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Alaska Marine Mammal Stock Assessments, 2015

by
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U.S. DEPARTMENT OF COMMERCE
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Cover photo: Dall's porpoise photographed in Icy Strait during an AFSC survey in Southeast Alaska, July 2015. Photographer: Daniel Webster (AFSC-NMML), NMFS Permit No. 14245.

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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 Alaska 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), 2010 (Allen and Angliss 2011), 2011 (Allen and Angliss 2012), 2012 (Allen and Angliss 2013), 2013 (Allen and Angliss 2014), and 2014 (Allen and Angliss 2015). 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 is 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, bearded seals, ringed seals, Cook Inlet beluga whales, AT1 Transient killer whales, harbor porpoise, sperm whales, humpback whales, fin whales, North Pacific right whales, and bowhead whales) was reviewed in 2014-2015. This review, and a review of other stocks, led to the revision of the following stock assessments for the 2015 document: Western U.S. Steller sea lions; northern fur seals; Aleutian Islands, Pribilof Islands, Bristol Bay, North Kodiak, South Kodiak, Prince William Sound, Cook Inlet/Shelikof Strait, Glacier Bay/Icy Strait, Lynn Canal/Stephens Passage, Sitka/Chatham Strait, Dixon/Cape Decision, and Clarence Strait stocks of harbor seals; bearded seals; ringed seals; ribbon seals; Cook Inlet beluga whales; AT1 Transient killer whales; Pacific white-sided dolphins; Southeast Alaska, Gulf of Alaska, and Bering Sea stocks of harbor porpoise; Dall's porpoise; sperm whales; Western North Pacific and Central North Pacific stocks of humpback whales; fin whales; minke whales; North Pacific right whales; and bowhead whales. 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 the final 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: Karl Haflinger, Lloyd Lowry (Chair from 2012 to present), Beth Mathews, Craig Matkin, Mike Miller, Grey Pendleton, Robert Small, Kate Stafford, Robert Suydam, David Tallmon, and Kate Wynne. We would also like to acknowledge the contributions from the Communications Program of the Alaska Fisheries Science Center.

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*

*Stock Assessment Reports and Appendices revised in 2015 are in boldface.

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. 1). Large numbers of individuals disperse widely outside of the breeding season (late May-early July), probably to access seasonally important prey resources. This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing in foraging areas of animals that were born in different 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).

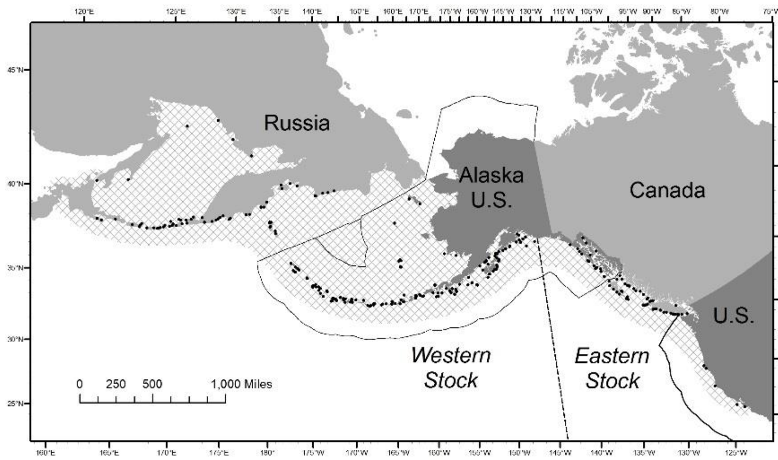

Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; S. Majewski, Fisheries and Oceans Canada, pers. comm.). Black dashed line (144°W) indicates stock boundary (Loughlin 1997) and solid black line delineates U.S. Exclusive Economic Zone.

Loughlin (1997) and Phillips et al. (2009) 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 among rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: differences in size (males) and shape (females) of skulls (Phillips et al. 2009); 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 born east of Cape Suckling, Alaska (144°W), and a Western U.S. stock, which includes animals born at and west of Cape Suckling (Loughlin 1997; Fig. 1). However, Jemison et al. (2013) summarized that there is regular movement of Steller sea lions from the western distinct population segment (DPS) (males and females equally) and eastern DPS (almost exclusively males) across the DPS boundary.

Steller sea lions that breed in Asia are considered part of the western stock. Whereas Steller sea lions seasonally inhabit coastal waters of Japan in the winter, breeding rookeries outside of the U.S. 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. Berta and Churchill (2012) concluded that a putative Asian stock is "not substantiated by microsatellite data since the Asian stock groups with the western stock." 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), although a recent review by Berta and Churchill (2012) characterized the status of these subspecies assignments as "tentative" and requiring further attention before their status can be determined. 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 impact of change on the population. The results suggested that during historic glacial periods, dispersal events were correlated with historically low effective population sizes, whereas range fragmentation type events were correlated with larger effective population sizes. This work again reinforced 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).

In 1998, a single Steller sea lion pup was observed on Graves Rock in northern Southeast Alaska and, by 2013, pup counts had increased to 551 (DeMaster 2014). Mitochondrial and microsatellite analysis of pup tissue samples collected in 2002 revealed that approximately 70% of the pups had mtDNA haplotypes that were consistent with those found in the western stock (Gelatt et al. 2007). Similarly, a rookery to the south on the White Sisters Islands, where pups were first noted in 1990, was also sampled in 2002 and approximately 45% of those pups had western stock haplotypes. Collectively, this information demonstrates that these two most recently established rookeries in northern Southeast Alaska have been partially to predominately established by western stock females. While movements of animals marked as pups in both stocks support these genetic results (Jemison et al. 2013), overall the observations of marked sea lion movements corroborate the extensive genetics research findings for a strong separation between the two currently recognized stocks. O'Corry-Crowe et al. (2014) concluded that the results of their study of the genetic characteristics of pups born on these new rookeries "demonstrates that resource limitation may trigger an exodus of breeding animals from declining populations, with substantial impacts on distribution and patterns of genetic variation. It also revealed that this event is rare because colonists dispersed across an evolutionary boundary, suggesting that the causative factors behind recent declines are unusual or of larger magnitude than normally occur." Thus, although recent colonization events in the northern part of the eastern DPS indicate movement of western sea lions into this area, the mixed part of the range remains small (Jemison et al. 2013), and the overall discreteness of the eastern from the western stock remains distinct. Hybridization among subspecies and species along a contact zone such as now occurs near the stock boundary is not unexpected as the ability to interbreed is a primitive condition whereas reproductive isolation would be derived. In fact, as stated by NMFS and USFWS in a 1996 response to a previous comment regarding stock discreteness policy (61 FR 47222), "*The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment*" or stock. The fundamental concept overlying this distinctiveness is the collection of morphological, ecological and behavioral, and genetic evidence for stock differences initially described by Bickham et al. (1996) and Loughlin (1997) and supported by Baker et al. (2005), Harlin-Cognato et al. (2006), Hoffman et al. (2006, 2009), O'Corry-Crowe et al. (2006), and Phillips et al. (2009, 2011).

POPULATION SIZE

The western stock of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000 (Loughlin et al. 1984, Loughlin and York 2000, Burkanov and Loughlin 2005). Since 2000, the abundance of the western stock has increased, but there has been considerable regional variation in trend (Sease and Gudmundson 2002, Burkanov and Loughlin 2005, Fritz et al. 2013). The most recent comprehensive aerial photographic and land-based surveys of western Steller sea lions in Alaska were conducted in 2013-2014 (DeMaster 2014, Fritz et al. 2015). Western Steller sea lion pup and non-pup counts in Alaska in 2014 were estimated to be 12,189 (90% credible interval: 11,318-13,064) and 37,308 (34,373-40,314), respectively, using agTrend (Johnson and Fritz 2014) and 2013-2014 survey results (DeMaster 2014, Fritz et al. 2015). Demographic multipliers (e.g., pup production multiplied by 4.5) and proportions of each age-sex class that are hauled out during the day in the breeding season (when aerial surveys are conducted) have been proposed as methods to estimate total population size from pup and/or non-pup counts (Calkins and Pitcher 1982, Higgins et al. 1988, Milette and Trites 2003, Maniscalco et al. 2006). However, there are several factors which make using these methods problematic when applied to counts of western Steller sea lions in Alaska, including the lack of vital (survival and reproductive) rate information for the western and central Aleutian Islands, the large variability in abundance trends across the range (see Current Population Trend section below and Pitcher et al. 2007), and the large uncertainties related to reproductive status and foraging conditions that affect proportions hauled out (see review in Holmes et al. 2007).

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 cliff counts for non-pups and ground counts for pups. The most recent counts of non-pup Steller sea lions in Russia were conducted in 2007-2011 and totaled ~12,700 (V. Burkanov, NMFS-AFSC-NMML, 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm.). The most recent estimate of pup production in Russia is available from counts conducted in 2011 and 2012, which totaled 6,021 pups.

Minimum Population Estimate

Because of the uncertainty regarding the use of the pup multiplier to estimate N, we will use the best estimate of the total count of western Steller sea lions in Alaska as the minimum population estimate (N_{MIN}). The agTrend (Johnson and Fritz 2014) estimates (with 90% credible intervals) of western Steller sea lion pup and non-pup counts in 2014 in Alaska are 12,189 (11,318-13,064) and 37,308 (34,373-40,314), respectively, which total 49,497 and will be used as the minimum population estimate (N_{MIN}) for the U.S. portion of the western stock of Steller sea lions (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 (sums of counts at consistently surveyed, large sites used to examine population trends) of Steller sea lions in Alaska were made in 1956-1960. Those counts indicated that there were at least 140,000 (no correction factor 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 totaled about 110,000 sea lions (no correction factor applied). The decline appears to have spread eastward to Kodiak Island 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). During the late 1980s, counts in Alaska overall declined at ~15% per year (NMFS 2008) which prompted the listing (in 1990) of the species as “threatened” range-wide under the Endangered Species Act (ESA). Continued declines in counts of western sea lions in Alaska in the 1990s (Sease et al. 2001) led NMFS to change the ESA listing status to “endangered” in 1997 (NMFS 2008). Surveys in Alaska in 2002, however, were the first to note an increase in counts, which suggested that the overall decline of western Steller sea lions stopped in 2000-2002 (Sease and Gudmundson 2002).

Johnson and Fritz (2014) developed agTrend to estimate regional and overall trends in counts of pups and non-pups in Alaska using data collected at all sites with at least two non-zero counts, rather than relying solely on counts at “trend” sites (see also Fritz et al. 2013). Using agTrend with data collected through 2014, there is strong evidence that non-pup counts of western stock Steller sea lions in Alaska increased between 2000 and 2014 (Table 1; Fritz et al. 2015). However, there are strong regional differences across the range in Alaska, with positive trends east of Samalga Pass (~170°W) and negative trends to the west (Table 1; Fig. 2).

Regional variation in trends in pup counts in 2000-2014 is similar to that of non-pups (Table 1). Overall, there is strong evidence that pup counts increased in the overall western stock in Alaska and that there is considerable regional variation west and east of Samalga Pass. West of Samalga Pass, pup counts are stable in the central Aleutian Islands but decreasing rapidly in the western Aleutian Islands. East of Samalga Pass, there is strong evidence that pup counts increased in each of the four regions. Regional differences in pup trends cannot be explained by movement of pups during the breeding season. However, slower growth in pup counts in the central Gulf of Alaska than in the surrounding regions east of Samalga Pass could be due to movement of adult females out of the region (suggesting some level of permanent emigration) or poor local conditions, both of which suggest sea lions have responded to meso-scale (on the order of 100s of kilometers) variability in their environment.

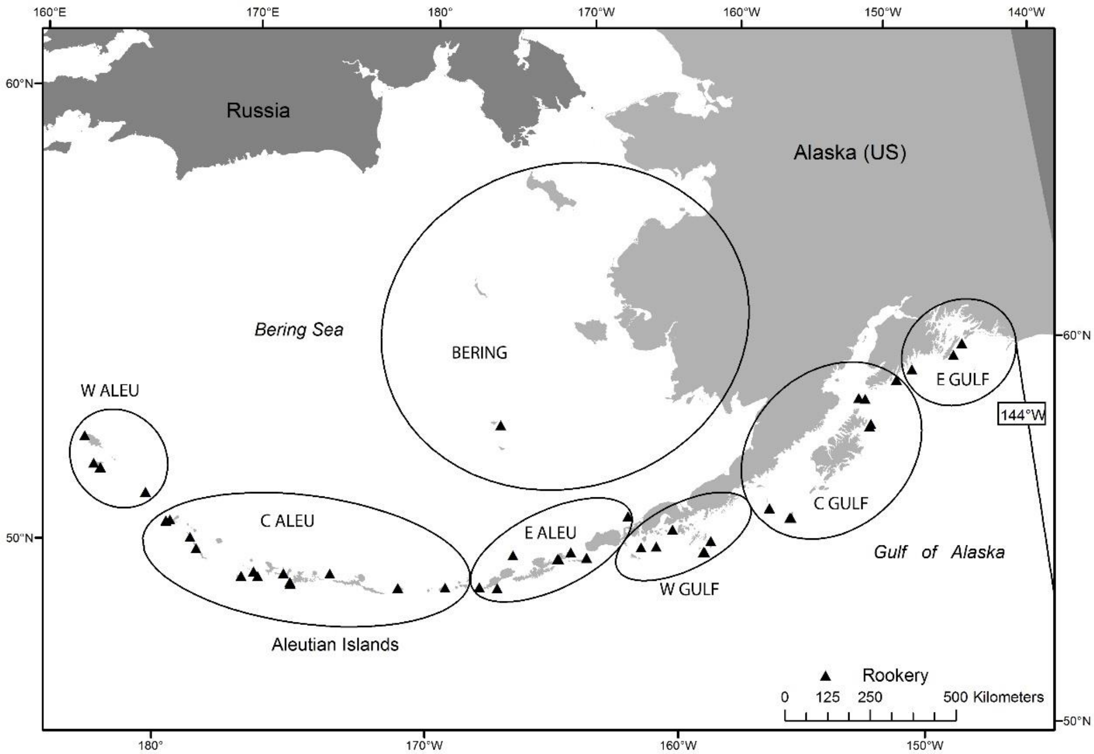

Figure 2. Regions of Alaska used for western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands Islands regions, respectively.

Table 1. Trends (annual rates of change expressed as % y^{-1} with 95% credible interval) in counts of western Steller sea lion non-pups (adults and juveniles) and pups in Alaska, by region, for the period 2000-2014 (Johnson and Fritz 2014, Fritz et al. 2015).

		Non-pups				**Pups**		
Region	**Latitude Range**	**Trend**	**-95%**	**+95%**		**Trend**	**-95%**	**+95%**
Western Stock in Alaska	144°W-172°E	2.17	1.54	2.76		1.76	1.16	2.31
E of Samalga Pass	144°-170°W	3.41	2.59	4.15		3.18	2.44	3.91
Eastern Gulf of Alaska	144°-150°W	5.22	2.48	8.06		4.44	2.36	6.42
Central Gulf of Alaska	150°-158°W	2.61	1.46	3.76		2.14	0.45	3.61
E-C Gulf of Alaska	144°-158°W	3.67	2.36	5.08		2.83	1.58	4.07
Western Gulf of Alaska	158°-163°W	4.09	2.77	5.33		3.27	1.86	4.72
Eastern Aleutian Islands	163°-170° W	2.3	0.98	3.67		3.55	2.43	4.62
W of Samalga Pass	170°W-172°E	-1.22	-2.02	-0.4		-1.66	-2.46	-0.86
Central Aleutian Islands	170°W-177°E	-0.27	-1.17	0.61		-0.64	-1.56	0.23
Western Aleutian Islands	172°-177°E	-7.10	-8.66	-5.57		-8.92	-10.14	-7.53

The distribution of sightings of branded animals during the breeding season indicates an average annual net movement of sea lions from the central to the eastern Gulf of Alaska, which could have depressed trend estimates in the former and increased trend estimates in the latter region (Fritz et al. 2013). Non-pup counts in the combined eastern-central Gulf of Alaska region increased at 3.67% y^{-1} (2.36-5.08% y^{-1}) between 2000 and 2014 (Table 1). Although less is known about inter-regional movement west of Samalga Pass, including Russia, sea lion dispersal during the breeding season may have had a smaller influence on non-pup trends here than in the eastern-central Gulf of Alaska given the much larger area over which regional non-pup (and pup) trends are declining (see discussion of Russia below).

Fritz et al. (2013) estimated the magnitude of cross-boundary movement of Steller sea lions between the western and eastern stocks using transition probabilities of individually marked sea lions by sex, age, and region estimated by Jemison et al. (2013); survival rates by age, sex, and region estimated by Hastings et al. (2011) and Fritz et al. (2014); and pup production by region based on aerial surveys conducted in 2009. There was an estimated average net annual movement of only ~200 sea lions from Southeast Alaska (eastern stock) to the western stock during the breeding season. Given that only approximately 60% of sea lions are hauled out and available to be counted during breeding season aerial surveys (see summary of sightability by age and sex in Holmes et al. 2007), an average net movement of this magnitude represents a very small (<0.5%) percentage of the total count of sea lions in the western stock or Southeast Alaska and would have a negligible impact on non-pup trend estimates in either area. However, there were significant differences by sex and age in the cross-boundary movement, with a net increase of ~400 females in Southeast Alaska (eastern stock) and a net increase of ~600 males in the western stock. The pattern of movement is supported by mitochondrial DNA evidence that indicated that the newest rookeries in northern Southeast Alaska (eastern stock) were colonized in part by western females (Gelatt et al. 2007, O'Corry-Crowe et al. 2014).

Burkanov and Loughlin (2005) estimated that the Russian Steller sea lion population (pups and non-pups) declined from about 27,000 in the 1960s to 13,000 in the 1990s and increased to approximately 16,000 in 2005. Data collected through 2012 (V. Burkanov, pers. comm.) indicate that overall Steller sea lion abundance in Russia has continued to increase and is now similar to the 1960s (27,100 based on life table multiplier of 4.5 on the most recent total pup count). Between 1995 and 2011/2012, pup production has increased overall in Russia by 3.1% per year (V. Burkanov, pers. comm., 27 February 2013). However, just as in the U.S. portion of the stock, there are significant regional differences in population trend in Russia. Pup production in the combined Kuril Islands and the Sea of Okhotsk areas increased 59% between 1995 and 1997 (3,596 pups) and 2011 (5,729 pups), while non-pup counts increased 87% over the same time period (6,205 to 11,576). However, Steller sea lion population trends in eastern Kamchatka, the Commander Islands, and the western Bering Sea have been quite different. In eastern Kamchatka, pup production at the single rookery (Kozlova Cape) declined 50% between the mid-1980s (~200 pups) and 2012 (101 pups), while non-pup counts were 80% lower in 2010 than in the early 1980s. On the Commander Islands, non-pup counts increased between 1930 and the late 1970s, when the rookery became re-established. Pup production on the Commander Islands increased to a maximum of 280 in 1998 and has varied between 180 and 228 since then (through 2012). Non-pup counts on the Commander Islands also reached a maximum in 1998-1999 (mean of 880), and since then have ranged between 581 and 797 (through 2010). The largest decline in Steller sea lions in Russia has been in the western Bering Sea (which has no rookeries), where non-pup counts declined 98% between 1982 and 2010. The overall increase in the abundance of Steller sea lions in Russia is due entirely to recovery and increases in abundance in the Kuril Islands and Sea of Okhotsk. Regions in Russia that are either stable or declining (eastern Kamchatka, Commander Islands, and western Bering Sea) border regions in the U.S. where sea lion trends are similar (Aleutian Islands west of 170°W).

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 ESA (Wade and Angliss 1997). Thus, for the U.S. portion of the western stock of Steller sea lions, PBR = 297 animals (49,497 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Between 2009 and 2013, serious injury and mortality of western Steller sea lions was observed in the following 7 fisheries of the 22 federally-regulated commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: 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 Pacific cod longline, and Gulf of Alaska sablefish longline fisheries (Table 2).

Observers also monitored the Alaska State-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording two mortalities in 1991, extrapolated to 29 (95% CI: 1-108) for the entire fishery (Wynne et al. 1992). No mortality was observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean annual mortality rate of 14.5 (CV = 1.0) sea lions for 1990 and 1991. It is not known whether this incidental mortality rate is representative of the current rate in this fishery.

Combining the mortality and serious injury estimates from the Bering Sea/Aleutian Islands groundfish trawl, Gulf of Alaska groundfish trawl, and Gulf of Alaska longline fisheries (16) with the estimate from the Prince William Sound salmon drift gillnet fishery (15) results in an estimated mean annual mortality and serious injury rate in observed fisheries of 31 sea lions from this stock (Table 2).

Table 2. Summary of incidental mortality and serious injury of the Western U.S. stock of Steller sea lions due to commercial fisheries in 2009-2013 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Breiwick 2013; NMML, unpubl. data). N/A indicates that data are not available. Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. Atka mackerel trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 1 0 0 0	0 1 0 0 0	0.2 (CV = 0.05)
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	3 4 (+1)[a] 7 6 7	3.0 4 (+1)[b] 7 6.0 7.0	5.6 (CV = N/A)
Bering Sea/Aleutian Is. Pacific cod trawl	2009 2010 2011 2012 2013	obs data	63 66 60 68 80	0 1 1 0 1	0 1 1.0 0 1.9	0.8 (CV = 0.33)
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	6 5 9 7 (+1)[c] 5	6.2 8.2 9.3 7 (+1)[d] 5.1	7.4 (CV = N/A)
Gulf of Alaska Pacific cod longline	2009 2010 2011 2012 2013	obs data	21 29 31 13 28	0 1 0 0 0	0 1.1 0 0 0	0.2 (CV = 0.32)

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Gulf of Alaska Pacific cod trawl	2009	obs data	29	0	0	0.2 (CV = 0)
	2010		31	0	0	
	2011		41	0	0	
	2012		25	1	1	
	2013		11	0	0	
Gulf of Alaska sablefish longline	2009	obs data	16	0	0	1.1 (CV = 0.91)
	2010		15	0	0	
	2011		14	0	0	
	2012		14	1	5.5	
	2013		13	0	0	
Prince William Sound salmon drift gillnet	1990	obs data	4	0	0	15 (CV = 1.0)
	1991		5	2	29	
Minimum total estimated annual mortality						31 (CV = 0.87)

[a]Total mortality and serious injury observed in 2010: 4 in sampled hauls + 1 in an unsampled haul.
[b]Since the total known mortality and serious injury (4 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (4) for the fishery in 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.
[c]Total mortality and serious injury observed in 2012: 7 in sampled hauls + 1 in an unsampled haul.
[d]Since the total known mortality and serious injury (7 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (7) for the fishery in 2012, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Reports from the NMFS Alaska Region stranding database of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality and serious injury data (Helker et al. 2015; Table 3). During the 5-year period from 2009 to 2013, there were six confirmed fishery-related Steller sea lion strandings in the range of the western stock. Five reports involved a Steller sea lion in poor body condition with a flasher lure hanging from its mouth and, in each case, the animal was believed to have ingested the hook (Table 3). The sixth animal had a string leader line hanging out of its mouth, with a hook apparently inside its mouth. Fishery-related strandings during 2009-2013 resulted in an estimated average annual mortality and serious injury rate of 1.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported. Additionally, since Steller sea lions from parts of the western stock are known to travel to parts of Southeast Alaska to forage, and higher rates of entanglement of Steller sea lions have been observed in this area (e.g., see Raum-Suryan et al. 2009), estimates based solely on stranding reports in areas west of 144°W longitude may underestimate the total entanglement of western stock animals in fishery-related and other marine debris. Steller sea lions reported in the stranding database as shot are not included in this estimate, as they may have been animals that were struck and lost in the Alaska Native subsistence harvest.

Table 3. Summary of Western U.S. Steller sea lion mortality and serious injury by year and type reported to the NMFS Alaska Region, marine mammal stranding database, and Alaska Department of Fish and Game in 2009-2013 (Helker et al. 2015).

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Swallowed troll gear	1	0	1	3	0*	1
Ring neck entanglement (packing band)	1	2	0	1	0*	0.8
Ring neck entanglement (unknown marine debris/gear)	0	3	1	1	0*	1
Swallowed unknown fishing gear	0	1	0	0	0	0.2
Shot with arrow	0	0	0	0	1	0.2
Entangled in aquaculture facility net	0	0	0	0	1	0.2

*The 2013 Alaska Department of Fish and Game entanglement and flasher injury data are not included. Thus, this number is artificially low and will be revised as data become available.

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 (Merrick and Loughlin 1997; Lander et al. 2009, 2011a, 2011b; NMML, unpubl. data).

The minimum average annual estimated mortality and serious injury rate incidental to U.S. commercial fisheries is 31 Steller sea lions. Based on observer data (31) and stranding data (1.2), the minimum average annual estimated mortality and serious injury rate incidental to commercial and recreational fisheries is 32 Steller sea lions. 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, thus, the estimated mortality and serious injury is likely an underestimate of the actual level.

Alaska Native Subsistence/Harvest Information

Information on the subsistence harvest of Steller sea lions comes via two sources: the Alaska Department of Fish and Game (ADF&G) and the Ecosystem Conservation Office (ECO) of the Aleut Community of St. Paul. The ADF&G 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, 2006, 2008, 2009a, 2009b). 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, annual statewide data on community subsistence harvests are no longer being collected. Data are being collected periodically in subareas. Therefore, the most recent 5 years of data (2004-2008) will be retained and used for calculating an annual mortality and serious injury 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 2010). Information on subsistence harvest levels is provided in Table 4; data from ECO (e.g., Zavadil 2010) are relied upon as the source of data for St. Paul Island and all other data are from the ADF&G (e.g., Wolfe et al. 2005). Data were collected on the Alaska Native harvest of Steller sea lions for seven communities on Kodiak Island in 2011; the Alaska Native Harbor Seal Commission and ADF&G estimated a total of 20 adult sea lions were harvested, with a 95% confidence range between 15 to 28 animals (Wolfe et al. 2012). This estimate does not represent a comprehensive statewide estimate; therefore, the best available statewide subsistence harvest estimates for a 5-year period are those from 2004 to 2008. No monitoring occurred on St. Paul in 2012; therefore, the most recent 5 years of data from St. Paul are from 2008-2011 and 2013.

The mean annual subsistence take from this stock for all areas except St. Paul in 2004-2008, combined with the mean annual take for St. Paul in 2008-2011 and 2013, was 199 Steller sea lions (Table 4).

Table 4. 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 calculating an annual mortality and serious injury estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5 years of data available (2008-2011 and 2013).

	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[a]		
2005	153.2	27.6	180.8[b]		
2006	114.3	33.1	147.4[c]		
2007	165.7	45.2	210.9[d]		
2008	114.7	21.6	136.3[e]	22[f]	158
2009	N/A	N/A	N/A	26[g]	N/A
2010	N/A	N/A	N/A	20[h]	N/A
2011	N/A	N/A	N/A	32[i]	N/A
2012	N/A	N/A	N/A	N/A	N/A
2013	N/A	N/A	N/A	34[j]	N/A
Mean annual take	136.9	35.3	172.3	26.8	199

[a]Wolfe et al. (2005); [b]Wolfe et al. (2006); [c]Wolfe et al. (2008); [d]Wolfe et al. (2009a); [e]Wolfe et al. (2009b); [f]Jones (2009); [g]Zavidil (2010); [h]Lestenkof (2011); [i]Lestenkof (2012); [j]ADF&G, unpubl. data.

Other Mortality

Reports from the NMFS Alaska Region stranding database of Steller sea lions entangled in marine debris or with injuries caused by other types of human interaction are another source of mortality and serious injury data. From 2009 to 2013, nine animals were observed with circumferential neck entanglements from packing bands or other unknown marine debris/gear, one animal was shot with an arrow, and one entangled in an aquaculture facility net (Table 3). The mean annual mortality and serious injury rate from these sources of human interactions for 2009-2013 is 2.2 sea lions from this stock.

Mortality and serious injury 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 2008 and 2012, there was no reported mortality or serious injury resulting from research on the western stock of Steller sea lions (Division of Permits and Conservation, 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 and serious injury (31) exceeds 10% of the PBR (30) 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 (31 (commercial fisheries) + 1.2 (unknown fisheries) + 199 (Alaska Native harvest) + 2.2 (entanglement in marine debris/gear and other human-interaction) = 233) is below the PBR level (297) for this stock. The Western U.S. stock of Steller sea lions 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, the population previously declined for unknown reasons that are not explained by the level of direct human-caused mortality and serious injury.

HABITAT CONCERNS

Many factors have been suggested as causes of the steep decline in abundance of western Steller sea lions observed in the 1980s, including competitive effects of fishing, environmental change, disease, contaminants, killer whale predation, incidental take, and illegal and legal shooting (Atkinson et al. 2008, NMFS 2008). Potential threats to Steller sea lion recovery are shown in Table 5. A number of management actions have been implemented between 1990 and 2011 to promote the recovery of the Western U.S. stock of Steller sea lions, including 3 nautical mile no-entry zones around rookeries, prohibition of shooting at or near sea lions, and regulation of fisheries for sea lion prey species (e.g., walleye pollock, Pacific cod, and Atka mackerel; see reviews by Fritz et al. 1995, McBeath 2004, Atkinson et al. 2008, NMFS 2008).

Table 5. Potential threats and impacts to Steller sea lion recovery and associated references. Threats and impact to recovery as described by the Revised 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	Trites and Donnelly 2003, Fritz and Hinckley 2005
Competition with fisheries	Potentially high	Fritz and Ferrero 1998, Hennen 2004, Fritz and Brown 2005, Dillingham et al. 2006
Predation by killer whales	Potentially high	Springer et al. 2003, Williams et al. 2004, DeMaster et al. 2006, Trites et al. 2007
Toxic substances	Medium	Calkins et al. 1994, Lee et al. 1996, Albers and Loughlin 2003
Incidental take by fisheries	Low	Wynne et al. 1992, Nikulin and Burkanov 2000, Perez 2006
Subsistence harvest	Low	Haynes and Mishler 1991, Loughlin and York 2000, Wolfe et al. 2005
Illegal shooting	Low	Loughlin and York 2000, NMFS 2001
Entanglement in marine debris	Low	Calkins 1985
Disease and parasitism	Low	Burek et al. 2005

Threat	Impact on Recovery	Reference Examples
Disturbance from vessel traffic and tourism	Low	Kucey and Trites 2006
Disturbance or mortality due to research activities	Low	Calkins and Pitcher 1982, Loughlin and York 2000, Kucey 2005, Kucey and Trites 2006, Atkinson et al. 2008, Wilson et al. 2012

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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. 1). Large numbers of individuals disperse widely outside of the breeding season (late May-early July), probably to access seasonally important prey resources. This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing in foraging areas of animals that were born in different 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, 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).

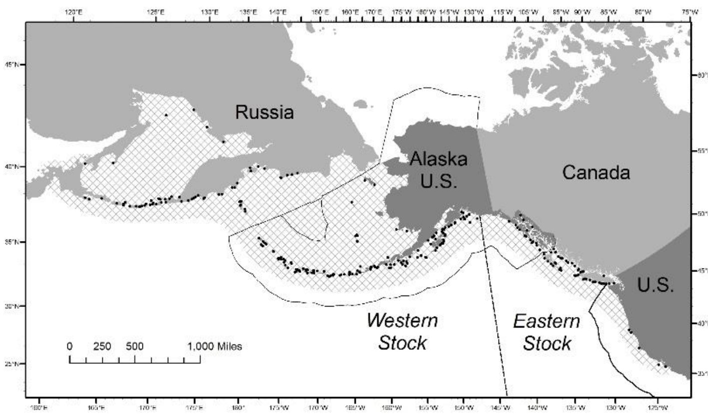

Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; S. Majewski, Fisheries and Oceans Canada, personal communication). Black dashed line (144°W) indicates stock boundary (Loughlin 1997) and solid black line delineates U.S. Exclusive Economic Zone.

Loughlin (1997) and Phillips et al. (2009) 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: skull morphology (Phillips et al. 2009); 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 born east of Cape Suckling, Alaska (144°W), and a western U.S. stock, which includes animals born at and west of Cape Suckling (Loughlin 1997; Fig. 1).

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 in substantial numbers at two northern southeast Alaska rookeries (Gelatt et al. 2007).

In 1998, a single Steller sea lion pup was observed on Graves Rock just north of Cross Sound in Southeast Alaska, and within 15 years (2013), pup counts had increased to 551 (DeMaster 2014). Mitochondrial and microsatellite analysis of pup tissue samples collected in 2002 revealed that approximately 70% of the pups had mtDNA haplotypes that were consistent with those found in the western stock (Gelatt et al. 2007). Similarly, a rookery to the south on the White Sisters Islands where pups were first noted in 1990 was also sampled in 2002 and approximately 45% of those pups had western stock haplotypes. Collectively, this information demonstrates that these two most recently established rookeries in northern southeast Alaska have been partially to predominately established by western stock females. Movements of animals marked as pups in both stocks support these genetic results (Jemison et al. 2013).

Overall, however, the observations of marked sea lion movements corroborate the extensive genetics research findings for a strong separation between the two currently recognized stocks. Although recent colonization events in the northern part of the eastern DPS indicate movement of western sea lions into this area, the mixed part of the range remains small (Jemison et al. 2013), and the overall discreteness of the eastern from the western stock remains distinct. Hybridization among subspecies and species along a contact zone such as now occurs near the stock boundary is not unexpected as the ability to interbreed is a primitive condition whereas reproductive isolation would be derived. In fact as stated by NMFS and FWS in a 1996 response to a previous comment regarding stock discreteness policy (61 FR 47222), "*The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment*" or stock. The fundamental concept overlying this distinctiveness is the collection of morphological, ecological and behavioral, and genetic evidence for stock differences initially described by Bickham et al. (1996) and Loughlin (1997), and supported by Baker et al. (2005), Harlin-Cognato et al. (2006), Hoffman et al. (2006, 2009), O'Corry-Crowe et al. (2006), and Phillips et al. (2009, 2011).

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 abundance 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 total eastern stock pup count is 14,317 and includes counts made between 2009 and 2013 (Table 1; DeMaster 2014; NMFS, Fisheries and Oceans Canada, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, 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 60,131 (14,317 × 4.2) and 74,448 (14,317 × 5.2). These are not minimum population estimates, since they are extrapolated from pup counts from photographs taken between 2009 and 2013, 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 was due to high fecundity, and as high as 5.2 if it was due to low juvenile mortality (Pitcher et al. 2007).

Minimum Population Estimate

The minimum population estimate was calculated by adding the most recent non-pup and pup counts from all sites surveyed (Table 1).

Table 1. Non-pup and pup counts from rookery and haulout sites of eastern Steller sea lions, by region. The most recent counts for each site were used to calculate the minimum population estimate (N_{MIN}) for the entire eastern stock, and for the U.S. portion.

Region	Year	Non-pups	Pups	Total count
Southeast Alaska (USA)	2013	19,101	6,741	25,842
British Columbia (Canada)	2010	17,932	5,485	23,417
Washington (USA)	2011	1,749	--	1,749
Oregon (USA)	2013	4,761	--	4,761
Oregon (USA)	2009	--	1,418	1,418
California (USA)	2011	2,108	673	2,781
Eastern stock, total		45,651	14,317	59,968
Eastern stock, U.S. portion only		27,719	8,832	36,551

This results in an N_{MIN} for the eastern U.S. (only) stock of Steller sea lions of 36,551 based on counts as old as 2009 for Oregon pup counts (NMFS, unpublished data) to as recent as 2013 for Oregon and southeast Alaska. Including counts in British Columbia (Canada) yields an N_{MIN} for the entire eastern stock of 59,968. These counts are considered minimum estimates of population size because they have not been corrected for animals at sea.

Current Population Trend

The best available information indicates the eastern stock of Steller sea lion increased at a rate of 4.18% per year (90% confidence bounds of 3.71 - 4.62% per year) between 1979 and 2010 based on an analysis of pup counts in California, Oregon, British Columbia and Southeast Alaska (NMFS 2013). A similar analysis of non-pup counts in the same regions plus Washington yielded an estimate of population increase of 2.99% per year (2.62-3.31% per year; NMFS 2013). Pitcher et al. (2007) reported that the eastern U.S. stock increased at a rate of 3.1% per year during a 25-year time period from 1977 to 2002; however, they used a slightly different method to estimate population growth than the methods reported in NMFS (2013). The eastern U.S. stock increase has been driven by growth in pup counts in all regions (NMFS 2013).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Non-pup counts in California ranged between 4,000 and 6,000 with no apparent trend from 1927 and 1947, but have subsequently declined by over 50%, and were between 1,500 and 2,000 in the period 1980-2011. At Año Nuevo Island off central California, a steady decline in abundance began in 1970, and there was an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). Counts of non-pups in California have been relatively stable, while those in Oregon and Washington have been increasing since 1990. Non-pup counts in southeast Alaska and British Columbia increased steadily between 1990 and 2013, and comprise ~80% of the total eastern stock count (Table 2; Fig. 2).

Fritz et al. (2013) estimated the magnitude of cross-boundary movement of Steller sea lions between the western and eastern stocks using transition probabilities of individually marked sea lions by sex, age and region estimated by Jemison et al. (2013); survival rates by age, sex and region estimated by Hastings et al. (2011) and Fritz et al. (2014); and pup production by region based on aerial surveys conducted in 2009. There was an estimated average net annual movement of only ~200 sea lions from southeast Alaska (eastern stock) to the western stock during the breeding season. Given that only approximately 60% of sea lions are hauled out and available to be counted during breeding season aerial surveys (see summary of sightability by age and sex in Holmes et al. 2007), an average net movement of this magnitude represents a very small (<0.5%) percentage of the total count of sea lions in the western stock or southeast Alaska, and would have a negligible impact on non-pup trend estimates in either area. However, there were significant differences by sex and age in the cross-boundary movement, with a net increase of ~400 females in southeast Alaska (eastern stock) and a net increase of ~600 males in the western stock. The pattern of movement is supported by mitochondrial DNA evidence that indicated that the newest rookeries in northern southeast Alaska (eastern stock) were colonized in part by western females (Gelatt et al. 2007).

Table 2. Counts of adult and juvenile Steller sea lions observed at consistently surveyed rookery and haulout (trend) sites by year and region for the eastern U.S. stock from 1990 through 2013*. California (CA) includes Año Nuevo, Farallon Islands, and St. George Reef. Oregon (OR) includes counts at all sites. Washington (WA) includes Split Rock Complex, Sea Lion Rock/Carroll Island, Bodelteh/Cape Alava/Guano Rock, and Tatoosh. British Columbia (BC) includes counts from all sites. Southeast Alaska (SEAK) includes counts from 24 trend sites.

Region	1990	1991	1992	1994	1996	1998	2000	2002	2006	2008	2009	2010	2011	2013
CA	1,329	1,163	969	1,046	1,369	1,277[1]	1,215	1,096			1,236		935	
OR	2,414		3,581	3,293	3,205	3,971	2,927	4,169	4,506	4,090				4,761
WA	89[2]	274	278	384	595	470	681	650	714	1,198	1,343	1,421	1,749	
BC	6,122[3]	--	7,378	8,104	--	9,818	--	12,122	15,721	15,061		17,932	--	
SEAK	9,149	9,294		11,524	10,778	11,117	12,412	15,138	--	13,902	16,635	15,431	--	18,595
Total	19,103		21,500[4]	24,351		26,653		33,176		35,414[5]		40,174[6]		

*Data sources for counts of adult and juvenile Steller sea lions: Merrick et al. 1992; NMFS 1995; Strick et al. 1997; Sease et al. 1999; Sease and Loughlin 1999; Sease et al. 2001; Olesiuk 2003, 2004, 2008; Brown et al. 2002; NMFS 2008, 2013; ODF&W, unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; WDF&W, unpubl. data, Marine Mammal Investigations, 7801 Phillips Road SW, Lakewood WA 98498; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970; NMFS, unpublished data (M. Lowry, SWFSC); DeMaster 2009, 2014.

[1] This count was conducted in 1999.
[2] This count was conducted in 1989.
[3] This count was conducted in 1987.
[4] Total includes 1991 SEAK count.
[5] Total includes 2004 CA count of 1,163.
[6] Total includes 2008 OR and 2009 CA count.

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. NMFS (2013) estimated that the eastern stock increased at rates of 4.18% per year using pup counts, and 2.99% per year using non-pup counts between 1979 and 2009. 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).

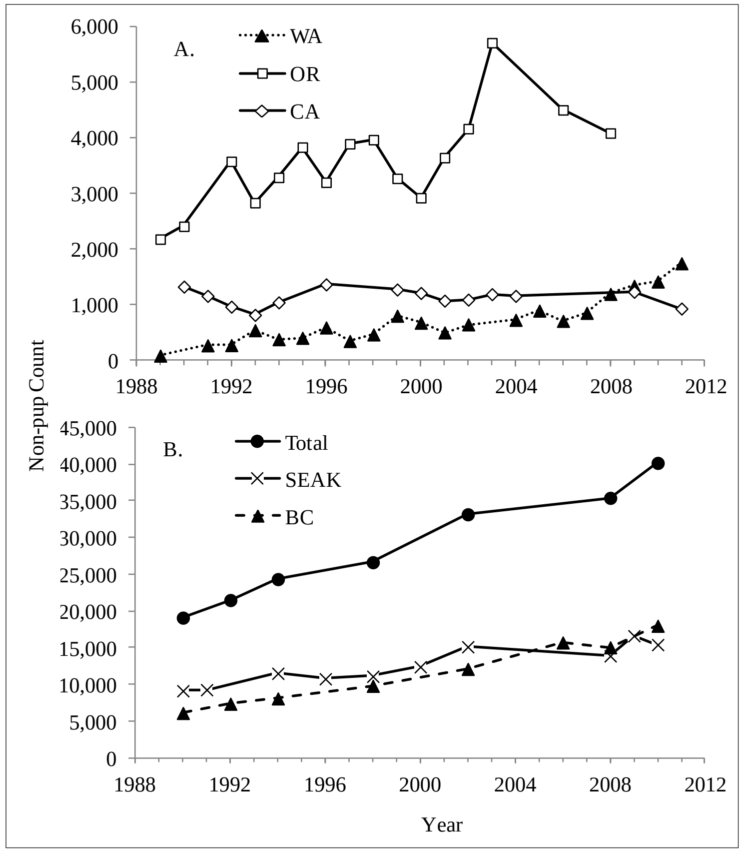

Figure 2. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites by region throughout the range of the eastern U.S. stock, 1990-2013. Data from Oregon and British Columbia include all sites. Region abbreviations and data are in Table 2. (A.) CA, OR, and WA. (B.) BC, SEAK, and Total Eastern 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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. On 4 December 2013, the eastern stock of Steller sea lion was removed from the list of 'threatened' species under the Endangered Species Act (ESA; 78 FR 66140). NMFS's decision to delist this species was based on the information presented in the Status Review (NMFS 2013), the factors for delisting in section 4(a)(1) of the ESA, the biological and threats-based recovery criteria in the 2008 Recovery Plan (NMFS 2008), the continuing efforts to protect the species, and information received during public comment and peer review. NMFS's consideration of this information led to a determination that the eastern population has recovered and no longer meets the definition of a threatened species under the ESA. Per the 2013 SAR, NMFS for now will continue, under the MMPA, to consider the stock depleted; the recovery factor of 0.75 is maintained and PBR = 1,645 (36,551 × 0.06 × 0.75).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Between 2008 and 2012, there were no incidental serious injuries and mortalities of eastern Steller sea lions observed in the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality by fisheries observers.

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 3. There have been no observed serious injuries or mortalities incidental to the CA/OR thresher shark and swordfish drift gillnet fishery since the 1990s (Carretta 2002; Carretta and Chivers 2003, 2004). In the WA/OR/CA groundfish trawl (Pacific whiting component only) one Steller sea lion was observed killed in each year in 2000-2003. No data are available after 1998 for the northern Washington marine set gillnet fishery. Between 2005 and 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 fishery since 2000 (Perez, unpubl. ms.; Breiwick 2013). During the 4-year period from 2007 to 2010, a total of 45 Steller sea lions mortalities occurred in fisheries operating south of 49°N latitude (2007 = 14 mortalities, 2008 = 6 mortalities, 2009 = 0 mortalities, 2010 = 25 mortalities), with an average annual take of 11.25 animals. These takes were reported as animals killed by gear; however, they could not be assigned to a particular fishery. The total mean annual mortality rate from all fisheries is 17.0 Steller sea lions (Breiwick 2013). 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 3. Summary of incidental mortality of Steller sea lions (eastern U.S. stock) due to commercial fisheries from 2005 to 2009 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 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
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)
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						5.71 (CV = 0.23)

[1] A "--" indicates bycatch estimate is 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. An average annual mortality and serious injury of 30.6 sea lions with flashers, or salmon troll lures, hanging from their mouth were observed in Southeast Alaska and northern British Columbia between 2008 and 2012. It is not clear whether entanglements with hooks and flashers involved the recreational or commercial component of the salmon troll fishery. Based on guidelines presented in 77FR3233, 23 January 2012, these fishery interactions are considered "serious injuries". The average minimum annual serious injury and mortality attributed to entanglement in fishing gear, ingestion of gear other than troll gear, or other fishery-related injury and mortality between 2008 and 2012 was 34.6. These estimates are based on opportunistic reports, and actual levels of occurrence are likely higher.

Table 4. Summary of eastern Steller sea lion mortalities and serious injuries by year and type reported to the NMFS Alaska Regional Office, marine mammal stranding database, and ADF&G for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015).

Cause of Injury	2008	2009	2010	2011	2012	Mean Annual Mortality
Dependent animal with seriously injured mother	4	1	3	1	1	2.0
Entanglement (foreign high seas gillnet)	0	0	1	0	0	0.2
Entanglement (halibut gangion line)	0	0	0	1	0	0.2
Entanglement (troll gear)	1	0	0	0	0	0.2
Entanglement (unknown marine debris/gear)	1	0	0	0	0	0.2
Entanglement (unknown pot fishery gear)	1	0	0	0	0	0.2
Neck entanglement (fishing line)	1	0	1	1	0	0.6
Neck entanglement (longline gear)	0	0	0	1	0	0.2
Neck entanglement (packing band)	5	2	4	7	5	4.6
Neck entanglement (rope)	1	0	0	0	2	0.6
Neck entanglement (rubber band)	1	1	1	1	0	0.8
Neck entanglement (unknown marine debris/gear)	25	15	19	24	17	20
Vessel strike (unknown vessel)	0	1	0	0	0	0.2
Gunshot	0	1	2	0	15	3.0
Swallowed troll gear	38	15	42	30	28	30.6
Swallowed unknown fishing gear	0	0	1	0	0	0.2
Swallowed unknown marine debris/gear	1	0	0	0	0	0.2
Minimum total annual mortality						64.0*

*Total excludes gunshot animals from Alaska since these animals are likely already accounted for in the "struck and lost" from the Alaska Native harvest estimates.

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 51.6 sea lions per year, based on fisheries observer data (17.0), opportunistic observations, and stranding data (34.6).

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 consistently collected. Therefore, the most recent 5-years of data (2005-2008 and 2012) will be used for estimating an annual mortality estimate. The average number of animals harvested and struck but lost is 11 animals/year (Table 5). No monitoring occurred in 2010 and 2011. In 2012, one animal was landed and 8 animals were struck and lost.

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 (Fisheries and Oceans Canada 2010). 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 5. Summary of the subsistence harvest data for the eastern stock of Steller sea lions, 2005-2008 and 2012. As of 2009, data on community subsistence harvests are no longer being consistently collected at a statewide level. Therefore, the most recent 5-years of data (2005-2008 and 2012) will be retained and used for estimating an annual mortality estimate.

Year	Estimated total number taken	Number harvested	Number struck and lost
2005	19[1]	0	19
2006	12.6[2]	2.5	10.1
2007	6.1[3]	0	6.1
2008	9.7[4]	1.7	8.0
2012	9	1	8
Mean annual take (2004-2008)	11.3	1.0	10.2

[1]Wolfe et al. 2006; [2]Wolfe et al. 2008; [3]Wolfe et al. 2009a; [4]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. (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).

Steller sea lions were taken in British Columbia during commercial salmon farming operations. 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.). However, Fisheries and Oceans Canada (2010) summarized that "illegal and undocumented killing of Steller Sea Lions is likely to occur in B.C." and reported "[s]everal cases of illegal kills have been documented (DFO unpublished data), and mortality may also occur outside of the legal parameters assigned to permit holders (e.g. for predator control or subsistence harvest)" but "…data on these activities are currently lacking."

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 2008 to 2012, there was 1 reported stranding of an animal from this stock with gunshot wounds in Oregon and Washington in 2010, resulting in an estimated annual mortality of 0.2 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). Eighteen mortalities from gunshots were reported in Alaska (1 in 2009, 2 in 2010, and 15 in 2012). Although it is likely that illegal shooting does occur in Alaska, Steller sea lions reported in the Alaska stranding database as shot are not included in this estimate unless it was confirmed that the death was due to illegal shooting and not already accounted for in the estimate of animals struck and lost in the Alaska Native subsistence harvest. In addition, human-related stranding data are not available for British Columbia. One Steller sea lion death attributed to vessel collision was reported to the Alaska stranding network (0.2 mean annual mortality). Other sources of non-fishery human-related serious injury and mortality include ingestion of unknown marine debris/gear (0.4), entanglement in unknown marine debris/gear (26.2), and dependent of a seriously injured or dead mother (2.0) (Table 4).

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 2006 and 2010, there was 1 incidental mortality (2010) resulting from research on the eastern stock of Steller sea lions, which results in an annual average of 0.2 mortalities per year from this stock (T. Adams, pers. comm., Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910; 11 January 2012). 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 mean average human-caused mortality and serious injury of eastern Steller sea lions for 2008-2012 from sources other than fisheries and Alaska Native harvest is 29.4.

STATUS OF STOCK

Based on currently available data, the minimum estimated U.S. commercial fishery-related mortality and serious injury for this stock (17.0) is less than 10% of the calculated PBR (10% of PBR = 164) 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 (51.6 (commercial and recreational fisheries) + 11.3 (subsistence) + 29.4 (other human-caused mortality) = 92.3) does not exceed the PBR (1,645) for this stock. The eastern U.S. stock of Steller sea lion is currently not listed under the ESA but is considered "depleted" under the MMPA; therefore, this stock is classified as a strategic stock. Because the counts of eastern Steller sea lions have steadily increased over a 30+ year period, this stock is likely within its OSP; however, no determination of its status relative to OSP has been made.

Habitat Concerns

Unlike the western U.S. stock of Steller sea lion, there has been a sustained and robust increase in abundance of the eastern U.S. stock throughout most of its breeding range. 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 portion (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).

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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. 1) 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, on San Miguel Island off southern California (Lander and Kajimura 1982, NMFS 1993), and on the Farallon Islands off central California. 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).

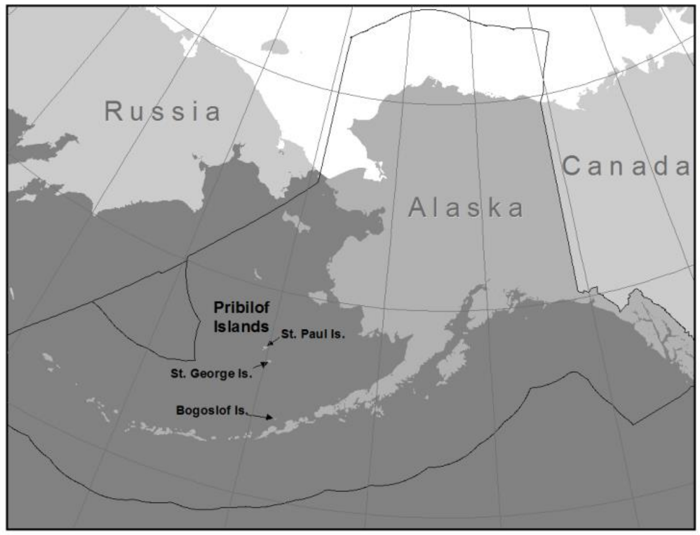

Figure 1. Approximate distribution of northern fur seals in the eastern North Pacific (dark shaded area).

During the reproductive season, adult males usually are on shore during the 4-month period from May to 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, on average around mid-November but ranging from late October to early December, 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 (Ream 2002, Dickerson et al. 2010). Thus, an Eastern Pacific stock and a California stock are recognized. The California stock is reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

The population estimate for the Eastern Pacific stock of northern fur seals is calculated as the estimated number of pups 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. Juvenile northern fur seals are pelagic and are not included in the rookery counts. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. Coefficients of variation (CVs) are unavailable for the expansion factor. As the great majority of pups are born on St. Paul and St. George Islands, pup surveys are conducted biennially on these islands. Counts are available less frequently on Sea Lion Rock (adjacent to St. Paul Island) and Bogoslof Island (Table 1). The most recent estimate for the number of fur seals in the Eastern Pacific stock, based on pup counts on Sea Lion Rock (2008), on St. Paul and St. George Islands (mean of 2008, 2010, and 2012), and on Bogoslof Island (2011), is 648,534 (4.47 × 145,086).

Table 1. Estimates and/or counts of northern fur seal pups born on the Pribilof Islands and Bogoslof Island. Standard errors for pup estimates at rookery locations and the CV for total pup production estimates are provided in parentheses (direct counts do not have standard errors). 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	94,502 (1,259)	"	17,973 (323)	"	136,790 (0.011)
2011	"	"	"	22,905 (921.5)	142,121 (0.011)
2012	96,828 (1,260)	"	16,184 (155)	"	142,658 (0.011)

* 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 of the correction factor is not available. Consistent with a recommendation of the Alaska Scientific Review Group (SRG) in October 1997 (DeMaster 1998) 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. N_{MIN} is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 3-year mean population estimate (N) of 648,534 and the default CV (0.2), N_{MIN} for the Eastern Pacific stock of northern fur seals is 548,926.

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. 2; York and Fowler 1992). There has been a decline in pup production on St. Paul Island since the mid-1990s. Pup production at St. George Island had a less pronounced period of stabilization that was similarly followed by decline. However, pup production appeared to stabilize again on St. George Island beginning around 2002 (Fig. 3). During 1998-2012, pup production declined 4.84% per year (SE = 0.49%; P < 0.01) on St. Paul Island and 1.95% per year

(SE = 0.50%; P < 0.01) on St. George Island. The estimated pup production in 2012 was below the 1916 level on both St. Paul and St. George Islands (NMFS, unpubl. data). Northern fur seal pup production at Bogoslof Island has grown at an exponential rate since the 1990s (R. Ream, NMFS-AFSC-NMML, 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm., 5 February 2009). Despite continued growth at Bogoslof Island, recent estimates of pup production indicate that the rate of increase may be slowing. Between 2005 and 2011, pup production at Bogoslof Island increased 9.9% per year. Incorporation of the 2012 estimates from the Pribilofs shows an insignificant change in pup production on the Pribilof Islands since 2010. Temporary increases in the overall stock size are observed when opportunistic estimates are conducted at Bogoslof, but declines at the larger Pribilof colony (specifically St. Paul) continue to drive the overall stock estimate down over time.

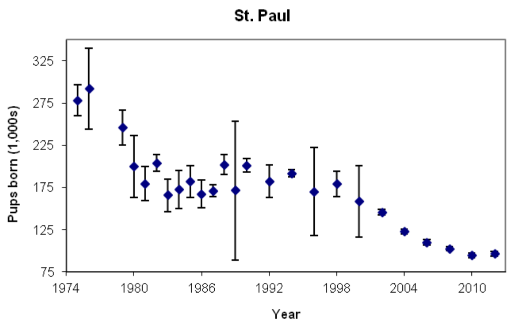

Figure 2. Estimated number of northern fur seal pups born on St. Paul Island, 1970-2012.

