NORTHERN FUR SEAL (*Callorhinus ursinus*): Eastern Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea (Fig. 5) and west to the Okhotsk Sea and Honshu Island, Japan. During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U. S. waters outside of the Pribilof Islands, approximately 1% of the population is found on Bogoslof Island in the southern Bering Sea and on San Miguel Island off southern California (NMFS 1993). Northern fur seals may temporarily haul out onto land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally do so outside of the breeding season (Fiscus 1983).

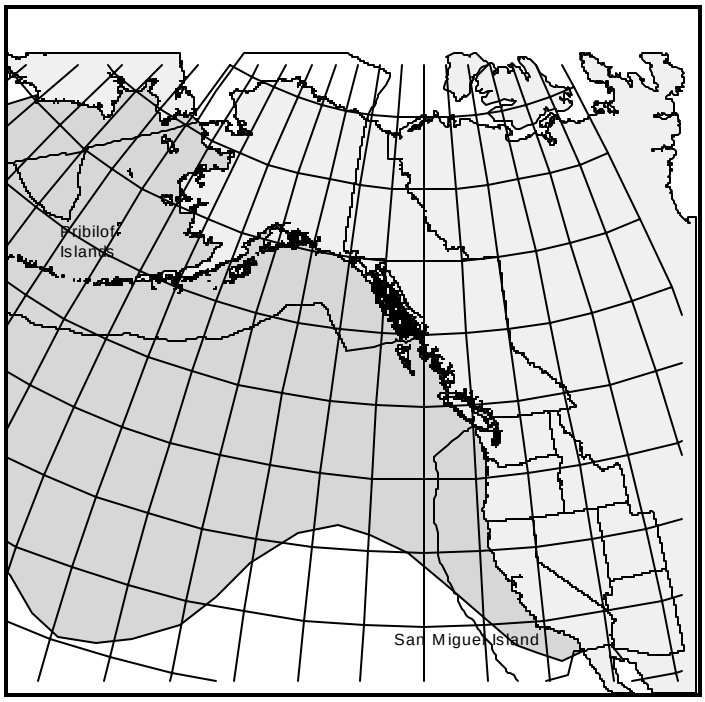

Figure 5. Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping times. Adult males usually occur on shore during the 4-month period from May-August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as 6 months (June-November). Following their respective times ashore, seals of both genders then migrate south and spend the next 7-8 months at sea (Roppel 1984). Adult females and pups from the Pribilof Islands migrate through the Aleutian Islands into the North Pacific Ocean, often to the Oregon and California offshore waters. Many pups may remain at sea for 22 months before returning to their rookery of birth. Adult males generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). There is considerable interchange of individuals between rookeries.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution is continuous during feeding, geographic separation during the breeding season, high natal site fidelity (DeLong 1982); 2) Population response data: substantial differences in population dynamics between Pribilof and San Miguel Islands (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this information, two separate stocks of northern fur seals are recognized within U. S. waters: an Eastern Pacific stock and a San Miguel Island stock. The San Miguel Island stock is reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

The population estimate for the Eastern Pacific stock of northern fur seals is calculated as the estimated number of pups at rookeries multiplied by a series of different expansion factors determined from a life table analysis to estimate the number of yearlings, 2 year olds, 3 year olds, and animals at least 4 years old (Lander 1981). The resulting population estimate is equal to the pup count multiplied by 4.475. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. A preliminary analysis indicated that the dynamics of the population have not changed in the last 15 years, so the 4.475 expansion factor remains appropriate (J. Baker, pers. comm., Southwest Fisheries Science Center, 2570 Dole St., Honolulu, HI 96822). Currently, CVs are unavailable for the expansion

factor. As the great majority of pups are born on the Pribilof Islands, pup estimates are concentrated on these islands, though additional counts are made on Bogoslof Island. Since 1990, pup counts have occurred biennially. In 1992, 1994, and 1996 pup counts on the Pribilof Islands were 219,151 (CV=0.041), 227,239 (CV=0.036) and 210,401 (CV=0.101), respectively (Antonelis et al. 1994, Antonelis et al. 1996, York et al. 1997). The average mean pup count from these three years of Pribilof Islands data is 218,930 (CV=0.065). In 1997, the number of pups born on Bogoslof Island was 5,096 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). Therefore, the most recent estimate for the number of fur seals in the Eastern Pacific stock is approximately 1,002,516 (4.475×[218,930+5,096]).

