Revised 06/10/2013

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). The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas (Sease and York 2003). Despite the wide-ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) is low (NMFS 1995).

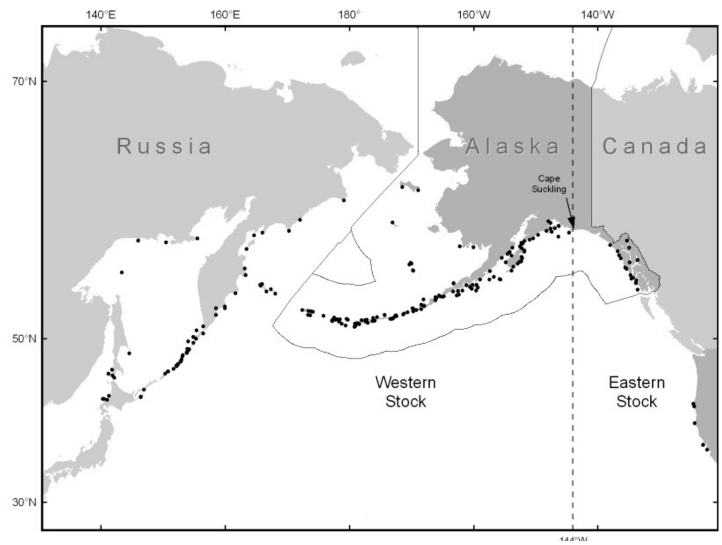

Figure 1. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (Burkanov and Loughlin, 2005) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997).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

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: unknown; and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions were recognized within U. S. waters: an eastern U. S. stock, which includes animals east of Cape Suckling, Alaska (144°W), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 1).

Steller sea lions that breed in Asia 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. 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). 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, while range fragmentation type events were correlated with larger effective population sizes. This work again re-inforced the stock delineation concept by noting that ancient population subdivision likely led to the sequestering of most mtDNA haplotypes as DPS, or subspecies-specific (Phillips et al. 2011). Overall, the basis for this distinctiveness of the eastern and western stocks is the overwhelming collection of morphological, ecological and behavioral, and genetic evidence for DPS differences.

In 1998 Steller sea lion pups were first noted on Graves Rock just north of Cross Sound in Southeast Alaska in the range of the eastern stock of Steller sea lion. By 2002 the population had increased to approximately 100 pups and 50 of those pups were captured, branded, and tissue-sampled in July 2002. Mitochondrial and microsatellite analysis of those samples 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 near northern Chichagof Island 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 have been partially to predominately established by females that were born in the western stock. Movements of animals marked as pups in both stocks support these genetic results (Jemison et al., in preparation; NMML and ADFG unpublished data), with females moving from the northern Gulf of Alaska (western stock; Prince William Sound and northern Kodiak area) to breed on rookeries in northern southeast Alaska (eastern stock) with virtually no eastern stock females moving to the west.

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

POPULATION SIZE

The most recent comprehensive estimate (pups and non-pups) of abundance of the western stock of Steller sea lions in Alaska is derived from aerial photographic surveys of non-pups conducted in June-July 2008-2012 and aerial photographic and ground-based pup counts conducted in June-July 2009-2012 (DeMaster 2011; 2012). During the 2008-2012 non-pup surveys, a total of 34,056 non-pups was counted at 269 terrestrial rookery and haulout sites; 19,593 in the Gulf of Alaska and 14,463 in the Bering Sea/Aleutian Islands. Most of the data represented in the aggregate 2008-2012 non-pup count was collected in the 2011 survey (29,705 non-pups on 114 of the largest sites). Twenty-three (23) sites in the central and western Aleutian Island were surveyed in 2012 and had a total of 1,240 non-pups. Sites that were not surveyed in 2011 or 2012 contributed less to the aggregate 2008-2012 total: 553 non-pups on 46 sites last surveyed in 2008, 152 non-pups on 1 site last surveyed in 2009, and 2,406 non-pups on 85 sites last surveyed in 2010. The composite pup count of the western stock in Alaska from 2009-2012 totaled 11,603. Most of the data represented in the aggregate 2009-2012 pup count were collected in 2011 (10,418 pups on 73 sites) and 2012 (200 pups on 5 sites), with the remainder collected in 2009 (273 pups on 6 sites) and 2010 (712 pups on 4 sites). There were 6,034 pups counted in the Gulf of Alaska and 5,569 pups counted in the Bering Sea/Aleutian Islands.