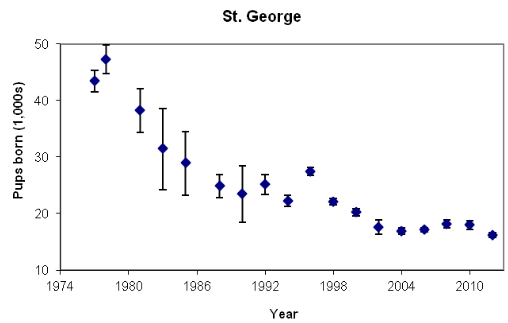

Figure 3. Estimated number of northern fur seal pups born on St. George Island, 1970-2012.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Pelagic sealing led to a decrease in the fur seal population; however, a moratorium on fur seal harvesting and termination of pelagic sealing resulted in a steady increase in the northern fur seal population during 1912-1924. During this period, the rate of population growth was approximately 8.6% (SE = 1.47) per year (A. York, NMFS-AFSC-NMML (retired), 7600 Sand Point Way NE, Seattle, WA 98115, unpubl. data), 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 Marine Mammal Protection Act (MMPA), the 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 = 11,802 animals (548,926 × 0.043 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 and serious injury rate calculation in this Stock Assessment Report because the fisheries are no longer operative, although some low level of illegal fishing may still be occurring. Commercial net fisheries in international waters of the North Pacific Ocean have decreased significantly in recent years. The assumed level of incidental catch of northern fur seals in those fisheries, though unknown, is thought to be minimal (T. Loughlin, NMFS-AFSC-NMML (retired), 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm.).

Between 2009 and 2013, incidental mortality and serious injury of northern fur seals was observed in the following 3 fisheries of the 22 federally-regulated commercial fisheries in Alaska monitored for incidental mortality by fisheries observers: Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands pollock trawl, and Bering Sea/Aleutian Islands Pacific cod longline fisheries. The total estimated mean annual fishery-related incidental mortality and serious injury rate in these fisheries from 2009 to 2013 is 1.1 (CV = 0.23) northern fur seals (Breiwick 2013; NMML, unpubl. data; Table 2).

Observer programs for Alaska State-managed commercial fisheries have not documented any mortality or serious injury of northern fur seals (Wynne et al. 1991, 1992; Manly 2006, 2007).

Table 2. Summary of incidental mortality and serious injury of the Eastern Pacific stock of northern fur seals due to commercial fisheries in 2009-2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	1 0 (+1)[a] 0 0 0	1.0 0 (+1)[b] 0 0 0	0.4 (CV = N/A)
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	0 2 0 0 0	0 2.0 0 0 0	0.4 (CV = 0.07)
Bering Sea/Aleutian Is. Pacific cod longline	2009 2010 2011 2012 2013	obs data	60 64 57 51 67	0 1 0 0 0	0 1.4 0 0 0	0.3 (CV = 0.52)
Minimum total estimated annual mortality						1.1 (CV = 0.23)

[a]Total mortality and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul.
[b]Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

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 and 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).

Entanglements of northern fur seals have been observed on St. Paul, St. George, and Bogoslof Islands. In 2011, there was an increased effort to include entanglement reports in the NMFS Alaska Region stranding database. A summary of entanglements in fishing gear between 2009 and 2013 is provided in Table 3. The mean annual mortality and serious injury rate due to entanglement in trawl gear (0.4), fishing line (0.2), pot gear (0.2), and fishing net (0.6) in Alaska waters in 2009-2013 is 1.4 northern fur seals. These entanglements cannot be assigned to a specific fishery, and it is unknown whether commercial, recreational, or subsistence fisheries are the source of the fishing debris. There is significantly higher observation effort on the rookeries during the years of pup production (even years) than during odd numbered years, so this difference in the level of effort should be taken into consideration with estimates of entanglement based on opportunistic reports.

The Eastern Pacific stock can occur off the west coast of the continental U.S. in winter/spring; therefore, any mortality or serious injury of northern fur seals reported off the coasts of Washington, Oregon, or California during December through May will be assigned to both the Eastern Pacific and California stocks of northern fur seals. Between 2009 and 2013, two northern fur seal entanglements occurred off the Oregon coast during this time period: one in an unknown fishing net in February 2009 and one in trawl gear in April 2011 (Carretta et al. 2015), resulting in an average annual mortality and serious injury rate of 0.4 Eastern Pacific northern fur seals in these waters (Table 3). An additional northern fur seal that stranded with a serious injury, due to an unidentified fishery interaction, in May 2012 in California was treated and released with a non-serious injury (Carretta et al. 2015).

Table 3. Summary of mortality and serious injury of the Eastern Pacific stock of northern fur seals, by year and type, reported to the NMFS Alaska Region (Helker et al. 2015) and NMFS U.S. West Coast Region (Carretta et al. 2015), marine mammal stranding databases, in 2009-2013. Only cases of serious injuries are reported in this table; animals that were disentangled and released with non-serious injuries have been excluded.

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Entanglement (unknown fishing net)	1[a]	0	0	1	0	0.4
Entanglement (unknown marine debris/gear)	3[a]	0	0	1	0	0.8
Entanglement (trawl gear)	0	0	1[a]	0	0	0.2
Neck entanglement (fishing line)	0	0	1	0	0	0.2
Neck entanglement (fishing net)	0	0	0	2	0	0.4
Neck entanglement (packing band)	0	0	2	0	0	0.4
Neck entanglement (pot gear)	0	0	1	0	0	0.2
Neck entanglement (trawl gear)	0	0	2	0	0	0.4
Neck entanglement (unknown marine debris/gear)	0	0	8	3	1	2.4
Power plant entrainment	0	0	0	1[a]	0	0.2
Sum of 2011, 2012 M/SI events[b]			15	8		12

[a]Mortality or serious injury that occurred off the coasts of Washington, Oregon, or California in December through May was assigned to both the Eastern Pacific and California stocks of northern fur seals.

[b]An increase in the number of reports is not necessarily an indication of an increase in occurrence of entanglements but rather is a reflection of more thorough reporting of these events in the NMFS Alaska Region stranding database as of 2011. The average of the sum of mortality/serious injury (M/SI) events reported in 2011 and 2012 may be a more accurate number of annual M/SI for management purposes due to more thorough reporting for those years.

Alaska Native Subsistence/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 based on historic local needs. Typically, only juvenile males are taken in the subsistence harvest, which results in a much smaller impact on population growth than a harvest that includes females. However, accidental harvesting of females and adult males does occur. 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. A single female was killed during the harvest on St. Paul in 2011 (Lestenkof et al. 2011). One female was killed on St. George Island in 2012 (Lekanof 2013) and three females were killed on St. Paul Island in 2013 (Lestenkof et al. 2014). Between 2009 and 2013, there was an annual average of 432 seals harvested in the subsistence harvest (Table 4).

Table 4. Summary of the Alaska Native subsistence harvest of northern fur seals on St. Paul and St. George Islands in 2009-2013.

Year	St. Paul	St. George	Total harvested
2009	341[a]	114[b]	455
2010	357[c]	78[d]	435
2011	323[e]	120[f]	443
2012	383[g]	64[h]	447
2013	301[i]	80[j]	381
Mean annual take (2009-2013)			432

[a]Zavadil (2009); [b]Lekanof (2009); [c]Zavadil et al. (2011); [d]Merculief (2010); [e]Lestenkof et al. (2011); [f]Merculief (2011); [g]Lestenkof et al. (2012); [h]Lekanof (2013); [i]Lestenkof et al. (2014); [j]Kashevarof (2014).

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 designated as "depleted" in 1988.

Since the Eastern Pacific and California stocks of northern fur seals overlap off the west coast of the continental U.S. during December through May, non-fishery mortality and serious injury reported off the coasts of Washington, Oregon, or California during that time will be assigned to both stocks. The mean annual mortality and serious injury rate due to entanglement in packing bands (0.4 in Alaska waters) and unknown marine debris or gear (3.2: 2.6 in Alaska waters + 0.6 in Oregon waters) is 3.6 Eastern Pacific northern fur seals in 2009-2013 (Table 3). An additional mean annual mortality and serious injury rate of 0.2 Eastern Pacific northern fur seals occurred in 2009-2013 due to entrainment in the cooling water system of a California power plant in 2012 (Carretta et al. 2015).

Mortality and serious injury 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 2008 and 2012, there was a single mortality resulting from research on the Eastern Pacific stock of northern fur seals in 2009, for an average annual mortality and serious injury rate of 0.2 northern fur seals (Division of Permits and Conservation, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910). Mortality and serious injury of northern fur seals also occurred during a research groundfish bottom trawl survey in Alaska waters in 2009 (Helker et al. 2015) and a research trawl survey in California waters in 2009 (Carretta et al. 2015), resulting in an average annual mortality and serious injury rate of 0.4 northern fur seals in 2008-2012. The total combined mortality and serious injury of northern fur seals from marine mammal (0.2) and fisheries (0.4) research activities is 0.6 per year in 2008-2012.

STATUS OF STOCK

Based on currently available data, the minimum estimated U.S. commercial fishery-related mortality and serious injury for this stock (1.1) is less than 10% of the calculated PBR (1,180) 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 (1.1 (commercial fisheries) + 1.8 (unknown fisheries) + 432 (Alaska Native harvest) + 0.6 (research activities) + 3.6 (marine debris/gear) + 0.2 (power plant entrainment) = 439) does not exceed the PBR (11,802) 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 known direct human-caused mortality and serious injury, there is no reason to believe that limiting mortality and serious injury 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 seals is classified as a strategic stock because it is designated as "depleted" under the MMPA. This stock will remain designated 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, 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). Call et al. (2008) found northern fur seals had three types of individual foraging route tactics at the rookery, which is important to consider in the context of adaptation to changes in environmental conditions and prey distributions.

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, pup production declined on St. Paul and St. George Islands (Figs. 2 and 3). 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 8 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, such as an increase in vessel traffic in Alaska waters and an increased potential for oil spills, 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*)

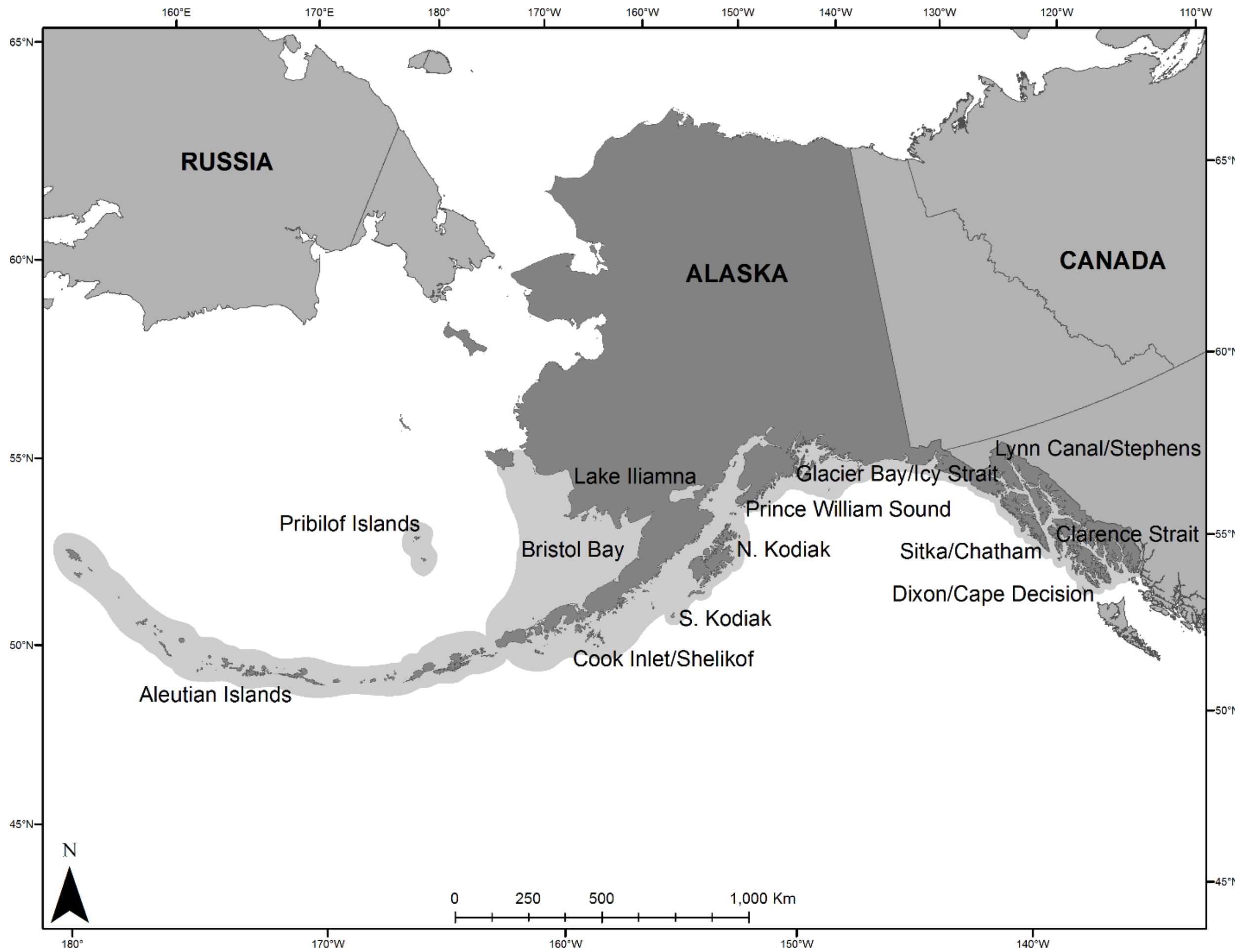

Figure 1. Approximate distribution of harbor seals in Alaska waters (shaded coastline area).

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 past and recent satellite-tagging studies in Southeast Alaska, Prince William Sound, Kodiak Island, and Cook Inlet are also consistent with the conclusion that harbor seals are non-migratory (Swain et al. 1996, Lowry et al. 2001, Small et al. 2003, Boveng et al. 2012). 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, Womble 2012, Womble and Gende 2013). Strong fidelity of individuals for haul-out sites during the breeding season has been documented in several populations (Härkönen and Harding 2001), including some harbor seal stocks in Alaska such as South Kodiak Island, Prince William Sound, Glacier Bay/Icy Strait, and Cook Inlet (Pitcher and McAllister 1981, Small et al. 2005, Boveng et al. 2012, Womble 2012, Womble and Gende 2013).

Local or regional trends in harbor seal numbers have been monitored at various time intervals since the 1970s, revealing diverse spatial patterns in apparent population trends. Where declines have been observed, they seem generally to have been strongest in the late 1970s or early 1980s to the 1990s. For example, counts of harbor seals declined by about 80% at Tugidak Island in the 1970s and 1980s (Pitcher 1990), and numbers at Nanvak Bay in northern Bristol Bay also declined at about the same time (Jemison et al. 2006). In Prince William Sound, harbor seal numbers declined by about 63% overall between 1984 and 1997, including a 40% decline prior to the *Exxon Valdez* oil spill that occurred in 1989 (Frost et al. 1999, Ver Hoef and Frost 2003). Harbor seal counts in Glacier Bay National Park, where the majority of seals haul out on floating ice calved from glaciers, declined by roughly 60% between 1992 and 2001 and continued to decline through 2008 (Mathews and Pendleton 2006, Womble et al. 2010). At Aialik Bay, a site in Kenai Fjords National Park where harbor seals also haul out on ice calved from a glacier, harbor seal numbers declined by 93% from 1979 to 2009 (Hoover-Miller et al. 2011). In the Aleutian Islands, counts declined by 67% between the early 1980s and 1999, with declines of about 86% in the western Aleutians (Small et al. 2008). Although there is evidence for recent stabilization or even partial recovery of harbor seal numbers in some areas of long-term harbor seal decline, such as Tugidak Island and Nanvak Bay (Jemison et al. 2006), most have not made substantial recoveries toward historical abundances. But these areas of declines in harbor seals contrast strongly with other large regions of Alaska where harbor seal numbers have remained stable or increased over the same period: trend monitoring regions around Ketchikan and the Kodiak area increased significantly in the 1980s and 1990s and were stable in around Sitka and Bristol Bay (Small et al. 2003). Differences in trend across the various regions of Alaska suggest some level of independent population dynamics (O'Corry-Crowe et al. 2003, O'Corry-Crowe 2012).

Westlake and O'Corry-Crowe's (2002) analysis of genetic information from 881 samples across 181 sites 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 unsampled (O'Corry-Crowe et al. 2003).

In 2010, NMFS and their co-management partners, the Alaska Native Harbor Seal Commission, identified 12 separate stocks of harbor seals based largely on genetic structure; 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. 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 Alaska Native use areas in the final designation of stock boundaries. The 12 stocks of harbor seals currently identified in Alaska are 1) the Aleutian Islands stock – occurring along the entire Aleutian chain from Attu Island to Ugamak Island; 2) the Pribilof Islands stock – occurring on Saint Paul and Saint George Islands, as well as on Otter and Walrus Islands; 3) the Bristol Bay stock – ranging from Nunivak Island south to the west coast of Unimak Island and extending inland to Kvichak Bay and Lake Iliamna; 4) the North Kodiak stock – ranging from approximately Middle Cape on the west coast of Kodiak Island northeast to West Amatuli Island and south to Marmot and Spruce Islands; 5) the South Kodiak stock – ranging from Middle Cape on the west coast of Kodiak Island southwest to Chirikof Island and east along the south coast of Kodiak Island to Spruce Island, including the Trinity Islands, Tugidak Island, Sitkinak Island, Sundstrom Island, Aiaktalik Island, Geese Islands, Two Headed Island, Sitkalidak Island, Ugak Island, and Long Island; 6) the Prince William Sound stock – ranging from Elizabeth Island off the southwest tip of the Kenai Peninsula to Cape Fairweather, including Prince William Sound, the Copper River Delta, Icy Bay, and Yakutat Bay; 7) the Cook Inlet/Shelikof Strait stock – ranging from the southwest tip of Unimak Island east along the southern coast of the Alaska Peninsula to Elizabeth Island off the southwest tip of the Kenai Peninsula, including Cook Inlet, Knik Arm, and Turnagain Arm; 8) the Glacier Bay/Icy Strait stock – ranging from Cape Fairweather southeast to Column Point, extending inland to Glacier Bay, Icy Strait, and from Hanus Reef south to Tenakee Inlet; 9) the Lynn Canal/Stephens Passage stock – ranging north along the east and north coast of Admiralty Island from the north end of Kupreanof Island through Lynn Canal, including Taku Inlet, Tracy Arm, and Endicott Arm; 10) the Sitka/Chatham Strait stock – ranging from Cape Bingham south to Cape Ommaney, extending inland to Table Bay on the west side of Kuiu Island and north through Chatham Strait to Cube Point off the west coast of Admiralty Island, and as far east as Cape Bendel on the northeast tip of Kupreanof Island; 11) the Dixon/Cape Decision stock – ranging from Cape Decision on the southeast side of Kuiu Island north to Point Barrie on Kupreanof Island and extending south from Port Protection to Cape Chacon along the west coast of Prince of Wales Island and west to Cape Muzon on Dall Island, including Coronation Island, Forrester Island, and all the islands off the west coast of Prince of Wales Island; and 12) the Clarence Strait stock – ranging along the east coast of Prince of Wales Island from Cape Chacon north through Clarence Strait to Point Baker and along the east coast of Mitkof and Kupreanof Islands north to Bay Point, including Ernest Sound, Behm Canal, and Pearse Canal (Fig. 1). Individual stock distributions can be seen in Figures 2a-l.

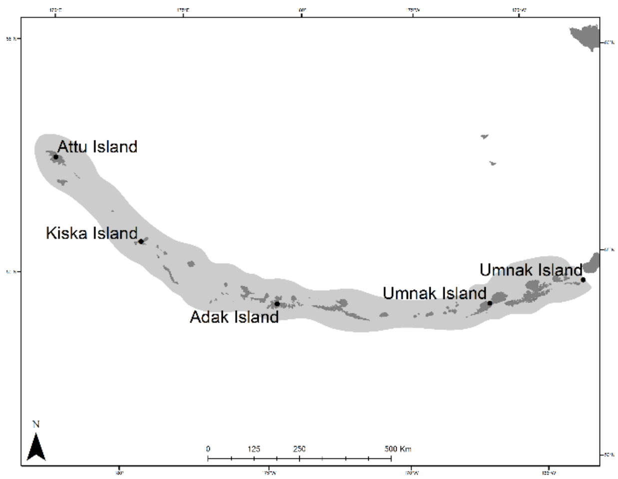

Figure 2a. Approximate distribution of Aleutian Islands harbor seal stock (shaded area).

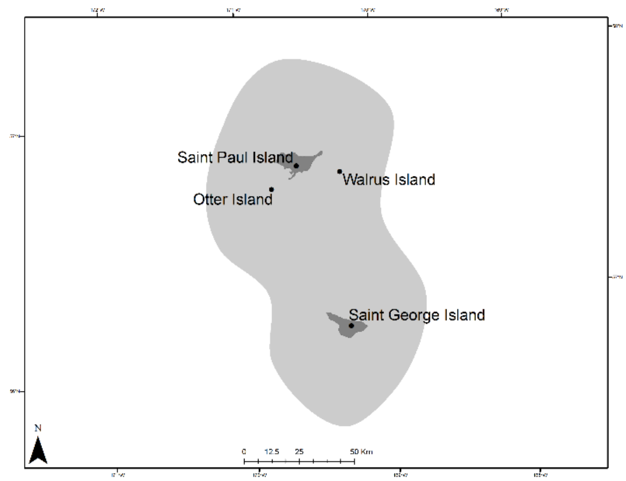

Figure 2b. Approximate distribution of Pribilof Islands harbor seal stock (shaded area).

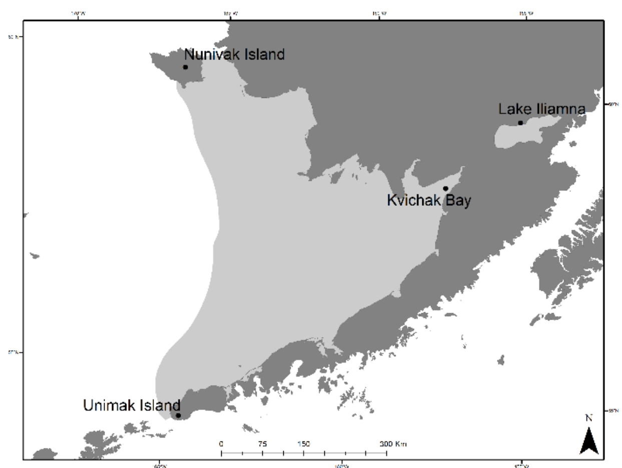

Figure 2c. Approximate distribution of Bristol Bay harbor seal stock (shaded area).

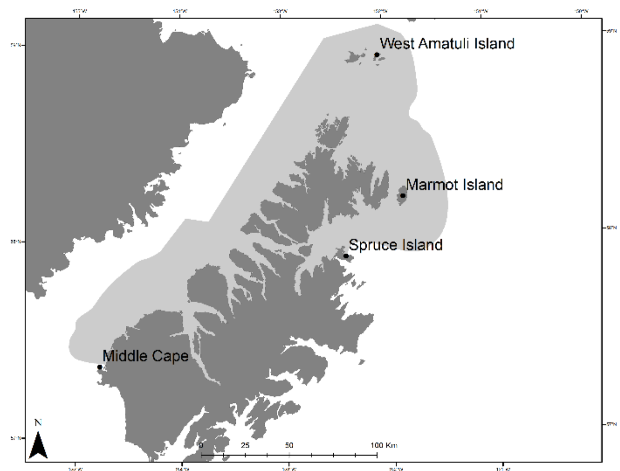

Figure 2d. Approximate distribution of North Kodiak harbor seal stock (shaded area).

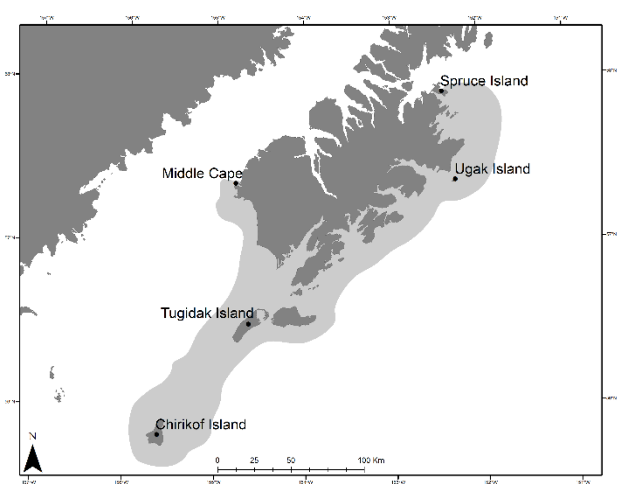

Figure 2e. Approximate distribution of South Kodiak harbor seal stock (shaded area).

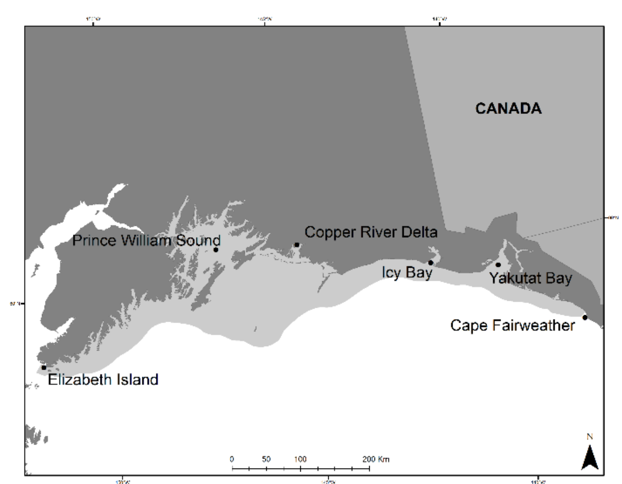

Figure 2f. Approximate distribution of Prince William Sound harbor seal stock (shaded area).

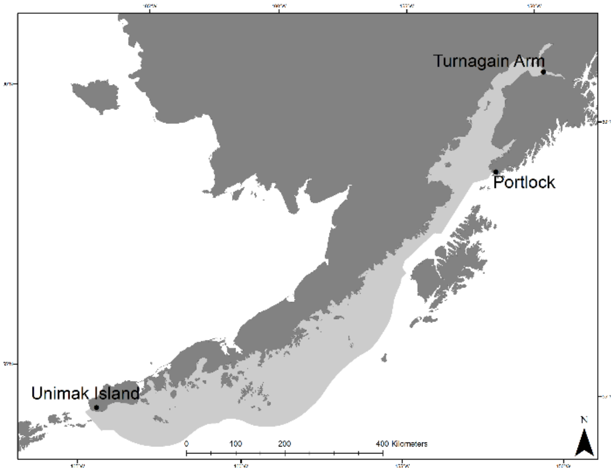

Figure 2g. Approximate distribution of Cook Inlet/Shelikof Strait harbor seal stock (shaded area).

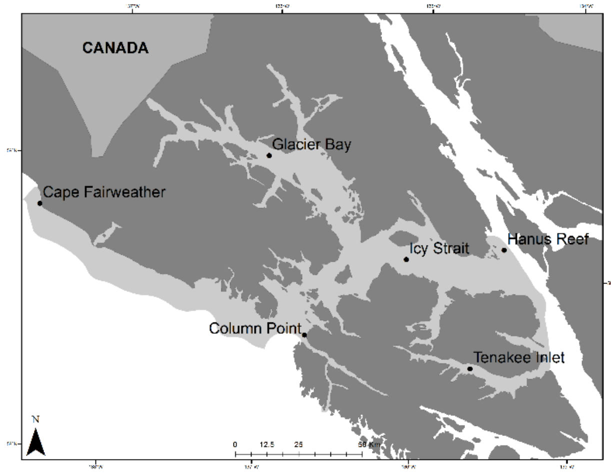

Figure 2h. Approximate distribution of Glacier Bay/Icy Strait harbor seal stock (shaded area).

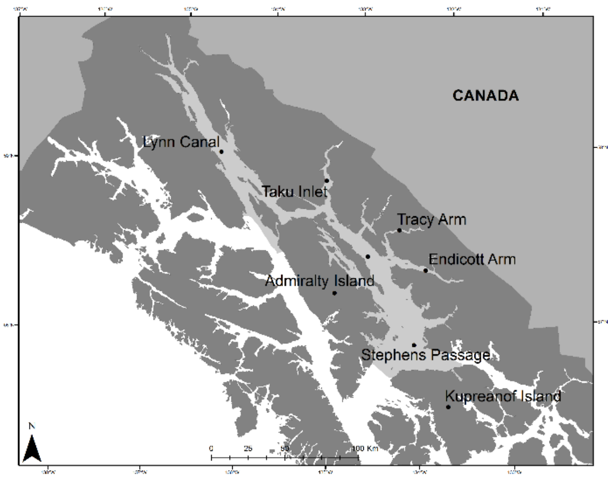

Figure 2i. Approximate distribution of Lynn Canal/Stephens Passage harbor seal stock (shaded area).

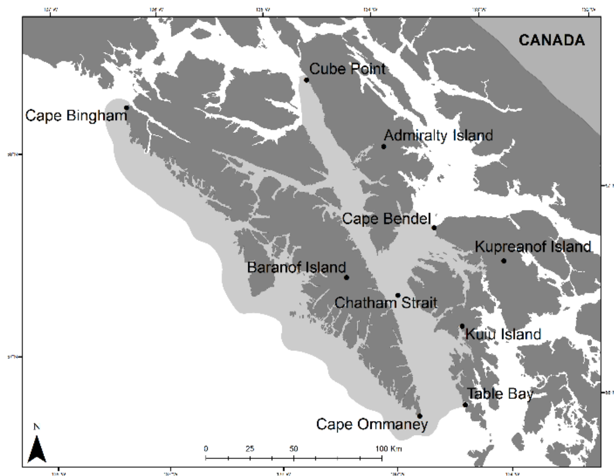

Figure 2j. Approximate distribution of Sitka/Chatham Strait harbor seal stock (shaded area).

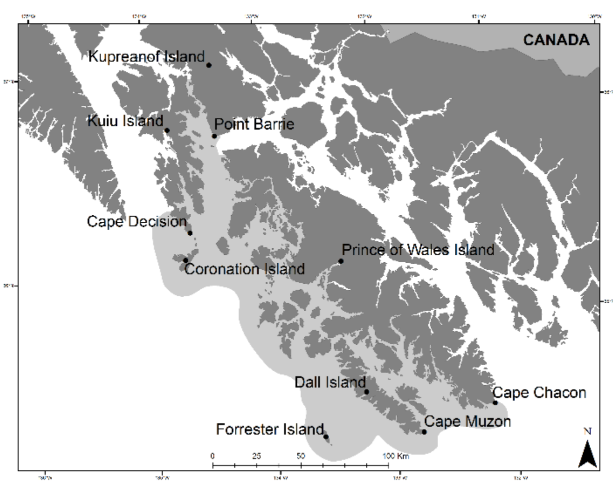

Figure 2k. Approximate distribution of Dixon/Cape Decision harbor seal stock (shaded area).

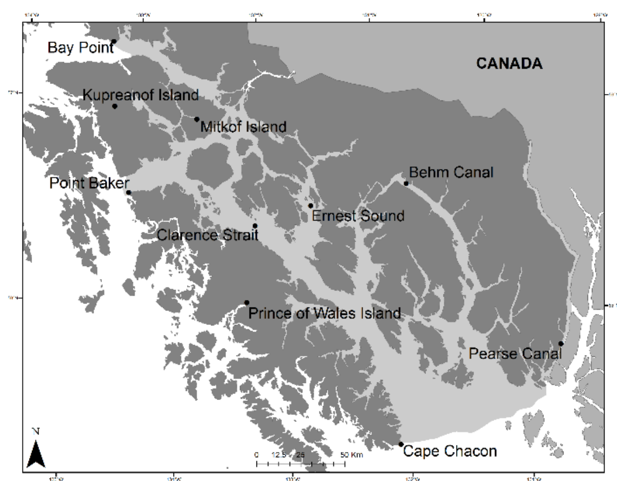

Figure 2l. Approximate distribution of Clarence Strait harbor seal stock (shaded area).

POPULATION SIZE

The Alaska Fisheries Science Center's National Marine Mammal Laboratory 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 sample the full geographic range of harbor seals in Alaska, with a focus on sites that make up a significant portion of each stock's population every year; sites with fewer seals are flown every 3 to 5 years. This site specific survey approach is designed to provide the counts necessary to estimate stock specific population abundance and trend for all 12 stocks annually. 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.

Abundance Estimates and Minimum Population Estimates

The current statewide abundance estimate for Alaskan harbor seals is 205,090 (Boveng et al. in press a), based on aerial survey data collected during 1998-2011. See Table 1 for abundance estimates of the 12 stocks of harbor seals in Alaska. The minimum population estimate (N_{MIN}) for 11 of the 12 stocks of harbor seals in Alaska is calculated as the lower bound of the 80% credible interval obtained from the posterior distribution of abundance estimates. This approach is consistent with the definition of potential biological removal (PBR) in the current guidelines (Wade and Angliss 1997). The abundance estimate and N_{MIN} for the remaining stock, the Pribilof Islands stock, is simply the number counted in the most recent survey of this very small group.

Table 1. Abundance and 5-year trend estimates, by stock, for harbor seals in Alaska, along with respective estimates of standard error. The probability of decrease represents the proportion of the posterior probability distribution for the 5-year trend that fell below a value of 0 seals per year.

Stock	Year of last survey	Abundance estimate	SE	5-year trend estimate	SE	Probability of decrease	N_{MIN}
Aleutian Islands	2011	6,431	882	75	220	0.36	5,772
Pribilof Islands	2010	232	n/a	n/a	n/a	n/a	232
Bristol Bay	2011	32,350	6,882	1,209	1,941	0.25	28,146
North Kodiak	2011	8,321	1,619	531	590	0.16	7,096
South Kodiak	2011	19,199	2,429	-461	761	0.72	17,479
Prince William Sound	2011	29,889	13,846	26	3,498	0.56	27,936
Cook Inlet/Shelikof Strait	2011	27,386	3,328	313	1,115	0.38	25,651
Glacier Bay/Icy Strait	2011	7,210	1,866	179	438	0.40	5,647
Lynn Canal/Stephens Passage	2011	9,478	1,467	-176	388	0.71	8,605
Sitka/Chatham Strait	2011	14,855	2,106	411	568	0.23	13,212
Dixon/Cape Decision	2011	18,105	1,614	216	360	0.29	16,727
Clarence Strait	2011	31,634	4,518	921	1,246	0.21	29,093

Current Population Trend

Aerial surveys of harbor seal haulout sites throughout Alaska have been conducted annually and provide information on trends in abundance. The most current estimates of trend (Table 1) were estimated as the means of the slopes of 1,000 simple linear regressions over the most recent eight annual estimates in each of the 1,000 Markov

Chain Monte Carlo (MCMC) samples from the posterior distributions for abundance. Thus, they are in units of seals per year, rather than the typical annual percent growth rate. There is no appropriate method for converting these estimates of trend to annual percent growth rate. As a reflection of uncertainty in trend estimates, the proportion of the posterior distribution for each stock's trend that lies below the value of 0 is used as an estimate of the probability that a stock is currently decreasing (Table 1). This allows a probabilistic determination of the qualitative trend status: a value greater than 0.5 means the evidence suggests that the stock is decreasing; less than 0.5 means the stock is increasing. Because there will typically be a 2-3 year lag between the most recent surveys and the Stock Assessment Report update, a 5-year interval was used for estimating trend. This ensures trend estimates are based on data no more than about 8 years old, which is considered to be the approximate threshold of reliability for Marine Mammal Protection Act (MMPA) stock assessment data. One caveat of this approach is that, due to the skewness inherent in the posterior distribution, it is possible for a stock to exhibit a positive trend while also having a probability of decrease greater than 0.5. The following summarizes historical and recent information on the population trend for each of the 12 stocks.

Aleutian Islands: A partial estimate of harbor seal abundance in the Aleutian Islands was determined from skiff surveys of 106 islands from 1977 to 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 (2007-2011) estimate of the population trend in the Aleutian Islands is +75 seals per year, with a probability that the stock is decreasing of 0.36 (Table 1).

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 when a total of 202 seals were counted. In July 2010, approximately 185 adults 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 2010 pup numbers were slightly less (27 vs. 42). The current population trend in the Pribilof Islands is unknown.

Bristol Bay: At Nanvak Bay, the largest haulout in northern Bristol Bay, harbor seals declined in abundance from 1975 to 1990 and increased from 1990 to 2000 (Jemison et al. 2006). Land-based harbor seal counts at Nanvak Bay from 1990 to 2000 increased at 9.2% per year during the pupping period and 2.1% per year during the molting period (Jemison et al. 2006). The Iliamna Lake harbor seal population of about 400 seals, that forms a small portion of the Bristol Bay stock, likely increased through the 1990s and is now stable at around 400 animals (Boveng et al. in press b). The current (2007-2011) estimate of the population trend in the Bristol Bay stock is +1,209 seals per year, with a probability that the stock is decreasing of 0.25 (Table 1).

North Kodiak: The current (2007-2011) estimate of the North Kodiak population trend is +531 seals per year, with a probability that the stock is decreasing of 0.16 (Table 1).

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 coast 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 shown 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 (2007-2011) estimate of the South Kodiak population trend is -461 seals per year, with a probability that the stock is decreasing of 0.72 (Table 1).

Prince William Sound: The Prince William Sound stock includes harbor seals both within and adjacent to Prince William Sound proper. Within Prince William Sound proper, harbor seals declined in abundance by 63% between 1984 and 1997 (Frost et al. 1999). In Aialik Bay, adjacent to Prince William Sound proper, there has been a decline in pup production by 4.6% annually from 40 down to 32 pups born from 1994 to 2009 (Hoover-Miller et al. 2011). The current (2007–2011) estimate of the Prince William Sound population trend over a 5-year period is +26 seals per year, with a probability that the stock is decreasing of 0.56 (Table 1). As noted earlier, this is an example where the skewed nature of the posterior distribution of the abundance estimate has resulted in a higher than 0.5 probability of decrease while subsequently showing an increasing trend.

Cook Inlet/Shelikof Strait: 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 the data indicated a stable population of harbor seals during the August molting period (Boveng et al. 2011). Aerial surveys along the Alaska Peninsula present greater logistical challenges and have therefore been conducted less frequently. The current (2007-2011) estimate of the Cook Inlet/Shelikof Strait population trend is +313 seals per year, with a probability that the stock is decreasing of 0.38 (Table 1).

Glacier Bay/Icy Strait: The Glacier Bay/Icy Strait stock showed a negative population trend estimate for harbor seals from 1992 to 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 similarly negative for both glacial and terrestrial sites. Long-term monitoring of harbor seals on glacial ice has occurred in Glacier Bay since the 1970s (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 (more than 7 km), in the East Arm of Glacier Bay, between 1973 and 1986 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 current (2007–2011) estimate of the Glacier Bay/Icy Strait population trend is +179 seals per year, with a probability that the stock is decreasing of 0.40 (Table 1).

Lynn Canal/Stephens Passage: The current (2007-2011) estimate of the Lynn Canal/Stephens Passage population trend is -176 seals per year, with a probability that the stock is decreasing of 0.71 (Table 1).

Sitka/Chatham Strait: The current (2007-2011) estimate of the Sitka/Chatham Strait population trend is +411 seals per year, with a probability that the stock is decreasing of 0.23 (Table 1).

Dixon/Cape Decision: The current (2007-2011) estimate of the Dixon/Cape Decision population trend is +216 seals per year, with a probability that the stock is decreasing of 0.29 (Table 1).

Clarence Strait: The current (2007-2011) estimate of the Clarence Strait population trend is +921 seals per year, with a probability that the stock is decreasing of 0.21 (Table 1).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated directly from the 12 stocks of harbor seals identified in Alaska. Based on monitoring in Washington State from 1978 to 1999, Jeffries et al. (2003) estimated R_{MAX} to be 12.6% and 18.5% for harbor seals of the inland and coastal stocks, respectively. Harbor seals have been protected in British Columbia since 1970, and the monitored portion of that population responded with an annual rate of increase of approximately 12.5% through the late 1980s (Olesiuk et al. 1990), though a more recent evaluation suggested that 11.5% may be a more appropriate figure (DFO 2010). These empirical estimates of R_{MAX} indicate that the continued use of the pinniped maximum theoretical net productivity rate of 12% is appropriate for the Alaska stocks (Wade and Angliss 1997).

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 = $N_{MIN} \times 0.5R_{MAX} \times F_R$. Marine mammal stocks such as the harbor seal stocks in Alaska that are taken by subsistence hunting may be given F_R values up to 1.0, provided they are "known to be increasing" or "not known to be decreasing" and "there have not been recent increases in the levels of takes" (Wade and Angliss 1997). For harbor seals in Alaska, these guidelines were followed by assigning all harbor seal stocks an initial, default recovery factor of 0.5. The default value was adjusted up to 0.7 if the estimated probability of decrease was greater than 0.7. The value was adjusted down to 0.3 if the estimated probability of decrease was less than 0.3. This provides a simple, balanced approach for providing a recovery factor consistent with current guidelines while incorporating results from novel statistical methods. Table 2 summarizes the PBR levels for each stock of harbor seals in Alaska based on N_{MIN} estimates, R_{MAX} = 12%, and F_R values.

Table 2. PBR calculations by stock for harbor seals in Alaska. The N_{MIN} values are determined from the 20th percentile of the posterior distribution for stock-level abundance estimates, except for the Pribilof Islands. A default value of 0.5 was used as the recovery factor. Based on evaluation of the trend estimates and probability of decrease, the recovery factor for some stocks was increased to 0.7. For other stocks, the recovery factor was decreased to 0.3.

Stock	N_{MIN}	R_{MAX}	Recovery Factor (F_R) (default value = 0.5)	PBR
Aleutian Islands	5,772	0.12	0.5	173
Pribilof Islands	232	0.12	0.5	7
Bristol Bay	28,146	0.12	0.7	1,182
North Kodiak	7,096	0.12	0.7	298
South Kodiak	17,479	0.12	0.3	314
Prince William Sound	27,936	0.12	0.5	838
Cook Inlet/Shelikof Strait	25,651	0.12	0.5	770
Glacier Bay/Icy Strait	5,647	0.12	0.5	169
Lynn Canal/Stephens Passage	8,605	0.12	0.3	155
Sitka/Chatham Strait	13,212	0.12	0.7	555
Dixon/Cape Decision	16,727	0.12	0.7	703
Clarence Strait	29,093	0.12	0.7	1,222

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Previous stock assessments 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 MMPA List of Fisheries have resulted in separating these fisheries into 14 fisheries in the Bering Sea, 9 fisheries in Southeast Alaska, 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 mortality or serious injury of marine mammal stocks in Alaska.

Observer programs have documented mortality and serious injury of harbor seals in the Bering Sea/Aleutian Islands (BSAI) flatfish trawl fishery (1 in 2011 and 2 in 2012), Gulf of Alaska (GOA) Pacific cod trawl fishery (1 in 2010), and GOA flatfish trawl fishery (1 in 2011 and 2 in 2013) in 2009-2013 (Breiwick 2013; NMML, unpubl. data) (Table 3).

Although a reliable estimate of the overall mortality and serious injury 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, for the purposes of stock assessment, mean annual mortality and serious injury rates are assigned to the following harbor seal stocks based on the location of takes in observed fisheries in 2009-2013 (Table 3): Bristol Bay stock: 0.6 from the BSAI flatfish trawl fishery; South Kodiak stock: 0.6 from the GOA Pacific cod trawl fishery + 1.3 from the GOA flatfish trawl fishery; Cook Inlet/Shelikof Strait stock: 0.4 from the GOA flatfish trawl fishery mortality in 2011 (this seal could have been from either the South Kodiak or Cook Inlet/Shelikof Strait stock, so the mortality is assigned to both stocks).

Table 3. Summary of incidental mortality and serious injury of harbor seals in Alaska due to U.S. commercial fisheries in 2009-2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data).

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 1 2 0	0 0 1 2 0	0.6 (CV = 0.02)
Gulf of Alaska Pacific cod trawl	2009 2010 2011 2012 2013	obs data	29 31 41 25 11	0 1 0 0 0	0 2.8 0 0 0	0.6 (CV = 0.81)
Gulf of Alaska flatfish trawl	2009 2010 2011 2012 2013	obs data	21 26 31 42 46	0 0 1 0 2[a]	0 0 1.9 0 4.7	1.3 (CV = 0.69)[b]
Minimum total estimated annual mortality						2.5 (CV = 0.41)

[a]Two pinnipeds incidentally caught in 2013 were recently genetically identified as harbor seals.
[b]The CV for this fishery does not accommodate the 2013 data.

Observer programs in Alaska State-managed salmon set gillnet and salmon drift gillnet fisheries have documented harbor seal mortality and serious injury (Table 4). 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 are from 1990 and 1991. The minimum estimated average annual mortality and serious injury rate (24 seals) in this fishery will be applied to the Prince William Sound stock of harbor seals.

Table 4. Summary of incidental mortality and serious injury of harbor seals in Alaska due to U.S. commercial salmon drift and set gillnet fisheries in 1990 and 1991 and calculation of the mean annual mortality and serious injury rate based on the most recent observer program data available.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Prince William Sound salmon drift gillnet	1990 1991	obs data	4 5	2 1	36 12	24 (CV = 0.50)
Minimum total estimated annual mortality						24 (CV = 0.50)

Reports to the NMFS Alaska Region stranding database of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality and serious injury data (Helker et al. 2015). During 2009-2013, harbor seal mortality and serious injury occurred due to interactions with unknown fisheries (1 Clarence Strait harbor seal was observed with a hook and weight in its mouth in 2010 and 1 Cook Inlet/Shelikof Strait harbor seal entangled in an unknown set net in 2011) and recreational fishing gear (1 Prince William Sound harbor seal was caught in hook and line gear and cut loose with trailing gear in 2009), resulting in mean annual mortality and serious injury rates of 0.2 harbor seals from each of these stocks due to fishery-related strandings.

Alaska Native Subsistence/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 (ADF&G). Information from the ADF&G indicates the average harvest levels for the 12 stocks of harbor seals identified in Alaska from 2004 to 2008, including struck and lost, as follows (see Table 5; average annual harvest column). In 2011 and 2012, data on community subsistence harvests were collected for Kodiak Island, Prince William Sound, and Southeast Alaska (see Table 5; annual harvest 2011-2012 column). The remaining stocks have no updated community subsistence data, therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating average annual mortality and serious injury for these stocks.

Table 5. Summary of the subsistence harvest data for all 12 harbor seal stocks in Alaska, 2004-2008 and 2011-2012. Data are from Wolfe et al. (2005, 2006, 2008, 2009a, 2009b, 2012, 2013).

Stock	**Minimum annual harvest 2004-2008**	**Maximum annual harvest 2004-2008**	**Average annual harvest 2004-2008**	**Annual harvest 2011 or 2012**
Aleutian Islands	50	146	90	N/A
Pribilof Islands	0	0	0	N/A
Bristol Bay	82	188	141	N/A
North Kodiak	66	260	131	37
South Kodiak	46	126	78	126
Prince William Sound	325	600	439	255
Cook Inlet/Shelikof Strait	177	288	233	N/A
Glacier Bay/Icy Strait	22	108	52	104
Lynn Canal/Stephens Passage	17	60	30	50
Sitka/Chatham Strait	97	314	222	77
Dixon/Cape Decision	100	203	157	69
Clarence Strait	71	208	164	40

Other Mortality

Reports to the NMFS Alaska Region stranding database of harbor seals entangled in marine debris or with injuries caused by other types of human interaction are another source of mortality and serious injury data (Helker et al. 2015). During 2009-2013, one harbor seal (observed towing a buoy in 2011) was determined to be seriously injured due to entanglement in marine debris and one harbor seal mortality due to a ship strike occurred in 2009, 2010, and 2012. The estimated average annual serious injury and mortality rates based on these stranding data are 0.6 Clarence Strait harbor seals (0.2 due to entanglement in marine debris/gear + 0.4 due to ship strikes in 2009 and 2012) and 0.2 Lynn Canal/Stephens Passage harbor seals (due to a ship strike in 2010) for 2009 to 2013. An additional average annual mortality and serious injury rate of 0.2 will be applied to the Prince William Sound stock for a harbor seal entanglement, observed (with a remotely operated vehicle) in the salmon seine net of a sunken fishing vessel in Prince William Sound in 2011, that was reported to the NMFS Alaska Region (Helker et al. 2015). Mortality and serious injury 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 and 2007, there was no mortality or serious injury resulting from research on any stock of harbor seals in Alaska (Division of Permits and Conservation, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

No harbor seal stocks in Alaska are designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act, and human-caused mortality does not exceed PBR for any of the stocks; therefore, none of the stocks are strategic. At present, average annual mortality and serious injury levels incidental to U.S. commercial fisheries that are 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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury rate due to commercial fishing is insignificant. The status of all 12 stocks of harbor seals identified in Alaska relative to their Optimum Sustainable Population is unknown.

Aleutian Islands: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 17 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 (commercial fisheries) + 90 (harvest) + 0 (other fisheries + other mortality) = 90) is not known to exceed the PBR (173). The Aleutian Islands stock of harbor seals is not classified as a strategic stock.

Pribilof Islands: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 0.7 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 0 + 0 = 0) is not known to exceed the PBR (7). The Pribilof Islands stock of harbor seals is not classified as a strategic stock.

Bristol Bay: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 118 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (0.6 + 141 + 0 = 142) is not known to exceed the PBR (1,182). The Bristol Bay stock of harbor seals is not classified as a strategic stock.

North Kodiak: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 30 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 37 + 0 = 37) is not known to exceed the PBR (298). The North Kodiak stock of harbor seals is not classified as a strategic stock.

South Kodiak: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 32 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (1.9 + 126 + 0 = 128) is not known to exceed the PBR (315). The South Kodiak stock of harbor seals is not classified as a strategic stock.

Prince William Sound: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 84 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 255 + 0.4 = 279) is not known to exceed the PBR (838). The Prince William Sound stock of harbor seals is not classified as a strategic stock.

Cook Inlet/Shelikof Strait: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 77 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 233 + 0.2 = 234) is not known to exceed the PBR (770). The Bristol Bay stock of harbor seals is not classified as a strategic stock.

Glacier Bay/Icy Strait: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 17 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 104 + 0 = 104) is not known to exceed the PBR (169). The Glacier Bay/Icy Strait stock of harbor seals is not classified as a strategic stock.

Lynn Canal/Stephens Passage: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 16 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 50 + 0.2 = 50) is not known to exceed the PBR (155). The Lynn Canal/Stephens Passage stock of harbor seals is not classified as a strategic stock.

Sitka/Chatham Strait: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 56 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 77 + 0 = 77) is not known to exceed the PBR (555). The Sitka/Chatham Strait stock of harbor seals is not classified as a strategic stock.

Dixon/Cape Decision: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 70 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 69 + 0 = 69) is not known to exceed the PBR (703). The Dixon/Cape Decision stock of harbor seals is not classified as a strategic stock.

Clarence Strait: At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 122 animals (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 and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the mortality and serious injury 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 + 40 + 0.8 = 41) is not known to exceed the PBR (1,222). The Clarence Strait stock of harbor seals is not classified as a strategic stock.

HABITAT CONCERNS

Glacial fjords in Alaska are critical for harbor seal whelping, nursing, and molting. Several of these areas have experienced a ten-fold increase in tour ship visitation since the 1980s. This increase in the presence of tour vessels has resulted in additional levels of disturbance to pups and adults (Jansen et al. 2015). The level of serious injury or mortality resulting from increased disturbance is not known.

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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. 1). 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 breeding areas in the Bering Sea; 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.

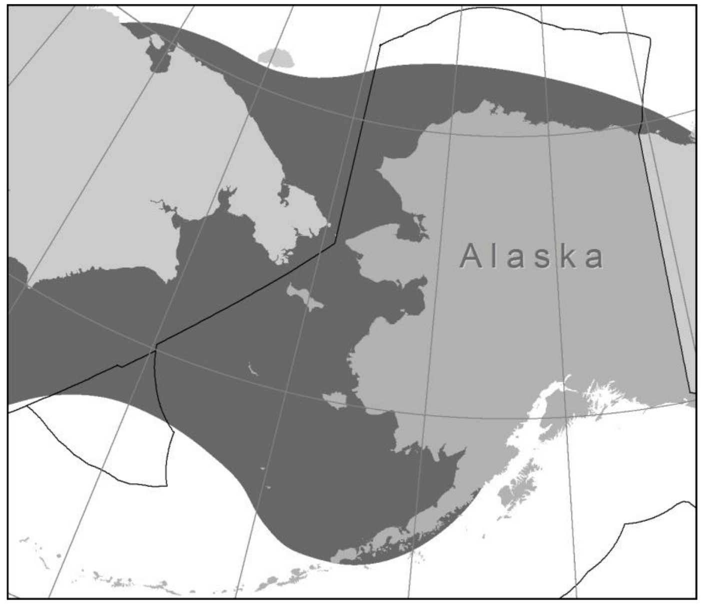

Figure 1. Approximate distribution of spotted seals (shaded area).

The distribution of spotted seals is seasonally related to specific life history events that can be broadly divided into two periods: late-fall through spring when whelping, nursing, breeding, and molting occur in association with the presence of sea ice on which the seals haul out, and summer through fall when seasonal sea ice has melted and most spotted seals use land for hauling out (Boveng et al. 2009). 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 water depth does not exceed 200 m, and move to coastal habitats after molting and 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 haul-out sites 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 richardii*). 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, O'Corry-Crowe and Westlake 1997).

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 Alaska spotted seals into more than one stock. Therefore, only one Alaska stock is recognized in U.S. waters.

POPULATION SIZE

Recent surveys and analyses have substantially improved the documentation of the spotted seal population breeding in the U.S. waters of the Bering Sea. A large segment (280,000 km^2) of the breeding area was surveyed by helicopter from an icebreaker in the spring of 2007; the abundance of spotted seals was estimated using a model that incorporated variation due to detectability, availability (proportion hauled out), and changes in extent and concentration of sea ice during the surveys. The modal estimate of abundance was 233,700 spotted seals with a 95% credible interval of 137,300-793,100 (Ver Hoef et al. 2014). A more extensive fixed-wing aerial survey (767,000 km^2) conducted during April-May of 2012 and 2013 encompassed the vast majority of the spotted seal breeding area. Analysis of a portion of the data, from 10 broadly-distributed survey flights during 20-27 April 2012, resulted in a mean estimate of 460,268 spotted seals, with a 95% CI of 391,000-559,993 (Conn et al. 2014). The method accounted for uncertainty in detection rate and species classification, as well as availability.

Other, previous surveys and estimates for spotted seals in the Bering Sea (e.g., Braham et al. 1984, Fedoseev et al. 1988, Fedoseev 2000, Rugh et al. 1995) are problematic to interpret and to compare with recent estimates because there is insufficient information available to assess detection rates, species mis-classification rates, area surveyed, extrapolation to unsurveyed areas, and other critical factors for estimating abundance and trends (Burkanov et al. 1988, Conn et al. 2013, Ver Hoef et al. 2014).

Minimum Population Estimate

The 2012 survey was used as the basis for the minimum population estimate because it was the most current survey, the survey tracks encompassed more of the spotted seal breeding area than did the 2007 tracks, and it was conducted at a substantially higher altitude (1,000 ft.) than the 2007 survey (400 ft.), reducing the potential for bias from disturbance. Conn et al. (2014) acknowledged potential upward bias resulting from the process of extrapolating to unsurveyed areas; consequently, the lower 95% confidence limit, rather than the lower 80% limit was used for the minimum population estimate, N_{MIN} = 391,000.

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. Because this represents only a fraction of the stock's range and the 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). Therefore, PBR for this stock is 391,000 × 0.06 × 0.5 = 11,730 individuals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Prior to 2004, there were no reports of incidental serious injuries and mortalities of spotted seals in any of the observed fisheries. Between 2008 and 2012, incidental serious injuries and mortalities of spotted seals were reported in 3 of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality by fisheries observers: the Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands pollock trawl, and the Bering Sea/Aleutian Islands Pacific cod longline fisheries (Table 1). The total estimated minimum annual mortality rate incidental to commercial fisheries is 1.5 (CV = 0.13) spotted seals per year, based on observer data.

