Revised 4/21/01

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, 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 (NMFS 1995); however, resighting data from branded animals have not yet been analyzed.

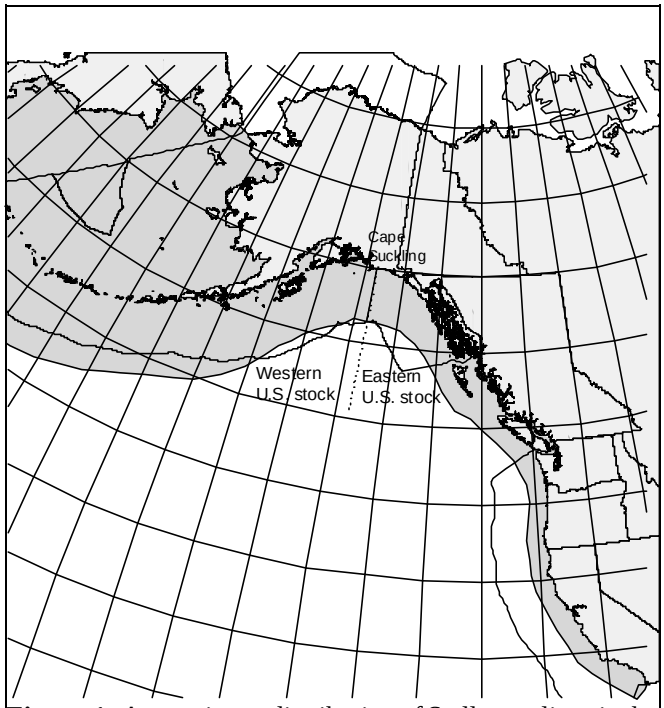

Figure 1. Approximate distribution of Steller sea lions in the eastern North Pacific (shaded area).

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 are now 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).

POPULATION SIZE

The most recent comprehensive estimate (pups and non-pups) of Steller sea lion abundance in Alaska is based on aerial surveys and ground based pup counts in June and July 1998 from Southeast Alaska to the western Aleutian Islands (Sease and Loughlin 1999). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites in Alaska. During the 1998 survey, a total of 28,658 non-pups were counted; 12,299 in the Gulf of Alaska and 16,359 in the Bering Sea/Aleutian Islands (Sease and Loughlin 1999). Note that the 1998 counts for the Gulf of Alaska (12,299) were incomplete because only three of the 25 sites in the eastern Gulf of Alaska were surveyed during 1998. These three sites, however, are major rookeries and included a majority of the animals counted in the eastern Gulf subarea during the 1994 and 1996 surveys (52% and 60%, respectively). The 22 remaining sites were surveyed in 1999 and 757 animals were counted (NMFS, unpublished data). The pup counts were conducted at all known rookeries for this stock during 1998. There were 4,058 pups counted in the Gulf of Alaska and 5,315 pups counted in the Bering Sea/Aleutian Islands for a total of 9,373 for the stock. Combining the pup count data from 1998 (9,373), non-pup count data from 1998 (28,658), and estimate for unsurveyed sites from 1999 (757) results in a minimum abundance estimate of 38,788 Steller sea lions in the western U. S. stock in 1998.

Surveys of all non-pup trend sites, haulout sites, and rookeries were conducted during 2000. During the 2000 survey, a total of 25,227 non-pups were counted; 11,562 in the Gulf of Alaska and 13,665 in the Bering Sea/Aleutian Islands. The best available population estimate for the western stock of Steller sea lions is the sum of the total number

of non-pups counted in 2000 (25,277) and the number of pups counted in 1998 (9,373). Thus, the best available count is 34,600.

Minimum Population Estimate

The 2000 count of non-pups (25,227) plus the number of pups in 1998 (9,373) is 34,600, which will be used as the minimum population estimate (N_{MIN}) for the western U. S. 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 which were at sea during the surveys.