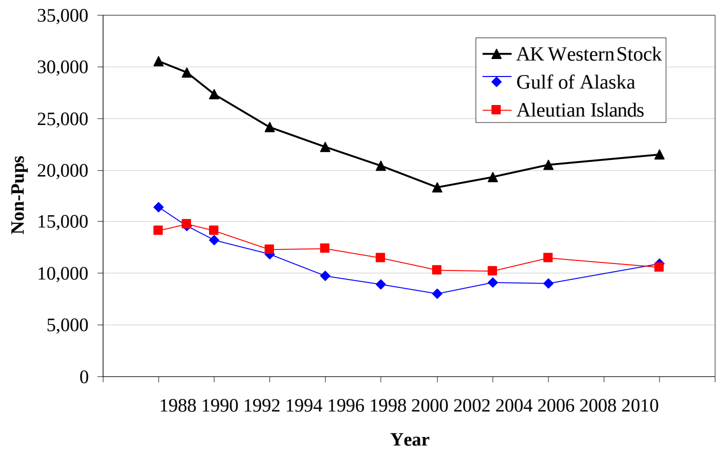

Figure 2. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U.S. stock in Alaska, 1990-2008. Correction factor applied to 2004 and 2008 counts for film format differences (Fritz and Stinchcomb 2005).

An estimate of the total population size of western Steller sea lion in Alaska may be obtained by multiplying the best estimate of total pup production (11,603) by 4.5 (Calkins and Pitcher 1982), which yields approximately 52,200. This is not a minimum abundance estimate since it is an extrapolated total population size from pup counts based on survival and fecundity estimates in a life table. The 4.5 multiplier may not be appropriate for use in estimating the abundance of the western stock, as it is based on a life history table using vital rates (age-specific fecundity and survival) for the stable, mid-1970s population sampled in the central Gulf of Alaska. Vital rates of Steller sea lions in the central Gulf of Alaska have changed considerably since the mid-1970s as the population declined through the 1980s and 1990s, and has been relatively stable in the 2000s (York 1994, Holmes and York 2003, Fay and Punt 2006, Pendleton et al. 2006, Winship and Trites 2006, Holmes et al. 2007).

Factors that caused the population decline, particularly those that contributed to lower rates of juvenile survival, were likely quite different from those that are now affecting recovery (e.g., factors that may by impacting reproductive rates of adult females; Holmes and York 2003, Fay and Punt 2006, Winship and Trites 2006, 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. The most recent estimate of pup production in Russia is available from counts conducted in 2011 and 2012, which totaled 6,021 pups and yields a total population abundance estimate of 27,100 Steller sea lions using the 4.5 multiplier.

An estimate of the abundance of the entire (U.S. and Russia) western stock of Steller sea lions (pups and non-pups) can be made by adding the most recent US and Russian pups counts, and multiplying by 4.5 (11,603 + 6,021 = 17,624 pups × 4.5), which yields 79,300.

Minimum Population Estimate

The 2008-2012 aggregate total count of non-pups (34,056) plus the number of pups in 2009-2012 (11,603) is 45,659, which will be used as the minimum population estimate (N_{MIN}) for the U.S. portion of the western stock of Steller sea lion (Wade and Angliss 1997). This is considered a minimum estimate because it has not been corrected to account for animals that were at sea during the surveys.

