern regions determined by the survey legs of the pollock survey, and oceanographic domains within each (Friday et al. in review).~~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).~~ Pooling the northern domains, abundance for Dall's porpoise was estimated to be 12,486 (CV = 0.38) in 1999 and 14,597 (CV=0.27) in 2002 (the northern regions were not surveyed in 2000 and 2004). Pooling the southern domains, the abundance for Dall's porpoise was estimated to be 13,012 (CV = 0.45) in 2000, 26,922 (CV = 0.92) in 2002, and 6,478 (CV = 0.36) in 2004 (the southern region were not surveyed in 1999). These estimates have not been corrected for animals missed on the trackline or animals submerged when the ship passed. They are also uncorrected for potential biases from responsive movements (ship attraction) and are, therefore, not used as minimum population estimates.

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. This stock was considered to be within optimum sustainable population (Buckland et al. 1993), thus the recovery factor (F_R) for this stock was 1.0 (Wade and Angliss 1997). However, the PBR level is currently unknown. ~~The PBR reported in the previous stock assessment was 1,537 animals (76,874 × 0.02 × 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 Dall's porpoise 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 ~~3~~4-year period (2007-2010~~9~~), as well as the annual observed and estimated mortalities are presented in Table 31.

The Alaska Peninsula and Aleutian Island salmon driftnet fishery was monitored in 1990. Observers were onboard 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~~ (0.~~41~~69) 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 28.~~4~~7 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 31. Summary of incidental mortality of Dall's porpoise (Alaska stock) due to commercial fisheries from 2007 to 2010~~9~~ and calculation of the mean annual mortality rate.

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	2007 2008 2009 2010	obs data	85 85 86 86	0 0 1 0	0 0 1.24 0	0.~~41~~31 (CV = 0.~~44~~67)
Bering Sea/ Aleutian Is. (BSAI) Pacific cod longline	2007 2008 2009 2010	obs data	63 63 61 64	0 0 1 0	0 0 1.5 0	0.38 (CV = 0.77)
Gulf of Alaska (GOA) pollock trawl	2007 2008 2009 2010	obs data	27 34 43 29	0 0 0 0	0 0 0 0	0
AK Peninsula/ Aleutian Island salmon drift gillnet	1990	obs data	4%	1	28	28 (CI: 1-81)
Minimum total annual mortality						28.~~4~~69 (CV = 0.52)

No incidental takes of Dall's porpoises were recorded in the Cook Inlet salmon driftnet and setnet fisheries (1999-2000), the Kodiak Island salmon set gillnet fishery (2002 and 2005), and Yakutat salmon setnet fishery (2007 and 2008) by the Alaska Marine Mammal Observer Program, although Dall's porpoises were among the species spotted in the area of operations (Manly et al. 2003; Manly 2006, 2007). 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.

From 2006-2010, two entanglements of Dall's porpoises have been reported to the Alaska Region Stranding Program (NMFS Alaska Regional Office, unpublished data). These animals both entangled together in a sockeye salmon gillnet in 2008, with one self-release and one mortality. The mean minimum annual mortality rate of Dall's porpoises based on stranding reports is 0.2.

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 (~~28~~29) 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 also take substantial quantities of large demersal and mesopelagic sharks, skates, and fishes (Rice 1989). 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). Although females and young sperm whales were thought to remain in tropical and temperate waters year-round, Mizroch and Rice (2006) showed that there were extensive catches of female sperm whales above 50°N and Mizroch and Rice (submitted) show female movements into the Gulf of Alaska and western Aleutians and catch concentrations in the western Aleutians. Males are ~~thought~~found ~~to move north~~ in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands (Kasuya and Miyashita 1988, Mizroch and Rice submitted). Sightings surveys conducted by NMML in the summer months between 2001 and 2006 have found sperm whales to be the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands (NMML unpublished data). Acoustic surveys detected the presence of sperm whales year-round in the Gulf of Alaska although they appear to be more common in summer than in winter (Mellinger et al. 2004). These seasonal detections are consistent with the hypothesis that sperm whales migrate to higher latitudes in summer and migrate to lower latitudes in winter (Whitehead and Arnbom 1987).

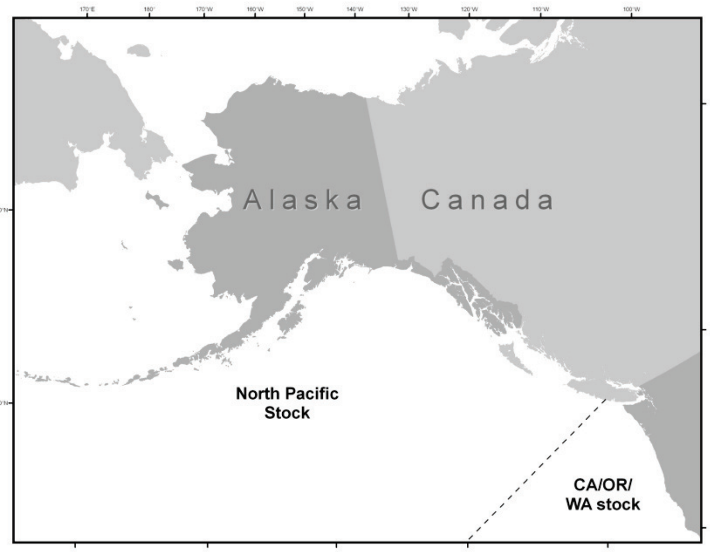

Figure 31. Approximate distribution of sperm whales in the North Pacific includes deep waters south of 62°N to the equator.

Mizroch and Rice (submitted) examined 261 Discovery ~~M~~mark ~~data~~recoveries from the days of commercial whaling (~~264 recoveries in the North Pacific with location data~~recovery data from Omura and Ohsumi 1964; Ivashin and Rovnin 1967; Ohsumi and Masaki 1975; Wada 1980; Kasuya and Miyashita 1988, DWR unpublished data) ~~show~~and found extensive movements from U.S. and Canadian coastal waters into the Gulf of Alaska and Bering Sea. ~~(Omura and Ohsumi 1964, Ivashin and Rovnin 1967, Ohsumi and Masaki 1975, Wada 1980, Kasuya and Miyashita 1988.~~ Rice (AFSC-NMML, retired, pers. comm.) marked 176 sperm whales during U.S. cruises from 1962-1970, mostly between 32° and 36° N off the California coast. Seven of those marked whales in locations ranging from offshore California, Oregon, British Columbia waters to the western Gulf of Alaska. A male whale marked by Canadian researchers moved from near Vancouver Island, British Columbia to the Aleutian Islands near Adak. A whale marked by Soviet researchers moved from coastal Michoacán, mainland Mexico to a location about 1,300km offshore of Washington state. These data show extensive movements throughout the North Pacific and along the U.S. west coast into the Gulf of Alaska and Bering Sea/Aleutian Islands region (BSAI) ~~(S. Mizroch, AFSC-NMML, pers. comm. 6 January 2011)~~. Mizroch and Rice (submitted) also analyzed whaling data and found that males and females concentrated seasonally in the subtropical frontal zone (ca. 28-34°N lat) and the subarctic frontal zones (ca. 40-43°N lat), and males also concentrated seasonally near the Aleutian Islands and along the Bering Sea shelf edge. Their analyses of marking and whaling data indicate that there are no apparent divisions between separate demes or stocks within the North Pacific.

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)~~no apparent discontinuities based on whale marking data;2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknowngenetics studies indicate the possibility of a "somewhat" discrete US coastal stock (Mesnick et al. 2011). 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.For management purposes, three stocks of sperm whales are currently recognized in U.S. waters: 1) Alaska (North Pacific stock), 2) California/Washington/Oregon, and 3) Hawaii. New information from Mizroch and Rice (submitted) suggests that this structure should be reviewed and updated, if appropriate, to reflect current data. 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

Between 2007 and 20109, there was one observed serious injuries of a sperm whale in the Gulf of Alaska sablefish longline fishery (Table 32). This animal was designated as seriously injured because it became caught in the gear, and was released alive with trailing gear.

Table 32. Summary of incidental mortality and serious injury of sperm whales due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 2007-2010~~9~~ data. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
GOA sablefish longline	2007 2008 2009 2010	obs data	~~37~~17 ~~35~~16 ~~38~~16 15	1 0 0 0	8.3~~2~~ 0 0 0	~~2.77~~2.08 (CV = 0.9~~4~~7)
Estimated total annual takes						~~2.77~~2.08 (CV = 0.9~~4~~7)

Subsistence/Native Harvest Information

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

Other Mortality

Sperm whales were the dominant species killed by the commercial whaling industry as it developed in the North Pacific in the years after the second World War (Mizroch and Rice 2006). Between 1946 and 1967, most of the sperm whales were caught in waters near Japan and in the Bering Sea/Aleutian Islands (BSAI) region. The BSAI catches were dominated by males. After 1967, whalers moved out of the BSAI region and began to catch even larger numbers of sperm whales further south in the North Pacific between 30° and 50° N (Mizroch and Rice 2006, Figs. 7-9). The reported catch of sperm whales taken by commercial whalers operating in the North Pacific between 1912 and 2006 was 261,148 sperm whales, of which, 259,120 were taken between 1946 and 1987 (International Whaling Commission, BIWS catch data, February 2008 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. Brownell et al. (2000) estimated that the U.S.S.R. under-reported catches during 1949-71 by as much as 60%. Berzin (2008) described extreme underreporting and misreporting of Soviet sperm whale catches from the mid-1960s into the early 1970s including enormous (and underreported) whaling pressure on female sperm whales in the latter years of whaling. 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 last year that the U.S.S.R reported catches of sperm whales was in 1979 and the last year that Japan reported substantial catches was in 1987, but Japanese whalers reported catches of 42 sperm whales between 2000 and 2006 (International Whaling Commission, BIWS catch data, February 2008 version, unpublished).

From 2006-2010, there were 11 sperm whale mortalities reported to Alaska Region Stranding Program (NMFS Alaska Regional Office, unpublished data). Human interaction for these cases could not be determined.

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, Sigler et al. 2008). 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 (Hanselman et al. 2008). Sperm whale depredation in the sablefish longline fishery is widespread in the Central and Eastern Gulf of Alaska, but rarely observed in the Bering Sea; the majority of interactions occur in the West Yakutat and East Yakutat/Southeast areas (Hanselman et al. 2008; Perez 2006). Sigler et al. (2008) analyzed catch data from 1998-2004 and found that catch rates were about 2% less at locations where depredation occurred, but the effect was not significant ($p = 0.34$). Hill et al. (1999) analyzed data collected by fisheries observers in Alaska waters and also found no significant effect on catch. A small, significant effect on catch rates was found in a study using data collected in southeast Alaska, in which longline fishery catches between sets were compared with sperm whales present and sets with sperm whales absent (3% reduction, t-test, 95% CI of (0.4 – 5.5%), $p = 0.02$, Straley et al. 2005). Undamaged catches may also occur when sperm whales are present; in these cases, sperm whales apparently feed off the discard.

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.

HABITAT CONCERNS

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

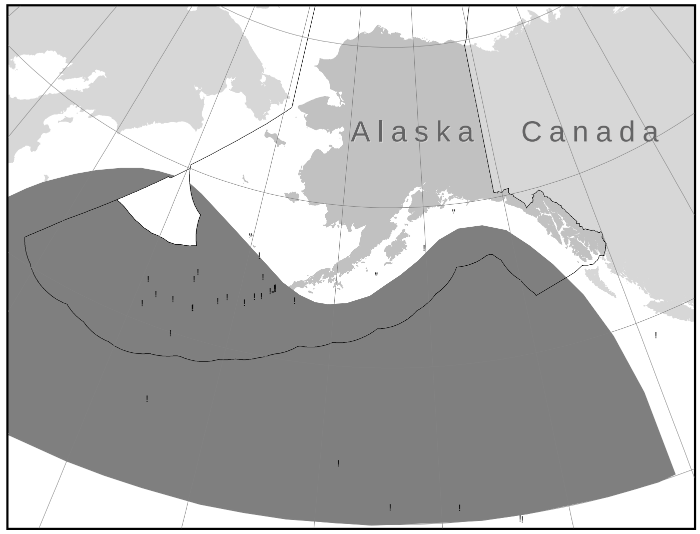

Figure 32. Approximate distribution of Baird's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted. (Forney and Brownell 1996, Moore et al. 2002, NMFS unpublished data). Note: Distribution updated based on Kasuya 2002.

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).

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

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with the Alaska stock of Baird's beaked whales. 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 of Baird's beaked whales incidental to observed commercial fisheries reported between 2002 and 2006 (Perez 2006; Perez unpubl. ms a, b).

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). Total annual catches of Baird's beaked whales in Japan were 62 in 2003 (IWC 2004), 62 in 2004 (IWC 2005), 66 in 2005 (IWC 2006), 66 in 2006 (IWC 2007), and 67 in 2007 (IWC 2008). 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.

Habitat concerns

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high.

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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).

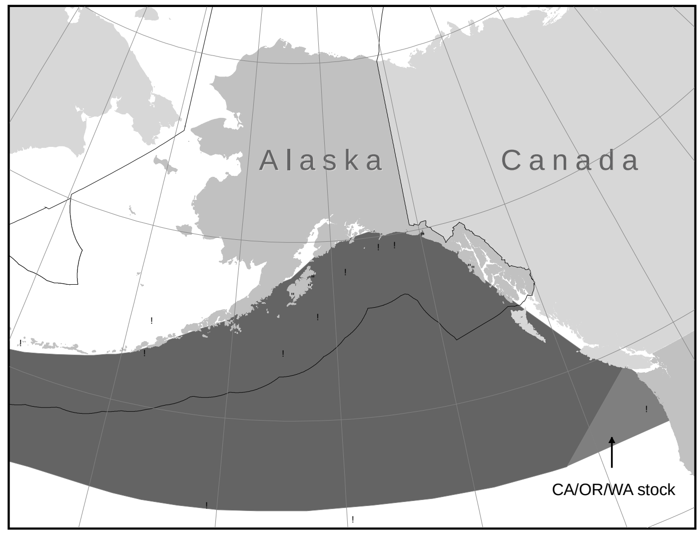

Figure 33. Approximate distribution of Cuvier's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted (Forney and Brownell 1996, NMFS unpublished data).

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.

Habitat concerns

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high.

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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).

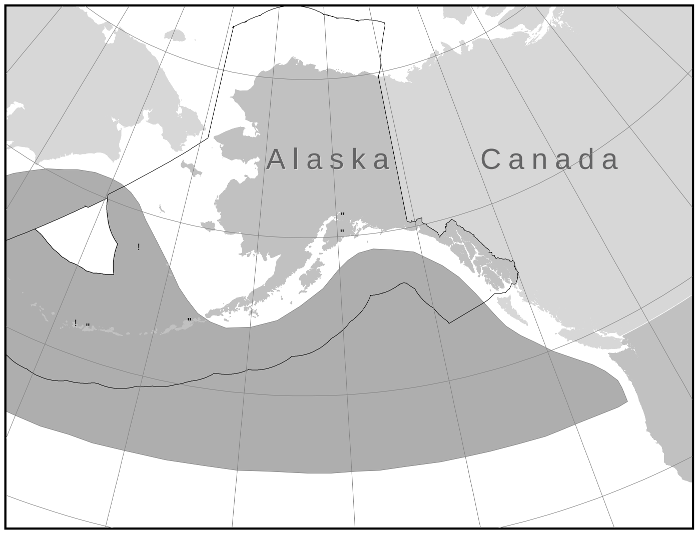

Figure 34. Approximate distribution of Stejneger's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted (Walker and Hanson 1999, NMFS unpublished data).

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.

Habitat concerns

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high.

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, Swartz et al. 2006). 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, Swartz et al. 2006).

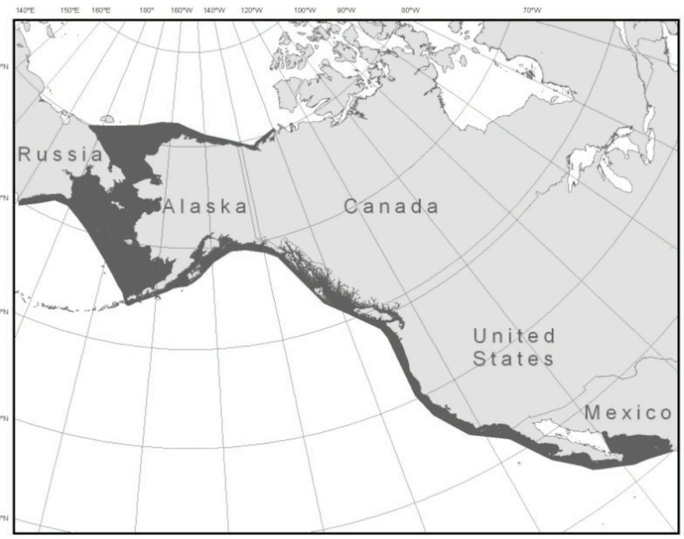

Figure 35. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area).

Most of the Eastern North Pacific stock spends the summer feeding in the northern and western Bering and Chukchi Seas (Rice and Wolman 1971, Berzin 1984, Nerini 1984). However, gray whales have been reported feeding in the summer in waters near Kodiak Island, Southeast Alaska, British Columbia, Washington, Oregon, and California (Rice and Wolman 1971, Darling 1984, Nerini 1984, Rice et al. 1984, Moore et al. 2007). 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, Calambokidis et al. 2004). 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. 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), often seen on the migration well north of Mexico (Shelden et al. 2004). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981, Rice et al. 1984; Poole 1984a), with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast.

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 southbound counts were made during the 2000/01, 2001/02, and 2006/07. Recently, Rugh et al. (2008) evaluated the accuracy of various components of the shore-based survey method, with a focus on pod size estimation. They found that the correction factors that had been used to compensate for bias in pod size estimates have been calculated differently for different sets of years. In particular, the correction factors estimated by Laake et al. (1994) were substantially larger than those estimated by Reilly (1981). The pod size corrections of Reilly (1981) were used for the 1987/88 abundance estimate and the surveys prior to 1987 in the trend analysis were scaled based on the abundance estimate from 1987/88. The larger pod size correction factors of Laake (1992) were used for all of the surveys after 1987/88. This meant that the first 16 abundance estimates used one set of correction factors, and the more recent seven abundance estimates used different (and larger) correction factors which would influence the estimated trend and population trajectory. In addition, there have been other subtle differences in the analysis methods used for the sequence of abundance estimates. Thus, a re-evaluation of the analysis techniques and a reanalysis of the abundance estimates were warranted to apply a more uniform approach throughout the years. Laake et al. (2009) developed a more consistent, approach to abundance estimation that used a better model for pod size bias with weaker assumptions. They applied their estimation approach to re-estimate abundance for all 23 surveys; therefore, the abundance estimates presented here are different from those presented in previous Stock Assessment Reports.

The new abundance estimates between 1967 and 1987 were generally larger than previous abundance estimates; differences by year between the new abundance estimate and the old estimate range from -2.5% to 21%. However, the opposite was the case for survey years 1992 to 2006, with estimates smaller (-4.9% to -29%) than previous estimates. This pattern is largely explained by the differences in the correction for pod size bias which occurred because the pod sizes in the calibration data over-represented pods of two or more whales and underrepresented single whales relative to the estimated true pod size distribution. Re-evaluation of the correction for pod size bias and the other changes made to the estimation procedure yielded a somewhat different trajectory for population growth. The estimates still show the population increased steadily from the 1960s until the 1980s. Previously, the peak abundance estimate was in 1998 followed by a large drop in numbers (Rugh et al. 2008). Now the peak estimate is a decade earlier in 1987/88. The revised estimates for the most recent years are 16,369 (CV=6.1%) in 2000/01, 16,033 (CV=6.9%) in 2001/02, and 19,126 (CV=7.1%) in 2006/07. Revised estimates from the three years prior are 20,103 (CV=5.6%) in 1993-94, 20,944 (CV=6.1%) in 1995-96, and 21,135 (CV=6.8%) in 1997-98 (Laake et al. 2009).

