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STELLER SEA LION (*Eumetopias jubatus*): Eastern U. S. Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. 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. 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) appears low, although males have a higher tendency to disperse than females (NMFS 1995, Trujillo et al. 2004, Hoffman et al. 2006). A northward shift in the overall breeding distribution has occurred, with a contraction of the range in southern California and new rookeries established in southeastern Alaska (Pitcher et al. 2007).

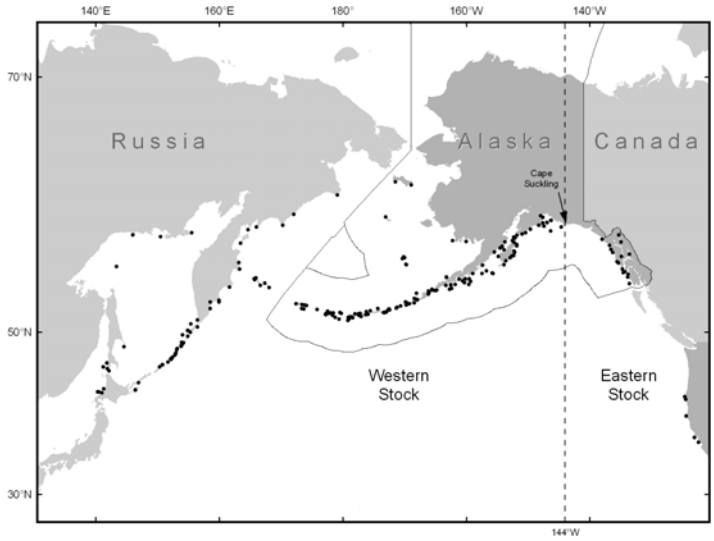

Figure 3. Approximate distribution of Steller sea lions in the North Pacific. Major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993) and active Asian haulouts and rookeries (Burkanov and Loughlin, 2005) are depicted (points). Black dashed line (144° W) indicates stock boundary (Loughlin 1997). Note: Haulouts and rookeries in British Columbia are not shown.

Loughlin (1997) considered the following information when classifying stock structure based upon the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: 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 (144EW), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 3).

Steller sea lions that breed in Asia have been considered part of the western stock since the two stocks were first delineated in 1997. Since then, analyses of genetic data differ in their interpretation of separation between Asian and Alaskan sea lions. In Asian waters, Steller sea lions seasonally inhabit coastal waters of Japan in the winter, but breeding rookeries are currently only located in Russia (Burkanov and Loughlin, 2005). Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split that includes Commander Island (Russia) within the western U.S. stock. However, Hoffman et al. (2006) did not support this split based on analysis of nuclear microsatellite markers indicating high rates of male gene flow. While all genetic analyses confirm a strong separation between western and eastern stocks, recent work indicates that western stock haplotypes are present in southeast Alaska rookeries (Gelatt et al. 2007).

POPULATION SIZE

The eastern stock of Steller sea lions breeds on rookeries located in southeast Alaska, British Columbia, Oregon, and California; there are no rookeries located in Washington. Counts of pups on rookeries conducted near the end of the birthing season are nearly complete counts of pup production. Calkins and Pitcher (1982) and Pitcher el al. (2007) concluded that the total Steller sea lion population could be estimated by multiplying pup counts by a factor based on the birth rate, sex and age structure, and growth rate of the Steller sea lion population. Using the

