Revised 12/30/2018

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) (Fig. 1). Large numbers of individuals disperse widely outside of the breeding season (late May-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). There is an exchange of sea lions across the stock boundary, especially due to the wide-ranging seasonal movements of juveniles and adult males (Baker et al. 2005, Jemison et al. 2013). During the breeding season, sea lions, especially adult females, typically return to their natal rookery, or a nearby breeding rookery to breed and pup (Hastings et al. 2017). However, mixing of mostly breeding females from Prince William Sound to Southeast Alaska began in the 1990s and two new, mixed-stock rookeries were established (Gelatt et al. 2007, Jemison et al. 2013, O'Corry-Crowe et al. 2014).

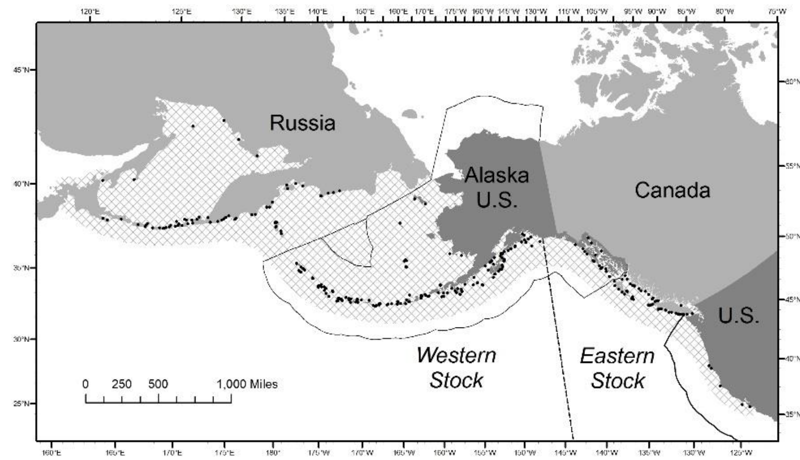

Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005, Olesiuk 2008). The black dashed line (144°W) indicates the stock boundary (Loughlin 1997) and the solid black line delineates the U.S. Exclusive Economic Zone.

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals among rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: differences in the length of pups (Merrick et al. 1995, Loughlin 1997); 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 of western stock animals 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 Alaska 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 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. 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 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. 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 genetic 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 (especially adult females) into this area, the mixed part of the range remains geographically distinct (Jemison et al. 2013), and the overall discreteness of the eastern from the western stock remains distinct. Movement of western stock sea lions south of these rookeries and eastern stock sea lions moving to the west is less common (Jemison et al. 2013, O'Corry-Crowe et al 2014). 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 the U.S. Fish and Wildlife Service (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, 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 2003, 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, 2016). Abundance surveys to count Steller sea lions are conducted in late June through mid-July starting ~10 days after the mean pup birth dates in the survey area (4-14 June) after ~95% of all pups are born (Pitcher et al. 2001, Kuhn et al. 2017). Modeled counts and trends are reported for the total western DPS in Alaska and the six regions (eastern, central, and western Gulf of Alaska and eastern, central, and western Aleutian Islands) that compose this geographic range. The boundaries for the six regions were identified based on metapopulation analysis of survey count data collected from 1976 to 1994 (York et al. 1996). The most recent comprehensive aerial photographic and land-based surveys of western Steller sea lions in Alaska were conducted during the 2016 and 2017 breeding seasons (Sweeney et al. 2016, 2017). Western Steller sea lion pup and non-pup counts in Alaska in 2017 were estimated to be 11,952 (95% credible interval of 10,879-13,195) and 42,315 (38,039-47,376), respectively, using the method of Johnson and Fritz (2014) and survey results from 1978 through 2017 (Sweeney et al. 2017). 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). 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 total count of live pups on rookeries in Russia is available from counts conducted in 2013, 2015, and 2016, which totaled 5,218 pups, 5% lower than the 5,491 pups counted in 2011 (Burkanov 2017). Rookery pup counts represent more than 95% of pup counts at all sites (including haulouts) but are underestimates of total pup production.

Minimum Population Estimate

Because current population size (N) and a pup multiplier to estimate N are not known, we will use the best estimate of the total count of western Steller sea lions in Alaska as the minimum population estimate (N_{MIN}). Western Steller sea lion pup and non-pup estimates in 2017 in Alaska were 11,952 and 42,315, respectively (Sweeney et al. 2017). These sum to 54,267, which will be used as the 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 Steller 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 the early 2000s (Sease and Gudmundson 2002).

