Revised 12/30/2015

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).

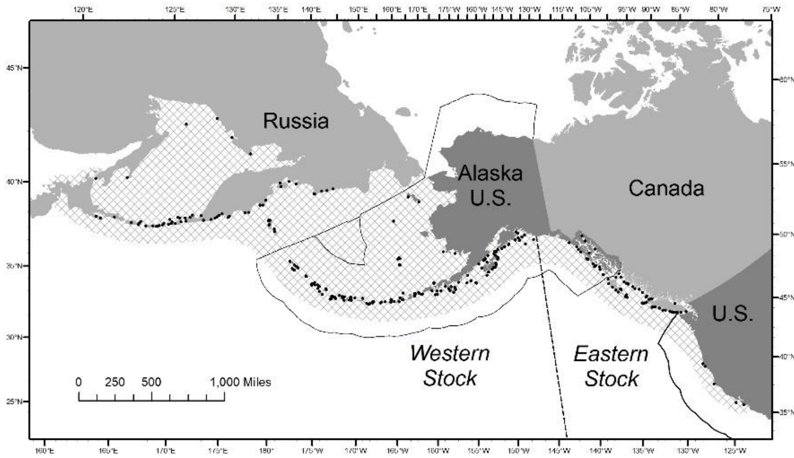

Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; S. Majewski, Fisheries 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.

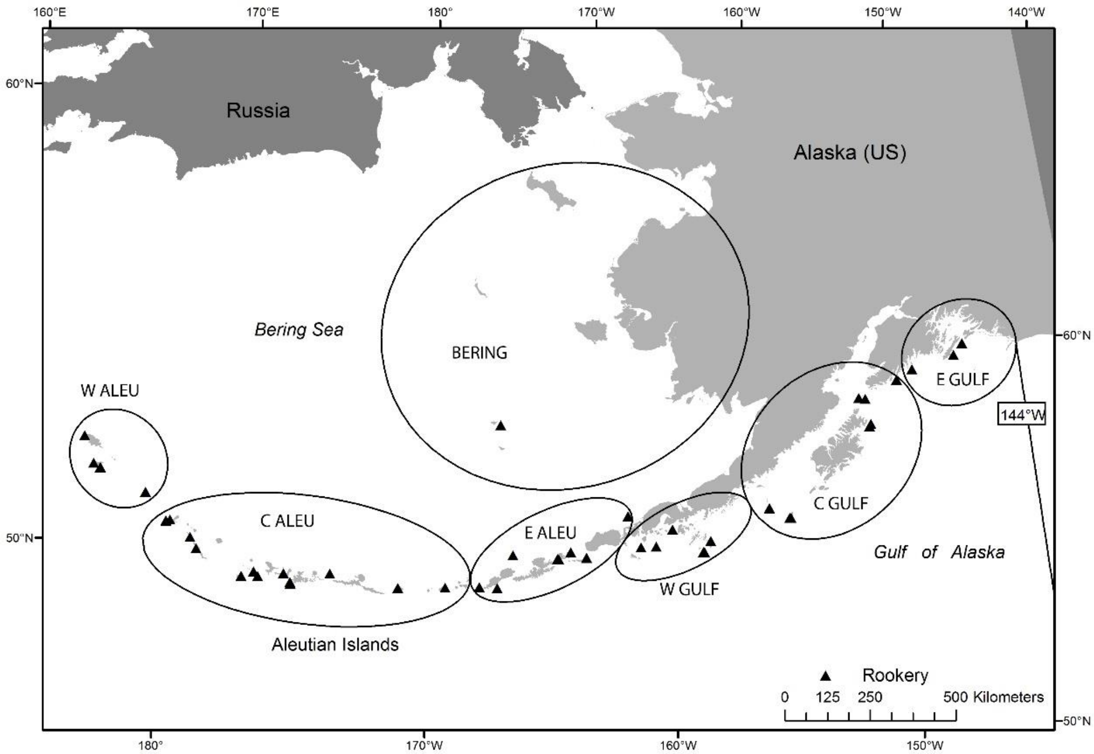

Figure 2. Regions of Alaska used for western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands Islands regions, respectively.