most recent 2002-2005 pup counts available by region from aerial surveys across the range of the eastern stock (total N=10,737), the total population of the eastern stock of Steller sea lions is estimated to be within the range of 45,095 to 55,832. This range is based on multiplying the total number of pups counted in southeast Alaska (5,510 in 2005; NMFS 2008), British Columbia (3,281 in 2002; Olesiuk and Trites 2003), Oregon (1,128 in 2002; NMFS, 2008), and California (818 in 2004; NMFS 2008) by either 4.2 or 5.2 (Pitcher et al. 2007). Using these pup multipliers, the population estimate is estimated to be within the range of 45,095 (10,737 × 4.2) and 55,832 (10,737 × 5.2). These are not minimum population estimates, since they are extrapolated from pup counts from photographs taken in 2002-2005, and demographic parameters estimated for an increasing (at 3.1% per year) eastern Steller sea lion population in equilibrium. The extrapolation factor varied depending on the vital rate parameter that resulted in the increased growth rate: as low as 4.2 if it were due to increased fecundity, and as high as 5.2 if it were due to decreased juvenile mortality. Pitcher et al. (2007) estimated the eastern stock of Steller sea lion to number between 46,000 and 58,000 in 2002 using this same method, but estimated a slightly higher population range because they estimated true fecundity by accounting for pup mortality between birth and when counts were made at approximately 1 month of age.

Minimum Population Estimate

The minimum population estimate was calculated by adding the most recent non-pup and pup counts from each trend site listed in Table 3c.

Table 3c. Non-pup and pup counts from rookery and haulout trend sites of eastern U.S. Steller sea lions. The most recent counts for each site were used to calculate the minimum population estimate.

Trend site	Year	Non-pups	Pups	Total count per site
Southeast Alaska	2005	15,283	5,510	20,793
British Columbia	2002	12,121	3,281	15,402
Washington (Pitcher et al., 2007)	2001	516	--	516
Oregon	2002	4,169	1,128	5,297
California	2004	1,578	818	2,396
Minimum population estimate				44,404

This results in an N_{MIN} for the eastern U. S. stock of Steller sea lions of 44,404. This count has not been corrected for animals which were at sea. Pitcher et al. (2007) counted 45,378 sea lions during the 2002 survey, which represents a minimum population size because not every site was surveyed and animals missing from rookeries and haulout sites were not counted. More recent counts from Southeast Alaska and California sites were used in place of the Pitcher et al. (2007) counts to calculate N_{MIN}.

Current Population Trend

Trend counts (an index to examine population trends) for Steller sea lions in Oregon were relatively stable in the 1980s, with uncorrected counts in the range of 2,000-3,000 sea lions (NMFS 1992). Counts in Oregon have shown a gradual increase since 1976, as the adult and juvenile state-wide count for that year was 1,486 compared to 4,169 in 2002 (NMFS 2008).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 4,000 and 6,000 non-pups with no apparent trend, but have subsequently declined by over 50%, remaining between 1,500 and 2,000 non-pups between 1980 and 2004. At Año Nuevo Island off central California, a steady decline in ground counts started around 1970, resulting in an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable or increasing slowly since the 1980s (Table 4, Fig. 4).

Table 4. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the eastern U. S. stock from 1982 through 2002 (NMFS 1995; Strick et al. 1997; Sease et al. 1999; Sease and Loughlin 1999; Sease et al. 2001; Olesiuk 2003; Brown et al. 2002; NMFS 2008; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970). Central California data include only Año Nuevo and Farallon Islands. Trend site counts in northern California/Oregon include St. George, Rogue, and Orford Reefs. British Columbia data include counts from all sites.

Area	1982	1990	1991	1992	1994	1996	1998	2000	2002
Central CA	511[1]	655	537	276	508	382	564[3]	349	380
Northern CA/OR	3,094	3,088	3,180	4,274	3,831	4,192	4,464	3,793	4,885
British Columbia	4,713	6,109[2]	--	7,376	8,091	--	9,818	--	12,121
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,892	9,951
Total	15,216	17,481	--	19,481	21,431	--	23,539	--	27,337

[1] This count includes a 1983 count from Año Nuevo.
[2] This count was conducted in 1987.
[3] This count was conducted in 1999.

