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# 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).

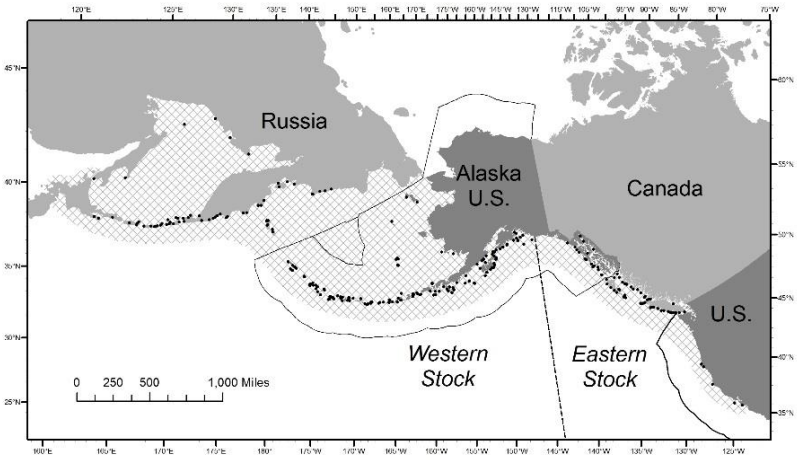


**Figure 1.** Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; S. Majewski, 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) 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 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 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 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 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 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 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 during the 2014 and 2015 breeding seasons (Fritz et al. 2015a, 2015b). Western Steller sea lion pup and non-pup counts in Alaska in 2015 were estimated to be 12,492 (95% credible interval of 11,480-13,612) and 38,491 (34,377-42,634), respectively, using agTrend (Johnson and Fritz 2014) and survey results through 2015 (Fritz et al. 2015a, 2015b). 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-MML, 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. Analysis of data collected in 2013 and 2015 is ongoing and results will be included in a future Stock Assessment Report.

**Minimum Population Estimate**

Because of the uncertainty regarding the use of a pup multiplier or haulout rate 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 ($N_{MIN}$). Western Steller sea lion pup and non-pup counts in 2015 in Alaska were estimated to be 12,492 and 38,491, respectively (Fritz et al. 2015b), which total 50,983 and 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 2000-2002 (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). Using data collected through 2015, there is strong evidence that non-pup and pup counts of western stock Steller sea lions in Alaska increased at ~2% $y^{-1}$ between 2000 and 2015 (Table 1; Fritz et al. 2015b). However, there are strong regional differences across the range in Alaska, with positive trends east of Samalga Pass (~170°W) in the Gulf of Alaska and eastern Bering Sea and negative trends to the west in the Aleutian Islands (Table 1; Fig. 2).

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), indicating that sea lions may have responded to meso-scale (on the order of 100s of kilometers) variability in their environment (O'Corry-Crowe et al. 2014).