Current Population Trend

The first reported trend counts (sums of counts at consistently surveyed, large sites used to examine population trends) of Steller sea lions in Alaska were made in 1956-60. Those counts indicated that there were at least 140,000 (no correction 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, Table 1). 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). Between 1991 and 2000, overall counts of Steller sea lions at trend sites decreased 40% (Table 1), an average annual decline of 5.4% (Loughlin and York 2000). In the 1990s, counts decreased more at the western (western Aleutians; -65%) and eastern edges (eastern and central Gulf of Alaska; -56% and -42%, respectively) of the U.S. range than they did in the center (range of -24% to -6% from the central Aleutians through the western Gulf of Alaska) (Fritz et al. 2008).

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

Area	late 1970s	1990	1991	1992	1994	1996	1998	2000	2002	2004	2008
Gulf of Alaska	65,296	16,409	14,598	13,193	11,862	9,784	8,937[1]	7,995	9,087	8,993	10,931
Bering Sea/Aleutians	44,584	14,116	14,807	14,106	12,274	12.426	11,501	10,330	10,253	11,507	10,559
Total	109,880	30,525	29,405	27,299	24,136	22,210	20,438[1]	18,325	19,340	20,500	21,489

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

Johnson and Fritz (2014) estimated regional and overall trends in Alaska western stock non-pup counts using data collected at all sites with more than two non-zero counts between 1990 and 2012 (see also Fritz et al. in prep). Their method uses data collected at a larger group of sites than those designated previously as 'trend' sites, and uses the magnitude and variance observed at each site to estimate counts for years when the site was not surveyed. A model was developed to estimate individual site-year counts for missing years and counts were summed by region and stock for each of 10,000 iterations. Regional and stock-wide trends and variances for 2000-2012 were obtained from the median and variance of the posterior predictive distribution (Table 2; Johnson and Fritz, in prep). Overall, there was strong evidence that non-pup counts in the western stock in Alaska increased between 2000 and 2012 (average rate of 1.67% y^{-1}; 95% credible interval of 1.01% y^{-1} and 2.38% y^{-1}). However, there were differences across the range in Alaska, with strong evidence of a positive trend east of Samalga Pass (2.89% y^{-1}; 2.07-3.80% y^{-1}) and strong evidence of a decreasing trend to the west (-1.53% y^{-1}; -2.35% y^{-1} to -0.66% y^{-1}).

Table 2. 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 2000-2012 (Johnson and Fritz, 2014).

		Non-pups			Pups		
Region	**Latitude Range**	**Trend**	**-95%**	**+95%**	**Trend**	**-95%**	**+95%**
Western Stock in Alaska	144°W-172°E	1.67	1.01	2.38	1.45	0.69	2.22
E of Samalga Pass	144°-170°W	2.89	2.07	3.80	--	--	--
Eastern Gulf of Alaska	144°-150°W	4.51	1.63	7.58	3.97	1.31	6.50
Central Gulf of Alaska	150°-158°W	0.87	-0.34	2.18	1.48	-0.56	3.30
E-C Gulf of Alaska	144°-158°W	2.40	0.92	3.86	--	--	--
Western Gulf of Alaska	158°-163°W	4.01	2.49	5.42	3.03	1.06	5.20
Eastern Aleutian Islands	163°-170° W	2.39	0.92	3.94	3.30	1.76	4.83
W Gulf & E Aleutians	158°-170°W	3.22	2.19	4.25			
W of Samalga Pass	170°W-172°E	-1.53	-2.35	-0.66	--	--	--
Central Aleutian Islands	170°W-177°E	-0.56	-1.45	0.43	-0.46	-1.50	0.72
Western Aleutian Islands	172°-177°E	-7.23	-9.04	-5.56	-9.36	-10.93	-7.78

The distribution of sightings of branded animals during the breeding season from 2001 to 2011 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. in preparation A); non-pup counts in the combined eastern-central Gulf of Alaska region increased at 2.40% y^{-1} (0.92-3.86% y^{-1}) between 2000 and 2012. West of Samalga Pass, trends in non-pup counts between 2000 and 2012 were largely negative, and were increasingly negative to the west. Non-pup counts were essentially stable (slow decline at -0.56% y^{-1}; -1.45% y^{-1} to 0.43% y^{-1}) in the central Aleutian Islands, but there is strong evidence of a steep decline (-7.23% y^{-1}; -9.04% y^{-1} to -5.56% y^{-1}) in the western Aleutian Islands. 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. (in prep A) estimated the magnitude of cross-boundary movement of Steller sea lions between the western and eastern stocks using the following information: transition probabilities 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. (in prep B); and pup production by region based on aerial surveys conducted in 2009 (Fritz et al. in prep A). Transition probabilities and survivorship were based on sightings of sea lions branded as pups within both stocks. 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).