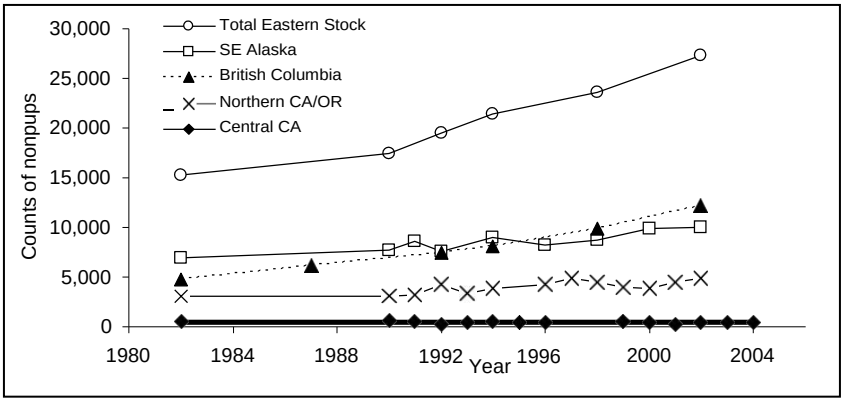

Figure 4. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U.S. stock, 1982-2004. Data from British Columbia include all sites.

In Southeast Alaska, counts of non-pups at trend sites increased by 56% from 1979 to 2002 from 6,376 to 9,951 (Merrick et al. 1992; Sease et al. 2001; NMFS 2008). NMFS conducted an aerial survey of Southeast Alaska in early June 2008 and counted only 8,748 non-pups on trend sites (Fritz et al. 2008). It is thought that the lower than expected count in Southeast Alaska may have been due to movement of animals early in the survey period (early June to early July) to the Prince William Sound region, since counts of non-pups there were over 1,300 more than in 2007. During 1979-2005, counts of pups on the three largest rookeries in Southeast Alaska increased a total of 148%. In British Columbia, counts of non-pups throughout the Province increased at a rate of 3.2% annually from 1971 through 2002 (Olesiuk and Trites 2003). Counts of non-pups at trend sites throughout the range of the eastern Steller sea lion stock are shown in Figure 4. Since the 1970s the average annual population growth rate of Eastern Steller sea lions is 3.1% (Pitcher et al. 2007).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rates for Steller sea lions. Pitcher et al. (2007) observed a rate of population increase of 3.1% per year for the eastern stock of Steller sea lions, but concluded this rate did not represent a maximum rate of increase. Thus in the absence of published data to the contrary, NMFS will continue to use the default value. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The default recovery factor (F_R) for stocks listed as "threatened" under the Endangered Species Act (ESA) is 0.5 (Wade and Angliss 1997). However, as total population estimates for the eastern U. S. stock have remained stable or increased over the last 20 years, the recovery factor is set at 0.75; midway between 0.5 (recovery factor for a "threatened" stock) and 1.0 (recovery factor for a stock within its optimal sustainable population level). This approach is consistent with recommendations of

the Alaska Scientific Review Group. Thus, for the eastern U. S. stock of Steller sea lions, PBR = 1,998 animals (44,404 H 0.06 H 0.75).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2003, there were six different federally regulated commercial fisheries in Alaska that could have interacted with Steller sea lions and 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.

Fishery observers monitored four commercial fisheries during the period from 1990 to 2005 in which Steller sea lions from this stock were taken incidentally: the California (CA)/Oregon (OR) thresher shark and swordfish drift gillnet, WA/OR/CA groundfish trawl, Northern Washington (WA) marine set gillnet, and Gulf of Alaska sablefish longline fisheries. The best data available on the rates of serious injury and mortality incidental to these fisheries is presented in Table 5. There have been no observed serious injuries or mortalities incidental to the CA/OR thresher shark and swordfish drift gillnet fishery in recent years (Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). In the WA/OR/CA groundfish trawl (Pacific whiting component only) one Steller sea lion was observed killed in each year in 2001-03; these observed takes in combination with a mortality that occurred in an unmonitored haul resulted in a mean estimated annual mortality level of 0.8 (Table 5). No data are available after 1998 for the northern Washington marine set gillnet fishery. There have been no observer reported mortalities in the Gulf of Alaska sablefish longline since 2000 (Perez unpubl. ms.). These mortalities result in a mean annual mortality rate of 0.8 (CV = 0.02) Steller sea lions. No mortalities were reported by fishery observers monitoring drift gillnet and set gillnet fisheries in Washington and Oregon this decade; though, mortalities have been reported in the past.