Minimum Population Estimate

A CV(N) that incorporates the variance due to the correction factor is not currently available. Consistent with a recommendation of the Alaska Scientific Review Group (SAR)and recommendations contained in Wade and Angliss (1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate (N_{MIN}) for this stock (DeMaster 1998). N_{MIN} is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN}= N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 1,002,516 and the default CV (0.2), N_{MIN} for the Eastern Pacific stock of northern fur seals is 848,539.

Current Population Trend

The Alaska population of northern fur seals recovered to approximately 1.25 million in 1974 after the killing of females in the pelagic fur seal harvest was terminated in 1968. The population then began to decrease with pup production declining at a rate of 6.5-7.8% per year into the 1980s (York 1987). By 1983 the total stock estimate was 877,000 (Briggs and Fowler 1984). Annual pup production on St. Paul Island has remained relatively stable since 1981 (Fig. 6a), indicating that stock size has not changed much in recent years (York and Fowler 1992). The 1996 estimate of number of pups born on St. Paul Island is not significantly different from the 1990, 1992, or 1994 estimates (York et al. 1997). The 1996 estimate of number of pups born on St. George Island is the highest since 1985 (Fig. 6b). The northern fur seal was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s and there was no compelling evidence that carrying capacity (K) had changed substantially since the late 1950s (NMFS 1993). Under the Marine Mammal Protection Act (MMPA), this stock will remain listed as depleted until population levels reach at least the lower limit of its optimum sustainable population (estimated at 60% of K).

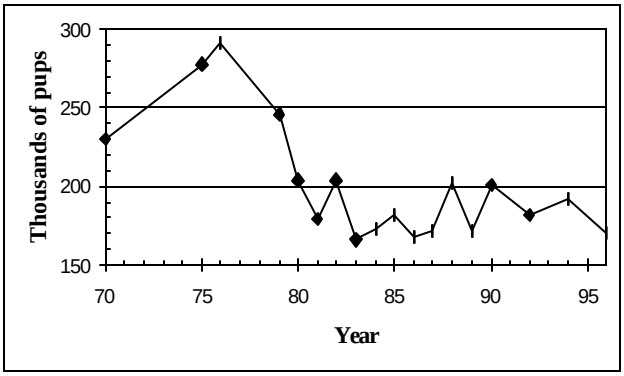

Figure 6a. Production of northern fur seal pups on St. Paul Island, Alaska, 1970-96.

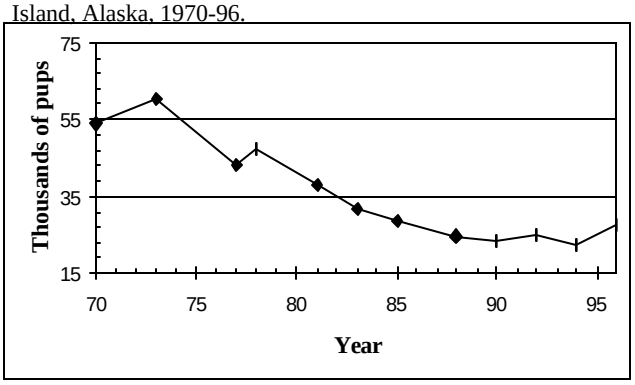

Figure 6b. Production of northern fur seal pups on St. George Island, Alaska, 1970-96.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population increased steadily during 1912-24 after the commercial harvest no longer included pregnant females. During this period, the rate of population growth was approximately 8.6% (SE=1.47) per year (A. York unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.12% rate of increase (approximate SE=1.29) estimated by Gerrodette et al. (1985). Though not