Regional variation in trends in pup counts in 2000-2012 is similar to that of non-pup counts (Johnson and Fritz, in prep; Table 2). Overall, there is strong evidence that pup counts in the western stock in Alaska increased (1.45% y^{-1}; 0.69-2.22% y^{-1}). Pup counts declined steeply in the western Aleutian Islands (-9.36% y^{-1}; -10.93% y^{-1} to -7.78% y^{-1}), but were stable (declining slowly) in the central Aleutian Islands (-0.46 % y^{-1}; -1.50% y^{-1} to 0.72% y^{-1}). As with non-pup counts, there is a west-east cline in pup trends in the central Aleutians, with declining counts in the western central Aleutians (RCA 2: -4.83% y^{-1} [-7.32% y^{-1} to -2.04% y^{-1}]; RCA 3: -1.74% y^{-1} [-3.37% y^{-1} to -0.13% y^{-1}]) and stable (slowly increasing) counts in the eastern central Aleutians (RCA 4: 2.56% y^{-1} [-0.15% y^{-1} to 5.39% y^{-1}]; RCA 5: 0.45% y^{-1} [-1.48% y^{-1} to 2.48% y^{-1}]). In three of the four regions east of Samalga Pass (eastern Aleutian Islands, and eastern and western Gulf of Alaska), there is strong evidence that pup counts increased (all >3% y^{-1}), but were stable (increasing slowly; 1.48% y^{-1} [-0.56% y^{-1} to 3.30% y^{-1}]) in the central Gulf of Alaska. 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 kms) variability in their environment.

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., NMML-AFSC, 7600 Sand Point Way NE, Seattle, WA, 27 February 2013) indicates 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 2011/12, pup production has increased overall in Russia by 3.1% per year (Vladimir Burkanov, pers. comm., NMML-AFSC, 7600 Sand Point Way NE, Seattle, WA, 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 1995-97 (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, 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 Commanders increased to a maximum of 280 in 1998 and has varied between 180 and 228 since then (through 2012). Non-pup counts on the Commanders also reached a recent maximum in 1998-99 (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 the western Bering Sea) border regions in the United States 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 Endangered Species Act (Wade and Angliss 1997). Thus, for the U.S. portion of the western stock of Steller sea lions, PBR = 274 animals (45,659 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

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

Fisheries Information

Until 2003, there were six different federally regulated commercial fisheries in Alaska that could have interacted with Steller sea lions. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these 6 fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2007-2011, there were incidental serious injuries and mortalities of western Steller sea lions observed in the following fisheries: Bering Sea/Aleutian Islands Atka mackerel trawl, Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Bering Sea/Aleutian Islands pollock trawl, and Gulf of Alaska Pacific cod longline (Table 3).

Observers also monitored the Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording 2 mortalities in 1991, extrapolated to 29 (95% CI: 1-108) kills for the entire fishery (Wynne et al. 1992). No mortalities were observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean kill rate of 14.5 (CV = 1.0) animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The Alaska Peninsula and Aleutian Islands salmon drift gillnet fishery was also monitored during 1990 (roughly 4% observer coverage) and no Steller sea lion mortalities were observed. It is not known whether these incidental mortality levels are representative of the current incidental mortality levels in these fisheries.

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000 in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and 3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly 2006). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly 2006). An observer program conducted for a portion of the Kodiak drift gillnet fishery in 2002 did not observe any serious injuries or mortalities of Steller sea lions, although Steller sea lions were frequently observed in the vicinity of the gear (Manly et al. 2003).