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 1. Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 2008 through 2012 and calculation of the mean annual mortality rate (Breiwick 2013). Details of how percent observer coverage is measured are included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Islands flatfish trawl	2008 2009 2010 2011 2012	obs data	100 100 100 100 100	2 1 0 0 2	2.0 1.0 0 0 2.0	1.00 (CV = 0.01)
Bering Sea/Aleutian Islands pollock trawl	2008 2009 2010 2011 2012	obs data	85 86 86 98 98	0 0 1 0 0	0 0 1.0 0 0	0.20 (CV = 0.11)
Bering Sea/Aleutian Islands Pacific cod longline	2008 2009 2010 2011 2012	obs data	63 60 64 57 51	0 0 0 1 0	0 0 0 1.6 0	0.32 (CV = 0.61)
Minimum total annual mortality						1.52 (CV = 0.13)

Subsistence/Native Harvest Information

Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions.

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 have reported subsistence harvest levels of harbor seals and sea lions annually (e.g., Wolfe et al. 2009). Harvest data were reported from 63 coastal communities, including 6 communities from northern 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). In 2008, six coastal villages in northern Bristol Bay reported a total of 271 spotted seals taken during for subsistence harvest (213 harvested, 58 struck and lost). As of 2009, data on community subsistence harvests are no longer being collected. Five Alaska Native communities in the Northwest Arctic region of Alaska voluntarily reported a total of 119 spotted seals were harvested during 2012 (Ice Seal Committee 2013). No complete data for the spotted seal harvest and struck and lost animals are available for the 2008-2012 period.

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 1990-1998 were used. As of August 2000; the subsistence harvest database indicated that the estimated number of spotted seals harvested for subsistence use per year was 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 among 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 designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the minimum estimated U.S. commercial fishery-related mortality and serious injury for this stock (1.52) is less than 10% of the calculated PBR (1,173) 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 is 1.52 (commercial fisheries) + 5,265 (Alaska Native harvest) = 5,267 does not exceed the PBR (11,730) for this stock. 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, 1981; Burns and Frost 1979; 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).

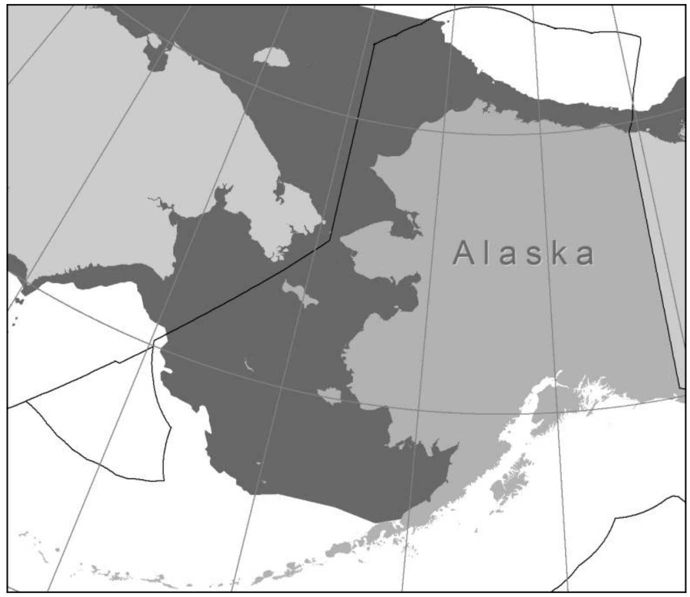

Figure 1. Approximate distribution of bearded seals (dark shaded area) in Alaska. The combined summer and winter distribution are depicted.

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 for consideration of listing as "threatened" or "endangered," Cameron et al. (2010) defined longitude 145°E as the Eurasian delineation between the two subspecies and 112°W in the Canadian Arctic Archipelago as the North American 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 (Fig. 1).

Spring surveys conducted in 1999 and 2000 along the Alaskan coast indicate that bearded seals 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, 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 in the Chukchi Sea (Burns 1967, 1981). Bearded seal sounds (produced by adult males) have been recorded nearly year-round (peak occurrence from December to June when sea ice concentrations were >50%) at multiple locations in the Bering, Chukchi, and Beaufort seas, and calling behavior is closely related to the presence of sea ice (MacIntyre et al. 2013, 2015). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals, mostly juveniles, may not follow the ice northward but remain near the coasts of the Bering and Chukchi seas (Burns 1967, 1981; Heptner et al. 1976; Nelson 1981). As the ice forms again in the fall and winter, most seals move south with the advancing ice edge through the Bering Strait into the Bering Sea where they spend the winter (Burns and Frost 1979; Frost et al. 2005, 2008; Cameron and Boveng 2007, 2009). This southward migration is less noticeable and predictable than the northward movements in late spring and early summer (Burns and Frost 1979, Burns 1981, Kelly 1988). During winter, the central and northern parts of the Bering Sea shelf have the highest densities of bearded seals (Fay 1974, Heptner et al. 1976, Burns and Frost 1979, Braham et al. 1981, Burns 1981, Nelson et al. 1984). In late winter and early spring, bearded seals are widely but not uniformly distributed in the broken, drifting pack ice ranging from the Chukchi Sea south to the ice front in the Bering Sea. In these areas, they tend to avoid the coasts and areas of fast ice (Burns 1967, Burns and Frost 1979).

POPULATION SIZE

A reliable population estimate for the entire stock is not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. In spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 299,174 (95% CI: 245,476-360,544) bearded seals in those waters. These data do not include bearded seals in the Chukchi and Beaufort seas.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for a stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. A reliable N_{MIN} for the entire stock cannot presently be determined because current reliable estimates of abundance are not available for the Chukchi and Beaufort seas. Using the 2012 Bering Sea abundance estimate by Conn et al. (2014), however, provides a partial N_{MIN} of 273,676 bearded seals in the U.S. sector of the Bering Sea.

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 PBR is defined as the product of the minimum population estimate (N_{MIN}), 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). Using the partial N_{MIN} calculated for bearded seals in the Bering Sea, a partial PBR for bearded seals that overwinter and breed in the U.S. portion of the Bering Sea = 8,210 (273,676 × 0.06 × 0.5). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available for the entire stock (i.e., N_{MIN} is not available for the Chukchi or Beaufort seas), the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality and serious injury by fisheries observers, 12 fisheries could potentially interact with bearded seals. Between 2009 and 2013, incidental serious injury and mortality of bearded seals occurred in three of these fisheries: the Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands flatfish trawl, and Bering Sea/Aleutian Islands Pacific cod trawl fisheries (Table 1). The estimated minimum mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is 1.2 bearded seals, based exclusively on observer data.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of bearded seals due to U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	1 0 (+1)[a] 0 1 0	1.0 0 (+1)[b] 0 1.0 0	0.6 (CV = N/A)
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 1 1 0	0 0 1.0 1.0 0	0.4 (CV = 0.03)
Bering Sea/Aleutian Is. Pacific cod trawl	2009 2010 2011 2012 2013	obs data	63 66 60 68 80	0 0 0 0 1	0 0 0 0 1	0.2 (CV = 0)
Minimum total estimated annual mortality						1.2 (CV = 0.03)

[a]Total mortality and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul.
[b]Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Alaska Native Subsistence/Harvest Information

Bearded seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2); but more than 50 other communities harvest bearded seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for bearded seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of bearded seals in 2009-2013 is 379 seals. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Bearded seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	Alaska Native population (2013)	Estimated bearded seal harvest				
		2009	2010	2011	2012	2013
Kivalina	352			123		
Noatak	514			65		
Buckland	519			47		
Deering	176			49		
Emmonak	782			106		
Scammon Bay	498			82	51	
Hooper Bay	1,144	332	148	210	212	171
Tununak	342	21	40	42	44	
Quinhagak	694		29	26	44	49
Togiak	842	0	0	2		
Twin Hills	66	0	0			
Total		353	217	752	351	220

Other Mortality

Mortality and serious injury 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 2007 and 2011, one mortality resulted from research on the Alaska stock of bearded seals (in 2007), which results in an average annual mortality and serious injury rate of 0.2 bearded seals from this stock (Division of Permits and Conservation, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910, 11 January 2012).

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, walrus, and a few bearded seals, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified.

STATUS OF STOCK

The primary concern for this population is the ongoing and projected loss of sea-ice cover stemming from climate change, which is expected to pose a significant threat to the persistence of these seals in the foreseeable future (based on projections through the end of the 21st century). On December 28, 2012, NMFS listed the Beringia DPS and, thus, the Alaska Stock of bearded seals, as “threatened” under the Endangered Species Act (ESA) (77 FR 76740). Because of its “threatened” status under the ESA, this stock was designated as “depleted” under the MMPA and was classified as a strategic stock. On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The decision vacated NMFS’ listing of the Beringia DPS of bearded seals as a “threatened” species. Consequently, it is also no longer designated as “depleted” or classified as a strategic stock. Because the PBR for the entire stock is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. A partial PBR for only those bearded seals that overwinter and breed in the U.S. portion of the Bering Sea, however, is 8,210. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (1.2), the most recent MMPA permit records (0.2), and a minimum estimate of the Alaska Native harvest (379) is 380 bearded seals. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

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 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., potentially 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 the Bering Strait. In June in the Bering Sea, 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 increased shipping (particularly in the Bering Strait), and 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. Morphologically, the Baltic and Okhotsk subspecies are fairly well differentiated from the Arctic subspecies (Ognev 1935, Müller-Wille 1969, Rice 1998) and the Ladoga and Saimaa subspecies differ significantly from each other and from the Baltic subspecies (Müller-Wille 1969, Hyvärinen and Nieminen 1990, Amano et al. 2002). Genetic analyses support isolation of the lake-inhabiting populations (Palo 2003, Palo et al. 2003, Valtonen et al. 2012) but suggest gene flow from the Arctic to the Baltic as well as widespread mixing within the Arctic (Palo et al. 2001, Davis et al. 2008, Kelly et al. 2009, Martinez-Bakker et al. 2013). Differences in body size, morphology, growth rates, or diet between ringed seals in shorefast versus pack ice have been taken as evidence of separate breeding populations in some locations (McLaren 1958, Fedoseev 1975, Finley et al. 1983); however, this has not been thoroughly examined and the taxonomic status of the Arctic subspecies remains unresolved (Berta and Churchill 2012). 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 (EEZ) of the Beaufort, Chukchi, and Bering seas (Fig. 1).

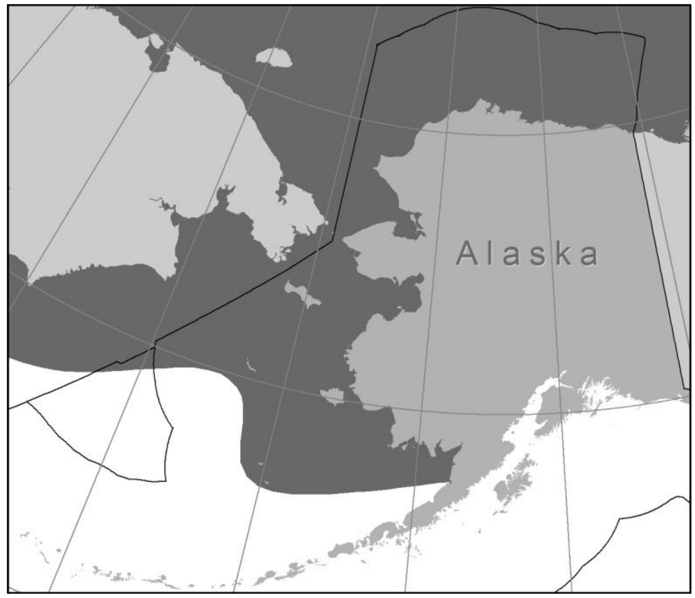

Figure 1. Approximate distribution of ringed seals (dark shaded area). The combined summer and winter distribution are depicted.

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. This species rarely comes ashore in the Arctic; however, in more southerly portions of its range where sea or lake ice is absent during summer and fall, ringed seals are known to use isolated haul-out sites on land for molting and resting (Härkönen et al. 1998, Trukhin 2000, Kunnasranta 2001, Lukin et al. 2006). In Alaska 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 thought 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, Crawford et al. 2012, Harwood et al. 2012). 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 Alaska 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 Alaska 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 Alaska 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 Alaska 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. (2004) conducted surveys within 40 km of shore in the Alaska 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 Alaska Beaufort Sea during 1997-1999 but reported substantially lower ringed seal densities than Frost et al. (2004). The reason for this disparity was unclear (Frost et al. 2004). Bengtson et al. (2005) conducted surveys in the Alaska 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 six 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 stock's range and were conducted over a decade ago. Using the most recent estimates from surveys by Bengtson et al. (2005) and Frost et al. (2004) in the late 1990s and 2000, for the purposes of an Endangered Species Act (ESA) status review of the species, Kelly et al. (2010a) estimated the total population in the Alaska Chukchi and Beaufort seas to be at least 300,000 ringed seals, which Kelly et al. (2010a) state is likely an underestimate since the Beaufort surveys were limited to within 40 km of shore.

During April-May in 2012 and 2013, U.S. and Russian researchers conducted comprehensive and synoptic aerial abundance and distribution surveys of ice-associated seals in the Bering and Okhotsk seas (Moreland et al. 2013). Preliminary analysis of the U.S. surveys, which included only a small subset of the 2012 data, produced an estimate of about 170,000 ringed seals in the U.S. EEZ of the Bering Sea in late April (Conn et al. 2014). This estimate does not account for availability bias, thus the actual number of ringed seals is likely much higher, perhaps by a factor of two or more. The full data sets are currently being processed and analyzed to provide abundance estimates for bearded, spotted, ribbon, and ringed seals in the Bering and Okhotsk seas. Similar surveys in the Chukchi and Beaufort seas are planned for the near future, pending funding.

Minimum Population Estimate

The estimate of 300,000 ringed seals presented in Kelly et al. (2010a) is based on estimates from surveys by Bengtson et al. (2005) and Frost et al. (2004) in the late 1990s and 2000. This estimate is likely an underestimate, as it is based on surveys of a portion of the range, and is more than 8 years old. A reliable estimate of N_{MIN} for the total population in the Alaska Chukchi and Beaufort sea regions is 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). Since the data used to produce the abundance estimate presented in Kelly et al. (2010a) are more than 8 years old, and no reliable N_{MIN} is available, PBR is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Between 2009 and 2013, incidental serious injury and mortality of ringed seals was reported in 4 of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality and serious injury by fisheries observers: the Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands Pacific cod trawl, and Bering Sea/Aleutian Islands Pacific cod longline fisheries (Table 1). Based on data from 2009 to 2013, the average annual rate of mortality and serious injury incidental to U.S. commercial fishing operations is 4.1 ringed seals.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of ringed seals due to U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	1 0 6 (+1)[a] 3 3	1.0 0 6.0 (+1)[b] 3.0 3.0	2.8 (CV = N/A)
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	1 0 3 0 0	1.0 0 3.0 0 0	0.8 (CV = 0.03)

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. Pacific cod trawl	2009 2010 2011 2012 2013	obs data	63 66 60 68 80	0 0 1 0 0	0 0 1.0 0 0	0.2 (CV = 0)
Bering Sea/Aleutian Is. Pacific cod longline	2009 2010 2011 2012 2013	obs data	60 64 57 51 67	0 0 1 0 0	0 0 1.6 0 0	0.3 (CV = 0.61)
Minimum total estimated annual mortality						4.1 (CV = 0.17)

[a]Total mortality and serious injury observed in 2011: 6 in sampled hauls + 1 in an unsampled haul.

[b]Since the total known mortality and serious injury (6 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (6.0) for the fishery in 2011, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Alaska Native Subsistence/Harvest Information

Ringed seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2), but more than 50 other communities harvest ringed seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for ringed seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of ringed seals in 2009-2013 is 1,040 seals. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Ringed seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	Alaska Native population (2013)	Estimated ringed seal harvest				
		2009	2010	2011	2012	2013
Kivalina	352			16		
Noatak	514			3		
Buckland	519			26		
Deering	176			0		
Emmonak	782			56		
Scammon Bay	498			137	169	
Hooper Bay	1,144	889	458	674	651	667
Tununak	342	232	162	257	219	

Community	Alaska Native population (2013)	Estimated ringed seal harvest				
		2009	2010	2011	2012	2013
Quinhagak	694		163	117	140	160
Togiak	842	1	1	0		
Twin Hills	66	0	0			
Total		1,122	784	1,286	1,179	827

Other Mortality

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, bearded seals, and walrus, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified.

Between 2009 and 2013, one ringed seal mortality, due to a gunshot wound to the head, was reported to the NMFS Alaska Region stranding database (Helker et al. 2015). This seal, presumably a struck and lost animal from the subsistence hunt, had skin lesions consistent with those seen in animals considered part of the multi-species Northern Pinniped 2011 Unusual Mortality Event.

STATUS OF STOCK

On December 28, 2012, NMFS listed Arctic ringed seals (*Phoca hispida hispida*) and, thus, the Alaska stock of ringed seals, as “threatened” under the ESA (77 FR 76706). The primary concern for this population is the ongoing and anticipated loss of sea ice and snow cover stemming from climate change, which is expected to pose a significant threat to the persistence of these seals in the foreseeable future (based on projections through the end of the 21st century; Kelly et al. 2010a). Because of its “threatened” status under the ESA, this stock was designated as “depleted” under the MMPA. As a result, the stock was classified as a strategic stock. On March 11, 2016, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of ringed seals under the ESA (Alaska Oil and Gas Association et al. v. Pritzker, Case No. 4:14-cv-00029-RPB). The decision vacated NMFS’ listing of the Arctic ringed seals as a “threatened” species. Consequently, it is also no longer designated as “depleted” or classified as a strategic stock. Since PBR is undetermined, it is not possible to determine whether direct human-caused mortality and serious injury exceeds PBR and it is not known whether the current annual level of incidental U.S. commercial fishery-related mortality and serious injury (4.1) exceeds 10% of the PBR. However, mortality and serious injury occurring incidental to commercial fishing is likely small. The total estimated average annual level of human-caused mortality and serious injury based on commercial fisheries observer data (4.1) and a minimum estimate of the Alaska Native harvest (1,040) is 1,044 ringed seals. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

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 effect will be lower snow accumulation on the ice (Hezel et al. 2012). 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 increased shipping (particularly in the Bering Strait) and 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 range from the North Pacific Ocean and Bering Sea into the Chukchi and western Beaufort seas (Fig. 1). From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970, 1981; Braham et al. 1984). Ribbon seals are very rarely seen on shorefast ice or land. 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, 1981; Burns et al. 1981). As the ice melts, seals become more concentrated, with at least part of the Bering Sea population moving towards the Bering Strait and the southern part of the Chukchi Sea. By the time the Bering Sea ice recedes through the Bering Strait, there is usually only a small number of ribbon seals hauled out on the ice. Ten ribbon seals tagged in the spring of 2005 near the eastern coast of Kamchatka spent the summer and fall throughout the Bering Sea and Aleutian Islands. However, of 72 ribbon seals satellite tagged in the central Bering Sea during 2007-2010, only 21 (29%) moved to the Bering Strait, Chukchi Sea, or Arctic Basin as the ice retreated northward. About 9.5% of ribbon seals' time budget during July through October was in those areas. The majority of the seals tagged in the central Bering Sea did not pass north of the Bering Strait. These seals, and the 10 seals tagged in 2005 near Kamchatka, dispersed widely, occupying coastal areas as well as the interior of the Bering Sea, both on and off the continental shelf (Boveng et al. 2013). Year-long passive acoustic sampling on the Chukchi Plateau from autumn 2008-2009 detected ribbon seal calls only in October and November 2008 (Moore et al. 2012).

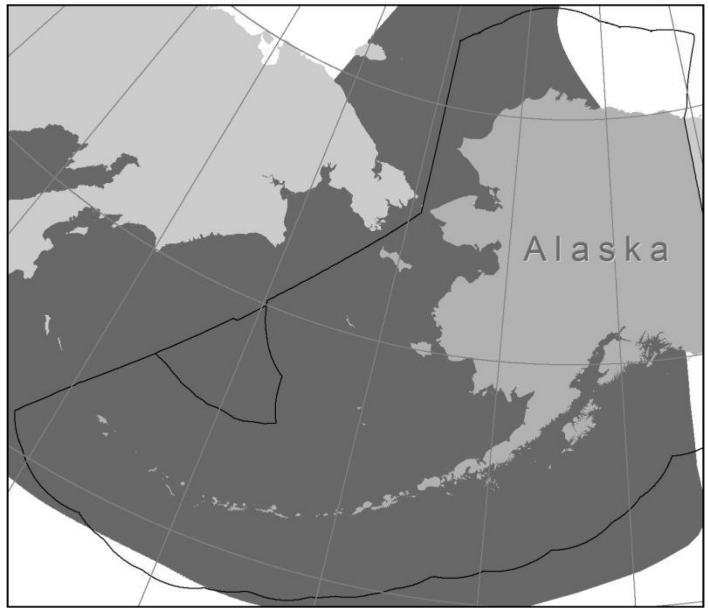

Figure 1. Approximate distribution of ribbon seals (dark shaded area) in Alaska waters. The combined summer and winter distribution is depicted.

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; and 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. 2013). Therefore, only the Alaska stock of ribbon seal is recognized in U.S. waters.

POPULATION SIZE

A reliable population estimate for the entire stock is not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. In spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 184,000 (95% CI: 145,752-230,134) ribbon seals in those waters. Though this should be considered only a preliminary estimate, it is appropriate to consider this a reasonable estimate for the entire U.S. population of ribbon seals because few ribbon seals are expected to be north of the Bering Strait in the spring when these surveys were conducted. When the final analyses for both the Bering and Okhotsk seas are complete they should provide the first range-wide estimates of ribbon seal abundance.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for a stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 2012 Bering Sea abundance estimate by Conn et al. (2014) provides an N_{MIN} of 163,086 ribbon seals in this stock.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ribbon seals are unavailable. This stock is thought to occupy its entire historically-observed range (Boveng et al. 2013).

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 PBR is defined as the product of the minimum population estimate (N_{MIN}), 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 stocks thought to be stable (Wade and Angliss 1997). Thus, the PBR for the Alaska stock of ribbon seals = 9,785 (163,086 × 0.06 × 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these 3 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 2009 and 2013, incidental mortality and serious injury of ribbon seals occurred in the Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Atka mackerel trawl, and Bering Sea/Aleutian Islands pollock trawl fisheries (Table 1). The minimum estimated average annual mortality and serious injury rate incidental to U.S. commercial fisheries is 0.6 ribbon seals, based exclusively on observer data.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of ribbon seals due to U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 0 1 0	0 0 0 1 0	0.2 (CV = 0.01)
Bering Sea/Aleutian Is. Atka mackerel trawl	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	1 0 0 0 0	1 0 0 0 0	0.2 (CV = 0.01)

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	1 0 0 0 0	1 0 0 0 0	0.2 (CV = 0.11)
Minimum total estimated annual mortality						0.6 (CV = 0.04)

Alaska Native Subsistence/Harvest Information

Ribbon seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2), but more than 50 other communities harvest ribbon seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for ribbon seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of ribbon seals in 2009-2013 is 3.2 seals. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Ribbon seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	Alaska Native population (2013)	Estimated ribbon seal harvest				
		2009	2010	2011	2012	2013
Kivalina	352			0		
Noatak	514			1		
Buckland	519			0		
Deering	176			0		
Emmonak	782			0		
Scammon Bay	498			4	2	
Hooper Bay	1144	0	0	0	4	0
Tununak	342	0	0	0	0	
Quinhagak	694		2	3	0	0
Togiak	842	0	0	0		
Twin Hills	66	0	0			
Total		0	2	8	6	0

Other Mortality

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, bearded seals, and walrus, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified. No ribbon seal cases were reported but they are not a coastal species and are seldom observed.

STATUS OF STOCK

Ribbon seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act (ESA). The minimum population estimate of ribbon seals in U.S. waters is 163,086, with a PBR of 9,785. Because the estimated average annual level of U.S. commercial fishery-related mortality and serious injury (0.6) is less than 10% of PBR (979), it can be considered insignificant and approaching zero mortality and serious injury rate. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (0.6) and a minimum estimate of the Alaska Native harvest (3.2) is 3.8 ribbon seals. The Alaska stock of ribbon seals is not considered a strategic stock.

HABITAT CONCERNS

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ribbon seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. 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. 2013). 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. 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 increased shipping (particularly in the Bering Strait) and oil and gas exploration activities (particularly in the outer continental shelf leasing areas), such as disturbance from vessel traffic, seismic exploration noise, and 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 summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea, and the Mackenzie Delta (Hazard 1988). Satellite transmitters on a few whales from the Beaufort Sea, Chukchi Sea and Eastern Bering Sea stocks have lasted through the winter demonstrating that beluga whales from these summering areas overwinter in the Bering Sea and the stocks may use separate wintering locations (Suydam 2009; ABWC, unpublished data). Belugas found in Bristol Bay and the northern Gulf of Alaska/Cook Inlet remain in those areas throughout the year (Shelden 1994, Quakenbush 2003, NMFS and ADF&G unpublished data). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985).

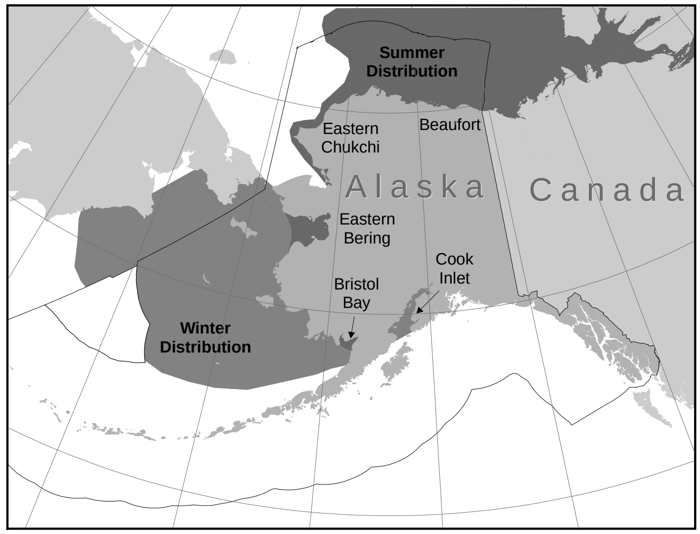

Figure 1. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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, Suydam 2009) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations can be more than thousands of kilometers (Richard et al. 2001).

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); 2) Population response data: distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among the five summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 beluga whale 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 (Fig. 1).

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 belugas for the Beaufort Sea stock, similar to that reported by Seaman et al. (1985). The most recent aerial survey was conducted in July 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 coefficient of variation (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). Additionally, the 1992 surveys did not encompass the entire summer range of Beaufort Sea belugas (Richard et al. 2001), thus are negatively biased.

Minimum Population Estimate

For the Beaufort Sea beluga whale stock, 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 whales and an associated CV(N) of 0.229, N_{MIN} for this stock is 32,453 whales. Because the survey data are more than 8 years old, it would not be considered a reliable minimum population estimate for calculating a PBR and N_{MIN} would be considered unknown. However, trend data from Harwood and Kingsley (2013) indicate the stock is at least stable or increasing; therefore, the Alaska SRG recommended at the 2014 meeting that NMFS retain the N_{MIN} estimate of 32,453 whales.

Current Population Trend

The current population trend of the Beaufort Sea stock of beluga whales is stable or increasing. Recent and historical aerial surveys off the Mackenzie River Delta indicate that the stock is at least stable or increasing (Harwood and Kingsley 2013). There are no data to suggest the stock is declining.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Beaufort Sea beluga whale stock. Hence, until additional data become available, it is recommended that the default maximum theoretical net productivity rate (R_{MAX}) for cetaceans 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 at least stable, the recovery factor (F_R) for this stock is 1 (Wade and Angliss 1997). Thus, using the abundance estimate calculated from 1992 surveys, the PBR for the Beaufort Sea beluga whale stock would be calculated to be 649 animals (32,453 × 0.02 × 1.0). 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. However, the recent trend data suggest that the stock is at least as large as it was during the last estimate of N_{MIN}; thus the 1992 estimate of N_{MIN} = 32,452 whales is sufficient to use for a PBR calculation. Therefore, the PBR for this stock is 649 (NMFS 2005).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality.*" Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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.

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 1 (Alaska Beluga Whale Committee, unpubl. data 2012). Given these data, the annual subsistence take by Alaska Native hunters averaged 65.6 belugas during the 5-year period from 2008 to 2012.

Table 1. Summary of beluga whales from the Beaufort Sea beluga whale stock landed by Alaska Native subsistence hunters, 2008-2012. Total taken includes landed and struck and lost in years 2010-2012; struck and lost data for 2008 and 2009 have not been quantified and are minimum counts.

Year	Harvested whales	Struck and lost whales	Reported total number taken
2008	48	N/A	48
2009	16	N/A	16
2010	71	1+	72
2011	42	6	48
2012	92	42+	144
Mean annual number of animals landed (2008-2012)			65.6+

The subsistence take of beluga whales within the Canadian waters of the Beaufort Sea is reported by the Fisheries Joint Management Committee (FJMC). The data are collected by on-site harvest monitors conducted by the FJMC at Inuvialuit communities in the Mackenzie Delta, Northwest Territories. The Canadian Inuvialuit subsistence harvest estimates for the Beaufort Sea beluga stock are provided in Table 2 (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 (2005-2009) and U.S. (2008-2012) waters from the Beaufort Sea beluga stock is 166 (100 + 65.6) whales.

Table 2. 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 designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. There are no reported fisheries mortalities, thus the estimated annual U.S. commercial fishery-related mortality is zero (0). The total mean annual human-caused mortality estimate is 166 based on the known subsistence harvest in the United States (65.6) and Canada (100). Because the PBR is less than 10% of PBR (65), the level of annual U.S. commercial fishery-related mortality is considered insignificant and approaching zero mortality and serious injury rate. Although the abundance estimates are more than 8 years old, since there are no records of incidental mortality in commercial fisheries, the level of incidental mortality and serious injury is considered to be insignificant. The Beaufort Sea beluga stock 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 rapidly and significantly, and one result of this change is a reduction in the extent of sea ice in at least some regions (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 from 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 beluga whale habitat (Moore et al. 2000, Lowry et al. 2006). However, 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 summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea, and the Mackenzie Delta (Hazard 1988). Satellite transmitters on a few whales from the Beaufort Sea, Chukchi Sea and eastern Bering Sea stocks have lasted through the winter demonstrating that beluga whales from these summering areas overwinter in the Bering Sea and the stocks may use separate wintering locations (Suydam 2009; Alaska Beluga Whale Committee, unpublished data). Belugas found in Bristol Bay and the northern Gulf of Alaska/Cook Inlet remain in those areas throughout the year (Shelden 1994; Quakenbush 2003; NMFS and ADF&G, unpublished data). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985).

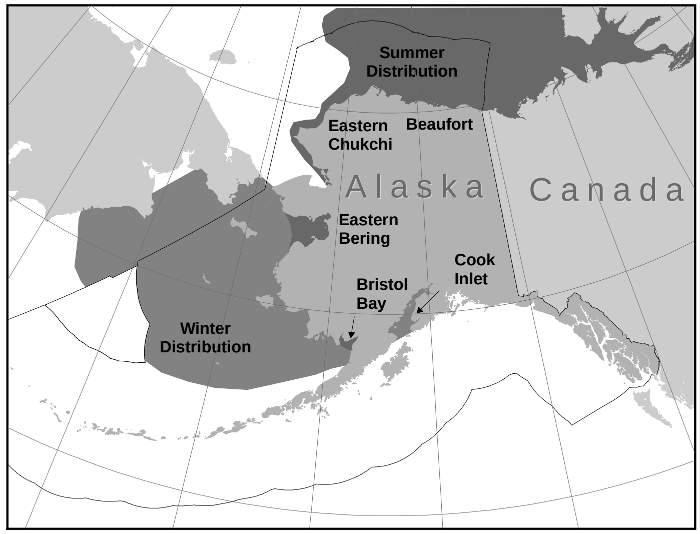

Figure 1. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The general distribution pattern for beluga whales shows major seasonal changes. During the winter, the Beaufort Sea, eastern Chukchi Sea, and Bering Sea stocks 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, Suydam 2009) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations can be more than thousands of kilometers (Richard et al. 2001).

Eastern Chukchi Sea belugas move into coastal areas, including 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 tags attached to eastern Chukchi belugas captured in Kaseguluk Lagoon during the summer showed these whales traveled 1,100 km north of the Alaska coastline, into the Canadian Beaufort Sea within 3 months (Suydam et al. 2001). This movement indicated some overlap in distribution with the Beaufort Sea beluga whale stock during late summer. Satellite telemetry data from 23 whales tagged during 1998-2007 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 in the Beaufort Sea and Arctic Ocean (79-80°N) by late July/early August. Adult and immature female belugas remained at or near the shelf break in the Chukchi Sea. After October, only three tags continued to transmit, and those whales migrated south through the eastern Bering Strait into the northern Bering Sea, remaining north of Saint Lawrence Island over the winter. A whale tagged in the eastern Chukchi Sea in 2007 overwintered in the waters north of Saint Lawrence Island during 2007/2008 and moved to near King Island in April and May before moving north through the Bering Strait in late May and early June (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); 2) Population response data: distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among the five summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 beluga whale 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 (Fig. 1).

POPULATION SIZE

Frost et al. (1993) estimated the minimum size of the eastern Chukchi beluga stock at 1,200 whales, based on counts of animals from aerial surveys conducted during 1989-1991. Survey effort was concentrated along the sea side of the 170 km long Kasegaluk Lagoon, an area known to be regularly used by belugas during the open-water season. Other areas that these belugas are known to frequent (e.g., offshore) were not surveyed. Therefore, these surveys provided only a minimum raw 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) whales.

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 belugas 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.

Aerial surveys were conducted in the summer of 2012 in the northeastern Chukchi and Alaskan Beaufort seas in late June through August (Clarke et al. 2013). Those data are currently being analyzed by the Alaska Beluga Whale Committee and an updated estimate should be available by 2015.

Minimum Population Estimate

The survey technique used for estimating beluga whale abundance is a direct count that incorporates correction factors. Although coefficients of variation (CVs) of the correction factors are not available, the Alaska Scientific Review Group concluded that the population estimate of 3,710 belugas can serve as the estimated minimum population size because the survey did not include all areas where beluga are known to occur (Small and DeMaster 1995). That is, if the beluga distribution in the eastern Chukchi Sea is similar to beluga distribution 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). However, because the survey data are more than 8 years old, it is not considered a reliable minimum population estimate for calculating a PBR, and N_{MIN} is considered unknown.

Current Population Trend

The current population trend for the eastern Chukchi Sea beluga stock is unknown.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this beluga whale stock. Hence, until additional data become available, it is recommended that the default maximum theoretical net productivity rate (R_{MAX}) for cetaceans 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). 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality.*" Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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 1990-1997: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury to beluga whales incidental to these groundfish fisheries. In the nearshore waters of the southeastern Chukchi Sea, substantial efforts occur in gillnet (mostly set nets) and personal-use fisheries. Although a potential source of mortality, there have been no reported beluga whale takes as a result of these fisheries.

Based on a lack of reported mortalities, the inferred 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 1. Given these data, the annual subsistence take by Alaska Native hunters averaged 57.4 belugas landed during the 5-year period 2008-2012 based on reports from ABWC representatives and on-site harvest monitoring.

Table 1. Summary of the number of beluga whales landed by the Alaska Native subsistence harvest of eastern Chukchi Sea beluga whales, 2008-2012. It should be noted that the 2010 and 2011 statistics include takes at Kivalina (2 in 2010 and 2 in 2011) and Kotzebue/Noatak (0 in 2010 and 30 in 2011) which may be from a population that is genetically distinct from the main population comprising the eastern Chukchi Sea beluga whale stock. Totals include landed and struck and lost.

Year	**Reported total number landed**
2008	74
2009	53
2010	36
2011	66
2012	58
Mean annual number of animals landed (2008-2012)	57.4

STATUS OF STOCK

Eastern Chukchi Sea beluga whales are not designated 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 trend is unknown; 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 rapidly and significantly, and one result of this change is a reduction in the extent of sea ice in at least some regions (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 from 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 beluga whale habitat (Moore et al. 2000, Lowry et al. 2006). However, 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

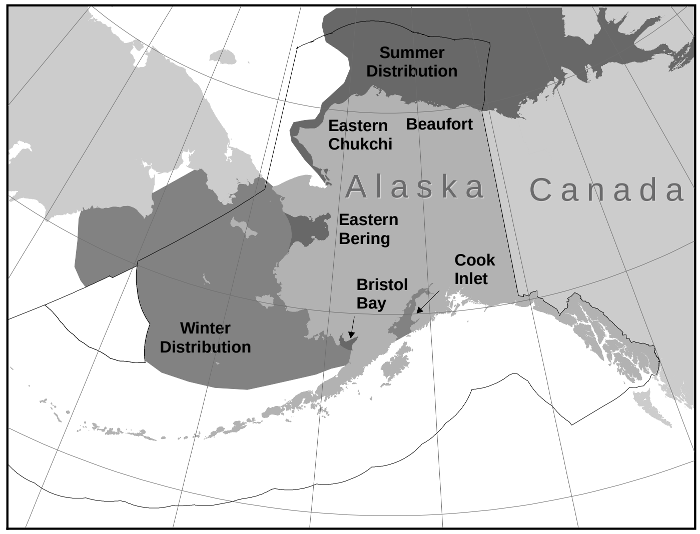

Figure 1. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea, and the Mackenzie Delta (Hazard 1988). Satellite transmitters attached to whales from the Beaufort Sea, Chukchi Sea and eastern Bering Sea stocks have provided detailed information on distribution and movements. The few transmitters that lasted through the winter showed that beluga whales from these summering areas overwinter in the Bering Sea and the stocks may use separate wintering locations (Suydam 2009; Alaska Beluga Whale Committee, unpublished data). Belugas found in Bristol Bay and the northern Gulf of Alaska/Cook Inlet remain in those areas throughout the year, showing only small seasonal shifts in distribution (Shelden 1994; Quakenbush 2003; NMFS and ADF&G, unpublished data). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human activities (Lowry 1985).

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, Suydam 2009) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Richard et al. 2001).

Two belugas from the eastern Bering Sea stock were tagged with satellite transmitters in 2012. The belugas were tagged near Nome and moved south from there in ice covered shelf waters during the winter, as far as the vicinity of Hagemeister Island and the Walrus Islands in Bristol Bay, before returning north to Norton Sound in the spring (Alaska Beluga Whale Committee, unpublished data).

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); 2) Population response data: distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among the five summering areas (O'Corry-Crowe et al. 1997). Based on this information, five beluga whale 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 (Fig. 1).

POPULATION SIZE

The Alaska Beluga Whale Committee has been working to develop a population estimate for the 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 9,593 belugas (CV = 0.32) seen at the surface in the study area (R. Hobbs, AFSC-NMML, pers. comm., 05 March 2014). If this estimate were doubled to correct for the proportion of animals that were diving and thus not visible at the surface, the total abundance for the eastern Bering Sea stock would be 19,186 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 N_{MIN} or 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 19,186 and an associated CV(N) of 0.32, N_{MIN} for this stock is 14,751 beluga whales. However, because the survey data are more than 8 years old, it is not considered a reliable minimum population estimate for calculating a PBR, and N_{MIN} is considered unknown. More recent data are considered preliminary and are not ready to be used for calculation of $N_{MIN,}$ but will be available soon (R. Hobbs, AFSC-NMML, pers. comm., 05 March 2014).

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 1992-1995 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 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). However, the 2005 revisions to the SAR guidelines 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality.*" Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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 in the commercial fisheries and there is no reporting requirement for takes in personal use fisheries. In 2010, one beluga was reported entangled in a subsistence salmon gillnet in the eastern Bering Sea (Table 1). 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.

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

Table 1. Summary of eastern Bering Sea stock of beluga whale mortalities and serious injuries by year and type reported to the Alaska Regional Office, marine mammal stranding database, for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of Injury	2008	2009	2010	2011	2012	Mean Annual Mortality
Entangled in subsistence salmon gillnet	0	0	1	0	0	0.2
Minimum total annual mortality						0.20

Because there has never been an observer program for nearshore commercial fisheries in the eastern Bering Sea region, a reliable estimate of the number of deaths 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 2 (Alaska Beluga Whale Committee, pers. comm., 13 June 2013). 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 181 belugas landed from the eastern Bering Sea stock during the 5-year period 2008-2012.

Table 2. Summary of the number of belugas landed by the Alaska Native subsistence harvest from the eastern Bering Sea stock of beluga whales, 2008-2012.

Year	Reported total number landed
2008	119
2009	181
2010	194
2011	224
2012	186
Mean annual number of animals landed (2008-2012):	180.8

STATUS OF STOCK

The estimated minimum annual mortality 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 181 based on subsistence harvest (180.8) and entanglement in a subsistence salmon gillnet (0.2). Eastern Bering Sea beluga whales are not designated as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The level of incidental mortality in commercial fisheries is unknown, although it is considered to be insignificant. 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 most 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 summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea, and the Mackenzie Delta (Hazard 1988). Satellite transmitters attached to whales from the Beaufort Sea, Chukchi Sea and eastern Bering Sea stocks have provided detailed information on distribution and movements. The few transmitters that lasted through the winter showed that beluga whales from these summering areas overwinter in the Bering Sea and the stocks may use separate wintering locations (Suydam 2009; Alaska Beluga Whale Committee, unpubl. data). Belugas found in Bristol Bay and the northern Gulf of Alaska/Cook Inlet remain in those areas throughout the year, showing only small seasonal shifts in distribution (Shelden 1994; Quakenbush 2003; NMFS and ADF&G, unpubl. data). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human activities (Lowry 1985).

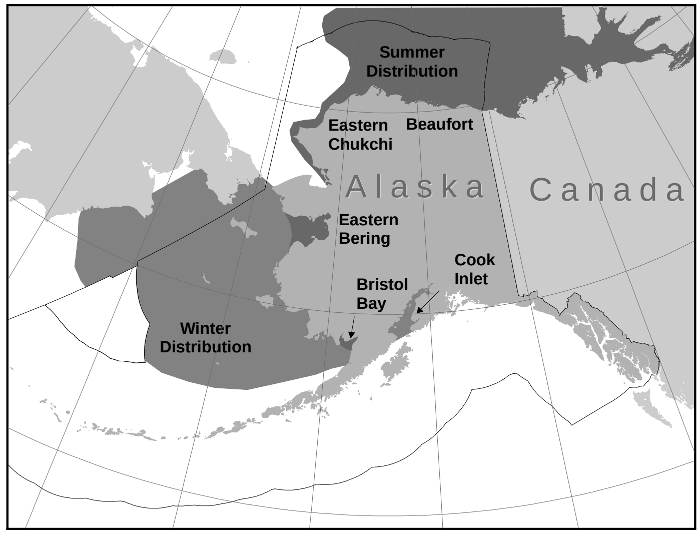

Figure 1. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

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, Suydam 2009) and give birth to and care for their calves (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Richard et al. 2001).

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, 10 in 2008, 5 in 2010, 10 in 2012, and 12 in 2013 (NMFS, BBMMC, ADF&G, unpubl. data). 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 (L. Quakenbush, Alaska Department of Fish and Game, Fairbanks, AK, pers. comm., 31 March 2008). Tags attached to whales in 2012 and 2013 have confirmed these observations (NMFS, unpubl. data).

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); 2) Population response data: distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among the five summering areas (O'Corry-Crowe et al. 1997). Based on this information, five beluga whale 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 (Fig. 1).

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 specifically designed to 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 whales for Bristol Bay, similar to that reported by Seaman et al. (1985). In 1994, the number was estimated at 1,555 belugas (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 whales (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 whales, with an average annual estimate of 2,877 (L. Lowry, University of Alaska Fairbanks, pers. comm., March 2011).

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 (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

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 at 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 = 59 animals (2,467 × 0.024 × 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality.*" Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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 1990-1997: 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 2008-2012, one mortality of a beluga in a subsistence salmon net was reported to the stranding network (Table 1). Based on this stranding report, the minimum annual mortality estimate due to fishery interactions over the 5-year period from 2008 to 2012 was 0.2 per year. However, this figure is clearly an underestimate because subsistence 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 Natives 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.

Table 1. Summary of the Bristol Bay stock of beluga whale mortalities and serious injuries by year and type reported to the Alaska Regional Office, marine mammal stranding database, for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of Injury	2008	2009	2010	2011	2012	Mean Annual Mortality
Entangled in Bristol Bay subsistence king salmon set gillnet	0	1	0	0	0	0.2
Minimum total annual mortality						0.20

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 2 (Alaska Beluga Whale Committee, 18 February 2010). These data show that the annual subsistence take by Alaska Natives averaged 24 belugas from the Bristol Bay stock during the 5-year period 2008-2012.

Table 2. Summary of the Alaska Native subsistence harvest from the Bristol Bay stock of beluga whales, 2008-2012. N/A indicates the data are not available.

Year	Reported total number landed
2008	19
2009	20
2010	27
2011	22
2012	32
Mean annual number of animals landed (2008-2012)	24.0

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 5.9 per year) because a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable. Bristol Bay beluga whales are 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 rate of human-caused mortality and serious injury (24 + 0.2 = 24.2) is not known to exceed the PBR (59). Because the population size has been increasing at a rate near R_{MAX}, 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 most 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

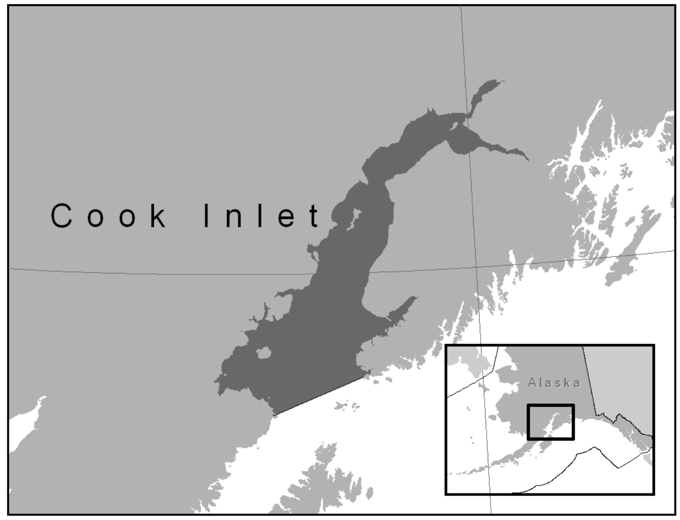

Figure 1. Approximate distribution of beluga whales in Cook Inlet.

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 summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea (including Kotzobue Sound), and Beaufort Sea (Mackenzie Delta) (Hazard 1988). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). Satellite transmitters on whales from the Beaufort Sea, Eastern Chukchi Sea, and Eastern Bering Sea stocks show monthly home ranges that are relatively distinct among these populations' summering areas and autumn migratory routes (e.g., Hauser et al. 2014). Belugas satellite-tagged in Bristol Bay (Quakenbush 2003, http://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.bristolbaybeluga) and Cook Inlet (Goetz et al. 2012a) remained in those areas throughout the year.

Beluga whale stock structure was 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 populations in summering areas (O'Corry-Crowe et al. 2002). Based on this information, five beluga whale stocks are recognized within U.S. waters: 1) Cook Inlet (Fig. 1), 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea.

During ice-free months, Cook Inlet beluga whales are typically concentrated near river mouths (Rugh et al. 2010). The winter distribution of this stock is not well known; however, there is evidence that some whales inhabit upper Cook Inlet year-round (Hansen and Hubbard 1999, Rugh et al. 2004, Lammers et al. 2013). During summers from 1999 to 2002, satellite tags were attached to a total of 15 belugas to determine their distribution through the fall and winter months (Hobbs et al. 2005, Goetz et al. 2012a). Ten tags transmitted from August to December and, of those, four tags deployed on males transmitted into March and one into late May (Goetz et al. 2012a). All tagged belugas remained in Cook Inlet.

A review of all marine mammal surveys conducted in the northern Gulf of Alaska between 1936 and 2000 found only 31 beluga sightings among 23,000 marine mammal sightings, indicating that very few belugas occurred in the Gulf of Alaska outside 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) are regularly observed in Yakutat Bay. Although not included in the Cook Inlet Distinct Population Segment (DPS), as listed under the Endangered Species Act (ESA), NMFS regulations under the Marine Mammal Protection Act (MMPA) (50 CFR 216.15) include the beluga whales occupying Yakutat Bay as part of the depleted Cook Inlet stock (75 FR 12498, 16 March 2010). Notice-and-comment rulemaking procedures would be required to change this regulatory definition. Until such procedures are completed, Yakutat Bay belugas remain designated as "depleted" and part of the Cook Inlet stock.

POPULATION SIZE

Aerial surveys during June documenting the early summer distribution and abundance of beluga whales in Cook Inlet were conducted by NMFS each year from 1993 to 2012 (Rugh et al. 2000, 2005; Shelden et al. 2013). In 2013, NMFS changed to a biennial survey schedule after detailed analysis showed that there would be no reduction in assessment quality (Hobbs 2013).

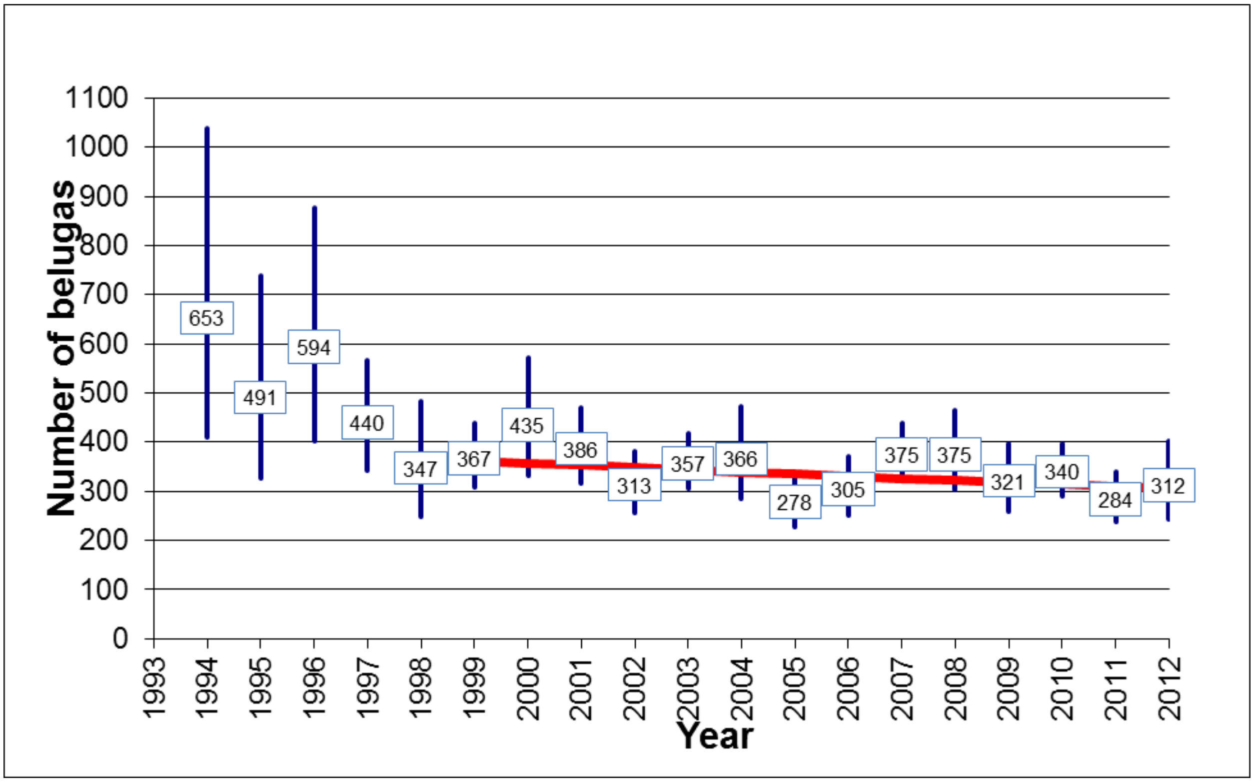

Figure 2. Annual abundance estimates of beluga whales in Cook Inlet, Alaska 1994-2012 (Hobbs et al. 2015). Vertical bars depict plus and minus one standard error. From 1999 to 2012, the rate of decline (red trend line) has been -1.60% per year (with a 97% probability that the growth rate is declining), while the 10-year trend (2002-2012) has been -0.6% per year.

The abundance estimate for beluga whales in Cook Inlet is based on counts by aerial observers and video analysis of whale groups. Paired, independent observers count each whale group while video is collected during each counting pass. Each count 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. 2000). When video counts are not available, observers' counts are corrected for availability and sightability using a regression of counts and an interaction term with an encounter rate against the video count estimates (Hobbs et al. 2000). The estimate of the abundance equation variance was revised using the squared standard error of the average for the abundance estimates in place of the abundance estimate variance and the measurement error (Hobbs et al. 2015). This reduced the CVs by almost half. The June 2012 survey resulted in an estimate of 312 whales (CV = 0.13) (Hobbs et al. 2015). This estimate is more than the estimate of 284 belugas for 2011; however, it falls within the statistical variation around the recent trend line and probably represents variability of the estimation process rather than an increase in the population from 2011 to 2012. Annual abundance estimates based on aerial surveys of Cook Inlet belugas during the most recent 3-year period were 340 (2010), 284 (2011), and 312 (2012), resulting in an average abundance estimate for this stock of 312 (CV = 0.10) belugas. The most recent annual abundance estimate survey was conducted in June 2014 and is currently undergoing analyses.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997). Thus, $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$.

Using the 3-year average population estimate (N) of 312 animals and an associated CV(N) of 0.10, N_{MIN} for the Cook Inlet beluga whale stock is 280 belugas.

Current Population Trend

The corrected annual abundance estimates for the period 1994-2012 are shown in Figure 2. From 1999 to 2012, the rate of decline was -1.60% (SE = 0. 75%) per year, with a 97% probability that the growth rate is declining (i.e., less than zero) (Hobbs et al. 2015).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently not available for the Cook Inlet beluga whale stock. Hence, until additional data become available, the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% is recommended to be employed for this stock (Wade and Angliss 1997). This figure is similar to the 4.8% annual increase that has been documented for the Bristol Bay beluga stock (Lowry et al. 2008).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized MMPA, the PBR was defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. In past Stock Assessment Reports from 1998 through 2005, NMFS calculated a value for PBR. 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 (2-6%), but for unknown reasons the Cook Inlet beluga whale stock is not increasing. Because this stock does not meet the assumptions inherent to the use of the PBR, NMFS has decided it would not be appropriate to calculate a maximum number that may be removed while allowing the population to achieve its Optimum Sustainable Population. Thus, the PBR for this stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

The estimated minimum average annual mortality and serious injury rate incidental to U.S. commercial fisheries is unknown, although probably low, because only one known beluga mortality has been reported in the past 10 years.

One entanglement in a subsistence fishery was reported to the Alaska Regional Office on May 7, 2012. A fisherman reported a juvenile beluga entangled in his salmon fishing net near Kenai. The beluga was dead and necropsy findings indicated that it was in poor health prior to entanglement and the cause of death was drowning.

Alaska Native Subsistence/Harvest Information

Subsistence harvest of beluga whales in Cook Inlet has been important to one local village (Tyonek) and the Alaska Native subsistence hunter community in Anchorage. Between 1993 and 1999, the annual subsistence take ranged from 30 to more than 100 animals, not including belugas struck but lost (Mahoney and Shelden 2000).