Johnson and Fritz (2014) estimated 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 (also see Fritz et al. 2013, 2016). Using data collected from 1978 through 2017, there is strong evidence that pup and non-pup counts of western stock Steller sea lions in Alaska were at their lowest levels in 2002 and have increased at 1.78% y^{-1} and 2.14% y^{-1}, respectively, between 2002 and 2017 (Table 1; Fig. 2; Sweeney et al. 2017). However, there are strong regional differences across the range in Alaska, with positive trends in the Gulf of Alaska and eastern Bering Sea east of Samalga Pass (~170°W) and generally negative trends to the west in the Aleutian Islands (Table 1; Fig. 3). Non-pup trends in 2002-2017 in Alaska have a longitudinal gradient with highest rates of increase generally in the east (eastern Gulf of Alaska) and steadily decreasing rates to the west (Table 1).

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 2002-2017 (Sweeney et al. 2017).

		Non-pups				**Pups**		
Region	**Latitude Range**	**Trend**	**-95%**	**+95%**		**Trend**	**-95%**	**+95%**
Western Stock in Alaska	144°W-172°E	2.14	1.49	2.78		1.78	1.19	2.34
E of Samalga Pass	144°-170°W	3.09	2.35	3.90		3.18	2.48	3.87
Eastern Gulf of Alaska	144°-150°W	4.21	2.04	6.26		2.65	0.99	4.63
Central Gulf of Alaska	150°-158°W	3.90	2.88	4.98		3.28	1.73	4.84
Western Gulf of Alaska	158°-163°W	3.01	1.50	4.56		3.65	2.31	5.12
Eastern Aleutian Islands	163°-170°W	1.85	0.42	3.27		2.79	1.80	3.83
W of Samalga Pass	170°W-172°E	-0.84	-1.94	0.26		-1.90	-2.88	-0.82
Central Aleutian Islands	170°W-177°E	-0.07	-1.26	1.15		-1.33	-2.43	-0.18
Western Aleutian Islands	172°-177°E	-6.73	-8.34	-5.20		-6.83	-7.93	-5.71

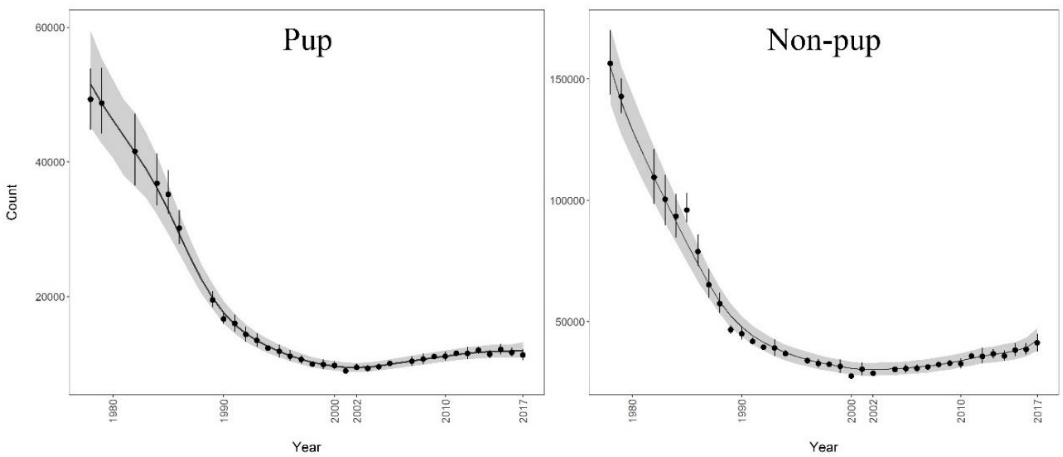

Figure 2. Realized and predicted counts of western Steller sea lion pups (left) and non-pups (right) in Alaska, 1978-2017. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the black line surrounded by the gray 95% credible interval.