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 2010 2011 2012 2013	obs data	29 31 41 25 11	0 0 0 1 0	0 0 0 1 0	0.2 (CV = 0)
Gulf of Alaska sablefish longline	2009 2010 2011 2012 2013	obs data	16 15 14 14 13	0 0 0 1 0	0 0 0 5.5 0	1.1 (CV = 0.91)
Prince William Sound salmon drift gillnet	1990 1991	obs data	4 5	0 2	0 29	15 (CV = 1.0)
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

CITATIONS

Albers, P. H., and T. R. Loughlin. 2003. Effects of PAHs on marine birds, mammals, and reptiles. Pp. 243-261 *In* P. E. T. Douben (ed.), PAHs: an Ecotoxicological Perspective. John Wiley and Sons, London.

Atkinson, S., D. P. DeMaster, and D. G. Calkins. 2008. Anthropogenic causes of the western Steller sea lion *Eumetopius jubatus* population decline and their threat to recovery. Mammal Rev. 38(1):1-18.

Baker, A. R., T. R. Loughlin, V. Burkanov, C. W. Matson, T. G. Trujillo, D. G. Calkins, J. K. Wickliffe, and J. W. Bickham. 2005. Variation of mitochondrial control region sequences of Steller sea lions: the three-stock hypothesis. J. Mammal. 86:1075-1084.

Berta, A., and M. Churchill. 2012. Pinniped taxonomy: review of currently recognized species and subspecies, and evidence used for their description. Mammal Rev. 42(2):207-234.

Bickham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). J. Mammal. 77:95-108.

Braham, H. W., R. D. Everitt, and D. J. Rugh. 1980. Northern sea lion decline in the eastern Aleutian Islands. J. Wildl. Manage. 44:25-33.

Breiwick, J. M. 2013. North Pacific marine mammal bycatch estimation methodology and results, 2007-2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-260, 40 p.

Burek, K. A., F. M. D. Gulland, G. Sheffield, K. B. Beckmen, E. Keyes, T. R. Spraker, A. W. Smith, D. E. Skilling, J. F. Evermann, J. L. Stott, J. T. Saliki, and A. W. Trites. 2005. Infectious disease and the decline of the Steller sea lions (*Eumetopias jubatus*) in Alaska, USA: insights from serologic data. J. Wildl. Dis. 41(3):512-524.

Burkanov, V., and T. R. Loughlin. 2005. Distribution and abundance of Steller sea lions on the Asian coast, 1720's–2005. Mar. Fish. Rev. 67(2):1-62.

Byrd, G. V. 1989. Observations of northern sea lions at Ugamak, Buldir, and Agattu Islands, Alaska in 1989. Unpubl. report, U.S. Fish and Wildlife Service. Alaska Maritime National Wildlife Refuge, P.O. Box 5251, NSA Adak, FPO Seattle, WA 98791.

Calkins, D. G. 1985. Steller sea lion entanglement in marine debris. Pp. 308-314 *In* R. S. Shomura and H. O. Yoshida (eds.), Proceedings of the Workshop on the Fate and Impact of Marine Debris, 27-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFC-54.

Calkins, D. G., and K. W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. Environmental Assessment of the Alaskan Continental Shelf. Final reports 19:455-546.

Calkins, D. G., E. Becker, T. R. Spraker, and T. R. Loughlin. 1994. Impacts on Steller sea lions. Pp. 119-139 *In* T. R. Loughlin (ed.), Marine Mammals and the *Exxon Valdez*. Academic Press, NY.

DeMaster, D. P. 2014. Results of Steller sea lion surveys in Alaska, June-July 2013. Memorandum to J. Balsiger, J. Kurland, B. Gerke, and L. Rotterman, January 27, 2014. Available from Alaska Fisheries Science Center, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

DeMaster, D. P., A. W. Trites, P. Clapham, S. Mizroch, P. Wade, R. J. Small, and J. Ver Hoef. 2006. The sequential megafaunal collapse hypothesis: testing with existing data. Prog. Oceanogr. 68(2-4):329-342.