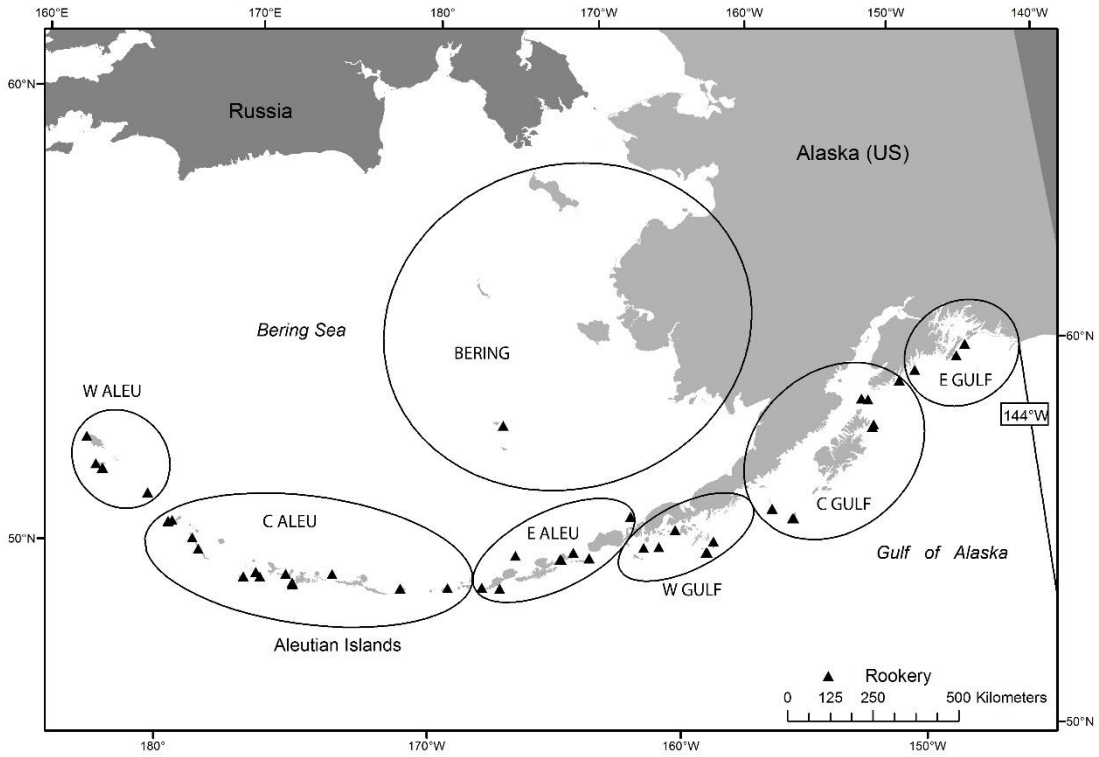


**Figure 2.** Regions of Alaska used for western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands regions, respectively.

**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 2000-2015 (Johnson and Fritz 2014; Fritz et al. 2013, 2015a, 2015b).

| | | Non-pups | | | | Pups | | |
|---|---|---|---|---|---|---|---|---|
| **Region** | **Latitude Range** | **Trend** | **-95%** | **+95%** | | **Trend** | **-95%** | **+95%** |
| Western Stock in Alaska | 144°W-172°E | 1.94 | 1.35 | 2.58 | | 1.87 | 1.30 | 2.40 |
| E of Samalga Pass | 144°-170°W | 3.28 | 2.55 | 4.10 | | 3.30 | 2.61 | 3.98 |
| Eastern Gulf of Alaska | 144°-150°W | 5.07 | 2.35 | 7.87 | | 4.31 | 2.54 | 6.00 |
| Central Gulf of Alaska | 150°-158°W | 2.68 | 1.53 | 3.73 | | 2.82 | 1.39 | 4.24 |
| Western Gulf of Alaska | 158°-163°W | 3.95 | 2.75 | 5.11 | | 3.28 | 1.86 | 4.61 |
| Eastern Aleutian Islands | 163°-170°W | 2.08 | 0.69 | 3.44 | | 3.35 | 2.29 | 4.37 |
| W of Samalga Pass | 170°W-172°E | -1.82 | -2.62 | -0.97 | | -1.62 | -2.45 | -0.82 |
| Central Aleutian Islands | 170°W-177°E | -0.84 | -1.69 | 0.05 | | -0.68 | -1.58 | 0.23 |
| Western Aleutian Islands | 172°-177°E | -8.71 | -10.65 | -6.83 | | -8.88 | -10.00 | -7.73 |

The distribution of sightings of branded animals during the breeding season indicates an average annual net movement of adult and juvenile sea lions from the central to the eastern Gulf of Alaska (Fritz et al. 2013). This could have depressed non-pup trend estimates in the central Gulf (2.68% $y^{-1}$ between 2000 and 2015) and increased them in the eastern Gulf (5.07% $y^{-1}$; 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).

The net magnitude of Steller sea lion movements during the breeding season between the eastern and western stocks appears to be relatively small and would have a negligible impact on non-pup trend estimates in either area (Fritz et al. 2013, Jemison et al. 2013). However, there were significant differences by sex in cross-boundary movements: for females, there was a net increase of ~600 in the east and very few moved from east to west, while males moved in both directions but with a net increase of ~500 males 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).

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, NMFS-AFSC-MML, pers. comm.) indicate that overall Steller sea lion abundance in Russia increased back to levels observed in the 1960s (~27,100 based on life table multiplier of 4.5 on the most recent total pup count of 6,021). However, just as in the U.S. portion of the stock, there are significant regional differences in population trend in Russia, with increasing abundance in the Sea of Okhotsk and Kuril Islands and stable or declining trends in eastern Kamchatka, the Commander Islands, and the western Bering Sea. 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. Regions in Russia that have either stable or declining counts of pups and non-pups are adjacent to regions in the U.S. with similar trends (Aleutian Islands west of 170°W). Results from surveys conducted in 2013 and 2015 will be available soon and included in a future Stock Assessment Report.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the 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 = 306 animals (50,983 × 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 2010 and 2014, mortality and serious injury of western Steller sea lions was observed in the following 8 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, Bering Sea/Aleutian Islands Pacific cod longline, Gulf of Alaska Pacific cod trawl, Gulf of Alaska Pacific cod longline, and Gulf of Alaska sablefish longline fisheries (Table 2; Breiwick 2013; MML, unpubl. data).