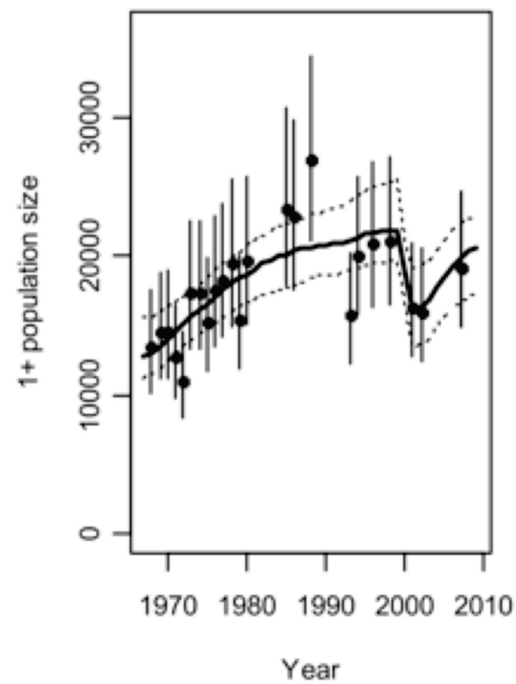

Figure 36. Estimated abundance of Eastern North Pacific gray whales from NMFS counts of migrating whales past Granite Canyon, California. Error bars indicated 90% probability intervals. The solid line represents the estimated trend of the population with 90% intervals as dashed lines (after Punt and Wade 2010).

The Eastern North Pacific population of gray whales experienced an unusual mortality event in 1999 and 2000. An unusually high number of gray whales were stranded along the west coast of North America in those years (Moore et al. 2001, Gulland et al. 2005). Over 60% of the dead whales were adults, and more adults and subadults stranded in 1999 and 2000 relative to the years prior to the mortality event (1996-98), when calf strandings were more common. Many of the stranded whales were in an emaciated condition, and aerial photogrammetry documented that gray whales were skinnier in girth in 1999 relative to previous years (Perryman and Lynn, 2002). In addition, calf production in 1999 and 2000 was less than 1/3 of that in the previous years (1996-98). 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) in 2001 and 2002, strandings of gray whales along the coast decreased to levels that were below their pre-1999 level (Gulland et al. 2005), 2) average calf production in 2002-2004 returned to the level seen in pre-1999 years, and 3) in 2001 living whales no longer appeared to be emaciated. A Working Group on Marine Mammal Unusual Mortality Events (Gulland et al. 2005) concluded that the emaciated condition of many of the stranded whales supported the idea that starvation could have been a significant contributing factor to the higher number of strandings in 1999 and 2000. Perryman et al. (2002) found a significant positive correlation between an index of the amount of ice-free area in gray whale feeding areas in the Bering Sea and their estimates of calf production for the following spring; the suggested mechanism is that more open water for a longer period of time provides greater feeding opportunities for gray whales. Unusual oceanographic conditions in 1997 may also have decreased productivity in the region (Minobe 2002). Regardless of the mechanism, visibly emaciated whales (LeBoeuf et al. 2000, Moore et al. 2001) suggest a decline in the availability of food resources, and it is clear that Eastern North Pacific gray whales were substantially affected in those years; whales were on average skinnier, they had a lower survival rate (particularly of adults), and calf production was dramatically lower. A modeling analysis estimates that 15.3% of the non-calf population died in each of the years of the mortality event, compared to about 2% in a normal year (Punt and Wade 2010). The most recent abundance estimate from 2006/07 suggests the population has nearly increased back up to the level seen in the 1990s before the mortality event in 1999 and 2000 (Fig. 36).

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), and in 2004 the index was 9% (Perryman et al. 2004). Gray whale calves have also been counted from shore stations along the California coast during the southbound migration (Shelden et al. 2004). Those results have indicated significant increases in average annual calf counts near San Diego in the mid- to late-1970s compared to the 1950s and 1960s, and near Carmel in the mid-1980s through 2002 compared to late-1960s through 1980 (Shelden et al. 2004. 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 (Shelden et al. 2004).

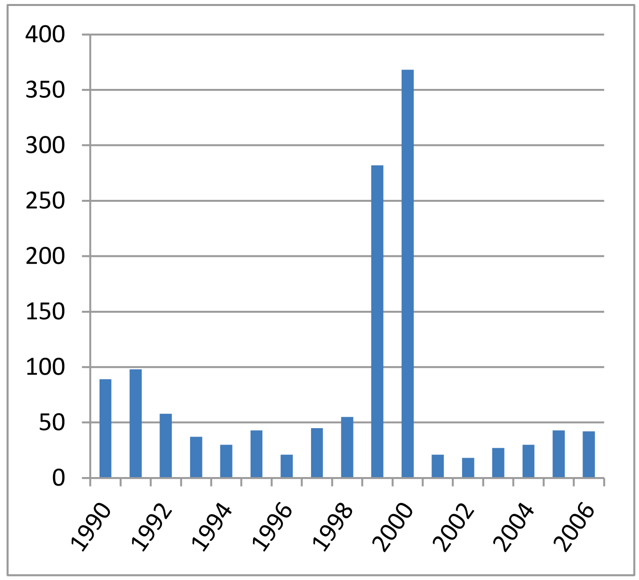

Figure 37. Number of stranded gray whales recorded along the west coast of North America between 1990 and 2006 (data from Brownell et al. 2007).

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 2006/07 abundance estimate of 19,126 and its associated CV of 0.071, N_{MIN} for this stock is 18,017.

Current Population Trend

The population size of the Eastern North Pacific gray whale stock has been increasing over the past several decades despite an unusual mortality event in 1999 and 2000. The estimated annual rate of increase, based on the unrevised abundance estimates between 1967 and 1988, is 3.3% with a standard error of 0.44% (Buckland et al. 1993); using the revised abundance time series from Laake et al. (2009) leads to an annual rate of increase for that same period of 3.2% with a standard error of 0.5% (Punt and Wade 2010).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The abundance time series has been revised (Laake et al. 2009), so estimates of productivity rates must be based on the revised time series. Using abundance data through 2006/07, an analysis of the Eastern North Pacific gray whale population led to an estimate of R_{max} of 0.062, with a 90% probability the value was between 0.032 and 0.088 (Punt and Wade 2010). 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, that accounted for the mortality event in 1999-2000. NMFS has decided to use the lower 10th percentile of that estimate of 0.040. This has the interpretation that there is a 90% probability that the true value of R_{max} is greater than 0.040. Therefore, the R_{max} for Eastern North Pacific gray whales is the same as the default value of 0.04. Therefore, NMFS will use an R_{max} of 0.040.

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 a stock estimated to be above MNPL and therefore not depleted. Thus, for the Eastern North Pacific stock of gray whales, PBR = 360 animals (18,017 × 0.02 × 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 four 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, AFSC-NMML, 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 33; 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.

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.

Table 33. Summary of incidental mortality of Eastern North Pacific gray whales due to commercial fisheries from 2003-2007 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2003-2007 (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	2003-2007	strand data	N/A	N/A, 1, 1, 1, 0	N/A	[≥0.6]
AK salmon purse seine	1999-2003	strand data	N/A	1, N/A, N/A, N/A, N/A	N/A	[≥0.5]
Pot fisheries	2003-2007	strand data	N/A	3, 0, 0, 1, 0	N/A	[≥0.8]

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
CA yellowtail/ barracuda/white seabass gillnet fishery	1999-2003	strand data	N/A	N/A, 1, N/A, N/A, N/A	N/A	[≥0.2]
Other entanglements	1999-2003	strand data	N/A	1, 2, N/A, 2, 1	N/A	[≥1.2]
Minimum total annual mortality						≥3.3

Strandings and Entanglements

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. Table 34 presents data on strandings that occurred on the U. S. west coast from 2005 to 2009; . The strandings resulting from commercial fishing are listed as unknown west coast fisheries in Table 34, unless they could be attributed to particular fisheries. During the 5-year period from 2005 to 2009, stranding network data indicate a minimum annual mean of 2.4 gray whale mortalities resulting from interactions with commercial fishing gear.

Table 34. Human-related gray whale strandings and entanglements, 2005-2009. An asterisk in the "number" column indicates cases that were not considered serious injuries. Note: NMFS convened a workshop in 2007 to review and update the guidelines for what constitutes "serious injury". Changes to the agency's guidelines resulting from this workshop may affect whether injured animals identified are considered "seriously injured" in future SARs.

Year	Number	Area	Condition	Description
2005	1	Grayland, WA	Dead	Entanglement lines on head
2005	1	Horsefall Beach, OR	Dead	Entanglement; fishing line wrapped around animal
2006	1	Grays Harbor, WA	Dead	Entangled in crab pot; rope wrapped around fluke, tailstock, mid-body, and through baleen; rope scarring on head and left side
2006	1	San Francisco Bay, CA	Dead	Fresh floating carcass; propeller wounds evident
2006	1	Cape Lookout, OR	Live	Entangled whale observed from shore; netting over rostrum and trailing long line (8-10 times length of animal) and 2 bright orange floats
2006	1	Lakeside, OR	Live/ Dead	Calf initially sighted alive entangled with crab pot and gear wrapped around tail stock and mouth; found dead 1 month later
2006	1	Bristol Bay, AK	Alive	Trailing gear; able to swim but not dive; ropes, buoys, and single line with buoys around mid-section; possible Bristol Bay gillnet
2007	1	Newport, OR	Alive	Adult found entangled in crab gear; 8 pots removed, but unable to remove 8 other buoys and several wraps of line around mid-section, left pectoral flipper, and through mouth

2007	1	Bering Sea, AK	Alive	Emacited juvenile; "S"-shaped spinal deformity; trailing 40-50 ft of line w/3 buoys; line wrapped at insertion of flukes 1-2 times; partial disentanglement, but 20-30 ft. of trailing gear remained
2008	1	Huntington Beach, CA	Dead	Calf w/propeller wounds to left dorsum from mid-body to caudal peduncle; deep external bruising on right side of head; necropsy revealed multiple cranial fractures
2009	1	Offshore Seal Beach, Orange County, CA	Alive	Gillnet wrapped around head in front of blowholes; apparent wound near net on top of head; trailing 4 ft. of netting in water
2009	1	Off Trinidad Head, CA	Alive	Adult female (mom), free-swimming w/green net w/ black floats wrapped around peduncle; gear trailing 2-3 m

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 4 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. Since then, stranding rates have been low (21, 18, 27, 30, 43, and 42 whales in 2001-2006, respectively; Brownell et al. 2007). Hypothesized reasons for the high stranding rate in 1999 and 2000 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, so the high rates were not a function of increased observational effort. The other hypotheses 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; therefore, the high rate of strandings does not seem to be an area of concern.

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. Total takes by Russian aboriginalwere 126 in 2003 (IWC 2005), 110 in 2004 (IWC 2006), 115 in 2005 (IWC 2007), 129 in 2006 (IWC 2008), and 126 in 2007 (IWC 2009). Based on this information, the annual subsistence take averaged 121 whales during the 5-year period from 2003 to 2007.

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.

One gray whale was illegally killed by hunters in Neah Bay in 2007.

STATUS OF STOCK

In 1994, due to steady increases in population abundance, the eastern North Pacific stock of gray whales 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.

Prior to the revised abundance estimates of Laake et al. (2009), Wade (2002) conducted an assessment of the Eastern North Pacific gray whale stock using survey data through 1995-96. Wade and Perryman (2002) updated the assessment in Wade (2002) to incorporate the abundance estimates from 1997-1998, 2000-2001, and 2001-2002, as well as calf production estimates from the northward migration (1994 to 2001), into a more complete analysis that further increased the precision of the results. All analyses concluded that the population was within the stock's optimum sustainable population (OSP) level (i.e., there was essentially zero probability that the population was below the stock's maximum net population level), and estimated the population in 2002 was between 71% and 102% of current carrying capacity. Similar results were found in a separate assessment (Punt et al. 2004). The Scientific Committee of the International Whaling Commission reviewed both assessments and agreed that management advice could be formulated from the results. Both assessments indicated that the population was above MSYL, and was likely close to or above its unexploited equilibrium level (IWC 2003).

Using assessment methods similar to those of Wade (2002), Wade and Perryman (2002), and Punt et al. (2004), Punt and Wade (2010) conducted the first assessment of the Eastern North Pacific gray whale stock to use the revised abundance estimates from Laake et al. (2009). From that assessment, the population is estimated to be at 91% of K, and at 129% of MNPL, with a probability of 0.884 that the population is above MNPL. Those results were consistent across all the model runs. Therefore, the assessment using the revised abundance time-series is consistent with previous assessments, and estimates the population is within OSP.

Even though the stock is within OSP, abundance will rise and fall as the population adjusts to natural and man-caused factors affecting the carrying capacity of the environment (Rugh et al. 2005). In fact, it is expected that a population close to or at the carrying capacity of the environment will be more susceptible to fluctuations in the environment (Moore et al. 2001). The recent correlation between gray whale calf production and environmental conditions in the Bering Sea (Perryman et al. 2002) may be an example of this. For this reason, it can be predicted that the population will undergo fluctuations in the future that may be similar to the 2-year event that occurred in 1999-2000 (Norman et al. 2000, Pérez-Cortés et al. 2000, Brownell et al. 2001, Gulland et al. 2005). Overall, the population increased (nearly doubled in size) over approximately the first 20 years of monitoring, and then has fluctuated for the last 30 years around its average carrying capacity. This is entirely consistent with a population approaching K.

Alter et al. (2007) used estimates of genetic diversity to infer that North Pacific gray whales may have numbered ~96,000, including animals in both the western and eastern populations, 1,100-1,600 years ago. The authors recommend that because the current estimate of the eastern stock of gray whales is at most 28-56% of this historic abundance, the stock should be designed as "depleted" under the MMPA. NMFS does not accept the recommendation made by Alter et al. (2007) for the following reasons. First, their analysis examines the population of the entire historical Pacific population of gray whales, while MMPA management occurs at the level of a stock, which in this case is the eastern north Pacific stock. It is speculative to try to determine what proportion of the estimated abundance may have been the eastern or western populations. It is also uncertain whether Alter et al.'s estimates include the Atlantic population (Palsboll et al. 2007). Second, NMFS relies on current carrying capacity in making MMPA determinations. Ecosystem conditions change over time and with those changes the carrying capacity of the ecosystem for different species will also change. NMFS adopted the practice of interpreting carrying capacity to mean "current" carrying capacity in part because it is not reasonable to expect ecosystems to remain static over a time span of thousands of years, even in the absence of human activity. Thus an estimate of stock abundance 1,100-1,600 years ago is not relevant to MMPA decision-making, even if such an estimate were available.

At present, U.S. commercial fishery-related annual mortality levels less than 36.0 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 (127.7), which includes mortalities from commercial fisheries (3.3), Russian harvest (121), unlawful hunt (1), and ship strikes and entanglements (2.4), does not exceed the PBR (360). Therefore, the Eastern North Pacific stock of gray whales is not classified as a strategic stock.

HABITAT CONCERNS

Eastern North Pacific gray whales range from subtropical lagoons in Baja Mexico to arctic seas around Alaska and eastern Russia (Braham 1984). 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). These changes are likely to affect marine mammal species in the Arctic, including the gray whale, due to the impacts of a changing Arctic environment on the species' benthic food supply. With the increase in numbers of gray whales (Rugh et al. 2005), in combination with changes in prey distribution (Grebmeier et al. 2006; Moore et al. 2007), some gray whales have moved into new feeding areas, spreading their summer range (Rugh et al. 2001). Moore and Huntington (2008) observed that "gray whales are perhaps the most adaptable and versatile of the mysticete species," are opportunistic foragers, and have recently been documented feeding year-round off Kodiak, Alaska. Bluhm and Gradinger (2008) examined likely trends in the availability of pelagic and benthic prey in the arctic and concluded that pelagic prey is likely to increase while benthic prey is likely to decrease. They noted that marine mammal species that feed both pelagically and benthically (such as gray whales) will fare better than those that only feed benthically. For gray whales, they observed that the composition of gray whale prey may be less important than the energy density at feeding sites.

Global climate change is also likely to lead to increased human activity in the arctic as sea ice decreases, including oil and gas exploration and shipping (Hovelsrud et al. 2008). This increased activity will increase the chance or oil spills and ship strikes in this portion of the whales' range. Shipping and some O&G activities have been occurring throughout the whales' range over the past several decades but have not prevented the species' recovery

Ocean acidification is another future development that could affect gray whales by affecting their prey. Increased acidity in the ocean will reduce the abundance of shell-forming organisms (Fabry et al. 2008, Hall-Spencer et al. 2008), many of which are important in the gray whales' diet (Nerini 1984, Moore and Huntington 2008).

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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. 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 (Nemoto 1957; 1959, Clapham and Mead 1999). The humpback whale population was considerably reduced as a result of intensive commercial exploitation during the 20th century.

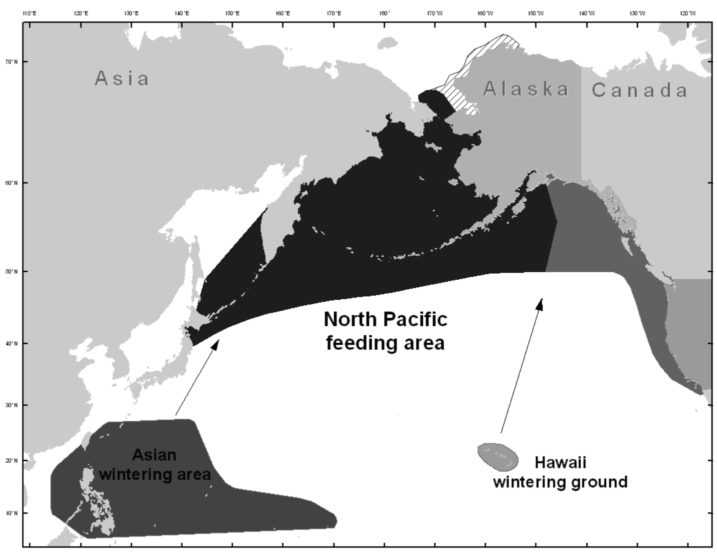

Figure 38. Approximate distribution of humpback whales in the western North Pacific (shaded area). Feeding and wintering grounds are presented above (see text). Area within the hash lines is a probable distribution area based on sightings in the Beaufort Sea (Hashagen et al. 2009). See Figure 39 for humpback whale distribution in the eastern North Pacific.

A large-scale study of humpback whales throughout the North Pacific was conducted in 2004-06 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks, or SPLASH, project). Initial results from this project (Calambokidis et al. 2008), including abundance estimates and movement information, are used in this report. Genetic results, which may provide a more comprehensive understanding of humpback whale population structure in the North Pacific, ~~should be available in the near future~~have been reported in Baker et al. (2008); however, these results are still being considered for stock structure analysis.

The historic summer 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 and north of the Bering Strait (Zenkovich 1954, Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Historically, the Asian wintering area extended from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). Humpback whales are currently found throughout this historic range, with sightings during summer months occurring as far north as the Beaufort Sea (Hashagen et al. 2009). Most of the current winter range of humpback whales in the North Pacific is relatively well known, with aggregations of whales in Japan, the Philippines, Hawaii, Mexico, and Central America. The winter range includes the main islands of the Hawaiian archipelago, with the greatest concentration along the west side of Maui. In Mexico, the winter range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedos Islands off the mainland coast. The winter range also extends from southern Mexico into Central America, including Guatemala, El Salvador, Nicaragua, and Costa Rica (Calambokidis et al. 2008).

Photo-identification data, distribution information, and genetic analyses have indicated that in the North Pacific there are at least three breeding populations (Asia, Hawaii, and Mexico/Central America) that all migrate between their respective winter/spring calving and mating areas and their summer/fall feeding areas (Calambokidis et al. 1997, Baker et al. 1998). Calambokidis et al. (2001) further suggested that there may be as many as six subpopulations on the wintering grounds. From photo-identification and Discovery tag mark information there are known connections between Asia and Russia, between Hawaii and Alaska, and between Mexico/Central America and California (Calambokidis et al. 1997, Baker et al. 1998, Darling 1991; Darling and Cerchio 1993; S. Mizroch, AFSC-NMML, pers. comm., North Pacific Humpback Whale Working Group, unpublished data). This information led to the designation of three stocks of humpback whales in the North Pacific: 1) the California/Oregon/Washington and Mexico stock, consisting of 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); 2) the Central North Pacific stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997); and 3) the Western North Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands.