Table 5. Summary of incidental mortality of Steller sea lions (eastern U. S. stock) due to commercial fisheries from 2001 to 2005 (or most recent data available) and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. The most recent 5 years of available data are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. N/A indicates that data are not available. 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
WA/OR/CA groundfish trawl (Pacific whiting component)	2000 2001 2002 2003 2004	Obs data	80.3 96.2 66.8 85.5 91.5	0 1 1 1 0	1[1] 1 1 1 0	0.8 (CV = 0.02)
Observer program total						0.8 (CV = 0.02)
				Reported mortalities		
Alaska salmon troll	1992-2005	Strand data	N/A	0, 0, 0, 1, 0, 0, N/A, N/A, 1, 1, N/A, N/A, 2, N/A	N/A	[□0.6]
British Columbia aquaculture predator control program	2001 2002 2003 2004 2005	Permit reports	N/A	27 15 N/A[2] N/A[2] N/A[2]	N/A	0

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Minimum total annual mortality						1.4 (CV = 0.58)

[1] A mortality was seen by an observer, but during an unmonitored haul; because the haul was not monitored, an estimated annual mortality cannot be extrapolated.
[2] Aquaculture facilities are no longer permitted to shoot Steller sea lions.

Strandings of Steller sea lions provide additional information on the level of fishery-related mortality. Estimates of fishery-related mortality from stranding data are considered minimum estimates because not all entangled animals strand, and not all stranded animals are found or reported. In Alaska, during the 5-year period from 2001-2005, there were three situations where a flasher was seen in a Steller sea lion's mouth (NMFS Alaska Region, unpublished data). It is not clear whether entanglements with "flashers" involved the recreational or commercial component of the salmon troll fishery. Based on Angliss and DeMaster (1998), it is appropriate to call these entanglements "serious injuries". Based on Alaska stranding records, this information indicates a rate of incidental mortality of at least 0.6/year from the troll fishery. There were no fishery-related strandings of Steller sea lions in Washington, Oregon, or California between 2001 and 2005.

Due to limited observer program coverage, no data exist on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to take Steller sea lions). As a result, the number of Steller sea lions taken in Canadian waters is not known.

The minimum estimated mortality rate incidental to commercial fisheries (both U.S. and Canadian) is 1.4 sea lions per year, based on observer data (0.8) and stranding data (0.6).

Subsistence/Native Harvest Information

The subsistence harvest of Steller sea lions during 2003-2007 is summarized in Wolfe et al. (2008). During each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. Approximately 16 of the interviewed communities lie within the range of the eastern U.S. stock. The average number of animals harvested and struck but lost is 11 animals/year (Table 6).

An unknown number of Steller sea lions from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small. Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on the cooperative management process.

Table 6. Summary of the subsistence harvest data for the eastern stock of Steller sea lions, 2003-2007.

Year	Estimated total number taken	Number harvested	Number struck and lost
2003	7[1]	2	5
2004	12[2]	5	7
2005	19[3]	0	19
2006	12.6[4]	2.5	10.1
2007	6.1[5]	0	6.1
Mean annual take (2003-2007)	11.3	1.9	9.4

[1] Wolfe et al. 2004; [2] Wolfe et al. 2005; [3] Wolfe et al. 2006; [4] Wolfe et al. 2008; [5] J. Fall pers. comm., ADFG, 13 Jan 2009.