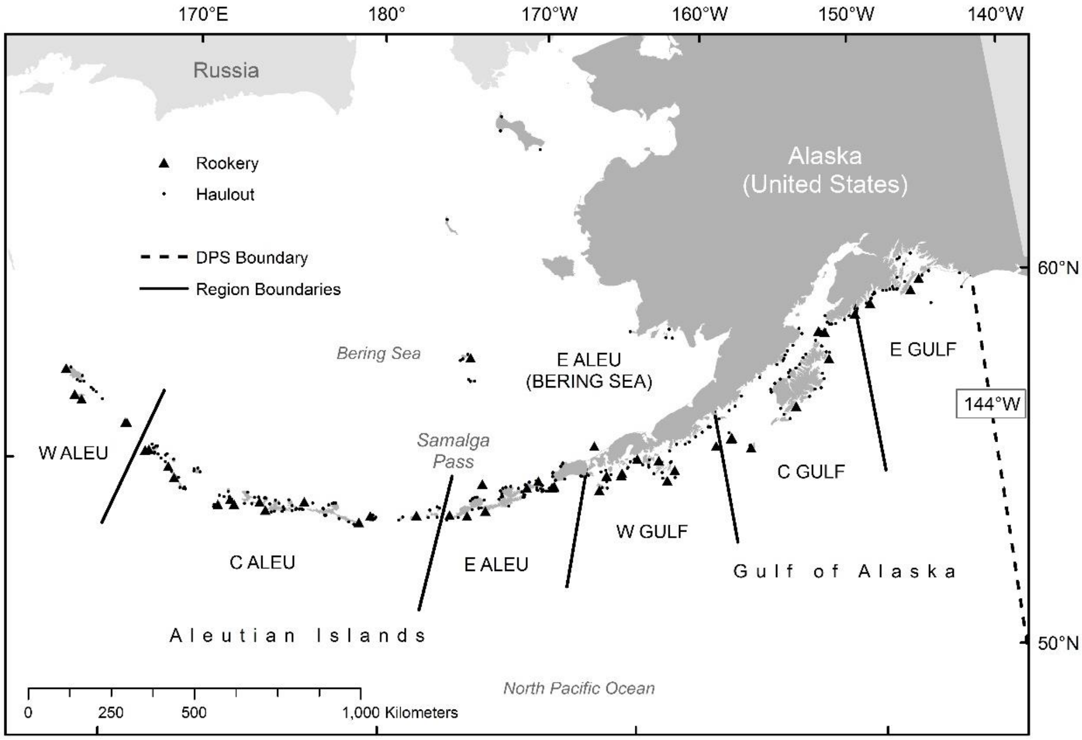

Figure 3. Regions of Alaska used for western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands regions, respectively.

Non-pup and pup counts in the western Aleutians have been in a steep decline overall (Fig. 4). However, there was a period of stability in this region from 2013 to 2017 (Sweeney et al. 2016, 2017). From 2011 to 2014, Pacific cod and Atka mackerel fisheries were closed in the western Aleutian Islands; Pacific cod and Atka mackerel are two of the primary prey species of Steller sea lions in the Aleutian Islands (Sinclair et al. 2013, Tollit et al. 2017). The western Aleutians were largely re-opened to these two fisheries in 2015. Surveys in the Aleutian Islands were conducted opportunistically in 2017 as survey effort was focused in the Gulf of Alaska. As such, only 17 sites were surveyed west of Samalga Pass in 2017, producing high estimates with large confidence bounds in the central Aleutian Islands.

Net movement between the eastern and western stocks appears to be small during the breeding season, with an estimated net 75 sea lions moving west in 2016 (Jemison et al. 2013, Fritz et al. 2016). As a result, trends in counts estimated from breeding season surveys should be relatively insensitive to inter-stock movements. Very few females move from Southeast Alaska to the western stock while ~500 were estimated to move from west to east (net increase in the east). Males move in both directions but with a net increase in the west. This 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).

Pup counts in the eastern (-33%) and central (-18%) Gulf of Alaska declined sharply between 2015 and 2017, counter to the relatively steady increases observed in both regions since 2002. These declines may have been due to changes in availability of prey associated with warm ocean temperatures that occurred in the northern Gulf of Alaska in 2014-2016 (Bond et al. 2015, Peterson et al. 2016).