New information from the SPLASH project mostly confirms this view of humpback whale distribution and movements in the North Pacific. For example, the SPLASH results confirm low rates of interchange between the three principal wintering regions (Asia, Hawaii, and Mexico). However, the full SPLASH results suggest the current view of population structure is incomplete. The overall pattern of movements is complex but indicates a high degree of population structure. Whales from wintering areas at the extremes of their range on both sides of the Pacific migrate to coastal feeding areas on the same side: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to California-Oregon. Whales from Hawaii and Mexico's offshore islands in the Revillagigedo Archipelago migrate to more central- and northern-latitude feeding areas, with considerable overlap (Calambokidis et al. 2008). Humpback whales from the Revillagigedos have been previously documented migrating to feeding areas off California, British Columbia, southeastern Alaska, Prince William Sound, and the Kodiak Island area (Gabriele et al. 1996, Calambokidis et al. 1997), and more recently Witteveen et al. (2004) reported matches between whales photographed at the Shumagin Islands in the western Gulf of Alaska between 1999 and 2002 and whales photographed in the Revillagigedos.

The SPLASH data now show the Revillagigedos whales are seen in all sampled feeding areas except California-Oregon and the south side of the Aleutians, and are primarily distributed in the Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia, but are also found in Russia and southern British Columbia/Washington. The migratory destinations of humpback whales from Hawaii were found to be quite similar, and a ~~significant~~ number of matches (14) were seen during SPLASH between Hawaii and the Revillagigedos (Calambokidis et al. 2008). This suggests a need for some modification to the current view of winter/breeding populations. A revision of population structure in the North Pacific, possibly similar to the structure based on summer feeding areas for the Atlantic population, will be considered when the full genetic results from the SPLASH project are available.

The winter distribution of humpback whales in the western stock includes several island chains in the western North Pacific. In the Ogasawara Islands, humpback sampling during SPLASH was conducted at the three main island groups of Chichi-jima, Haha-jima, and Muko-jima, separated from each other by ~50-70km. SPLASH sampling in Okinawa (southwest of Honshu) occurred at the Okinawa mainland and Zamami in the Kerama Islands (40 km from the Okinawa mainland), and in the Philippines SPLASH sampling occurred only at the northern tip of the archipelago around the Babuyan Islands. Humpback whales are reported to also occur in the South China Sea north of the Philippines near Tawian, and east of Ogasawara in the Marshall and Marianas Islands (Rice 1998), but as yet there are no known areas of high density in these regions that could be efficiently sampled. A relevant finding from the SPLASH project is that whales from the Aleutian Islands have an unusually low re-sighting rate in winter areas compared to whales from other feeding areas. To a lesser extent this is also true of whales from the Gulf of Anadyr in Russia and the Bering Sea. One explanation for this result could be that some of these whales have a winter migratory destination that was not sampled during the SPLASH project. No areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara, but this could be due to a lack of search effort.

The migratory destination of western North Pacific humpbacks is not ~~well~~completely known. Discovery tag recaptures have indicated movement of whales between Ogasawara and Okinawa and feeding areas in the Bering Sea, on the southern side of the Aleutian Islands, and in the Gulf of Alaska (Nishiwaki 1966, Omura and Ohsumi 1964, Ohsumi and Masaki 1975). Research on humpback whales at the Ogasawara Islands has documented recent movements of whales between there and British Columbia (Darling et al. 1996), the Kodiak Archipelago in the central Gulf of Alaska (Calambokidis et al. 2001), and the Shumagin Islands in the western Gulf of Alaska (Witteveen et al. 2004), but no photo-identification studies had previously been conducted in Russia. Individual movement information from the SPLASH study documents that Russia is likely the primary migratory destination for whales in Okinawa and the Philippines, but also re-confirms that some Asian whales go to Ogasawara, the Aleutian Islands, Bering Sea, and Gulf of Alaska (Calambokidis et al. 2008). A small amount of inter-yearly interchange was also found between the wintering areas (Philippines, Okinawa, and Ogasawara).

During the SPLASH study in Russia humpback whales were primarily found along the Pacific east side of the Kamchatka Peninsula, near the Commander Islands between Kamchatka and the Aleutians Islands, and in the Gulf of Anadyr just southwest of the Bering Strait. Analysis of whaling data show historical catches of humpback whales well into the Bering Sea and catches in the Bering Strait and Chukchi Sea from August-October in the 1930s (Mizroch and Rice 2007), but no survey effort occurred during SPLASH north of the Bering Strait. Other locations in the far western Pacific where humpback whales have been seen in summer include the northern Kuril Islands (V. Burkanov, AFSC-NMML, pers. comm.), far offshore southeast of the Kamchatka Peninsula and south of the Commander Islands (~~Japanese IWC reference~~Miyashita 2006), and along the north coast of the Chukotka Peninsula in the Chukchi Sea (Melnikov 2000).

These results indicate humpback whales from the western North Pacific (Asian) breeding stock overlap broadly on summer feeding grounds with whales from the central North Pacific breeding stock, as well as with whales that winter in the Revillagigedos in Mexico. Given the relatively small size of the Asian population, Asian whales probably represent a small fraction of all the whales found in the Aleutian Islands, Bering Sea, and Gulf of Alaska, which are primarily whales from Hawaii and the Revillagigedos. The only feeding area that appears to be primarily (or exclusively) composed of Asian whales is along the Kamchatka Peninsula in Russia. The initial SPLASH abundance estimates for Asia ranged from about 900-1100, and the estimates for Kamchatka in Russia ranged from about 100-700, suggesting a large portion of the Asian population occurs near Kamchatka. This also shows that Asian whales that migrate to feeding areas besides Russia would be only a small fraction of the total number of whales in those areas, give the much larger abundance estimates for the Bering Sea and Aleutian Islands (6,000-14,000) and the Gulf of Alaska (3,000-5,000) (Calambokidis et al. 2008). A full description of the distribution and density of humpback whales in the Aleutian Islands, Bering Sea, and Gulf of Alaska is in the Stock Assessment Report for the Central North Pacific stock of humpback whales.

In summary, information from a variety of sources indicates that humpback whales from the Western and Central North Pacific stocks mix to a limited extent on summer feeding grounds ranging from British Columbia through the central Gulf of Alaska and up to the Bering Sea.

POPULATION SIZE

In the SPLASH study fluke photographs were collected by over 400 researchers in all known feeding areas from Russia to California and in all known wintering areas from Okinawa and the Philippines to the coast of Central America and Mexico during 2004-2006. Over 18,000 fluke identification photographs were collected, and these have been used to estimate the abundance of humpback whales in the entire North Pacific Basin. Based on a comparison of all winter identifications to all summer identifications, the Chapman-Petersen estimate of abundance is 21,808 (CV=0.04) (Barlow et al. ~~submitted~~2011). A simulation study identifies significant biases in this estimate from violations of the closed population assumption (+5.3%), exclusion of calves (-10.3%), failure to achieve random geographic sampling (+1.5%), and missed matches (+9.8%) (Barlow et al. ~~submitted~~2011). Sex-biased sampling favoring males in wintering areas does not add significant bias if both sexes are proportionately sampled in the feeding areas. The bias-corrected estimate is 20,800 after accounting for a net positive bias of 4.8%. This estimate is likely to be lower than the true abundance due to two additional sources of bias: individual heterogeneity in the probability of being sampled (un-quantified) and the likely existence of an unknown and un-sampled wintering area (-7.2%).

~~Prior to the SPLASH study the only abundance estimates available for humpback whales on the Asian wintering grounds were from 1991-93. An average of pair-wise estimates for the years 1991-92, 1992-93, and 1991-93 results in an abundance estimate of 394 (CV = 0.084) (Calambokidis et al. 1997). This was an estimate for the Ogasawara Islands and Okinawa, but no data from the Philippines or other areas were included.~~ During the SPLASH study surveys were conducted in three winter field seasons (2004-06). The total numbers of unique individuals found in each area during the study were 77 in the Philippines, 215 in Okinawa, and 294 in the Ogasawara Islands. There were a total of 20 individuals seen in more than one area, leaving a total of 566 unique individuals seen in the Asian wintering areas. For abundance in winter or summer areas, a Hilborn mark-recapture model was used, which is a form of a spatially-stratified model that explicitly estimates movement rates between winter and summer areas. Two broad categories of models were used making different assumptions about the movement rates, and four different models were used for capture probability. Point estimates of abundance for Asia (combined across the three areas) were relatively consistent across models, ranging from 938 to 1,107. The model that fit the data the best (as selected by AICc) gave an estimate of 1,107 for the Ogasawara Islands, Okinawa, and the Philippines. Confidence limits or CVs have not yet been calculated for the SPLASH abundance estimates. Although no other high density aggregations of humpback whales are known on the Asian wintering ground, whales have been seen in other locations, indicating this is likely to represent an underestimate of the stock's true abundance to an unknown degree.

On the summer feeding grounds, the initial SPLASH abundance estimates for Kamchatka in Russia ranged from about 100-700, suggesting a large portion of the Asian population occurs near Kamchatka. No separate estimates are available for the other areas in Russia, the Gulf of Anadyr and the Commander Islands; abundance from those areas is included in the estimate of abundance for the Bering Sea and Aleutian Islands, which ranged from about 6,000 to 14,000. Abundance estimates for the Gulf of Alaska and for Southeast Alaska/northern British Columbia both ranged from 3,000-5,000 (Calambokidis et al. 2008).

From line-transect surveys Moore et al. (2000) estimated abundance of humpback whales in the central Bering Sea as 1,175 humpback whales (95% CI: 197-7,009) in 1999, though Moore et al. (2002) suggested these sightings were too clumped in the central-eastern Bering Sea to be used to provide a reliable estimate for the area. Moore et al. (2002) estimated abundance as 102 (95% CI: 40-262) for humpback whales in the eastern Bering Sea in 2000. Zerbini et al. (2006) estimated abundance of humpback whales from line-transect surveys as 2,644 (95% CI 1,899–3,680) for coastal/shelf waters from the central Gulf of Alaska through the eastern Aleutian Islands. Although there is a small amount over overlap between these surveys in the eastern Aleutian Islands, this suggests a combined total of about 4,000 whales, considerably less than the SPLASH abundance estimates, which range from 9,000 to 19,000 combined for the Aleutian Islands, Bering Sea, and Gulf of Alaska. However, the SPLASH surveys were more extensive in scope, including areas not covered in those surveys, such as parts of Russian waters (Gulf of Anadyr and Commander Islands), the western and central Aleutian Islands, offshore waters in the Gulf of Alaska and Aleutian Island, and Prince William Sound. Additionally, mark-recapture estimates can be higher than line-transect estimates because they estimate the total number of whales that have used the study area during the study period, whereas line-transect surveys provide a snapshot of average abundance in the survey area at the time of the survey.

Minimum Population Estimate

As discussed above, point estimates of abundance for Asia ranged from 938 to 1,107 (for 2004 to 2006), but no associated CV has yet been calculated. The 1991-93 abundance estimate for Asia using similar (though likely less) data had a CV of 0.084. Therefore, it is unlikely the CV of the SPLASH estimate, once calculated, would be greater than 0.300. 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 938 and an assumed conservative CV(N) of 0.30 would result in an N_{MIN} for this humpback whale stock of 732. Additionally, a total of 566 unique individuals were seen in the Asian wintering areas during the 2-year period (3 winter field seasons) of the SPLASH study.

Current Population Trend

The SPLASH abundance estimate for Asia represents a 6.7% annual rate of increase over the 1991-93 abundance estimate for Asia (Calambokidis et al. 2008). However, the 1991-93 estimate was for Ogaswara and Okinawa only, whereas the SPLASH estimate includes the Philippines, so the annual rate of increase in biased high to an unknown degree. No confidence limits are available as yet for the rate of increase.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE = 1.2%) for the well-studied humpback whale population in the Gulf of Maine, although there are indications that this rate has slowed in recent years (Clapham et al. 2003). 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. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods, and a Pradel model fit to data from Hawaii for the years 1980-1996 resulted in an estimated rate of increase of 10% per year (95% C.I. of 3-16%). For shelf waters of the northern Gulf of Alaska Zerbini et al. (2006) estimated an annual rate of increase for humpback whales from 1987-2003 of 6.6% (95% C.I. of 5.2-8.6%). The SPLASH abundance estimate for the total North Pacific represents an annual increase of 4.9% over the most complete estimate for the North Pacific from 1991-93. Comparisons of SPLASH abundance estimates for Hawaii to estimates from 1991-93 gave estimates of annual increase that ranged from 5.5 to 6.0% (Calambokidis et al. 2008). No confidence limits were calculated for these rates of increase from SPLASH data.

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). Using the smallest SPLASH abundance estimate calculated for 2004 - 2006 of 938 with an assumed CV of 0.300 for the Western North Pacific stock of humpback whale, PBR is calculated to be 2.6 animals (732 × 0.035 × 0.1). Alternatively, using the number of unique individuals seen during the SPLASH study results in a PBR of 2.0 (566 x 0.035 x 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 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 2007 and 2010~~9~~, there ~~were no~~was one ~~incidental serious injuries and~~ mortality~~ies~~ of a Western North Pacific humpback whale~~s~~ in the Bering Sea/Aleutian Islands ~~sablefish pot~~pollock trawl fishery and one in the Bering Sea/ Aleutian Islands flatfish trawl (Table 35). Average annual mortality from observed fisheries was 0.37 humpbacks from this stock (Table 35).

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 2001 and 2005; however, effort in western Alaska is low.

Table 35. Summary of incidental mortality and serious injury of humpback whales (Western North Pacific stock) due to commercial fisheries from 2007 to 2010~~9~~ and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6. 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	2007	obs data	-	0	0	0
	2008		-	0	0	
	2009		-	0	0	
	2010		-	0	0	
BSAI flatfish trawl	2007	obs data	72	0	0	0.25 (CV = 0.25)
	2008		100	0	0	
	2009		100	0	0	
	2010		100	1	1.0	

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
BSAI pollock trawl	2007 2008 2009 2010	obs data	85 85 86 86	0 0 0 1	0 0 0 1.5	0.37 (CV = 0.76)
~~Observer program total~~						~~0.62~~ ~~(CV = 0.46)~~
Minimum total annual mortality						0.62 (CV = 0.46)

.

The estimated annual mortality rate incidental to U. S. commercial fisheries is 0.62 whales per year from this stock based on 0.62 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 of the overlap in with 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. Because many mortalities pass unreported, the actual rate in these areas is likely much higher. An analysis of entanglement rates from photographs collected for SPLASH found a minimum entanglement rate of 31% for humpback whales from the Asia breeding grounds (Cascadia Research NFWF Report #2003-0170-019).

Subsistence/Native Harvest Information

Subsistence hunters in Alaska have reported one subsistence take of a humpback whale that was stranded in South Norton Sound in 2006. There have not been any additional reported takes of humpback whales from this stock by subsistence hunters in Alaska or Russia. Because this animal was in the process of stranding, this animal is not counted in the average annual mortality rate from subsistence takes for the 2005-2010~~9~~ period.

HISTORICAL WHALING

Rice (1978) estimated that the number of humpback whales in the North Pacific may have been approximately 15,000 individuals prior to exploitation; however, this was based upon incomplete data and, given the level of known catches (legal and illegal) since World War II, may be an underestimate. Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century (Rice 1978). A total of 3,277 reported catches occurred in Asia between 1910 and 1964, with 817 catches from Ogasawara between 1924 and 1944 (Nishiwaki 1966, Rice 1978). After World War II, substantial catches occurred in Asia near Okinawa (including 970 between 1958 and 1961), as well as around the main islands of Japan and the Ogaswara Islands. On the feeding grounds, substantial catches occurred around the Commander Islands and western Aleutian Islands, as well as in the Gulf of Anadyr (Springer et al. 2006).

Humpback whales in the North Pacific were theoretically fully protected in 1965, but illegal catches by the USSR continued until 1972 (Ivashchenko et al. 2007). From 1961 to 1971, 6,793 humpback whales were killed illegally by the USSR. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, additional illegal catches were made across the North Pacific, from the Kuril Islands to the Queen Charlotte Islands, and other takes in earlier years may have gone unrecorded.

STATUS OF STOCK

NMFS recently conducted a global humpback whale status review, the report of which is expected to be completed in 2012. NMFS will include the relevant results of this review in the SARs when they are available. The estimated human-related annual mortality rate (0.62) is less than the calculated conservative PBR level for this stock (2.0). The estimated human-related mortality rate based solely on mortalities that occurred incidental to U. S. commercial fisheries is 0.37; therefore, the estimated fishery mortality and serious injury rate ~~is less than~~exceeds 10% of the PBR (0.2) and cannot be considered insignificant and approaching zero. In addition, there is a lack of information about fisheries bycatch from Russia, Japan, Korea, and international waters, as well as earlier evidence of bycatch in Japan and Korea (1.1 to 2.4 whales per year based on bycatch, stranding and market data; Brownell et al. 2000).~~, T~~~~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. As a result, the Western North Pacific stock of humpback whale is classified as a strategic stock. The status of this stock relative to its Optimum Sustainable Population size is currently unknown.

HABITAT CONCERNS

Elevated levels of sound from the U. S. Navy's Low Frequency Active Sonar program and other anthropogenic sources (e.g., shipping) is a potential concern for humpback whales in the North Pacific, but no specific habitat concerns have been identified for this stock. Other potential impacts include possible changes in prey distribution with climate change, increased shipping in higher latitudes with changes in sea ice coverage, as well as oil and gas activities in the Chukchi and Beaufort seas.

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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. 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 (Nemoto 1957, 1959; Clapham and Mead 1999). The humpback whale population was considerably reduced as a result of intensive commercial exploitation during the 20th century.

A large-scale study of humpback whales throughout the North Pacific was conducted in 2004-06 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project). Initial results from this project (Calambokidis et al. 2008), including abundance estimates and movement information, are used in this report. Genetic results, which may provide a more comprehensive understanding of humpback whale population structure in the North Pacific, should be available in 2012~~0 or 2011~~.

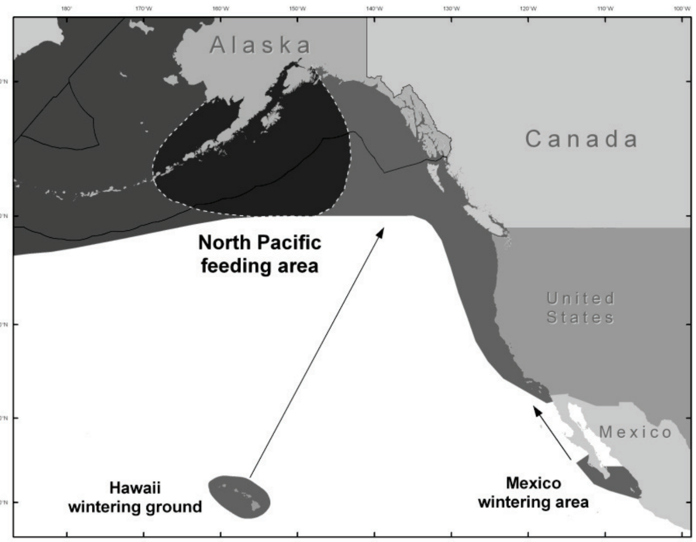

Figure 39. Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). Area within the dotted line is known to be an area of overlap with Western North Pacific stock. See Figure 38 for distribution of humpback whales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

The historic summer 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 and north of the Bering Strait (Zenkovich 1954, Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Historically, the Asian wintering area extended from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). Humpback whales are currently found throughout this historic range. Most of the current winter range of humpback whales in the North Pacific is relatively well known, with aggregations of whales in Japan, the Philippines, Hawaii, Mexico, and Central America. The winter range includes the main islands of the Hawaiian archipelago, with the greatest concentration along the west side of Maui. In Mexico, the winter range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedos Islands off the mainland coast. The winter range also extends from southern Mexico into Central America, including Guatemala, El Salvador, Nicaragua, and Costa Rica (Calambokidis et al. 2008).