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 or serious injury was observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean annual mortality rate of 15 (CV = 1.0) sea lions 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.

Combining the mortality and serious injury estimates from the Bering Sea/Aleutian Islands groundfish trawl, Bering Sea/Aleutian Islands longline, Gulf of Alaska groundfish trawl, and Gulf of Alaska longline fisheries (15) with the estimate from the Prince William Sound salmon drift gillnet fishery (15) results in an estimated mean annual mortality and serious injury rate of 30 sea lions from this stock in observed U.S. commercial fisheries (Table 2).

**Table 2.** Summary of incidental mortality and serious injury of Western U.S. Steller sea lions due to U.S. commercial fisheries in 2010-2014 (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. Atka mackerel trawl | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 100<br>99<br>99<br>99<br>99 | 1<br>0<br>0<br>0<br>0 | 1<br>0<br>0<br>0<br>0 | 0.2<br>(CV = 0.05) |
| Bering Sea/Aleutian Is. flatfish trawl | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 99<br>100<br>99<br>99<br>99 | 4 (+1)[a]<br>7<br>6<br>7<br>5 | 4 (+1)[b]<br>7<br>6.0<br>7.1<br>5.0 | 5.8 (+0.2)[c]<br>(CV = 0.01) |
| Bering Sea/Aleutian Is. Pacific cod trawl | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 66<br>60<br>68<br>80<br>80 | 1<br>1<br>0<br>1<br>0 | 1<br>1.0<br>0<br>1.9<br>0 | 0.8<br>(CV = 0.34) |
| Bering Sea/Aleutian Is. pollock trawl | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 86<br>98<br>98<br>97<br>98 | 5<br>9<br>7 (+1)[d]<br>5<br>2 | 8.2<br>9.3<br>7 (+1)[e]<br>5.1<br>2.1 | 6.3 (+0.2)[f]<br>(CV = 0.09) |
| Bering Sea/Aleutian Is. Pacific cod longline | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 64<br>57<br>51<br>66<br>64 | 0<br>0<br>0<br>0<br>1 | 0<br>0<br>0<br>0<br>1.7 | 0.3<br>(CV = 0.64) |
| Gulf of Alaska Pacific cod longline | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 29<br>30<br>13<br>29<br>31 | 1<br>0<br>0<br>0<br>0 | 1.1<br>0<br>0<br>0<br>0 | 0.2<br>(CV = 0.33) |
| Gulf of Alaska Pacific cod trawl | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 31<br>41<br>25<br>10<br>12 | 0<br>0<br>1<br>0<br>0 | 0<br>0<br>1<br>0<br>0 | 0.2<br>(CV = 0) |
| Gulf of Alaska sablefish longline | 2010<br>2011<br>2012<br>2013<br>2014 | obs data | 15<br>14<br>14<br>14<br>19 | 0<br>0<br>1<br>0<br>0 | 0<br>0<br>5.5<br>0<br>0 | 1.1<br>(CV = 0.89) |

| Fishery name | Years | Data type | Percent observer coverage | Observed mortality | Estimated mortality | Mean estimated annual mortality |
|---|---|---|---|---|---|---|
| Prince William Sound salmon drift gillnet | 1990<br>1991 | obs<br>data | 4<br>5 | 0<br>2 | 0<br>29 | 15<br>(CV = 1.0) |
| Minimum total estimated annual mortality | | | | | | 30<br>(CV = 0.50) |

[a]Total mortality and serious injury observed in 2010: 4 sea lions in sampled hauls + 1 sea lion in an unsampled haul.
[b]Total estimate of mortality and serious injury in 2010: 4 sea lions (extrapolated estimate from 4 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: 5.8 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 2012: 7 sea lions in sampled hauls + 1 sea lion in an unsampled haul.
[e]Total estimate of mortality and serious injury in 2012: 7 sea lions (extrapolated estimate from 7 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: 6.3 sea lions (mean of extrapolated estimates from sampled hauls) + 0.2 sea lions (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. 2016). During 2010 to 2014, there were five reports of 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). An additional animal was hooked by longline gear and two animals were entangled in unidentified fishing gear. Fishery-related strandings in these unknown (commercial, recreational, or subsistence) fisheries during 2010-2014 resulted in a minimum mean annual mortality and serious injury rate of 1.6 animals from this stock (Table 3). 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., 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.