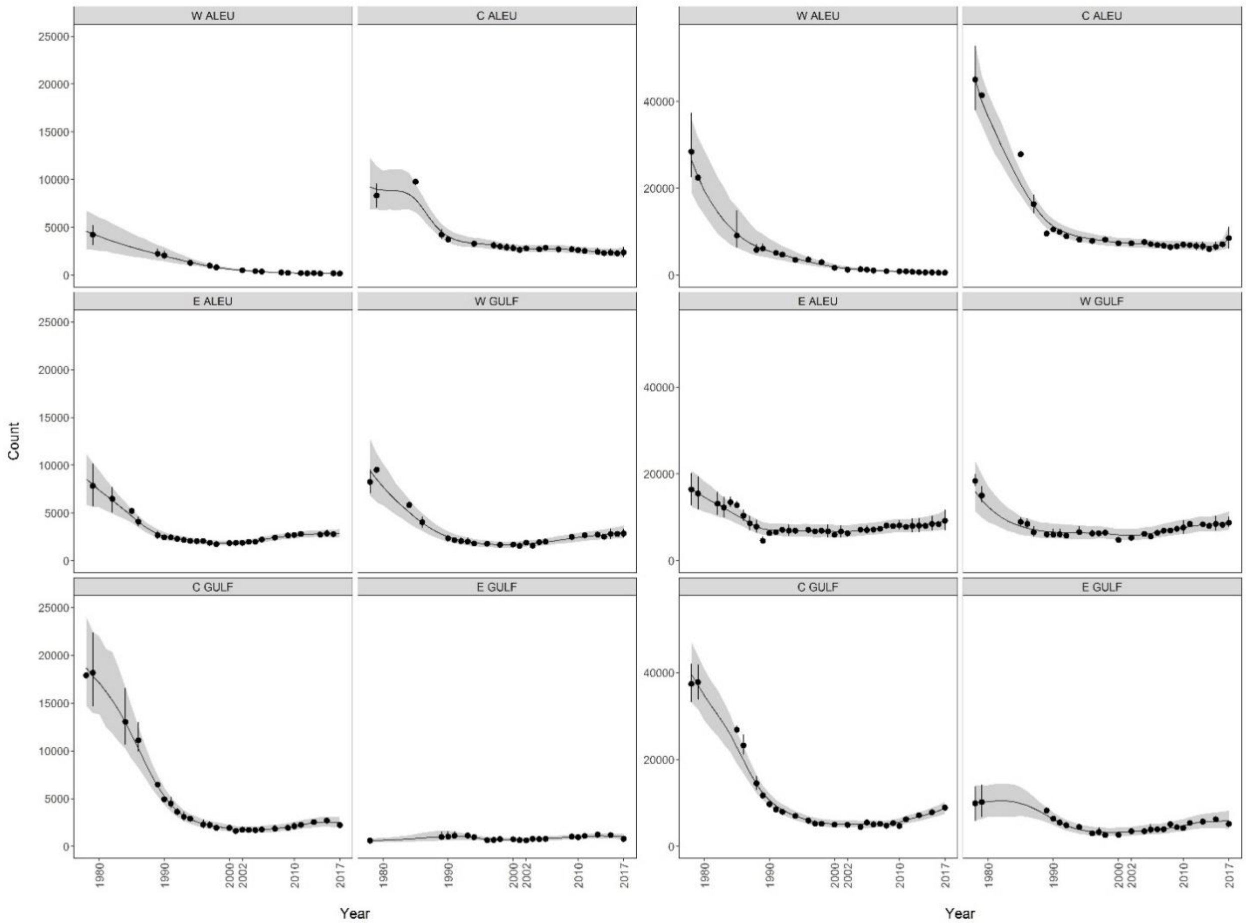

Figure 4. Realized and predicted counts of Steller sea lion pups (left) and non-pups (right) in the six regions that compose the western DPS in Alaska, 1978-2017. Realized counts are represented by points and vertical lines (95% credible intervals). Predicted counts are represented by the black line surrounded by the gray 95% credible interval.

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 2016 (Burkanov 2017) indicate that overall Steller sea lion abundance in Russia (~23,500 based on a life table multiplier of 4.5 on the most recent total pup count of 5,218) is greater than in 2005 but may not have increased back to levels observed in the 1960s. However, just as in the U.S. portion of the stock, there are significant regional differences in population trend in Russia. Pup production appears to be declining in most areas of Russia (Kuril Islands, eastern Kamchatka, the Commander Islands, parts of the Sea of Okhotsk, and the western Bering Sea); only Tuleny Island in the southern Sea of Okhotsk has had consistently increasing pup counts over the last 10 years (since 2007). 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.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the maximum net productivity rate (R_{MAX}) for Steller sea lions. Until additional data become available, the maximum theoretical net productivity rate for pinnipeds of 12% will be used for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