Combining the mortality estimates from the Bering Sea groundfish trawl and Gulf of Alaska longline fisheries presented above (15.1) with the mortality estimate from the Prince William Sound salmon drift gillnet fishery (14.5) results in an estimated mean annual mortality rate in the observed fisheries of 29.6 (CV = 0.49) sea lions per year from this stock (Table 3).

Table 3. Summary of incidental mortality of Steller sea lions (western U. S. stock) due to fisheries from 2007 through 2011 (or most recent data available) and calculation of the mean annual mortality rate (Breiwick 2013). Mean annual mortality in brackets represents a minimum estimate from stranding data. The most recent 5 years of available data, or best available information, are used in the mortality for a particular fishery. N/A indicates that data are not available. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. Atka mackerel trawl	2007 2008 2009 2010 2011	obs data	94 100 99 100 100	0 0 0 1 0	0 0 0 1.0 0	0.20 (CV = 0.05)
Bering Sea/Aleutian Is. flatfish trawl	2007 2008 2009 2010 2011	obs data	72 100 100 100 100	3 (+1)* 11 3 4 (+1)* 7	3.7 (4)** 11.0 3.0 4.0 (5)** 7.0	6.0 (CV = 0.03)
Bering Sea/Aleutian Is. Pacific cod trawl	2007 2008 2009 2010 2011	obs data	53 59 63 66 60	1 (+2)* 0 0 1 1	1.0 (3)** 0 0 1.0 1.0	1.0 (CV = 0.07)
Bering Sea/Aleutian Is. pollock trawl	2007 2008 2009 2010 2011	obs data	85 85 86 86 98	2 8 6 5 9	2.0 (+1)[1] 10.1 6.2 8.2 9.3	7.36 (CV = 0.11)
Gulf of Alaska Pacific cod longline	2007 2008 2009 2010 2011	obs data	20 15 21 28 30	0 1 0 1 0	0 1.6 0 1.1 0	0.54 (CV = 0.39)
Prince William Sound salmon drift gillnet	1990- 1991	obs data	4-5%	0 2	0 29	14.5 (CV = 1.0)
Prince William Sound salmon set gillnet	1990	obs data	3%	0	0	0
Alaska Peninsula/Aleutian Islands salmon drift gillnet	1990	obs data	4%	0	0	0
Cook Inlet salmon set gillnet	1999- 2000	obs data	2-5%	0 0	0, 0	0
Cook Inlet salmon drift gillnet	1999- 2000	obs data	2-5%	0 0	0, 0	0
Kodiak Island salmon set gillnet	2002	obs data	6.0%	0	0	0
Minimum total annual mortality						29.6 (CV = 0.49)

[1] Animal reported to Alaska Regional Office stranding program; however, it was not documented in the Observer Program data. This observation is being added to the estimated mortality since it is not accounted for in the extrapolated value.
*Total mortalities observed in unsampled hauls.
**Total mortalities observed in sampled and unsampled hauls is in parentheses. In cases where the total known mortality exceeds the estimated mortality for a fishery in given year, the sum of observed mortalities (both in sampled and unsampled hauls) will be used as a minimum estimate for that year.

Reports from the NMFS stranding database of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 2007 to 2011, there were four confirmed fishery-related Steller sea lion strandings in the range of the western stock. Two sightings involved a Steller sea lion that was reported to be in bad body condition and observed with a flasher lure hanging from its mouth; it was believed to have ingested the hook (Table 4). One animal was found on a Bering Sea/ Aleutian Islands pollock trawl vessel while offloading the catch, which was not accounted for in the estimated mortality for this fishery, and another with a string leader line hanging out its mouth with a hook apparently inside the mouth. Fishery-related strandings during 2007-2011 result in an estimated annual mortality of 0.8 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported. Steller sea lions reported in the stranding database as shot are not included in this estimate, as they may result from animals struck and lost in the Alaska Native subsistence harvest.

Table 4. Summary of western Steller sea lion mortalities and serious injuries by year and type reported to the NMFS Alaska Regional Office, marine mammal stranding database, for the 2007-2011 period (Allen et al. 2014).