Photo-identification data, distribution information, and genetic analyses have indicated that in the North Pacific there are at least three breeding populations (Asia, Hawaii, and Mexico/Central America) that all migrate between their respective winter/spring calving and mating areas and their summer/fall feeding areas (Calambokidis et al. 1997, Baker et al. 1998). Calambokidis et al. (2001) further suggested that there may be as many as six subpopulations on the wintering grounds. From photo-identification and Discovery tag mark information there are known connections between Asia and Russia, between Hawaii and Alaska, and between Mexico/Central America and California (Calambokidis et al. 1997, Baker et al. 1998, Darling 1991; Darling and Cerchio 1993; S. Mizroch, AFSC-NMML, pers. comm., North Pacific Humpback Whale Working Group, unpublished data). This information led to the designation of three stocks of humpback whales in the North Pacific: 1) the California/Oregon/Washington and Mexico stock, consisting of 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); 2) the central North Pacific stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997); and 3) the western North Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands.

New information from the SPLASH project mostly confirms this view of humpback whale distribution and movements in the North Pacific. For example, the SPLASH results confirm low rates of interchange between the three principal wintering regions (Asia, Hawaii, and Mexico). However, the full SPLASH results suggest the current view of population structure is incomplete. The overall pattern of movements is complex but indicates a high degree of population structure. Whales from wintering areas at the extremes of their range on both sides of the Pacific migrate to coastal feeding areas on the same side: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to California-Oregon. Whales from Hawaii and Mexico's offshore islands in the Revillagigedo Archipelago migrate to more central- and northern-latitude feeding areas, with considerable overlap (Calambokidis et al. 2008). Humpback whales from the Revillagigedos have been previously documented migrating to feeding areas off California, British Columbia, southeastern Alaska, Prince William Sound, and the Kodiak Island area (Gabriele et al. 1996, Calambokidis et al. 1997), and more recently Witteveen et al. (2004) reported matches between whales photographed at the Shumagin Islands in the western Gulf of Alaska between 1999 and 2002 and whales photographed in the Revillagigedos.

The SPLASH data now show the Revillagigedos whales are seen in all sampled feeding areas except California-Oregon and the south side of the Aleutians, and are primarily distributed in the Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia, but are also found in Russia and southern British Columbia/Washington. The migratory destinations of humpback whales from Hawaii were found to be quite similar, and a significant number of matches (14) were seen during SPLASH between Hawaii and the Revillagigedos (Calambokidis et al. 2008). This suggests a need for some modification to the current view of winter/breeding populations. A revision of population structure in the North Pacific~~, possibly similar to the structure based on summer feeding areas for the Atlantic population,~~ will be considered when the full genetic results from the SPLASH project are available.

The winter distribution of the central North Pacific stock is primarily in the Hawaiian archipelago. In the SPLASH study sampling occurred on Kauai, Oahu, Penguin Bank (off the southwest tip of the island of Molokai), Maui and the island of Hawaii (the Big Island). Interchange within Hawaii was extensive. Although most of the Hawaii identifications came from the Maui sub-area, identifications from the Big Island and Kauai at the eastern and western end of the region showed a high rate of interchange with Maui.

A relevant finding from the SPLASH project is that whales from the Aleutian Islands have an unusually low re-sighting rate in winter areas compared to whales from other feeding areas. To a lesser extent this is also true of whales from the Gulf of Anadyr in Russia and the Bering Sea. One explanation for this result could be that some of these whales have a winter migratory destination that was not sampled during the SPLASH project. Given the location of these feeding areas, the most parsimonious explanation would be that some of these whales winter somewhere between Hawaii and Asia, which would include the possibility of the Marianas Islands (southwest of the Ogaswara Islands), the Marshall Islands (approximately half-way between the Marianas and Hawiian Islands), and the Northwestern Hawaiian Islands. Indeed, humpback whales have been found to occur in the Northwestern Hawaiian Islands, though apparently at relatively low density (Johnston et al. 2007). No areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara, but this could be due to a lack of search effort. Which stock whales found in these locations would belong to is currently unknown.

In summer the majority of whales from the central North Pacific stock are found in the Aleutian Islands, Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia. High densities of humpback whales are found in the eastern Aleutian Islands, particularly along the north side of Unalaska Island, and along the Bering Sea shelf edge and break to the north towards the Pribilof Islands. Small numbers of humpback whales are known from a few locations not sampled during the SPLASH study, including northern Bristol Bay and the Chukchi and Beaufort Seas. In the Gulf of Alaska high densities of humpback whales are found in the Shumagin Islands, south and east of Kodiak Island, and from the Barren Islands through Prince William Sound. Although densities in any particular location are not high, humpback whales are also found in deep waters south of the continental shelf from the eastern Aleutians through the Gulf of Alaska. Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia.

POPULATION SIZE

Prior to the SPLASH study, the most complete estimate of abundance for humpback whales in the North Pacific was from data collected in 1991-93, with a best mark-recapture estimate of 6,010 (CV = 0.08) for the entire North Pacific, using a winter-to-winter comparison (Calambokidis et al. 1997). Estimates for Hawaii and Mexico were higher using marks from summer feeding areas with recaptures on the winter grounds, and totaled almost 10,000 summed across all winter areas. In the SPLASH study fluke photographs were collected by over 400 researchers in all known feeding areas from Russia to California and in all known wintering areas from Okinawa and the Philippines to the coast of Central America and Mexico during 2004-2006. Over 18,000 fluke identification photographs were collected, and these have been used to estimate the abundance of humpback whales in the entire North Pacific Basin. Based on a comparison of all winter identifications to all summer identifications, the Chapman-Petersen estimate of abundance is 21,808 (CV=0.04) (Barlow et al. ~~submitted~~2011). A simulation study identifies significant biases in this estimate from violations of the closed population assumption (+5.3%), exclusion of calves (-10.3%), failure to achieve random geographic sampling (+1.5%), and missed matches (+9.8%) (Barlow et al. ~~submitted~~2011). Sex-biased sampling favoring males in wintering areas does not add significant bias if both sexes are proportionately sampled in the feeding areas. The bias-corrected estimate is 20,800 after accounting for a net positive bias of 4.8%. This estimate is likely to be lower than the true abundance due to two additional sources of bias: individual heterogeneity in the probability of being sampled (un-quantified) and the likely existence of an unknown and un-sampled wintering area (-7.2%).

The central North Pacific 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 for 1980-83. Mobley et al. (2001) conducted aerial surveys throughout the main Hawaiian Islands during 1993, 1995, 1998, and 2000. Abundance during these line-transect 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). Before the SPLASH study, the best estimate of abundance for Hawaii from photo-identification data was 4,005 (CV = 0.10) for the years 1991-93 (Calambokidis et al. 1997). Initial mark-recapture abundance estimates have been calculated from the SPLASH data. Point estimates of abundance for Hawaii ranged from 7,469 to 10,103; the estimate from the best model (as chosen by AICc) was 10,103. Confidence limits or CVs have not yet been calculated for the SPLASH abundance estimates.

In summer feeding areas of the central North Pacific stock, photo-identification studies have been conducted in a number of locations in Alaska, but abundance estimates have been relatively modest. These include a catalogue of 315 individual humpback whales in Prince William Sound from 1977 to 2001 (von Ziegesar 1992, Waite et al. 1999, von Ziegesar et al. 2004), and mark-recapture estimates of 651 (95% CI: 356-1,523) for the Kodiak region (Waite et al. 1999) and 410 (95% CI: 241-683) for the Shumagin Islands from 1999-2002 (Witteveen et al. 2004).

From line-transect surveys Moore et al. (2000) estimated abundance of humpback whales in the central Bering Sea as 1,175 humpback whales (95% CI: 197-7,009) in 1999, though Moore et al. (2002) suggested these sightings were too clumped in the central-eastern Bering Sea to be used to provide a reliable estimate for the area. Moore et al. (2002) estimated abundance as 102 (95% CI: 40-262) for humpback whales in the eastern Bering Sea in 2000. Zerbini et al. (2006) estimated abundance of humpback whales from line-transect surveys in 2001-03 as 2,644 (95% CI 1,899–3680) for coastal/shelf waters from the central Gulf of Alaska through the eastern Aleutian Islands. Although there is a small amount over overlap between this survey and the Bering Sea surveys (in the eastern Aleutian Islands), considering both surveys this suggests a combined total of about 4,000 whales. In the SPLASH study the number of unique identifications in different regions included 63 in the Aleutian Islands (defined as everything on the south side of the Islands), 491 in the Bering Sea, 301 in the western Gulf of Alaska (including the Shumagin Islands), and 1,038 in the northern Gulf of Alaska (including Kodiak and Prince William Sound), with a few whales seen in more than one area (Calambokidis et al. 2008). The SPLASH abundance estimates ranged from 6,000 to 19,000 combined for the Aleutian Islands, Bering Sea, and Gulf of Alaska, a considerable increase from previous estimates that were available. However, the SPLASH surveys were more extensive in scope, including areas not covered in those surveys, such as parts of Russian waters (Gulf of Anadyr and Commander Islands), the western and central Aleutian Islands, offshore waters in the Gulf of Alaska and Aleutian Island, and Prince William Sound. Additionally, mark-recapture estimates can be higher than line-transect estimates because they estimate the total number of whales that have used the study area during the study period, whereas line-transect surveys provide a snapshot of average abundance in the survey area at the time of the survey. For the Aleutian Islands and Bering Sea, the SPLASH estimates ranged from 2,889 to 13,594. For the Gulf of Alaska, the SPLASH estimates ranged from

2,845 to 5,122. Given known overlap in the distribution of the western and central North Pacific humpback whale stocks, estimates for these feeding areas may include whales from the western North Pacific stock.

The SPLASH study showed a relatively high rate of interchange between Southeast Alaska and northern British Columbia, so they are considered together. Humpback whale studies have been conducted since the late 1960s 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 Southeast Alaska was 404 animals (95% CI: 350-458). Straley et al. (2009) examined data for the northern portion of southeast Alaska from 1994 to 2000 and provided an updated abundance estimate of 961 (CV=0.12). 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 had been identified in British Columbia (J. Ford, Department of Fisheries and Oceans, Canada, pers. comm.). During the SPLASH study 1,115 unique identifications were made in Southeast Alaska and 583 in northern British Columbia, for a total of 1,669 individual whales, after subtracting whales seen in both areas (1,115+583-13-16=1,669) (Calambokidis et al. 2008). From the SPLASH study estimates of abundance for Southeast Alaska/northern British Columbia ranged from 2,883 to 6,414. The estimates from SPLASH are considerably larger than the estimate from Straley et al. (2009). This is because the SPLASH estimates included areas not part of the Straley et al. (2009) estimate, including southern Southeast Alaska, northern British Columbia, and offshore waters of both British Columbia and Southeast Alaska.

Minimum Population Estimate

A total of 2,367 unique individuals were seen in the Hawaiian wintering areas during the 2-year period (3 winter field seasons) of the SPLASH study. As discussed above, point estimates of abundance for Hawaii from SPLASH ranged from 7,469 to 10,103; the estimate from the best model was 10,103, but no associated CV has yet been calculated. The 1991-93 abundance estimate for Hawaii using similar (but less) data had a CV of 0.095. Therefore, it is unlikely the CV of the SPLASH estimate, once calculated, would be greater than 0.300. The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. As a worst case, using the lowest population estimate (N) of 7,469 and an assumed conservative CV(N) of 0.30 results in an N_{MIN} for the central North Pacific humpback whale stock of 5,833.

Although the Southeast Alaska/northern British Columbia feeding aggregation is not formally considered a stock, the calculation of a PBR for this area is useful for management purposes. The total number of unique individuals seen during the SPLASH study was 1,669 (1,115 in southeast Alaska). The abundance estimate of Straley et al. (2009) had a CV of 0.12, and the SPLASH abundance estimates are unlikely to have a much higher CV. Using the lowest population estimate (N) of 2,883 and an assumed worst case CV(N) of 0.30, N_{MIN} for this aggregation is 2,251. Similarly, for the Aleutian Islands and Bering Sea, using the lowest SPLASH estimate of 2,889 with an assumed worst-case CV of 0.30 results in an N_{MIN} of 2,256. For the Gulf of Alaska, using the lowest SPLASH estimate of 2,845 with an assumed worst-case CV of 0.30 results in an N_{MIN} of 2,222. Estimates for these feeding areas may include whales from the western North Pacific stock.

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 abundance increased in Hawaii between the early 1980s and early 1990s. Mobley et al. (2001) estimated a trend of 7% per year for 1993-2000 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. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods, and a model fit to data from Hawaii for the years 1980-1996 resulted in an estimated rate of increase of 10% per year (95% C.I. of 3-16%). For shelf waters of the northern Gulf of Alaska, Zerbini et al. (2006) estimated an annual rate of increase for humpback whales from 1987-2003 of 6.6% per year (95% CI: 5.2-8.6%). The SPLASH abundance estimate for the total North Pacific represents an annual increase of 4.9% over the most complete estimate for the North Pacific from 1991-93. Comparisons of SPLASH abundance estimates for Hawaii to estimates from 1991-93 gave estimates of annual increase that ranged from 5.5 to 6.0% (Calambokidis et al. 2008). No confidence limits were calculated for these rates of increase from SPLASH data. It is also clear that the abundance has increased in Southeast Alaska, though a trend for the Southeast Alaska portion of this stock cannot be estimated from the data 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, although there are indications that this rate has slowed over the last decade (Clapham et al. 2003). Estimated rates of increase for the Central North Pacific stock include values for Hawaii of 7.0% (from aerial surveys), 5.5-6.0% (from mark-recapture abundance estimates), and 10% (95% CI 3-16%) (from a model fit to mark-recapture data), and for the northern Gulf of Alaska a value of 6.6% (95% CI 5.2-8.6%) (from ship surveys) (Calambokidis et al. 2008). Although there is no estimate of the maximum net productivity rate for the Central North Pacific 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 Central North Pacific humpback whale stock, it is recommended that 7% be employed as the maximum net productivity rate (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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. 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 is 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. For the Central North Pacific stock of humpback whale, using the smallest SPLASH study abundance estimate for 2004-06 for Hawaii of 7,469 with an assumed CV of 0.300 and its associated N_{MIN} of 5,833, PBR is calculated to be 61.2 animals (5,833 x 0.035 x 0.3). A recovery factor of 0.3 is used in calculating the PBR based on the suggested guidelines of Taylor et al. (2003).

At this time, stock structure of humpback whales is under consideration and revisions may be proposed within the next few years. One possibility would be to revise stock structure to be consistent with summer feeding aggregations, as has been done for the North Atlantic population of humpback whales. If this were to occur, possible groupings could be: Southeast Alaska/northern British Columbia, Gulf of Alaska, and Aleutian Islands/Bering Sea. For Southeast Alaska and northern British Columbia, the smallest abundance estimates from the SPLASH study were used with an assumed worst-case CV of 0.3 to calculate PBRs for feeding areas. Using the suggested guidelines presented in Taylor et al. (2003), it would be appropriate to use a recovery factor of 0.3 only for the Southeast Alaska/ northern British Columbia feeding aggregation since this aggregation has an Nmin greater than 1,500 and less than 5,000 and an increasing population trend. A recovery factor of 0.1 is appropriate for the Aleutian Islands and Bering Sea feeding aggregation and the Gulf of Alaska feeding aggregation because the Nmin is greater than 1,500 and less than 5,000 and based on an unknown population trend. For the Southeast Alaska/northern British Columbia feeding aggregation PBR is calculated to be 23.6 (2,251 x 0.035 x 0.3). For the Aleutian Islands and Bering Sea, PBR is calculated to be 7.9 (2,256 x 0.035 x 0.1). For the Gulf of Alaska, PBR is calculated to be 7.8 (2,222 x 0.035 x 0.1).

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 2007 and 2010~~9~~, there were no incidental serious injuries and mortalities of central North Pacific humpback whales in the Bering Sea/Aleutian Islands sablefish pot fishery nor in the Hawaii shallow set longline fishery (Table 36).

Table 36. Summary of observer reported incidental mortalities and serious injuries of humpback whales (Central North Pacific stock) due to commercial fisheries from 2007 to 2010~~9~~ 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/ serious injury (in given yrs.)	Estimated mortality/ serious injury (in given yrs.)	Mean annual mortality/ serious injury
Bering Sea sablefish pot	2007 2008 2009 2010	obs data	- - - -	0 0 0 0	0 0 0 0	0
HI shallow set longline	2007 2008 2009 2010	obs data	100 100 100 100	0 0 0 0	0 0 0 0	0
Minimum total annual mortality				North: 0 SE: 0.0 HI: 0 Total: 0		

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 200~~3~~6 to 2010~~7~~ are provided in Appendix 8 and a summary of the information is provided in Table 37. Overall, there were ~~86~~84 reports of human-related mortalities or injuries during this 5-year period. Of these, there were ~~54~~55 incidents which involved commercial fishing gear, and ~~23~~18 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 37. Summary of central North Pacific humpback whale mortalities and serious injuries caused by commercial and recreational fishery entanglement and ship strikes from stranding reports, 200~~3~~6-2010~~7~~. 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 (200~~3~~6-2010~~7~~)
North	Ship strike	~~2003~~	~~0~~	~~0~~	~~0~~	0.~~2~~6
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~1~~	~~0~~	~~1~~	
		2006	0	0	0	
		2007	0	0	1	
		2008	1	2	0	
		2009	0	0	1	
		2010	0	0	0	
	Unspecified gear	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.2~~0.4
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~1~~	
		2006	0	1	0	
		2007	0	0	1	
		2008	0	0	0	
		2009	0	1	0	
		2010	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (200~~3~~6-2010~~7~~)
	Salmon set gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified set gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	0~~.2~~
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~1~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Purse seine	~~2003~~	~~0~~	~~0~~	~~0~~	0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified pot gear	~~2003~~	~~0~~	~~0~~	~~0~~	0.2
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	1	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Crab pot gear	~~2003~~	~~0~~	~~0~~	~~0~~	0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Yakutat salmon set gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (200~~3~~6-2010~~7~~)
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Cook Inlet salmon set gillnet	~~2003~~	~~N/A~~	~~N/A~~	~~N/A~~	0~~.2~~
		~~2004~~	~~N/A~~	~~N/A~~	~~N/A~~	
		~~2005~~	~~0~~	~~1~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Kodiak salmon purse seine	~~2003~~	~~N/A~~	~~N/A~~	~~N/A~~	0~~.2~~
		~~2004~~	~~N/A~~	~~N/A~~	~~N/A~~	
		~~2005~~	~~1~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Lower Cook Inlet salmon purse seine	~~2003~~	~~N/A~~	~~N/A~~	~~N/A~~	0~~.2~~
		~~2004~~	~~N/A~~	~~N/A~~	~~N/A~~	
		~~2005~~	~~1~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Average annual serious injury/mortality rate commercial fisheries only					~~1.2~~0.6
	Average annual serious injury/mortality rate total					~~1.4~~1.2
SE	Ship strike	~~2003~~	~~1~~	~~0~~	~~0~~	~~1.4~~0.8
		~~2004~~	~~2~~	~~1~~	~~0~~	
		~~2005~~	~~1~~	~~1~~	~~0~~	
		2006	0	0	1	
		2007	1	0	1	
		2008	0	0	0	
		2009	0	1	2	
		2010	2	0	0	
	Unspecified gear	~~2003~~	~~0~~	~~0~~	~~0~~	0.6
		~~2004~~	~~0~~	~~2~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~1~~	
		2006	1	0	4	
		2007	0	0	2	
		2008	0	0	0	
		2009	0	2	0	
		2010	0	0	2	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (200~~3~~6-2010~~7~~)
	Salmon set gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.0~~0.2
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~1~~	
		2006	0	0	0	
		2007	0	0	1	
		2008	0	0	0	
		2009	0	0	1	
		2010	0	1	3	
	Unspecified drift gillnet	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.2~~0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~1~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified net gear	~~2003~~	~~1~~	~~0~~	~~0~~	~~0.2~~0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Purse seine	~~2003~~	~~0~~	~~0~~	~~0~~	0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (200~~3~~6-2010~~7~~)
	Unspecified pot gear	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.2~~0.4
		~~2004~~	~~0~~	~~1~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	2	0	
	Crab pot gear	~~2003~~	~~0~~	~~1~~	~~0~~	~~0.6~~0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~2~~	~~2~~	
		2006	0	0	1	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	1	
		2010	0	0	0	
	Recreational crab pot gear	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.2~~0.0
		~~2004~~	~~0~~	~~1~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified longline gear	~~2003~~	~~0~~	~~0~~	~~0~~	0.0
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	1	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Unspecified shrimp gear	~~2003~~	~~0~~	~~0~~	~~0~~	~~0.0~~0.2
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	1	
		2008	0	0	0	
		2009	0	1	0	
		2010	0	0	0	
	Halibut longline	~~2003~~	~~0~~	~~0~~	~~0~~	0.2
		~~2004~~	~~0~~	~~0~~	~~0~~	
		~~2005~~	~~0~~	~~0~~	~~0~~	
		2006	0	1	0	
		2007	0	0	0	
		2008	0	0	0	

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (200~~3~~6-2010~~7~~)
		2009	0	0	0	
		2010	0	0	0	
	SE salmon drift gillnet	~~2003~~	~~N/A~~	~~N/A~~	~~N/A~~	~~0.2~~0.0
		~~2004~~	~~N/A~~	~~N/A~~	~~N/A~~	
		~~2005~~	~~1~~	~~0~~	~~0~~	
		2006	0	0	0	
		2007	0	0	0	
		2008	0	0	0	
		2009	0	0	0	
		2010	0	0	0	
	Average annual serious injury/mortality rate fishery only					~~2.2~~1.6
	Average annual serious injury/mortality rate total					~~3.8~~2.4
Hawaii	Unspecified gear	~~2005~~	~~0~~	~~0~~	~~0~~	0.4
		2006	0	0	0	
		2007	0	1	0	
		2008	0	1	0	
		2009	0	0	0	
		2010	0	0	0	
	Average annual serious injury/mortality rate fishery only					0.4
	Average annual serious injury/mortality rate total					0.4

Summary of central North Pacific humpback whale mortalities and serious injuries caused by entanglement and ship strikes based on stranding reports, 200~~3~~6-2010~~7~~.