as high as growth rates estimated for other fur seal species, the 8.6% rate of increase is considered a reliable estimate of R_{MAX} given the extremely low density of the population in the early 1900s.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized 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 0.5, the value for depleted stocks under the MMPA (Wade and Angliss 1997). Thus, for the Eastern Pacific stock of northern fur seals, PBR = 18,244 animals (848,539 x 0.043 x 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The NMFS estimate of the total number of northern fur seals killed incidental to both the foreign and the joint U. S.-foreign commercial groundfish trawl fisheries in the North Pacific from 1978 to 1988 was 246 (95% CI: 68 - 567), resulting in an estimated mean annual rate of 22 northern fur seals (Perez and Loughlin 1991). The foreign high seas driftnet fisheries also incidentally killed large numbers of northern fur seals, with an estimated 5,200 (95% CI: 4,500 - 6,000) animals taken during 1991 (Larntz and Garrott 1993). These estimates were not included in the mortality rate calculation because the fisheries are no longer operative. Commercial net fisheries in international waters of the North Pacific Ocean have decreased significantly in recent years. The assumed level of incidental catch of northern fur seals in those fisheries, though unknown, is thought to be minimal (T. Loughlin, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115).

Six different commercial fisheries in Alaska that could have interacted with northern fur seals were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only observed fishery in which incidental mortality occurred was the Bering Sea and Aleutian Islands groundfish trawl (Table 5), with a mean annual (total) mortality of 1.4 (CV=0.43). In 1990 and 1991, observers monitored the Prince William Sound salmon drift gillnet fishery and recorded no mortalities of northern fur seals. 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 (Wynne et al. 1991). 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). During 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). Although no interaction with northern fur seals was recorded by observers in 1990 and 1991 in these fisheries, due in part to the low level of observer coverage, mortalities did occur as recorded in fisher self-reports (see Table 5).

An additional source of information on the number of northern fur seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1998, fisher self-reports from 3 unobserved fisheries (see Table 5) resulted in an annual mean of 14.5 mortalities from interactions with commercial fishing gear. While logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), the bias in these estimates are hard to quantify because at least in one area (Prince William Sound), it is unlikely that fur seals occur and reports of fur seal-fishery interactions are likely the result of species misidentification. The great majority of the incidental take in fisher self-reports occurred in the Bristol Bay salmon drift net fishery. In 1990, self-reports from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the northern fur seal mortalities reported in 1990 may have occurred in the set net fishery. 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 4 for details).

Table 5. Summary of incidental mortality of northern fur seals (Eastern Pacific stock) due to commercial fisheries from 1990 through 1998 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1994 to 1998 (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.

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 Islands groundfish trawl	90-98	obs data	53-74%	0, 3, 4, 1, 2, 0, 1, 0, 0	0, 6, 5, 1, 3, 0, 2, 2, 0	1.4 (CV=0.43)
Observer program total						1.4 (CV=0.43)
				Reported mortalities		
Prince William Sound salmon drift gillnet	90-98	self reports	n/a	1, 1, 0, 0, n/a, n/a, n/a, n/a, n/a	n/a	[$0.5]
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90-98	self reports		2, 0, 0, 0, n/a, n/a, n/a, n/a, n/a	n/a	[$0.5]
Bristol Bay salmon drift gillnet	90-98	self reports	n/a	5, 0, 49, 0, n/a, n/a, n/a, n/a, n/a	n/a	[$13.5]
Minimum total annual mortality						$15.9 (CV=0.43)

No observers have been assigned to several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries is 16 fur seals per year based on observer data (1), and self-reported fisheries information (15) where observer data were not available.