Dillingham, P. W., J. R. Skalski, and K. E. Ryding. 2006. Fine-scale geographic interactions between Steller sea lion (*Eumetopias jubatus*) trends and local fisheries. Can. J. Fish. Aquat. Sci. 63:107-119.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fritz, L. W., and E. S. Brown. 2005. Survey-and fishery-derived estimates of Pacific cod (*Gadus macrocephalus*) biomass: implications for strategies to reduce interactions between groundfish fisheries and Steller sea lions (*Eumetopias jubatus*). Fish. Bull., U.S. 103:501-515.

Fritz, L. W., and R. C. Ferrero. 1998. Options in Steller sea lion recovery and groundfish fishery management. Biosphere Conserv. 1(1):7-19.

Fritz, L. W., and S. Hinckley. 2005. A critical review of the regime shift -"junk food"- nutritional stress hypothesis for the decline of the western stock of Steller sea lion. Mar. Mammal Sci. 21(3):476-518.

Fritz, L. W., R. C. Ferrero, and R. J. Berg. 1995. The threatened status of Steller sea lions, *Eumetopias jubatus*, under the Endangered Species Act: effects on Alaska groundfish fisheries management. Mar. Fish. Rev. 57(2):14-27.

Fritz, L., K. Sweeney, D. Johnson, M. Lynn, and J. Gilpatrick. 2013. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) conducted in Alaska in June-July 2008 through 2012, and an update on the status and trend of the western stock in Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-251, 91 p.

Fritz, L. W., R. Towell, T. S. Gelatt, D. S. Johnson, and T. R. Loughlin. 2014. Recent increases in survival of western Steller sea lions in Alaska and implications for recovery. Endang. Species Res. 26(1):13-24. DOI: 10.3354/esr00634.

Fritz, L., K. Sweeney, D. Johnson, and T. Gelatt. 2015. Results of Steller sea lion surveys in Alaska, June-July 2014. Memorandum to D. DeMaster, J. Balsiger, J. Kurland, and L. Rotterman, January 28, 2015. Available from National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

Gelatt, T. S., A. W. Trites, K. Hastings, L. Jemison, K. Pitcher, and G. O'Corry-Crowe. 2007. Population trends, diet, genetics, and observations of Steller sea lions in Glacier Bay National Park. Pp. 145-149 *In* J. F. Piatt, and S. M. Gende (eds.), Proceedings of the Fourth Glacier Bay Science Symposium, October 26–28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5047.

Harlin-Cognato, A., J. W. Bickham, T. R. Loughlin, and R. L. Honeycutt. 2006. Glacial refugia and the phylogeography of Steller's sea lion (*Eumetopias jubatus*) in the North Pacific. J. Evol. Biol. 19:955-969. DOI: 10.1111/j.1420-9101.2005.01052.x.

Hastings, K. K., L. A. Jemison, T. S. Gelatt, J. L. Laake, G. W. Pendleton, J. C. King, A. W. Trites, and K. W. Pitcher. 2011. Cohort effects and spatial variation in age-specific survival of Steller sea lions from southeastern Alaska. Ecosphere 2(10):1-21. DOI: 10.1890/ES11-00215.1.

Haynes, T. L., and C. Mishler. 1991. The subsistence harvest and use of Steller sea lions in Alaska. Alaska Department of Fish and Game Technical Paper No. 198. 44 pp.

Helker, V. T., B. A. Allen, and L. A. Jemison. 2015. Human-caused injury and mortality of NMFS-managed Alaska marine mammal stocks, 2009-2013. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-300, 94 p.

Hennen, D. R. 2004. The Steller sea lion (*Eumetopias jubatus*) decline and the Gulf of Alaska/Bering Sea commercial fishery. Unpubl. Ph.D. Diss., Montana State University, Bozeman, MT. 224 pp.