Current Population Trend

The first reported trend counts (an index 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 factors 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 indicated about 110,000 sea lions (no correction factors applied, Table 1). The decline appears to have spread eastward to the Kodiak Island area 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). The greatest declines since the 1970s occurred in the eastern Aleutian Islands and western Gulf of Alaska, but declines also occurred in the central Gulf of Alaska and central Aleutian Islands. More recently, counts of Steller sea lions at trend sites for the western U. S. stock decreased 40% from 1990 to 2000 (Table 1). Counts at trend sites during 2000 indicate that the number of sea lions in the Bering Sea/Aleutian Islands region has declined 9.8% between 1998 and 2000.

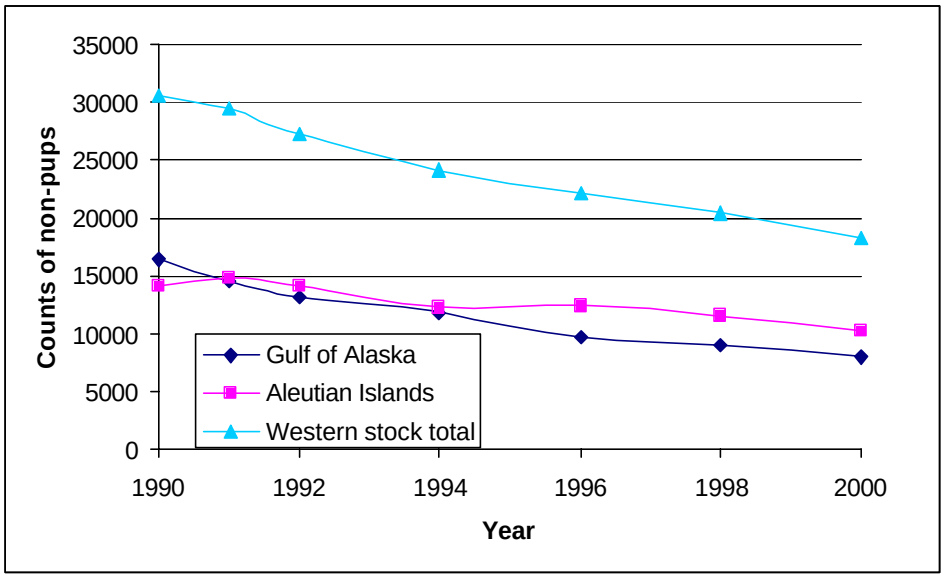

Figure 2. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U.S. stock, 1990-2000.

Table 1. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the western U. S. stock from the late 1970s through 1998 (NMFS 1995, Strick et al. 1997, Sease et al. 1999, Sease and Loughlin 1999). Counts from 1976-79 (NMFS 1995) were combined to produce complete regional counts which are comparable to the 1990-98 data. The asterisk identifies counts in 1998 that include an estimate of 500 non-pups for 6 unsurveyed trend sites in the eastern Gulf of Alaska.

Area	late 1970s	1990	1991	1992	1994	1996	1998	2000
Gulf of Alaska	65,296	16,409	14,603	13,179	11,871	9,789	8,680*	7,853
Bering Sea/Aleutians	44,584	14,116	14,815	14,107	12,248	12,434	11,521	10,340

Area	late 1970s	1990	1991	1992	1994	1996	1998	2000
Total	109,880	30,525	29,418	27,286	24,119	22,223	20,201*	18,193

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. However, it should be noted that the PBR management approach was developed with the understanding that direct human-related mortalities would be the primary reason for observed declines in abundance for marine mammal stocks in U. S. waters. For at least this stock, this assumption seems unwarranted. 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 western U. S. stock of Steller sea lions, PBR = 208 animals (34,600 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries operating within the range of the western U. S. stock of Steller sea lions were monitored for incidental take by fishery observers during 1990-99: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No sea lion mortality was observed by fishery observers in either pot fishery since 1990, nor in the BSAI longline fisheries during the past 5 years. For the fisheries with observed takes, the range of observer coverage over the 9-year period, as well as the annual observed and estimated mortalities, are presented in Table 2a. The mean annual (total) mortality for the most recent 5-year period was 7.0 (CV = 0.21) for the Bering Sea groundfish trawl fishery, 0.6 (CV = 0.6) for the Gulf of Alaska groundfish trawl fishery, and 0.8 (CV = 1.0) for the Gulf of Alaska groundfish longline fishery. In 1996 (66% observer coverage), only 2 of the 4 observed mortalities in the Bering Sea trawl fishery occurred during monitored hauls, leading to an underestimate (3) of the extrapolated mortality for that fishery. As a result, 4 mortalities were used as both the observed and estimated mortalities for that year (Table 2a). The observed mortality in the 1993 Bering Sea longline fishery (30% observer coverage) also occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1993 for that fishery, and should be considered a minimum estimate.