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 = 326 sea lions (54,267 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals in 2012-2016 is listed, by marine mammal stock, in Helker et al. (in press); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The total estimated annual level of human-caused mortality and serious injury for Western U.S. Steller sea lions in 2012-2016 is 247 sea lions: 35 in U.S. commercial fisheries, 1.2 in unknown (commercial, recreational, or subsistence) fisheries, 2 in marine debris, 5.5 due to other causes (arrow strike, entangled in hatchery net, illegal shooting, Marine Mammal Protection Act (MMPA) authorized research-related), and 203 in the Alaska Native subsistence harvest. No observers have been assigned to several fisheries that are known to interact with this stock and estimates of entanglement in fishing gear and marine debris based solely on stranding reports in areas west of 144°W longitude may underestimate the entanglement of western stock animals that travel to parts of Southeast Alaska. Due to a lack of available resources, NMFS is not operating the Alaska Marine Mammal Observer Program (AMMOP) focused on marine mammal interactions that occur in fisheries managed by the State of Alaska. The most recent data on Steller sea lion interactions with state-managed fisheries in Alaska are from the Southeast Alaska salmon drift gillnet fishery in 2012 and 2013 (Manly 2015), a fishery in which the vast majority of the Steller sea lions taken are likely to be from the eastern stock. Counts of annual illegal gunshot mortality in the Copper River Delta should be considered minimums as they are based solely on aerial carcass surveys in 2015 and 2016, no data are available for 2012-2014, a cause of death for all carcasses found was not determined, and it is not likely that all carcasses are detected. Disturbance of Steller sea lion haulouts and rookeries can potentially cause disruption of reproduction, stampeding, or increased exposure to predation by marine predators (NMFS 2008; see also NMFS 1990, 1997). Effects of disturbance are highly variable and difficult to predict. Data are not available to estimate potential impacts from non-monitored activities, including disturbance near rookeries without 3-nmi no-entry buffer zones. Potential threats most likely to result in direct human-caused mortality or serious injury of this stock include subsistence harvest, incidental take, illegal shooting, disturbance, and entanglement in fishing gear and marine debris.

Fisheries Information

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.

Based on historical reports and their geographic range, Steller sea lion mortality and serious injury could occur in several fishing gear types, including trawl, gillnet, longline, and troll fisheries. However, observer data are limited. Of these fisheries, only trawl fisheries are regularly observed and gillnet fisheries have had limited observations in select areas over short time frames and with modest observer coverage. Consequently, there are little to no data on Steller sea lion mortality and serious injury in non-trawl fisheries. Therefore, the potential for fisheries-caused mortality and serious injury may be greater than is reflected in existing observer data.

In 2012-2016, mortality and serious injury of western Steller sea lions was observed in 10 of the federally-managed commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands Pacific cod longline, Gulf of Alaska Pacific cod trawl, Gulf of Alaska Pacific cod longline, Gulf of Alaska sablefish longline, Gulf of Alaska flatfish trawl, Gulf of Alaska rockfish trawl, and Gulf of Alaska pollock trawl fisheries, resulting in a mean annual mortality and serious injury rate of 20 sea lions (Table 2; Breiwick 2013; MML, unpubl. data).

AMMOP observers monitored the Alaska State-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording two incidental mortalities in 1991, extrapolated to 29 (95% CI: 1-108) for the entire fishery (Wynne et al. 1992). No incidental mortality or serious injury was observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean annual mortality rate of 15 sea lions (CV = 1.0) for 1990 and 1991. It is not known whether this incidental mortality and serious injury rate is representative of the current rate in this fishery.

One Steller sea lion mortality resulting from entanglement in commercial longline gear was reported to the NMFS Alaska Region stranding network in 2015 (Helker et al. in press), resulting in a mean annual mortality and serious injury rate of 0.2 sea lions in 2012-2016 (Table 3). This mortality and serious injury estimate results from an actual count of verified human-caused deaths and serious injuries and is a minimum because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. An additional mortality reported in the Prince William Sound salmon drift gillnet fishery in 2015 (Helker et al. in press) is already accounted for in the extrapolated estimates derived from AMMOP observer data for this fishery (Table 2).

The estimated mean annual mortality and serious injury rate in U.S. commercial fisheries in 2012-2016 is 35 Steller sea lions from this stock (35 from observer data + 0.2 from stranding data) (Tables 2 and 3). 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.