Higgins, L. V., D. P. Costa, A. C. Huntley, and B. J. L. Boleuf. 1988. Behavioral and physiological measurements of maternal investment in the Steller sea lion, *Eumetopias jubatus*. Mar. Mammal Sci. 4:44-58.

Hoffman, J. I., C. W. Matson, W. Amos, T. R. Loughlin, and J. W. Bickham. 2006. Deep genetic subdivision within a continuously distributed and highly vagile marine mammal, the Steller's sea lion (*Eumetopias jubatus*). Mol. Ecol. 15:2821-2832.

Hoffman, J. I., K. K. Dasmahapatra, W. Amos, C. D. Phillips, T. S. Gelatt, and J W Bickham. 2009. Contrasting patterns of genetic diversity at three different genetic markers in a marine mammal metapopulation. Mol. Ecol. 18:2961-2978.

Holmes, E. E., L. W. Fritz, A. E. York, and K. Sweeney. 2007. Age-structured modeling provides evidence for a 28-year decline in the birth rate of western Steller sea lions. Ecol. Appl. 17(8):2214-2232.

Jemison, L. A., G. W. Pendleton, L. W. Fritz, K. K. Hastings, J. M. Maniscalco, A. W. Trites, and T. S. Gelatt. 2013. Inter-population movements of Steller sea lions in Alaska, with implications for population separation. PLOS ONE 8(8):e70167.

Johnson, D. S., and L. W. Fritz. 2014. agTrend: a Bayesian approach for estimating trends of aggregated abundance. Methods Ecol. Evol. DOI: 10.1111/2041-210X.12231.

Jones, D. J. 2009. 2008 subsistence harvest of Steller sea lion on St. Paul Island. Memorandum for the Record, April 27, 2009, Aleut Community of St. Paul, Tribal Government, Ecosystem Conservation Office, St. Paul Island, Pribilof Islands, AK.

Kucey, L. 2005. Human disturbance and the hauling out behaviour of Steller sea lions (*Eumetopias jubatus*). M.S. Thesis, University of British Columbia, Vancouver, BC. 67 pp.

Kucey, L., and A. W. Trites. 2006. A review of the potential effects of disturbance on sea lions: assessing response and recovery. *In* A. W. Trites, S. Atkinson, D. P. DeMaster, L. W. Fritz, T. S. Gelatt, L. D. Rea, and K. Wynne (eds.), Sea Lions of the World. Alaska Sea Grant College Program, University of Alaska Fairbanks AK-SG-06-01.

Lander, M. E., T. R. Loughlin, M. G. Logsdon, G. R. VanBlaricom, B. S. Fadely, and L. W. Fritz. 2009. Regional differences in the spatial and temporal heterogeneity of oceanographic habitat used by Steller sea lions. Ecol. Appl. 19(6):1645-1659.

Lander, M. E., D. S. Johnson, J. T. Sterling, T. S. Gelatt, and B. S. Fadely. 2011a. Diving behaviors and movements of juvenile Steller sea lions (*Eumetopias jubatus*) captured in the central Aleutian Islands, April 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-218, 41 p.

Lander, M. E., M. G. Logsdon, T. R. Loughlin, and G. R. VanBlaricom. 2011b. Spatial patterns and scaling behaviors of Steller sea lion (*Eumetopias jubatus*) distributions and their environment. J. Theor. Biol. 274: 74-83.

Lee, J. S., S. Tanabe, H. Umino, R. Tatsukawa, T. R. Loughlin, and D. C. Calkins. 1996. Persistent organochlorines in Steller sea lion (*Eumetopias jubatus*) from the bulk of Alaska and the Bering Sea, 1976-1981. Mar. Pollut. Bull. 32(7):535-544.

Lestenkof, A. D. 2011. 2010 subsistence harvest of Steller sea lion on St. Paul Island. Memorandum for the Record, March 7, 2011, Aleut Community of St. Paul, Tribal Government, Ecosystem Conservation Office, St. Paul Island, Pribilof Islands, AK.