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.

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. The observer coverage during both years was approximately 2-5%; precise coverage figures will be available when the contract report is provided to NMFS in 2001. There were no mortalities of marine mammals observed in either 1999 or 2000 (NMFS, unpublished data). Because information from observer programs is substantially more reliable than information from self-reported data, NMFS has removed the reference

to self-reported data for these fisheries from Table 2b and will rely on the 1999/2000 observer program data as an accurate reflection of the level of Steller sea lion mortality in this fishery.

Combining the mortality estimates from the Bering Sea and Gulf of Alaska groundfish trawl and Gulf of Alaska longline fisheries presented above (7.0+0.6+0.8 = 8.4) 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 22 (CV = 0.6) sea lions per year from this stock.

Table 2a. Summary of incidental mortality of Steller sea lions (western U. S. stock) due to commercial fisheries from 1990 through 1998 (1999, when available) and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1995 to 1999 (or 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. * Data from the 1999 Cook Inlet observer program are preliminary.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-99	obs data	53-74%	13, 13, 15, 4, 9, 2, 4, 6, 6, 8	13, 19, 21, 6, 11, 3, 4, 10, 9, 9	7.0 (CV = 0.21)
Gulf of Alaska (GOA) groundfish trawl	90-99	obs data	33-55%	2, 0, 0, 1, 1, 0, 0, 0, 1, 0	4, 0, 0, 3, 3, 0, 0, 0, 3, 0	0.6 (CV = 0.6)
GOA groundfish longline (incl. misc. finfish and sablefish fisheries)	90-98	obs data	8-21%	1, 0, 0, 0, 0, 1, 0, 0, 0, 0	2, 0, 0, 0, 1, 4, 0, 0, 0, 0	0.8 (CV = 1.0)
Prince William Sound salmon drift gillnet	90-91	obs data	4-5%	0, 2	0, 29	14.5 (CV = 1.0)
Prince William Sound salmon set gillnet	90	obs data	3%	0	0	0
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90	obs data	4%	0	0	0
Cook Inlet salmon set gillnet*	99	obs data	2-5%	0	0	0
Cook Inlet salmon drift gillnet*	99	obs data	2-5%	0	0	0
Observer program total						22.9 (CV = 0.64)
				Reported mortalities		

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Alaska Peninsula/Aleutian Islands salmon set gillnet	90-98	self reports	n/a	0, 1, 1, 1, n/a n/a, n/a, n/a	n/a	[$0.75]
Bristol Bay salmon drift gillnet	90-98	self reports	n/a	0, 4, 2, 8, n/a n/a, n/a, n/a, n/a	n/a	[$3.5]
Prince William Sound set gillnet	90-98	self reports	n/a	0, 0, 2, 0, n/a n/a, n/a, n/a, n/a	n/a	[$0.5]
Alaska miscellaneous finfish set gillnet	90-98	self reports	n/a	0, 1, 0, 0, n/a n/a, n/a, n/a, n/a	n/a	[$0.25]
Alaska halibut longline (state and federal waters)	90-98	self reports	n/a	0, 0, 0, 0, 1 n/a, n/a, n/a, n/a	n/a	[$0.2]
Alaska sport salmon troll (non-commercial)	93-98	strand	n/a	0, 0, 0, 0, 1, 0	n/a	[$0.2]
Minimum total annual mortality						$28.3 (CV = 0.64)