Cause of Injury	2007	2008	2009	2010	2011	Mean Annual Mortality
Swallowed troll gear	0	0	1	0	1	0.4
Caught in BSAI pollock trawl	1	0	0	0	0	0.2
Gaff puncture wound	1	0	0	0	0	0.2
Ring neck entanglement (unknown marine debris / gear)	0	0	0	1	0	0.2
Swallowed unknown fishing gear	0	0	0	1	0	0.2
Minimum total annual mortality						1.0*

*Excludes the 2007 BSAI pollock trawl mortality. This event has been added to data reported in Table 3.

NMFS studies using satellite tracking devices attached to Steller sea lions suggest that they rarely go beyond the U.S. Exclusive Economic Zone into international waters. Given that the high-seas gillnet fisheries have been prohibited and other net fisheries in international waters are minimal, the probability that Steller sea lions are taken incidentally in commercial fisheries in international waters is very low. NMFS concludes that the number of Steller sea lions taken incidental to commercial fisheries in international waters is insignificant.

The minimum estimated mortality rate incidental to U. S. commercial fisheries is 29.6 sea lions per year. Based on observer data (29.6) and stranding data (0.8), the minimum estimated mortality rate incidental to commercial and recreational fisheries is 30.4. Observer data on state fisheries dates as far back as 1990; however, these are the best data available to estimate takes in these fisheries. No observers have been assigned to several fisheries that are known to interact with this stock making the estimated mortality a minimum estimate.

Subsistence/Native Harvest Information

Information on the subsistence harvest of Steller sea lions comes via two sources: the Alaska Department of Fish and Game (ADFG) and the Ecosystem Conservation Office (ECO) of the Aleut Community of St. Paul. The ADFG conducted systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the range of the Steller sea lion in Alaska (Wolfe et al. 2005). The interviews were conducted once per year in the winter (January to March), and covered hunter activities for the previous calendar year. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating an annual mortality estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5-year period available. The ECO collects data on the harvest in near real-time on St. Paul Island, and records hunter activities within 36 hours of the harvest (Zavadil 2010). Information on subsistence harvest levels is provided in Table 5; 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 ADFG (e.g., Wolfe et al. 2005). Data were collected on Alaska Native harvest of Steller sea lions for 7 communities on Kodiak Island for 2011; the Alaska Native Harbor Seal Commission and ADFG 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 2004-2008.

The mean annual subsistence take from this stock over the 5-year period from 2004 through 2008, combined with the mean take over the 2007-2011 period from St. Paul, was 199 Steller sea lions/year (Table 5).

Table 5. Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating an annual mortality estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5-year period available (2007-2011).

	All areas except St. Paul Island			**St. Paul Island**	
Year	**Number harvested**	**Number struck and lost**	**Total**	**Number harvested + struck and lost**	**Total take**
2004	136.8	49.1	185.9[1]		
2005	153.2	27.6	180.8[2]		
2006	114.3	33.1	147.4[3]		
2007	165.7	45.2	210.9[4]	34[8]	245
2008	114.7	21.6	136.3[5]	22[9]	158
2009	N/A	N/A	N/A	26[10]	N/A
2010	N/A	N/A	N/A	20[9]	N/A
2011	N/A	N/A	N/A	32[10]	N/A
Mean annual take	136.9	35.3	172.3	26.8	199

[1]Wolfe et al. 2005; [2]Wolfe et al. 2006; [3]Wolfe et al. 2008; [4]Wolfe et al. 2009a; [5]Wolfe et al. 2009b; [8]Lestenkof et al. 2008, [9]Jones 2009, [10]Zavidil 2010, [9]Lestenkof 2011, [10]Lestenkof 2012.

Other Mortality

Reports from the NMFS 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 data. During the 5-year period from 2007 to 2011, one animal possessed a circumferential neck entanglement of unknown marine debris, and presented with a gaff puncture wound (Table 4). The mean annual mortality and serious injury from other sources of human interactions for 2007-2011 is 0.4.