Subsistence/Native Harvest Information

Alaska Natives residing on the Pribilof Islands are allowed an annual subsistence harvest of northern fur seals, with a take range determined from annual household surveys. From 1986 to 1996, the annual subsistence harvest level averaged 1,412 and 193 for St. Paul and St. George Islands, respectively, for a total of 1,605. The subsistence harvest in 1994 was 1,616 and 161 on St. Paul and St. George Islands, respectively, for a total of 1,777. The subsistence harvest in 1995 was 1,265 and 260 on St. Paul and St. George, respectively, for a total of 1,525. The subsistence harvest in 1996 was 1,591 (including 3 females accidentally harvested) and 232 on St. Paul and St. George Islands, respectively, for a total of 1,823. Thus, the mean annual subsistence take of northern fur seals from this stock during the 3-year period from 1994 to 1996 was 1,708 animals. Only juvenile males are taken in the subsistence harvest, which likely results in a much smaller impact on population growth than a harvest of equal proportions of males and females. Subsistence take in areas other than the Pribilof Islands is known to occur, though believed to be minimal (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115).

Other Mortality

Intentional killing of northern fur seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown. Such shooting has been illegal since the species was listed as depleted in 1988. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

Mortality resulting from entanglement in marine debris has been implicated as a contributing factor in the decline observed in the northern fur seal population on the Pribilof Islands during the 1970s and early 1980s (Fowler 1987, Swartzman et al. 1990). Surveys conducted from 1995 to 1997 on St. Paul Island indicate a rate of entanglement among subadult males comparable to the 0.2% rate observed from 1988 to 1992 (Fowler and Ragen 1990, Fowler et al. 1994), which is lower than the rate of entanglement (0.4%) observed during 1976-85 (Fowler et al. 1994). During 1995-97, NMFS researchers in conjunction with members of the Aleut communities of St. Paul and St. George Islands captured and removed entangling debris (including trawl net, packing bands, twine, and miscellaneous items) from 88, 146 and 87 northern fur seals, respectively.

STATUS OF STOCK

Based on currently available data, the minimum estimated fishery mortality and serious injury for this stock (16) is less than 10% of the calculated PBR (1,824) 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 (16 + 1,708 = 1,724) is not known to exceed the PBR (18,244) for this stock. The Eastern Pacific stock of northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA. The Alaska SRG has noted that the multiplier used to convert pup counts to total population size is likely negatively biased and that the estimate of the current population size using the existing multiplier is only marginally less than 60% of the best available estimate of K (DeMaster 1996). Therefore, the Alaska SRG has recommended that the NMFS undertake research to evaluate the degree to which the currently used multiplier may be biased, and if necessary, consider re-evaluating the status of this stock relative to carrying capacity.

Habitat Concerns

Recent rapid development on the Pribilof Islands increases the potential for negatively affecting habitat used by northern fur seals. Associated with the development on the islands comes the nearshore discharge of seafood processing waste, oil and contaminant spills, increased direct human disturbance, and increased levels of noise and olfactory pollution. Preliminary data suggest that the development on St. Paul Island may be impacting fur seal rookeries as pup production has declined on two of the three rookeries in closest proximity to human habitation and to the sewer and processor outfalls. Studies designed to assess the potential impact of human and industrial development on the Pribilofs have been planned.

CITATIONS

Antonelis, G. A., A. E. York, and C. W. Fowler. 1994. Population assessment, Pribilof Islands, Alaska. Pp. 29-47, *In* E. H. Sinclair (ed.), Fur seal investigations, 1992. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-45.

Antonelis, G. A., A. E. York, B. W. Robson, R. G. Towell, and C. W. Fowler. 1996. Population assessment, Pribilof Islands, Alaska. Pp. 9-30, *In* E. H. Sinclair (ed.), Fur seal investigations, 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-69.

Briggs, L., and C. W. Fowler. 1984. Table and figures of the basic population data for northern fur seals of the Pribilof Islands. *In* Background papers submitted by the United States to the 27th annual meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, March 29-April 9, 1984, Moscow, U.S.S.R. (available on request - National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115).

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.

DeLong, R. L. 1982. Population biology of northern fur seals at San Miguel Island, California. Ph.D. dissertation, University of California, Berkeley, CA. 185 pp.

DeLong, R. L., and G. A. Antonelis. 1991. Impacts of the 1982-1983 El Niño on the northern fur seal population at San Miguel Island, California. Pp. 75-83, *In* F. Trillmich and K. Ono (eds.), Pinnipeds and El Niño: responses to environmental stress. University of California Press: Berkeley, CA.