Table 2. Summary of incidental mortality and serious injury of Western U.S. Steller sea lions due to U.S. commercial fisheries in 2012-2016 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Breiwick 2013; MML, 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. flatfish trawl	2012 2013 2014 2015 2016	obs data	99 99 99 99 99	6 7 5 6 9	6.0 7.0 5.0 6 9.0	6.6 (CV = 0.01)
Bering Sea/Aleutian Is. Pacific cod trawl	2012 2013 2014 2015 2016	obs data	68 80 80 72 68	0 1 0 0 0	0 1.5 0 0 0	0.3 (CV = 0.56)
Bering Sea/Aleutian Is. pollock trawl	2012 2013 2014 2015 2016	obs data	98 97 98 99 99	7 (+1)[a] 5 2 1 13	7.0 (+1)[b] 5.1 2.1 1.2 13.1	5.7 (+0.2)[c] (CV = 0.03)
Bering Sea/Aleutian Is. Pacific cod longline	2012 2013 2014 2015 2016	obs data	51 66 64 62 57	0 0 1 3 0	0 0 1.7 4.8 0	1.3 (CV = 0.32)
Gulf of Alaska Pacific cod longline	2012 2013 2014 2015 2016	obs data	13 29 31 36 30	0 0 0 1 0	0 0 0 1.3 0	0.3 (CV = 0.50)
Gulf of Alaska Pacific cod trawl	2012 2013 2014 2015 2016	obs data	25 10 12 13 13	1 0 0 0 1	1 0 0 0 9.8	2.2 (CV = 0.82)
Gulf of Alaska sablefish longline	2012 2013 2014 2015 2016	obs data	14 14 19 20 14	1 0 0 0 0	3.9 0 0 0 0	0.8 (CV = 0.86)

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Gulf of Alaska flatfish trawl	2012	obs data	42	0	0	0 (+0.2)[f] (CV = N/A)
	2013		46	0	0	
	2014		47	0	0	
	2015		54	0 (+1)[d]	0 (+1)[e]	
	2016		39	0	0	
Gulf of Alaska rockfish trawl	2012	obs data		0	0	0 (+0.2)[f] (CV = N/A)
	2013			0	0	
	2014			0	0	
	2015		93	0 (+1)[d]	0 (+1)[e]	
	2016			0	0	
Gulf of Alaska pollock trawl	2012	obs data	27	0	0	1.0 (+1)[i] (CV = 0.9)
	2013		15	0	0	
	2014		14	0	0	
	2015		23	0 (+5)[g]	0 (+5)[h]	
	2016		27	1	5.0	
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						35 (CV = 0.46)

[a]Total mortality and serious injury observed in 2012: 7 sea lions in sampled hauls + 1 sea lion in an unsampled haul.
[b]Total estimate of mortality and serious injury in 2012: 7.0 sea lions (extrapolated estimate from 7 sea lions observed in sampled hauls) + 1 sea lion (1 sea lion observed in an unsampled haul).
[c]Mean annual mortality and serious injury for fishery: 5.7 sea lions (mean of extrapolated estimates from sampled hauls) + 0.2 sea lions (mean of number observed in unsampled hauls).
[d]Total mortality and serious injury observed in 2015: 0 sea lions in sampled hauls + 1 sea lion in an unsampled haul.
[e]Total estimate of mortality and serious injury in 2015: 0 sea lions (extrapolated estimate from 0 sea lions observed in sampled hauls) + 1 sea lion (1 sea lion observed in an unsampled haul).
[f]Mean annual mortality and serious injury for fishery: 0 sea lions (mean of extrapolated estimates from sampled hauls) + 0.2 sea lions (mean of number observed in unsampled hauls).
[g]Total mortality and serious injury observed in 2015: 0 sea lions in sampled hauls + 5 sea lions in unsampled hauls.
[h]Total estimate of mortality and serious injury in 2015: 0 sea lions (extrapolated estimate from 0 sea lions observed in sampled hauls) + 5 sea lions (5 sea lions observed in unsampled hauls).
[i]Mean annual mortality and serious injury for fishery: 1.0 sea lion (mean of extrapolated estimates from sampled hauls) + 1 sea lion (mean of number observed in unsampled hauls).

Reports from the NMFS Alaska Region stranding network 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 (Table 3; Helker et al. in press). From 2012 to 2016, there were four reports of a Steller sea lion in poor body condition with a flasher lure (troll gear) hanging from its mouth and, in each case, the animal was believed to have ingested the hook (Table 3). Two additional animals were entangled in unidentified fishing gear. Fishery-related strandings in these unknown (commercial, recreational, or subsistence) fisheries during 2012-2016 resulted in a minimum mean annual mortality and serious injury rate of 1.2 sea lions from this stock (Table 3). This mortality and serious injury estimate results from an actual count of verified human-caused deaths and serious injuries and is a minimum because not all entangled animals strand nor are all stranded animals found or reported. Additionally, since Steller sea lions from parts of the western stock are known to regularly occur in parts of Southeast Alaska (NMFS 2013), and higher rates of entanglement of Steller sea lions have been observed in this area (e.g., 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 sea lions in fishery-related and other marine debris.