	Vessel collisions	Commercial fishery related	Recreational fishery related	Total SI/M
Northern AK	0.~~2~~6	~~1.2~~0.6	0	~~1.4~~1.2
Southeast AK	~~1.4~~0.8	~~2.2~~1.6	~~0.2~~0.0	~~3.8~~2.4
TOTAL	~~1.6~~1.4	~~3.4~~2.2	~~0.2~~0.0	Average annual SI/M (200~~3~~6-2010~~7~~): ~~5.2~~3.6

The overall U. S. commercial fishery-related minimum mortality and serious injury rate for the entire stock is ~~3.8~~2.6 humpback whales per year, based on observer data from Alaska (0), observer data from Hawaii (0), stranding records from Alaska (~~3.4~~2.2), and stranding records from Hawaii (0.4). The estimated fishery-related minimum mortality and serious injury rate incidental to commercial fisheries for the northern portion of the stock is ~~1.6~~1.0 humpback whales per year, based on observer data from Alaska (0), stranding records from Alaska (~~1.2~~0.6), observer data from Hawaii (0), and stranding data from Hawaii (0.4) (Table 37). The estimated minimum mortality and serious injury rate incidental to the commercial fisheries in southeast Alaska is ~~2.8~~1.0 humpback whales per year, based on observer data from Hawaii (0~~.2~~), stranding records from Alaska (~~2.2~~1.6), and stranding data from Hawaii (0.4) (Table 37). The serious injury records from Hawaii were included in the minimum mortality and serious injury estimates for both the northern portion and southeast Alaska portion of this stock.

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 are not authorized to take from this stock of humpback whales, and no takes have been reported.

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 37. Of those, ~~eight~~seven ship strikes constitute "other sources" of mortality or serious injury; ~~seven~~four of these ship strikes occurred in Southeast Alaska and ~~one~~three 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 200~~3~~6 to 2010~~7~~, these account for an additional ~~1.6~~1.4 humpback whale mortalities per year for the entire stock (0.~~2~~6 ship strikes/year for the northern portion of the stock, and ~~1.4~~0.8 strikes/year for the Southeast portion).

HISTORICAL WHALING

Rice (1978) estimated that the number of humpback whales in the North Pacific may have been approximately 15,000 individuals prior to exploitation; however, this was based upon incomplete data and, given the level of known catches (legal and illegal) since World War II, may be an underestimate. Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century. Humpback whales in the North Pacific were theoretically protected in 1965, but illegal catches by the U.S.S.R. continued until 1972 (Ivashchenko et al. 2007). From 1961 to 1971, 6,793 humpback whales were killed illegally by the USSR. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, additional illegal catches were made across the North Pacific, from the Kuril Islands to the Queen Charlotte Islands, and other takes in earlier years may have gone unrecorded.

On the feeding grounds of the central North Pacific stock after World War II the highest density of catches occurred around the western Aleutian Islands, in the eastern Aleutian Islands (and adjacent Bering Sea to the north and Pacific Ocean to the south), and British Columbia (Springer et al. 2006). Lower but still relatively high density of catches occurred south of the Commander Islands, along the south side of the Alaska Peninsula and around Kodiak Island. Lower densities of catches also occurred in the Gulf of Anadyr, in the central Aleutian Islands, in much of the offshore Gulf of Alaska, and in Southeast Alaska.

No catches were reported in the winter grounds of the central North Pacific stock in Hawaii, nor in Mexican winter areas.

STATUS OF STOCK

NMFS recently conducted a global humpback whale status review, the report of which is expected to be completed in 2012. NMFS will include the relevant results of this review in the SARs when they are available. As the estimated annual mortality and serious injury rate for the entire stock (~~5.6~~4.0; ~~3.8~~2.6 of which were commercial fishery-related; Table 38) is considered a minimum, it is unlikely that the level of human-caused mortality and serious injury exceeds the PBR level (61.2) for the entire stock. The estimated annual mortality and serious injury rate in Southeast Alaska (~~4.0~~2.8, of which ~~2.4~~2.0 were commercial fishery-related) is less than the PBR level if calculated only for the Southeast Alaska portion of the population (23.3), or for the Southeast Alaska/northern British Columbia feeding aggregation (23.6). The estimated annual mortality and serious injury rate in the Northern area (Gulf of Alaska, Aleutian Islands, Bering Sea) is ~~1.8~~1.6, which does not exceed the combined PBR for these feeding areas (15.7). The minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock is less that 10% of the calculated PBR for the entire stock (6.1) and, therefore, can 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 38. Summary of average annual serious injury (SI) and mortality (M) levels for the central North Pacific (CNP) stock of humpback whales based on strandings (200~~3~~6-2010~~7~~) and observer data (2007-2010~~9~~).

Area	Data types for fishery-related information						Ship strikes	Total	"PBR"
	AK Observer	AK Strand.	HI Observer	HI Strand.	Total Commercial	Total Rec.			

	data		data		fish.	fish.			
Northern	0	~~1.2~~0.6	0	0.4	~~1.6~~1.0	0	0.~~2~~6	~~1.8~~1.6	15.7
Southeast	~~N/A~~0	~~2.2~~1.6	0	0.4	~~2.6~~2.0	~~0.2~~0.0	~~1.4~~0.8	~~4.2~~2.8	23.3
Southeast Alaska/northern British Columbia									23.6
TOTAL	0	~~3.4~~2.2	0	0.4[1]	~~3.8~~2.6[2]	~~0.2~~0.0	~~1.6~~1.4	~~5.6~~4.0	61.2

[1] The average annual SI/M in HI is 0.4.

[2] This is the sum of the observed SI/M (0), the AK strandings (~~3.4~~2.2), and the average HI stranding rate (0.4). The value for the HI stranding rate is included in the sum for both the northern and southeast portions of the stock; however, it is only counted once in the total SI/M for the entire stock.

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. Additional concerns have been raised about the impact of jet skis and similar fast waterborne tourist-related traffic, notably in nearshore areas inhabited by mothers and calves. 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.

Elevated 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 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, 2006, Watkins et al. 2000, Stafford et al. 2007). Moore et al. (1998, 2006) Watkins et al. (2000), and Stafford et al. (2007) 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 these may be important feeding areas during the winter. While peaks in call rates occurred during late summer, fall and winter in the central North Pacific and the Aleutian Islands, fin whale calls were seldom detected during summer months even though fin whales are regularly seen in summer months in the Gulf of Alaska (Stafford et al. 2007). In addition, fin whale calls were detected in the southeast Bering Sea using an instrument moored there from ~~from~~ April 2006 through April 2007, which showed peaks fin whale in call detections from September through November 2006 and also in February and March 2007 (Stafford et al. 2010). While seasonal differences in recorded call rates are in some cases 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). Some fin whale calls have also been recorded in Hawaiian waters in all months except June and July (Thompson and Friedl 1982; McDonald and Fox 1999). Sightings of fin whales in Hawaii are extremely rare: There was a sighting in 1976 (Shallenberger 1981), a sighting by Dale Rice in 1979 (Mizroch et al. 2009), ~~and~~ a sighting during an aerial survey in 1994 (Mobley et al. 1996), and 5 sightings during a survey in 2002 (Barlow 2006).

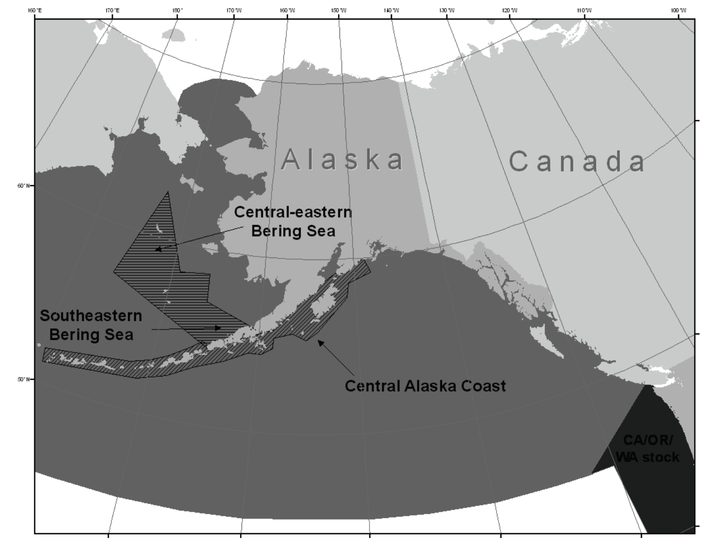

Figure 40. Approximate distribution of fin whales in the eastern North Pacific (shaded area). Striped areas indicate where vessel surveys occurred in 1999-2000 (Moore et al. 2002) and 2001-2003 (Zerbini et al. 2006).

Surveys in the central-eastern and southeastern Bering Sea in 1999 and 2000 and in coastal waters of the Aleutian Islands and the Alaska Peninsula 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. 2006). 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 eastern and western groups, which are isolated though may intermingle around the Aleutian Islands. Discovery mark recoveries (Rice 1974; Mizroch et al. 2009) indicate that animals wintering off the coast of southern California range from central California to the Gulf of Alaska during the summer months.

Mizroch et al. (2009) provided a comprehensive summary of whaling catch data, Discovery mark recoveries, and opportunistic sightings data and found evidence that suggests there may be at least 6 populations of fin whales: 2 that are migratory (eastern and western North Pacific) and 2 to 4 more that are resident year-round in peripheral seas such as the Gulf of California, East China Sea, Sanriku-Hokkaido and possibly in the Sea of Japan. It appears likely that the two migratory stocks mingle in the Bering Sea in July and August, rather than in the Aleutian Islands as Fujino (1960) concluded (Mizroch et al. 2009). During winter months, fin whales have been seen over a wide geographic area from 23°N to 60°N, but winter distribution and location of primary wintering areas (if any) are poorly known and need further study. ~~It appears likely that the two migratory stocks mingle in the Bering Sea in July and August, rather than in the Aleutian Islands as Fujino (1960) concluded.~~ As a result, stock structure of fin whales remains uncertain.

For management purposes, three stocks of fin whales are currently recognized in U.S. Pacific waters: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. New information from Mizroch et al. (2009) suggests that this structure should be reviewed and updated, if appropriate, to reflect current data. 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. Two recent studies provide some information on the distribution and occurrence 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 the presence of at least a few fin whales in waters off of Hawaii.

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. 2006). 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. (2006) estimated that 1,652 (95% CI: 1,142-2,389) whales occurred in the area.

Minimum Population Estimate

Information on abundance of fin whales in Alaskan waters has improved considerably in the past few years. 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. (2006). Using this approach, the provisional estimate of the fin whale population west of the Kenai Peninsula would be 5,700. This is a minimum estimate for the entire stock because it was estimated from surveys which covered only a small portion of the range of this stock.

Current Population Trend

Zerbini et al. (2006) estimated rates of increase 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 estimated for the period 1987-2003. This estimate is the first available for North Pacific fin whales and is consistent with other estimates of population growth rates of large whales. It should be used with caution, however, due to uncertainties in the initial population estimate for the first trend year (1987) and due to uncertainties about the population structure of the fin whales in the area. Also, the study represented only a small 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 (5,700 × 0.02 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Between 2007 and 20~~1~~09, there were no observed incidental mortalities of fin whales in the any Alaska commercial fishery (Table 39).

Table 39. Summary of incidental serious injury and mortality of fin whales due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 2007-2010~~9~~ data. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
BSAI pollock trawl	2007 2008 2009 2010	obs data	85 85 86 86	0 0 0 0	0 0 0 0	0
Estimated total annual takes						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). ~~Two~~Three ship strikes of fin whales occurred in Alaska waters between 200~~5~~6-2010~~9~~ (one in 2006, one in 2009, and one in 2010) and have been reported in the Alaska Region stranding database (NMFS Alaska Regional Office, unpublished data), resulting in an annual mean mortality rate of 0.6fin whales.

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 total estimated annual rate of mortality and serious injury for this stock is ~~0.4~~0.6 based on takes incidental to U. S. commercial fisheries (0) and ship strikes (~~0.4~~0.6) and 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.

HABITAT CONCERNS

~~There are no known habitat issues that are of particular concern for this stock.~~ Potential impacts on fin whale habitat include possible changes in prey distribution with climate change, range extension and increased shipping in higher latitudes with changes in sea ice coverage, as well as oil and gas activities in the Chukchi and Beaufort seas.

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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, in 1991 the International Whaling Commission (IWC) recognize~~s~~d 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).

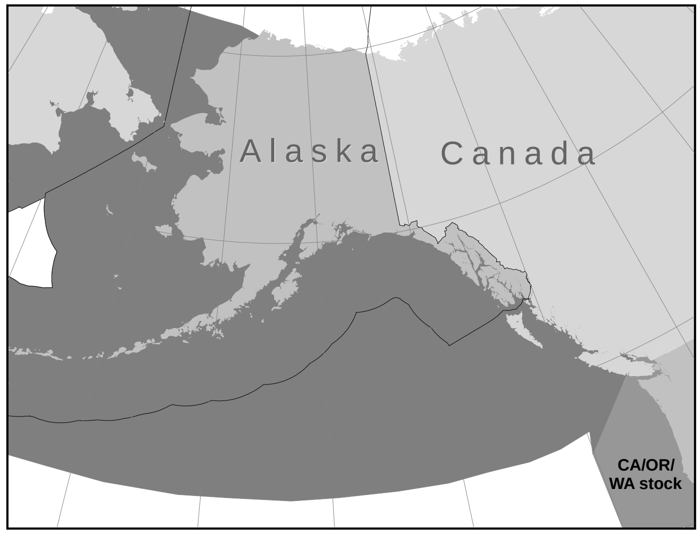

Figure 41. Approximate distribution of minke whales in the eastern North Pacific (shaded area).

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 (Dorsey et al. 1990). 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 some areas of Alaska. 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. Additionally, line-transect surveys were conducted in shelf and nearshore waters (within 30-45nm of land) in 2001-2003 from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands. Minke whale abundance was estimated to be 1,233 (CV=0.34) for this area (Zerbini et al. 2006). This estimate has also not been corrected for animals missed on the trackline. The majority of the sightings were in the Aleutian Islands rather than in the Gulf of Alaska, and in water shallower than 200 m. 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 2002-2006: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. In 1989, one minke whale mortality (extrapolated to 2 mortalities) was observed in the Bering Sea/Gulf of Alaska joint-venture groundfish trawl fishery, the predecessor to the current Alaska groundfish trawl fishery. The Bering Sea/Aleutian Islands groundfish trawl fishery incurred one mortality of a minke whale in 2000, which extrapolated to an estimated two minke whale mortalities for that year. The total estimated mortality and serious injury incurred by this stock as a result of interactions with U. S. commercial fisheries for 200~~2~~6-2010~~6~~ is 0.

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~~reported catches (2 whales) in Alaska occurred in 1989 (Anonymous 1991), but reporting is likely incomplete. Based on this information, the annual subsistence take averaged zero minke whales during the ~~3~~5-year period from ~~1993~~2006 to ~~1995~~2010.

Other Mortality

From 2006-2010, six dead minke whales have been reported to the Alaska Region Stranding Program (NMFS Alaska Regional Office, unpublished data). Two of these mortalities occurred in 2007, one of which was determined to be the result of a vessel strike. Four of these incidents occurred in 2010. The total mean annual mortality due to human-related causes based on stranding data is 0.2 for this 5-year period.

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 (0.2), this stock is presumed to not ~~considered~~be 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, Shelden et al. 2005). Although whaling records initially indicated that right whales ranged across the entire North Pacific north of 35°N and occasionally as far south as 20°N (Scarff 1986, 1991; Fig. 42), recent analysis shows a pronounced longitudinally bimodal distribution (Josephson et al. 2008a). 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). An analysis conducted on the North Pacific right whale fishery by Josephson et al. (2008b) showed that within the course of a decade (1840s), right whale abundance was severely depleted, particularly in the eastern portion of their range. During 1965-99, following large illegal catches by the U.S.S.R., 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).

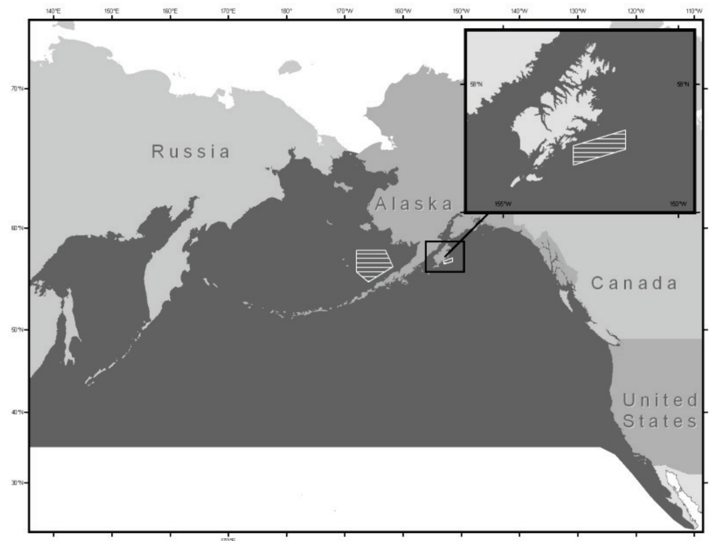

Figure 42. Approximate historical distribution of North Pacific right whales in the eastern North Pacific (shaded area). Striped areas indicate northern right whale critical habitat (71 FR 38277, 6 July 2006).