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishing operations is the self-reported fisheries information required of vessel operators by the MMPA. Some incidental takes of sea lions reported in the Gulf of Alaska fisheries were listed as "unknown species", indicating the animals could have been either Steller or California sea lions. Based on all logbook reports for both species within the Gulf of Alaska, California sea lions represented only 2.2% of all interactions. Thus, the reports of injured and killed "unknown" sea lions were considered to be Steller sea lions. During the period between 1990 and 1998, fisher self-reports from 6 unobserved fisheries (see Table 2a) resulted in an annual mean of 5.7 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reports for Alaska fisheries, except the groundfish trawl and longline fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska, and the Prince William Sound salmon drift gillnet fishery for which observer data were presented above. The Bristol Bay salmon drift gillnet and set gillnet fisheries accounted for the majority of the reported incidental take in unobserved fisheries. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

Strandings 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 1993 to 1997 the only fishery-related Steller sea lion

stranding was reported in August of 1997 in Prince William Sound. The animal had troll gear in its mouth and down its throat (considered a serious injury; see Angliss and DeMaster 1998). It is likely that this mortality occurred as a result of a sport fishery, not a commercial fishery (Table 2a). There was evidence of incidental fishery interactions with two stranded Steller sea lions in 1998; there were no such incidences in 1999. Additional information on the nature of the fishery interactions is not currently available. Fishery-related strandings during 1994-99 result in an estimated annual mortality of 0.6 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.

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 commercial fisheries is 28.3 sea lions per year, based on observer data (22.9) and self-reported fisheries information (5.2) or stranding data (0.2) where observer data were not available. No observers have been assigned to several fisheries that are known to interact with this stock (self-reported data from these fisheries are provided in Table 2a), making the estimated mortality a minimum estimate.

Subsistence/Native Harvest Information

The 1992-96 subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 2b: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997; Wolfe and Hutchinson-Scarbrough, 1999). In 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 43 of the interviewed communities lie within the range of the western U. S. stock. The majority (79%) of sea lions were taken by Aleut hunters in the Aleutian and Pribilof Islands. Details concerning the subsistence harvest of Steller sea lions from the western U. S. stock are provided in Table 2b. The great majority (approximately 99%) of the statewide subsistence take was from the western U. S. stock. The mean annual subsistence take from this stock over the 3-year period from 1993 to 1995 was 412 sea lions. The reported average age-composition of the harvest across all years was 31% adults, 62% juveniles, 3% pups, and 4% unknown age. The reported average sex composition of the harvest was approximately 64% males, 19% females, and 17% of unknown sex. In 1998, an estimate of 171 Steller sea lions were taken, of which approximately 128 were harvested and 43 were struck and lost. The 1993-95 subsistence harvest data were averaged with data from 1998 because 1996 data for Steller sea lion takes for several communities in the Pribilof Islands are in dispute and the 1997 subsistence harvest data were considered preliminary as they have not been reviewed. However, evidence indicates that the harvest levels in 1996 and 1997 were lower than those in 1993-1995. Data were not collected in 1999; however, funds for subsistence monitoring in 2001 were recently provided to the Alaska Department of Fish and Game by the NMFS.

Other Mortality

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 2 cases of illegal shootings of Steller sea lions in the Kodiak area in 1998, both of which were successfully prosecuted (NMFS, Alaska Enforcement Division).

Table 2b. Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions, 1992-98. Brackets indicate that the 1996 data remain in dispute and the 1997 data are preliminary. Subsistence harvest data were not collected in 1999 or 2000.