**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 2010-2014 (Helker et al. 2016).

| Cause of injury | 2010 | 2011 | 2012 | 2013 | 2014 | Mean annual mortality |
|---|---|---|---|---|---|---|
| Hooked by Gulf of Alaska longline gear* | 1 | 0 | 0 | 0 | 0 | 0.2 |
| Hooked by Southcentral Alaska salmon troll gear* | 0 | 1 | 0 | 0 | 1 | 0.4 |
| Hooked by Alaska Peninsula troll gear* | 0 | 0 | 0 | 1 | 0 | 0.2 |
| Hooked by troll gear* | 0 | 0 | 2 | 0 | 0 | 0.4 |
| Entangled in unidentified fishing gear* | 0 | 0 | 1 | 0 | 1 | 0.4 |
| Entangled in marine debris | 5 | 1 | 2 | 0 | 3 | 2.2 |
| Struck by arrow | 0 | 0 | 0 | 1 | 0 | 0.2 |
| Entangled in commercial Kodiak salmon hatchery net | 0 | 0 | 0 | 1 | 0 | 0.2 |
| *Total in unknown (commercial, recreational, or subsistence) fisheries | | | | | | 1.6 |
| Total in marine debris | | | | | | 2.2 |
| Total due to other causes (arrow strike, entangled in hatchery net) | | | | | | 0.4 |

NMFS studies using satellite-tracking devices attached to juvenile and adult female Steller sea lions suggest that these two age/sex classes rarely go beyond the U.S. Exclusive Economic Zone into international waters (Merrick and Loughlin 1997; Lander et al. 2009, 2011a, 2011b). Little is known about the at-sea distribution of sub-adult and adult males, however, since there have been no satellite-tracking devices attached to them. In the 1980s and 1990s, Steller sea lions of unknown sex and age were observed in international waters of the North Pacific Ocean and Bering Sea, but it is unclear how important these areas are for foraging (Himes-Boor and Small 2012).

The minimum average annual estimated mortality and serious injury rate incidental to U.S. commercial fisheries is 30 Steller sea lions. The minimum average annual mortality and serious injury rate for all fisheries, based on observer data (30 sea lions) for commercial fisheries and stranding data (1.6 sea lions) for unknown (commercial, recreational, or subsistence) fisheries is 32 western Steller sea lions. Observer data for state fisheries are from 1990-1991; 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 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. Therefore, the most recent 5 years of data available (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. 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 (Lestenkof 2011). Information on subsistence harvest levels is provided in Table 4; data from ECO (e.g., Lestenkof 2011) 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). The most recent 5 years of data from St. Paul are from 2010 to 2014 (Lestenkof 2011, 2012).

The mean annual subsistence take from this stock for all areas except St. Paul in 2004-2008 (172) combined with the mean annual take for St. Paul in 2010-2014 (29) is 201 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. Data from St. Paul are still being collected and will be updated with the most recent 5 years of data available (2010-2014). N/A indicates that data are not available.

| | All areas except St. Paul Island | | | St. Paul Island |
|---|---|---|---|---|
| **Year** | **Number harvested** | **Number struck and lost** | **Total** | **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] | |
| 2009 | N/A | N/A | N/A | |
| 2010 | N/A | N/A | N/A | 20[f] |
| 2011 | N/A | N/A | N/A | 32[g] |

| | All areas except St. Paul Island | | | St. Paul Island |
|---|---|---|---|---|
| Year | Number harvested | Number struck and lost | Total | Number harvested + Number struck and lost |
| 2012 | N/A | N/A | N/A | 24[h] |
| 2013 | N/A | N/A | N/A | 34[h] |
| 2014 | N/A | N/A | N/A | 35[h] |
| Mean annual take | 136.9 | 35.3 | 172.3 | 29 |

[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]Lestenkof (2011); [g]Lestenkof (2012); [h]ADF&G, 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. From 2010 to 2014, 11 animals were observed entangled in marine debris, 1 animal was struck by an arrow, and 1 entangled in a commercial Kodiak salmon hatchery net (Table 3; Helker et al. 2016). The minimum mean annual mortality and serious injury rate from these sources of human interactions in 2010-2014 is 2.6 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. In 2011, there were two reports of mortality incidental to research on the Western U.S. stock of Steller sea lions (Division of Permits and Conservation, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910), resulting in a mean annual mortality and serious injury rate of 0.4 sea lions from this stock in 2010-2014.

**STATUS OF STOCK**

The current mean annual U.S. commercial fishery-related mortality and serious injury rate (30 sea lions) is less than 10% of the PBR (10% of PBR = 31) and, therefore, can 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 (236 sea lions) is below the PBR level (306) 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 documented 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 since 1990 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 impacts 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 | 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 |
| 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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