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 been identified (Scarff 1986). Migratory patterns of North Pacific right whales are unknown, although it is thought they migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly well 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 most summers 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, LeDuc et al. 2001, Moore et al. 2000, Moore et al. 2002). Bottom-mounted acoustic recorders were deployed in the southeastern Bering Sea and the northern Gulf of Alaska starting in 2000 to document the seasonal distribution of right whale calls (Mellinger et al. 2004). Analysis of the data from those recorders deployed between October 2000 and January 2006 indicates that right whales remain in the southeastern Bering Sea from May through December with peak call detection in September (Munger and Hildebrand 2004). Data from recorders deployed between May 2006 and April 2007 show the same trends (Stafford and Mellinger 2009). Recorders deployed from 2007 on have not yet been fully analyzed, but seem to indicate the presence of right whales well into February in 2009 & 2010 (available Catherine Berchok, NOAA/AFSC/NMML, 7600 Sand Point Way, Seattle, WA; unpublished data). Use of this habitat may intensify in mid-summer through early fall based on higher monthly and daily call detection rates. Rates of detection on the middle shelf (<100 m depth) suggests that right whales pass through intermittently and typically do not remain longer than a few days (Munger and Hildebrand 2004, Munger et al. 2008). 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).

The use of satellite telemetry has been implemented to provide information about habitat use and population size. 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 together 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 by genotyping from skin biopsies. During a NMFS survey in 2008, a second right whale, last sighted in 2002, was satellite-tagged. The animal remained inside the Bering Sea critical habitat providing further indication of this area's importance as foraging habitat for eastern North Pacific right whales. Similarly, three other whales that were tagged in July and August 2009 remained within the critical habitat for periods of days to weeks (Phil Clapham, AFSC-NMML, pers. comm., 9 October 2009).

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 four 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 additional lone animals were observed off Kodiak Island in the Barnabas Canyon area from NOAA surveys in August 2004, 2005, and 2006 (available Alex Zerbini, AFSC-NMML, 7600 Sand Point Way, Seattle, WA; unpublished data). Acoustic monitoring from May 2000 to July 2001 at seven sites in the Gulf of Alaska detected right whale calls at only two: one off eastern Kodiak (detection distance 20-50 km) and the other in deep water south of the Alaska Peninsula (detection distance 10s of kilometers) (Mellinger et al. 2004).

Many of the illegal Soviet catches of right whales occurred across a large area to the southeast of Kodiak, where right whales were found in tight feeding concentrations (primarily in 1963 and 1964, Doroshenko 2000). Whether this region remains an important habitat for this species, or whether cultural memory of its existence has been lost, is currently unknown. The sightings and acoustic detection of right whales east of Kodiak indicates at least occasional continuing use of this area.

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 Western North Pacific and an Eastern North Pacific stock (Rosenbaum et al. 2000, Brownell et al. 2001). The former is believed to feed primarily in the Sea of Okhotsk.

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 mature female with a calf had been confirmed since 1900. However, confirmed sightings over the last 14 years, starting in 1996 (Goddard and Rugh 1998), 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", including the population in the Ohkotsk Sea.

There were several sightings of North Pacific right whales in the mid-1990s which renewed interest in conducting dedicated surveys for this species. Right whales can be individually identified by photographs of the unique callosity patterns on their heads. In April 1996 a right whale was sighted off Maui (Salden and Mickelsen 1999) , and that same animal was identified 119 days later and 4,111km north (in the Bering Sea); this represents the first high- to low-latitude match of a North Pacific right whale (Kennedy et al. in press). ~~This~~The April Maui sighting was the first documented sighting of a right whale in Hawaiian waters since 1979 (Herman et al. 1980, Rowntree et al. 1980) and, even though the photographic match confirms that Bering Sea animals occasionally travel south,although there is no reason to believe that either Hawaii or tropical Mexico have ever been anything except extra-limital 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). The individual seen in Hawaii was one of the whales seen in the southeastern Bering Sea later the same year (1996), and that individual was observed again in 2008, 2009, and 2010 (Amy Kennedy, AFSC-NMML, pers. comm., 3 November 2009). This represents the first high to low latitude North Pacific right whale match and proves at least one annual migration of at least 2200nm.

DuringIn 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. Genetic 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).

During the southest Bering Sea survey in 2002, 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). This concentration also included two probable calves. In the southeast Bering Sea during September 2004, multiple right whales were acoustically located and subsequently sighted by another survey vessel approaching a near-real-time position of an individual located with a satellite tag (Wade et al. 2006). An analysis of photographs confirmed at least 17 individual whales (not including the tagged whales). Genetic analysis of biopsy samples identified 17 individuals: 10 males and 7 females. The discovery of 7 females was significant as only 1 female had been identified previously,. Genetics also confirmed the presence of and at least two calves were present. In 2008, 8 right whales were sighted during NMFS vessel and aerial surveys of the southeastern Bering Sea and North Aleutian Basin.From 2007 to 2010, 12 individual right whales were seen (some individuals were seen many times over all survey years).

Photographic and genotype data through 2008 were used to calculate the first mark-recapture estimates of abundance for right whales in the Bering Sea and Aleutian Islands, resulting in estimates of 31 (95% CL 23-54, CV=0.22) and 28 (95% CL 24-42), respectively (Wade et al. 20110). The abundance estimates are for the last year of each study, corresponding to 2008 for the photo-identification estimate, and 2004 for the genetic identification estimates. Wade et al. (20110) also estimate the population consists of eight females (95% CL 7-18) and 20 males (95% CL 17-37). Wade et al. (20110) summarized the photo-identification and genetic-identification catalogues as follows. Twenty-one individuals were identified from genotyping from the Aleutian Islands and Bering Sea from 1997-2004, comprising 15 males and 6 females. In aggregate, there were 8 matches across years involving 5 individuals. Wade et al. (2006) reported 17 individuals (including 7 females) identified from genotyping in 2004; that number was revised to 16 individuals (including 6 females) because a typographical error was subsequently discovered that masked a duplicate sample. There were 4 biopsies taken in 2008 and 2009 of 2 males and 2 females; three of these animals had been sampled in previous years. These samples were only recently processed and did not make it into Wade et al (2011) abundance estimate (Amy Kennedy, pers comm., 21 September 2011).

The photo-identification catalogue, for purposes of abundance estimation, was restricted to aerial andor left-side oblique photographs of good or excellent photo quality. After this restriction, there were a total of eighteen unique individuals identified from photographs of callosity patterns and scars from 1998-2008, with 10 resights across years involving 5 individuals.

Another 7 individuals were observed in the summer of 2009 (Amy Kennedy, AFSC-NMML, pers. comm. 3 November 2010). One individual was seen in the summer of 2010 (Amy Kennedy, AFSC-NMML, pers. comm. 3 November 2010).

Detections of right whales have been very rare in the Gulf of Alaska, even though large numbers of whales were caught there in the 1800s. From the 1960s through 2002, only two sightings of right whales occurred in the Gulf of Alaska: an opportunistic sighting in March 1979 near Yakutat Bay in the eastern Gulf (Shelden et al. 2005) and a sighting during an aerial survey for harbor porpoise in July 1998 south of Kodiak Island, Alaska, USA (Waite et al. 2003). Both sightings occurred in shelf waters less than 100 m deep. However, from 2004 to 2006, four sightings of right whales occurred in the Barnabus Trough region on Albatross Bank, south of Kodiak Island, Alaska, USA (Wade et al. 2011). Sightings of right whales occurred at locations within the trough with the highest density of zooplankton, as measured by active-acoustic backscatter. Photo-identification (of two whales) and genotyping (of one whale) failed to reveal a match to Bering Sea right whales. Fecal hormone metabolite analysis from one whale estimated levels consistent with an immature male, indicating either recent reproduction in the Gulf of Alaska or movements between the Bering Sea and Gulf of Alaska.

In recent decades, the only detections of right whales in pelagic waters of the Gulf of Alaska came from passive-acoustic recorders. These detections of calls were exceptionally rare; instruments in seven widespread locations detected right whale calls from only 2 of the locations on only 6 days out of a total of 80 months of recordings (Mellinger et al. 2004), and on only 5 days out of a total of 70 months of recordings from the 5 deep-water stations. The calls were heard at the deep-water station in the Gulf of Alaska ~500 km southwest of Kodiak Island on 5 days in August and September of 2000, but no calls were detected from 4 other instruments deployed in deep water farther east during 2000 and 2001 (Mellinger et al. 2004). Calls classified as "probable" right whales were detected from an instrument deployed on the shelf at the location of the aerial visual detection on Albatross Bank on 6 September 2000 (Waite et al. 2003), but no calls were detected from two instruments deployed at the base of the continental slope off Albatross Bank just northeast of Barnabus Trough (Mellinger et al. 2004, Munger et al. 2008). Twenty sonobuoy deployments in 2004 throughout the Gulf of Alaska resulted in the detection of right whale calls only in Barnabus Trough, near the location of the visual sightings mentioned above (Wade et al. 2011). The lack of detection of right whales from passive acoustic recorders does not provide indisputable evidence there were no right whales in the area, as the whales may not always vocalize or their calls may not always be detected by the automatic algorithms used. However, it is interesting to note the contrasting data from the southeastern Bering Sea where similar instruments on the middle shelf (<100m depth) detected right whale calls on > 6 d per month in July-October (Munger et al. 2008), despite a population estimated to be only 31 whales (Wade et al. 2010). The lack of detections of right whales in pelagic waters of the Gulf of Alaska may still be partially due to a lack of survey and recording effort in those areas, but the lack of calls in passive-acoustic monitoring suggests that right whales are very rare in pelagic waters today. More extensive coverage of shelf and nearshore waters of the Gulf of Alaska during previous ship and airplane surveys for cetaceans (summarized in Wade et al. 2011) have not detected right whales other than the single detection near Kodiak Island by Waite et al. (2003). Therefore, the Barnabus Trough/Albatross Bank area represents the only location in the Gulf of Alaska where right whales have been repeatedly detected in the last 4 decades, and those detections add only a minimum of two additional whales (from photo-identification in 2005 and 2006) to the total eastern population).

Minimum Population Estimate

The minimum estimate of abundance of North Pacific right whales is 25.7 ~~for the year 2008,~~ based on the 20th percentile of the photo-identification estimate of 31 (CV=0.226; Wade et al. 2011~~0~~). The photo-identification catalogue used in the mark-recapture abundance estimate has a ~~total~~minimum of 18 reliably unique individuals seen from 1998 to ~~2008~~2011, yet this number could be higher given that there are many animals with poor quality photos or poor coverage (one side only). The genetic-identification catalogue has a total of 22~~1~~ individuals identified from 1997 to 20~~04~~09.

Current Population Trend

No estimate of trend in abundance is currently available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Due to insufficient information, the default cetacean maximum net productivity rate (R_{MAX}) of 4% is used 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 for this stock is 25.7 based on the mark-recapture estimate of 31 (CV = 0.226; Wade et al. 2010). The PBR level for this stock is therefore 0~~.05~~. This PBR level is nearly zero, as this is equivalent to one take every 20 years. Regardless of the PBR level, because this species is listed under the Endangered Species

Act and no negligible impact determination has been made, no human-caused takes of this population are authorized.

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, although one photograph from the catalog shows potential fishing gear entanglement (Amy Kennedy, pers comm. 21 September 2011). Vessel collisions are considered the primary source of human-caused mortality of right whales in the Atlantic (Cole et al. 2005). 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.

There are no records of fisheries mortalities of eastern North Pacific right whales. Thus, the estimated annual mortality rate incidental to U. S. 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 whales which tend to congregate in coastal areas. Their thick layer of blubber causes them to float when killed. These attributes made them an easy and profitable species for early (pre-modern) whalers. By the time the modern whale fishery (harpoon cannons and steam powered catcher boats) 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 are known to have been 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 U.S.S.R. 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. In 2008, NMFS relisted the North Pacific right whale as “endangered” as a separate species (*Eubalaena japonica*) from the North Atlantic species, *E. glacialis* (73 FR 12024, 06 March 2008). 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". Biologists working aboard the Soviet factory ships which killed right whales in the eastern North Pacific in the 1960s considered that the fleets had caught close to 100% of the animals they encountered (Nikolai V. Doroshenko, pers. comm.); accordingly, it is quite possible that the Soviets wiped out the great majority of the animals in the population at that time. 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), which is arguably the most endangered stock of large whales in the world.

HABITAT CONCERNS

NMFS conducted an analysis of right whale distribution in historic times and in recent years, and stated that principal habitat requirements for right whales ~~is~~are dense concentrations of prey (Clapham et al. 2006), and on this basis proposed two areas of critical habitat: 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 these 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; Fig. 42). In 2008, NMFS redesignated the same two areas as eastern North Pacific right whale critical habitat under the newly recognized species name, *E. japonica*.

There are no known current threats to the habitat of this population, although this partly reflects a lack of information about the current distribution and habitat requirements of right whales in the eastern North Pacific, as well as about the location and nature of any potential threats to the animal or its environment. ~~However, there has been recent interest in oil/gas exploration with possible development in the "North Aleutian Basin" area, which occurs in Bristol Bay and overlaps and extends beyond designated North Pacific right whale critical habitat.~~The Department of the Interior has designated areas within the southeastern Bering Sea, including areas designated as right whale critical habitat, as one of their outer continental shelf oil and gas lease areas. This planning area, referred to as the North Aleutian Basin, was not included in the current 2012-2017 National lease schedule by the Bureau of Ocean Energy Management, and there are no residual active leases from past sales. The Mineral Management Service (currently Bureau of Ocean Energy Management) ~~is supporting~~supported a series of surveys from 2007-2009 to better understand right whale distribution in this area so that potential impacts and mitigation measures can be better assessed.

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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, four stocks of bowhead whales have been recognized worldwide by the International Whaling Commission (IWC 2010a). Single small stocks occur in the Sea of Okhotsk and the offshore waters of Spitsbergen, comprised of only a few tens to a few hundreds of individuals (Shelden and Rugh 1995, Wiig et al. 2009, Zeh et al. 1993). ~~Until recently, available evidence indicated that only a few hundred b~~Bowheads ~~were~~occur in ~~the W~~western Greenland (Hudson Bay and Foxe Basin) and ~~E~~eastern Canada (Baffin Bay and Davis Strait) stocks, ~~but~~and recent evidence suggests that these should be considered one ~~instead of two~~ stocks based on genetics (Postma et al. 2006; Heide-Jørgensen et al. 2010; Wiig et al. 2010; Bachmann et al. 2010), aerial surveys (Cosens et al. 2006), and tagging data (Dueck et al. 2006; Heide-Jørgensen et al. 2006; IWC 2010a, 2011a).~~,~~ ~~and~~ This stock, previously thought to include only a few hundred animals, ~~the abundance~~ may ~~be~~ number over a thousand (Heide-Jørgensen et al. 2007, Wiig et al. 2011), and perhaps over 6,000 (IWC 2008a). ~~The International Whaling Commission's Scientific Committee (IWC SC) has agreed "to consider a single stock of bowhead whales in this [Eastern Canada and Western Greenland] region as the 'working hypothesis' while acknowledging that there is still some uncertainty about the population structure" (IWC 2010a, 2011a).~~ The only stock found within U. S. waters is the Western Arctic stock (Figs. 43 and 44), also known as the Bering-Chukchi-Beaufort stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). Although Jorde et al. (20~~04~~07) suggested there might be multiple stocks of bowhead whales in US waters, several studies (George et al. 2007, Rugh et al. 2009, Taylor et al. 2007) and the IWC SC concluded that data are most consistent with one bowhead stock that migrates ~~around~~throughout waters of northern and western Alaska ~~waters~~ (IWC 2008b).

Figure 43. Dark areas depict the approximate distribution of the western Arctic stock of bowhead whales. The spring migration represented here by lines and arrows follows a route from the Bering Sea wintering area to the Beaufort Sea summering area, mostly along a coastal tangent that constricts somewhat as it goes east past Point Barrow.

Figure 44. Dark areas depict the approximate distribution of the western Arctic stock of bowhead whales. The fall migration is represented here by lines and arrows showing generalized routes used to travel from the Beaufort Sea (summering area) to the Bering Sea (wintering area).

The majority of the Western Arctic stock migrates annually from wintering areas

(December to March) in the northern Bering Sea, through the Chukchi Sea in the spring (April through May), to the Beaufort Sea (Fig. 43) where they spend much of the summer (June through ~~August~~September) before returning again to the Bering Sea (Fig. 44) in the fall (~~August~~October through December) to overwinter (Braham et al. 1980, Moore and Reeves 1993, Quakenbush et al. 2010a). Some bowheads are found in the Chukchi and Bering Seas in summer, and these are thought to be a part of the expanding Western Arctic stock (Rugh et al. 2003).

Most of the year, bowhead whales are closely associated with sea ice (Moore and Reeves 1993, Quakenbush et al. 2010a). 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). Bowheads on wintering grounds in the Bering Sea often use areas with 100% sea ice cover, even when polynas are available (Quakenbush et al. 2010a).

Evidence suggests that bowhead whales feed on concentrations of zooplankton throughout their range. Likely or confirmed feeding areas include Amundsen Gulf; ~~Barrow~~central and western U.S. Beaufort Sea; Wrangel Island; the coast of Chukotka, between Wrangel Island and the Bering Strait; and the western Bering Sea~~; and the Alaskan Beaufort Sea~~ (Quakenbush et al. 2010a, Quakenbush et al. 2010b, Lowry et al. 2004, Clarke and Ferguson 2010a, Ashjian et al. 2010, Okkonen et al. 2011). Bowheads have also been observed feeding during the summer in the northeastern Chukchi Sea (Clarke and Ferguson 2010b).

POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling, 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, Bockstoce et al. 2007). Woodby and Botkin (1993) summarized previous efforts to ~~approximate~~estimate 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). Brandon and Wade (2004) used Bayesian model averaging to estimate that the Western Arctic stock consisted of 10,960 (9,190-13,950; 5th and 9th percentiles, respectively) bowheads in 1848 at the start of commercial whaling.

Since 1978, systematic counts of bowhead whales have been conducted from sites on sea ice ~~north of~~near 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 since the mid-1980s, described in Clark et al. 1994), whales missed when no watch was in effect (through interpolations from sampled periods), 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 42 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. Attempts to count migrating whales near Point Barrow in 2009 and 2010 were unsuccessful due to sea ice conditions~~, resulting in no new estimates of abundance~~ (IWC 2010b, George et al. 2011). A count was successful in 2011, and

Table 42. 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 George et al. (2004) and 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)		

the data are currently being analyzed (pers. comm.. J.C. George, North Slope Borough, Barrow, AK). The most recent ice-based abundance estimate~~, based on surveys conducted~~ in 2001, ~~is~~was 10,545 (CV = 0.128) (updated from George et al. 2004 by Zeh and Punt 2004).

Bowhead whales were identified from aerial photographs taken in 1985 and 1986, and the results were used in a sight-resight analysis. This approach provided estimates of 4,719 (95% CI: 2,382 - 9,343; SE 1,696) to 7,022 (95% CI: 4,701 - 12,561; SE 2,017), 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 (6,039; SE 1,915) and 1986 (7,734; SE 1,450; Raftery and Zeh 1998). Aerial photographs provided another sampling of the bowhead population in 2003 and 2004. Sight-resight results provided estimates of 8,250 whales (95% CI: 3,150 to 15,450) in 2001 (Schweder et al. 2009) and ~~11,836~~12,631 whales (95% CI: ~~6,795~~7,900 to ~~20,618~~19,700) in 200~~3-~~4 (Koski et al. 20~~08~~10), estimates that are consistent with trends in abundance estimates made from ice-based counts.