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 network and Alaska Department of Fish and Game in 2012-2016 (Helker et al. in press). N/A indicates that data are not available.

Cause of injury	2012	2013	2014	2015	2016	Mean annual mortality
Entangled in commercial longline gear	0	0	0	1	0	0.2
Hooked by Southcentral Alaska salmon troll gear*	0	0	1	0	0	0.2
Hooked by Alaska Peninsula troll gear*	1	0	0	0	0	0.2
Hooked by troll gear*	2	0	0	0	0	0.4
Entangled in unidentified fishing gear*	1	0	1	0	0	0.4
Entangled in marine debris	2	0	3	4	1	2
Struck by arrow	0	1	0	0	0	0.2
Entangled in commercial Kodiak salmon hatchery net	0	1	0	0	0	0.2
Illegally shot	N/A	N/A	N/A	8	1	4.5[a]
MMPA authorized research-related	0	0	0	1	2	0.6
Total in commercial fisheries						0.2
*Total in unknown (commercial, recreational, or subsistence) fisheries						1.2
Total in marine debris						2
Total due to other causes (arrow strike, entangled in hatchery net, illegally shot, research-related)						5.5

[a]Dedicated effort to survey the Copper River Delta for stranded marine mammals began in 2015 in response to a high number of reported strandings, some of which were later determined to be human-caused (illegally shot). Dedicated surveys were also conducted in 2016. Because similar data are not available for 2012-2014, the data were averaged over the 2 years of survey effort for a more informed estimate of mean annual mortality.

The minimum average annual mortality and serious injury rate for all fisheries, based on observer data and stranding data (35 sea lions) for U.S. commercial fisheries and stranding data (1.2 sea lions) for unknown (commercial, recreational, or subsistence) fisheries, is 36 western Steller sea lions.

Alaska Native Subsistence/Harvest Information

Information on the subsistence harvest of Steller sea lions comes via three sources: the Alaska Department of Fish and Game (ADF&G), the Ecosystem Conservation Office of the Aleut Community of St. Paul Island, and the Kayumixtax Eco-Office of the Aleut Community of St. George Island. 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 geographic 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 consistently collected. Data are being collected periodically in subareas. Data were collected on the Alaska Native harvest of Western U.S. Steller sea lions for 7 communities on Kodiak Island in 2011 and 15 communities in Southcentral Alaska in 2014. The Alaska Native Harbor Seal Commission (ANHSC) and ADF&G estimated a total of 20 adult sea lions were harvested on Kodiak Island in 2011, with a 95% confidence range between 15 and 28 animals (Wolfe et al. 2012), and 7.9 sea lions (CI = 6-15.3) were harvested in Southcentral Alaska in 2014, with adults comprising 84% of the harvest (ANHSC 2015). These estimates do 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. Thus, the most recent 5 years of data available from the ADF&G (2004-2008) will be retained and used for calculating an annual mortality and serious injury estimate for all areas except St. Paul and St. George Islands (Wolfe et al. 2005, 2006, 2008, 2009a, 2009b) (Table 4). Harvest data are collected in near real-time on St. Paul Island (e.g., Melovidov 2013) and St. George Island (e.g., Kashevarof 2015) and recorded within 36 hours of the harvest. The most recent 5 years of data from St. Paul (Melovidov 2013, 2014, 2015, 2016; NMFS, unpubl. data) and St. George (Kashevarof 2015; NMFS, unpubl. data) are for 2012-2016 (Table 4).

The mean annual subsistence harvest from this stock for all areas except St. Paul and St. George in 2004-2008 (172) combined with the mean annual harvest for St. Paul (30) and St. George (1.4) in 2012-2016 is 203 western Steller sea lions (Table 4).

Table 4. Summary of the subsistence harvest data for Western U.S. Steller sea lions. As of 2009, data on community subsistence harvests are no longer being consistently 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 and St. George Islands. Data from St. Paul and St. George are still being collected and will be updated with the most recent 5 years of data available (2012-2016). N/A indicates that data are not available.