Following a significant decline in Cook Inlet beluga whale abundance estimates between 1994 and 1998, the Federal government took actions to conserve, protect, and 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 conducted under cooperative agreements between NMFS and affected Alaska Native organizations. These cooperative agreements, also referred to as co-management agreements, were not signed in 1999, 2004, and 2007, so no harvest was authorized. Harvests from 2001 through 2004 were conducted under harvest regulations (69 FR 17973, 6 April 2004) following an interim harvest management plan developed through an administrative hearing. Three belugas were harvested in Cook Inlet under this interim harvest plan. In August 2004, an administrative hearing was held to create a long-term harvest plan. This plan allowed 8 whales to be harvested between 2005 and 2009. Under the plan, allowable harvest levels are established for a 5-year period, based on the average abundance in the previous 5-year period and the growth rate during the previous 10-year period. A harvest is not allowed if the previous 5-year average abundance is less than 350 belugas. Because the 5-year average abundance during the period 2003-2007 was 336 (i.e., below 350 whales), no harvest was allowed during the subsequent 5-year period 2008-2012 (73 FR 60976; 15 October 2008). The average abundance of Cook Inlet beluga whales remained below 350 whales during the period 2008-2012; therefore, a harvest is not allowed for the 5-year period 2013-2017.

Other Mortality

Mortality related to stranding events has been reported in Cook Inlet (Table 1). Improved record-keeping was initiated in 1994, and reports have since included the number of dead and live stranded belugas. Most whales involved in a live stranding event probably survive, although some mortalities may be missed by observers if whales die later from strand-related injuries. In 2012, there were 38 whales involved in three live stranding events, with no mortalities reported (Table 1). There were no live stranding events reported to NMFS in 2013. In 2014, at least 76 whales were involved in a single live stranding event in Eagle Bay in Knik Arm. That same year, necropsy results from two dead whales found near Kincaid Park along Turnagain Arm suggested the whales had recently live stranded, and that the live stranding may have contributed to their deaths, although no live stranding events were reported to NMFS (Table 1). Most live strandings occur in Knik Arm or Turnagain Arm, both of which are shallow and dangerous waterways. Turnagain Arm has the largest tidal range in the U.S., with a mean of 9.2 m (30 ft).

Table 1. Cook Inlet beluga strandings investigated by NMFS during 2009-2014 (NMFS, unpubl. data).

Year	Beachcast carcasses	Number of belugas per live stranding event (number of associated known or suspected mortalities)
2009	4	16-21 (0)
2010	5	11(0), 2(0)
2011	3	2(0)
2012	3	12(0), 23(0), 3(0)
2013	5	0
2014	10	76 (0), unknown (2)
Total	30	145-150 (2)

Another source of beluga whale mortality in Cook Inlet is killer whale predation. Killer whale sightings were not well documented and appear to be rare in the upper inlet prior to the mid-1980s. From 1982 through 2014, killer whale sightings in upper Cook Inlet (north of East and West Foreland) were reported to NMFS 29 times, and 9-11 beluga mortalities were suspected to be a direct result of killer whale predation. The last confirmed killer whale predation of a beluga in Cook Inlet occurred in 2008 in Turnagain Arm. In June 2010, a beluga carcass found near Point Possession was speculated to have injuries associated with killer whale predation; however, the poor condition of the beluga carcass prevented a positive determination of cause of death. From 2011 through 2014, NMFS has received no reports of killer whale sightings in upper Cook Inlet or possible predation attempts.

A photo-identification study (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, in 2010, a beluga with a rope entangled around its girth was observed and photo-documented during the period of May through August. The same whale was photographed in July and August 2011, August 2012, and July 2013, still entangled in the rope line (McGuire et al. 2014). This whale is currently considered to have a non-serious injury (Helker et al. 2015).

STATUS OF STOCK

The Cook Inlet beluga whale stock was designated as “depleted” under the MMPA (65 FR 34590, May 21, 2000), and on October 22, 2008, NMFS listed Cook Inlet belugas as “endangered” under the ESA (73 FR 62919, October 22, 2008). Therefore, the Cook Inlet beluga whale stock is considered a strategic stock. There are no fisheries observers in Cook Inlet and there have been no voluntary reports of beluga mortalities in U.S. commercial fisheries. Annual mortality and serious injury rate for commercial fisheries is likely low, although the incompleteness of data for commercial fisheries operating within the range of Cook Inlet belugas is a concern for this small population. NMFS convened a Recovery Team to aid in the development of a Recovery Plan for the Cook Inlet beluga whales; the Recovery Team’s draft plan was submitted to NMFS in March 2013. NMFS intends to release a draft Recovery Plan for public review and comment in 2015, in advance of finalizing the Recovery Plan for Cook Inlet beluga whales.

HABITAT CONCERNS

Beluga whale critical habitat includes two geographic areas of marine habitat in Cook Inlet that comprise 7,800 km^2 (3,013 mi^2), excluding waters by the Port of Anchorage (76 20180, 11 April 2011). Based on available information from aerial surveys, tagged whales, and opportunistic sightings, belugas remain within the inlet year-round. Since 2000, most whales have been found in the upper inlet north of East and West Foreland not only during the summer months (Rugh et al. 2010) but in the fall as well (Rugh et al. 2004), with tagged whales travelling between the lower and upper inlet and offshore waters >10 m deep during the winter (Goetz et al. 2012a). It is unknown if this contracted distribution is a result of changing habitat (Moore et al. 2000), prey concentration, or predator avoidance (Shelden et al. 2003) or can simply be explained as the contraction of a reduced population into a small number of preferred habitat areas (Goetz et al. 2007, 2012b). With the limited range of this stock, Cook Inlet belugas are vulnerable to human-induced or natural perturbations within their preferred habitat. Goetz et al. (2012b) modeled habitat preferences using NMFS' 1994-2008 abundance survey data. In large areas, such as the Susitna Delta and Knik Arm, they found a high probability of beluga presence in larger group sizes. Beluga presence also increased closer to rivers with Chinook salmon (*Oncorhynchus tshawytscha*) runs, such as the Susitna River. The Susitna Delta also supports two major spawning migrations of a small, schooling smelt (eulachon, *Thaleichthys pacificus*) in May and July. Additional effects that have the potential to impact this stock and its habitat include: changes in prey availability due to natural environmental variability, ocean acidification, and commercial fisheries; climatic changes affecting habitat; predation by killer whales; contaminants; noise; ship strikes; waste management; urban runoff; construction projects; and physical habitat modifications that may occur as Cook Inlet becomes increasingly urbanized (Moore et al. 2000, Lowry et al. 2006). Planned projects that may alter the physical habitat of Cook Inlet include highway improvements; mine construction and operation; oil and gas exploration and development; and expansion and improvements to ports.

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Revised 5/15/2013

NARWHAL (*Monodon monoceros*): Unidentified Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Figure 1. 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; populations are defined for 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 at this time due to extremely low genetic variability within and among management stocks (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 of the 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.

Narwhal in Alaska are thought to originate from a Canadian population, but there is no available method to verify this. 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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 designated 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 unidentified 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

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 whales have been labeled as 'resident,' 'transient,' and 'offshore' type killer whales (Bigg et al. 1990, Ford et al. 2000; Dahlheim et al. 2008) 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).

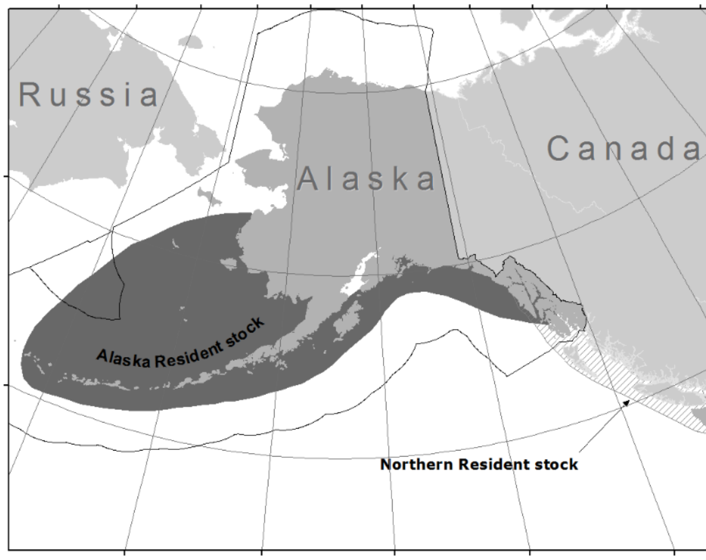

Figure 1. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy's Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg's killer whales (e.g., Ford 2011; Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Within the resident ecotype, association data were 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 Alaska residents. Alaska 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, at least as far west as the eastern Aleutian Islands.

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 Washington State 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 southeastern Alaska 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.

Resident killer whales ranging from Southeastern Alaska to Kodiak Island have been observed in regular association during multipod encounters since 1984 (Matkin et al. 2010). Tagging data also indicates the range of killer whales seen in these aggregations extends from Southeastern Alaska to south of Kodiak Island (Matkin et al. 2010). Although recent studies have documented movements of Alaska resident killer whales from the Bering Sea into the Gulf of Alaska as far north as southern Kodiak Island, none of these whales have been photographed further north and east in the Gulf of Alaska where regular photoidentification studies have been conducted since 1984 (P. Wade, pers. comm., NMML-AFSC, Seattle, WA, 10 December 2012; unpublished data; Matkin et al. 2010). The resident-type killer whales encountered in western Alaska possibly belong to groups that are distinct from the groups of resident killer whales in the Gulf of Alaska because no call syllables or call patterns (sequence of syllables) between groups were found to match (Matkin et al. 2007).

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 the NMFS National Marine Mammal Laboratory (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 were added to the Alaska resident stock. Internal matches within the NMML data set have been subtracted, resulting in a final count of western Alaska residents for 2001-2012 as 1,475 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 9,053 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 2,347 (Southeast Alaska + Prince William Sound + Western Alaska; 121 + 751 + 1,475) killer whales belonging to the Alaska Resident stock (Table 1).

Table 1. 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)**	**2005-2012 estimate (and source)**
Southeast Alaska			33 (Matkin et al. in prep.)
AF22			
AF5	49 (Dahlheim et al. 1997, Matkin et al. 1999)	61 (C. Matkin, NGOS, pers. comm.)	46 (Matkin et al. in prep.)
AG	27 (Dahlheim et al. 1997, Matkin et al. 1999)	33 (C. Matkin, NGOS, pers. comm.)	42 (Matkin et al. in prep.)
AZ	23+ (Dahlheim, AFSC-NMML, pers. comm.)	23+ (Dahlheim et al. 1997)	Not seen since prior to 1997
Total, Southeast Alaska	**99+**	**117+**	**121 (excluding AZ)**
Prince William Sound	**Matkin et al. 1999**	**Matkin et al. 2003 and C. Matkin, NGOS, pers. comm.**	**Matkin et al. in prep.**
AA1	---	8	8
AA30	---	---	24
AB	25	19	20
AB25	---	10	19
AD05	---	16	22
AD16	7	4	9
AE	16	19	17
AH01		9	9
AH20		12	12
AI	7	7	8
AJ	38	42	57
AK	12	13	19
AL	---	---	23
AN10	20	27	36
AN20	assume 9	33	30
AS2	assume 20	21	31
AS30		14	19
AW		24	27
AX01	21	20	33
AX27		24	26
AX32		15	18
AX40		14	16
AX48		20	23
AY	assume 11	18	21
Unassigned to pods	138 (C. Matkin, NGOS, pers. comm.)	112	220
Total, Prince William Sound/ Kenai Fjord/ Kodiak	**341**	**501**	**751**
Western Alaska	**Dahlheim et al. 1997 and NMML unpublished data[2]**	**2001/2003 NMML unpublished data[2]**	**2001-2012 NMML/NGOS unpublished catalog[2]**

Pod ID	1999/2000 estimate (and source)	2001/2004 estimate (and source)	2005-2012 estimate (and source)
Unassigned to pods (NMML)	68+	464	1,475 (H. Fernbach, NOAA-SWFSC, pers. comm., April 2013)
Total, Western Alaska	**68+**	**505**	**1,475**
Total, all areas	**507**	**1,123**	**2,347[1]**

[1]Although there is strong evidence (Matkin et al. 2003, 2010) 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 2001-2012 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 based on photo-identification studies conducted between 2005-2009 is 2,084 animals (Table 1). 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 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

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 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 2,084 is higher than the last population count of 1,123, 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 = 23.4 animals (2,347 × 0.02 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

In previous assessments, there were six different commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these commercial fisheries were changed to reflect target species; this new definition has resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were three that incurred serious injuries or mortalities of killer whales (any stock) between 2007 and 2011: the BSAI flatfish trawl, the BSAI rockfish trawl and the BSAI Greenland turbot longline.

Over the past few years, observers have collected tissue samples of many of the killer whales that were killed incidental to commercial fisheries. Genetics analyses of samples from seven killer whales collected between 1999-2004 have confirmed Alaska resident killers whales are occasionally killed incidentally in the BSAI flatfish trawl (n = 3) and the BSAI Pacific cod fisheries (n = 1). Also during this period, 3 transient killer whales from the GOA/AI/BS stock were killed incidental to the BSAI pollock trawl fishery (M. Dahlheim, pers. comm., National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105; 20 February 2013). Photo-identification of an entangled male killer whale confirmed the single whale killed incidental to the BSAI Greenland turbot longline was a resident whale (ID = AK218), an animal known since 1993 (Dahlheim 1997; M. Dahlheim, pers. comm., National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105; 20 February 2013). However, given the overlap in range of the transient and resident stocks, unless genetic samples can be collected from animals injured or killed by gear or the propeller, these events are assigned to both the transient and resident stock occurring in that area. Thus, the mean annual estimated level of serious injury and mortality of Alaska resident killer whales is 0.9/year (CV = 0.17) (Table 2).

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 2. Summary of incidental mortality of Alaska resident stock of killer whales due to commercial fisheries from 2007 to 2011 and calculation of the mean annual mortality rate (Breiwick 2013). 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 2010 2011	obs data	72 100 100 100 100	0 1 1* 0 0	0 1.0 1.0 0 0	0.4 (CV = 0.02)
BSAI rockfish trawl	2007 2008 2009 2010 2011	obs data	88 98 99 100 100	0 0 0 1 0	0 0 0 1.0 0	0.2 CV = N/A
BSAI Greenland turbot longline	2007 2008 2009 2010 2011	obs data	64 74 74 59 59	1 0 0 0 0	1.5 0 0 0 0	0.3 (CV = 0.570.61)

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Estimated total annual mortality						0.9 (CV = 0.17)

*One record originally reported as a killer whale "killed by prop" was rejected due to insufficient documentation to confirm the event (B. M. Allen, National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105; 20 February 2013).

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 0.9 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 who is 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.

Fisheries observers report that large groups of killer whales in the Bering Sea follow 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 killer whales in the trawl fisheries.

STATUS OF STOCK

The eastern North Pacific Alaska Resident stock of killer whales is not designated 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 (0.9) is less than 10% of the PBR (2.3) 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 (0.9 animals per year) is not known to exceed the PBR (23.4). 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 whales have been labeled as 'resident,' 'transient,' and 'offshore' type killer whales (Bigg et al. 1990, Ford et al. 2000; Dahlheim et al. 2008) 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 type whales identified in Prince William Sound have been observed in southeastern Alaska and lower Cook Inlet. (Matkin et al. 2010) Movements of transient type 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).

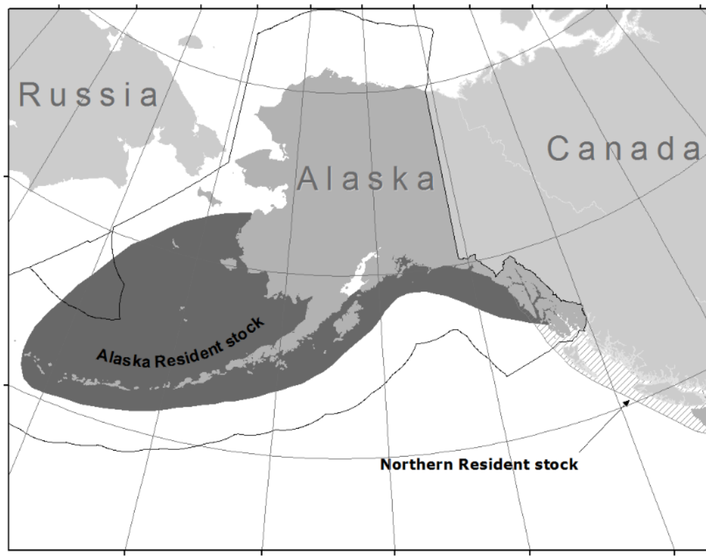

Figure 1. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy's Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg's killer whales (e.g., Ford 2011; Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Within the resident ecotype, association data were initially used to describe three separate communities in the North Pacific (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999). The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia. The Northern Resident population is found in summer primarily in central and northern British Columbia. 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 Washington State 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 southeastern Alaska 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 (Dahlheim et al. 1997; 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). In 1998, the photo catalog included 216 whales (Ford et al. 2000). The photo-identification catalogue was updated in 2011 summarizing individual identifications made between 1974 and 2010. At the conclusion of the 2010 field season, the population was composed of three clans representing a total of 261 whales (plus four missing and possibly dead). The population is twice the size it was in 1974, representing an average annual increase of 2.1% (Ellis et al. 2011).

Table 1. 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	Ellis et al. 2011
A1	15	16	22
A4	11	11	16
A5	12	13	13
B1	9	7	6*
C1	13	14	17*
D1	7	12	12
H1	8	9	5
I1	10	8	18*
I2	7	2	3
I18	19	16	24
G1	28	29	34*
G12	11	13	16
I11	18	22	26
I31	10	12	10
R1	23	29	38
W1	3	3	1
Total	**204**	**216**	**261**

Note: * indicates that one whale may be missing/ dead

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 261 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 261 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

From the mid 1970s to the mid 1990s, the northern resident killer whale population grew steadily at an annual rate of 2.6% (i.e., from 122 whales in 1974 to 218 in 1997). A decline was reported during the 1998 -2001 period at a rate of 7%. That period coincided with a significant reduction in Chinook salmon (Ford et al. 2010). Then after 2001, the growth was positive with the population increasing at an average rate of 3.1% per year (2001 – 2010). At the end of the 2010 field season, 261 whales were catalogued. This represents an average annual increase of 2.1% over the 36-year time series (Ellis et al. 2011).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Studies of northern '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). Analyses of photographic data collected from 1974 through 2010 indicated a population growth from 122 individuals to 261 whales. This represents an average annual increase of 2.1% over the 36-year period (Ellis et al. 2011). The period from 2001 to 2010 was a period of maximum growth for this population when it grew at an average rate of 3.1% per year. Therefore, the maximum net productivity rate (R_{MAX}) is estimated to be 3.1% (Ellis et al. 2011, Olesiuk et al. 2005).

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 = 1.96 animals ($261 \times 0.015 \times 0.5$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

All Canadian trawl and longline fisheries are monitored by observers or video; salmon net fisheries are not observed (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). The interaction of resident killer whales with 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. Interactions have been reported between northern resident killer whales in the British Columbia halibut longline and salmon troll fisheries (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). Since 1990, there have been no reported fishery-related strandings or bycatch 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).

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 2010). 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). In Canada, northern resident killer whales have been reported to depredate fish from both commercial salmon trollers and recreational sportfishers, as well as halibut longliners. Most reports occur in the northern half of the coast, especially Dixon Entrance, and early in the season (April to June), although some are scattered throughout the summer (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 3 December 2012).

STATUS OF STOCK

The Northern Resident 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 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). Monitoring of fisheries in BC over the past decade has been quite extensive and likely at the same level as in U.S. waters. No incidental killer whale mortalities from fishery interactions have been reported or observed (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013).

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 (0.20) 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 (0) is not known to exceed the PBR (2.0). 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*): Eastern North Pacific 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, 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 whales have been labeled as ‘resident,’ ‘transient,’ and ‘offshore’ type killer whales (Bigg et al. 1990, Ford et al. 2000; Dahlheim et al. 2008) 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, 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).

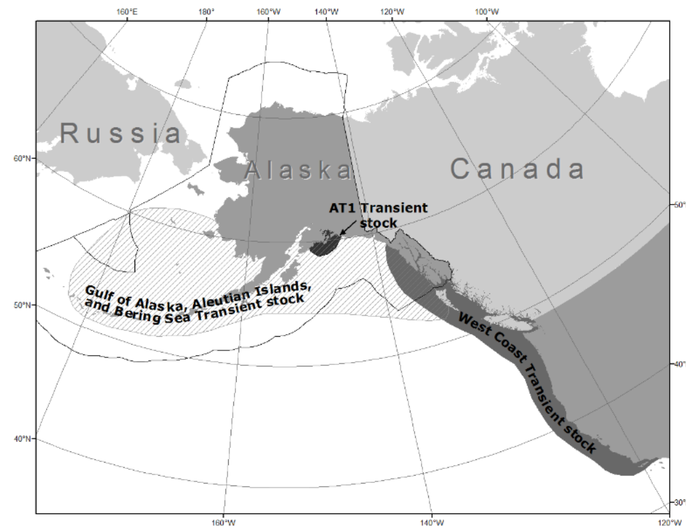

Figure 1. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy’s Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg’s killer whales (e.g., Ford 2011; Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

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 populations of transients which were never found in association with one another, the so-called ‘Gulf of Alaska’ transients and ‘AT1’ transients. Gulf of Alaska’ transients are documented 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. Recently, on one occasion, members of the Gulf of Alaska transient population were seen in association with the transient killer whales that range from California to southeastern Alaska, the west coast transients, which are identified by a unique mtDNA haplotype (Matkin et al. 2012). Photographs have identified 14 out of 217 whales considered "outer coast" transients in British Columbia that were also photographed in Alaskan waters and considered Gulf of Alaska transients (Matkin et al. 2012, Ford et al. 2013). Transients that within the 'Gulf of Alaska' population have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 populations. Members of the AT1 population share a single mtDNA haplotype. Transient killer whales from the 'west coast' stock have been found to share a single mtDNA haplotype that is not found in the other stocks. Additionally, all three populations have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found between these stocks by Saulitis (1993) and Saulitis et al. (2005). 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.

Biopsy samples from the eastern Aleutians and south side of the end of the Alaska Peninsula have produced the same haplotypes as killer whales in the northern Gulf of Alaska; however, nuclear DNA analysis strongly suggest they belong to a separate population (Parsons et al. in prep.). Samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting additional population structure in western Alaska. At this time 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 observed in the northern Bering Sea and Beaufort Sea that have the physical characteristics of transient type whales, 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, 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 Washington State 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 southeastern Alaska 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.

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. Since that time an additional 22 whales have been added to the NGOS catalogue (Matkin et al. in prep.). Therefore, a total of 136 transients (104 + 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 (NGOS/NMML 2012) now contains 451 individually identifiable whales (not counting unmarked calves and 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 (451) with the Gulf of Alaska count (136), a total count of 587 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. 2010). 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 longer time period (through 2012). 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 587 individual whales have been identified in the photograph catalogues from the Gulf of Alaska (Matkin et al. in prep.) and from western Alaska (NMML/NGOS 2012). 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 cannot be presumed dead if not resighted because long periods of time between sightings are common for some transient animals. The catalogue for the western area used data only from 2001-2012, 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 and the entire range has not been surveyed, 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 587 animals based on the count of individuals using photo-identification.

Current Population Trend

Recently Matkin et al. (2012) analyzed photographic data collected since 1984 and determined Gulf of Alaska transients in the northern Gulf of Alaska have had stable numbers. At present, reliable data on trends in population abundance for the Aleutian Islands and Bering Sea portion of this 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 = 5.87 animals (587 × 0.02 × 0.5). Although only a few individuals have been observed in Canadian waters, 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

In previous assessments, there were six different federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these fisheries were changed to reflect target species; these new definitions have resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were three which incurred serious injury and mortality of killer whales (any stock) between 2007 and 2011: the BSAI flatfish trawl, BSAI rockfish trawl, and the BSAI Greenland turbot longline.

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 seven killer whales collected between 1999-2004 have confirmed Alaska resident killers whales are occasionally killed incidentally in the BSAI flatfish trawl (n = 3) and the BSAI Pacific cod fisheries (n = 1); during this period, 3 transient killer whales from the GOA/AI/BS stock were killed incidental to the BSAI pollock trawl fishery (M. Dahlheim, pers. comm., National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98105; 20 February 2013). Photo-identification of an entangled male killer whale confirmed the single whale killed incidental to the BSAI Greenland turbot longline was a resident whale (ID = AK218), an animal known since 1993 (Dahlheim 1997; M. Dahlheim, pers. comm., National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105; 20 February 2013). However, given the overlap in range of the transient and resident stocks, unless genetic samples can be collected from animals injured or killed by gear or the propeller, these events are assigned to both the transient and resident stock occurring in that area. Thus, the mean annual estimated level of serious injury and mortality of Alaska resident killer whales for 2007-2011 is 0.6/year (CV = 0.02) (Table 1).

Table 1. 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 (Breiwick 2013). Mean annual takes are based on 2007-2011 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 2010 2011	obs data	72 100 100 100 100	0 1 1* 0 0	0 1.0 1.0* 0 0	0.4 (CV = 0.02)
BSAI rockfish trawl	2007 2008 2009 2010 2011	obs data	88 98 99 100 100	0 0 0 1 0	0 0 0 1.0 0	0.2 CV = N/A
Estimated total annual mortality						0.6 (CV = 0.02)

*One record originally reported as a killer whale "killed by prop" was rejected due to insufficient documentation to confirm the event (B. M. Allen, National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98105; 20 February 2013).

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 primarily been observed feeding on marine mammals.

STATUS OF STOCK

The Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0.6) is equal to 10% of the PBR (0.6) 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 (0.6 animals per year) is less than the PBR (5.9). Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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KILLER WHALE (*Orcinus orca*): AT1 Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, Forney and Wade 2006). Killer whales are found throughout the North Pacific. Along the west coast of North America, seasonal and year-round occurrence of killer whales has been noted 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). Killer whales from these areas have been labeled as "resident," "transient," and "offshore" type killer whales (Bigg et al. 1990, Ford et al. 2000, Dahlheim et al. 2008) 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).

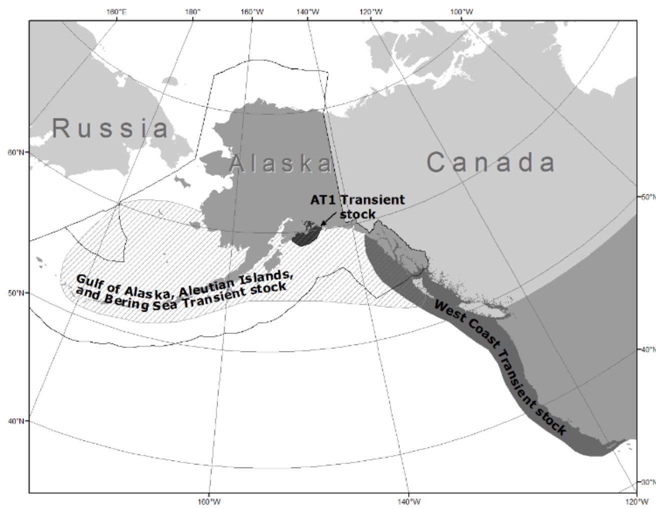

Figure 1. Approximate distribution of transient killer whales in the eastern North Pacific (shaded areas). The distribution of resident and transient killer whale stocks in the eastern North Pacific largely overlap (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy's Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg's killer whales (e.g., Ford 2011, Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

The first studies of transient killer whales in Alaska 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 populations of transients which were never found in association with one another, the so-called "Gulf of Alaska" transients and "AT1" transients. In the past, neither of these populations were known to associate with the population of transient killer whales that ranged from California to Southeast Alaska, which are described as the West Coast Transient stock. Gulf of Alaska transients are documented throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients have been seen only in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with Gulf of Alaska transients. In addition, recent data have identified 14 out of 217 transients on the outer coast of

Southeast Alaska and British Columbia as Gulf of Alaska transients and in one encounter they were observed mixing with West Coast Transients (Matkin et al. 2012, Ford et al. 2013). Transients within the Gulf of Alaska population have been found to have two mtDNA haplotypes, neither of which is found in the West Coast or AT1 populations. Members of the AT1 population share a single mtDNA haplotype. Transient killer whales from the West Coast population have been found to share a single mtDNA haplotype that is not found in the other populations. Additionally, all three populations 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 populations are considered discrete from the West Coast Transients.

Biopsy samples from the eastern Aleutians and the south side of the west end of the Alaska Peninsula have produced the same haplotypes as killer whales in the northern Gulf of Alaska, however, nuclear DNA analysis strongly suggests they belong to a separate population (Parsons et al. 2013). The geographic distribution of mtDNA haplotypes revealed samples from the central Aleutian Islands and Bering Sea with haplotypes not found in Gulf of Alaska transients, suggesting additional population structure in western Alaska. At this time, 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 observed in the northern Bering Sea and Beaufort Sea have physical characteristics of transient-type whales, but little is known about these whales. AT1 haplotype whales are also present west of the Aleutian Islands and into the Bering Sea, however, nuclear DNA analysis indicates these animals are not part of the AT1 transient population in the Gulf of Alaska (L. Barrett-Lennard, Vancouver Aquarium, pers. comm., 21 March 2014).

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Ford and Ellis 1999, Saulitis et al. 2005) 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, 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 Southeast Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from Washington State through part of Southeast 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 Southeast Alaska 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 Southeast 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 (von Ziegesar et al. 1986). 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 or more 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, 2012), are genetically and acoustically distinct from other transient killer whales in the North Pacific (Barrett-Lennard 2000, Saulitis et al. 2005), and appear to have a more limited range than other transients. Their approximately 200-mile range includes only Prince William Sound and Kenai Fjords and adjacent offshore waters (Matkin et al. 1999, 2012).

POPULATION SIZE

Using photographic identification methods, all 22 individuals in the AT1 Transient population were 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, 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 two have been missing since 1992 (last seen in 1990 and 1991). Three of the missing AT1s (AT5, AT7, and AT8) were seen near the leaking *Exxon Valdez* shortly after the spill (Matkin et al. 1993, 1994, 2008). Two whales were found dead, stranded in 1989-1990, both genetically assigned to the AT1 population and one visually recognized as AT19, one of the missing nine (Matkin et al. 1994, 2008; Heise et al. 2003). The second unidentified whale was most likely one of the other missing AT1 whales. Additional mortalities of four older males include whales AT1 found stranded in 2000, AT13 and AT17 missing in 2002 (one of which was thought to be the carcass from the AT1 population that was 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 resighted and all 15 missing whales are presumed dead (Matkin et al. 2008). In 2014, AT2, AT3, AT4, and AT6 were observed by researchers from the North Gulf Oceanic Society; AT9, AT10, and AT18 were not seen in 2014. Although the absence of sightings of these three whales is of some concern, they are a matriline that is typically closely associated and may not have been encountered during research cruises. Their absence may be linked to their time spent around glaciers, which are not routinely surveyed. At this time, they are not considered to be dead. Therefore, the population estimate as of the summer of 2014 remains at seven whales (C. Matkin, North Gulf Oceanic Society, pers. comm., 21 March 2014). There has been no recruitment in this population since 1984 (Matkin et al. 2012).

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, four of those whales have not been seen for four or more consecutive years, so the minimum population estimate is seven 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 is the total population size.

Current Population Trend

The population counts have declined from a level of 22 whales in 1989 to 7 whales in 2014, a decline of 68%. Most of the mortalities apparently occurred in 1989-1990.

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 2.9% and 2.5% 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 MMPA 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

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 injury or mortality of AT1 killer whales. Several subsistence fisheries (salmon, halibut, non-salmon finfish, and shellfish) also occur within this area, and no reports of incidental serious injury or mortality has been reported for these fisheries.

Alaska Native Subsistence/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 or serious injury 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 has been no known mortality or serious injury of AT1 killer whales due to ship strikes. Most of the mortality occurred from 1989 to 1991 following the *Exxon Valdez* oil spill.

STATUS OF STOCK

The AT1 Transient stock of killer whales is below its Optimum Sustainable Population and designated as "depleted" under the MMPA; therefore, it is classified as a strategic stock. The AT1 Transient stock is not listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual U.S. commercial fishery-related mortality and serious injury 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 only 7 individuals remain alive. The AT1 group has been reduced to 32% (7/22) of its 1984 level. Since no births have occurred in the past 30 years, it is unlikely that this stock will recover.

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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, 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 whales have been labeled as 'resident,' 'transient,' and 'offshore' type killer whales (Bigg et al. 1990, Ford et al. 2000; Dahlheim et al. 2008) 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).

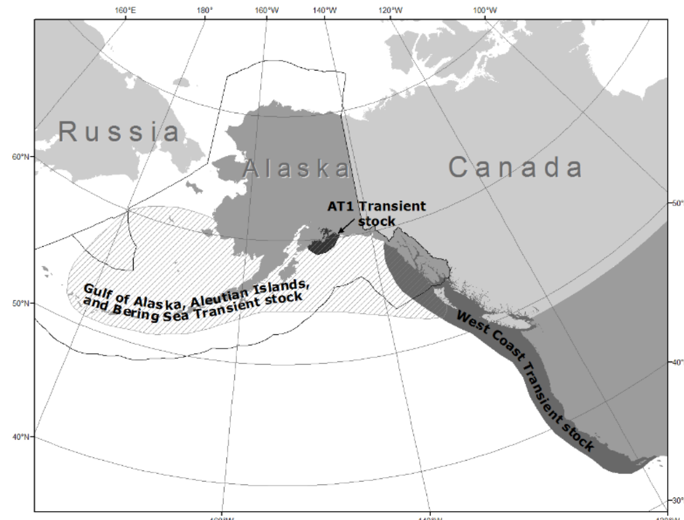

Figure 1. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy's Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg's killer whales (e.g., Ford 2011, Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

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 Washington State 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 southeastern Alaska 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.

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 populations of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Gulf of Alaska' transients are documented 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. Recently members of the Gulf of Alaska transient population have been seen in association with the transient killer whales that range from California to southeastern Alaska, the west coast transients, which are identified by a unique mtDNA haplotype. Recent data have identified 14 out of 217 whales considered "outer coast" transients in British Columbia as photographed in Alaskan waters and considered Gulf of Alaska transients (Ford et al. 2013). Transients within the 'Gulf of Alaska' population have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 populations. Members of the AT1 population share a single mtDNA haplotype. Transient killer whales from the 'west coast' stock have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three populations have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) and 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.

Biopsy samples from the eastern Aleutians and south side of the end of the Alaska Peninsula have produced the same haplotypes as killer whales in the northern Gulf of Alaska, however nuclear DNA analysis strongly suggest they belong to a separate population (Parsons et al. 2013). Samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting additional population structure in western Alaska. At this time, 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 observed in the northern Bering Sea and Beaufort Sea that have the physical characteristics of transient type whales, 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, Parsons et al. 2013) 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.

Most of the transient whales photographed in the inland waters of Southeast Alaska share the west coast transient haplotype and have been seen in association with British Columbia/Washington State transients. Transients most often seen off California have also share the West Coast Transient (WCT) haplotype and have been observed in association with transients in Washington and British Columbia. The West Coast Transient Stock is therefore considered to include transient killer whales from California through 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). Canadian researchers have now identified 46 individual whales in British Columbia that are known from California (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). They also noted that the Gulf of Alaska transients are seen occasionally within the range of WCTs (in southeastern Alaska and off British Columbia) but have only been observed to travel in association with WCTs on one occasion (DFO 2007, Matkin et al. 2012). 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. Over the time series from 1975 to 2012, 521 individual transient killer whales have been identified. Of these, 217 are considered part of the poorly known "outer coast" subpopulation and 304 belong to the well-known "inner coast" population. However of the 304, the number of whales currently alive is not certain (see Ford et al. 2013). A recent mark-recapture estimate that does not include the "outer coast" subpopulation or whales from California for the west coast transient population 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 the inside waters of southeastern Alaska, British Columbia, and northern Washington. Given that the California transient numbers have not been updated since the publication of the catalogue in 1997 (Black et al. 1997), the total number of transient killer whales reported above should be considered as a minimum count for the west coast transient stock.

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. However, the number of 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 connection of the outer coast whales with the west coast transient population of inshore waters is not well established, and the photographic catalogue from California has not been updated in 15 years. Estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) that include the "outer coast" whales are not currently available. Thus, the minimum population estimate (N_{MIN}) for the West Coast Transient stock of killer whales is derived from the recent mark-recapture analysis for West Coast transient population whales from the inside waters of Alaska and British Columbia of 243 whales (95% probability interval = 180-339) in 2006 (DFO 2009), 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 of the inshore west coast transient population indicate that this segment 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 west coast transient 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). Given population estimates are based on photo identification of individuals and considered minimum estimates, no reliable estimate of trend is available.

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) and an observed growth rate of 3.1% was observed in northern resident killer whales and used in calculations of R_{MAX} for that stock. However, until additional data become available for this stock of transient type killer whales, 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 = 2.4 animals (243 × 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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.

All Canadian trawl and longline fisheries are monitored by observers or video; salmon net fisheries are not observed (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. However, transient killer whales typically are not involved in these interactions. Resident killer whales are well documented to interact with the longline fishery. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Canada has a Marine Mammal Response Network to track human interaction incidents such as entanglements (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. In 1994, one killer whale was reported to have contacted a salmon gillnet, but it did not entangle (Guenther et al. 1995).

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. Killer whales interacting with trawl vessels are occasionally struck by the propeller; there were 4 incidents of mortality and serious injury in the Bering Sea/Aleutian Islands flatfish trawl and Bering Sea/ Aleutian Islands rockfish trawl fisheries between 2007-2011. Stock identification for these occurrences is unknown; however, this area is outside of the known range for this stock. There have been no reported mortalities of killer whales from this stock due to vessel collisions.

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. 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 (0.2) 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 (2.4). 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).

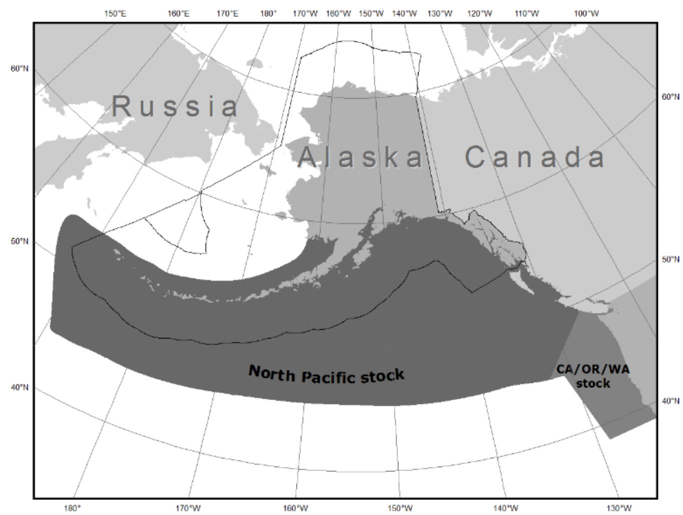

Figure 1. Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (dark shaded areas).

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 dolphins 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 and 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; 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. 1). The California/Oregon/Washington stock is reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

The most complete population abundance estimate for Pacific white-sided dolphins was calculated from line-transect analyses applied to the 1987-1990 central North Pacific marine mammal sighting 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 (95% CI: 868-265,000) 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-AFSC-NMML, pers. comm.).

Minimum Population Estimate

Historically, the minimum population estimate (N_{MIN}) for this stock was 26,880, based on the sum of abundance estimates for four separate 5° × 5° blocks north of 45°N (1,970 + 6,427 + 6,101 + 12,382 = 26,880) from surveys conducted during 1987-1990, reported in Buckland et al. (1993). This was 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, was 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 and 1990. However, because the abundance estimate is more than 8 years old, the current 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 dolphins.

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 Pacific white-sided dolphins. 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). The estimate of abundance for Pacific white-sided dolphins is 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Between 1978 and 1991, mortality and serious injury of thousands of Pacific white-sided dolphins occurred annually incidental to high-seas fisheries for salmon and squid. However, these fisheries were closed in 1991 and no other large-scale fisheries have operated in the central North Pacific since 1991.

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA 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 mortality or serious injury of marine mammal stocks in Alaska. No mortality or serious injury of Pacific white-sided dolphins incidental to observed U.S. commercial fisheries was reported between 2009 and 2013 (Breiwick 2013; NMML, unpubl. data).

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 and serious injury rate unreliable. However, because the stock size is large, it is unlikely that unreported mortality and serious injury from those fisheries would be significant.

Alaska Native Subsistence/Harvest Information

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

Other Mortality

From 2009 to 2013, no human-caused mortality or serious injury of Pacific white-sided dolphins was reported to the NMFS Alaska Region stranding database (Helker et al. 2015).

STATUS OF STOCK

Pacific white-sided dolphins are not designated as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock. Because the PBR for Pacific white-sided dolphins is undetermined, the level of human-caused mortality and serious injury relative to PBR is unknown and the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

While the majority of Pacific white-sided dolphins are found throughout the North Pacific, there are also significant numbers found in shelf break and deeper nearshore areas. Thus, they are subject to a variety of habitat impacts. Of particular concern are nearshore areas, bays, channels, and inlets where some Pacific white-sided dolphins are vulnerable to physical modifications of nearshore habitats, resulting from urban and industrial development (including waste management and nonpoint source runoff), and noise (Linnenschmidt et al. 2013).

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Revised 12/30/2015

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

NOTE – December 2015: In areas outside of Alaska, studies of harbor porpoise distribution have indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, it is likely that several regional and sub-regional populations exist. 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, harbor porpoise range from Point Barrow and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), typically occurring 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, Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

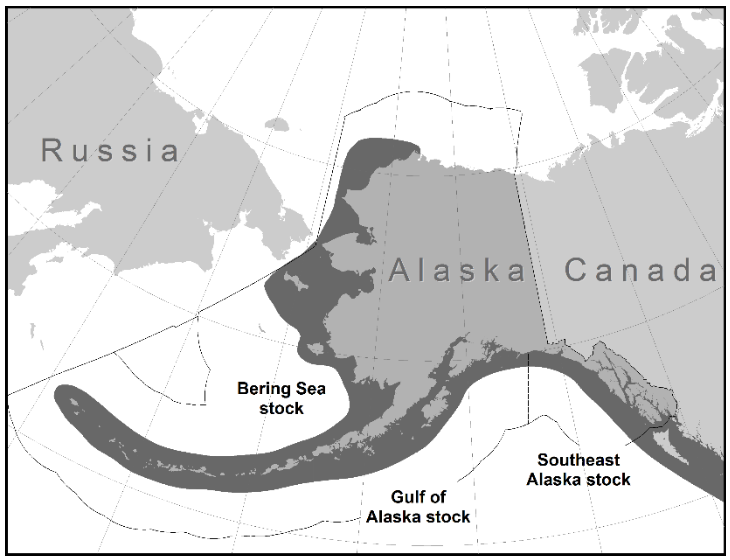

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

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 eight 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 the 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 the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

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 Zarembo/Wrangell Islands may represent different subpopulations (Dahlheim et al. 2015) based on analogy with other west coast harbor porpoise populations, differences in trends in abundance of the two concentrations, and a hiatus in distribution between the northern and southern harbor porpoise concentrations. NMFS will consider whether these concentrations should be considered "prospective stocks" in a future Stock Assessment Report (SAR). Incidental takes from commercial fisheries within a small region (e.g., Wrangell and Zarembo Islands area) are of concern because they could impact undefined localized stocks of harbor porpoise which could go easily undetected unless stock structure is identified. The Alaska Scientific Review Group concurred that available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska instead of only one; however, 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 were recommended, recognizing that the boundaries of these three stocks were identified primarily based upon geography or perceived areas of porpoise low density: 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. 1). To date, there have been no analyses to assess the validity of these stock designations.

POPULATION SIZE

Information on harbor porpoise abundance and relative abundance has been collected by the Alaska Fisheries Science Center's National Marine Mammal Laboratory (NMML) using both aerial and shipboard surveys. Aerial surveys of this stock were conducted in June and July 1997 and resulted in an observed abundance estimate of 3,766 (CV = 0.162) porpoise (Hobbs and Waite 2010); the surveys included a subset of smaller bays and inlets. Correction factors for observer perception bias and porpoise availability at the surface were used to develop an estimated corrected abundance of 11,146 (3,766 × 2.96; CV = 0.242) harbor porpoise in the coastal and inside waters of Southeast Alaska (Hobbs and Waite 2010).

In 1991, researchers initiated harbor porpoise studies aboard the NOAA ship *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. Surveys were carried out each year in the 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 in 2010-2012. Previous studies reported no evidence of seasonality for harbor porpoise occupying the inland waters of Southeast Alaska. Thus, we opted to analyze data collected during the summer season only, given the broader spatial coverage and the greater number of surveys completed for this season (i.e., representing a total of eight line-transect vessel surveys). Methods applied to the 2006-2012 surveys were comparable to those employed during the early 1990s; however, because these surveys only covered inland waters and not the entire range of this stock, they are not used to compute a stock-specific estimate of abundance. Each year, greater densities of harbor porpoise were observed in the Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and adjacent waters of Sumner Strait. Abundance estimates for inland waters of Southeast Alaska were found to vary across survey periods spanning the 22-year study (1991-2012). Abundance (N = 1,076; 95% CI = 910-1,272) in 1991-1993 was higher than the estimate obtained for 2006-2007 (N = 604; 95% CI = 468-780) but comparable to the estimate for 2010-2012 (N = 975; 95% CI = 857-1,109; Dahlheim et al. 2015). These estimates assume g(0) = 1 (the probability of detection directly on the track line) and, therefore, may be biased low to an unknown degree. A range of possible g(0) values for harbor porpoise vessel surveys in other regions is 0.5-0.8 (Barlow et al. 1988, Palka 1995).

Minimum Population Estimate

For the Southeast Alaska stock of harbor porpoise, the minimum population estimate (N_{MIN}) for the 1997 aerial surveys is 1,996 calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. However, because the survey data are now more than 8 years old, the N_{MIN} is considered unknown and PBR cannot be determined. The 2010-2012 abundance estimate for harbor porpoise occupying the inland waters of Southeast Alaska of 975 (95% CI = 857-1,109) represents a small portion of the total number of animals in the stock. Therefore, this number would not be an accurate estimate of N_{MIN} for the entire stock of Southeast Alaska harbor porpoise. Although harbor porpoise in the Wrangell and Zarembo Islands area have not been determined to be a subpopulation or stock, a PBR calculation for this area of the inland waters of Southeast Alaska may provide a frame of reference for the harbor porpoise takes in the portion of the Southeast Alaska salmon drift gillnet fishery, monitored in 2012-2013, which partially overlaps this area. We used the pooled 2010-2012 abundance estimate of 526 (CV = 0.15; assumes g(0) = 1) for the Wrangell and Zarembo Islands area (Dahlheim et al. 2015) to calculate an N_{MIN} of 463 for this area of the inland waters of Southeast Alaska. The porpoise survey area for which the abundance estimate and N_{MIN} were calculated (Area 5: Dahlheim et al. 2015) partially overlaps ADF&G Districts 6 and 8, which are two of the three districts (6, 7, and 8) where the fishery was observed (Manly 2015). Dahlheim et al. (2015) also provide information sufficient to calculate an N_{MIN} for the concentrations of harbor porpoise in the northern and southern regions of the inland waters of Southeast Alaska; this will be provided in a future draft SAR.

Current Population Trend

The abundance of harbor porpoise for the Southeast Alaska stock was estimated in 1993 and 1997. In 1993, abundance estimates were determined from a coastal aerial survey from Prince William Sound to Dixon Entrance and a vessel survey in the inside waters of 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 abundance estimate was determined with an aerial survey for both the coastal region from Prince William Sound to Dixon Entrance and the inside waters of Southeast Alaska (Hobbs and Waite 2010). The 1997 estimate of 11,146 is double the 1993 estimate; however, these estimates are not directly comparable because of differences in survey methods. The total area for the 1997 survey was greater than in 1993 and included a correction of perception bias.

An analysis of the line-transect vessel survey data collected throughout the inland waters of Southeast Alaska between 1991 and 2010 suggested high probabilities of a population decline ranging from 2 to 4% per year for the whole study area (Zerbini et al. 2011), thus highlighting a potentially important conservation issue. However, when data from 2011 and 2012 were added to this analysis, the population decline was no longer significant (Dahlheim et al. 2015). It is still unclear why the population estimate fluctuation for harbor porpoise in Southeast Alaska occurred. When examined on a more regional scale, abundance was relatively constant in Glacier Bay throughout the survey period. In contrast, declines were documented for the Wrangell and Zarembo Islands area; an area where net fisheries occur.

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 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). 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). A putative PBR level calculation for the Wrangell and Zarembo Islands area of the inland waters of Southeast Alaska may provide a frame of reference for the observed takes of harbor porpoise in this area of the Southeast Alaska salmon drift gillnet fishery in 2012-2013. However, some of the observed takes in this fishery were outside of the area for which this putative PBR level is calculated. This PBR calculation, based on the pooled 2010-2012 abundance estimate of 526 (CV = 0.15) and its corresponding N_{MIN} of 463, for the Wrangell and Zarembo Islands area of the inland waters of Southeast Alaska, is 4.6 harbor porpoise.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 MMPA List of Fisheries resulted in separating the Gulf of Alaska (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 (GOA Pacific cod longline, Pacific halibut longline, rockfish longline, and sablefish longline) were monitored for incidental mortality by fishery observers from 2009 to 2013, although observer coverage has been very low in the offshore waters of Southeast Alaska (Appendix 6; Breiwick 2013; NMML, unpubl. data). No mortality or serious injury has been observed from this stock of harbor porpoise incidental to commercial groundfish fisheries. There is no consistent observer coverage for fisheries operating within the inside waters of Southeast Alaska. A reliable estimate of the mortality and serious injury rate incidental to commercial fisheries is currently unavailable because of the limited observer placements in Southeast Alaska fisheries. Therefore, it is unknown whether the mortality and serious injury rate is insignificant.

In 2007 and 2008, the Alaska Marine Mammal Observer Program (AMMOP) placed observers in four regions where the state-managed Yakutat salmon set gillnet fishery operates (Manly 2009). These regions included the Alsek River area, the Situk area, the Yakutat Bay area, and the Kaliakh River and Tsiu River areas. Based on observed mortality and serious injury during these 2 years, the estimated mean annual mortality and serious injury rate in the Yakutat salmon set gillnet fishery was 22 harbor porpoise (Table 1).

In 2012 and 2013, the AMMOP placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery in ADF&G Management Districts 6, 7, and 8 to assess mortality and serious injury of marine mammals (Manly 2015). These Management Districts cover areas of Frederick Sound, Sumner Strait, Clarence Strait, and Anita Bay which include, but are not limited to, areas around and adjacent to Petersburg and Wrangell and Zarembo Islands. In 2013, four harbor porpoise were entangled and released: two were determined to be seriously injured and two were determined to be not seriously injured. Based on the two observed serious injuries, 23 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 12 harbor porpoise in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery.

Table 1. Summary of incidental mortality and serious injury of harbor porpoise from the Southeast Alaska stock due to U.S. commercial fisheries in 2009-2013 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Manly 2009, 2015). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska SARs.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Yakutat salmon set gillnet	2007 2008	obs data	5.3 7.6	1 3	16.1 27.5	22 (CV = 0.54)
SE Alaska salmon drift gillnet (Districts 6, 7, and 8)	2012 2013	obs data	6.4 6.6	0 2	0 23	12 (CV = 1.0)
Minimum total estimated annual mortality						34 (CV = 0.77)

Two harbor porpoise mortalities, due to entanglement in Yakutat salmon set gillnets, were reported to the NMFS Alaska Region, one each in 2009 and 2010; however, the AMMOP mean estimated annual mortality for the fishery accounts for these mortalities (Table 1).

A harbor porpoise mortality, due to entanglement in a subsistence king salmon set gillnet, was reported to the NMFS Alaska Region in 2009, resulting in an estimated minimum mean annual mortality and serious injury rate of 0.2 harbor porpoise in this fishery from 2009 to 2013 (Table 2).

Table 2. Summary of incidental mortality and serious injury of the Southeast Alaska stock of harbor porpoise, by year and type, reported to the NMFS Alaska Region, marine mammal stranding database, in 2009-2013 (Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Caught in Yakutat subsistence king salmon set gillnet	1	0	0	0	0	0.2

Alaska Native Subsistence/Harvest Information

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

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is undetermined, the annual level of U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The total estimated annual level of human-caused mortality and serious injury based on observer data (34) and stranding data (0.2) is 34 harbor porpoise from this stock. Because the abundance estimates are more than 8 years old (with the exception of the 2010-2012 abundance estimates provided for the inland waters of Southeast Alaska and for the Wrangell and Zarembo Islands area) and the frequency of incidental mortality and serious injury in U.S. commercial fisheries throughout Southeast Alaska 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 its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

Harbor porpoise are mostly found in waters less than 100 m deep and they often concentrate in nearshore areas and inland waters, including bays, tidal areas, and river mouths (Dahlheim et al. 2000, 2009; Hobbs and Waite 2010). 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, dredging, and noise (Linnenschmidt et al. 2013).

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Revised 12/30/2015

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

NOTE – December 2015: In areas outside of Alaska, studies of harbor porpoise distribution have indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, it is likely that several regional and sub-regional populations exist. 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 and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), typically occurring 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, Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

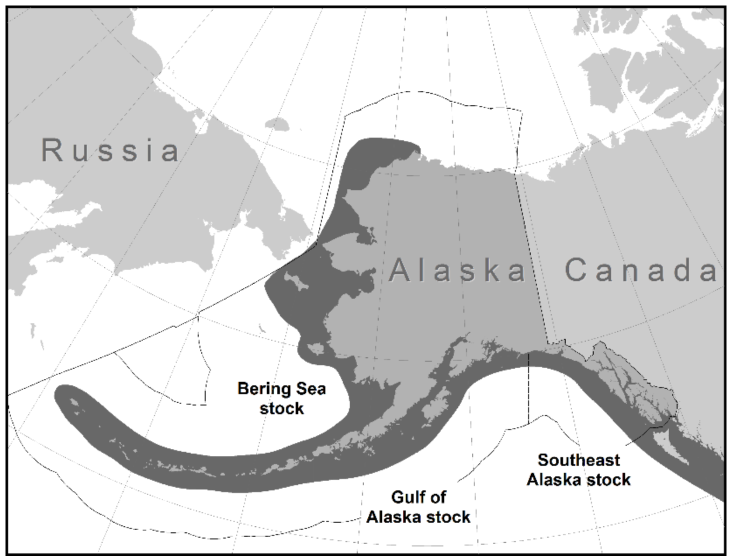

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

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 eight 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 the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

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 available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska instead of only one; however, 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 were identified, recognizing that the boundaries of these three stocks were inferred primarily based upon geography or perceived areas of low porpoise density: 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. 1). To date, there have been no analyses to assess the validity of these stock designations.

POPULATION SIZE

In June and July of 1998, an aerial survey covered 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 abundance estimate for the Gulf of Alaska harbor porpoise stock of 10,489 (CV = 0.115) animals (Hobbs and Waite 2010), 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 the 1998 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 1991-1993 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 selected bays, channels, and inlets in Prince William Sound, the outer Kenai Peninsula, the south side of the Alaska Peninsula, and the 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 potential biological removal (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 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 more than 8 years old, N_{MIN} is considered unknown.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Gulf of Alaska stock of harbor porpoise since survey methods and results are not comparable.

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 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, 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

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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: the Gulf of Alaska groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the MMPA List of Fisheries resulted in separating these 3 Gulf of Alaska (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 or serious injury 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 1 mortality in 1990 and 3 in 1991, which extrapolated to 8 (95% CI: 1-23) and 32 (95% CI: 3-103) for the entire fishery, resulting in a mean annual mortality and serious injury rate of 20 (CV = 0.60) animals when averaged over 1990 and 1991 (Wynne et al. 1991, 1992) (Table 1). The Prince William Sound salmon drift gillnet fishery has not been observed since 1991 and 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. One harbor porpoise mortality was observed in 2000 in the Cook Inlet salmon drift gillnet fishery (Manly 2006). This single mortality extrapolates to an estimated mortality and serious injury rate of 31 for that year and an average of 16 per year when averaged over the 2 years of observer data (Table 1).

In 2002 and 2005, observers were placed on state-managed Kodiak Island set gillnet vessels. Two harbor porpoise mortalities were observed in this fishery in both 2002 and 2005 (Manly 2007), which extrapolates to an estimated mean annual mortality and serious injury rate of 36 harbor porpoise (Table 1).