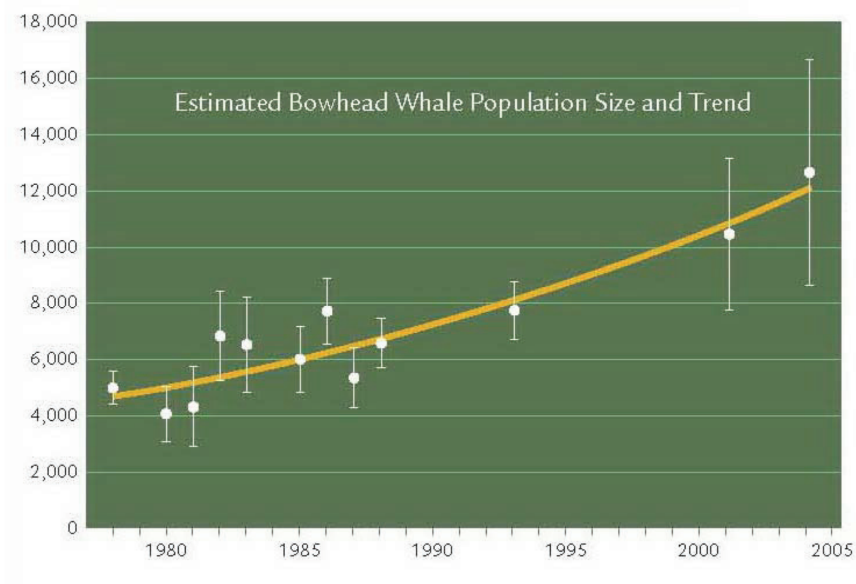

Figure 45. Population abundance estimates for the western Arctic stock of bowhead whales, 1977-200~~1~~4 (George et al. 2004, Koski et al. 2010), as computed from ice-based counts, acoustic locations, and aerial transect data collected during bowhead whale spring migrations past Barrow, AK. The 2004 estimate is based on sight-resight results. Vertical bars show +/- 1 standard error.

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 200~~1~~4 population estimate (N) of ~~10,545~~12,631 and its associated CV(N) of ~~0.128~~0.2442, N_{MIN} for the Western Arctic stock of bowhead whales is ~~9,472~~10,314.

Current Population Trend

Based on concurrent passive acoustic and ice-based visual surveys, George et al. (2004) reported that the Western Arctic stock of bowhead whales has increased at a rate of 3.4% (95% CI = 1.7-5.0%) from 1978 to 2001, during which time abundance doubled from approximately 5,000 to approximately 10,000 whales. ~~Similarly,~~ Schweder et al. (2009) estimated the yearly growth rate to be 3.2% (95% CI = 0.5-4.8%) between 1984 and 2003 using a sight-resight analysis of aerial photographs. 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). The calf count 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 (3.2-3.4%) 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 used 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 has been set at 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 = 95103 animals (9,47210,314 × 0.02 × 0.5). The calculation of a PBR level for the Western Arctic bowhead stock is required by the MMPA even though the subsistence harvest quota is managedestablished under the authority of the International Whaling Commission (IWC) based on extensively tested strike limit algorithms. The quota is based on subsistence need or the ability of the bowhead population to sustain a harvest, whichever is smaller. Accordingly, tThe IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. For 2008-2012, the IWC established a block quota of 280 landed bowheads. strikes has been allowed, Because some whales are struck and lost, a strike limit of which 67 (plus up to 15 unharvested in the previous yearpreviously unused strikes) could be taken each year. This quota includes an allowance of 5 animals to be taken by Chukotka Natives in Russia. A new quota (for 2013 to 2017) will be considered at the 2012 meeting of the SC.

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 (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. However, some bowhead whales have historically had interactions with crab pot gear. There are several documented cases of bowheads having ropes or rope scars on them. Alaska Region stranding reports document three bowhead whale entanglements between 2001 and 2005. In 2003 a bowhead whale was found dead in Bristol Bay entangled in line around the peduncle and both flippers; the origin of the line is unknown. In 2004 a bowhead whale near Point Barrow was observed swimming slowly with fishing net and line around the head. One dead whale was found floating in Kotzebue Sound in early July 2010 entangled in crab pot gear similar to that used by commercial crabbers in the Bering Sea (Suydam et al. 2011). The minimum average annual entanglement rate in U.S. commercial fisheries for the 5-year period from 2006-2010 is 0.2; however, the overall rate is currently unknown.

Subsistence/Native Harvest Information

Eskimos have been taking bowhead whales for subsistence purposes 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 teneleven Alaska communities (Philo et al. 1993; Suydam et al. 2011). Under this quota, the number of kills has ranged between 14 and 72 per year, the number 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) summarized Alaskan subsistence harvests of bowheads from 1974 to 2003 and reporteding a total of 832 whales landed by hunters from 11 villages with Barrow landing the most whales (n = 418) while Little Diomede and Shaktoolik each landed only one. Alaska Natives landed 55 bowheads in 2005 (Suydam et al. 2006), 31 bowheads in 2006 (Suydam et al. 2007), 41 in 2007 (Suydam et al. 2008), 38 in 2008 (Suydam et al. 2009), and 31 in 2009 (Suydam et al. 2010), and 45 in 2010 (Suydam et al. 2011). The number of whales landed at each village varies greatly from year to year, as success is influenced by village size and ice and weather conditions. The efficiency of the hunt (the percent of whales struck that are retrieved) has increased since the implementation of the bowhead quota in 1978. In 1978, the efficiency was about 50%, the mean for 19992000-200809 was 7877% (SD=87%), and in 200910 it was 8263% (Suydam et al. 201011).

Canadian and Russian Natives are also known to take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik harvested one whale in 1991 and one in 1996. Eight whales were harvested by Russian subsistence hunters between 1999-2005 (Borodin 2004, 2005; IWC 2007). No catches were reported by either Canadian or Russian hunters for 2006-2007 (IWC 2008b) or by Russia in 2009 (IWC 2010b), but two bowheads were taken in Russia in 2008 (IWC 2009), and in 2010 (IWC 2011a,b). The annual average subsistence take (by Natives of Alaska, Russia, and Canada) during the 5-year period from 20~~05~~06 to 20~~09~~10 was ~~39.6~~38 bowhead whales.

Other Mortality

Pelagic commercial whaling for bowheads was conducted from 1849 to 1914 in the Bering, Chukchi, and Beaufort ~~S~~seas (Bockstoce et al. 2007). ~~Within~~During the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling abundance was harvested, ~~although~~and 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 the U. S., Canada, and Russia) 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. Estimates of mortality likely underestimate the actual harvest as a result of under-reporting of the Soviet catches (Yablokov 1994) and incomplete reporting of struck and lost animals.

Transient killer whales are the only known predators of bowhead whales. In a study of marks on bowheads taken in the subsistence harvest, 4.1% to 7.9% had scars indicating that they had survived attacks by killer whales (George et al., 1994).

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 (~~9.5~~10.3), and therefore can be considered to be insignificant. The annual level of human-caused mortality and serious injury (~~40~~38) is not known to exceed the PBR (~~95~~103) nor the IWC annual maximum quota (67). The Western Arctic bowhead whale stock has been increasing in recent years; the estimate of ~~10,545~~12,631 is between ~~19~~22% and 1~~24~~~~05~~% 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, 2006). However, the stock is classified as a strategic stock because the bowhead whale is listed as "endangered" under the U. S. Endangered Species Act (ESA) and is therefore also designated as "depleted" under the MMPA. ~~NMFS intends to use recovery criteria developed for large whales in general (Angliss et al. 2002) and bowhead whales in particular (Shelden et al. 2001) in the next formal review of stock status.~~An ESA recovery plan has not been prepared for bowhead whales because: 1) only the Western Arctic stock occurs in U.S. waters and, therefore, a U.S. recovery plan for other stocks would not be appropriate; 2) all stocks are managed under the international authority of the IWC (of which the United States is a member); 3) cooperative agreements already exist between NOAA and the AEWC for purposes of protecting the bowhead whale and the Eskimo culture, promoting scientific investigations, and effectuating the other purpose of the MMPA, the Whaling Convention Act, and the ESA as these acts relate to aboriginal subsistence whaling; and, 4) a recovery plan is not needed to direct research and management necessary to promote the recovery of this stock. NMFS will use criteria developed for the recovery of large whales in general (Angliss et al., 2002) and bowhead whales in particular (Shelden et al., 2001) in the next five-year ESA status review to determine if a change in listing status is needed (Gerber et al., 2007).

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, other pollutants, and nontoxic waste. Noise produced by increased seismic surveys and vessel traffic resulting from exploration and drilling operations and shipping are also of concern. Evidence indicates that bowhead whales are sensitive to noise 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) may cause bowhead whales to ~~avoid the vicinity~~deflect away from the activity. ~~Figure 2b in Schick and Urban (2000) demonstrates, however, that the area of disturbance was localized in this instance. 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 three 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 noise 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 probably did not occur as a result of noise 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 in the past have likely been minor. However, since 2006 there has been elevated interest in exploiting petroleum reserves in the seas around Alaska, including most areas where bowheads feed or migrate. The accumulation of impacts from vessels, seismic exploration, and drilling are of concern across the North Slope of Alaska and Canada. Studies in the 1980s indicated that bowheads appeared to recover from these behavioral changes within 30-60 minutes following the end of seismic activity (Richardson et al., 1986b; Ljungblad et al., 1988). Monitoring studies of 3-D seismic exploration in the nearshore Beaufort Sea during 1996-1998 have demonstrated that nearly all bowhead whales will avoid an area within 20 km of an active seismic source and suggest that the offshore displacement may have begun roughly 35 km (19 n. mi. or 22 statute miles [st. mi.]) east of the activity and may have persisted more than 30 km to the west (Richardson et al., 1999). Richardson et al. (1986) observed that feeding bowheads started to turn away from a 30-airgun array with a source level of 248 dB re 1 μPa at a distance of 7.5 km (4.7 mi.) and swim away when the vessel was within about 2 km (1.2 mi.); other whales in the area continued feeding until the seismic vessel was within 3 km (1.9 mi.). More recent studies have similarly shown greater tolerance of feeding bowhead whales to higher sound levels than migrating whales (Miller et al. 2005, Harris et al. 2007). Data from an aerial monitoring program in the Alaskan Beaufort Sea during 2006-2008 also indicate that bowheads feeding during late summer and autumn did not exhibit large-scale distribution changes in relation to seismic operations (Funk et al., 2011). This apparent tolerance, however, should not be interpreted to mean that bowheads are unaffected by the noise. Feeding bowheads may be so highly motivated to stay in a productive feeding area that they remain in an area with noise levels that could cause adverse physiological effects (NMFS, 2010). They could be experiencing increased stress by staying in a location with very loud noise (MMS, 2008).

Another concern is climate change in the Arctic, which is affecting high northern latitudes more than elsewhere. Climate projections for the next 50–100 years produced by global climate models consistently show a pronounced warming over the Arctic, accelerated sea-ice loss, and continued permafrost degradation (IPCC, 2007; USGS, 2011). Within the Arctic, some of the largest changes are expected to occur in the Bering, Beaufort, and Chukchi seas (Chapman and Walsh, 2007; Walsh, 2008). There is evidence of a shift in regional weather patterns as well as a reduction in the extent of sea ice in some regions of in the Arctic region (Tynan and DeMaster 1997Johannessen et al. 2004). 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. Laidre et al. (2008) concluded that on a worldwide basis, bowhead whales were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales. A study reported in George et al. (2006) showed that landed bowheads had better body condition during years of light ice cover. This, together with high calf production in recent years, suggests that the stock is tolerating the recent ice-retreat at least at present.

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 increasing and approaching its pre-commercial whaling population size, there are no known habitat issues that are slowing the growth of the population, and activities that 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 201~~1~~2 stock assessments. An 'X' indicates sections where the information presented has been updated since the 201~~0~~1 stock assessments were released (last revised 0~~7~~5/~~22~~04/201~~1~~2).

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		
Northern fur seal		X	X	X	X	
Harbor seal (Aleutian Islands)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Pribilof Islands)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Bristol Bay)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (N. Kodiak)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (S. Kodiak)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Prince William Sound)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Cook Inlet/ Shelikof)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Glacier Bay/ Icy Strait)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Lynn Canal/ Stephens)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Sitka/ Chatham)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Dixon/ Cape Decision)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Harbor seal (Clarence Strait)	~~X~~	~~X~~	~~X~~	X	~~X~~	~~X~~
Spotted seal				~~X~~		
Bearded seal				~~X~~		
Ringed seal				~~X~~		
Ribbon seal				~~X~~		
Beluga whale (Beaufort)					~~X~~	
Beluga whale (E. Chukchi)					~~X~~	
Beluga whale (E. Bering Sea)		~~X~~	~~X~~		~~X~~	
Beluga whale (Bristol Bay)				~~X~~	~~X~~	
Beluga whale (Cook Inlet)		X			X	
Narwhal						
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		
Harbor porpoise (SE Alaska)				X		
Harbor porpoise (GOA)				X		
Harbor porpoise (Bering Sea)				X		
Dall's porpoise				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						

Stock	**Stock definition**	**Population size**	**PBR**	**Fishery mortality**	**Subsistence mortality**	**Status**
North Pacific right whale		~~X~~	~~X~~			
Bowhead whale		X	X	X	X	

Appendix 2. Stock summary table (last revised ~~7~~05/~~20~~04/201~~1~~2). Stock assessment reports for those stocks in boldface were updated in the 201~~1~~2 draft 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	2.7	6,788	6,791	NS
Beluga whale	Beaufort Sea	39,258	0.23	32,453	19/1992	0.04	0.50	UNDET	0	126	126	NS
Beluga whale	E. Chukchi Sea	3,710	N/A	3,710	12/1998	0.04	1.00	UNDET	0	94.2	94.2	NS
Beluga whale	E. Bering Sea	28,406	0.24	20,231	10/2000	0.04	1.00	UNDET	0	192.6	192.6	NS
Beluga whale	Bristol Bay	2,877	0.2	2,467	6/2005	0.04	1.00	49	0.8[5]	20.0	20.8	NS
Beluga whale	**Cook Inlet**	**~~345~~ 315**	**0.13**	**~~309~~ 283**	**1/201~~0~~1**	**0.04**	**0.1**	**UNDET**	**0**	**0**	**0**	**S**
Bowhead whale	**W. Arctic**	**~~10,545~~ 12,631**	**~~0.13~~ 0.24**	**~~9,472~~ 10,314**	**~~9~~10/200~~1~~4**	**0.04**	**0.50**	**~~95~~ 103**	**0.2**	**~~39.6~~ 38**	**~~40~~ 38.2**	**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**	**~~15~~18/1993**	**0.04**	**1.00**	**UNDET**	**28.~~4~~9**	**0**	**28.~~4~~9**	**NS**
Fin whale	**NE Pacific**	**5,700**	**N/A**	**5,700**	**~~7~~8/2003**	**0.04**	**0.10**	**11.4**	**0**	**0**	**0.~~4~~6**	**S**
~~**Gray whale**~~	~~**E. N. Pacific**~~	~~**19,126**~~	~~**0.07**~~	~~**18,017**~~	~~**2/2007**~~	~~**0.04**~~	~~**1.00**~~	~~**360**~~	~~**3.3**~~	~~**121**~~	~~**127**~~	~~**NS**~~
Harbor porpoise	**SE Alaska**	**11,146**	**0.242**	**9,116**	**~~12~~15/1997**	**0.04**	**0.50**	**UNDET**	**22.8[1]**	**0**	**22.8**	**S**
Harbor porpoise	**Gulf of Alaska**	**31,046**	**0.214**	**25,987**	**~~11~~14/1998**	**0.04**	**0.50**	**UNDET**	**72.0**	**0**	**~~74~~72.0**	**S**
Harbor porpoise	**Bering Sea**	**48,215**	**0.223**	**40,039**	**~~10~~12/1999**	**0.04**	**0.50**	**UNDET**	**0.~~7~~5**	**0**	**~~2~~0.9**	**S**
Harbor seal	**Aleutian Islands**	**3,579**		**3,313**	**~~3~~7/20~~10~~04**	**0.12**	**0.50**	**99**	**~~0.4~~1.0**	**90**	**93.1**	**NS**
Harbor seal	**Pribilof Islands**	**232**		**232**	**~~3~~1/2010**	**0.12**	**0.50**	**7**	**~~0.4~~1.0**	**0**	**3.1**	**NS**
Harbor seal	**Bristol Bay**	**18,577**		**17,690**	**~~3~~6/20~~10~~05**	**0.12**	**1.0**	**1,061**	**~~0.4~~1.0**	**141**	**144.1**	**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	North Kodiak	4,509		4,272	~~3~~5/20~~10~~06	0.12	1.0	256	~~0.4~~1.0	131	134.1	NS
Harbor seal	South Kodiak	11,117		10,645	~~3~~5/20~~10~~06	0.12	1.0	639	~~0.4~~1.0	78	81.1	NS
Harbor seal	Prince William Sound	31,503		27,157	~~3~~5/20~~10~~06	0.12	0.5	815	~~24.4~~ 25.0	439	466.1	NS
Harbor seal	Cook Inlet/ Shelikof	22,900		21,896	~~3~~5/20~~10~~06	0.12	1.0	1,314	~~0.4~~1.0	233	236.1	NS
Harbor seal	Glacier Bay/ Icy Strait	5,042		4,735	~~3~~4/20~~10~~07	0.12	0.5	142	~~0.4~~1.0	52	55.1	NS
Harbor seal	Lynn Canal/ Stephens	8,870		8,481	~~3~~4/20~~10~~07	0.12	0.5	254	~~0.4~~1.0	30	33.1	NS
Harbor seal	Sitka/ Chatham	8,586		8,222	~~3~~4/20~~10~~07	0.12	0.5	247	~~0.4~~1.0	222	225.1	NS
Harbor seal	Dixon/ Cape Decision	14,388		13,682	~~3~~5/20~~10~~03	0.12	1.0	821	~~0.4~~1.0	157	160.1	NS
Harbor seal	Clarence Strait	23,289		22,471	~~3~~5/20~~10~~03	0.12	1.0	1,348	~~0.4~~1.0	164	167.1	NS
Humpback whale	W. N. Pacific	938	0.30	732	45/2006	0.07	0.10	2.6/2.0	0.6	0	0.6	S
Humpback whale	CNP - entire stock	7,469	0.30	5,833	45/2004-2006	0.07	0.3	61.2	~~3.8~~2.6	0	~~5.6~~4.0[4]	S
	CNP – SEAK/NBC feeding area	2,883	0.3	2,251		0.07	0.3	23.6	~~2.4~~2.0	0	~~4.0~~2.8[4]	N/A
	CNP – GOA feeding area	2,845	0.3	2,222		0.07	0.10	7.8	1.6[5]		~~1.8~~1.6[5]	N/A
	CNP – BS/AI feeding area	2,889	0.3	2,256		0.07	0.10	7.9	1.6[5]		~~1.8~~1.6[5]	N/A
Killer whale	Alaska Resident	2,084[3]	N/A	2,084	8+/2009	0.04	0.50	20.8	1.5	0	1.5	NS
Killer whale	Northern Resident (British Columbia)	216[3]	N/A	216	10/2000	0.03	0.5	1.62	0	0	0	NS
Killer whale	AT1 transient	7[3]	N/A	7	1/2011	0.04	0.10	0	0	0	0	S
Killer whale	GOA, AI, BS Transient	552[3]	N/A	552	8+/2003	0.04	0.5	5.5	1.5	0	1.5	NS
Killer whale	West Coast Transient	354[3]	N/A	354	1999	0.04	0.5	3.5	0	0	0	NS
Minke whale	Alaska	N/A		N/A		0.04	0.50	N/A	0	0	0.2	NS
Narwhal	Unidentified stock	N/A		N/A		0.04	0.50	N/A	0	0	0	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
Northern fur seal	**E. North Pacific**	**~~653,171~~ 611,617**	**N/A**	**~~642,265~~ 517,679**	**1/20~~08~~10**	**0.086**	**0.50**	**~~13,809~~ 11,130**	**~~2.7~~ 3.2**	**~~530~~ 496**	**~~534.7~~ 500**	**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	49,000 (provisional)		N/A	2/2008	0.12	0.50	N/A	2.25	193	195	NS
Right whale	**E. N. Pacific**	**31**	**0.23**	**25.7**	**~~N/A~~2010**	**0.04**	**0.10**	**0**	**0**	**0**	**0**	**S**
Ringed seal	Alaska	N/A		N/A		0.12	0.50	N/A	1.75	9,567	9,570	NS
Sperm whale	**N. Pacific**	**N/A**		**N/A**		**0.04**	**0.10**	**N/A**	**2.~~8~~1**	**0**	**2.~~8~~1**	**S**
Spotted seal	Alaska	N/A		N/A		0.12	0.50	N/A	1.0	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.**	**58,334-72,223**		**52,847**	**~~4~~2/2009**	**0.12**	**0.75**	**2,378**	**~~33.5~~ 45.8[4]**	**~~10~~ 11.9**	**~~48.3~~ 59.1**	**S**
Steller sea lion	**W. U. S.**	**~~42,286~~ 45,916**		**~~42,286~~ 45,916**	**1/201~~0~~1**	**0.12**	**0.10**	**~~253~~275**	**~~28~~33.~~5~~8**	**198**	**~~227~~232**	**S**

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

[1] No or minimal reported take by fishery observers; however, observer coverage was minimal or nonexistent.