Illegal shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the U.S. Endangered Species Act (ESA) in 1990. Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except for subsistence take by Alaska Natives or where imminently necessary to protect human life). Records from NMFS enforcement indicate that there were two cases of illegal shootings of Steller sea lions in the Kodiak area in 1998, both of which were successfully prosecuted (NMFS, Alaska Enforcement Division). There have been no cases of successfully prosecuted illegal shootings between 1999 and 2003 (NMFS, Alaska Enforcement Division).

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2006-2010, there was a total of 0 mortalities resulting from research on the western stock of Steller sea lions (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

The current annual level of incidental U. S. commercial fishery-related mortality (29.6) exceeds 10% of the PBR (27) 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 (29.6 [commercial fisheries] + 0.8 [unknown fisheries] + 199 [Alaska Native harvest] + 0.4 [other human-interaction] = 229.8) is below the PBR level (274) for this stock. The western U. S. stock of Steller sea lion is currently listed as “endangered” under the ESA, and therefore designated as “depleted” under the MMPA. As a result, the stock is classified as a strategic stock. However, the population previously declined for unknown reasons that are not explained by the level of direct human-caused mortality.

Habitat Concerns

The decline in the western U. S. stock of Steller sea lion caused a change in the listing status of the stock in 1997 from “threatened” to “endangered” under the U. S. Endangered Species Act of 1973. Survey data collected since 2000 indicate that the decline continues in the central and western Aleutian Islands but that regional populations east of Samalga Pass have increased or are stable. Many factors have been suggested as causes of the steep decline observed in the 1980s, (e.g., competitive effects of fishing, environmental change, disease, killer whale predation, incidental take, illegal and legal shooting). Decreases in rates of survival, particularly for juveniles, were associated with the steep 1980s declines (Holmes et al. 2007). Factors causing direct mortality were likely the most important. The slowing of the decline in the 1990s, and the periods of increase and stability observed between 2000 and 2008 were associated with increases in survival of both adults and juveniles, but also with continuation of a chronic decline in reproductive rate that may have been initiated in the early 1980s (Pitcher et al. 1998, Holmes et al. 2007). Nutritional stress related to competition with commercial fisheries or environmental change, along with predation by killer whales, have been identified as potentially important threats to recovery (NMFS 2008). Additional potential threats to Steller sea lion recovery are shown in Table 6.

Table 6. 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	Fritz and Hinckley 2005, Trites and Donnelly 2003
Competition with fisheries	Potentially high	Dillingham et al. 2006, Fritz and Brown 2005, Hennen 2004, Fritz and Ferrero 1998
Predation by killer whales	Potentially high	DeMaster et al. 2006, Trites et al. 2007, Williams et al. 2004, Springer et al. 2003
Toxic substances	Medium	Albers and Loughlin 2003, Lee et al. 1996, Calkins et al. 1994
Incidental take by fisheries	Low	Perez 2006, Nikulin and Burkanov 2000, Wynne et al. 1992
Subsistence harvest	Low	Wolfe et al. 2005, Loughlin and York 2000, Haynes and Mishler 1991
Illegal shooting	Low	NMFS 2001, Loughlin and York 2000
Entanglement in marine debris	Low	Calkins 1985
Disease and parasitism	Low	Burek et al. 2005
Disturbance from vessel traffic and tourism	Low	Kucey and Trites 2006
Disturbance or mortality due to research activities	Low	Atkinson et al. 2008, Kucey and Trites 2006, Kucey 2005, Loughlin and York 2000, Calkins and Pitcher 1982