Table 1. Summary of incidental mortality and serious injury of the Gulf of Alaska stock of harbor porpoise due to state-managed fisheries from 1990 through 2005 and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Manly 2006, 2007). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	**Years**	**Data type**	**Percent observer coverage**	**Observed mortality**	**Estimated mortality**	**Mean estimated 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	1.6 3.6	0 1	0 31	16 (CV = 1.0)
Cook Inlet salmon set gillnet	1999 2000	obs data	0.16-1.1 2.7	0 0	0 0	0
Kodiak Island set gillnet	2002 2005	obs data	6.0 4.9	2 2	32 39	36 (CV = 0.68)
Minimum total estimated annual mortality						72 (CV = 0.44)

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are another source of mortality data. Between 2009 and 2013, one Gulf of Alaska harbor porpoise mortality, due to entanglement in a commercial salmon drift gillnet near Kenai, Alaska, in 2013, was reported to the NMFS Alaska Region stranding database (Helker et al. 2015). However, this event is accounted for in the extrapolated estimate (derived from Alaska Marine Mammal Observer Program (AMMOP) observer data) of annual mortality and serious injury occurring in the commercial Cook Inlet salmon drift gillnet fishery (Table 1).

A complete estimate of the total mortality and serious injury incidental to commercial fisheries is unavailable because of the absence of observer placements in all salmon and herring fisheries. However, the minimum estimated annual mortality and serious injury rate incidental to U.S. commercial fisheries is 72 harbor porpoise (Table 1).

Alaska Native Subsistence/Harvest Information

Porpoise in the Gulf of Alaska were hunted by prehistoric societies in Kodiak, Cook Inlet, and Prince William Sound (Shelden et al. 2014). Subsistence hunters have not been reported to harvest from this stock of harbor porpoise since the early 1900s (Shelden et al. 2014).

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is undetermined, the annual level of U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The estimated annual level of human-caused mortality and serious injury is 72 harbor porpoise. Because the most recent abundance estimate is more than 8 years old and information on incidental harbor porpoise mortality and serious injury in commercial fisheries is not complete, the Gulf of Alaska stock of harbor porpoise is classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

Harbor porpoise are mostly found in waters less than 100 m in depth and they often concentrate in nearshore areas, bays, tidal areas, and river mouths (Dahlheim et al. 2000, Hobbs and Waite 2010). 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, dredging, and noise (Linnenschmidt et al. 2013).

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

NOTE – December 2015: In areas outside of Alaska, studies of harbor porpoise distribution have indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, it is likely that several regional and sub-regional populations exist. 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 and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), typically occurring 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, Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

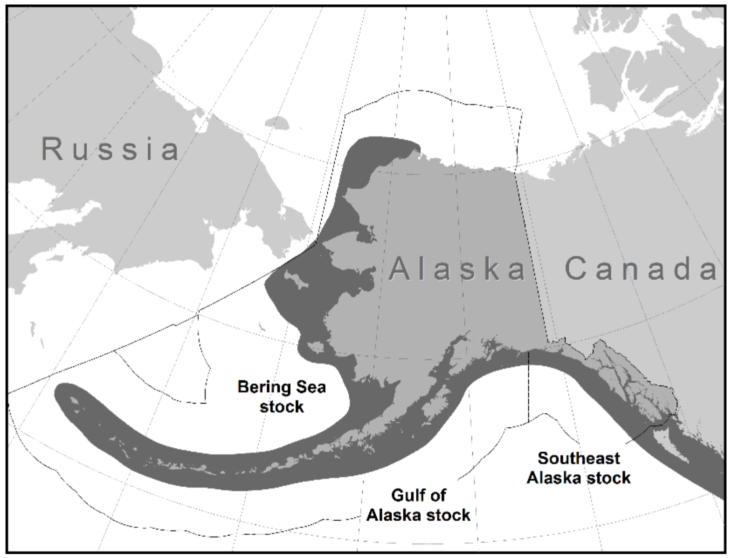

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

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 eight 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 the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

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 available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska instead of only one; however, 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 were identified, recognizing that the boundaries of these three stocks were inferred primarily based upon geography or perceived areas of low porpoise density: 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. 1). To date, there have been no analyses to assess the validity of these stock designations.

Harbor porpoise 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 and November from 2006 to 2010 (Funk et al. 2010, 2011; Aerts et al. 2011; Reiser et al. 2011). Harbor porpoise were the third most frequently sighted cetacean species in the Chukchi Sea, after gray and bowhead whales, with most sightings occurring during the September-October monitoring period (Funk et al. 2011, Reiser et al. 2011). Over the 2006-2010 industry-sponsored monitoring period, six sightings of 11 harbor porpoise were reported in the Beaufort Sea, suggesting harbor porpoise regularly occur in both the Chukchi and Beaufort seas (Funk et al. 2011).

POPULATION SIZE

In June and July of 1999, an aerial survey covered the waters of Bristol Bay. Two types of corrections were needed for these aerial surveys: one for observer perception bias to correct for animals not counted because they were not observed 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), which includes the perception bias correction factor (1.337; CV = 0.062) obtained during the survey using an independent belly window observer. 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. Applying this second correction factor, the corrected abundance estimate is 48,215 ($16,289 \times 2.96 = 48,215$; CV = 0.223). The estimate for 1999 can be considered conservative for that time period, 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).

Shipboard visual line-transect surveys for cetaceans were conducted on the eastern Bering Sea shelf in association with pollock stock assessment surveys in June and July of 1999, 2000, 2002, 2004, 2008, and 2010 (Moore et al. 2002; Friday et al. 2012, 2013). The entire range of the survey was completed in three of those years (2002, 2008, and 2010) and harbor porpoise abundance estimates were calculated for each of these surveys (Friday et al. 2013); however, correction factors were not applied for perception bias, availability bias, or responsive movement to the ship. The abundance estimate was 1,971 (CV = 0.46) for 2002, 4,056 (CV = 0.40) for 2008, and 833 (CV = 0.66) for 2010. Although the 2010 estimate is the lowest of the three years, it is not significantly different from the 2002 and 2008 estimates (Friday et al. 2013). These surveys are useful for showing distribution throughout the southeastern Bering Sea and the relationship to hydrographic domains; however, because the surveys were not designed for harbor porpoise and no correction factors are available, the abundance estimates are not used to calculate a population estimate.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 1999 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). However, because the survey data are more than 8 years old, N_{MIN} is considered unknown.

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 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 currently not 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 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, the 2005 revisions to the Stock Assessment Report 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 (NMFS 2005). Therefore, the PBR for this stock is considered undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 1990-1998: the Bering Sea/Aleutian Islands groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the MMPA 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 mortality or serious injury of marine mammal stocks in Alaska. No mortality or serious injury of Bering Sea harbor porpoise was observed in these commercial fisheries during 2009-2013 (Breiwick 2013; NMML, unpubl. data).

One harbor porpoise mortality due to entanglement in a commercial salmon gillnet in Kotzebue, Alaska, was reported to the NMFS Alaska Region stranding database in 2013 (Table 1; Helker et al. 2015), resulting in a minimum average annual mortality and serious injury rate of 0.2 Bering Sea harbor porpoise in commercial fisheries in 2009-2013. However, a reliable estimate of the mortality and serious injury rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in all of the salmon and herring fisheries. Therefore, it is unknown whether the mortality and serious injury rate is insignificant.

In 2012, one harbor porpoise entangled in a subsistence salmon gillnet in Nome, Alaska (Helker et al. 2015), resulting in a minimum average annual mortality and serious injury rate of 0.2 harbor porpoise due to subsistence fishery interactions in 2009-2013 (Table 1).

Table 1. Summary of incidental mortality and serious injury of the Bering Sea stock of harbor porpoise, by year and type, reported to the NMFS Alaska Region, marine mammal stranding database, in 2009-2013 (Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Entangled in commercial salmon gillnet	0	0	0	0	1	0.2
Entangled in subsistence salmon gillnet	0	0	0	1	0	0.2

Alaska Native Subsistence/Harvest Information

Subsistence hunters in Alaska have not been reported to hunt from this stock of harbor porpoise; however, when porpoise are caught incidental to subsistence or commercial fisheries, subsistence hunters may claim the carcass for subsistence use (R. Suydam, North Slope Borough, pers. comm.).

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is undetermined, the annual level of U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The minimum estimate of mean annual mortality and serious injury (0.2 from commercial fisheries + 0.2 from subsistence fisheries) is 0.4; however, the estimated annual level of human-caused mortality and serious injury relative to PBR is unknown. Because the abundance estimates are more than 8 years old and information on incidental mortality and serious injury 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 its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

Harbor porpoise are mostly found in waters less than 100 m in depth (Dahlheim et al. 2000, Hobbs and Waite 2010). 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, dredging, and noise (Linnenschmidt et al. 2013). 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 porpoise in the Chukchi Sea (Funk et al. 2010, 2011). Shipping and noise from oil and gas activities may also be a habitat concern for harbor porpoise, 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. 1). They are found over the continental shelf adjacent to the slope and over deep (2,500+ m) oceanic waters (Hall 1979). They have been sighted throughout the North Pacific as far north as 65°N (Buckland et al. 1993) and as far south as 28°N in the eastern North Pacific (Leatherwood and Fielding 1974). The only apparent distribution gaps in Alaska waters are upper Cook Inlet and the shallow eastern flats of the Bering Sea. Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the west coast of the continental U.S. (Loeb 1972, Leatherwood and Fielding 1974) and winter movements of populations out of areas with ice such as Prince William Sound (Hall 1979).

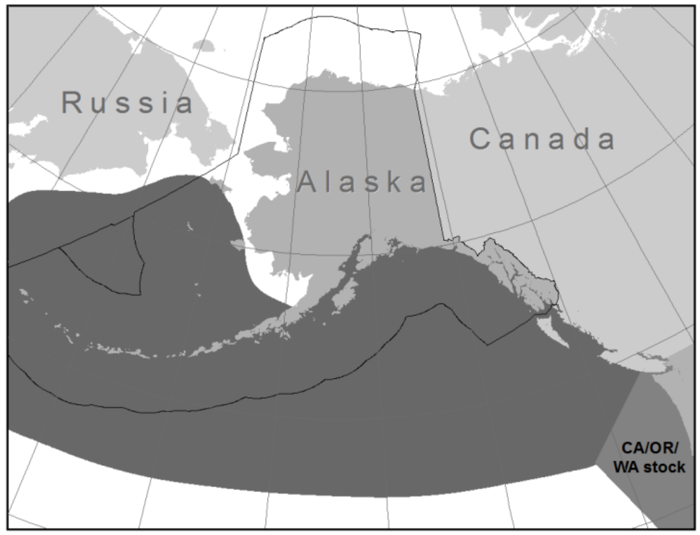

Figure 1. Approximate distribution of Dall's porpoise in Alaska waters (dark shaded area).

Surveys on the eastern Bering Sea shelf and slope to the 1,000 m isobath in 1999, 2000, 2002, 2004, 2008, and 2010 provided information about the distribution and relative abundance of Dall's porpoise in this area (Moore et al. 2002; Friday et al. 2012, 2013). Dall's porpoise were sighted on the shelf and slope in waters deeper than 100 m in 2002, 2008, and 2010 with greater densities at the shelf break than in shallower waters (Friday et al. 2013).

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 U.S. 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 three sightings were reported between 1987 and 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 five 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 more than 8 years old, consequently there are 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 NMFS pollock stock assessment surveys in 1999, 2000, 2002, 2004, 2008, and 2010 on the eastern Bering Sea shelf (Moore et al. 2002; Friday et al. 2012, 2013). The entire range of the survey was completed in three of those years (2002, 2008, and 2010) and Dall's porpoise estimates were calculated for each of these surveys (Friday et al. 2013). The abundance estimate was 35,303 (CV = 0.53) in 2002, 14,543 (CV = 0.32) in 2008, and 11,143 (CV = 0.32) in 2010. Although the 2010 estimate is the lowest of the three years, it is not significantly different from the 2002 and 2008 estimates (Friday et al. 2013). These estimates have not been corrected for animals missed on the trackline (perception bias) or animals submerged when the ship passed (availability bias). 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 potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. 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.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. 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 more than 8 years old, the N_{MIN} is unknown and therefore the PBR level is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA 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. For the fisheries with observed takes, the range of observer coverage in 2009-2013, as well as the annual observed and estimated mortality and serious injury, are presented in Table 1.

The Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery was monitored in 1990 (Wynne et al. 1991). One Dall's porpoise mortality was observed, which extrapolated to an annual (total) incidental mortality and serious injury rate of 28 Dall's porpoise (Table 1).

In 2012 and 2013, the Alaska Marine Mammal Observer Program (AMMOP) placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess mortality and serious injury of marine mammals. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were observed during the 2012-2013 program (Manly 2015). In 2012, one Dall's porpoise was seriously injured. Based on the one observed serious injury, 18 serious injuries were estimated for Districts 6, 7, and 8 in 2012, resulting in an estimated mean annual mortality and serious injury rate of 9 Dall's porpoise in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery. Note that the AMMOP has not observed the Southeast Alaska salmon drift gillnet fishery in the other districts; additionally, NMFS has not observed several other gillnet fisheries that are known to interact with this stock, therefore, the total estimated mortality and serious injury is unavailable. However, due to the large stock size, it is unlikely that unreported mortality and serious injury from those fisheries are a significant source of mortality. Combining the estimates from the Bering Sea and Gulf of Alaska fisheries (0.5) with the estimate from the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery (28) and the Southeast Alaska salmon drift gillnet fishery (9) results in an estimated average annual mortality and serious injury rate in observed fisheries of 38 Dall's porpoise from this stock.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of Dall's porpoise due to U.S. commercial fisheries from 2009 to 2013 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991; Breiwick 2013; Manly 2015; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	**Years**	**Data type**	**Percent observer coverage**	**Observed mortality**	**Estimated mortality**	**Mean estimated annual mortality**
Bering Sea/Aleutian Is. pollock trawl	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	1 0 0 0 0	1.04 0 0 0 0	0.2 (CV = 0.19)
Bering Sea/Aleutian Is. Pacific cod longline	2009 2010 2011 2012 2013	obs data	60 64 57 51 67	1 0 0 0 0	1.5 0 0 0 0	0.3 (CV = 0.77)
SE Alaska salmon drift gillnet (Districts 6, 7, 8)	2012 2013	obs data	6.4 6.6	1 0	18 0	9 (CV = 1.0)
AK Peninsula/Aleutian Is. salmon drift gillnet	1990	obs data	4	1	28	28 (CV = 0.585)
Minimum total estimated annual mortality						38 (CV = 0.498)

From 2009 to 2013, no mortality or serious injury of Dall's porpoise was reported to the NMFS Alaska Region stranding database (Helker et al. 2015).

Alaska Native Subsistence/Harvest Information

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

STATUS OF STOCK

Dall's porpoise are not designated 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 (38) 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 annual level of U.S. commercial fishery-related mortality and serious injury 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 its Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

While the majority of Dall's porpoise are found throughout the North Pacific, there are also significant numbers found in shelf break and deeper nearshore areas. Thus, they are subject to a variety of habitat impacts. Of particular concern are nearshore areas, bays, channels, and inlets where some Dall's porpoise are vulnerable to physical modifications of nearshore habitats (resulting from urban and industrial development, including waste management and nonpoint source runoff) and noise (Linnenschmidt et al. 2013). 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 Dall's porpoise in the Chukchi Sea (Funk et al. 2010, 2011). Shipping and noise from oil and gas activities may also be a habitat concern for Dall's porpoise, particularly in the Chukchi Sea.

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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 marine mammal species, perhaps exceeded in its global range only by the killer whale (Rice 1989). In the North Pacific, sperm whales were depleted by extensive commercial whaling over a period of more than a hundred years, and the species was the primary target of illegal Soviet whaling in the second half of the 20th century (Ivashchenko et al. 2013, 2014).

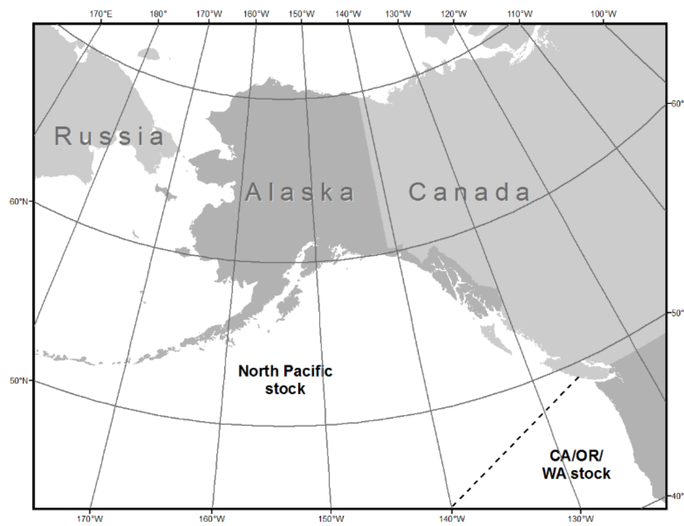

Figure 1. The approximate distribution of sperm whales in the North Pacific includes deep waters south of 62°N to the equator.

Sperm whales 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. 1), 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) and Ivashchenko et al. (2014) showed that there were extensive catches of female sperm whales above 50°N, in the western Bering Sea and in the western Aleutian Islands. Mizroch and Rice (2013) also showed female movements into the Gulf of Alaska and western Aleutians. Males are found in the summer in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands (Kasuya and Miyashita 1988, Mizroch and Rice 2013, Ivashchenko et al. 2014). Sighting surveys conducted by the Alaska Fisheries Science Center's National Marine Mammal Laboratory in the summer months between 2001 and 2010 have found sperm whales to be the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands (NMML, unpubl. 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 move to higher latitudes in summer and to lower latitudes in winter (Whitehead and Arnbom 1987).

Mizroch and Rice (2013) examined 261 Discovery mark recoveries from the days of commercial whaling and found extensive movements from U.S. and Canadian coastal waters into the Gulf of Alaska and Bering Sea. The U.S. marked 176 sperm whales from 1962 to 1969 off southern California and northern Baja California (Mizroch and Rice 2013). Seven of those marked whales were recovered in locations ranging from offshore California, Oregon, and 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 1,300 km offshore of Washington State. Similar extensive movements have also been demonstrated by recent satellite-tagging studies (Straley et al. 2014). Three adult males satellite-tagged off southeastern Alaska moved far south, one to coastal Baja California, one into the north-central Gulf of California, and the third to a location near the Mexico-Guatemala border (Straley et al. 2014). Marking 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.

Mizroch and Rice (2013) also analyzed whaling data and found that males and females concentrated seasonally along oceanic frontal zones, for example, in the subtropical frontal zone (ca. 28-34°N) and the subarctic frontal zones (ca. 40-43°N). 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. Analysis of Soviet catch data by Ivashchenko et al. (2014)

showed broad agreement with these results, although a sharp division was evident at Amchitka Pass in the Aleutians, with mature males to the east and males and family groups to the west, including in the Commander Islands. There were four main areas of concentration in the Soviet catches: a large pelagic area (30-50°N) in the eastern North Pacific, including the Gulf of Alaska and western coast of North America; the northeastern and southwestern central North Pacific; and the southern Kuril Islands. Some of the catch distribution was similar to that of 19th century Yankee whaling catches plotted by Townsend (1935), notably in the "Japan Ground" (in the pelagic western Pacific) and the "Coast of Japan Ground." Many females were caught in Olyutorsky Bay (western Bering Sea) and around the Commander Islands.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: no apparent discontinuities based on whale marking data; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: genetics studies indicate the possibility of a "somewhat" discrete U.S. 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). 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 (2013) suggests that this structure should be reviewed and updated to reflect current data. The California/Oregon/Washington and Hawaii sperm whale stocks are reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

Current and historical estimates of the abundance of sperm whales in the North Pacific are considered unreliable, and caution should be exercised in interpreting published estimates. 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 U.S. Pacific Region). Estimates for a large area of the eastern temperate North Pacific were produced from line-transect and acoustic survey data by Barlow and Taylor (2005), but no recent estimate exists for other areas, including for the central or western North Pacific.

Although Kato and Miyashita (1998) believe their estimate to be positively biased, their analysis suggested 102,112 (CV = 0.155) sperm whales in the western North Pacific. The number of sperm whales occurring within Alaska waters is unknown.

As the data used in estimating the abundance of sperm whales in the entire North Pacific are more than 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

No current estimate of abundance exists for this stock; therefore, 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 whales. 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

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Between 2009 and 2013, there were four serious injuries of sperm whales observed in the Gulf of Alaska sablefish longline fishery (two each in 2012 and 2013), resulting in an average annual observed mortality and serious injury of 0.8 sperm whales in U.S. commercial groundfish fisheries in 2009-2013 (Helker et al. 2015). Extrapolations based on observer effort are not available at this time.

Alaska Native Subsistence/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, Ivashchenko et al. 2014). 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 (IWC, Bureau of International Whaling Statistics (BIWS) catch data, February 2008 version, unpubl.). This value underestimates the actual kill in the North Pacific as a result of under-reporting by U.S.S.R. pelagic whaling operations. Berzin (2008) described extreme under-reporting and misreporting of Soviet sperm whale catches from the mid-1960s into the early 1970s, including enormous (and under-reported) whaling pressure on female sperm whales in the latter years of whaling. More recently, Ivashchenko et al. (2013, 2014) estimate that 157,680 sperm whales were killed by the U.S.S.R. in the North Pacific between 1948 and 1979, of which 25,175 were unreported; the Soviets also extensively misreported the sex and length of catches. In addition, new information indicates that Japanese land-based whaling operations also misreported the number and sex of 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 48 sperm whales between 2000 and 2009 (IWC, BIWS catch data, October 2010 version, unpubl.). It should be noted that the reliability of data concerning large pelagic catches of sperm whales by Japan in the North Pacific is unknown, but analysis of length distribution data suggests at least some degree of systematic misreporting (Cooke et al. 1983). Thus, studies that use Japanese data to assess the North Pacific distribution of this species, including by sex, should be interpreted with caution.

From 2009 to 2013, one suspected human-related sperm whale mortality was reported to the NMFS Alaska Region stranding database (Helker et al. 2015). A beachcast sperm whale was found in 2012 on a beach near Yakutat with a net from an unknown fishery wrapped around its lower jaw. However, due to the advanced decomposition of this whale, the cause of death 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 1995-1997 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 (Perez 2006, Hanselman et al. 2008). Sigler et al. (2008) analyzed catch data from 1998 to 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 in sets with sperm whales present were compared to catches in 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 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 and serious injury 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. However, potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

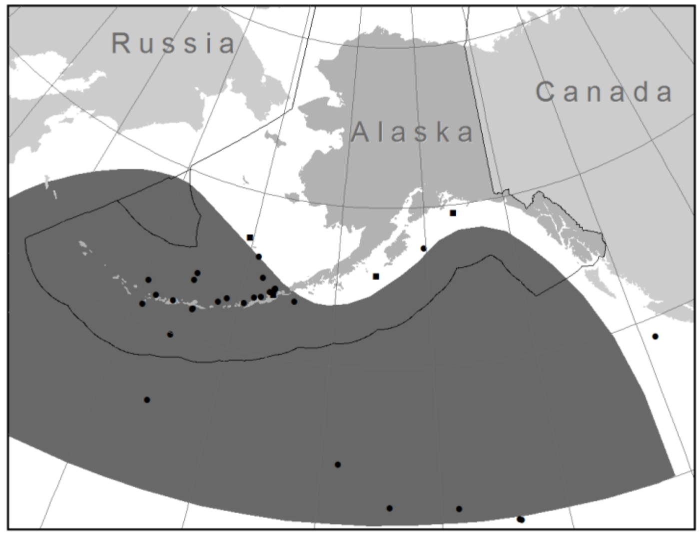

Figure 1. Approximate distribution of Baird's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted. (Forney and Brownell 1996, Moore et al. 2002, NMFS unpublished data). Note: Distribution updated based on Kasuya 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) and the Commander Islands (Fedutin et al. 2012). 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) (Fig. 1). 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). 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). Observations during 2007-2011 in the western Bering Sea were made in all months except winter (December to March) around the Commander Islands, with encounters peaking in April-June and to a lesser extent in August-November (Fedutin et al. 2012). During winter months, they are rarely found in offshore waters and their winter distribution is unknown (Kasuya 2002). However, acoustic detections of Baird's beaked whales from November through January (and no detections in July-October) in the northern Gulf of Alaska suggest that this region may be wintering habitat for some Baird's beaked whales (Baumann-Pickering et al. 2012b). There were no detections of this species from early June to late August 2010 off Kiska Island (Baumann-Pickering et al. 2012a). 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). Photo-identification analysis of animals sighted between 2007-2011 revealed resightings of some individuals around the Commander Islands and confirmed associations of individuals over several years in this species (Fedutin et al. 2012).

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

No reliable estimates of abundance are available for this stock; therefore, 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Twenty-two different commercial fisheries operating within the potential range of the Alaska stock of Baird's beaked whale were monitored for incidental take by fisheries observers from 2007-2011 (see 76 FR 73912, final List of Fisheries for 2012) . There were no serious injuries or mortalities of Baird's beaked whales incidental to observed commercial fisheries reported between 2007-2011 (Breiwick 2013). The estimated annual mortality rate incidental to commercial fisheries is zero.

Subsistence/Native Harvest Information

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

Other Mortality

Between 1925 and 1987, 618 Baird's beaked whales were reported taken throughout the North Pacific (International Whaling Commission, BWIS catch data, February 2003 version, unpublished). The annual quota of Baird's beaked whales for small-type whaling in Japan was 62 from 1999-2004, which increased temporarily to 66 from 2005-2010 and will remain a permanent increase (Kasuya 2011). 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 designated 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 is an increasing habitat concern for most species of beaked whales, particularly in areas of oil and gas activities or where shipping or military activities are high. Shipping noise and the use of military sonars have been found to alter dive behavior and movements, as well as vocal activity in some species of beaked whales (Aguilar de Soto et al. 2006, McCarthy et al. 2011, Tyack et al. 2011). Little is known about the effects of noise on beaked whales in Alaska. Ingestion of marine debris, particularly plastics, is a concern; plastic is occasionally found in the stomach contents of stranded beaked whales, including Baird's beaked whales (Smithsonian Institution, Cetacean Distributional Database, accessed 04 June 2012).

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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. 1) 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). Relatively few (4 total) acoustic detections of Cuvier's beaked whales were recorded off Kiska Island (1 in summer) and in the offshore Gulf of Alaska (3 total detections, 1 in October and 2 in January; Baumann-Pickering et al. 2012a, 2012b).

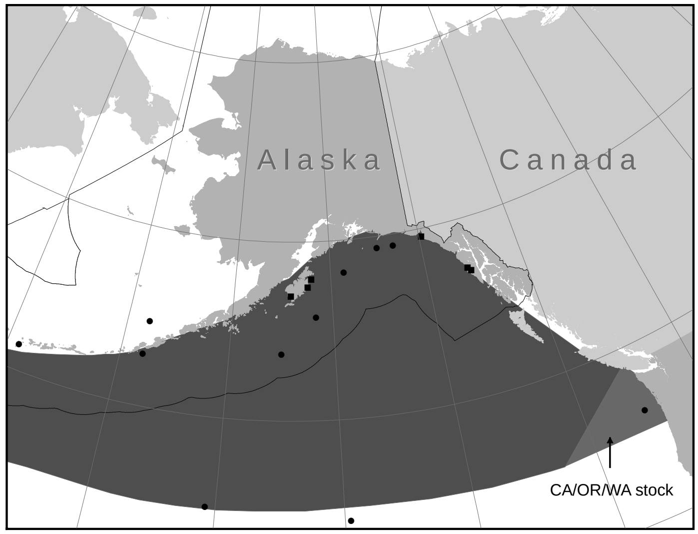

Figure 1. Approximate distribution of Cuvier's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted (Forney and Brownell 1996, NMFS unpublished data).

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

No reliable estimates of abundance are available for this stock; therefore, 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Twenty-two different commercial fisheries operating within the potential range of the Alaska stock of Cuvier's beaked whale were monitored for incidental take by fishery observers from 2007-2011 (see 76 FR 73912, final List of Fisheries for 2012) . There were no serious injuries or mortalities of Cuvier's beaked whales incidental to observed commercial fisheries reported between 2007-2011 (Breiwick 2013). 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.

Other Mortality

Unknown levels of injuries and mortality of Cuvier's beaked whales may occur as a result of anthropogenic noise, such as military sonars (U.S. Dept. of Commerce and Secretary of the Navy 2001) or other commercial and scientific activities producing high-energy sound. The use of active sonar from military vessels has been implicated or coincident with mass strandings of beaked whales (Cox et al. 2006, Frantzis 1998, Martel 2002, Jepson et al. 2003, Simmonds and Lopez-Jurado 1991, U.S. Dept. of Commerce and Secretary of the Navy 2001), and all atypical single and mixed-species mass strandings involved Cuvier's beaked whales (D'Amico et al. 2009). There is concern regarding the potential effects of underwater sounds from seismic operations on beaked whales, although investigations of causation of atypical strandings of Cuvier's beaked whales and nearby seismic air gun operations have been inconclusive (Gentry 2002, Gordon et al. 2003/2004, Malakoff 2002). Changes in dive behavior, particularly a quick ascent from deep dives, in response to sound exposure may result in injuries related to bubble growth during decompression (Cox et al. 2006, Tyack et al. 2011, Hooker et al. 2011). Such injuries or mortality would rarely be documented due to the remote nature of many of these activities and the low probability that an injured or dead beaked whale would strand. No estimates of potential mortality or serious injury are available for Cuvier's beaked whales in Alaska waters.

STATUS OF STOCK

Cuvier's beaked whales are not designated 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 is an increasing habitat concern for most species of beaked whales, particularly in areas of oil and gas activities or where shipping or military activities are high. Shipping noise may disrupt the behavior of Cuvier's beaked whales (Aguilar de Soto et al. 2006), and the use of military sonars has been found to alter dive behavior and movements, as well as vocal activity in some species of beaked whales (McCarthy et al. 2011, Tyack et al. 2011). Moore and Barlow (2013) report impacts of anthropogenic sound and ecosystem change as the most plausible hypotheses for declining abundance of *Ziphius* and *Mesoplodon* spp. in the California Current large marine ecosystem. Little is known about the effects of noise or ecosystem change on beaked whales in Alaska, and the lack of abundance estimates hinder the detection of any population trends. Ingestion of marine debris, particularly plastics, is a concern; plastic is occasionally found in the stomach contents of stranded beaked whales, including Cuvier's beaked whales. (Smithsonian Institution, Cetacean Distributional Database, accessed 04 June 2012).

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Revised 2/11/2013

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. 1). 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). Acoustic signals believed to be produced by Stejneger's beaked whales (based on frequency characteristics, interpulse interval and geographic location, Baumann-Pickering et al. 2012a) were recorded 2-5 times a week in July off Kiska Island and almost weekly from July 2011 to February 2012 in the northern Gulf of Alaska (Baumann-Pickering et al. 2012b).

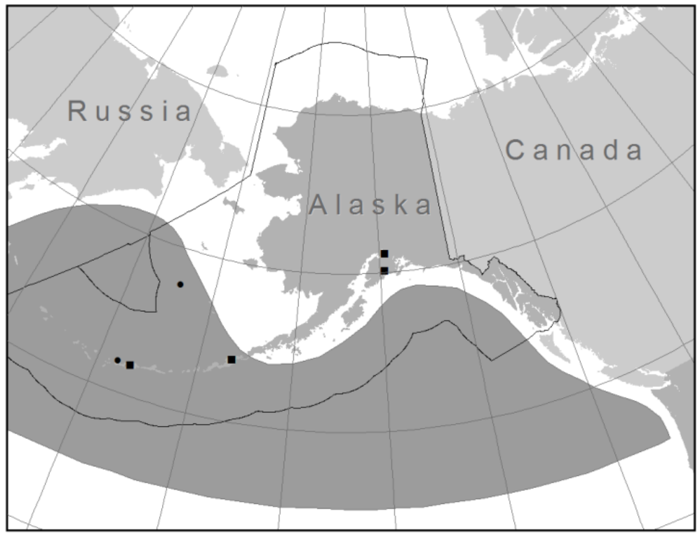

Figure 1. Approximate distribution of Stejneger's beaked whales in the eastern North Pacific (shaded area). Sightings (circles) and strandings (squares) within the last 10 years are also depicted (Walker and Hanson 1999, NMFS unpublished data).

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

No reliable estimates of abundance are available for this stock; therefore, 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Twenty-two different commercial fisheries operating within the potential range of the Alaska stock of Cuvier's beaked whale were monitored for incidental take by fishery observers from 2007-2011 (see 76 FR 73912, final List of Fisheries for 2012) . There were no serious injuries or mortalities of Stejneger's beaked whales incidental to observed commercial fisheries reported between 2007-2011 (Breiwick 2013). 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 designated 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 is an increasing habitat concern for most species of beaked whales, particularly in areas of oil and gas activities or where shipping or military activities are high. Shipping noise and the use of military sonars have been found to alter dive behavior and movements, as well as vocal activity in some species of beaked whales (Aguilar de Soto et al. 2006, McCarthy et al. 2011, Tyack et al. 2011). Moore and Barlow (2013) report impacts of anthropogenic sound and ecosystem change as the most plausible hypotheses for declining abundance of *Ziphius* and *Mesoplodon* spp., including *M. stejnegeri*, in the California Current large marine ecosystem. Little is known about the effects of noise on beaked whales in Alaska. Ingestion of marine debris, particularly plastics, is a concern; plastic is occasionally found in the stomach contents of stranded beaked whales, including Stejneger's beaked whales. (Smithsonian Institution, Cetacean Distributional Database, accessed 04 June 2012).

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

NOTE – December 2015: NMFS has conducted a global Status Review of humpback whales (Bettridge et al. 2015) and has proposed revisions to the ESA listing of the species (80 FR 22303, April 21, 2015).

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 2004-2006 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project). Initial results from this project (Calambokidis et al. 2008, Barlow et al. 2011), including abundance estimates and movement information, have been reported in Baker et al. (2008, 2013) and are also summarized in Fleming and Jackson (2011); however, these results are still being considered for stock structure analysis.

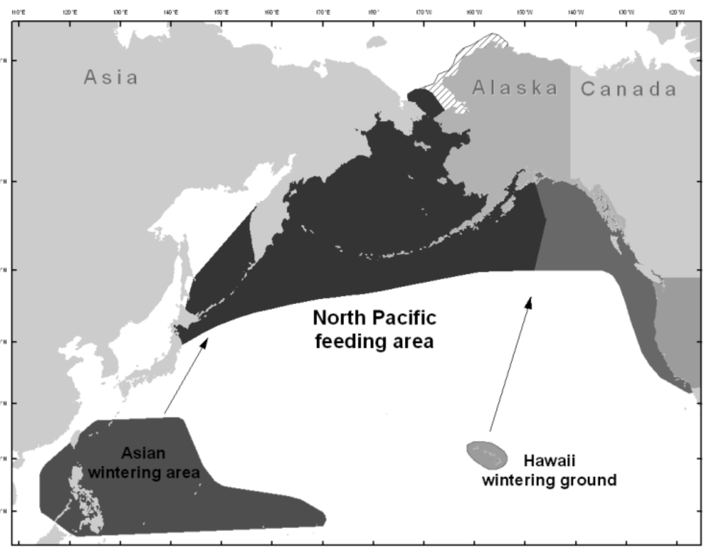

Figure 1. Approximate distribution of humpback whales in the western North Pacific (dark shaded areas). Feeding and wintering grounds are presented above (see text). Area within the hash lines is a probable distribution area based on sightings in the Beaufort Sea (Hashagen et al. 2009). See Figure 1 in the Central North Pacific humpback whale Stock Assessment Report for humpback whale distribution in the eastern North Pacific.

The historical 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 historical range (Clarke et al. 2013b), 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 breeding range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedo 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 (Darling 1991, Darling and Cerchio 1993, Calambokidis et al. 1997, Baker et al. 1998). 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.

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 that are on the same side of the Pacific: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to coastal waters off California/Oregon.

The SPLASH data now show the Revillagigedo whales are seen in all sampled feeding areas except northern 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 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. After a Status Review under the Endangered Species Act (ESA), NMFS has proposed designating four Distinct Population Segments (DPSs) of humpback whales in the North Pacific: Western North Pacific, Hawaii, Mexico, and Central America (https://www.federalregister.gov/articles/2015/04/21/2015-09010/endangered-and-threatened-species-humpback-whale-megaptera-novaeangliae-identification-of-14). If this proposed rule results in the designation of DPSs in the North Pacific, a parallel revision of Marine Mammal Protection Act (MMPA) population structure in the North Pacific will be considered.

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 ~50-70 km. 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 Taiwan, and east of Ogasawara in the Marshall and Mariana 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, and perhaps also the Gulf of Anadyr in Russia and the Bering Sea, have an unusually low resighting rate in winter areas compared to whales from other feeding areas. 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 Ogasawara Islands), the Marshall Islands (approximately half-way between the Marianas and Hawaiian 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), but no other areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara.

The migratory destination of Western North Pacific humpbacks is not 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 (Omura and Ohsumi 1964, Nishiwaki 1966, 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 reconfirms 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 Aleutian Islands, and in the Gulf of Anadyr just southwest of the Bering Strait. Analysis of whaling data shows historical catches of humpback whales well into the Bering Sea and catches in the Bering Strait and Chukchi Sea in August-October in the 1930s (Mizroch and Rice 2007), but no survey effort occurred during SPLASH north of the Bering Strait. Humpback whales are increasingly seen north of the Bering Strait into the northeastern Chukchi Sea (Clarke et al. 2013a, 2013b), with some indication that more humpback whales are seen on the Russian side north of the Bering Strait (Clarke et al. 2013b). Humpback whales are the most commonly recorded cetacean on hydrophones just north of the Bering Strait and occurred from September into early November from 2009 to 2012 (K. Stafford, Applied Physics Laboratory-University of Washington, Seattle, WA, pers. comm.). Other locations in the far western Pacific where humpback whales have been seen in summer include the northern Kuril Islands (V. Burkanov, NMFS-AFSC-NMML, pers. comm.), far offshore southeast of the Kamchatka Peninsula and south of the Commander Islands (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 to 1,100, and the estimates for Kamchatka in Russia ranged from about 100 to 700, suggesting a large portion of the Asian population migrates to 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, given 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. 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. 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. 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. 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 (unquantified) and the likely existence of an unknown and unsampled wintering area (-7.2%).

During the SPLASH study, surveys were conducted in three winter field seasons (2004-2006). 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 was a total of 20 individuals seen in more than one area, leaving a total of 566 unique individuals seen in the Asian wintering areas (Calambokidis et al. 2008). For abundance in winter or summer areas, a multistrata 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 to 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 to 5,000 (Calambokidis et al. 2008).

Minimum Population Estimate

As discussed above, point estimates of abundance for Asia ranged from 938 to 1,107 (for 2004-2006), but no associated CV has yet been calculated. The 1991-1993 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 potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the SPLASH population estimate (N) of 1,107 from the best fit model and an assumed conservative CV(N) of 0.300 would result in an N_{MIN} for this humpback whale stock of 865.

Current Population Trend

The SPLASH abundance estimate for Asia represents a 6.7% annual rate of increase over the 1991-1993 abundance estimate (Calambokidis et al. 2008). However, the 1991-1993 estimate was for Ogasawara and Okinawa only, whereas the SPLASH estimate includes the Philippines, so the annual rate of increase is biased high to an unknown degree.

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 1993-2000 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 Pradel model fit to data from Hawaii for the years 1980-1996 resulted in an estimated rate of increase of 10% per year (95% CI: 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 to 2003 of 6.6% (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 for 1991-1993. Comparisons of SPLASH abundance estimates for Hawaii to estimates for 1991-1993 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.

Estimates of observed rates of increase can be used to estimate maximum net productivity rates, although in most cases these estimates may be biased low, as maximum net productivity rates are only achieved at very low population sizes. However, if the observed rates of increase are greater than the default value recommended for R_{MAX}, it would be reasonable to use a higher value based on those observations. The rates of increase summarized above include estimates for the North Pacific of 7%, 10%, and 6.6%. Although there is no estimate of the maximum net productivity rate for just the Western stock (i.e., from trends in abundance in the Asia breeding areas), it is reasonable to assume that R_{MAX} for this stock would be at least 7% based on the other observations from the North Pacific. Hence, until additional data become available for 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 MMPA, the 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 ESA

(Wade and Angliss 1997). Using the N_{MIN} of 865, calculated from the SPLASH abundance estimate for 2004-2006 of 1,107 with an assumed CV of 0.300, the PBR is calculated to be 3.0 animals (865 × 0.035 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Between 2009 and 2013, there were two known mortalities of humpback whales in the Bering Sea/Aleutian Islands pollock trawl fishery and one in the Bering Sea/Aleutian Islands flatfish trawl fishery (Table 1). Since the stock identification of these whales is unknown, and the events occurred within the area where the Western North Pacific and Central North Pacific stocks are known to overlap, the mortality in these fisheries is assigned to both stocks of humpback whales. The minimum average annual mortality and serious injury rate from observed U.S. commercial fisheries is 0.6 humpbacks from the Western North Pacific stock in 2009-2013 (Table 1).

Table 1. Summary of incidental mortality and serious injury of the Western North Pacific stock of humpback whales due to observed U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports. N/A indicates that data are not available.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl[a]	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 (+1)[b] 0 0 0	0 0 (+1)[c] 0 0 0	0.2 (CV = N/A)
Bering Sea/Aleutian Is. pollock trawl[a]	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	0 1 0 1 0	0 1.0 0 1.0 0	0.4 (CV = 0.68)
Minimum total estimated annual mortality						0.6 (CV = 0.45)

[a]Mortality and serious injury in this fishery is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales, since the stock identification is unknown and the two stocks overlap within the area of operation of the fishery.
[b]Total mortality and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul.
[c]Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

One entanglement in the ground tackle of a commercial cod jig fishery vessel was reported to the NMFS Alaska Region in 2013 (Table 2; Helker et al. 2015). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 humpback whales in 2009-2013 (Table 2) and, since the event occurred in the area where the two stocks overlap, the mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales.

The estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is 0.8 (0.6 based on observed fisheries + 0.2 based on stranding data) Western North Pacific humpback whales; however, this estimate is considered a minimum because there are no data concerning fishery-related mortality and serious injury in Japanese, Russian, or international waters.

Reports of swimming, floating, or beachcast humpback whales entangled in fishing gear or with injuries caused by interactions with gear, which may be from commercial, recreational, or subsistence fisheries, are another source of fishery-related mortality and serious injury data. However, very few stranding reports are received from areas west of Kodiak. The estimated mean annual mortality and serious injury rate from fishery-related gear entanglements and interactions reported to the NMFS Alaska Region stranding database in 2009-2013, in which the events have not been attributed to a specific fishery listed on the MMPA List of Fisheries (76 FR 73912; 29 November 2011), is 0.4 humpbacks (Table 2). Since these events occurred in the area where the two stocks overlap, this mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales. These estimates are considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or have the cause of death determined. The estimated average annual mortality and serious injury rate due to interactions with all fisheries in 2009-2013 is 1.2 (0.8 in commercial fisheries + 0.4 in unknown fisheries) Western North Pacific humpback whales.

Table 2. Summary of mortality and serious injury of Western North Pacific humpback whales, by year and type, reported to the NMFS Alaska Region marine mammal stranding database in 2009-2013 (Helker et al. 2015). Injury events lacking detailed injury information are assigned prorated values following injury determination guidelines described in NOAA (2012). All events occurred within the area of known overlap between the Western North Pacific and Central North Pacific humpback whale stocks. Since the stock identification is unknown, the mortality and serious injury is reflected in both Stock Assessment Reports. A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in Helker et al. (2015).

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Entangled in ground tackle of commercial cod jig vessel	0	0	0	0	1	0.2
Entangled in unspecified pot gear	0	0	0.75	0	0	0.2
Entangled in unspecified set net gear	0	0	0.75	0	0	0.2
Ship strike (charter)	0	0	0	0.2	0	0.04
Ship strike (whale watch)	0	0	0	1	0	0.2
Entangled in unknown marine debris/gear	0.75	0	2.5	0.75	0	0.8

Brownell et al. (2000) compiled records of bycatch in Japanese and Korean commercial fisheries between 1993 and 2000. During the period 1995-1999, 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 per year (using bycatch data only) to 2.4 per 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).

Alaska Native Subsistence/Harvest Information

There are no reported takes of humpback whales from this stock by Native subsistence hunters in Alaska or Russia in 2009-2013.

Other Mortality

Other sources of human-caused mortality and serious injury include ship strikes and entanglement in unknown marine debris/gear. The minimum mean annual mortality and serious injury rate of one Western North Pacific humpback whale per year in 2009-2013 is based on ship strikes (0.2) and entanglement in unknown marine debris/gear (0.8) reported to the NMFS Alaska Region stranding database (Table 2). Since these events occurred in the area where the stocks overlap, this mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales.

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 Ogasawara 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 U.S.S.R. continued until 1972 (Ivashchenko et al. 2007). From 1961 to 1971, 6,793 humpback whales were killed illegally by the U.S.S.R. 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 concluded a global humpback whale Status Review (Bettridge et al. 2015). The estimated mean annual human-caused mortality and serious injury rate of 2.2 (1.2 from fishery-related interactions + 1 from other interactions) Western North Pacific humpback whales is less than the calculated conservative PBR level for this stock (3.0). The minimum estimate of the mean annual U.S. commercial fishery-related mortality and serious injury rate for this stock (0.8) exceeds 10% of the PBR (0.3) 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). 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 is currently unknown.

HABITAT CONCERNS

Elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars) are 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, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes and through the Bering Sea 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

NOTE – December 2015: NMFS has conducted a global Status Review of humpback whales (Bettridge et al. 2015) and has proposed revisions to the ESA listing of the species (80 FR 22303, April 21, 2015).

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 2004-2006 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project). Initial results from this project (Calambokidis et al. 2008, Barlow et al. 2011), including abundance estimates and movement information, have been reported in Baker et al. (2008, 2013) and are also summarized in Fleming and Jackson (2011); however, these results are still being considered for stock structure analysis.

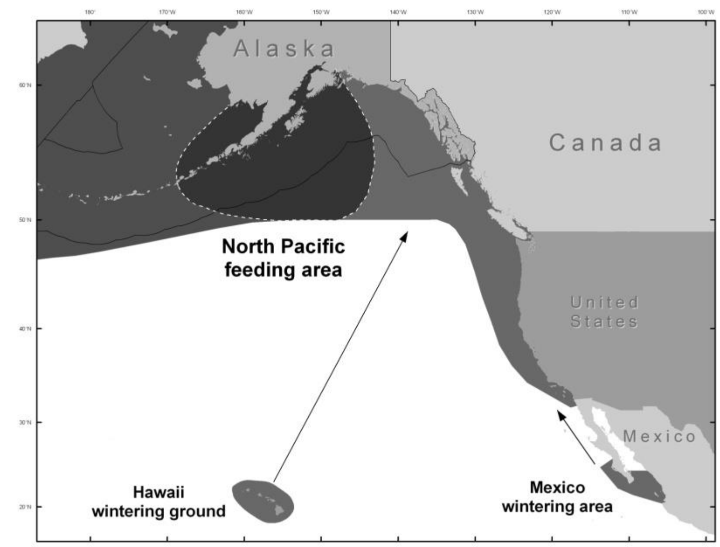

Figure 1. Approximate distribution of humpback whales in the eastern North Pacific (dark shaded areas). Feeding and wintering areas are presented above (see text). Area within the dotted line is known to be an area where the Central North Pacific and Western North Pacific stocks overlap. See Figure 1 in the Western North Pacific humpback whale Stock Assessment Report for distribution of humpback whales in the western North Pacific.

The historical 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 historical 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 breeding range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedo 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 (Darling 1991, Darling and Cerchio 1993, Calambokidis et al. 1997, Baker et al. 1998). 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.

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 that are on the same side of the Pacific: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to coastal waters off California/Oregon.

The SPLASH data now show the Revillagigedo whales are seen in all sampled feeding areas except northern 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. After a Status Review under the Endangered Species Act (ESA), NMFS has proposed designating four Distinct Population Segments (DPSs) of humpback whales in the North Pacific: Western North Pacific, Hawaii, Mexico, and Central America (https://www.federalregister.gov/articles/2015/04/21/2015-09010/endangered-and-threatened-species-humpback-whale-megaptera-novaeangliae-identification-of-14). If this proposed rule results in the designation of DPSs in the North Pacific, a parallel revision of Marine Mammal Protection Act (MMPA) population structure in the North Pacific will be considered.

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, and perhaps also the Gulf of Anadyr in Russia and the Bering Sea, have an unusually low resighting rate in winter areas compared to whales from other feeding areas. 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 Mariana Islands (southwest of the Ogasawara Islands), the Marshall Islands (approximately half-way between the Mariana and Hawaiian 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), but no other areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara. Which stock that 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 1991-1993, 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. 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. 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 (unquantified) and the likely existence of an unknown and unsampled wintering area (-7.2%).

The Central North Pacific stock of humpback whales winters in Hawaiian waters (Baker et al. 1986). Preliminary mark-recapture abundance estimates from the SPLASH data were calculated in Calambokidis et al. (2008), using a multistrata Hilborn model. The best estimate for Hawaii (as chosen by AICc) was 10,103; no confidence limit or CV was calculated for that estimate.

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 combined estimates ranged from 6,000 to 19,000 for the Aleutian Islands, Bering Sea, and Gulf of Alaska, a considerable increase from previous estimates that were available (e.g., Waite et al. 1999, Moore et al. 2002, Witteveen et al. 2004, Zerbini et al. 2006). However, the SPLASH surveys covered areas not covered in those previous 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 Islands, 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 (including the Commander Islands and Gulf of Anadyr in Russia), the SPLASH estimates ranged from 2,889 to 13,594; for the Gulf of Alaska (from Prince William Sound to the Shumigan Islands, including Kodiak Island), 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 in 1979-1986. 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 1979-1986 data set. Using 1986-1992 data 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 in 1994-2000 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, the 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 1991-1993 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 potential biological removal (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 10,103 from the best fit model and an assumed conservative CV(N) of 0.300 results in an N_{MIN} for the Central North Pacific humpback whale stock of 7,890.

Although the Southeast Alaska/northern British Columbia feeding aggregation is not formally considered a stock, the calculation of what a PBR would be 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 0.300, 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 0.300 results in an N_{MIN} of 2,256. For the Gulf of Alaska (from Prince William Sound to the Shumigan Islands, including Kodiak Island), using the lowest SPLASH estimate of 2,845 with an assumed worst case CV of 0.300 results in an N_{MIN} of 2,222. Estimates for these feeding areas may include whales from the Western North Pacific stock and the Mexican breeding population.

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 et al. (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% CI: 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 to 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 for 1991-1993. Comparisons of SPLASH abundance estimates for Hawaii to estimates for 1991-1993 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 a value for the northern Gulf of Alaska 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 MMPA, the 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 this stock is 0.1, the recommended value for cetacean stocks listed as "endangered" under the ESA (Wade and Angliss 1997). A recovery factor of 0.3 is used in calculating the PBR based on the suggested guidelines of Taylor et al. (2003). 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 whales, using the SPLASH study abundance estimate from the best fit model for 2004-2006 for Hawaii of 10,103 with an assumed CV of 0.300 and its associated N_{MIN} of 7,890, PBR is calculated to be 83 animals (7,890 x 0.035 x 0.3).

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. Just for information purposes, PBR calculations are completed here for these feeding area aggregations. For Southeast Alaska and northern British Columbia, the smallest abundance estimates from the SPLASH study were used with an assumed worst-case CV of 0.300 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 for the Southeast Alaska/northern British Columbia feeding aggregation since this aggregation has an N_{MIN} greater than 1,500 and less than 5,000 and has 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 N_{MIN} is greater than 1,500 and less than 5,000 and has an unknown population trend. If we calculated a PBR for the Southeast Alaska/northern British Columbia feeding aggregation it would be 24 (2,251 x 0.035 x 0.3). If we calculated a PBR for the Aleutian Islands and Bering Sea, it would be 7.9 (2,256 x 0.035 x 0.1). If we calculated a PBR for the Gulf of Alaska, it would be 7.8 (2,222 x 0.035 x 0.1). However, note that the actual PBR for the Central North Pacific stock is 83 based on the breeding population size in Hawaii, as calculated above.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 and serious injury by fishery observers. As of 2004, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these 4 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 2009 and 2013, there was one known incidental serious injury and mortality of a humpback whale in the Bering Sea/Aleutian Islands flatfish trawl fishery and two in the Bering Sea/Aleutian Islands pollock trawl fishery (Table 1; Breiwick 2013; NMML, unpubl. data). Since the stock identification of these whales is unknown, and the events occurred within the area where the Central North Pacific and Western North Pacific stocks are known to overlap, the mortality in these fisheries is assigned to both stocks of humpback whales. One Central North Pacific humpback whale injured in the Hawaii shallow set longline fishery in 2011 is prorated at 0.75 under the injury determination guidelines for large whales, since the severity of its injury is unknown (Table 1; Bradford and Forney 2014).

In 2012 and 2013, the Alaska Marine Mammal Observer Program (AMMOP) placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess mortality and serious injury of marine mammals. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were observed during the 2012-2013 program (Manly 2015). In 2013, one humpback whale was seriously injured. Based on the one observed serious injury, 11 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 5.5 Central North Pacific humpback whales in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery.

Humpback whale mortality and serious injury due to entanglement in the Southeast Alaska salmon drift gillnet fishery was reported to the NMFS Alaska Region in 2012 (1 whale) and 2013 (1.75 whales) (Helker et al. 2015); however, this mortality and serious injury is accounted for by the AMMOP observer data for this fishery (in Table 1). One entanglement in the ground tackle of a commercial cod jig fishery vessel was also reported to the NMFS Alaska Region in 2013 (Table 2; Helker et al. 2015). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 humpback whales in 2009-2013 (Table 2) and, since the event occurred in the area where the two stocks overlap, the mortality is assigned to both the Central North Pacific and Western North Pacific stocks of humpback whales.

The minimum estimate of the mean annual mortality and serious injury rate incidental to U.S. commercial fisheries for the entire Central North Pacific stock is 6.5 humpback whales, based on observer data from Alaska (0.6 in the federal groundfish fisheries + 5.5 in the state-managed Southeast Alaska salmon drift gillnet fishery: Table 1) and Hawaii (0.2: Table 1) and on reports, in which the commercial fishery is confirmed, to the NMFS Alaska Region stranding database (0.2: Table 2).

Table 1. Summary of incidental mortality and serious injury of the Central North Pacific stock of humpback whales due to observed U.S. commercial fisheries from 2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; Bradford and Forney 2014; Manly 2015; NMFS, unpubl. data; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports. N/A indicates that data are not available.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl[a]	2009 2010 2011 2012 2013	obs data	99 99 99 99 99	0 0 (+1)[b] 0 0 0	0 0 (+1)[c] 0 0 0	0.2 (CV = N/A)
Bering Sea/Aleutian Is. pollock trawl[a]	2009 2010 2011 2012 2013	obs data	86 86 98 98 97	0 1 0 1 0	0 1.0 0 1.0 0	0.4 (CV = 0.68)
SE AK salmon drift gillnet (Districts 6, 7, 8)	2012 2013		6.4 6.6	0 1	0 11	5.5 (CV = 1.0)
HI shallow set longline	2009 2010 2011 2012 2013	obs data	100 100 100 100 100	0 0 1[d] 0 0	0 0 0.75[d] 0 0	0.2
Minimum total estimated annual mortality					Bering Sea/Aleutian Is.: SE AK: HI: Total:	0.6 5.5 0.2 6.3 (CV = 0.88)

[a]Mortality and serious injury in this fishery is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales, since the stock identification is unknown and the two stocks overlap within the area of operation of the fishery.
[b]Total mortality and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul.
[c]Since the total known mortality and serious injury (0 observed in monitored hauls + 1 in an unmonitored haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.
[d]A humpback was entangled and cut free with trailing gear. Due to the unknown configuration of the entanglement, this injury is being prorated with a value of 0.75 (Bradford and Forney 2014).