Lestenkof, A. D. 2012. 2011 subsistence harvest of Steller sea lion on St. Paul Island. Memorandum for the Record, May 30, 2012, Aleut Community of St. Paul, Tribal Government, Ecosystem Conservation Office, St. Paul Island, Pribilof Islands, AK.

Loughlin, T. R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. Pp. 329-341 *In* A. Dizon, S. J. Chivers, and W. Perrin (eds.), Molecular genetics of marine mammals, incorporating the proceedings of a workshop on the analysis of genetic data to address problems of stock identity as related to management of marine mammals. Soc. Mar. Mammal., Spec. Rep. No. 3.

Loughlin, T. R., and A. E. York. 2000. An accounting of the sources of Steller sea lion mortality. Mar. Fish. Rev. 62(4):40-45.

Loughlin, T. R., D. J. Rugh, and C. H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-1980. J. Wildl. Manage. 48:729-740.

Maniscalco, J. M., P. Parker, and S. Atkinson. 2006. Interseasonal and interannual measures of maternal care among individual Steller sea lions (*Eumetopias jubatus*). J. Mammal. 87:304-311.

McBeath, J. 2004. Greenpeace v. National Marine Fisheries Service: Steller sea lions and commercial fisheries in the North Pacific. Alaska Law Rev. 21:1-42.

Merrick, R. L., and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions in Alaskan waters. Can. J. Zool. 75(5):776-786.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in 1956-86. Fish. Bull., U.S. 85:351-365.

Milette, L. L., and A. W. Trites. 2003. Maternal attendance patterns of Steller sea lions (*Eumetopias jubatus*) from stable and declining populations in Alaska. Can. J. Zool. 81:340–348.

NMFS (National Marine Fisheries Service). 1995. Status review of the United States Steller sea lion (*Eumetopias jubatus*) population. Prepared by the National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115. 61 pp.

NMFS (National Marine Fisheries Service). 2001. Endangered Species Act, Section 7 Consultation Biological Opinion and Incidental Take Statement on the Authorization of the Bering Sea/Aleutian Islands and Gulf of Alaska Groundfish Fishery Management Plan Amendments 61 and 70. NMFS Alaska Region, Protected Resources Division, Juneau, AK.

NMFS (National Marine Fisheries Service). 2008. Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). Revision. National Marine Fisheries Service, Silver Spring, MD. 325 pp.

Nikulin, V. S., and V. N. Burkanov. 2000. Species composition of marine mammal by-catch during Japanese driftnet salmon fishery in southwestern Bering Sea. Unpubl. manuscript. 2 pp. Available from National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

O'Corry-Crowe, G., B. L. Taylor, and T. Gelatt. 2006. Demographic independence along ecosystem boundaries in Steller sea lions revealed by mtDNA analysis: implications for management of an endangered species. Can. J. Zool. 84:1796-1809.

O'Corry-Crowe, G., T. Gelatt, L. Rea, C. Bonin, and M. Rehberg. 2014. Crossing to safety: dispersal, colonization and mate choice in evolutionarily distinct populations of Steller sea lions, *Eumetopias jubatus*. Mol. Ecol. 23(22):5415-5434.

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.

Phillips, C. D., J. W. Bickham, J. C. Patton, and T. S. Gelatt. 2009. Systematics of Steller sea lions (*Eumetopias jubatus*): subspecies recognition based on concordance of genetics and morphometrics. Occas. Papers, Museum of Texas Tech University 283:1-15.

Phillips, C. D., T. S. Gelatt, J. C. Patton, and J. W. Bickham. 2011. Phylogeography of Steller sea lions: relationships among climate change, effective population size, and genetic diversity. J. Mammal. 92(5):1091-1104.

Pitcher, K. W., P. F. Olesiuk, R. F. Brown, M. S. Lowry, S. J. Jeffries, J. L. Sease, W. L. Perryman, C. E. Stinchcomb, and L. F. Lowry. 2007. Status and trends in abundance and distribution of the eastern Steller sea lion (*Eumetopias jubatus*) population. Fish. Bull., U.S. 107(1):102-115.