[2] Recent 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.

[3] N(est) based on counts of individual animals identified from photo-identification catalogs. Surveys for abundance estimates of these stocks are conducted infrequently.

[4] Includes entanglements from recreational or subsistence fisheries.

[5] Mortality and serious injury estimates calculated for humpbacks in the northern area of the Central North Pacific humpback whale stock range (Gulf of Alaska, Aleutian Islands, and Bering Sea).

Appendix 3. Summary table for Alaska **Category 2** commercial fisheries (last updated 08/08/2011). Source: 75 FR 68468; 08 November 2011 and the Alaska Commercial Fisheries Entry Commission (2011). Notice of continuing effect of list of fisheries.

Fishery (area and gear type)	**Target species**	**Permits issued or fished (2007)**	**Soak time**	**Landings per day**	**Sets per day**	**Season duration**	**Fishery trends (1990-1997)**
Southeast AK drift gillnet	salmon	474	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	379	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	167	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	537	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	569	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	736	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	162	2 -5 hrs; day / night	1	3 - 8	mid-June to mid-Sept	# vessels stable; catch up
AK Peninsula/Aleutians set gillnet	salmon	114	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	1863	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	982	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	salmon	0					new fishery
Metlakatla/Annette Island drift gillnet	salmon	10					
AK Bering Sea, Aleutian islands flatfish trawl	flatfish	34					
AK Bering Sea, Aleutian Islands pollock trawl (subsistence)	pollock	95					
AK Bering Sea, Aleutian Islands Pacific cod longline	Pacific cod	154					

CITATIONS

Alaska Commercial Fisheries Entry Commission (CFEC). 2011. Fishery Participation & Earnings. Accessed on 4/26/2011. http://www.cfec.state.ak.us/.

Appendix 4. Interaction table for Alaska **Category 2** commercial fisheries (last revised 08/08/2011). Source: 75 FR 68468; 08 November 2011, Perez (2006), Manly (2009), Manly (2006), Manly et al. (2003), and the Alaska Commercial Fisheries Entry Commission (2011). Notice of continuing effect of list of fisheries.

Fishery (area and gear type)	**# of permits issued or fished (2010)**	**Observer program**	**Species recorded as taken incidentally in this fishery (records dating back to 1988)**	**Data type**
Southeast AK drift gillnet	474	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	379	never observed	humpback whale	self reports and stranding
Yakutat set gillnet	167	2007 2008	harbor seal, harbor porpoise (obs), humpback whale, gray whale (stranding)	logbook, observer, and stranding
Prince William Sound drift gillnet	537	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	569	1999 2000	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	736	1999 2000	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 2005	harbor seal, harbor porpoise, sea otter	observer and logbook
Alaska Peninsula/Aleutians drift gillnet	162	1990	northern fur seal, harbor seal, harbor porpoise, Dall's porpoise (obs)	observer and logbook
Alaska Peninsula/Aleutians set gillnet	114	never observed	Steller sea lion, harbor porpoise	logbook
Bristol Bay drift gillnet	1863	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	982	never observed	northern fur seal, harbor seal, spotted seal, beluga whale, gray whale	logbook
Metlakatla/Annette Island drift gillnet	10	never observed	none documented	none
AK pair trawl	0	never observed	none documented	none
AK Bering Sea, Aleutian islands flatfish trawl	34	2009	Bearded seal, harbor porpoise (Bering Sea), harbor seal (Bering Sea), killer whale (Alaska Resident), killer whale (GOA, Aleutian Islands, and Bering Sea Transient), northern fur seal, spotted seal, ringed seal, ribbon seal, Steller sea lion (Western U.S.), walrus	observer
AK Bering Sea, Aleutian Islands pollock trawl	95	2009	Dall's porpoise, harbor seal, humpback whale (Central North Pacific), humpback whale (Western North Pacific), fin whale, killer whale (GOA, Aleutian Islands, and Bering Sea Transient), minke whale, ribbon seal, spotted seal, ringed seal, bearded seal, northern fur seal, Steller sea lion (western U.S.),	observer
AK Bering Sea, Aleutian Islands Pacific cod longline	54	2009	Killer whale (Alaska Resident), killer whale (GOA, Aleutian Islands, and Bering Sea Transient), ribbon seal, northern fur seal, Steller sea lion (western U.S.)	observer
AK Bering Sea, Aleutian Islands sablefish pot	10	2009	humpback whale (Central North Pacific), humpback whale (Western North Pacific)	observer

Note: Only species with positive records of being taken incidentally in a fishery since 1988 (the first year of the Marine Mammal Protection Act 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.

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Alaska Commercial Fisheries Entry Commission (CFEC). 2011. Fishery Participation and Earnings. Accessed on 4/26/2011. http://www.cfec.state.ak.us/.

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Appendix 5. Interaction table for Alaska **Category 3** commercial fisheries (last revised 08/08/2011). 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: 75 FR 68468; 08 November 2011, Perez (2006), and the Alaska Commercial Fisheries Entry Commission (2011). Notice of continuing effect of list of fisheries.

Fishery name	# of permits issued or fished 2010	Observer program	Species recorded as taken incidentally in this fishery (records dating back to 1990)	Data type
Prince William Sound salmon set gillnet	29	1990	Steller sea lion, harbor seal	logbook
Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet	1702	never observed	harbor porpoise	none
AK roe herring and food/bait herring gillnet	990	never observed	none documented	none
AK miscellaneous finfish set gillnet	0	never observed	Steller sea lion	logbook
AK salmon purse seine (except for Southeast AK)	935	never observed	harbor seal, gray whale (eastern North Pacific)	logbook
AK salmon beach seine	31	never observed	none documented	none
AK roe herring and food/bait herring purse seine	367	never observed	none documented	none
AK roe herring and food/bait herring beach seine	6	never observed	none documented	none
Metlakatla purse seine (tribal)	10	never observed	none documented	none
AK octopus/squid purse seine	0	never observed	none documented	none
AK miscellaneous finfish purse seine	2	never observed	none documented	none
AK miscellaneous finfish beach seine	1	never observed	none documented	none
AK salmon troll (includes hand and power troll)	2008	never observed	Steller sea lion	logbook
AK north Pacific halibut/bottom fish troll	120	never observed	none documented	none
AK state waters groundfish longline /set line (incl. sablefish/ rockfish/misc. finfish)	1323	never observed	none documented	none
AK Gulf of Alaska halibut longline	1,302	2009	none documented	observer
AK Gulf of Alaska rockfish longline	0	2009	none documented	observer
AK Gulf of Alaska Pacific cod longline	0	2009	Steller sea lion (Western U.S.)	observer
AK Gulf of Alaska sablefish longline	291	2009	Steller sea lion, sperm whale	observer
AK Bering Sea, Aleutian Islands Greenland turbot longline	29	2009	Killer whale (Eastern North Pacific resident), Killer whale (Eastern North Pacific transient), Killer whale (Alaska resident), killer whale (GOA, Aleutian Islands, and Bering Sea Transient),	observer
AK Bering Sea, Aleutian islands rockfish longline	0	2009	none documented	observer
AK Bering Sea, Aleutian Islands sablefish longline	28	2009	none documented	observer
AK halibut longline/set line (state and federal waters)	2280	never observed	Steller sea lion	self reports
AK octopus/squid longline	2	never observed	none documented	none
AK shrimp otter and beam trawl (statewide and Cook Inlet)	33	never observed	none documented	none
AK Gulf of Alaska flatfish trawl	41	2009	none documented	observer
AK Gulf of Alaska Pacific cod trawl	62	2009	Steller sea lion	observer
AK Gulf of Alaska pollock trawl	62	2009	Steller sea lion (Western U.S.), fin whale, northern elephant seal, Dall's porpoise	observer
AK Gulf of Alaska rockfish trawl	34	2009	none documented	observer
AK Bering Sea, Aleutian Islands Atka mackerel trawl	9	2009	Ribbon seal, Steller sea lion (Western U.S.)	observer
AK Bering Sea, Aleutian Islands Pacific cod trawl	93	2009	Harbor seal, Steller sea lion (Western U.S.)	observer
AK Bering Sea, Aleutian Islands rockfish trawl	10	2009	none documented	observer

Fishery name	# of permits issued or fished 2010	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	282	never observed	none documented	none
AK food/bait herring trawl (Kodiak area only)	4	never observed	none documented	none
AK Bering Sea, Aleutian Islands Pacific cod pot	68	2009	possible harbor seal	observer
AK Bering Sea, Aleutian Islands crab pot	296	2009	none documented	observer
AK Gulf of Alaska crab pot	389	2009	none documented	observer
AK Gulf of Alaska Pacific cod pot	154	2009	harbor seal	observer
AK Southeast Alaska crab pot	415	never observed	none documented	observer
AK Southeast Alaska shrimp pot	274	never observed	none documented	observer
AK octopus/squid pot	26	never observed	none documented	none
AK snail pot	1	never observed	none documented	none
AK statewide misc finfish pot	243	never observed	none documented	none
AK shrimp pot	210	never observed	none documented	none
AK North Pacific halibut handline and mechanical jig	180	never observed	none documented	none
AK other finfish handline and mechanical jig	456	never observed	none documented	none
AK octopus/squid handline	0	never observed	none documented	none
AK statewide Herring spawn on kelp (pound net)	411	never observed	none documented	none
Southeast AK herring food/bait pound net	4	never observed	none documented	none
Coastwise scallop dredge	12	never observed	none documented	none
AK Dungeness crab (hand pick/dive)	2	never observed	none documented	none
AK herring spawn-on-kelp (hand pick/dive)	266	never observed	none documented	none
AK urchin and other fish/shellfish (hand pick/dive)	521	never observed	none documented	none
AK commercial passenger fishing vessel	2,702 (may contain freshwater vessels, will be updated later)	never observed	none documented	none
AK octopus/squid "other"	0	never observed	none documented	none

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

CITATIONS

Alaska Commercial Fisheries Entry Commission (CFEC). 2011. Fishery Participation & Earnings. Accessed on 4/26/2011. http://www.cfec.state.ak.us/.

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 1990-2009 (last revised 08/08/11). Sources: Manly in review, Manly et al. 2003, Perez 2006, Perez unpubl. ms., Wynne et al. 1991, and Wynne et al. 1992.

Fishery name	Method for calculating observer coverage	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gulf of Alaska (GOA) groundfish trawl		55%	38%	41%	37%	33%	44%	37%	33%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GOA flatfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	39.2%	35.8%	36.8%	40.5%	35.9%	40.6%	76.9%	29.2%	24.2%	31%	28%	22%
GOA Pacific cod trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.6%	16.4%	13.5%	20.3%	23.2%	27.0%	82.5%	21.4%	22.8%	25%	24%	38%
GOA pollock trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37.5%	31.7%	27.5%	17.6%	26.0%	31.4%	96.1%	24.2%	26.5%	27%	34%	43%
GOA rockfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51.4%	49.8%	50.2%	51.0%	37.2%	48.4%	74.1%	51.4%	49.1%	88%	87%	91%
GOA longline		21%	15%	13%	13%	8%	18%	16%	15%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GOA Pacific cod longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.8%	5.7%	6.1%	4.9%	11.4%	12.6%	21.4%	3.7%	10.2%	45%	32%	43%
GOA Pacific halibut longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	51.3%	47.1%	51.1%	43.0%	41.4%	9.6%	36.4%	6.5%	2.8%	N/A	N/A	N/A
GOA rockfish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0%	1.4%	0.2%	1.3%	4.9%	2.5%	0%	0%	3.1%	N/A	N/A	83%
GOA sablefish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.9%	14.0%	15.2%	12.4%	13.7%	9.4%	37.7%	10.4%	11.2%	37%	35%	38%
GOA finfish pots		13%	9%	9%	7%	7%	7%	5%	4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BSAI finfish pots	% of observed biomass	43%	36%	34%	41%	27%	20%	17%	18%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BSAI Pacific cod pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.6%	16.2%	8.5%	14.7%	12.1%	12.4%	33.1%	14.4%	12.4%	30%	23%	29%
BS sablefish pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42.1%	44.1%	62.6%	38.7%	40.6%	21.4%	72.5%	44.3%	35.3%	N/A	N/A	N/A
AI sablefish pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100%	50.3%	68.2%	60.6%	69.4%	47.5%	51.2%	64.4%	18.7%	N/A	N/A	N/A
GOA Pacific cod pot	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.7 %	5.7%	7.0%	5.8%	7.0%	4.0%	40.6%	3.8%	2.9%	14%	18%	13%
Bering Sea/Aleutian Islands (BSAI) groundfish trawl		74%	53%	63%	66%	64%	67%	66%	64%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BSAI Atka mackerel trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	65.0%	77.2%	86.3%	82.4%	98.3%	95.4%	96.6%	97.8%	96.7%	94%	100%	99%
BSAI flatfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59.4%	66.3%	64.5%	57.6%	58.4%	63.9%	68.2%	68.3%	67.8%	72%	100%	100%
BSAI Pacific cod trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	55.3%	50.6%	51.7%	57.8%	47.4%	49.9%	75.1%	52.8%	46.8%	52%	56%	64%
BSAI pollock trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	66.9%	75.2%	76.2%	79.0%	80.0%	82.2%	92.8%	77.3%	73.0%	85%	85%	86%

Fishery name	Method for calculating observer coverage	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BSAI rockfish trawl	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	85.4%	85.6%	85.1%	65.3%	79.9%	82.6%	94.1%	71.0%	80.6%	88%	98%	99%
BSAI longline		80%	54%	35%	30%	27%	28%	29%	33%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BSAI Greenland turbot longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31.6%	30.8%	52.8%	33.5%	37.3%	40.9%	39.3%	33.7%	36.2%	64%	74%	74%
BSAI Pacific cod longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	34.4%	31.8%	35.2%	29.5%	29.6%	29.8%	25.7%	24.6%	26.3%	63%	63%	61%
BSAI Pacific halibut longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38.9%	48.4%	55.3%	67.2%	57.4%	20.3%	44.5%	27.9%	26.4%	N/A	N/A	N/A
BSAI rockfish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	41.5%	21.4%	53.0%	26.9%	36.0%	74.9%	37.9%	36.3%	46.8%	88%	N/A	100%
BSAI sablefish longline	% of observed biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	19.5%	28.4%	24.4%	18.9%	30.3%	10.4%	50.9%	19.3%	11.2%	48%	49%	56%
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.	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.	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.	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.	not obs.	not obs.	not obs.	not obs.	not obs.
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.	not obs.	not obs.	not obs.	not obs.	not obs.
Kodiak Island 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.	not obs.	not obs.	not obs.	6.0%	not obs.	not obs.	4.9%	not obs.	not obs.	not obs.	not obs.
Yakutat 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.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	not obs.	6.8	9.0	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 feet have 100% coverage, vessels 60-125 feet have 30% coverage, and vessels less than 60 feet 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.

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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

Fishery	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Minimum estimated mortality
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

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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, 2003-2007. 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 one change from the SRG's recommendations.

Date	Area	Condition	Brief description	Area	Severity of injury
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
6/6/06	Anton Larsen Bay	Disentangled	Disentangled from set gillnet	North	Not serious
7/14/06	Cook Inlet	Entangled	Entangled with net on head; possible gillnet	North	Serious
9/28/06	Dutch Harbor	Entangled	Trailing orange buoy from mouth with at least one pot attached; subsistence pot gear	North	Serious
6/10/07	Whittier	Ship strike	Ship strike; propeller struck animal, animal observed bleeding	North	Not determinable
6/27/07	Long Island	Possible entanglement	Possible entanglement in green gillnet	North	Not serious
9/23/07	Kachemak Bay	Entangled	1-2 ft. long white buoy on rostrum	North	Not determinable
5/03	Icy Bay	Dead	53 ft. female humpback with skull completely disarticulated from the vertebrae	SE	Mortality

Date	Area	Condition	Brief description	Area	Severity of injury
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 ft. of rope, 2 cone-shaped buoys, and 1-2 ft. of wood between buoys.	SE	Serious
5/27/04	Benjamin Island	Collision	Humpback collided with drifting fishing boat. 18-24 in. 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 in. 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 ft. 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 in. 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
6/6/05	Juneau	Entangled	Green gillnet (approx. 3 in. 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[1]
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

Date	Area	Condition	Brief description	Area	Severity of injury
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
1/7/06	Sitka	Entangled	Observed towing 1-2ft white buoy 40-50 yards behind whale; gear unknown	SE	Not determinable
5/30/06	Petersburg	Disentangled	Disentangled from gillnet	SE	Not serious
6/6/06	Glacier Bay	Entangled, self release	Towing line and buoy, self release; sport Dungeness crab pot	SE	Not serious
6/9/06	Thorn Bay	Entangled	Swimming slowly at surface, not diving; trailing 20-50 yards of line with 2 light colored buoys; longline gear	SE	Not determinable
6/10/06	Saginaw Channel	Collision	Ferry report of possible shipstrike	SE	Not determinable
7/5/06	Portland Is	Entangled, self release	Calf in pot gear, swam away clear of gear	SE	Not serious
7/15/06	Craig	Entangled	Halibut longline gear with hooks around pectoral fin	SE	Serious
7/21/06	Hoonah	Possible entanglement	Thought saw rop around head	SI	Not determinable
8/6/06	Kake	Entangled	Trailing 100-150 ft. of lines and floats	SE	Not determinable
8/13/06	Stephens Passage	Entangled	Trailing line and 2 buoys, one red, one white	SE	Not determinable
8/15/06	Auke Bay	Collision	Auke Bay boat collision	SE	Not serious
8/20/06	Stephens Passage	Disentangled	Removed gillnet	SE	Not serious
8/25/06	Lynn Canal	Entangled	Towing 40’ line with red poly ball; wraps on peduncle	SE	Not determinable
8/26/06	Frederick Sound	Dead	Large gauge yellow poly line, 1 in. diameter, on animal	SE	Mortality
8/28/06	Peril Strait	Entangled	Towing 40’ line and faded orange poly ball; more line trailing behind buoy; crab pot gear	SE	Not determinable
8/31/06	Hoonah Sound	Entangled	Trailing 20-25 ft. of line with small orange round buoy	SE	Not serious

Date	Area	Condition	Brief description	Area	Severity of injury
9/14/06	Petersburg	Entangled, self release	Entangled, self release	SE	Not serious
6/10/07	Sitka Sound	Entangled	Swimming entangled but fluking; dragging several hundred feet heavy gauge line (>1/2 in.) and 2 ft. orange poly ball; no gear on flukes or peduncle; possible pot gear	SE	Not determinable
6/15/07	Tenakee	Entangled	Trailing small styrofoam floats; shrimp gear	SE	Not determinable
6/19/07	Spasski Island	Entangled	Calf trailing 50' gillnet	SE	Not determinable
6/22/07	Port Frederick	Entangled	Calf trailing 2 orange buoys	SE	Not determinable
7/1/07	Sitka	Collision	27' charter boat hit; felt jolt	SE	Not serious
7/1/07	Benjamin Is	Entangled; possible self-release	Calf in gillnet	SE	Not serious
7/4/07	Port Snettisham	Collision	26' aluminum skiff; hull impacted back of animal	SE	Not serious
7/8/07	Chatham Strait	Dead	Fresh dead, inflated tongue; fractured and dislocated right mandible, hemorrhage at necropsy; probable vessel collision		Mortality
8/9/07	Gustavus	Entangled	Fluke tip with monofilament	SE	Not serious
8/14/07	Spasski Is	Collision	32' landing craft collision at 17kt	SE	Not determinable
11/13/07	Petersburg	Disentangled	Disentangled from shrimp pot gear	SE	Not serious
1/28/01	Hawaii	Injured	Entangled in line/buoy from an AK fishery; released, injured - extent unknown	Unk	Not determinable

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