Reports of swimming, floating, or beachcast humpback whales entangled in fishing gear or with injuries caused by interactions with gear, which may be from commercial, recreational, or subsistence fisheries, are another source of information on fishery-related mortality and serious injury. The mean annual mortality and serious injury rate from entanglements in recreational gear is 0.7 humpback whales: 0.4 in recreational shrimp pot gear reported to the NMFS Alaska Region in 2009-2013 (Table 2; Helker et al. 2015) and 0.3 in recreational troll fisheries reported to the NMFS Pacific Islands Region in 2008-2012 (Table 3; Bradford and Lyman 2015). Based on events that have not been attributed to a specific fishery listed on the MMPA List of Fisheries (76 FR 73912; 29 November 2011), the estimated mean annual mortality and serious injury rate from fishery-related gear entanglements is 7.1 humpback whales: 2.5 reported to the NMFS Alaska Region stranding database in 2009-2013 (Table 2; Helker et al. 2015) and 4.6 reported to the NMFS Pacific Islands Region stranding database in 2008-2012 (Table 3; Bradford and Lyman 2015). These estimates are considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or cause of death determined.

The minimum average annual estimate of mortality and serious injury rate due to all fisheries is 14 (6.5 from commercial fisheries + 0.7 from recreational fisheries + 7.1 from unknown fisheries) Central North Pacific humpbacks.

Table 2. Summary of mortality and serious injury of Central North Pacific humpback whales reported to the NMFS Alaska Region marine mammal stranding database in 2009-2013 (Helker et al. 2015). Injury events lacking detailed information on the injury are assigned prorated values following injury determination guidelines described in NOAA (2012). A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in Helker et al. (2015).

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Entangled in ground tackle of commercial cod jig vessel	0	0	0	0	1	0.2
Entangled in unknown gillnet gear	0.75	3	0.75	1.75	0	1.3
Entangled in recreational shrimp pot gear	1.75	0	0	0	0	0.4
Entangled in unspecified crab gear	0	0	0.75	0	0	0.2
Entangled in unspecified longline gear	0	0	0.75	0.75	0	0.3
Entangled in unspecified pot gear	0	1.5	0.75	0	0	0.5
Entangled in unspecified set net gear	0	0	0.75	0	0	0.2
Ship strike (charter)	0.76	0	0	0.2	0	0.2
Ship strike (pilot vessel)	0	0	0	0.2	0	0.04
Ship strike (unknown)	0.36	4	2	1.2	0.14	1.5
Ship strike (whale watch)	0	0	0	1	0	0.2
Unknown marine debris/gear entanglement	2.25	2.25	5.5	0.75	2.25	2.6

Table 3. Summary of mortality and serious injury of Central North Pacific humpback whales reported to the NMFS Pacific Islands Region stranding database in 2008-2012 (Bradford and Lyman 2015).

Cause of injury	2008	2009	2010	2011	2012	Mean annual mortality
Entangled in AK king crab pot gear	0	0	0	0.75	0	0.2
Entangled in AK tanner crab pot gear	0	0	0	0	1	0.2
Entangled in AK shrimp pot gear	0	1	0	0	0	0.2
Entangled in HI crab pot gear	0	0.75	0	0	0	0.2
Entangled in recreational troll gear	0	0	0	1.5	0	0.3
Entangled in unknown fishing gear	1.75	4.75	5	3.25	4.25	3.8
Ship strike	5.04	1.4	2.0	1.72	1.72	2.4

However, these estimates of serious injury and 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 and serious injury rate unreliable. Further, due to limited Canadian observer program data, mortality and serious injury 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 and serious injury related to commercial fisheries in northern British Columbia are not available, again indicating that the estimated mortality and serious injury incidental to commercial fisheries is underestimated for this stock.

Alaska Native Subsistence/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 occur frequently with humpback whales (Tables 2 and 3). Neilson et al. (2012) summarized 108 large whale ship-strike events in Alaska from 1978 to 2011, 25 of which are known to have resulted in the whale's death. Eighty-six percent of these reports involved humpback whales. The mean annual mortality and serious injury rate due to ship strikes reported in Alaska in 2009-2013 (1.9: Table 2) and Hawaii in 2008-2012 (2.4: Table 3) is 4.3 humpback whales. Most ship strikes of humpbacks are reported from Southeast Alaska; however, there are also reports from the south-central and Kodiak areas of Alaska (Helker et al. 2015). Many of the ship strikes occurring off Hawaii are reported from waters near Maui (Bradford and Lyman 2015). 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. Entanglements in unknown marine debris/gear reported to the NMFS Alaska Region account for an estimated average annual mortality and serious injury rate of 2.6 Central North Pacific humpbacks in 2009-2013 (Table 2).

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 U.S.S.R. 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 densities 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 concluded a global humpback whale Status Review (Bettridge et al. 2015). Although the estimated mean annual human-caused mortality and serious injury rate for the entire Central North Pacific stock (21) is considered a minimum, it is unlikely that the total level of human-caused mortality and serious injury exceeds the PBR level (83) for the entire stock. The minimum estimate of the mean annual U.S. commercial fishery-related mortality and serious injury rate for this stock (6.5) is less than 10% of the calculated PBR for the entire stock (8.3) 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 ESA 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 is unknown.

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 and Alaska waters in an attempt to minimize the impact of whale watching. Additional concerns have been raised in Hawaii about the impact of jet skis and similar fast waterborne tourist-related traffic, notably in nearshore areas inhabited by mothers and calves. In Alaska, NMFS issued regulations in 2001 to prohibit approaches to humpback whales within 100 yards (91.4 m; 66 FR 29502; 31 May 2001). The growth of the whale-watching industry, however, is an ongoing concern as preferred habitats may be abandoned if disturbance levels are too high. Other potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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FIN WHALE (*Balaenoptera physalus*): Northeast Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

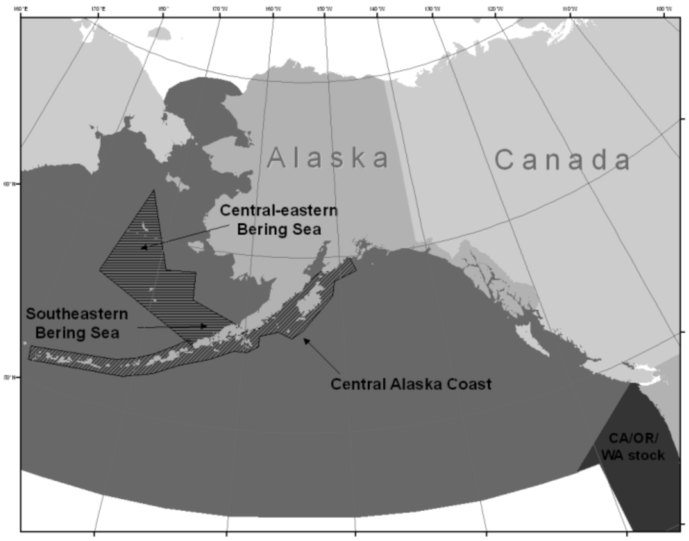

Figure 1. Approximate distribution of fin whales in the eastern North Pacific (dark shaded areas). Striped areas indicate where vessel surveys occurred in 1999-2000 (Moore et al. 2002) and 2001-2003 (Zerbini et al. 2006).

Within the U.S. waters in the Pacific Ocean, fin whales are found seasonally off the coast of North America and in the Bering Sea during the summer (Fig. 1). 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; Širović et al. 2013; Soule and Wilcock 2013). Moore et al. (1998, 2006), Watkins et al. (2000), and Stafford et al. (2007) documented high rates of fin whale calling 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. Širović et al. (2013) speculated that both resident and migratory fin whales may occur off Southern California based on shifts in peaks in fin whale calling data. Soule and Wilcock (2013) documented fin whale call rates in a presumed feeding area along the Juan de Fuca Ridge, offshore of northern Washington State, and found that some whales appear to head northwest from August to October. They speculate that some fin whales may migrate northward in fall and southward in 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). Fin whale calls were detected in the southeast Bering Sea using an instrument moored there from April 2006 through April 2007, which showed peaks in fin whale call detections from September through November 2006 and also in February and March 2007 (Stafford et al. 2010). In addition, fin whale calls were detected in the northeastern Chukchi Sea using instruments moored there in July through October from 2007 through 2010 (Delarue et al. 2013). Call data collected from the Bering Sea suggest that several fin whale stocks may feed in the Bering Sea, but call data collected in the northeast Chukchi Sea suggest that only one of the putative Bering Sea stocks appears to migrate that far north to feed (Delarue et al. 2013). Some fin whale calls have also been recorded in the Hawaiian Exclusive Economic Zone 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 in 1979 (Mizroch et al. 2009), a sighting during an aerial survey in 1994 (Mobley et al. 1996), and five sightings during a survey in 2002 (Barlow 2006).

Surveys on the Bering Sea shelf in 1997, 1999, 2000, 2002, 2004, 2008, and 2010 and in coastal waters of the Aleutian Islands and the Alaska Peninsula from 2001 to 2003 provided information about the distribution and relative abundance of fin whales in these areas (Moore et al. 2000, 2002; Zerbini et al. 2006; Friday et al. 2012, 2013). Fin whales were the most common large whale sighted during the Bering Sea shelf surveys in all years except for 1997 and 2004 (Friday et al. 2012, 2013). Fin whales were consistently distributed both in the “green belt,” an area of high productivity along the edge of the eastern Bering Sea (EBS) continental shelf (Springer et al. 1996), and in the middle shelf with the highest abundances occurring in the “green belt.” Abundance estimates for fin whales in the Bering Sea were consistently higher in cold years than in warm years (Friday et al. 2012, 2013) indicating a shift in distribution. This is consistent with a fine-scale comparison of fin whale occurrence on the middle shelf between a cold year (1999) and a warm year (2002), which found that the group and individual encounter rates were 7-12 times higher in the cold year (Stabeno et al. 2012).

Based on historical whaling data, fin whales were found to range into the southern Sea of Okhotsk and Chukchi Sea. It was assumed that they passed through the Bering Strait into the southwestern Chukchi Sea during August and September. Many were taken as far west as Mys (Cape) Shmidta (68°55'N, 179°24'E) and as far north as 69°04'N, 171°06'W (Mizroch et al. 2009). Fin whale sightings have been increasing during sighting surveys in the Chukchi Sea in summer (Funk et al. 2010, Aerts et al. 2012, Clarke et al. 2013) and fin whale calls have been recorded each year from 2007 to 2010 in August and September on bottom-mounted hydrophones in the Chukchi Sea (Delarue et al. 2013), suggesting they may be re-occupying habitat used prior to large-scale commercial whaling.

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 six populations of fin whales: two that are migratory (eastern and western North Pacific) and 2-4 more that are resident year-round in peripheral seas such as the Gulf of California, East China Sea, Sanriku-Hokkaido, and possibly 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. 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. Mizroch et al. (2009) suggest that this structure should be reviewed and updated, if appropriate, to reflect recent analyses, but the absence of any substantially new data on stock structure makes this difficult. 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 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 could be made.

Visual shipboard surveys for cetaceans were conducted on the eastern Bering Sea shelf during summer in 1997, 1999, 2000, 2002, 2004, 2008, and 2010 (Moore et al. 2000, 2002; Friday et al. 2012, 2013). These surveys were conducted in conjunction with the Alaska Fisheries Science Center echo-integrated trawl survey for walleye pollock, which determined the survey area and timing. The surveys included from 789 km to 3,752 km of effort depending on the year and whether the entire area was surveyed for cetaceans. Results of the surveys in 2002, 2008, and 2010, years when the entire pollock area was surveyed, provided provisional estimates of 419 (CV = 0.33), 1,368 (CV = 0.34), and 1,061 (CV = 0.38) fin whales (Friday et al. 2013). 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, they are expected to be robust as previous studies have shown that only small correction factors are needed for this species (Barlow 1995). 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 (as far as 85 km offshore) 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 between the Kenai Peninsula (150°W) and Amchitka Pass (178°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) fin whales occurred in the area.

Minimum Population Estimate

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 has been calculated in previous Stock Assessment Reports by summing the estimates from Moore et al. (2002) and Zerbini et al. (2006) (n = 5,700). However, based on analyses presented in Mizroch et al. (2009), whales surveyed in the Aleutians (Zerbini et al. 2006) could migrate into the Bering Sea and be counted during the Bering Sea surveys. There are also indications that fin whale distribution in the Bering Sea is related to oceanographic conditions (Stabeno et al. 2012, Friday et al. 2013), making it possible that whales could be double counted when estimates from different years are summed (Moore et al. 2002). Therefore, our best provisional estimate of the fin whale population west of the Kenai Peninsula would be 1,368, the greater of the minimum estimates from the 2008 and 2010 surveys (Friday et al. 2013). 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. This is considered a minimum estimate for a portion of the range of this stock; therefore, the N_{MIN} for the entire stock is unknown.

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 fin whales in the area. Also, the study represented only a small fraction of the range of the Northeast Pacific stock.

Friday et al. (2013) estimated a 14% (95% CI: 1.0-26.5%) annual rate of change in abundance of fin whales during the period from 2002 to 2010. However, this apparent rate of change in abundance is higher than most plausible estimates of rates of change for large whale populations (see Zerbini et al. 2010 for a discussion of maximum rates of increase for humpback whale populations). It is likely that the apparent rate of change in abundance in the study area is due at least in part to changes in distribution and not just to changes in overall population size. Friday et al. (2013) found that the abundance of fin whales in the survey area increased in colder years, likely due to shifts in the distribution of prey. Stafford et al. (2010) provided evidence of prey-driven distribution where fin and right whale call rates in the vicinity of mooring M2 (approximate location: 57.9°N, 164.1°W) increased following peaks in euphausiid and copepod biomass.

Moore and Barlow (2011) analyzed trends in fin whale abundance from 1991 to 2008 from surveys conducted off California and found sufficient variability in trend estimates to conclude that the estimates were likely demonstrating dispersal of new individuals into the study area rather than actual population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Zerbini et al. (2006) estimated an annual increase in coastal waters south of the Alaska Peninsula of 4.8% (95% CI: 4.1-5.4%) for the period 1987-2003. However, there are uncertainties in the initial population estimate from 1987, as well as uncertainties regarding fin whale population structure in this area. 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). However, because an estimate of minimum abundance is not available, the PBR level for the Northeast Pacific fin whale stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

One incidental mortality of a fin whale due to entanglement in the ground tackle of a commercial mechanical jig fishing vessel was reported to the NMFS Alaska Region in 2012 (Table 1; Helker et al. 2015). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 fin whales in 2009-2013 (Table 1).

Table 1. Summary of mortality and serious injury of the Northeast Pacific stock of fin whales, by year and type, reported to the Alaska Region, marine mammal stranding database, in 2009-2013 (Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of injury	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean annual mortality**
Ship strike	1	1	0	0	0	0.4
Entangled in ground tackle of commercial mechanical jig fishing vessel	0	0	0	1	0	0.2

Alaska Native Subsistence/Harvest Information

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

Other Mortality

Between 1911 and 1985, 49,936 fin whales were reported killed throughout the North Pacific (Mizroch et al. 2009), 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). Fin whale mortality due to ship strikes in Alaska waters (one each in 2009 and 2010) has also been reported to the NMFS Alaska Region stranding database (Helker et al. 2015), resulting in a mean annual mortality and serious injury rate of 0.4 fin whales due to ship strikes in 2009-2013 (Table 1).

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 and population trends 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 is currently not available. The total estimated annual rate of mortality and serious injury for this stock is 0.6 based on takes incidental to U.S. commercial fisheries (0.2) and ship strikes (0.4). Because the PBR is undetermined, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

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) recognized 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°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 (Moore et al 2000, Friday et al. 2012, Clarke et al. 2013) but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982, Brueggeman et al. 1990). Recent visual and acoustic data found minke whales in the Chukchi Sea north of Bering Strait in July and August (Clarke et al. 2013), and minke whale "boing" sounds have been detected in the northeast Chukchi Sea in August, October, and November (Delarue 2013). There are two types of geographically distinct "boing" sounds produced by minke whales in the North Pacific (Rankin and Barlow 2005). Those recorded in the Chukchi Sea matched "central Pacific" boings leading the authors to hypothesize that minke whales from the Chukchi Sea might winter in the central North Pacific, not near Hawaii (Delarue et al. 2013).

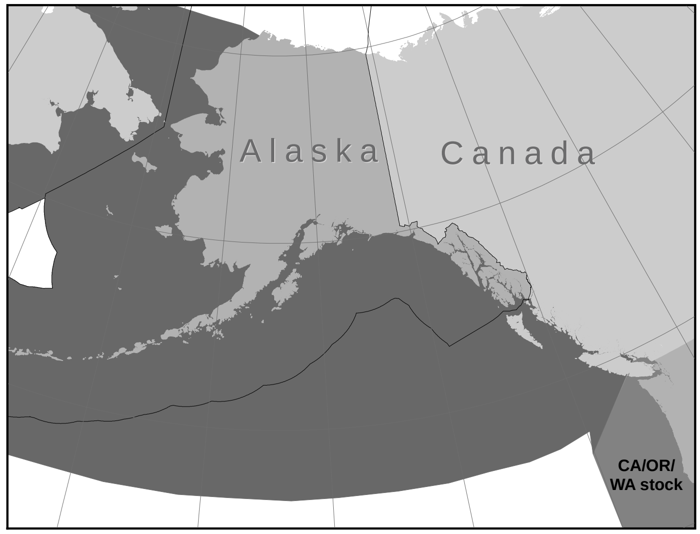

Figure 1. Approximate distribution of minke whales in the eastern North Pacific (dark shaded areas).

Ship surveys on the eastern Bering Sea shelf in 1999, 2000, 2002, 2004, 2008, and 2010 resulted in new information about the distribution and relative abundance of minke whales in this area (Moore et al. 2002; Friday et al. 2012, 2013). When comparing distribution and abundance in years when the entire study area was surveyed (2002, 2008, and 2010), Friday et al. (2013) found that minke whales were scattered throughout the study area in all oceanographic domains (coastal, middle shelf, and outer shelf/slope) in 2002 and 2008 but were concentrated in the outer shelf and slope in 2010. The highest minke whale abundance in the study area occurred in 2010 and abundance was greater in cold years (2008 and 2010) than a warm year (2002); however, changes in abundance were thought to be due at least in part to changes in distribution (Friday et al. 2013).

So few minke whales were seen during two offshore Gulf of Alaska surveys for cetaceans in 2009 and 2013 that a population estimate for this species in this area could not be determined (Rone et al. 2010, 2014).

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

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. However, some information is available on the numbers of minke whales in some areas of Alaska. Visual surveys for cetaceans were conducted on the eastern Bering Sea shelf in 2002, 2008, and 2010 in cooperation with research on commercial fisheries (Friday et al. 2013). The surveys included 3,752 km, 3,253 km, and 1,638 km of effort in 2002, 2008, and 2010, respectively. Results of the surveys in 2002, 2008, and 2010 provide provisional abundance estimates of 389 (CV = 0.52), 517 (CV = 0.69), and 2,020 (CV = 0.73) minke whales on the eastern Bering Sea shelf, respectively (Friday et al. 2013). 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 30-45 nautical miles 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

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historical injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

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 2009-2013: the Bering Sea/Aleutian Islands groundfish trawl, longline, and pot fisheries and the Gulf of Alaska groundfish trawl, longline, and pot fisheries. However, no mortality or serious injury of minke whales occurred in observed U.S. commercial fisheries in 2009-2013.

Alaska Native Subsistence/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 to have been taken for subsistence by Alaska

Natives between 1930 and 1987 (C. Allison, International Whaling Commission, UK, pers. comm.). The most recent reported catches (two whales) in Alaska occurred in 1989 (Anonymous 1991), but reporting is likely incomplete. Based on this information, the average annual subsistence take was zero minke whales in 2009-2013.

Other Mortality

From 2009 to 2013, no human-related mortality or serious injury of minke whales was reported to the NMFS Alaska Region stranding database (Helker et al. 2015).

STATUS OF STOCK

Minke whales are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The greatest uncertainty regarding the status of the Alaska minke whale stock has to do with the uncertainty pertaining to the stock structure of this species in the eastern North Pacific. Because minke whales are considered common in the waters off Alaska and, because the number of human-related removals is currently thought to be minimal, this stock is presumed to not be a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population are currently not available. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

Potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

A review of all 20th century sightings, 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 (Fig. 1; 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. 1), 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. Following large illegal catches (1962-1968) by the U.S.S.R. (Ivashchenko and Clapham 2012, Ivashchenko et al. 2013), only 82 sightings of right whales in the entire eastern North Pacific were reported from 1962 to 1999, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). Additional sightings have been reported as far south as central Baja California and as far east as Yakutat Bay and Vancouver Island 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; Rowntree et al. 1980; Berzin and Doroshenko 1982; Salden and Mickelsen 1999; Brownell et al. 2001; J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm., 28 October 2013). However, most right whale sightings in the past 20 years have occurred in the southeastern Bering Sea, with a few in the Gulf of Alaska, near Kodiak, Alaska (Waite et al. 2003; Shelden et al. 2005; Wade et al. 2011a, 2011b).

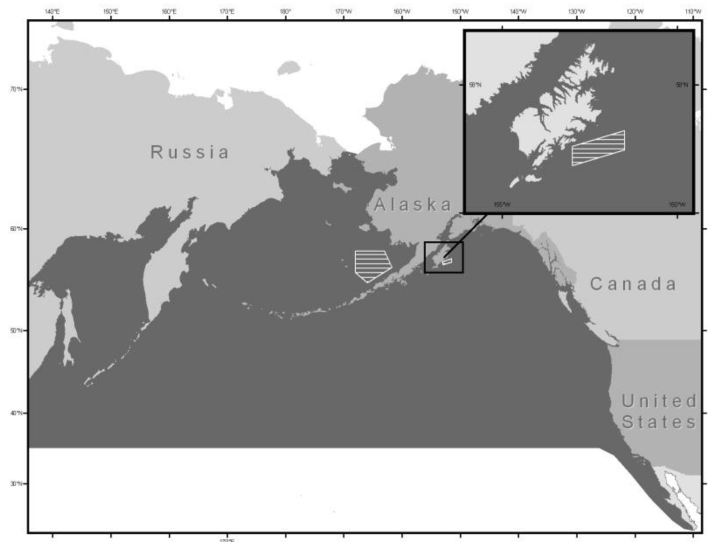

Figure 1. Approximate historical distribution of North Pacific right whales in the eastern North Pacific (dark shaded area). Striped areas indicate northern right whale critical habitat (71 FR 38277, 6 July 2006).

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). A right whale sighted off Maui in April 1996 was identified 119 days later and 4,111 km north in the Bering Sea (Salden and Michelsen 1999, Kennedy et al. 2011). While the photographic match confirms that Bering Sea animals occasionally travel south, there is currently 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).

Information on the summer and autumn distribution of right whales is available from dedicated vessel and aerial surveys, bottom-mounted acoustic recorders, and vessel surveys for fisheries ecology and management that 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. 1) where right whales have been observed most summers since 1996 (Goddard and Rugh 1998, Rone et al. 2012). 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 (Moore et al. 2000, 2002; LeDuc et al. 2001; Clapham et al. 2004). 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, Stafford et al. 2010). Recorders deployed from 2007 to 2013 have not yet been fully analyzed, but they indicate the presence of right whales in the southeastern Bering Sea almost year-round, with a peak in August and a sharp decline in detections in early January (Catherine Berchok, NMFS-AFSC-NMML, 7600 Sand Point Way NE, Seattle, WA 98115, unpubl. data). Use of this habitat may intensify in mid-summer through early fall based on higher monthly and daily call detection rates. The probability of acoustically detecting right whales in the Bering Sea has been found to be strongly influenced by the abundance of the copepod *Calanus marshallae* (Baumgartner et al. 2013), and those authors propose that *C. marshallae* is the primary prey for right whales on the Bering Sea shelf. The seasonal development of these copepods into later life-history stages that can be exploited by right whales closely matches the peak timing of right whale call detections (Munger et al. 2008, Baumgartner et al. 2013). Additionally, right whale "gunshot" call detections increased shortly after peaks in copepod biovolume (Stafford et al. 2010). Baumgartner et al. (2013) suggest that the availability of *C. marshallae* on the middle shelf of the southeast Bering Sea is the reason right whales aggregate there annually. Satellite telemetry data from four whales tagged in 2008 and 2009 provide further indication of this area's importance as foraging habitat for Eastern North Pacific right whales (Zerbini et al. 2015). Right whales have not been observed outside the localized area in the southeastern Bering Sea during surveys conducted for fishery management purposes that covered a broader area of Bristol Bay and the Bering Sea (Moore et al. 2000, 2002; see Fig. 1 in the Northeast Pacific fin whale Stock Assessment Report for locations of tracklines for these surveys).

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, notably in the offshore areas where right whales commonly occurred during whaling days (Ivashchenko and Clapham 2012). Waite et al. (2003) summarized sightings from the Platforms of Opportunity Program from 1959 to 1997. Additional lone animals were observed off Kodiak Island in the Barnabas Canyon area from NOAA surveys in August 2004, 2005, and 2006 (A. Zerbini, NMFS-AFSC-NMML, 7600 Sand Point Way NE, Seattle, WA 98115, unpubl. data). A single right whale was reported in Pasagshak Bay by a kayaker in May of 2010, and one was sighted in December 2011 by humpback researchers in Uganik Bay (A. Kennedy, NMFS-AFSC-NMML, pers. comm., 7 October 2012). A single right whale was sighted south of the Alaska Peninsula (53.5°N, 156.5°W) during a seismic survey in July 2011 (Davis et al. 2011). Acoustic monitoring from May 2000 to July 2001 at seven sites in the Gulf of Alaska detected right whale calls at only two sites: one off eastern Kodiak and the other in deep water south of the Alaska Peninsula (detection distance in 10s of kilometers) (Mellinger et al. 2004). More recently, right whale up calls were detected on a recorder deployed near Quinn Seamount in the Gulf of Alaska on a few days each in June, July, August, and September 2013 (Širović et al. 2014).

Most of the illegal Soviet catches of right whales occurred in offshore areas, including a large area to the east and southeast of Kodiak (Doroshenko 2000, Ivashchenko and Clapham 2012); the Soviet catch distribution closely parallels that seen in plots of 19th century American whaling catches by Townsend (1935). 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 in coastal waters east of Kodiak indicate at least occasional continuing use of this area.

In recent years, there have been two sightings of single right whales in the waters of British Columbia. The first was observed off Haida Gwaii on 9 June 2013 and the second, a large adult, was seen in the Strait of Juan de Fuca on 25 October 2013; this second animal had an apparently healed major wound across the rostrum, which may have been caused by a previous entanglement in fishing gear (J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm., 26 October 2013). Two right whale calls were detected on a bottom-mounted hydrophone off the Washington Coast on 29 June 2013. No right whale calls were detected in previous years at this site (Širović et al. 2014).

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: evidence for some isolation of populations. 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, LeDuc et al. 2012). The former is believed to feed primarily in the Sea of Okhotsk.

POPULATION SIZE

Illegal catches of an estimated 681 right whales in the eastern and western North Pacific between 1962 and 1968 severely impacted the two populations concerned, notably in the east (Ivashchenko and Clapham 2012, Ivashchenko et al. 2013). 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 Okhotsk Sea.

There were several sightings of North Pacific right whales in the mid-1990s, which renewed interest in conducting dedicated surveys for this species that included the collection of photo-IDs and biopsies. 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 4,111 km north (in the Bering Sea); this represents the first high- to low-latitude match of a North Pacific right whale (Kennedy et al. 2011). The Maui sighting in April 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, there is little 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, that may have included a juvenile animal, was sighted in western Bristol Bay, southeastern Bering Sea, in July 1996 (Goddard and Rugh 1998). In 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 of 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 southeast 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 southeastern 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 seven females was significant as only one female had been identified previously, and at least two calves were present. From 2007 to 2011, 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. 2011a). 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. (2011a) also estimate the population consists of 8 females (95% CL: 7-18) and 20 males (95% CL: 17-37). Wade et al. (2011a) 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 to 2004, comprising 15 males and 6 females. In aggregate, there were eight photo matches of individual whales across years involving five 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 four biopsies taken in 2008 and 2009 of two males and two females; three of these animals had been sampled in previous years. These samples were only recently processed and were not included in the Wade et al. (2011a) abundance estimate (A. Kennedy, NMFS-AFSC-NMML, pers. comm., 21 September 2011).

The photo-identification catalogue, for purposes of abundance estimation, was restricted to aerial or left-side oblique photographs of good or excellent photo quality. After this restriction, there were a total of 18 unique individuals identified from photographs of callosity patterns and scars from 1998 to 2008, with 10 resightings across years involving 5 individuals.

Another seven individuals were observed in the summer of 2009, and one individual was seen in the summer of 2010 (A. Kennedy, NMFS-AFSC-NMML, pers. comm., 3 November 2010). Four individuals were seen in the summer of 2011 (B. Rone, NMFS-AFSC-NMML, pers. comm., 7 October 2012). The two sightings noted above of right whales (one in June and one in October) in British Columbia waters in 2013 were the first sightings of this species in this region in decades. Comparisons with the photo-identification catalogue curated at the National Marine Mammal Laboratory showed that neither individual had been previously photographed elsewhere. Whether this indicates that right whales are returning to these coastal waters where they were once hunted is unclear.

LeDuc et al. (2012) analyzed 49 biopsy samples from right whales identified as being from 24 individuals, of which all but one were from the eastern North Pacific. The analysis revealed a male-biased sex ratio and a loss of genetic diversity that appeared to be midway between that observed for right whales in the North Atlantic and the Southern Hemisphere. The analysis also suggested a degree of separation between eastern and western populations, a male:female ratio of 2:1, and a low effective population size for the Eastern North Pacific stock, which LeDuc et al. (2012) considered to be at “extreme risk” of extirpation.

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 and 1960s. With the exception of the Soviet catches, primarily in 1963-1964 (Ivashchenko and Clapham 2012), 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 (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 (Wade et al. 2011b). 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 two 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 five 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 four 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. 2011b). Right whale up-calls were detected far offshore in the Gulf of Alaska in 2013 on a bottom-mounted recorder at Quinn Seamount during a total of 3 hours on 2 days (21 June and 3 August 2013). Right whale down calls were detected during 50 hours from 27 July to 5 September 2013 (Širović et al. 2014). 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 or the call type targeted for detection. Until very recently, only a single call type, the “up call” was used to automatically detect right whales. The “gunshot” call has recently been identified as another candidate for right whale detections (Stafford et al. 2010). However, it is interesting to note the contrasting data from the southeastern Bering Sea, where similar instruments on the middle shelf (<100 m depth) detected right whale calls on >6 days per month in July-October (Munger et al. 2008), despite a population estimated to be only 31 whales (Wade et al. 2011a). 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 at least the monitored pelagic areas 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. 2011b) 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. However, there has been virtually no survey coverage of the offshore waters in which right whales commonly occurred during historical and recent whaling periods (Townsend 1935, Ivashchenko and Clapham 2012).

Minimum Population Estimate

The minimum estimate of abundance of North Pacific right whales is 25.7 based on the 20th percentile of the photo-identification estimate of 31 (CV = 0.226; Wade et al. 2011a). The photo-identification catalogue used in the mark-recapture abundance estimate has a minimum of 20 unique individuals seen from 1998 to 2013, 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 23 individuals identified from 1997 to 2011 (LeDuc et al. 2012).

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, male bias, and low observed calving rate of this population, this rate is likely to 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. 2011a). The calculated PBR level for this stock is therefore 0.05 which would be equivalent to one take every 20 years. However, because the Eastern North Pacific right whale population is far below historical levels and considered to include less than 30 mature females, the calculated value for PBR is considered unreliable.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Gillnets were implicated in the death of a right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994), which was presumably from the western North Pacific population. No other incidental takes of right whales are known to have occurred in the North Pacific, although one photograph from the catalogue shows potential fishing gear entanglement (A. Kennedy, NMFS-AFSC-NMML, pers. comm., 21 September 2011). The right whale photographed on 25 October 2013 off British Columbia and northern Washington State, showed potential fishing gear entanglement (J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm., 28 October 2013). Vessel collisions are considered the primary source of human-caused mortality and serious injury of right whales in the North Atlantic (Cole et al. 2005). Given the very small estimate of abundance, any mortality or serious injury 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 and serious injury for the North Atlantic right whale stock (Waring et al. 2004).

There are no records of mortality or serious injury of Eastern North Pacific right whales in any U.S. fishery. Thus, the estimated annual mortality and serious injury rate incidental to U.S. commercial fisheries approaches zero whales per year from this stock. Therefore, the annual human-caused mortality and serious injury level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Alaska Native Subsistence/Harvest Information

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

Other Mortality

Ship strikes are a significant source of mortality and serious injury 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. There is concern regarding the effects of increased shipping through Arctic waters and the Bering Sea with retreating sea ice, which may increase the potential risk to right whales from shipping.

Overall, given the remote nature of the known and likely habitats of North Pacific right whales, it is very unlikely that any mortality in this population would be observed. Consequently, it is possible that the current absence of reported deaths in this stock is not a reflection of the true situation.

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. The abundance of this stock is considered to represent only a small fraction of its pre-commercial whaling abundance (i.e., the stock is well below its Optimum Sustainable Population). The estimated annual rate of human-caused mortality and serious injury is considered 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 (Ivashchenko and Clapham 2012); 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 currently the most endangered stock of large whales in the world for which an abundance estimate is available.

HABITAT CONCERNS

NMFS conducted an analysis of right whale distribution in historical times and in recent years and stated that principal habitat requirements for right whales 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. 1). In 2008, NMFS redesignated the same two areas as Eastern North Pacific right whale critical habitat under the newly recognized species name, *E. japonica*.

Potential threats to the habitat of this population derive primarily from commercial shipping and fishing vessel activity. There is considerable fishing activity within portions of the critical habitat of this species, increasing the risk of entanglement, although photographs of right whales taken to date have shown no evidence of entanglement scars. The high volume of large vessels transiting Unimak Pass (e.g., 1,961 making 4,615 transits in 2012 (Nuka Research and Planning Group, LLC 2014a, 2014b), a subset of which continue north through the Bering Sea, increases both the risk of ship strikes and the risk of a large or very large oil spill in areas in which right whales may occur. The risk of accidents in Unimak Pass, specifically, is predicted to increase in the coming decades, and studies indicate that more accidents are likely to involve container vessels (Wolniakowski et al. 2011) The U.S. Department of the Interior has designated areas within the southeastern Bering Sea, including areas designated as right whale critical habitat, as an outer continental shelf oil and gas lease area. 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. On December 16, 2014, President Obama announced that, under authority granted him by Section 12(a) of the Outer Continental Lands Act (OCSLA), he was withdrawing the North Aleutian Basin from future oil and gas leasing, development or production "for a time period without specific expiration." Thus, oil and gas leasing in federal waters in this area is not likely for the foreseeable future.

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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 2010). Small stocks, comprised of only a few tens to a few hundreds of individuals, occur in the Sea of Okhotsk and the offshore waters of Spitsbergen (Zeh et al. 1993, Shelden and Rugh 1995, Wiig et al. 2009). Bowheads occur in western Greenland (Hudson Bay and Foxe Basin) and eastern Canada (Baffin Bay and Davis Strait), and recent evidence suggests that these should be considered one stock based on genetics (Postma et al. 2006, Bachmann et al. 2010, Heide-Jørgensen et al. 2010, Wiig et al. 2010), aerial surveys (Cosens et al. 2006), and tagging data (Dueck et al. 2006; Heide-Jørgensen et al. 2006; IWC 2010, 2011). This stock, previously thought to include only a few hundred animals, may number over a thousand (Heide-Jørgensen et al. 2006, Wiig et al. 2011), and perhaps over 6,000 (IWC 2008). The only stock found within U.S. waters is the Western Arctic stock (Figs. 1 and 2), also known as the Bering-Chukchi-Beaufort stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). Although Jorde et al. (2007) suggested there might be multiple stocks of bowhead whales in U.S. waters, several studies (George et al. 2007, Taylor et al. 2007, Rugh et al. 2009) and the IWC Scientific Committee concluded that data are most consistent with one stock that migrates throughout waters of northern and western Alaska (IWC 2008).

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 eastern Beaufort Sea (Fig. 1) where they spend much of the summer (June through early to mid-October) before returning again to the Bering Sea (Fig. 2) in the fall (September through December) to overwinter (Braham et al. 1980, Moore and Reeves 1993, Quakenbush et al. 2010a). Some bowheads are found in the western Beaufort,

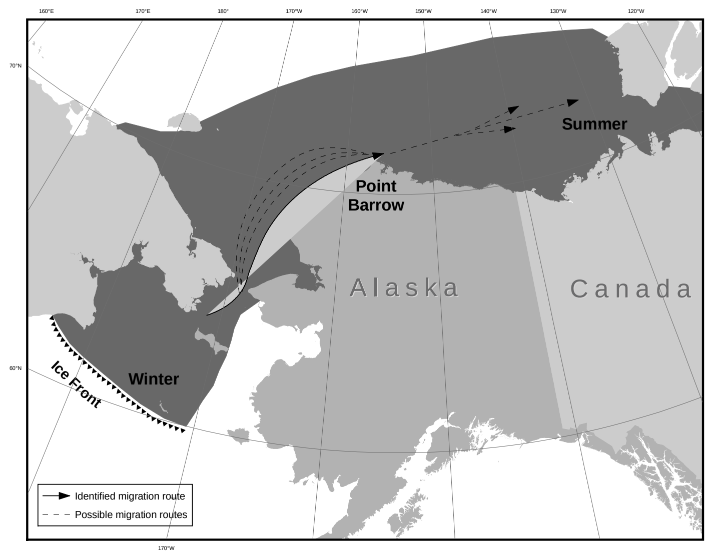

Figure 1. Dark areas depict the approximate distribution of the Western Arctic stock of bowhead whales. The spring migration represented here by lines and arrows follows a route from the Bering Sea wintering area to the Beaufort Sea summering area, mostly along a coastal tangent that constricts somewhat as it goes east past Point Barrow.

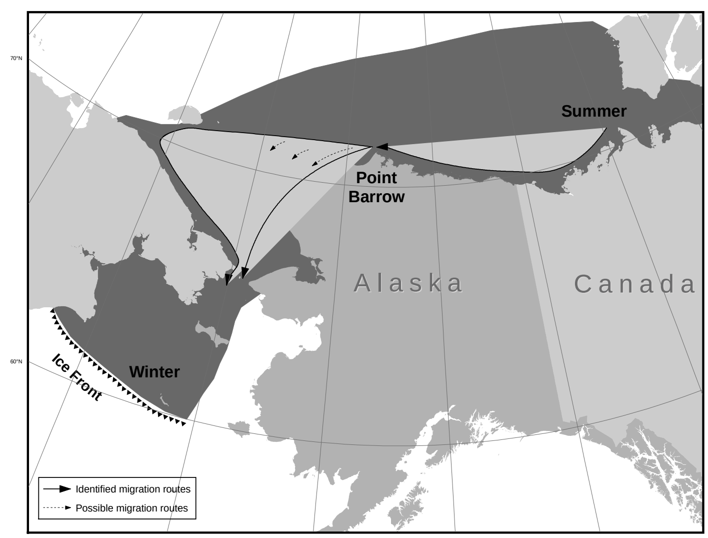

Figure 2. Dark areas depict the approximate distribution of the Western Arctic stock of bowhead whales. The fall migration is represented here by lines and arrows showing generalized routes used to travel from the Beaufort Sea (summering area) to the Bering Sea (wintering area).

Chukchi, and Bering seas in summer, and these are thought to be a part of the expanding Western Arctic stock (Rugh et al. 2003; Clarke et al. 2013, 2014).

During winter and spring, 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 summer, most of the population is in relatively ice-free waters in the southeastern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration (e.g., Richardson et al. 1987, Davies 1997). Summer aerial surveys conducted in the western Beaufort Sea during July and August of 2012-2014 have had relatively high sighting rates of bowhead whales, including cows with calves and feeding animals (Clarke et al. 2013, 2014; NMML, unpubl. data, available online: http://www.afsc.noaa.gov/nmml/cetacean/bwasp/flights_2014.php, accessed December 2015). During the autumn migration through the Beaufort Sea, bowheads select shelf waters in all but "heavy ice" conditions, when they select slope habitat (Moore 2000). Heavy ice years in the autumn in the Beaufort Sea are becoming less common because of the retreat of Arctic sea ice. In winter in the Bering Sea, bowheads 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 and eastern Canadian Beaufort Sea; central and western U.S. Beaufort Sea; Wrangel Island; and the coast of Chukotka, between Wrangel Island and the Bering Strait (Lowry et al. 2004; Ashjian et al. 2010; Clarke and Ferguson 2010a; Quakenbush et al. 2010a, 2010b; Okkonen et al. 2011; Clarke et al. 2012, 2013, 2014; NMML, unpubl. data, available online: http://www.afsc.noaa.gov/nmml/cetacean/bwasp/flights_2014.php, accessed December 2015). 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 estimate bowhead population size 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 (2006) used Bayesian model averaging to estimate that the Western Arctic stock consisted of 10,960 (9,190-13,950; 5th and 95th 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 near Point Barrow during the whales' spring migration (Krogman et al. 1989). These counts have been corrected for whales missed due to distance offshore (since the mid-1980s, using acoustical methods 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 1 and Figure 3. These estimates of abundance have not been corrected for a small portion of the population that may not migrate past Point Barrow during

Table 1. Summary of 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). The 2011 estimate is reported in Givens et al. (2013).

Year	Abundance estimate (CV)	Year	Abundance estimate (CV)
Historical estimate	10,400-23,000	1985	5,762 (0.253)
End of commercial whaling	1,000-3,000	1986	8,917 (0.215)
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)	2011	16,892 (0.058)

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 (IWC 2010, George et al. 2011) but were successful in 2011. The ice-based abundance estimate in 2001 was 10,545 (CV = 0.128) (updated from George et al. 2004 by Zeh and Punt 2004). The 2011 ice-based abundance estimate was 16,892 (95% CI: 15,074-18,928) (Givens et al. 2013).

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: 3,150-15,450) in 2001 (Schweder et al. 2009) and 12,631 whales (95% CI: 7,900-19,700) in 2004 (Koski et al. 2010), which are consistent with trends in abundance estimates made from ice-based counts. An aerial photographic survey was conducted near Point Barrow concurrently with the ice-based spring census in 2011; these data are currently being analyzed to produce a revised abundance estimate based on sight-resight data (Mocklin et al. 2012).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 2011 population estimate (N) of 16,892 and its associated CV(N) of 0.058, N_{MIN} for the Western Arctic stock of bowhead whales is 16,091.

Current Population Trend

Based on concurrent passive acoustic and ice-based visual surveys, Givens et al. (2013) reported that the Western Arctic stock of bowhead whales increased at a rate of 3.7% (95% CI = 2.8-4.7%) from 1978 to 2011, during which time abundance tripled from approximately 5,000 to approximately 16,000 whales (Givens et al. 2013). 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.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.2-3.7%) should not be used as an estimate of (R_{MAX}) because the population is currently being harvested. It is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be used for the Western Arctic stock of bowhead whales (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the 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 Wade and Angliss 1997, Pp. 27-28). Thus, PBR = 161 animals (16,091 × 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 established under the authority of the IWC based on an extensively tested strike limit algorithm (IWC 2003). The quota is based on subsistence need or the ability of the bowhead population to sustain a harvest, whichever is smaller. The IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. For 2013-2018, the IWC established a block quota of 306 landed bowheads. Because some whales are struck and lost, a strike limit of 67 (plus up to 15 previously unused strikes) could be taken each year. This quota includes an allowance of five animals to be taken by Chukotka Natives in Russia. The 2013-2018 quota maintains the *status quo* of the previous 5-year block quota (2008-2012) but was extended for 6 years.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

Several cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al. 1993). Further, a thorough reexamination of bowhead harvest records is ongoing and there are preliminary indications that entanglements or scarring attributed to ropes may include over 20 cases (C. George, Department of Wildlife Management, North Slope Borough, pers. comm.).

There are no observer program records of bowhead whale mortality incidental to U.S. commercial fisheries in Alaska. However, some bowhead whales have historically had interactions with crab pot gear and fishing nets. 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; Table 2), and one entangled bowhead was photographed during the 2011 spring aerial photographic survey of bowhead whales near Point Barrow (Mocklin et al. 2012). More recently, Citta et al. (2014) found that the distribution of satellite-tagged bowhead whales in the Bering Sea spatially and temporally overlapped areas where commercial pot fisheries occurred and noted the potential risk of entanglement in lost gear. The minimum average annual mortality and serious injury rate in U.S. commercial fisheries in 2009-2013 is 0.2 whales; however, the actual rate is currently unknown.

Table 2. Summary of mortality and serious injury of the Western Arctic stock of bowhead whales, by year and type, reported to the NMFS Alaska Region, marine mammal stranding database, in 2009-2013 (Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of injury	2009	2010	2011	2012	2013	Mean annual mortality
Entangled in unspecified pot gear	0	1	0	0	0	0.2

Alaska Native Subsistence/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, primarily from 11 Alaska communities, take approximately 0.1-0.5% of the population per annum (Philo et al. 1993, Suydam et al. 2011). Under this quota, the number of kills in any one year has ranged between 14 and 72. The maximum number of takes per year is set by the quota, which is itself determined by the subsistence need and the abundance and trend estimates (Stoker and Krupnik 1993). Suydam and George (2012) summarized Alaskan subsistence harvests of bowheads from 1974 to 2011 and reported a total of 1,149 whales landed by hunters from 12 villages, with Barrow landing the most whales (n = 590) and Shaktoolik landing only one. Alaska Natives landed 31 whales in 2009 (Suydam et al. 2010), 45 in 2010 (Suydam et al. 2011), 38 in 2011 (Suydam et al. 2012), 55 in 2012 (Suydam et al. 2013), and 46 in 2013 (George and Suydam 2014, Suydam et al. 2014). 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% and Suydam et al. (2014) reported that the current mean efficiency, from 2004 to 2013, is 77%.

Canadian and Russian Natives also take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik harvested one whale in 1991 and one in 1996. No catches for Western Arctic bowheads were reported by either Canadian or Russian hunters for 2006-2007 (IWC 2008, 2009) or by Russia in 2009, 2011, and 2012 (IWC 2011, Ilyashenko 2013), but two bowheads were taken in Russia in 2008 (IWC 2010), two in 2010 (IWC 2012), and one in 2013 (Ilyashenko and Zharikov 2014). The average annual subsistence take (by Natives of Alaska, Russia, and Canada) during the 5-year period from 2009 to 2013 was 44 bowhead whales.

Other Mortality

Pelagic commercial whaling for bowheads was conducted from 1849 to 1914 in the Bering, Chukchi, and Beaufort seas (Bockstoce et al. 2007). During the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling population was killed, 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).

With increasing ship traffic and oil and gas activities in the Chukchi and Beaufort seas, bowheads may become increasingly at risk from ship strikes.

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 (16.1) and, therefore, can be considered to be insignificant. The average annual level of human-caused mortality and serious injury (44) is not known to exceed the PBR (161) nor the IWC annual maximum strike limit (67). The Western Arctic bowhead whale stock has been increasing in recent years; the estimate of 16,892 from 2011 is between 31% and 170% 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.

HABITAT CONCERNS

Vessel traffic in Arctic waters is increasing, largely due to an increase in oil and gas activities and commercial shipping. This increase in vessel traffic could result in an increased number of vessel collisions with bowhead whales (Huntington et al. 2015).

Increasing oil and gas development in the Arctic has led to an increased risk of various forms of pollution in bowhead whale habitat, including oil spills and other pollutants. Also of concern is noise produced by the increased number of seismic surveys and increased vessel traffic resulting from shipping and offshore energy exploration, development, and production operations. 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 activity. Studies in the 1980s indicated that bowheads reacting to seismic activity appeared to recover from behavioral changes within 30-60 minutes following the end of the activity (Richardson et al. 1986, Ljungblad et al. 1988). However, more recent monitoring studies of 3-D seismic exploration in the nearshore Beaufort Sea during 1996-1998 demonstrated that nearly all fall-migrating bowhead whales avoided an area within 20 km of an active seismic source (Richardson et al. 1999). Furthermore, the studies also suggested that the bowhead whales' offshore displacement may have begun roughly 35 km (19 nautical miles or 22 statute miles) 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 swam 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 that feeding bowhead whales had a greater tolerance of higher sound levels than did 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 indicated that bowheads feeding during late summer and autumn did not exhibit large-scale distribution changes in relation to seismic operations (Funk et al. 2010). 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. They could be experiencing increased stress by staying in a location with very loud noise (MMS 2008). A recent study by Blackwell et al. (2015) found that bowheads react differently to different thresholds of seismic noise. At relatively low cumulative exposure levels (as soon as airguns were just detectable), bowhead whales almost doubled their call rates. Once cumulative exposure levels exceeded 127 dB re 1 μPa^2-s, call rates decreased. Bowheads went completely silent at received levels over 160 dB re 1 μPa^2-s. These authors note that the existence of two behavioral thresholds for calling by bowhead whales can explain results of previous studies that found variability in bowhead call rates in the presence or absence of airgun pulses (i.e., Greene et al. 1996).

Another concern for bowhead whales and other Arctic species is climate change, 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, Jeffries et al. 2014). 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). Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or sea-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. 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 presently tolerating recent trends in declining seasonal sea-ice coverage, volume, and duration.

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Appendix 1. Summary of changes to the 2015 stock assessments (last revised 12/30/2015). An 'X' indicates sections where the information presented has been updated since the 2014 stock assessments were released.

Stock	**Stock definition**	**Population size**	**PBR**	**Fishery mortality**	**Subsistence mortality**	**Status**
Steller sea lion (Western U.S.)	X	X	X	X	X	X
Steller sea lion (Eastern U.S.)						
Northern fur seal	X			X	X	X
Harbor seal (Aleutian Islands)	X	X	X	X		X
Harbor seal (Pribilof Islands)	X	X		X		X
Harbor seal (Bristol Bay)	X	X	X	X		X
Harbor seal (North Kodiak)	X	X	X	X	X	X
Harbor seal (South Kodiak)	X	X	X	X	X	X
Harbor seal (Prince William Sound)	X	X	X	X	X	X
Harbor seal (Cook Inlet/Shelikof Strait)	X	X	X	X		X
Harbor seal (Glacier Bay/Icy Strait)	X	X	X	X	X	X
Harbor seal (Lynn Canal/Stephens Passage)	X	X	X	X	X	X
Harbor seal (Sitka/Chatham Strait)	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						
Bearded seal	X	X	X	X	X	X
Ringed seal	X			X	X	X
Ribbon seal	X	X	X	X	X	X
Beluga whale (Beaufort Sea)						
Beluga whale (Eastern Chukchi Sea)						
Beluga whale (Eastern Bering Sea)						
Beluga whale (Bristol Bay)						
Beluga whale (Cook Inlet)	X	X		X	X	X
Narwhal						
Killer whale (Alaska Resident)						
Killer whale (Northern Resident)						
Killer whale (Gulf of Alaska, Aleutian Islands, and Bering Sea Transient)						
Killer whale (AT1 Transient)	X	X		X		X
Killer whale (West Coast Transient)						
Pacific white-sided dolphin	X			X		
Harbor porpoise (Southeast Alaska)	X	X	X	X		X
Harbor porpoise (Gulf of Alaska)	X			X	X	X
Harbor porpoise (Bering Sea)	X	X		X	X	X
Dall's porpoise	X	X	X	X		X
Sperm whale	X	X		X		
Baird's beaked whale						
Cuvier's beaked whale						
Stejneger's beaked whale						
Humpback whale (Western North Pacific)	X	X	X	X		X
Humpback whale (Central North Pacific)	X	X	X	X		X
Fin whale	X			X		
Minke whale	X	X		X		
North Pacific right whale	X	X	X	X		
Bowhead whale	X	X	X	X	X	X

Appendix 2. Stock summary table (last revised 12/30/2015). Stock assessment reports for those stocks in boldface were updated in the 2015 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}	Year of last survey	R_{MAX}	F_R	PBR	Commer. fishery mort.	Native subsist. mort.	Total mort.	Status
Steller sea lion	**Western U.S.**	**49,497**		**49,497**	**2014**	**0.12**	**0.1**	**297**	**31**	**199**	**233**	**S**
Steller sea lion	Eastern U.S.	60,131-74,448		36,551	2013	0.12	0.75	1,645	51.6[a]	11.3	92.3	S
Northern fur seal	**Eastern Pacific**	**648,534**	**0.2**	**548,926**	**2012**	**0.086**	**0.5**	**11,802**	**1.1**	**432**	**439**	**S**
Harbor seal	**Aleutian Islands**	**6,431**		**5,772**	**2011**	**0.12**	**0.5**	**173**	**0**	**90**	**90**	**NS**
Harbor seal	**Pribilof Islands**	**232**		**232**	**2010**	**0.12**	**0.5**	**7**	**0**	**0**	**0**	**NS**
Harbor seal	**Bristol Bay**	**32,350**		**28,146**	**2011**	**0.12**	**0.7**	**1,182**	**0.6**	**141**	**142**	**NS**
Harbor seal	**North Kodiak**	**8,321**		**7,096**	**2011**	**0.12**	**0.7**	**298**	**0**	**37**	**37**	**NS**
Harbor seal	**South Kodiak**	**19,199**		**17,479**	**2011**	**0.12**	**0.3**	**314**	**1.9**	**126**	**128**	**NS**
Harbor seal	**Prince William Sound**	**29,889**		**27,936**	**2011**	**0.12**	**0.5**	**838**	**24**	**255**	**279**	**NS**
Harbor seal	**Cook Inlet/Shelikof Strait**	**27,386**		**25,651**	**2011**	**0.12**	**0.5**	**770**	**0.4**	**233**	**234**	**NS**
Harbor seal	**Glacier Bay/Icy Strait**	**7,210**		**5,647**	**2011**	**0.12**	**0.5**	**169**	**0**	**104**	**104**	**NS**
Harbor seal	**Lynn Canal/Stephens Passage**	**9,478**		**8,605**	**2011**	**0.12**	**0.3**	**155**	**0**	**50**	**50**	**NS**
Harbor seal	**Sitka/Chatham Strait**	**14,855**		**13,212**	**2011**	**0.12**	**0.7**	**555**	**0**	**77**	**77**	**NS**
Harbor seal	**Dixon/Cape Decision**	**18,105**		**16,727**	**2011**	**0.12**	**0.7**	**703**	**0**	**69**	**69**	**NS**
Harbor seal	**Clarence Strait**	**31,634**		**29,093**	**2011**	**0.12**	**0.7**	**1,222**	**0**	**40**	**41**	**NS**
Spotted seal	Alaska	460,268		391,000	2012	0.12	0.5	11,730	1.5	5,265	5,267	NS
Bearded seal	**Alaska**	**N/A**		**N/A**	**2013**	**0.12**	**0.5**	**N/A**	**1.2**	**379**	**380**	**NS**

Species	Stock	N_{EST}	CV	N_{MIN}	Year of last survey	R_{MAX}	F_R	PBR	Commer. fishery mort.	Native subsist. mort.	Total mort.	Status
Ringed seal	**Alaska**	**N/A**		**N/A**	**2013**	**0.12**	**0.5**	**UNDET**	**4.1**	**1,040**	**1,044**	**NS**
Ribbon seal	**Alaska**	**184,000**		**163,086**	**2013**	**0.12**	**1.0**	**9,785**	**0.6**	**3.2**	**3.8**	**NS**
Beluga whale	Beaufort Sea	39,258	0.23	32,453	1992	0.04	1.0	649	0	166	166	NS
Beluga whale	Eastern Chukchi Sea	3,710	N/A	UNK	1991	0.04	1.0	UNDET	0	57.4	57.4	NS
Beluga whale	Eastern Bering Sea	19,186	0.32	UNK	2000	0.04	1.0	UNDET	0	181	181	NS
Beluga whale	Bristol Bay	2,877	0.2	2,467	2005	0.048	1.0	59	0.2	24	24.2	NS
Beluga whale	**Cook Inlet**	**312**	**0.10**	**280**	**2014**	**0.04**	**0.1**	**UNDET**	**0**	**0**	**0**	**S**
Narwhal	Unidentified	N/A		N/A		0.04	0.5	N/A	0	0	0	NS
Killer whale	Eastern North Pacific Alaska Resident	2,347[b]	N/A	2,347	2012	0.04	0.5	23.4	0.9	0	0.9	NS
Killer whale	Eastern North Pacific Northern Resident (British Columbia)	261[b]	N/A	261	2011	0.03	0.5	1.96	0	0	0	NS
Killer whale	Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	587[b]	N/A	587	2012	0.04	0.5	5.9	0.6	0	0.6	NS
Killer whale	**AT1 Transient**	**7[b]**	**N/A**	**7**	**2014**	**0.04**	**0.1**	**0**	**0**	**0**	**0**	**S**
Killer whale	West Coast Transient	243[b]	N/A	243	2009	0.04	0.5	2.4	0	0	0	NS
Pacific white-sided dolphin	**North Pacific**	**26,880**	**N/A**	**N/A**	**1990**	**0.04**	**0.5**	**UNDET**	**0**	**0**	**0**	**NS**
Harbor porpoise	**Southeast Alaska**	**11,146**	**0.242**	**N/A**	**1997**	**0.04**	**0.5**	**UNDET**	**34**	**0**	**34**	**S**
Harbor porpoise	**Gulf of Alaska**	**31,046**	**0.214**	**N/A**	**1998**	**0.04**	**0.5**	**UNDET**	**72**	**0**	**72**	**S**
Harbor porpoise	**Bering Sea**	**48,215**	**0.223**	**N/A**	**1999**	**0.04**	**0.5**	**UNDET**	**0.2**	**0**	**0.4**	**S**
Dall's porpoise	**Alaska**	**83,400**	**0.097**	**N/A**	**1993**	**0.04**	**1.0**	**UNDET**	**38**	**0**	**38**	**NS**
Sperm whale	**North Pacific**	**N/A**		**N/A**		**0.04**	**0.1**	**N/A**	**0.8**	**0**	**0.8**	**S**
Baird's beaked whale	Alaska	N/A		N/A		0.04	0.5	N/A	0	0	0	NS
Cuvier's beaked whale	Alaska	N/A		N/A		0.04	0.5	N/A	0	0	0	NS
Stejneger's beaked whale	Alaska	N/A		N/A		0.04	0.5	N/A	0	0	0	NS

Species	Stock	N_{EST}	CV	N_{MIN}	Year of last survey	R_{MAX}	F_R	PBR	Commer. fishery mort.	Native subsist. mort.	Total mort.	Status
Humpback whale	**Western North Pacific**	**1,107**	**0.300**	**865**	**2006**	**0.07**	**0.1**	**3**	**0.8**	**0**	**2.2**	**S**
Humpback whale	**Central North Pacific - entire stock**	**10,103**	**0.300**	**7,890**	**2006**	**0.07**	**0.3**	**83**	**6.5**	**0**	**21**	**S**
Fin whale	**Northeast Pacific**	**N/A**	**N/A**	**N/A**	**2010**	**0.04**	**0.1**	**UNDET**	**0.2**	**0**	**0.6**	**S**
Minke whale	**Alaska**	**N/A**	**N/A**	**N/A**	**2010**	**0.04**	**0.5**	**N/A**	**0**	**0**	**0**	**NS**
North Pacific right whale	**Eastern North Pacific**	**31**	**0.226**	**25.7**	**2013**	**0.04**	**0.1**	**0.05**	**0**	**0**	**0**	**S**
Bowhead whale	**Western Arctic**	**16,892**	**0.058**	**16,091**	**2011**	**0.04**	**0.5**	**161**	**0.2**	**44**	**44**	**S**

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

[a]Includes entanglements from recreational or subsistence fisheries.