Other Mortality

Illegal shooting of sea lions in U.S. waters was thought to be a potentially significant source of mortality prior to the listing of sea lions as "threatened" under the ESA in 1990. 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 hunting 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 Southeast Alaska between 1995 and 1999: the cases involved the illegal shooting of one Steller sea lion near Sitka, and three Steller sea lions in Petersburg. Both cases were successfully prosecuted (NMFS, Alaska

Enforcement Division). There are no records of illegal shooting of Steller sea lions from the eastern stock listed in the NMFS enforcement records for 1999-2003 (NMFS, unpublished data).

Steller sea lions were taken in British Columbia during commercial salmon farming operations (Table 5). Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 45.75 Steller sea lions from this stock over the period from 1999 to 2003 (Olesiuk 2004). As of 2004, aquaculture facilities are no longer permitted to shoot Steller sea lions (P. Olesiuk, Pacific Biological Station, Canada, pers. comm.).

Strandings of Steller sea lions with gunshot wounds do occur, along with strandings of animals entangled in material that is not fishery-related. During the period from 2001 to 2005 strandings of animals with gunshot wounds from this stock occurred in Oregon and Washington (one in 2004 and three in 2005) resulting in an estimated annual mortality of 0.8 Steller sea lions from this stock. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). In addition, human-related stranding data are not available for British Columbia. Reports of stranded animals in Alaska with gunshot wounds have not been included in the above estimates because it is not possible to tell whether the animal was illegally shot or if the animal was struck and lost by subsistence hunters (in which case the mortality would have been legal and accounted for in the subsistence harvest estimate).

Stranding data may also provide information on additional sources of potential human-related mortality. Between 2001 and 2005 there were three reported non-fishery related serious injuries or mortalities to Steller sea lions in Washington and Oregon: one with a head injury (2001), one with a piece of cargo net around its neck (2003), and one mortality due to blunt trauma (2004). If the number of interactions (3) is averaged over 5 years, the "other" interaction rate would be a minimum of 0.6 animals per year.

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 2003-2007, there were a total of 9 incidental mortalities resulting from research on the eastern stock of Steller sea lions, which results in an annual average of 1.8 mortalities per year from this stock (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

Based on currently available data, the minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock (0.8 + 0.6 = 1.4) is less than that 10% of the calculated PBR (200) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury (1.4 + 11 + 0.8 + 0.6 + 1.8 = 15.6) does not exceed the PBR (1998) for this stock. The eastern U.S. stock of Steller sea lion is currently listed as "threatened" under the ESA, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. The eastern stock of Steller sea lion has been proposed as a candidate for removal from listing under the ESA by the Steller sea lion recovery team and NMFS (NMFS 2008), based on its annual rate of increase of approximately 3% since the mid-1970s. Although the stock size has increased, the status of this stock relative to its Optimum Sustainable Population size is unknown. The overall annual rate of increase of 3.1% throughout most of the range (Oregon to southeastern Alaska) of the eastern U. S. stock has been consistent and long-term, and may indicate that this stock is reaching OSP size (Pitcher et al. 2007).

Habitat Concerns

Unlike the observed decline in the western U. S. stock of Steller sea lion there has not been a concomitant decline in the eastern U. S. stock. The eastern U. S. stock is increasing throughout the northern portion of its range (Southeast Alaska and British Columbia), and is stable or increasing slowly in the central (Oregon through central California). In the southern end of its range (Channel Islands in southern California), it has declined considerably since the late 1930s, and several rookeries and haulouts south of Año Nuevo Island have been abandoned. Changes in the ocean environment, particularly warmer temperatures, may be possible factors that have favored California sea lions over Steller sea lions in the southern portion of the Steller's range (NMFS 2008). A Revised Recovery Plan reviewing current threats to the eastern and western U.S. stocks and proposing actions and guidelines for recovery was released by NMFS in March 2008 (NMFS 2008).

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