Raum-Suryan, K., L. A. Jemison, and K. W. Pitcher. 2009. Entanglement of Steller sea lions (*Eumetopias jubatus*) in marine debris: identifying causes and finding solutions. Mar. Pollut. Bull. 58:1487-1495.

Sease, J. L., and C. J. Gudmundson. 2002. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) from the western stock in Alaska, June and July 2001 and 2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-131, 54 p.

Sease, J. L., and A. E. York. 2003. Seasonal distribution of Steller's sea lions at rookeries and haul-out sites in Alaska. Mar. Mammal Sci. 19(4):745-763.

Sease, J. L., W. P. Taylor, T. R. Loughlin, and K. W. Pitcher. 2001. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1999 and 2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-122, 52 p.

Springer, A. M., J. A. Estes, G. B. van Vliet, T. M. Williams, D. F. Doak, E. M. Danner, K. A. Forney, and B. Pfister. 2003. Sequential megafaunal collapse in the North Pacific Ocean: an ongoing legacy of industrial whaling? Proc. Natl. Acad. Sci. 100:12223-12228.

Trites, A. W., and C. P. Donnelly. 2003. The decline of Steller sea lions in Alaska: a review of the nutritional stress hypothesis. Mammal Rev. 33:3-28.

Trites, A. W., V. B. Deecke, E. J. Gregr, J. K. B. Ford, and P. F. Olesiuk. 2007. Killer whales, whaling and sequential megafaunal collapse in the North Pacific: a comparative analysis of the dynamics of marine mammals in Alaska and British Columbia following commercial whaling. Mar. Mammal Sci. 23(4):751-765.

Trujillo, R. G., T. R. Loughlin, N. J. Gemmell, J. C. Patton, and J. W. Bickham. 2004. Variation in microsatellites and mtDNA across the range of the Steller sea lion, *Eumetopias jubatus*. J. Mammal. 85(2):338-346.

Wade, P. R., and R. Angliss. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 p.

Williams, T. M., J. A. Estes, D. F. Doak, and A. M. Springer. 2004. Killer appetites: assessing the role of predators in ecological communities. Ecology 85(12):3373-3384.

Wilson, K., L. W. Fritz, E. Kunisch, K. Chumbley, and D. Johnson. 2012. Effects of research disturbance on the behavior and abundance of Steller sea lions (*Eumetopias jubatus*) at two rookeries in Alaska. Mar. Mammal Sci. 28(1): E58-E74.

Wolfe, R. J., J. A. Fall, and R. T. Stanek. 2005. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2004. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 303, Juneau, AK.

Wolfe, R. J., J. A. Fall, and R. T. Stanek. 2006. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2005. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 319, Juneau, AK.

Wolfe, R. J., J. A. Fall, and M. Riedel. 2008. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2006. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 339, Juneau, AK.

Wolfe, R. J., J. A. Fall, and M. Riedel. 2009a. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2007. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 345, Juneau, AK.

Wolfe, R. J., J. A. Fall, and M. Riedel. 2009b. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2008. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 347, Juneau, AK.

Wolfe, R. J., L. Hutchinson-Scarbrough, and M. Riedel. 2012. The subsistence harvest of harbor seals and sea lions on Kodiak Island in 2011. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 374, Anchorage, AK.

Wynne, K. M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Report NMFS/NOAA Contract 50ABNF000036. 65 pp. Available from 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 Report NMFS/NOAA Contract 50ABNF000036. 53 pp. Available from NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

York, A. E., R. L. Merrick, and T. R. Loughlin. 1996. An analysis of the Steller sea lion metapopulation in Alaska. Chapter 12, Pp. 259-292 *In* D. R. McCullough (ed.), Metapopulations and Wildlife Conservation. Island Press, Covelo, CA.

Zavadil, P. A. 2010. 2009 subsistence harvest of Steller sea lion on St. Paul Island. Memorandum for the Record, April 2010, Aleut Community of St. Paul, Tribal Government, Ecosystem Conservation Office, St. Paul Island, Pribilof Islands, AK.