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

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 – 4 hrs/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

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, humpback whale, Steller sea lion 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, Steller sea lion	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
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, gray whale, 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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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	northern elephant seal	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
State waters of Kachemak Bay Cook Inlet, Prince William Sound, Southeast AK groundfish trawl	2	never observed	none documented	none

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
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 abalone	0	never observed	none documented	none
AK clam	156	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, 194 p.

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%
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

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 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 than 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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Manly, B. F. J. 2009. Incidental catch of marine mammals and birds in the Yakutat salmon set gillnet fishery, 2007 and 2008. Final report to NMFS Alaska Region. 96 pp. Available online: http://alaskafisheries.noaa.gov/protectedresources/observers/bycatch/yakutat07-08.pdf

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, 194 p.

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Wynne, K. M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 65 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

Wynne, K. M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

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
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

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

CITATIONS

DeMaster, D. P. 1998. Minutes from the sixth meeting of the Alaska Scientific Review Group, 21-23 October 1997, Seattle, Washington. 40 pp. Available from Alaska Fisheries Science Center, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

Appendix 8. Stock Assessment Reports published by the U.S. Fish and Wildlife Service.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

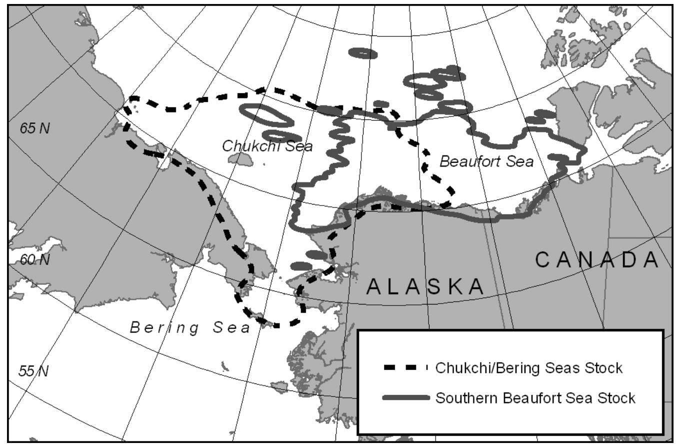

Figure 1. Map of the Southern Beaufort Sea and the Chukchi/Bering seas polar bear stocks.

Polar bears are circumpolar in their distribution in the northern hemisphere. They occur in several largely discrete stocks or populations (Harington 1968). Polar bear movements are extensive and individual activity areas are enormous (Garner *et al.* 1990, Amstrup *et al.* 2000). The parameters used by Dizon *et al.* (1992) to classify stocks based on the phylogeographic approach were considered in the determination of stock separation in Alaska. Several polar bear stocks are known to be shared between countries (Amstrup *et al.* 1986, Amstrup and DeMaster 1988). Lentfer hypothesized that in Alaska two stocks exist, the Southern Beaufort Sea (SBS) and the Chukchi/Bering seas (CBS), based upon: (a) variations in levels of heavy metal contaminants of organ tissues (Lentfer 1976, Lentfer and Galster 1987); (b) morphological characteristics (Manning 1971, Lentfer 1974, Wilson 1976); (c) physical oceanographic features which segregate the Chukchi Sea and Bering Sea stock from the Beaufort Sea stock (Lentfer 1974); and (d) movement information collected from mark and recapture studies of adult female bears (Lentfer 1974, 1983) (Figure 1). Information on contaminants (Woshner *et al.* 2001, Evans 2004a, Evans 2004b, Kannan *et al.* 2005, Smithwick *et al.* 2005, Verreault *et al.* 2005, Muir *et al.* 2006, Smithwick *et al.* 2006, Kannan *et al.* 2007, Rush *et al.* 2008) and movement data using satellite collars (Amstrup *et al.* 2004, Amstrup *et al.* 2005) continue to support the presence of these two stocks.

The CBS population is widely distributed on the pack ice in the Chukchi Sea and northern Bering Sea and adjacent coastal areas in Alaska and Russia. The northeastern boundary of the Chukchi/Bering seas stock is near the Colville Delta in the central Beaufort Sea (Garner *et al.*1990, Amstrup 1995, Amstrup *et al.* 2005) and the western boundary is near Chauniskaya Bay in the Eastern Siberian Sea. The boundary between the Eastern Siberian Sea stock and the Chukchi Sea stock is designated based on movements of adult female polar bears captured in the Bering and Chukchi seas region. Female polar bears initially captured and radio collared on Wrangel Island exhibited no movement into the Eastern Siberian Sea, while female polar bears captured and radio collared in the Eastern Siberian Sea, exhibited only limited short term movement into the western Chukchi Sea (Garner *et al.* 1990). The Chukchi/Bering seas stock extends into the Bering Sea and its southern boundary is determined by the annual extent of pack ice (Garner *et al.* 1990). Adult female polar bears captured from the Southern Beaufort Sea stock may make seasonal movements into the Chukchi Sea in an area of overlap located between Point Hope and Colville Delta, centered near Point Lay (Garner *et al.* 1990, Garner *et al.* 1994, Amstrup 1995, Amstrup *et al.* 2002, Amstrup *et al.* 2005). Probabilistic distribution information for zones of overlap between the Chukchi/Bering seas and the Southern Beaufort Sea population exist (Amstrup *et al.* 2004, Amstrup *et al.* 2005). Telemetry data indicate that these bears, marked in the Beaufort Sea, spend about 25% of their time in the northeastern Chukchi Sea, whereas females captured in the Chukchi Sea spend only 6% of their time in the Beaufort Sea (Amstrup 1995). Average activity areas of females in the Chukchi/Bering seas from 1986–1988 (244,463 km^2, range 144,659–351,369 km^2) (Garner *et al.* 1990) were more extensive than the Beaufort Sea from 1983– 1985 (96,924 km^2, range 9,739–269,622 km^2) (Amstrup 1986) or from 1985–1995 (166,694 km^2, range 14,440–616,800 km^2) (Amstrup *et al.* 2000). Radio collared adult females spent a greater proportion of their time in the Russian region than in the American region (Garner *et al.* 1990). Historically polar bears ranged as far south as St. Matthew Island (Hanna 1920) and the Pribilof Islands (Ray 1971) in the Bering Sea.

Analysis of mitochondrial DNA indicates little differentiation of the Alaska polar bear stocks (Cronin *et al.* 1991, Scribner *et al.* 1997, Cronin *et al.* 2006). Using 16 highly variable micro-satellite loci, Paetkau *et al.* (1999) determined that polar bears throughout the arctic (19 populations) are genetically similar. Genetically, polar bears in the southern Beaufort Sea differed more from polar bears in the Chukchi/Bering seas than from polar bears in the northern Beaufort Sea (Paetkau *et al.* 1999).

While genetically similar, demographic and movement data of the CBS population, indicates a high degree of site fidelity, suggesting that the stocks should be managed separately (Amstrup 2000, Amstrup *et al.* 2000, Amstrup *et al.* 2001a, Amstrup *et al.* 2002, Amstrup *et al.* 2004, Amstrup *et al.* 2005).

Past management has consistently distinguished between the southern Beaufort Sea and the Chukchi/Bering seas stocks. The Inuvialuit of the Inuvialuit Game Council (IGC), Northwest Territories, and the Inupiat of the North Slope Borough (NSB), Alaska, polar bear management agreement for the Southern Beaufort Sea stock was based on stock boundaries described previously (Brower *et al.* 2002, Nageak *et al.* 1991, Treseder and Carpenter 1989) and reaffirmed by the information in this stock assessment report.

POPULATION SIZE

Polar bears typically occur at low densities throughout their circumpolar range (DeMaster and Stirling 1981). It has been difficult to obtain a reliable population estimate for this population due to the vast and inaccessible nature of the habitat, movement of bears across international boundaries, logistical constraints of conducting studies in Russian territory, and budget limitations (Amstrup and DeMaster 1988, Garner *et al.* 1992, Garner *et al.* 1998, Evans *et al.* 2003). The Chukchi Sea population is estimated to comprise 2,000 animals, based on extrapolation of aerial den surveys (Lunn *et al.* 2002). Estimates of the population have been derived from observations of dens and aerial surveys (Chelintsev 1977, Stishov 1991a, Stishov 1991b, Stishov *et al.* 1991); however, these estimates (see below) have wide confidence intervals and are considered to be of little value for management and cannot be used to evaluate status and trends for this population.

Minimum Population Estimate

A reliable population estimate for the Chukchi/Bering seas stock currently does not exist. Lentfer, in the Administrative Law Judge (ALJ) proceeding to waive the Marine Mammal Protection Act of 1972 (MMPA) moratorium on taking and return management to the State of Alaska (ALJ 1977), estimated the size of the Chukchi/Bering seas population stock (Wrangel Island to western Alaska) at 7,000, and Chapman estimated the Alaska population (both stocks) at 5,550 to 5,700 (ALJ 1977). Lentfer and Chapman's estimates (ALJ 1977), however, were not based on rigorous statistical analysis of population data and variance estimates could not be calculated. Amstrup *et al.* (1986) estimated densities (1976–129 km^2/bear, 1981–211 km^2/bear) based on mark and recapture of 266 polar bears near Cape Lisburne on the Chukchi Sea, but a population estimate for the Chukchi Sea was not developed at that time. An August 2000 aerial survey of polar bears in the Eastern Chukchi Sea resulted in density estimates of (0.00748 bear/km^2, or 147 km^2/bear, C.V. = 0.38) (Evans *et al.* 2003). A population estimate was not derived from this density since the study area included only a portion of the total area used by the population.

Amstrup and DeMaster (1988) estimated the Alaska population (both stocks) at 3,000 to 5,000 animals based on densities calculated previously by Amstrup *et al.* (1986). The area that the estimate applied to and the variance associated with the estimate were not provided for in the 1988 population estimate (Amstrup and DeMaster 1988). A crude population estimate for the Chukchi/Bering seas stock of 1,200 to 3,200 animals was derived by subtracting the Beaufort Sea population estimate of 1,800 animals (Amstrup 1995) from the total Alaska statewide estimate of 3,000 to 5,000 (Amstrup and DeMaster 1988). The IUCN Polar Bear Specialist Group (IUCN 2006) estimated this population to be approximately 2,000 animals based on extrapolation of multiple years of denning data for Wrangel Island, assuming that 10% of the population dens annually as adult females. However, confidence in this estimate is low due to the lack of current denning estimates and reliable data with measurable levels of precision (IUCN 2006). Nonetheless, an N_{MIN} of 2,000 is the best available information we have at this time.

Current Population Trend

Prior to the 20th century, when Alaska's polar bears were hunted primarily by Alaskan Natives, both stocks probably existed at near carrying capacity (K). The size of the Beaufort Sea stock declined substantially in the late 1960's and early 1970's (Amstrup *et al.* 1986) due to excessive sport harvest. Similar declines could have occurred in the Chukchi Sea, although there are no population data to support this assumption. Since passage of the MMPA, the southern Beaufort Sea population grew during the late 1970's and 1980's and then stabilized during the 1990's (Amstrup *et al.* 2001b). Based on demographic data 2001 to 2006, the overall population growth rate in the Southern Beaufort Sea population declined approximately 0.3% per year (Hunter *et al.* 2007). Until 1992 it is likely that the Chukchi/Bering seas stock mimicked the growth pattern and later stability of Southern Beaufort Sea stock, since both stocks experienced similar management and harvest histories. However, since 1992 the CBS population has faced different stressors than the SBS population. These include increased harvest in Russia (150 – 250 bears/yr) (Kochnev 2006, Ovsyanikov 2006, Eduard Zdor personal communication) and greater loss of summer sea ice habitat from global warming (Overland and Wang 2007), which suggest that using the growth rate for the Southern Beaufort Sea may not be applicable. The status of the Chukchi/Bering seas stock was listed as data deficient (Aars *et al.* 2006) due to the lack of abundance estimates with measurable levels of precision. The population is believed to be declining and the status relative to historical levels is believed to be reduced based on harvest levels that were demonstrated to be unsustainable in the past.

MAXIMUM NET PRODUCTIVITY RATES

Polar bears are long lived, mature at a relatively old age, have an extended breeding interval, and have small litters (Lentfer *et al.* 1980, DeMaster and Stirling 1981). Population/stock specific data to estimate R_{MAX} are not available for the Chukchi/Bering seas polar bear stock. The Southern Beaufort Sea is one of four polar bear populations with long-term data sets and as it overlaps with the Chukchi/Bering seas stock using the default value for R_{MAX} for the Southern Beaufort Sea seems reasonable as it is based on empirical data. Survival rates for the Southern Beaufort Sea stock (Regehr *et al.* 2006), which can be used in a Leslie matrix model, suggest that under optimal conditions and in the absence of human perturbations the population could increase at a rate of between 4 and 6%. Amstrup (1995) projected an annual intrinsic growth rate (including natural mortality but not human-caused mortality) of 6.03% for the Southern Beaufort Sea stock using a Leslie type matrix of recapture data. Since the Chukchi/Bering seas area is one of the most productive areas in the Arctic using the 6.03% for the Chukchi/Bering seas polar bear stock seems reasonable.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

Under the 1994 reauthorized 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 = $(N_{MIN})(½\ R_{MAX})(F_R)$. Wade and Angliss (1997) recommend a default recovery factor (F_R) of 0.5 for a threatened population or when the status of a population is unknown. We used 0.5 as the recovery factor since reliable population estimates to assess population trends are not available. In the following calculation: $(N_{MIN})(½\ R_{MAX})(F_r)$ = PBR (Wade and Angliss 1997) the minimum population estimate, N_{MIN} was 2,000; the maximum rate of increase R_{MAX} was 6.03%; and the recovery factor F_R was 0.50. Therefore, the PBR level for the Chukchi/Bering seas stock is 30 bears per year. However, confidence in these numbers is low due to dated and extrapolated population information and, therefore, the PBR value has little utility for management purposes.

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities. Consequently, the total fishery mortality and serious injury rate for the Chukchi/Bering seas stock is zero.

Alaska Native Subsistence Harvest

Historically, polar bears have been killed for subsistence, handicrafts, and recreation. Based on records of skins shipped from Alaska for 1925–53, the estimated annual statewide harvest averaged 120 bears, taken primarily by Native hunters. Recreational hunting by non-native sports hunters using aircraft was common from 1951–72, increasing statewide annual harvest to 150 during 1951–60 and to 260 during 1960–72 (Amstrup *et al.* 1986, Schliebe *et al.* 1995). Hunting by non-Natives has been prohibited since 1973 when provisions of the MMPA went into effect. This reduced the mean annual statewide harvest for both populations to 98 during 1980–2007 (SD=40; range 48–242) (USFWS unpublished data). The annual harvest from the Chukchi/Bering seas stock was 92/year in the 1980s, 49/year in the 1990s, and 43/year in the 2000s. More recently, the 2003−2007 average Alaska harvest for the Chukchi/Bering seas stock in Alaska was 37 and the sex ratio was 66M:34F.

Under the MMPA, an exemption was made for Alaska Natives living in coastal communities to allow them to hunt polar bears for subsistence and making of handicrafts provided that the hunt was not done in a wasteful manner. Recently, harvest levels by Alaska Natives from the Chukchi/Bering seas stock have been declining (Figure 2). The sex ratio of known-sex bears harvested since 1980 has remained relatively consistent at 66% males and 34% females (Schliebe *et al.* 2006).

The number of unreported kills in Alaska since 1980 to the present time is approximately 7% based on: (a) tagging information; (b) interviews with local hunters; and (c) law enforcement investigations. No user agreement, similar to that between the Inuvialuit and Inupiat for the Beaufort Sea stock, exists for the Bering/Chukchi stock. Harvest levels are not limited at this time.

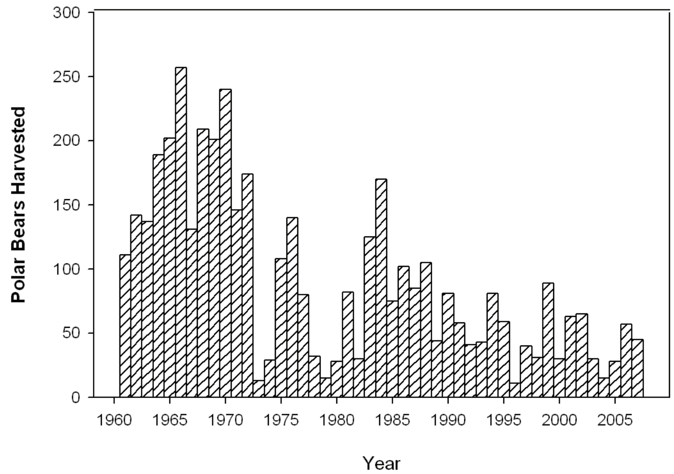

Figure 2. Annual Alaska polar bear harvest from the Chukchi/Bering Seas stock, 1961-2007.

Other Removals

Russia prohibited all hunting of polar bears in 1956 in response to perceived population declines caused by over-harvest. In Russia, only a small number of animals, less than 3–5 per year, were removed for placement in zoos prior to 1986 (Uspenski 1986) and a few were killed in defense of life. No bears were taken for zoos or circuses from 1993 to 1995 (Belikov 1998). The occurrence of increased takes of problem bears in Chukotka was acknowledged in 1992, and Belikov (1993) estimated that up to 10 problem bears were killed annually in all of the Russian Arctic. Increased illegal hunting of polar bears in the Russian Arctic was also recognized to have begun in 1992. While the magnitude of the illegal harvest in Russia from the Chukchi/Bering seas stock is unquantified, reports indicate that a substantial number of bears, 150–250/yr (Kochnev 2006), or alternatively 120–150/yr (Eduard Zdor pers. comm.), are being harvested. Combining the reported Chukotka harvest with the documented Alaska harvest indicates that up to 200 bears may have been harvested from this population in many years. Harvest levels similar to these are believed to have caused population depletion by the early 1970s. Belikov *et al.* (2006) indicated that the current level of poaching in Russia poses a serious threat to the population. No serious injuries, other than the mortalities discussed here, have been reported for the Chukchi/Bering seas stock.

No orphaned cubs from the Alaskan Chukchi/Bering seas stock were placed in zoos since 2002. Illegal harvest has not been detected in Alaska. Oil and gas exploration in the Bering/Chukchi region of Alaska, began again in 2006, primarily during the open water season has resulted in minimal interaction with polar bears; there was no evidence of mortality or serious injury.

STATUS OF STOCK

Polar bears in the Chukchi/Bering seas stock are currently classified as depleted under the MMPA and listed as threatened under the U.S. Endangered Species Act of 1973 (ESA) as amended. Reliable estimates of the minimum population, PBR level, and human-caused mortality or serious injury in Chukotka are currently not available

The ongoing level of the subsistence hunting in western Alaska and Chukotka is a concern. There is no incidental mortality or serious injury of polar bear in any U.S. commercial fishery. The primary concerns for this population are habitat loss resulting from climate change, potential over-harvest, human activities including industrial activities occurring within the near-shore environment, and potential effects of contaminants on nutritionally stressed populations. The Chukchi/Bering seas polar bear stock is designated as a strategic stock because the population is listed as threatened under the ESA.

Conservation Issues and Habitat Concerns

Oil and Gas Exploration

In 2008, the Minerals Management Service held an oil and gas lease sale for offshore blocks in the eastern Chukchi Sea. Polar bears from Chukchi/Bering seas stock seasonally use the shallow, productive, ice-covered waters of the eastern Chukchi Sea for feeding, breeding, and movements. The Fish and Wildlife Service (USFWS) works to monitor and mitigate potential impacts of oil and gas activities on polar bears through incidental take regulations (ITR) as authorized under the Marine Mammal Protection Act. Activities operating under these regulations must adopt measures to: ensure that the total of such incidental taking of polar bears remains negligible; minimize impacts to their habitat; and ensure no unmitigable adverse impact on their availability for Alaska Native subsistence use. ITR also specify monitoring requirements that provide a basis for evaluating potential impacts of current and future activities on marine mammals.

Climate Change

Polar bears evolved over thousands of years to life in a sea ice environment. They depend on the sea ice-dominated ecosystem to support essential life functions. Sea ice provides a platform for hunting and feeding, for seeking mates and breeding, for movement to terrestrial maternity denning areas and occasionally for maternity denning, for resting, and for long-distance movements. The sea ice ecosystem supports ringed seals, the primary prey for polar bears, and other marine mammals that are also part of their prey base.

Sea ice is rapidly diminishing throughout the Arctic and large declines in optimal polar bear habitat have occurred in the Southern Beaufort and Chukchi Seas between the two time periods, 1985–1995 and 1996–2006 (Durner et al 2009). In addition, it is predicted that the greatest declines in 21st century optimal polar bear habitat will occur in Chukchi and Southern Beaufort Seas (Durner *et al.* 2009a). Patterns of increased temperatures, earlier onset of and longer melting periods, later onset of freeze-up, increased rain-on-snow events, and potential reductions in snowfall are occurring. In addition, positive feedback systems (i.e., the sea-ice albedo feedback mechanism) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can operate to amplify the effects of these phenomena. As a result, there is fragmentation of sea ice, a dramatic increase in the extent of open water areas seasonally, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al 1999, Rothrock *et al.* 1999, Comiso 2003, Fowler *et al.* 2004, Lindsay and Zhang 2005, Holland *et al.* 2006, Comiso 2006, Serreze *et al.* 2007, Stroeve *et al.* 2008).

The Chukchi/Bering seas and the Southern Beaufort Sea population stocks are currently experiencing the initial effects of changes in sea ice conditions (Rode *et al.* 2007, Regehr *et al.* 2007, Hunter *et al.* 2007). These populations are vulnerable to large-scale dramatic seasonal fluctuations in ice movements, decreased abundance and access to prey, and increased energetic costs of hunting. The USFWS is working on measures to protect polar bears and their habitat.

Subsistence Harvest

Past differences in management regimes between the United States and Russia have made coordination of studies on the shared Alaska-Chukotka polar bear population difficult. In the former Soviet Union, hunting of polar bears was banned nationwide in 1956. Recently, Russia's ability to enforce that ban has been difficult due to logistical and financial constraints. In Alaska, subsistence hunting of polar bears by Alaska Natives is currently unrestricted under section 101(b) of the MMPA provided that the take is for subsistence purposes or creating authentic articles of Alaska Native handicrafts and conducted in a non-wasteful manner. While several joint research and management projects have been successfully undertaken in the past between the United States and Russia, today comparable efforts are either no longer occurring or are unilateral in scope.

The bilateral "Agreement between the United States and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population (Agreement)" was signed by the governments of the United States and the Russian Federation on October 16, 2000, with subsequent advice and consent provided by the U.S. Senate. Among other provisions the Agreement recognizes the needs of Native people to harvest polar bears for subsistence purposes and includes provisions for developing sustainable harvest limits, allocation of the harvest between jurisdictions, and compliance and enforcement. Each jurisdiction is entitled to up to one-half of a harvest limit to be determined by a future the joint Commission. The Agreement reiterates requirements of the 1973 multi-lateral agreement and includes restrictions on harvesting denning bears, females with cubs, or cubs less than one year old, and prohibitions on the use of aircraft, large motorized vessels, and snares or poison for hunting polar bears.

On January 12, 2007, President Bush signed into law H.R. 5946, the "Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006." This Act includes Title X implementing the Agreement. This action allows for the establishment of the commission and development of enforceable harvest management agreements. The Russian Federation and the United States have completed documents necessary to implement the Agreement within Russia and the United States. The USFWS is currently developing recommendations for the Bilateral Commission that will direct research and establish sustainable and enforceable harvest limits needed to address current potential population declines due to over-harvest of the population.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

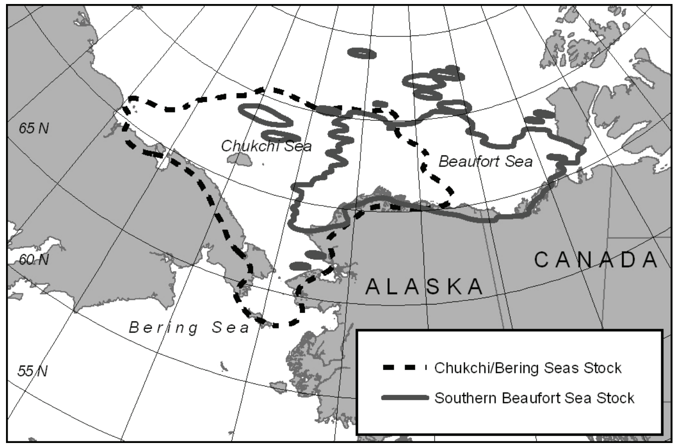

Figure 1. Map of the Southern Beaufort Sea and the Chukchi/Bering seas polar bear stocks.

Polar bears are circumpolar in their distribution in the northern hemisphere. They occur in several largely discrete stocks or populations (Harington 1968). Polar bear movements are extensive and individual activity areas are enormous (Garner et al. 1990, Amstrup et al. 2000). The parameters used by Dizon et al. (1992) to classify stocks based on the phylogeographic approach were considered in the determination of stock separation in Alaska. Several polar bear stocks are known to be shared between countries (Amstrup et al. 1986, Amstrup and Demaster 1988). Lentfer hypothesized that two Alaska stocks exist, the Southern Beaufort Sea, and the Chukchi/Bering Seas, based upon: (a) variations in levels of heavy metal contaminants of organ tissues (Lentfer 1976, Lentfer and Galster 1987); (b) morphological characteristics (Manning 1971; Lentfer 1974; Wilson 1976); (c) physical oceanographic features which segregate stocks (Lentfer 1974) and; (d) movement information collected from mark and recapture studies of adult female bears (Lentfer 1983) (Figure 1**)**. Information on contaminants (Woshner et al. 2001, Evans 2004a, Evans 2004b, Kannan et al. 2005, Smithwick et al. 2005, Verreault et al. 2005, Muir et al. 2006, Smithwick et al. 2006, Kannan et al. 2007, Rush et al. 2008) and movement data using satellite collars (Amstrup et al. 2004, Amstrup et al. 2005) continue to support the existence of these two stocks.

Amstrup et al. (2000) demonstrated that the eastern boundary of the Southern Beaufort Sea stock occurs south of Banks Island and east of the Baillie Islands, Canada. The bears in the Northern Beaufort Sea and Southern Beaufort Sea populations spend the summer on pack ice and move toward the coast during fall, winter, and spring (Durner et al. 2004). The range of the two populations previously overlapped extensively in the vicinity of the Baille Islands, Canada (Amstrup 2000) but recent data no longer support this degree of overlap (Amstrup et al. 2005). Recent analysis of polar bear movements using satellite telemetry from 2000 to 2006 (Amstrup et al. 2004, Amstrup et al. 2005), capture and recapture data (Regehr et al. 2006, Stirling et al. 2007), and harvest information suggest that the eastern population boundary has shifted westward to near the village of Tuktoyaktuk, Canada. The assignment of this new boundary could be adjusted somewhat based on local management considerations; however, it will probably necessitate a downward readjustment of the population size of the Southern Beaufort Sea stock to correspond with the smaller geographic area. The proposed boundary change is under consideration and has not been accepted by the parties to the Polar Bear Management Agreement for the Southern Beaufort Sea between the Inuvialuit Game Council of Canada and the North Slope Borough of Alaska. For the purposes of this report, we continue to use the previously published boundaries for the Southern Beaufort Sea population delineated by Amstrup et al. (2000). The western boundary is near Point Hope. An extensive area of overlap between the Southern Beaufort Sea stock and the Chukchi/Bering seas stock occurs between Point Barrow and Point Hope, centered near Point Lay (Garner et al. 1990, Garner et al. 1994, Amstrup et al. 2000). The southern boundary of the Northern Beaufort Sea stock in the Canadian Arctic was delineated by Bethke et al. (1996). Telemetry data indicates that adult female polar bears marked in the Southern Beaufort Sea spend about 25% of their time in the northeastern Chukchi Sea, whereas females captured in the Chukchi Sea spend only 6% of their time in the Southern Beaufort Sea (Amstrup 1995). However, polar bears are not dispersed evenly throughout their range. To access ringed and bearded seals, polar bears in the Southern Beaufort Sea concentrate in shallow waters less that 300 m deep over the continental shelf and in areas with >50% ice cover (Stirling et al. 1999, Durner et al. 2004, Durner et al. 2006a, Durner et al. 2009). Polar bears from this population have historically denned on both the sea ice and land. Thinning of the sea ice in recent years has caused a decline in the number of polar bears denning on the sea ice. Fischbach et al. (2007) found that the proportion of dens on the pack ice declined from 62% from 1985—1994 to 37% in 1998-2004. The main terrestrial denning areas for the Southern Beaufort Sea population in Alaska occur on the barrier islands from Barrow to Kaktovik and along coastal areas up to 25 miles inland including the Arctic National Wildlife Refuge to Peard Bay, west of Barrow (Amstrup and Gardner 1994, Amstrup 2000, Durner et al. 2001, Durner et al. 2006b).

In response to changes in the sea ice characteristics and declines in sea ice habitat over the continental shelf during the summer and late fall, some polar bears have changed distribution to search for seals and to access the remains of subsistence harvested bowhead whales (Schliebe et al. 2008). It is expected that changes in the distribution and movements may occur with increasing frequency in the future (Durner et al. 2009, Schliebe et al. 2008) Polar bears may also become more nutritionally stressed due to global climate changes in the Arctic (Stirling and Parkinson 2006) and, thus, continued monitoring is required to document these changes.

Analysis of mitochondrial DNA and microsatellite DNA loci indicates little differentiation of the Alaska polar bear stocks (Cronin et al. 1991, Scribner et al. 1997, Cronin et al. 2006). Using 16 highly variable micro satellite loci, Paetkau et al. (1999) determined that polar bears throughout the arctic (19 populations) were genetically very similar. Genetically, polar bears in the Southern Beaufort Sea differed more from polar bears in the Chukchi/Bering Seas than from polar bears in the Northern Beaufort Sea (Paetkau et al. 1999, Thiemann et al. 2008). While genetically similar, demographic and movement data indicates a high degree of site fidelity, suggesting that the stocks should be managed separately (Amstrup 2000, Amstrup et al. 2000, Amstrup et al. 2001a, Amstrup et al. 2002, Amstrup et al. 2004, Amstrup et al. 2005).

POPULATION SIZE

Polar bears occur at low densities throughout their circumpolar range (DeMaster and Stirling 1981). They are long lived, mature late, have an extended breeding interval, and have small litters (Lentfer et al. 1980, DeMaster and Stirling 1981, Amstrup 2003). Accurate population estimates for the Alaskan populations have been difficult to obtain because of low population densities, inaccessibility of the habitat, movement of bears across international boundaries, and budget limitations (Amstrup and DeMaster 1988, Garner et al. 1992). Research on the Southern Beaufort Sea population began in 1967 and is one of only four polar bear populations with long term (>20 yrs) data.

Amstrup et al. (1986) estimated the Southern Beaufort Sea stock at 1,778 (S.D. $\pm$ 803; C.V. = 0.45) during the 1972-83 period. Amstrup (1995) estimated the Southern Beaufort Sea stock near 1,480 animals in 1992. Amstrup (USGS unpublished data) using data for the 1986-98 period (excluding 4 unsampled years), estimated the population at 2,272 in 2001. This total population estimate was based on as estimate of 1,250 females (C.V. = 0.17) and a sex ratio of 55% females (Amstrup et al. 2001b). The population estimate of 1,526 (95% CI =1211−1841; C.V. = 0.106) (Regehr et al. 2006), which is based on open population capture-recapture data collected from 2001 to 2006, is considered the most current and valid population estimate.

Minimum Population Estimate

N_{MINn} is calculated as follows $N/exp(0.842 * (ln(1+CV(N)^2))^{½})$ and is 1,397 bears for population size of 1,526 and C.V. of 0.106. This population estimate applies to an area that extends from Pt. Barrow in the west, east to the Baillie Islands in Canada.

Current Population Trend

Prior to the 20th century, when Alaska's polar bears were hunted primarily by Natives, both the Chukchi/Bering seas and Southern Beaufort Sea stocks probably existed near carrying capacity (K). Once harvest by non-Natives became common in the Southern Beaufort Sea in the early 1960s, the size of these stocks declined substantially (Amstrup et al. 1986, Amstrup 1995). Since passage of the Marine Mammal Protection Act (MMPA) in 1972, both Alaska polar bear stocks seem to have increased; this is based on: (a) mark and recapture data; (b) observations by Natives and residents of coastal Alaska and Russia; (c) catch per unit effort indices (USGS unpublished data); (d) reports from Russian scientists (Uspenski and Belikov 1991); and (e) harvest statistics on the age structure of the population. Recapture data from the stock indicated a population growth rate of 2.4% from 1981 to 1992 (Amstrup 1995).

The Southern Beaufort Sea stock experienced little or no growth during the 1990's (Amstrup et al. 2001b). Declining survival, recruitment, and body size (Regehr et al. 2006, Regehr et al. 2007), and low growth rates (λ) during years of reduced sea ice during the summer and fall (2004 and 2005), and an overall declining growth rate of 3% per year from 2001-2005 (Hunter et al. 2007) indicates that the Southern Beaufort Sea population is now declining.

MAXIMUM NET PRODUCTIVITY RATES

Population/stock specific data to estimate R_{MAX} are not available for the stock. Taylor et al. (1987) estimated the sustainable yield of the female component of the population at < 1.6% per annum. The following information is used to understand the R_{MAX} determination. From 1981-92, when the population was increasing, vital rates of polar bears in the Southern Beaufort Sea were as follows: average age of sexual maturity (females) was 6 years; average COY litter size was 1.67; average reproductive interval was 3.68 years; and average annual natural mortality (nM), which varies by age class, ranged from 1-3% for adults (Amstrup 1995).

Amstrup (1995) projected an annual intrinsic growth rate (including natural mortality but not human-caused mortality) of 6.03% for the Southern Beaufort Sea stock using a Leslie type matrix of recapture data. This analysis mimics a life history scenario where environmental resistance is low and survival high.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

Under the 1994 reauthorized MMPA, the potential biological removal (PBR) level is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $(N_{MIN})(\frac{1}{2} R_{MAX})(F_R)$. Wade and Angliss (1997) recommend a default recovery factor (F_R) of 0.5 for a threatened population or when the status of a population is unknown. In the following calculation: $(N_{MIN})(\frac{1}{2} R_{MAX})(F_r)$ = PBR (Wade and Angliss 1997) the minimum population estimate, N_{MIN} was 1,397; the maximum rate of increase R_{MAX} was 6.03%; and the recovery factor F_R was 0.5. Therefore, the PBR level for the Southern Beaufort Sea stock is 22 bears per year.

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities. Consequently, the total fishery mortality and serious injury rate for the Southern Beaufort Sea stock is zero.

Alaska Native Subsistence Harvest

Historically, polar bears have been killed for subsistence, handicrafts, and recreation (sport hunting). Based upon records of skins shipped from Alaska, the estimated annual statewide harvest (both stocks) for 1925−53 averaged 120 bears taken primarily by Native hunters. Sport hunting using aircraft was common from 1951−72, increasing annual harvest in Alaska to 150 during 1951-60 and to 260 during 1960−72 (Amstrup et al. 1986; Schliebe et al.1995). The annual harvest for the Southern Beaufort Sea stock was 81/year from 1960−1972. Although polar bear hunting was prohibited by the MMPA, an exemption was made for Alaska Natives living in coastal communities to allow them to hunt polar bears for subsistence and making of handicrafts provided that the hunt was not done in a wasteful manner. The cessation of sport hunting in 1972 reduced the mean annual combined harvest for both Alaskan stocks to 98 during 1980−2007 (SD=40; range 48−242) (USFWS unpublished data). The annual harvest from the Southern Beaufort Sea was 39/year in the 1980s, 33/year in the 1990s, and 32/year in the 2000s. More recently, the 2003−2007 average Alaska harvest for the Southern Beaufort Sea in Alaska was 33 and the sex ratio was 67M:33F. During the same time period the average Canadian harvest for the Southern Beaufort Sea was 21.0 and the sex ratio was 45M:55F. The combined average annual Alaska and Canada harvest during the past five years was 53.6. Figure 2 illustrates the annual Alaska polar bear harvest and trend for the Southern Beaufort Sea stock from 1961−2007. No serious injuries, other than the mortalities discussed here, have been reported for the Southern Beaufort Sea stock.

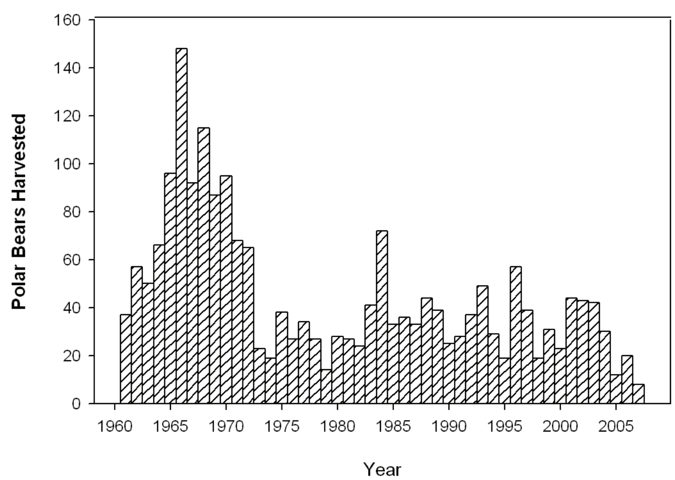

Figure 2. Annual Alaska polar bear harvest from the Southern Beaufort Sea stock, 1961-2007.

During the 1980–2007 period the Alaska harvest from the Southern Beaufort Sea accounted for 34% of the total Alaska kill (annual mean=33 bears) with the remaining 66% occurring in the Chukchi Sea. The sex ratio of the harvest from 1980–2007 in the Southern Beaufort Sea was 69M:31F.

Other Removals

Orphaned cubs are occasionally removed from the wild and placed in zoos; no cubs were placed into public display facilities during the past five years. One bear died as a result of research mortality and two bears were euthanized during the last five years. Activities operating under "incidental take" regulations, associated with the oil and gas industry, have the potential to impact polar bears and their habitat. During the past five years no lethal takes related to industrial activities of polar bears have occurred. Three lethal takes related to oil and gas activities have been documented in the Southern Beaufort Sea: one at an offshore drilling site in the Canadian Beaufort Sea (1968); one bear at the Stinson site in the Alaska Beaufort Sea (1990); and one bear that ingested ethylene glycol stored at an offshore island in the Alaska Beaufort Sea (1988). In 1993, a polar bear was killed at the Oliktok remote radar defense site when it broke into a residence and severely mauled a worker.

STATUS OF STOCK

The Southern Beaufort Sea Stock is currently classified as depleted under the MMPA and listed as threatened under the U.S. Endangered Species Act of 1973 (ESA), as amended. The primary concerns for this population are loss of the sea ice habitat due in part to climate changes in the Arctic, potential overharvest, and current and proposed human activities including industrial activities occurring in the nearshore and offshore environment. Recent data on the vital rates, population estimate, and growth rates for the Southern Beaufort Sea suggests that this population stock is declining. Because of its status as a threatened species under the ESA, the Southern Beaufort Sea population is designated as a strategic stock.

Conservation Issues and Habitat Concerns

Oil and Gas Exploration

The Minerals Management Service (MMS) (2004) estimated an 11 percent chance of a marine spill greater than 1,000 barrels in the Beaufort Sea from the Beaufort Sea Multiple Lease Sale in Alaska. Amstrup et al. (2006) evaluated the potential effects of a hypothetical 5,912-barrel oil spill (the largest spill thought possible from a pipeline spill) on polar bears from the Northstar offshore oil production facility in the southern Beaufort Sea, and found that there is a low probability that a large number of bears (i.e., 25–60) might be affected by such a spill. For the purposes of this scenario, it was assumed that a polar bear would die if it came in contact with the oil. Amstrup et al. (2006) found that 0–27 bears could potentially be oiled during the open water conditions in September; and from 0–74 bears in mixed ice conditions during October. If such a spill occurred, particularly during the broken ice period, the impact of the spill could be significant to the Southern Beaufort Sea polar bear population (Amstrup et al. 2006, 65 FR 16828; March 30, 2000). At the time that Amstrup did this analysis, the sustainable harvest yield per year for the Southern Beaufort Sea polar bear population, based on a stable population size of 1,800 bears, was estimated to be 81.1 bears (1999–2000 to 2003–2004) (Lunn et al. 2005). For the same time period, the average harvest was 58.2 bears, leaving an additional buffer of 23 bears that could have been removed from the population. Therefore, an oil spill that resulted in the death of greater than 23 bears, which was possible based on the range of oil spill-related mortalities from the previous analysis, could have had population level effects for polar bears in the southern Beaufort Sea. However, the harvest figure of 81 bears may no longer be sustainable for the Southern Beaufort Sea population so, given the average harvest rate cited above, fewer than 23 oil spill-related mortalities could result in a population decline or increase the time required for recovery.

The Fish and Wildlife Service (USFWS) works to monitor and mitigate potential impacts of oil and gas activities on polar bears through incidental take regulations (ITR) as authorized under the Marine Mammal Protection Act. Activities operating under these regulations must adopt measures to: ensure that the total taking of polar bears remains negligible; minimize impacts to their habitat; and ensure no unmitigable adverse impact on their availability for Alaska Native subsistence use. ITR also specify monitoring requirements that provide a basis for evaluating potential impacts of current and future activities on marine mammals.

Climate Change

Polar bears evolved over thousands of years to life in a sea ice environment. They depend on the sea ice-dominated ecosystem to support essential life functions. Sea ice provides a platform for hunting and feeding, for seeking mates and breeding, for movement to terrestrial maternity denning areas and occasionally for maternity denning, for resting, and for long-distance movements. The sea ice ecosystem supports ringed seals, the primary prey for polar bears, and other marine mammals that are also part of their prey base.

Sea ice is rapidly diminishing throughout the Arctic and large declines in optimal polar bear habitat have occurred in the Southern Beaufort and Chukchi Seas between the two time periods, 1985–1995 and 1996–2006 (Durner et al. 2009). In addition, it is predicted that the greatest declines in 21st century optimal polar bear habitat will occur in Chukchi and Southern Beaufort Seas (Durner et al. 2009). Patterns of increased temperatures, earlier onset of and longer melting periods, later onset of freeze-up, increased rain-on-snow events, and potential reductions in snowfall are occurring. In addition, positive feedback systems (i.e., the sea-ice albedo feedback mechanism) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can operate to amplify the effects of these phenomena. As a result, there is fragmentation of sea ice, a dramatic increase in the extent of open water areas seasonally, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al 1999, Rothrock et al. 1999, Comiso 2003, Fowler et al. 2004, Lindsay and Zhang 2005, Holland et al. 2006, Comiso 2006, Serreze et al. 2007, Stroeve et al. 2008).

The Chukchi/Bering Seas and the Southern Beaufort Sea population stocks are currently experiencing the initial effects of changes in sea ice conditions (Rode et al. 2007, Regehr et al. 2007, Hunter et al. 2007). These populations are vulnerable to large-scale dramatic seasonal fluctuations in ice movements, decreased abundance and access to prey, and increased energetic costs of hunting. The USFWS is working on measures to protect polar bears and their habitat.

Subsistence Harvest

Recognition that the polar bears in the southern Beaufort Sea were shared between Canada and the Alaska led to the development of the Polar Bear Management Agreement for the Southern Beaufort Sea between the Inuvialuit of the Inuvialuit Game Council (IGC), Canada and the Inupiat of the North Slope Borough (NSB) Alaska in 1988 (Nageak et al. 1991, Treseder and Carpenter 1989, Prestrud and Stirling 1994, Brower et al. 2002). Since initiation of this local user agreement in 1988, the combined Alaska/Canada mean harvest from this stock has been 56.9 bears per year (1988-2007). The harvest in Canada is limited primarily to Native hunters and is regulated by a quota system (Prestrud and Stirling 1994, Brower et al. 2002). Canada has a well regulated and controlled harvest, which has resulted in accurate harvest reporting, strict controls on the harvest, and efficient monitoring and enforcement. The harvest management system in Alaska is voluntary and is less efficient overall than the Canadian system (Brower et al 2002).

The calculation of a PBR level for the Southern Beaufort Sea stock is required by the MMPA even though the subsistence harvest quota is managed under the authority of the Polar Bear Agreement between the NSB and the IGC. Accordingly, the quota from the Board of Commissioners for the Polar Bear Agreement takes precedence over the PBR estimate for the purposes of managing the Alaska Native subsistence harvest from this stock. The Southern Beaufort Sea population is currently thought to be declining; therefore, overharvest could hasten the decline or prevent and/or slow the recovery. Analysis is currently underway to evaluate the effects of different harvest levels on the population dynamics of the Southern Beaufort Sea population.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

Pacific walrus range throughout the continental shelf waters of the Bering and Chukchi seas, occasionally moving into the East Siberian Sea and the Beaufort Sea (Figure 1). During the summer months most of the population migrates into the Chukchi Sea; however, several thousand animals, primarily adult males, aggregate near coastal haulouts in the Gulf of Anadyr, Bering Strait region, and in Bristol Bay. During the late winter breeding season walrus are found in two major concentration areas of the Bering Sea where open leads, polynyas, or thin ice occur (Fay *et al.* 1984). While the specific location of these groups varies annually and seasonally depending upon the extent of the sea ice, generally one group ranges from the Gulf of Anadyr into a region southwest of St. Lawrence Island, and a second group is found in the southeastern Bering Sea from south of Nunivak Island into northwestern Bristol Bay.

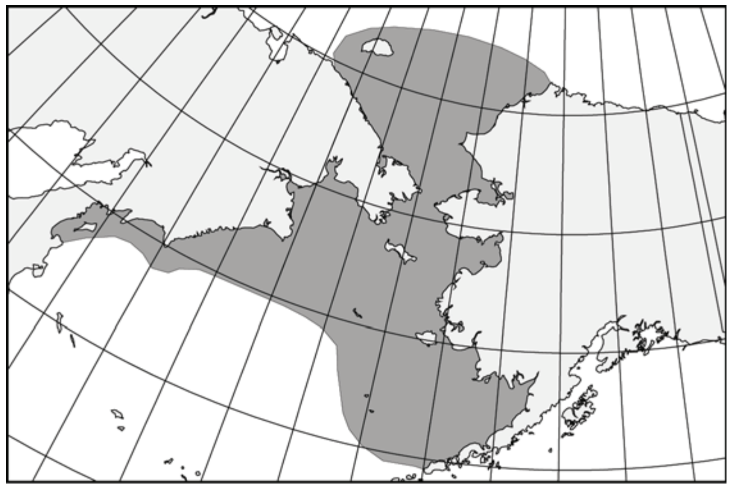

Figure 1. Approximate distribution of Pacific walrus in U.S. and Russian territorial waters (shaded area). The combined summer and winter distributions are depicted.

Pacific walrus are currently managed as a single panmictic population; however, stock structure has not been thoroughly investigated. Scribner *et al.* (1997) found no difference in mitochondrial and nuclear DNA among walrus sampled shortly after the breeding season from four areas of the Bering Sea (Gulf of Anadyr, Koryak Coast, southeast Bering Sea, and St. Lawrence Island). More recently, Jay *et al.* (2008) found indications of stock structure based on differences in the ratio of trace elements in the teeth of walruses sampled in January and February from two breeding areas (southeast Bering Sea and St. Lawrence Island). Further research on stock structure of Pacific walruses is needed.

POPULATION SIZE

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

Between 1975 and 1990, visual aerial surveys were carried out by the United States and Russia at 5-year intervals, producing population estimates ranging from 201,039 to 234,020 animals (Table 1). The estimates generated from these surveys are considered minimum values that are not suitable for detecting trends in population size (Hills and Gilbert 1994, Gilbert *et al.* 1992). Efforts to survey the Pacific walrus population were suspended after 1990 due to unresolved problems with survey methods that produced population estimates with unknown bias and unknown or large variances that severely limited their utility (Gilbert *et al.* 1992, Gilbert 1999).

An international workshop on walrus survey methods, hosted by the U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) in 2000, concluded that it would not be possible to obtain a population estimate with adequate precision for tracking trends using the existing visual methodology and any feasible amount of survey effort (Garlich-Miller and Jay 2000). Workshop participants recommended investing in research on walrus distribution and haul-out patterns, and exploring new survey tools, including remote sensing systems and development of satellite transmitters, prior to conducting another aerial survey. Remote sensing systems were viewed as having great potential

Table 1. Estimates of Pacific walrus population size, 1975-2006. Estimates are highly variable and not directly comparable among years (Fay *et al*. 1997, Gilbert 1999) because of differences in survey methodologies, timing of surveys, segments of the population surveyed, and incomplete coverage of areas where walrus may have been present. Therefore, these estimates do not provide a definitive basis for inference with respect to population trends.

Year	Population Estimate	References
1975	221,350	Gol'tsev 1976, Estes and Gilbert 1978, Estes and Gol'tsev 1984
1980	246,360	Johnson *et al.* 1982, Fedoseev 1984
1985	234,020	Gilbert 1986, 1989a, 1989b; Fedoseev and Razlivalov 1986
1990	201,039	Gilbert *et al.* 1992
2006	129,000	Speckman *et al*. in prep.

to address many of the shortcomings of visual aerial surveys by sampling larger areas per unit of time (Burn *et al*. 2006), objectively detecting and quantifying walruses (Udevitz *et al.* 2001), and reducing observer error (Burn *et al*. 2006).

Four years of field study by the USFWS and Russian partners led to the development of a survey method that uses thermal imaging systems to reliably detect walrus groups hauled out on sea ice (Burn *et al.* 2006, Udevitz *et al*. 2008). At the same time, the USGS developed satellite transmitters that record information on haul-out status of individual walrus, which can be used to estimate the proportion of the population in the water. This allows correction of an estimate of walrus numbers on ice to account for walrus in the water that cannot be detected in thermal imagery. These technological advances led to a joint U.S.-Russia survey in March and April of 2006, when the Pacific walrus population hauls out on sea ice habitats across the continental shelf of the Bering Sea.

The goal of the 2006 survey was to estimate the size of the Pacific walrus population (Speckman *et al.* in prep.). U.S. and Russian teams coordinated aerial survey efforts on their respective sides of the international border. The Bering Sea was partitioned into survey blocks, and a systematic random sample of transects within a subset of the blocks was surveyed with airborne thermal scanners using standard strip-transect methodology. An independent set of scanned walrus groups was aerially photographed. Counts of walrus in photographed groups were used to model the relation between thermal signatures and the number of walrus in groups, which was used to estimate the number of walrus in groups that were detected by the scanner but not photographed. The probability of thermally detecting various-sized walrus groups was modeled to estimate the number of walrus in groups undetected by the scanner. Thermal imagery detects walrus that are hauled out on sea ice, but is unable to detect walrus swimming in water. Therefore, data from walrus tagged with satellite transmitters were used to adjust on-ice estimates to account for walrus in the water during the survey.

The estimated area of available walrus sea ice habitat in 2006 averaged 668,000 km^2, and the area of surveyed blocks was 318,204 km^2. The number of Pacific walrus within the surveyed area was estimated at 129,000 with 95% confidence limits of 55,000 to 507,000 individuals (Speckman *et al.* in prep.). As this estimate does not account for areas that were not surveyed, some of which are known to have had walrus present, it is negatively biased to an unknown degree.

Minimum Population Estimate

An estimate of minimum population size (N_{MIN}) can be calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842 * [\ln(1+[CV(N)^2]^{1/2})$. However, the 2006 estimate of Pacific walrus population size is known to be negatively biased (Speckman *et al.* in prep.), which provides assurance that walrus population size was greater than the estimate (NMFS 2005). The 2006 estimate of 129,000 walruses within the surveyed area is, therefore, also the best estimate of N_{MIN}.

Current Population Trend

The 2006 estimate is lower than other estimates of Pacific walrus population size to date (Table 1). However, estimates of population size from 1975 to 2006 (Table 1) are highly variable and not directly comparable among years (Fay *et al*. 1997, Gilbert 1999) because of differences in survey methodologies, timing of surveys, and segments of the population surveyed, as well as incomplete coverage of areas where walrus may have been present. Therefore, these estimates do not provide a definitive basis for inference with respect to population trends.