A number of management actions were implemented between 1990 and 1998 to promote the recovery of the western U. S. stock of Steller sea lions, including 3 nautical mile (nmi) no-entry zones around rookeries, prohibition of groundfish trawling within 10-20 nmi of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock and Aleutian Island Atka mackerel total allowable catch. In 2000, NMFS issued a Biological Opinion (BO) on effects of the groundfish fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska regions on listed species. In this BO, NMFS determined that the continued prosecution of the groundfish fisheries as described in the Fishery Management Plan for Bering Sea/Aleutian Islands Groundfish and in the Fishery Management Plan for Gulf of Alaska Groundfish was likely to jeopardize the continued existence of the western population of Steller sea lion and to adversely modify critical habitat. NMFS also identified several other factors that could contribute to the decline of the population, including a shift in the large-scale weather regime and predation. To avoid jeopardy, NMFS identified a Reasonable and Prudent Alternative that included components such as 1) adoption of a more precautionary rule for setting “global” harvest limits, 2) extension of 3 nmi protective zones around rookeries and haulouts not currently protected, 3) closures of many areas around rookeries and haulouts to 20 nmi, 4) establishment of four seasonal and area catch limits, and 5) establishment of a procedure (“fishing in proportion to biomass”) for setting seasonal catch limits on removal levels in critical habitat based on the biomass of the target species residing in critical habitat.

In 2001, NMFS developed a programmatic SEIS to consider the impacts on Steller sea lions of different management regimes for the Alaska groundfish fisheries. A committee composed of 21 members from fishing groups, processor groups, Alaska communities, environmental advocacy groups, and NMFS representatives met to recommend conservation measures for Steller sea lions and to develop a "preferred alternative" for the SEIS. Although consensus was not reached, a "preferred alternative" was identified and included in the SEIS. The preferred alternative included complicated, area-specific management measures (e.g., area restrictions and closures) designed to reduce direct and indirect interactions between the Atka mackerel, pollock, and Pacific cod fisheries and Steller sea lions, particularly in waters within 10 nmi of haulouts and rookeries. The suite of conservation measures, which were implemented in 2002, were developed after working with the: 1) State of Alaska to explore whether there are potential adverse effects of state fisheries on Steller sea lions, and 2) the North Pacific Fishery Management Council (Council) to further minimize overcapitalization of fisheries and concentration of fisheries in time and space. The 2002 suite of conservation measures also removed the broad prohibition of fishing with trawl gear within 10 (or 20) nmi of rookeries in the western stock in U.S. waters, and did not apply the “fishing in proportion to biomass” procedure for regulating seasonal catch for the three Steller sea lion prey species in the same manner as was initially applied in the 2000 BO. All Steller sea lion-fishery management measures were reviewed in a programmatic, status quo ESA Biological Opinion on the effects of groundfish fisheries on listed species released in December 2010 (NMFS 2010). NMFS concluded that the groundfish fisheries in the Bering Sea/Aleutian Islands area and in the Gulf of Alaska, as managed in 2010 were likely to jeopardize the continued existence (recovery) and adversely modify the critical habitat of the western stock of Steller sea lion. In 2011, NMFS implemented interim final measures (reasonable and prudent alternatives to the status quo suite of fishery management regulations) that mitigate jeopardy and adverse modification: closure of the western Aleutian Islands region (170°-177°E) to directed fishing for Atka mackerel and Pacific cod, and additional measures in the central Aleutian Islands (170°W-177°E) to reduce catches of Atka mackerel and Pacific cod in critical habitat and disperse the fisheries temporally and spatially. The state of Alaska, along with some members of the groundfish fishing industry, challenged the conclusions of the 2010 Biological Opinion, the rationale for the measures enacted as part of the interim final rule (IFR), and the process that NMFS undertook to follow the National Environmental Policy Act (NEPA). The Court rejected the plaintiffs’ ESA claims (upheld the 2010 Biological Opinion), but granted a summary judgment on their NEPA claims, requiring NMFS to complete an Environmental Impact Statement (EIS) by March 2014 that will consider alternatives to the IFR measures that will also mitigate jeopardy and adverse modification. NMFS, in collaboration with its partners at the North Pacific Fishery Management Council, is currently (in 2013) preparing an EIS for Steller sea lion protective measures in the Aleutian Islands, as well as a new ESA Biological Opinion that will also be finalized by March 2014. Any changes to Aleutian Island groundfish fishery regulations to manage fishery-Steller sea lion interactions would be enacted no sooner than January 2015.

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