	All areas except St. Paul Island			St. Paul Island	St. George Island
Year	Number harvested	Number struck and lost	Total	Number harvested + Number struck and lost	Number harvested + Number struck and lost
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]		
2012	N/A	N/A	N/A	24[f]	3[g]
2013	N/A	N/A	N/A	34[h]	0[g]
2014	N/A	N/A	N/A	35[i]	1[g]
2015	N/A	N/A	N/A	24[j]	3[g]
2016	N/A	N/A	N/A	31[k]	0[k]
Mean annual harvest	137	35	172	30	1.4

[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]Melovidov (2013); [g]Kashevarof (2015); [h]Melovidov (2014); [i]Melovidov (2015); [j]Melovidov (2016); [k]NMFS, unpubl. data.

Other Mortality

Reports from the NMFS Alaska Region stranding network 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. These mortality and serious injury estimates result from an actual count of verified human-caused deaths and serious injuries and are minimums because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. From 2012 to 2016, reports to the NMFS Alaska Region stranding network resulted in mean annual mortality and serious injury rates of 4.5 Steller sea lions illegally shot in the Copper River Delta (2-year average), 2 observed entangled in marine debris, 0.2 struck by an arrow, and 0.2 entangled in a commercial Kodiak salmon hatchery net (Table 3; Helker et al. in press).

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. In 2012-2016, there were three reports (1 in 2015 and 2 in 2016) of mortality incidental to research on the Western U.S. stock of Steller sea lions (Table 3; Helker et al. in press), resulting in a mean annual mortality and serious injury rate of 0.6 sea lions from this stock.

STATUS OF STOCK

The minimum mean annual U.S. commercial fishery-related mortality and serious injury rate (35 sea lions) is more than 10% of the PBR (10% of PBR = 33) and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. Based on available data, the total estimated annual level of human-caused mortality and serious injury (247 sea lions) is below the PBR level (326) 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. The population previously declined for unknown reasons that are not explained by the documented level of direct human-caused mortality and serious injury.

There are key uncertainties in the assessment of the Western U.S. stock of Steller sea lions. Some genetic studies support the separation of Steller sea lions in western Alaska from those in Russia; population numbers in this assessment are only from the U.S. to be consistent with the geographic range of information on mortality and serious injury. There is some overlap in range between animals in the western and eastern stocks in northern Southeast Alaska. The population abundance is based on counts of visible animals; the calculated N_{MIN} and PBR levels are conservative because there are no data available to correct for animals not visible during the visual surveys. There are multiple nearshore commercial fisheries which are not observed; thus, there is likely to be unreported fishery-related mortality and serious injury of Steller sea lions. Estimates of human-caused mortality and serious injury from stranding data are underestimates because not all animals strand nor are all stranded animals found, reported, or have the cause of death determined. Several factors may have been important drivers of the decline of the stock. However, there is uncertainty about threats currently impeding their recovery, particularly in the Aleutian Islands.

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 since 1990 to promote the recovery of the Western U.S. stock of Steller sea lions, including 3-nmi 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). Since the removal of the Eastern U.S. stock of Steller sea lions from protection under the ESA in 2013, NMFS has undertaken a review of ESA critical habitat for the Western U.S. stock.

Table 5. Potential threats and impacts to Steller sea lion recovery, as described by the Revised Steller Sea Lion Recovery Plan (NMFS 2008), and associated references. Reference examples identify research related to corresponding threats and may or may not support the underlying hypotheses.

Threat	Impact on Recovery	Level of Uncertainty	Reference Examples
Environmental variability	Potentially high	High	Trites and Donnelly 2003, Fritz and Hinckley 2005
Competition with fisheries	Potentially high	High	Fritz and Ferrero 1998, Hennen 2004, Fritz and Brown 2005, Dillingham et al. 2006
Predation by killer whales	Potentially high	High	Springer et al. 2003, Williams et al. 2004, DeMaster et al. 2006, Trites et al. 2007
Toxic substances	Medium	High	Calkins et al. 1994, Lee et al. 1996, Albers and Loughlin 2003, Rea et al. 2013
Incidental take by fisheries	Low	High	Wynne et al. 1992, Nikulin and Burkanov 2000, Perez 2006
Subsistence harvest	Low	Low	Haynes and Mishler 1991, Loughlin and York 2000, Wolfe et al. 2005
Illegal shooting	Low	Medium	Loughlin and York 2000, NMFS 2001
Entanglement in marine debris	Low	Medium	Calkins 1985
Disease and parasitism	Low	Medium	Burek et al. 2005
Disturbance from vessel traffic and tourism	Low	Medium	Kucey and Trites 2006
Disturbance or mortality due to research activities	Low	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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