A decline in Pacific walrus population size from its peak in the late 1970s and 1980s would not be unexpected. Walrus researchers in the 1970s and 1980s were concerned that the population had reached or exceeded carrying capacity, and predicted that density-dependent mechanisms would begin to cause a decrease in population size (Fay and Stoker 1982b, Fay *et al*. 1986, Sease 1986, Fay *et al*. 1989). Estimates of demographic parameters from the late 1970s and 1980s support the idea that population growth was slowing (Fay and Stoker 1982a, Fay *et al*. 1986, Fay *et al*. 1989). Garlich-Miller *et al*. (2006) found that the median age of reproduction for female walrus decreased in the 1990s, which is consistent with reduction in density-dependent pressures. However, data are not available to allow conclusion of whether changes in walrus life-history parameters might have been mediated by changes in walrus abundance, or by changes in the carrying capacity of the environment.

The estimate for 2006 of about 129,000 walruses is biased low because some areas known to be important to walrus were not surveyed due to poor weather conditions. The area south of Nunivak Island was not surveyed, an area where walrus are known to aggregate (Krogman *et al*. 1979), and where several thousand walrus were sighted after the 2006 survey was completed (USFWS unpublished data). Additional unsurveyed areas were located to the southwest of St. Lawrence Island and to the south of Cape Navarin, where aggregations of walrus have been documented during April in other years (Fay 1957, Fedoseev 1979, Fay 1982, Braham *et al*. 1984, Fay *et al*. 1984, Fedoseev *et al*. 1988, Burn *et al*. 2006, Burn *et al*. 2009). However, earlier estimates of walrus population size are also likely to be negatively biased since they did not adjust for walrus in the water, a proportion of the population that may be as high as 0.65 – 0.87 (Born and Knutsen 1997, Gjertz *et al*. 2001, Jay *et al*. 2001, Born *et al*. 2005, Acquarone *et al*. 2006, Lydersen *et al*. 2008). In summary, as noted above, the estimates in Table 1 are not directly comparable and cannot be used to identify current population trends; more surveys will be required to verify any trends in population size and to quantify such changes.

MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) of a marine mammal stock is defined in the Marine Mammal Protection Act (MMPA) as the product of the minimum population estimate (N_{MIN}), one-half the maximum theoretical net productivity rate (R_{MAX}), and a recovery factor (F_R): PBR = N_{MIN} x 0.5 R_{MAX} x F_R. The recovery factor (F_R) for the Pacific walrus is 0.50 (NMFS 2005) as the population has unknown status (Speckman *et al.* in prep.). R_{MAX} is estimated as 0.08 (Chivers 1999). Therefore, for the Pacific walrus population, PBR = 2,580 walrus (129,000 x 0.5 (0.08) x 0.50).

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

A complete list of fisheries and marine mammal interactions is published annually by NOAA-Fisheries, the most recent of which was published on December 1, 2008 (73 FR 73032). Pacific walrus occasionally interact with trawl and longline gear of groundfish fisheries. No data are available on incidental catch of walrus in fisheries operating in Russian waters, although trawl and longline fisheries are known to operate there. In Alaska each year, fishery observers monitor a percentage of commercial fisheries and report injury and mortality to marine mammals incidental to these operations. Overall, 13 observed fisheries operate in Alaska within the range of the Pacific walrus in the Bering Sea, and could potentially interact with them. Incidental mortality during the 5-year period 2002-2006 was recorded only for one fishery, the Bering Sea/Aleutian Island flatfish trawl fishery (non-pelagic; Table 2), which according to NOAA-Fisheries' List of Fisheries is a Category II Commercial Fishery with an estimated 34 vessels and/or persons participating in the fishery. No incidental injury was recorded during this time period; therefore, annual serious injury is estimated to be zero. Observer coverage for this fishery averaged 64.7% during 2002-2006. The mean number of observed mortalities was 1.8 walrus per year, with a range of 0 to 3 (Table 2). The total estimated

Table 2. Summary of incidental mortality of Pacific walrus due to commercial fisheries from 2002-2006 and estimated mean annual mortality. All mortalities occurred in the Bering Sea/Aleutian Islands flatfish trawl fishery. Fisheries observer data provided by NMFS. NE = no estimate made because no take was recorded.

Fishery	Year	Data type	Observer coverage (%)	Observed mortality (in given years)	Estimated mortality (in given years)	95% CI
Bering Sea/ Aleutian Islands flatfish trawl	2002	obs data	58.4	2	3.3	1.4 – 7.5
	2003		64.1	0	NE	NE
	2004		64.3	2	3.1	1.4 – 6.8
	2005		68.3	3	4.1	2.3 – 7.31
	2006		67.8	2	2.8	1.4 – 5.9
Mean	2002-2006	obs data	64.7	1.8	2.66 CV = 0.39	1.83 – 3.86

annual fishery-related incidental mortality in Alaska was 2.66 walrus per year (CV = 0.39). We consider fishery mortality insignificant.

Subsistence Harvest

Over the past 47 years the Pacific walrus population has sustained estimated annual harvest removals ranging from 3,184 to 16,127 animals per year (mean: 6,713; Figure 2). Recent harvest levels are lower than the long-term average over this period. It is not known whether recent reductions in harvest levels reflect changes in walrus abundance or hunting effort. Factors affecting harvest levels include: 1) the cessation of Russian commercial walrus harvests after 1991; 2) changes in political, economic, and social conditions of subsistence hunters in Alaska and Chukotka; and 3) the effects of variable weather and ice conditions on hunting success.

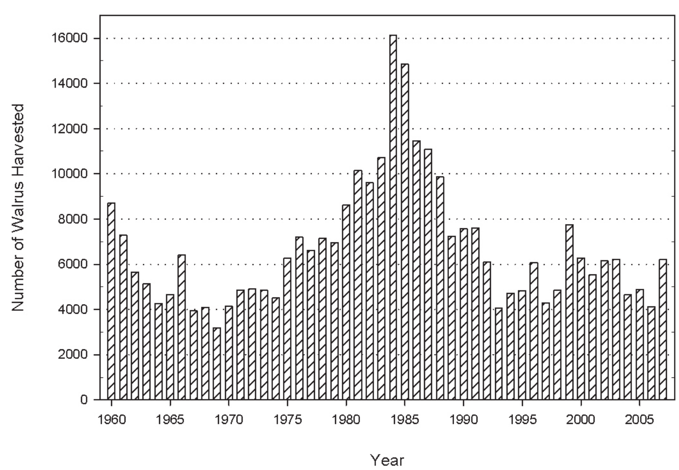

Figure 2. Estimated subsistence harvest of Pacific walrus in the U.S.and Russia, 1960-2007.

The USFWS uses the average annual harvest over the past five years as a representative estimate of current harvest levels in the U.S. and Russia. Total U.S. annual harvest is estimated using data collected by direct observation in selected communities and through the statewide regulatory Marking, Tagging, and Reporting Program (MTRP). The two sources of data are combined to calculate annual reporting compliance and to correct for any unreported harvest. Total U.S. subsistence harvest is estimated as the sum of reported and estimated unreported harvests. Harvest estimates in Russia were collected through both an observer program and a reporting program instituted by the Russian government.

The estimated number harvested is multiplied by 1.72 to adjust for walruses wounded but not retrieved (struck and lost; Fay *et al.* 1994), yielding the estimated total number taken. Fay *et al.* (1994) estimated the proportion of targeted walrus that were struck and lost at 42% using data collected between 1952 and 1972. Current accuracy of this estimate is unknown. Based on the same study, all walruses that have been shot with a firearm are assumed to be mortally wounded (Fay *et al.* 1994).

Table 3. Estimated harvest of Pacific walrus, 2003-2007. Russian harvest information was provided by ChukotTINRO and the Russian Agricultural Department. U.S. harvest information was collected by the U.S. Fish and Wildlife Service, and adjusted for unreported walrus using the Mark Recapture method, which yields upper and lower harvest estimates. Number struck and lost is estimated using a 42% struck and lost rate from Fay *et al.* (1994).

Year	Estimated Total Number Taken	Number Harvested, U.S.	Number Harvested, Russia	Number Struck and Lost
2003	5,909 – 6,551	2,002 – 2,375	1,425	2,482 – 2,751
2004	4,429 – 4,858	1,451 – 1,700	1,118	1,860 – 2,040
2005	4,762 -5,037	1,292 – 1,451	1,470	2,000 – 2,115
2006	3,907 – 4,262	1,219 – 1,425	1,047	1,641 – 1,790
2007	5,789 – 6,571	2,185 – 2,638	1,173	2,432 – 2,760
Mean	4,960 – 5,457	1,630 – 1,918	1,247	2,083 – 2,292

Harvest mortality levels from 2003-2007 are estimated at 4,960 – 5,457 walrus per year (Table 3). The sex-ratio of the reported U.S. walrus harvest over this time period was 1.55:1 males to females. The sex-ratio of the reported Russian walrus harvest was 3.76:1 males to females based on harvest information collected by ChukotTINRO in 2003 and 2005 only.

Other Removals

Between 2003 and 2007, satellite transmitters were affixed by crossbow to 143 walrus (annual mean: 28.6), and collections of skin and blubber biopsy samples were attempted from 214 walrus (annual mean: 42.8). No mortalities or serious injuries were associated with these research activities. Four orphaned walrus calves were rescued from the wild and placed on public display between 2003 and 2007. Based on this information, an estimated 0.8 walrus per year were removed from the wild due to other human activities.

Total Estimated Human-Caused Mortality and Serious Injury

The total estimated annual human-caused mortality or removal is calculated to be 4,963 - 5,460 walrus per year (2.66 attributed to fisheries interactions, 4,960 to 5,457 due to harvest, and 0.8 due to other human activities). There is insufficient information to accurately estimate human-caused serious injury, but there is no evidence that levels of human-caused serious injury are significant.

STATUS OF STOCK

Pacific walrus are not designated as depleted under the MMPA, and are not listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended. In February 2008, the USFWS received a petition to list the Pacific walrus under the ESA. The 90-day finding on this petition was published in the Federal Register on September 10, 2009 (74 FR 46548), and found that there was substantial information in the petition to indicate that listing the Pacific walrus under the ESA may be warranted. A status review of the Pacific walrus under the ESA was initiated on October 1, 2009, and a 12-month finding will be published in the Federal Register on or before September 10, 2010. Based on the best available data, the estimated incidental mortality and serious injury related to commercial fisheries (2.66 walrus per year) is less than 10% of the calculated PBR and therefore can be considered insignificant and approaching a zero mortality and serious injury rate. However, the total human-caused removals exceed estimated PBR. Therefore, the Pacific walrus stock is classified as strategic.

Conservation Issues and Habitat Concerns

Oil and Gas Exploration

In 2008, the Minerals Management Service held an oil and gas lease sale for offshore blocks in the eastern Chukchi Sea. A significant proportion of the Pacific walrus population migrates into the Chukchi Sea region each summer, and the shallow, productive, ice covered waters of the eastern Chukchi Sea are considered particularly important habitat for female walrus and their dependent young. The USFWS works to monitor and mitigate potential impacts of oil and gas activities on walrus and polar bears through incidental take regulations (ITR) as authorized under the

MMPA. Activities operating under these regulations must adopt measures to: ensure that impacts to walruses remain negligible; minimize impacts to their habitat; and ensure no unmitigable adverse impact on their availability for Alaska Native subsistence use. ITR also specify monitoring requirements that provide a basis for evaluating potential impacts of current and future activities on marine mammals.

Climate Change

Impacts to walrus of changes in arctic and subarctic ice dynamics are not well understood. Walrus are dependent on sea ice as a substrate for birthing, nursing, and resting between foraging trips. Annual winter ice in the Bering Sea is predicted to decrease in extent by 40% by the year 2050 (Overland and Wang 2007). Summer sea-ice extent in the Chukchi Sea has decreased rapidly in recent years (Meier et al. 2007, Stroeve et al. 2008), retreating off the shallow continental shelf and over deep Arctic Ocean waters where walruses presumably can not feed. Declines in sea-ice extent, duration, and thickness are expected to continue (Overpeck et al. 2005, Maslanik et al. 2007, Stroeve et al. 2007).

Some impacts of the loss of summer sea ice on walrus have been documented. Over the past decade, the number of walrus coming to shore along the coastline of the Chukchi Sea in Russia has increased (Kavry et al. 2008). Female and young walrus are arriving earlier and staying longer at coastal haulouts as summer ice disappears. Numbers in the tens of thousands have been reported anecdotally from some haulouts in Chukotka (Kavry *et al*. 2008, A.A. Kochnev personal communication). In fall of 2007 and 2009, large walrus aggregations were also observed along the Alaska coast. The ability of the food supply within foraging range of coastal haulouts to support large numbers of walruses over the long term is unknown. Thin walrus that appear to be physiologically stressed have also been reported from Chukotka (Ovsyanikov *et al*. 2008, A.A. Kochnev personal communication). Walrus at dense coastal haulouts are vulnerable to disturbance, which can result in increased mortality from stampedes (Ovsyanikov 1994, Kavry *et al*. 2008). The USFWS will review all available information on the impacts of climate change on the Pacific walrus population when it considers the petition to list them under the ESA.

Subsistence Harvest

Impacts of climate change on subsistence harvests of walrus are also difficult to predict. Changes in walrus distribution, abundance, individual health, ice type, length and timing of the hunting season, and weather and sea state during the hunting season, can all influence hunting success. Recent harvest levels are lower than historical levels but it is not clear if this represents reduced hunting effort. Harvest levels must be assessed within the context of the best available information on walrus population size, weather and climate, and political, economic, and social conditions of subsistence hunters in Alaska and Chukotka.

Cooperative Agreements have been developed annually between the USFWS and the Eskimo Walrus Commission since 1997 to facilitate the participation of subsistence hunters in activities related to the conservation and management of walrus stocks in Alaska. This co-management process is on-going. Ensuring that harvest levels remain sustainable is a goal shared by subsistence hunters and resource managers in the U.S. and Russia. Achieving this management goal will require continued investments in co-management relationships, harvest monitoring programs, international coordination, and research.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

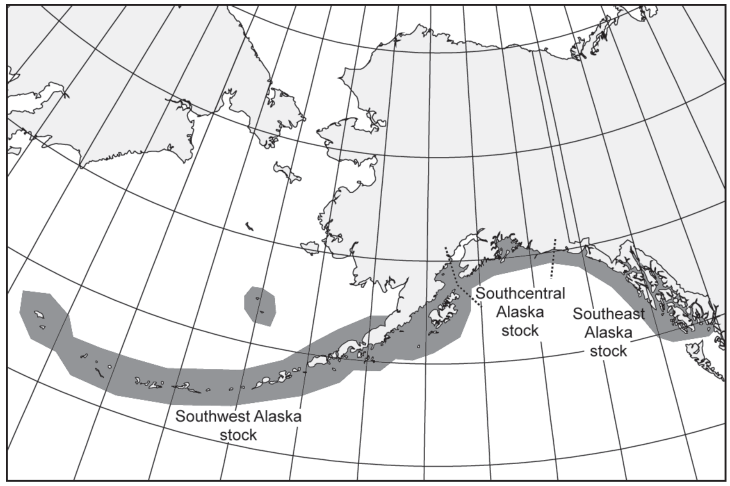

Figure 1. Approximate distribution of northern sea otters in Alaska waters (shaded area)

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

POPULATION SIZE

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

Although population regrowth began following legal protection, no remnant colonies of sea otters existed in southeast Alaska. As part of efforts to re-establish sea otters in portions of their historical range, otters from Amchitka Island and Prince William Sound were translocated to other areas (Jameson et al. 1982). These translocation efforts met with varying degrees of success. From 1965 to 1969, 412 otters (89% from Amchitka Island in southwest Alaska, and 11 percent from Prince William Sound in southcentral Alaska) were translocated to 6 sites in southeast Alaska (Jameson et al. 1982). In the first 20 years following translocation, these populations grew in numbers and expanded their range (Pitcher 1989).

Nearly all of the current population estimates for the southeast Alaska stock were developed using the aerial survey methods of Bodkin and Udevitz (1999). The lone exception was a survey of the outer coastline from the western boundary of the stock at Cape Yakataga to Cape Spencer conducted by U.S. Geological Survey (USGS) in 2000 (N=32, CV=0.378). In 2002, USGS also surveyed Glacier Bay (N=1,266, CV=0.15) and the northern half of the southeast Alaska (N=1,838, CV=0.17; Bodkin and Esslinger 2006). The southern half was surveyed by USGS in 2003 (N=5,845; CV=0.14). In 2005, the U.S. Fish and Wildlife Service (Service) surveyed Yakutat Bay using the same

Table 1. Population estimates for the southcentral Alaska stock of northern sea otters. Previous stock assessment report (SAR) total is from August 2002.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{MIN}	Reference
North Gulf of Alaska	2000	198	428	0.378	314	USGS unpublished data
Cook Inlet/Kenai Fiords	2002		2,673	0.271	2,136	Bodkin et al. (2003b)
Prince William Sound	2003		11,989	0.179	10,324	Bodkin et al. (2003a)
Current Total			**15,090**		**12,774**	
Previous SAR Total			16,552		13,955	

methods (N=1,582; CV=0.33; Gill and Burn 2007). The most recent population estimates for the southeast Alaska stock are presented in Table 1.

Glacier Bay was also surveyed as recently as 2006, with a resulting estimate of 2,785 sea otters (Bodkin and Esslinger 2006). The increase in sea otter abundance in Glacier Bay cannot be explained by reproduction alone, indicating that there has been substantial redistribution of sea otters in the past several years (Bodkin and Esslinger 2006). Therefore, to avoid double-counting of animals in both the Glacier Bay and northern southeast Alaska survey areas, we used the 2002 estimate for Glacier Bay, combined with adjusted estimates for the remainder of the stock, which results in a total estimate of 10,563 sea otters for the southeast Alaska stock.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1. The estimated N_{MIN} for the southeast Alaska stock is 9,136 sea otters.

Current Population Trend

Prior to the most recent aerial surveys, the trend for this stock of sea otters had been one of growth (Pitcher 1989, Agler et al. 1995). Comparing the current population estimate with that of the previous stock assessment report suggests that the southeast Alaska stock may not have continued to increase in abundance (USGS unpublished data). The comparison of abundance estimates is complicated by substantial differences in methods between the 1994 skiff survey of Agler et al. (1995) and the USGS aerial surveys; however, GIS analysis of the most recent surveys compared with original data from Pitcher (1989) indicates that range expansion from the outer coast to inner, protected waters has not occurred. The distribution of sea otters has changed; however, with substantial immigration into Glacier Bay in the past decade. In addition, residents of southeast Alaska also report changes in sea otter distribution, and consider the population to be healthy in their local areas.

Sea otter abundance in Yakutat Bay has also increased over the last decade, likely through reproduction, although some amount of immigration cannot be ruled out (Gill and Burn 2007). During this process, otters appear to have expanded their range to include the western shores of Yakutat Bay.

Although the estimated population size of this stock is lower than in the previous stock assessment report, due to improved precision in some of the estimates, the value for N_{MIN} is comparable. Therefore, the current population trend for the southeast Alaska stock is believed to be stable.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. Although maximum productivity rates have not been measured through much of the sea otter's range in Alaska, in the absence of more detailed information, the rate of 20% calculated by Estes (1990) is considered the best available estimate of R_{MAX}. There is insufficient information available to estimate the current net productivity rate for this population stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5\ R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997) as population levels have remained stable with a known human take. Thus, for the southeast stock of sea otters, PBR = 914 animals (9,136 × 0.5(0.2) × 1.0).

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

A complete list of fisheries and marine mammal interactions is published annually by the National Marine Fisheries Service (NMFS), the most recent of which was published on November 27, 2007 (72 FR 66048). Although numerous fisheries exist within the range of the southeast Alaska stock of northern sea otters, none have been identified as interacting with this stock. Other types of fisheries that have been known to interact with sea otters in the southwest and southcentral Alaska stocks do occur in southeast Alaska, specifically the southeast Alaska salmon drift gillnet (481 vessels) and the Yakutat salmon set gillnet (170 participants) fisheries. However, available information suggests that fisheries using other types of gear, such as trawl, longline, pot, and purse seine, appear to be less likely to have interactions with sea otters due to either the areas where such fisheries operate, or the specific gear used, or both. Thus, this may explain the lack of fishery interaction with the southeast Alaska stock

The estimated level of incidental mortality and serious injury of this stock can be estimated from fishery observer programs that monitor a portion of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to those operations. No incidents of sea otter incidental take have been observed in trawl, longline, or pot groundfish fisheries in southeast Alaska from 1989-2006 (Perez 2003; Perez 2006; Perez 2007).

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska is found in fisher self-reports required of vessel-owners by NMFS. From 1990 to 1993, self-reported fisheries data reflected no sea otter kills or injuries in southeast Alaska. Self-reports were incomplete for 1994 and not available for 1995 or 1996. Between 1997 and 2005, there were no records of incidental take of sea otters by commercial fisheries in this region. Credle et al. (1994) considered fisher self-reports to be a minimum estimate of incidental take as these data are most likely negatively biased.

Information is insufficient to determine if the total fishery mortality and serious injury for the southeast Alaska stock of the northern sea otter is insignificant and is approaching a zero mortality and serious injury rate (i.e., 10% of PBR) because observer coverage is not adequate.

Oil Spills

Activities associated with exploration, development, and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (<10% of body surface), but that greater levels (>25%) will lead to death (Costa and Kooyman 1981, Siniff et al. 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Total estimates of mortality for the Prince William Sound area vary from 750 (range 600 - 1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) (Garrot et al. 1993) otters. Statewide, it is estimated that 3,905 sea otters (range 1,904 - 11,257) died in Alaska as a result of the spill (DeGange et al. 1994). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the spill (Bodkin et al. 2002, Stephensen et al. 2001).

There is currently no oil and gas development in southeast Alaska. Tankers carrying oil south from the Trans-Alaska Pipeline typically travel offshore and, therefore, pose a minimal risk to sea otters in southeast Alaska. Information on oil spills compiled by the Alaska Department of Environmental Conservation from 2002-2006 indicate that there were no reported spills of crude oil in southeast Alaska. In addition to spills that may occur in association with the development, production, and transport of crude oil, each year numerous spills of non-crude oil products in the marine environment occur from ships and shore facilities throughout southeast Alaska. During that same time period, there was an average of 167 spills occur each year, ranging in size from less than 1 and up to 6,000 gallons. The vast majority of these spills are small, with a median size of 2 gallons, and there is no indication that these small-scale spills have an impact on the southeast Alaska stock of northern sea otters

Subsistence/Native Harvest Information

The MMPA exempted Native Alaskans from the prohibition on hunting marine mammals, provided such taking was not wasteful. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. Data for subsistence harvest of sea otters in southeast Alaska are collected by a mandatory Marking, Tagging and Reporting Program administered by the Service since 1988. Figure 2 provides a summary of harvest information for the southeast stock from 1989-2006. The mean reported annual subsistence take during the past five complete calendar years (2002-2006) was 322 animals. Reported age composition during this period was 84% adults, 12% subadults, and 4% pups. Sex composition during the past five years was 70% males, 28% females, and 2% of unknown sex.

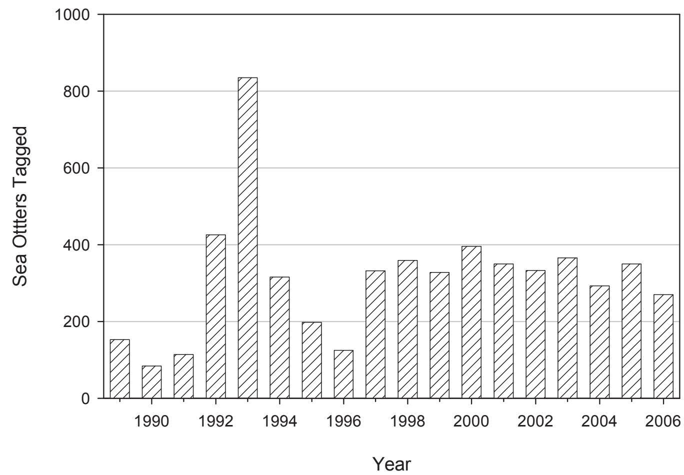

Figure 2. Reported subsistence harvest of northern sea otters from the southeast Alaska stock, 1989-2006.

Research and Public Display

In the past five years, no sea otters were removed from the southeast Alaska stock for public display, nor were any sea otters captured and released for scientific research.

Other Factors

In August 2006, the Working Group on Marine Mammal Unusual Mortality Events reviewed information provided by the Service, and declared that a dramatic increase in sea otter strandings since 2002 constitutes an Unusual Mortality Event (UME) in accordance with Section 404 of the MMPA. The disease that typifies this UME is caused by a *Streptococcus infantarius* infection and has been observed over a broad geographic range in Alaska, including a few cases from southeast Alaska; however, the majority of cases have come from Kachemak Bay in the southcentral Alaska stock. It is not clear if the observed stranding pattern is representative of overall sea otter mortality, or an artifact of having a well-developed stranding network in the Kachemak Bay area. The Service will continue to work with the NMFS and Alaska SeaLife Center to develop the infrastructure for a statewide marine mammal stranding network in Alaska.

STATUS OF STOCK

The level of direct human-caused mortality within the southeast Alaska stock does not exceed the PBR level, and the southeast Alaska stock is neither listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act, nor is it likely to be listed as such in the foreseeable future. The known level of direct human-cause mortality is 322 otters per year. It would require an annual rate of fishery mortality and serious injury of nearly 600 otters per year for the total amount of direct human-caused mortality to exceed PBR for this stock. Despite uncertainties regarding fishery mortality and serious injury, we believe that it is unlikely this level is occurring at present. Therefore, the southeast Alaska stock of the northern sea otter is classified as non-strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

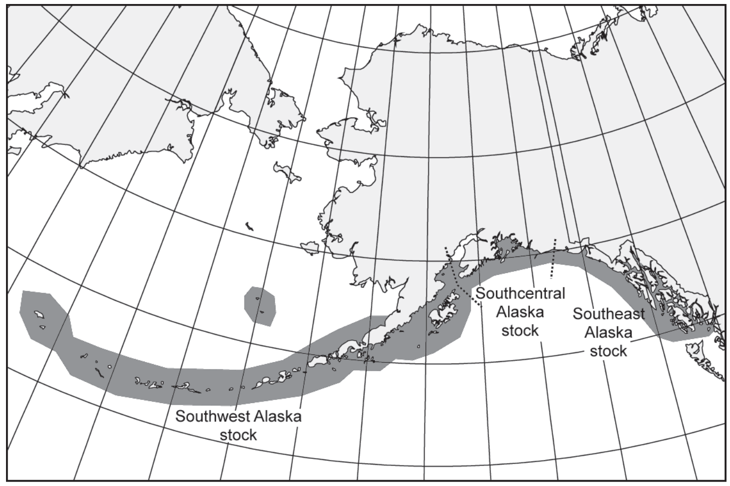

Figure 1. Approximate distribution of northern sea otters in Alaska waters (shaded area)

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

POPULATION SIZE

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

In 2003, an aerial survey of Prince William Sound resulted in an abundance estimate of 11,989 (CV = 0.18) animals (Bodkin et al. 2003a). This survey used methods described in Bodkin and Udevitz (1999) and included a survey-specific correction factor to account for undetected animals.

A survey of lower Cook Inlet and the Kenai Fiords area conducted in June and August 2002 also followed the methods of Bodkin and Udevitz (1999) and produced an abundance estimate of 2,673 (CV = 0.271) (Bodkin et al. 2003b).

Finally, an aerial survey of the northern Gulf of Alaska coastline flown in 2000 provided a minimum uncorrected count of 198 sea otters between Cape Hinchinbrook and Cape Yakataga (USGS Unpublished data). Applying a correction factor of 2.16 (CV = 0.378) for this observer conducting sea otter aerial surveys produces an adjusted estimate of 428 (CV = 0.378).

The most recent population estimates for survey areas within the southcentral Alaska stock are presented in Table 1. Combining the adjusted estimates for these three areas results in a total estimate of 15,090 sea otters for the southcentral Alaska stock.

Table 1. Population estimates for the southcentral Alaska stock of northern sea otters. Previous stock assessment report (SAR) total is from August 2002.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{MIN}	Reference
North Gulf of Alaska	2000	198	428	0.378	314	USGS unpublished data
Cook Inlet/Kenai Fiords	2002		2,673	0.271	2,136	Bodkin et al. (2003b)
Prince William Sound	2003		11,989	0.179	10,324	Bodkin et al. (2003a)
Current Total			**15,090**		**12,774**	
Previous SAR Total			16,552		13,955	

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1. The estimated N_{MIN} for the southcentral Alaska stock is 12,774 sea otters.

Current Population Trend

Prior to the most recent survey results, the trend for this stock of sea otters had generally been one of growth (Irons et al. 1988, Bodkin and Udevitz 1999).

Sea otter abundance in Prince William Sound has not increased appreciably since 1994 (Bodkin et al. 2002). Although the current population estimate for the entire stock is slightly lower (approximately 8%) than the 2002 stock assessment, there is anecdotal evidence that this change may be due to emigration of sea otters from Orca Inlet in eastern Prince William Sound into areas that have not been surveyed recently, most likely Copper River Flats and Kayak Island. Our best assessment is that the overall trend for this stock appears to be stable at this time.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. Although maximum productivity rates have not been measured through much of the sea otter's range in Alaska, in the absence of more detailed information, the rate of 20% calculated by Estes (1990) is considered the best available estimate of R_{MAX}. There is insufficient information available to estimate the current net productivity rate for this population stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5\ R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0 (Wade and Angliss 1997) as population levels have remained stable with a known human take. Thus, for the southcentral stock of sea otters, PBR = 1,277 animals (12,774 × 0.5 (0.2) × 1.0).

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

A complete list of fisheries and marine mammal interactions is published annually by the National Marine Fisheries Service (NMFS), the most recent of which was published on November 27, 2007 (72 FR 66048). Numerous fisheries exist within the range of the southcentral Alaska stock of northern sea otters, with the only one identified as interacting with the southcentral Alaska stock being the Prince William Sound drift gillnet, with an estimated 541 vessels and/or persons participating in the fishery. Additional salmon drift gillnet fisheries occur in Cook Inlet, with 576 vessels;

however, all of this fishing effort occurs north of the range of sea otters from the southcentral Alaska stock. Although no interactions with salmon set gillnets have been identified for this stock, they have been observed in the Kodiak area within the southwest Alaska stock. Salmon set gillnet fisheries occur in Prince William Sound (30 participants), and Cook Inlet (745). With the exception of Kachemak Bay, much of the salmon set gillnet effort occurs north of the range of sea otters from the southcentral Alaska stock (Manly 2006). Available information suggests that fisheries using other types of gear, such as trawl, longline, pot, and purse seine, appear to be less likely to have interactions with sea otters due to either the areas where such fisheries operate, or the specific gear used, or both.

The estimated level of incidental mortality and serious injury of this stock can be estimated from fishery observer programs that monitor a portion of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to those operations. No incidents of sea otter incidental take have been observed in trawl, longline, or pot groundfish fisheries in southcentral Alaska from 1989-2006 (Perez 2003; Perez 2006; Perez 2007). In addition to these fisheries, observers monitored the Cook Inlet set gillnet and drift gillnet fisheries from 1999-2000 (Manly 2006). The observer coverage during both years was approximately 2-5%. No mortalities or injuries of sea otters were reported by fisheries observers for the Cook Inlet set gillnet and drift gillnet fisheries for this period. On several occasions, sea otters were observed within 10 meters of the gillnet gear, but did not become entangled. No other fisheries operating in the region of the southcentral Alaska stock were monitored by observer programs from 1992 through 2006. From 1990 to 1991, fisheries observers in the southcentral Alaska region reported no mortalities or injuries of sea otters. Prior to the implementation of the NMFS observer program, studies were conducted on sea otter interactions with the drift net fisheries in western Prince William Sound from 1988 to1990, and no mortalities were observed (Wynne 1990, Wynne et al. 1991).

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska is found in fisher self-reports required of vessel owners by NMFS. In 1990, fisher self-report records show one mortality and four injuries due to gear interaction, and three injuries due to deterrence in the Prince William Sound drift gillnet fishery. Self-reports were not available for 1994 and 1995. Between 2000 and 2004, there were no records of incidental take of sea otters by commercial fisheries in this region thus the estimated mean annual mortality and serious injury reported for the 5-year period from 2000-2004 is zero. Credle et al. (1994) considered fisher self-reports to be a minimum estimate of incidental take as these data are most likely negatively biased.

Information is insufficient to determine if the total fishery mortality and serious injury for the southcentral Alaska stock of the northern sea otter is insignificant and is approaching a zero mortality and serious injury rate (i.e., 10% of PBR) because observer coverage is not adequate.

Oil Spills

Activities associated with exploration, development and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (< 10% of body surface), but that greater levels (>25%) will lead to death (Costa and Kooyman 1981, Siniff et al. 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Total estimates of mortality for the Prince William Sound area vary from 750 (range 600 - 1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) otters (Garrot et al. 1993). Statewide, it is estimated that 3,905 sea otters (range 1,904 - 11,257) died in Alaska as a result of the spill (DeGange et al.1994). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the 1989 oil spill (Bodkin et al. 2002, Stephensen et al. 2001).

Within the proximity of the southcentral Alaska sea otter stock, oil and gas development and production occurs only in Cook Inlet. In addition to existing offshore platforms, there was a Federal lease sale in Cook Inlet in 2004, but no tracts were purchased. Tankering of North Slope crude oil occurs regularly through the waters of Prince William Sound with no major oil spills since the *Exxon Valdez*. While the catastrophic release of oil has the potential to take large numbers of sea otters, there is no evidence that other effects (such as disturbance) associated with routine oil and gas development and transport have had a direct impact on the Southcentral Alaska sea otter stock.

Information on oil spills compiled by the Alaska Department of Environmental Conservation from 2002-2006 indicate that an average of 9 spills of crude oil occur each year, ranging in size from less than 1 and up to 525 gallons. In addition to spills directly associated with the development, production, and transport of crude oil, each year numerous spills of non-crude oil products in the marine environment occur from ships and shore facilities throughout southcentral Alaska. During the same time period, there was an average of 94 spills of non-crude oil per year, ranging in size from less than 1 and up to 3,065 gallons. The vast majority of these crude and non-crude oil spills are small, with a median size of 1 gallon, and there is no indication that these small-scale spills have an impact on the southcentral Alaska stock of northern sea otters.

Subsistence/Native Harvest Information

The MMPA exempted Native Alaskans from the prohibition on hunting marine mammals, provided such taking was not wasteful. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. Data for subsistence harvest of sea otters in southcentral Alaska are collected by a mandatory Marking, Tagging and Reporting Program administered by the U.S. Fish and Wildlife Service (Service) since 1988. Figure 2 provides a summary of harvest information for the southcentral stock from 1989-2006. The mean reported annual subsistence take during the past five complete calendar years (2002-2006) was 346 animals. Reported age composition during this period was 92% adults, 7% subadults, and 1% pups. Sex composition during the past 5 years was 72% males, 23% females, and 5% of unknown sex. The majority of the harvest over the past 5 years has occurred in northern and eastern Prince William Sound.

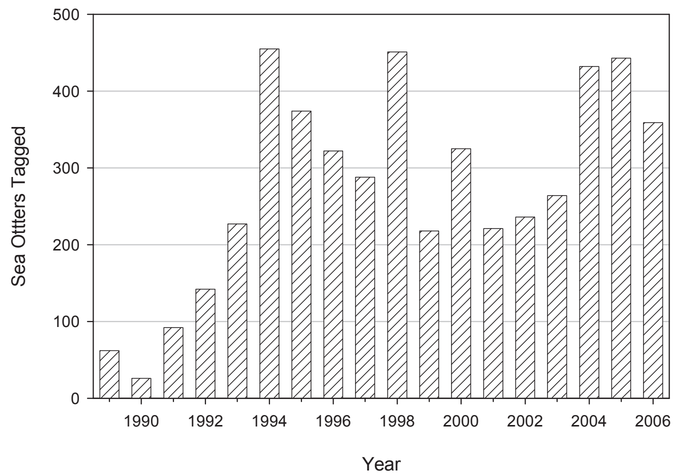

Figure 2. Reported subsistence harvest of northern sea otters from the southcentral Alaska stock, 1989-2006.

Research and Public Display

During the past five years there have been no live captures of sea otters for public display from the southcentral Alaska stock. Between 2002-2006, 127 sea otters were captured and released for scientific research in Prince William Sound. There were no reported injuries and/or mortalities related to these activities.

Other Factors

In August 2006, the Working Group on Marine Mammal Unusual Mortality Events (WGMMUME) reviewed information provided by the Service and declared that a dramatic increase in sea otter strandings since 2002 constitutes an Unusual Mortality Event (UME) in accordance with Section 404 of the MMPA. The disease that typifies this UME is caused by a *Streptococcus infantarius* infection and has been observed over a broad geographic range in Alaska, with the majority of cases having come from Kachemak Bay in the southcentral Alaska stock. Although not considered to be human-caused mortality at the present time, the impacts of this UME on the southcentral Alaska population have yet to be determined. The Service and the WGMMUME have formed an investigative team to conduct additional studies into the causes and effects of the UME. Result are not yet available for inclusion in this stock assessment report.

STATUS OF STOCK

The level of direct human-caused mortality within the southcentral Alaska stock does not exceed the PBR level, and the southcentral Alaska stock is neither listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the U. S. Endangered Species Act of 1973, as amended, nor is it likely to be listed as such in the foreseeable future. The known level of direct human-cause mortality is 346 otters per year. It would require an annual rate of fishery mortality and serious injury of over 900 otters per year for the total amount of direct human-caused mortality to exceed PBR for this stock. Despite uncertainties regarding fishery mortality and serious injury, we believe that it is unlikely this level is occurring at present. Therefore, the southcentral Alaska stock of the northern sea otter is classified as non-strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

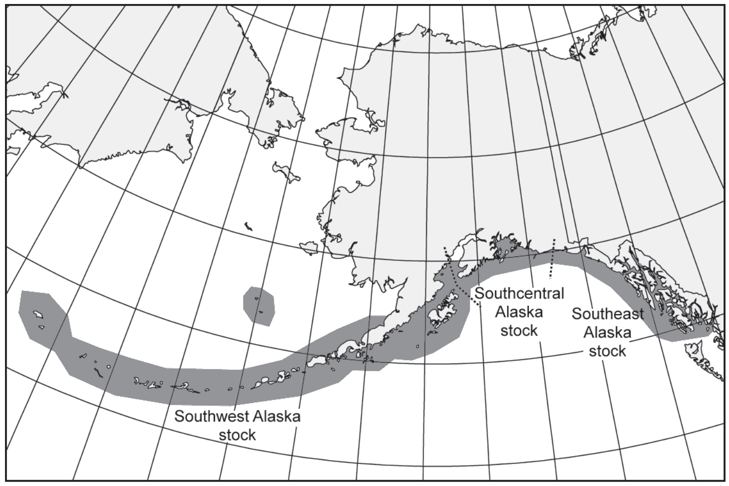

Figure 1. Approximate distribution of northern sea otters in Alaska waters (shaded area)

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

POPULATION SIZE

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

Aerial surveys along the shoreline of the Aleutian Islands in April 2000 produced a count of 2,442 sea otters in the nearshore waters (Doroff et al. 2003). Comparison of aerial and skiff survey counts at 6 islands in 2000 was used to calculate a correction factor of 3.58 for this aerial survey, which resulted in an adjusted population estimate of 8,742 (CV= 0.215) sea otters (Doroff et al. 2003).

In May 2000, a survey of offshore areas along the north Alaska Peninsula from Unimak Island to Cape Seniavin produced an abundance estimate of 4,728 (CV= 0.326) sea otters (Burn and Doroff 2005). A similar survey of offshore areas along the south Alaska Peninsula from False Pass to Pavlov Bay conducted in summer 2001 resulted in a population estimate of 1,005 (CV= 0.811) animals (Burn and Doroff 2005). Although a correction factor to account for sightability was not calculated during this survey, Evans et al. (1997) used a similar twin-engine aircraft flying at the same altitude and air speed to calculate a correction factor of 2.38 (CV = 0.087). Using this correction factor produced adjusted estimates of 11,253 (CV = 0.337) and 2,392 (CV = 0.816) for the north and south Alaska Peninsula offshore areas, respectively.

In 2001, aerial surveys along the shoreline of the south Alaska Peninsula from Seal Cape to Cape Douglas recorded 2,190 sea otters (Burn and Doroff 2005). Additional aerial surveys of the south Alaska Peninsula island groups (Sanak, Caton, and Deer Islands, and the Shumagin and Pavlov island groups) and a survey of Unimak Island, recorded 405 otters for the south Alaska Peninsula island groups and 42 animals for Unimak Island. Applying the same correction factor of 2.38 from Evans et al. (1997) produced adjusted estimates of 5,212 (CV = 0.087), 964 (CV = 0.087) and 100 (CV = 0.087) for the south Alaska Peninsula shoreline, south Alaska Peninsula islands, and Unimak Island, respectively.

An aerial survey of the Kodiak Archipelago conducted in 2004 produced an adjusted population estimate of 11,005 (CV = 0.228) sea otters (Doroff et al. in prep.). The methods used in this survey follow those of Bodkin and Udevitz (1999) which include the calculation of a survey-specific correction factor for animals undetected by observers.

Finally, an aerial survey of Kamishak Bay conducted in June 2002 produced an adjusted population estimate of 6,918 (CV = 0.147) sea otters (Bodkin et al. 2003). Similar to the Kodiak archipelago, this survey also used the methods of Bodkin and Udevitz (1999).

The most recent abundance estimates for survey areas within the southwest Alaska stock are presented in Table 1. Combining the adjusted estimates for these areas results in a total estimate of 47,676 sea otters for the southwest Alaska stock.

Table 1. Population estimates for the Southwest Alaska stock of northern sea otters. Previous stock assessment report (SAR) total is from August 2002.

Survey Area	Year	Unadjusted Estimate	Adjusted Estimate	CV	N_{min}	Reference
Aleutian Islands	2000	2,442	8,742	0.215	7,309	Doroff et al. (2003)
North Alaska Peninsula	2000	4,728	11,253	0.337	8,535	Burn and Doroff (2005)
South Alaska Peninsula - Offshore	2001	1,005	2,392	0.816	1,311	Burn and Doroff (2005)
South Alaska Peninsula - Shoreline	2001	2,190	5,212	0.087	4,845	Burn and Doroff (2005)
South Alaska Peninsula - Islands	2001	405	964	0.087	896	Burn and Doroff (2005)
Unimak Island	2001	42	100	0.087	93	USFWS Unpublished data
Kodiak Archipelago	2004		11,005	0.194	9,361	Doroff et al. (in prep.)
Kamishak Bay	2002		6,918	0.315	5,340	Bodkin et al. (2003)
Current Total			**47,676**		**38,703**	
Previous SAR Total			41,474		33,203	

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. The N_{MIN} for each survey area is presented in Table 1. The estimated N_{MIN} for the entire southwest Alaska stock is 38,703.

Current Population Trend

In spring 2000, U.S. Fish and Wildlife Service (Service) repeated an aerial survey that had previously been conducted in 1992 and observed widespread declines throughout the Aleutian Islands, with the greatest decreases occurring in the central Aleutians. The uncorrected count for the area was 2,442 animals, indicating that sea otter populations had declined 70% since 1992 (Doroff et al. 2003). Burn et al. (2003) estimated that the sea otter population in the Aleutians in 2000 may have been reduced to less than 10% of the carrying capacity for this area.

With the exception of the Kodiak archipelago, there have been no new large-scale abundance surveys for sea otters in southwest Alaska since the previous stock assessment report of August 2002; however, additional skiff and aerial surveys conducted from 2003 to 2005 show that sea otter abundance has continued to decline in the western and central Aleutians (63%) and the eastern Aleutians (48%;) (Estes et al. 2005, USFWS unpublished data).

Aerial surveys in other portions of southwest Alaska also show further evidence of population declines. Sea otter counts in the Shumagin Islands area south of the Alaska Peninsula showed an additional 33% decline between 2001 and 2004, and counts at Sutwik Island declined by 68% over the same time period (USFWS unpublished data). Unlike the Aleutian Islands and portions of the Alaska Peninsula, the population trend in the Kodiak archipelago does not appear to have undergone a significant population decline over the past 20 years (Doroff et al. in prep.). Other portions of the southwest Alaska stock, such as the Alaska Peninsula coast from Castle Cape to Cape Douglas and Kamishak Bay in lower western Cook Inlet, also show no signs of population declines similar to those observed in the Aleutian and Shumagin Islands areas.

The estimated population size for the southwest Alaska stock is slightly higher than in the previous stock assessment report, primarily due to a higher population estimate for the Kodiak archipelago in 2004. However, the overall sea otter population in southwest Alaska has declined by more than 50% since the mid-1980s. Thus, the overall population trend for the southwest Alaska stock is believed to be declining.

MAXIMUM NET PRODUCTIVITY RATE

Estes (1990) estimated a population growth rate of 17 to 20% per year for four northern sea otter populations expanding into unoccupied habitat. Although maximum productivity rates have not been measured through much of the sea otter's range in Alaska, in the absence of more detailed information, the rate of 20% calculated by Estes (1990) is considered the best available estimate of R_{MAX}. There is insufficient information available to estimate the current net productivity rate for this population stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the 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: $PBR = N_{MIN} \times 0.5\ R_{MAX} \times F_R$. In August 2005, sea otters in southwest Alaska were listed as a threatened distinct population segment (DPS) under the Endangered Species Act (70 FR 46366; August 9, 2005). Although Wade and Angliss (1997) provide a default recovery factor (F_R) of 0.5 as a guideline for threatened species, a lower value may be considered appropriate in the case of a declining population. Therefore, for the southwest Alaska stock, which has been experiencing a continual decline, we are taking a more conservative approach and have set the recovery factor at the default value for an endangered species (0.1). The calculated PBR for this stock would be 38,703 × 0.5 (0.2) × 0.1 which yields 387 sea otters per year.

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

A complete list of fisheries and marine mammal interactions is published annually by the National Marine Fisheries Service (NMFS), the most recent of which was published on November 27, 2007 (72 FR 66048). Numerous fisheries exist within the range of the southwest Alaska stock of northern sea otters, with the only one identified as interacting with this stock being the Kodiak salmon set gillnet, with an estimated 188 vessels and/or persons participating in the fishery. Additional salmon set gillnet fisheries occur in Bristol Bay (1,104 participants) and the Alaska Peninsula/Aleutian Islands (116 participants). Although no interactions with salmon drift gillnets have been identified for this stock, they have been observed in Prince William Sound within the southcentral Alaska stock. Salmon drift gillnet fisheries occur in Bristol Bay (1,903 vessels), and the Alaska Peninsula/Aleutian Islands (164 vessels). Although both salmon set and gillnet fisheries also occur in Cook Inlet, most of the effort in fisheries occurs north of the range of the southwest Alaska population stock. Available information suggests that fisheries using other types of gear, such as trawl, longline, pot, and purse seine, appear to be less likely to have interactions with sea otters due to either the areas where such fisheries operate, or the specific gear used, or both.

The estimated level of incidental mortality and serious injury of this stock can be estimated from fishery observer programs that monitor a portion of commercial fisheries in Alaska and report injury and mortality of marine mammals incidental to those operations. Observer data were summarized from 1989-2006 by Perez (2003, 2006, 2007) for Bering Sea, Aleutian Islands, and Gulf of Alaska trawl, longline, and pot groundfish fisheries. During this period, no sea otters were taken in any trawl or longline fisheries. In 1992, a total of eight sea otters were observed caught in the Pacific cod pot fishery in the Aleutian islands. Observer records indicate that those takes occurred in nearshore waters that had been closed to fishing, which explains why no additional take of sea otters was observed in pot fisheries through 2006 (Perez 2006, Perez 2007).

The NMFS conducted a marine mammal observer program for the Kodiak salmon set net fishery during the 2002 and 2005 fishing seasons. This fishery has a seasonal component, occurring only during the summer months. In 2002, 4 entanglement events were observed in this fishery (Manly et al. 2003). Two of these events required intervention to untangle the otter from the net, and the other two were able to escape by themselves. In none of these instances was there any sign of external injuries. The sea otter bycatch in this fishery was estimated as 62 otters during the 2002 fishing season. Assuming from this sample that half of these otters would be capable of escaping from the nets by themselves, an estimated 31 otters would require assistance from the fishermen. Of the two observed entanglement incidents, no serious injury was observed, but given the small sample size, it is reasonable to assume that some of these otters may suffer injury as a result of entanglement. In fact, there was one self report of an otter killed during the 2002 fishing season. Results from the 2005 Kodiak salmon set net fishery indicate entanglement of one otter that subsequently released itself from the net, although it was not clear if this was a sea otter or river otter (Manly 2007). Assuming that this animal was a sea otter, the total bycatch in this fishery would be estimated at 28 animals during the 2005 season. Based on these results, it would appear that although entanglement of sea otters does occur in this fishery, the rate of mortality or serious injury is low. Considering the rates of entanglement for 2002 and 2005, we estimate that fewer than 10 sea otters per year from an estimated population size of 11,000 in the Kodiak archipelago could be killed or seriously injured as a result of entanglements.

An additional source of information on the number of sea otters killed or injured incidental to commercial fishery operations in Alaska are fisher self-reports required of vessel-owners by NMFS. In 1997, fisher self-reports indicated one sea otter caught in the Bering Sea and Aleutian Island groundfish trawl fishery; however, it is unclear if the animal was alive when caught. Credle et al. (1994) considered fisher self-reports to be a minimum estimate of incidental take as these data are most likely negatively biased. The estimated level of incidental mortality and serious injury associated with Alaska trawl, longline, and pot groundfish fisheries averages less than one animal per year. Given this extremely low level, no seasonal or area differences in mortality or serious injury in this fishery are known to exist.

The total fishery mortality and serious injury rate (less than 10 animals per year) for the southwest Alaska stock of the northern sea otter can be considered insignificant and approaching a zero mortality and serious injury rate (i.e., less than 10% of PBR).

Oil Spills

Activities associated with exploration, development, and transport of oil and gas resources can adversely impact sea otters and nearshore coastal ecosystems in Alaska. Sea otters rely on air trapped in their fur for warmth and buoyancy. Contamination with oil drastically reduces the insulative value of the pelage, and consequently sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (less than 10% of body surface), but that greater levels (more than 25%) will lead to death (Costa and Kooyman 1981, Siniff et al. 1982). Vulnerability of sea otters to oiling was demonstrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound. Estimates of mortality for the Prince William Sound area vary from 750 (range 600-1,000) (Garshelis 1997) to 2,650 (range 500 - 5,000) (Garrott et al. 1993) otters. Statewide, 3,905 sea otters (range 1,904 - 11,257) were estimated to have died in Alaska as a result of the spill (DeGange et al. 1994). At present, abundance of sea otters in some oiled areas of Prince William Sound remains below pre-spill estimates, and evidence from ongoing studies suggests that sea otters and the nearshore ecosystem have not yet fully recovered from the 1989 oil spill (Bodkin et al. 2002, Stephensen et al. 2001). Other areas outside of Prince William Sound that were affected by the spill have not been intensively studied for long-term impacts.

Within the proximity of the Southwest Alaska sea otter stock, oil and gas development and production occurs only in Cook Inlet. In addition to existing offshore platforms, there was a Federal lease sale in Cook Inlet in 2004 but no tracts were purchased. The Minerals Management Service is currently preparing a draft Environmental Impact Statement for a proposed lease sale in the North Aleutian Basin area in Bristol Bay. Although the amount of oil transported in southwest Alaska is relatively small, the *Exxon Valdez* oil spill demonstrated that spilled oil can travel long distances and take large numbers of sea otters far from the point of initial release. While the catastrophic release of oil has the potential to take large numbers of sea otters, there is no evidence that other effects (such as disturbance) associated with routine oil and gas development and transport have had a direct impact on the Southwest Alaska sea otter stock.

Information on oil spills compiled by the Alaska Department of Environmental Conservation from 2002-2006 indicate that there were no reported spills of crude oil in southwest Alaska. In addition to spills that may occur in association with the development, production, and transport of crude oil, each year numerous spills of non-crude oil products in the marine environment occur from ships and shore facilities throughout southwest Alaska. During that same time period, there was an average of 119 spills occur each year, ranging in size from less than 1 and up to 321,000 gallons. The vast majority of these spills are small, with a median size of 5 gallons, and there is no indication that these small-scale spills have an impact on the southwest Alaska stock of northern sea otters.

The one notable exception during this period was the grounding of the freighter *Selendang Ayu*, which spilled 321,000 gallons of non-crude oil and caused at least two sea otter mortalities in late 2004 and early 2005 (USFWS unpublished data). Each year, thousands of vessels of varying size traverse the North Pacific great circle route between North America and Asia. This route passes through Unimak Pass to the east, and near Buldir Island to the west. The National Academy of Science is in the process of designing a risk assessment for the Aleutian Islands area.

Subsistence/Native Harvest Information

The MMPA exempted Native Alaskans from the prohibition on hunting marine mammals, provided such taking was not wasteful. Alaska Natives are legally permitted to take sea otters for subsistence use or for creating and selling authentic handicrafts or clothing. In addition, Section 10(e) of the ESA allows for subsistence harvest of listed species. Data for subsistence harvest of sea otters in Southwest Alaska are collected by a mandatory Marking, Tagging and Reporting Program administered by the Service since 1988. Figure 2 provides a summary of harvest information for the Southwest stock from 1989 through 2006. The mean reported annual subsistence take during the past five complete calendar years (2002-2006) was 91 animals. Reported age composition during this period was 87% adults, 9% subadults, and 4% pups. Sex composition during the past five years was 73% males, 23% females, and 4% unknown sex. The majority of this harvest (81%) comes from the Kodiak archipelago; areas within the stock that show signs of continued population declines have little to no record of subsistence harvest.

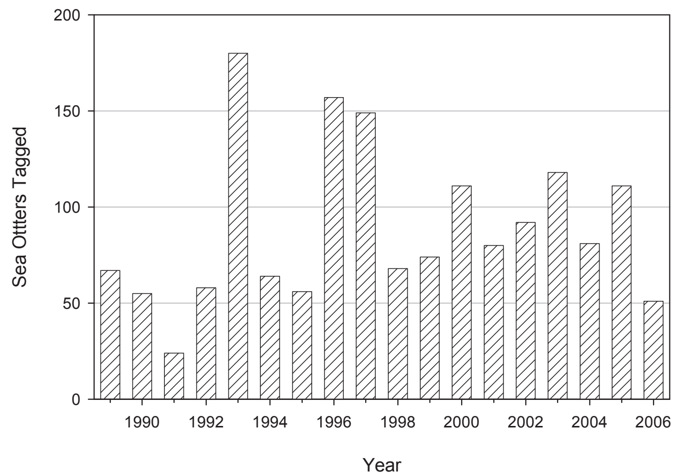

Figure 2. Reported subsistence harvest of northern sea otters from the southwest Alaska stock, 1989-2006.

Research and Public Display

In the past five years, no sea otters were removed from the southwest Alaska stock for public display. During this period, a total of 98 otters were live-captured and released for research purposes from this stock. Most of these captures occurred in the Kodiak archipelago, with the remainder in the Aleutian and Shumagin islands areas. There were no reported injuries and/or mortalities related to these activities.

Other Factors

In August 2006, the Working Group on Marine Mammal Unusual Mortality Events reviewed information provided by the Service and declared that a dramatic increase in sea otter strandings since 2002 constitutes an Unusual Mortality Event (UME) in accordance with Section 404 of the MMPA. The disease that typifies this UME is caused by a *Streptococcus infantarius* infection and has been observed over a broad geographic range in Alaska, including a few cases from southwest Alaska; however, the majority of cases have come from Kachemak Bay in the southcentral Alaska stock. It is not clear if the observed stranding pattern is representative of overall sea otter mortality, or an artifact of having a well-developed stranding network in the Kachemak Bay area. The Service will continue to work with the NMFS and Alaska SeaLife Center to develop the infrastructure for a statewide marine mammal stranding network in Alaska.

STATUS OF STOCK

On August 9, 2005, the southwest Alaska distinct population segment of the northern sea otter was listed as "threatened" under the ESA, and is, therefore, classified as a strategic stock under the MMPA.

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