Year	Estimated total number taken	95% confidence interval	Number harvested	Number struck and lost
1992	549	452-712	370	179

Year	Estimated total number taken	95% confidence interval	Number harvested	Number struck and lost
1993	487	390-629	348	139
1994	416	330-554	336	80
1995	339	258-465	307	32
1996	[179]	[158-219]	[149]	[30]
1997	[164]	[129-227]	[146]	[18]
1998	171	130-246	128	43
Mean annual take (1993-95, 1998)	353			

STATUS OF STOCK

The current annual level of incidental mortality (28.3) exceeds 10% of the PBR (21) 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 (28.3+353 = 381.3) is known to exceed the PBR (208) for this stock. The western U. S. stock of Steller sea lion is also 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, given that the population is declining for unknown reasons that are not explained by the level of direct human-caused mortality, there is no guarantee that limiting those mortalities to the level of the PBR will reverse the decline.

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 (nmi) no-entry zones around rookeries, prohibition of groundfish trawling within 10-20 nautical miles of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock total allowable catch. More recent modifications beginning in 1999 include reductions in removals of Atka mackerel within areas designated as critical habitat in the central and western Aleutian Islands, greater temporal dispersion of the Atka mackerel harvest, further temporal and spatial dispersal of the Bering Sea and Gulf of Alaska pollock fisheries, closure of the Aleutian Islands to pollock trawling, and expansion of the number and extent of buffer zones around sea lion rookeries and haulouts.

Habitat Concerns

The unprecedented decline in the western U. S. stock of Steller sea lion has caused a recent change in the listing status of the stock from "threatened" to" endangered" under the U. S. Endangered Species Act of 1973. There is currently no sign that the population decline has slowed or stopped. Many theories have been suggested as causes of the decline, (overfishing, environmental change, disease, killer whale predation, etc.) but it is not clear what factor or factors are most important in causing the decline. However, competition for food, perhaps in conjunction with commercial fisheries, is a hypothesis currently receiving serious attention.

NMFS developed a Biological Opinion (BO) on the groundfish fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska regions in 2000. 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 is 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 which could contribute to the decline of the population, including a shift in a 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 4 seasonal catch limits inside critical habitat and two seasonal releases outside of critical habitat, and 5) establishment of a procedure for setting limits on removal levels in critical habitat based on the biomass of target species in critical habitat.

In addition, NMFS completed a draft Supplemental Environmental Impact Statement (SEIS) in September 2000 for the groundfish fisheries in the Bering Sea Aleutian Islands and the Gulf of Alaska. Based on the potential for indirect interactions between the groundfish fisheries and Steller sea lions, northern fur seals, and harbor seals, NMFS determined that the current practices involved in the management of the groundfish fishery in Alaska "may have adverse impacts on the western U. S. stock of Steller sea lions, northern fur seals in the Bering Sea, and both the GOA and western stocks of harbor seals". However, the SEIS was determined to be incomplete in a Federal District Court ruling and remanded back to NMFS for further development. NMFS plans to revise the SEIS in 2001.

CITATIONS

Angliss, R. P., and D. P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-13, 48 pp.

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

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

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

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

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

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

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

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

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

Sease, J. L., and T. R. Loughlin. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1997 and 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-100, 61 pp.

Sease, J. L., J. M. Strick, R. L. Merrick, and J. P. Lewis. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-99, 43 pp.

Strick, J. M., L. W. Fritz, and J. P. Lewis. 1997. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-71, 55 pp.

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

Wolfe, R. J., and C. Mishler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 94 pp. + appendices.

Wolfe, R. J., and C. Mishler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 60 pp. + appendices.

Wolfe, R. J., and C. Mishler. 1995. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1994. Final report for year three, subsistence study and monitor system (no. 50ABNF20055). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 69 pp. + appendices.

Wolfe, R. J., and C. Mishler. 1996. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1995. Final report for year four, subsistence study and monitor system (no. 50ABNF400080). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 69 pp. + appendices.

Wolfe, R. J., and C. Mishler. 1997. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1996. Technical Paper 241. Draft Final report for year five, subsistence study and monitor system (no. 50ABNF400080). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 70 pp. + appendices.

Wolfe, R. J., and L. B. Hutchinson-Scarbrough. 1999. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 1998. Technical paper No. 250. Alaska Dept. Fish and Game, Division of Subsistence, Juneau, Alaska.

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

Wynne, K. M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

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