DeMaster, D. P. 1996. Minutes from the 11-13 September 1996 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 20 pp + appendices. (available upon request - D. P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

DeMaster, D. P. 1998. Minutes from sixth meeting of the Alaska Scientific Review Group, 21-23 October 1997, Seattle, Washington. 40 pp. (available upon request - D. P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

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.

Fiscus, C.F. 1983. Fur seals. *In* Background papers submitted by the United States to the 26th annual meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, Washington, D.C., 28 March -5 April, 1983. (available upon request - National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.)

Fowler, C. W. 1987. Marine debris and northern fur seals: A case study. Mar. Poll. Bull. 18:326-335.

Fowler, C. W., and T. J. Ragen. 1990. Entanglement studies, St. Paul Island, 1989; Juvenile male roundups. U.S. Dep. Commer., NWAFC Processed Rep. 90-06, 39 pp. (Available upon request - Alaska Fish. Sci. Cent., NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115).

Fowler, C. W., J. D. Baker, R. Ream, B. W. Robson, and M. Kiyota. 1994. Entanglement studies on juvenile male northern fur seals, St. Paul Island, 1992. Pp. 100-136, *In* Sinclair, E. H. (ed.), Fur seal investigations, 1992, U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-45.

Gerrodette, T., D. Goodman, and J. Barlow. 1985. Confidence limits for population projections when vital rates vary randomly. Fish. Bull. 83:207-217.

Kajimura, H. 1984. Opportunistic feeding of the northern fur seal, *Callorhinus ursinus*, in the eastern North Pacific Ocean and eastern Bering Sea. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-779, 49 pp.

Lander, R. H. 1981. A life table and biomass estimate for Alaskan fur seals. Fish. Res. (Amst.) 1:55-70.

Lander, R. H., and H. Kajimura. 1982. Status of northern fur seals. FAO Fisheries Series 5:319-345.

Larntz, K., and R. Garrott. 1993. Analysis of 1991 bycatch of selected mammal species in the North Pacific neon squid driftnet fishery. Final contract report prepared for the NMFS, 68 pp. + appendices.

National Marine Fisheries Service. 1993. Final Conservation Plan for the northern fur seal (*Callorhinus ursinus*). Prepared by the National Marine Mammal Laboratory/Alaska Fisheries Science Center, Seattle, Washington, and the Office of Protected Resources/National Marine Fisheries Service, Silver Spring, Maryland. 80 pp.

Perez, M. A., and T. R. Loughlin. 1991. Incidental catch of marine mammals by foreign-directed and joint-venture fishing vessels in the U.S. EEZ of the North Pacific, 1973-1988. U.S. Dep. Commer., NOAA Tech. Rep. NMFS-104, 57 pp.

Roppel, A. Y. 1984. Management of northern fur seals on the Pribilof Islands, Alaska, 1786-1981. U.S. Dep. Commer., NOAA Tech. Rep. NMFS-4, 32 pp.

Swartzman, G. L., C. A. Ribic, and C. P. Haung. 1990. Simulating the role of entanglement in northern fur seal, *Callorhinus ursinus*, population dynamics. Pp. 513-530, *In* R. S. Shomura and M. L. Godfrey (eds.), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-154.

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.

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. 1987. Northern fur seal, *Callorhinus ursinus*, eastern Pacific population (Pribilof Islands, Alaska, and San Miguel Island, California). Pp. 9-21, *In* J. P. Croxall and R. L. Gentry (eds.), Status, biology, and ecology of fur seals. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 51.

York, A. E. and C. W. Fowler. 1992. Population assessment, Pribilof Islands, Alaska. Pp. 9-26, *In* H. Kajimura and E. Sinclair (eds.), Fur seal investigations, 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-2.

York, A. E., J. D. Baker, R. G. Towell, and C. W. Fowler. 1997. Population assessment, Pribilof Islands, Alaska. Pp. 9-28, *In* E. H. Sinclair (ed.), Fur seal investigations, 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-87.