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NORTHERN FUR SEAL (*Callorhinus ursinus*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (Fig. 1). As of 2014, the worldwide population size is approximately 1.1 million animals (Gelatt *et al*. 2015). During the breeding season, approximately 45% 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 (Gelatt *et al*. 2015). Of the seals in U.S. waters outside of the Pribilofs, approximately 9% of the population is found on Bogoslof Island in the southern Bering Sea, 1% on San Miguel Island off southern California, and 0.3% on the Farallon Islands off central California (Gelatt *et al*. 2015). Northern fur seals may temporarily haul out on land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally this occurs outside of the breeding season (Fiscus 1983).

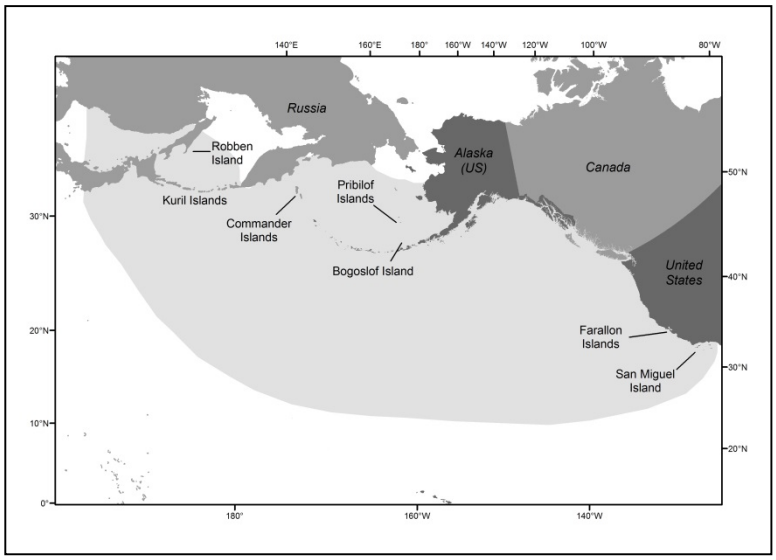

Figure 1. Approximate distribution of northern fur seals in the North Pacific (shaded area).

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping, times. Adult males occur ashore and defend reproductive territories during a 3-month period from June through 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). After their respective times ashore, fur seals of both sexes spend the next 7 to 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 waters off Washington, Oregon, and California. Many pups may remain at sea for 22 months before returning to their natal rookery. Adult females and pups from San Miguel Island and the Farallon Islands migrate northward to these same areas (Lea *et al*. 2009). Adult males from the Pribilof Islands generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). Little is known about where adult males from San Miguel Island and the Farallon Islands migrate.

The following information was considered in classifying stock structure based on the Dizon *et al*. (1992) phylogeographic approach: 1) Distributional data: continuous geographic distribution during feeding, geographic separation during the breeding season, and high natal site fidelity (DeLong 1982); 2) Population response data: substantial differences in population dynamics between the Pribilofs and San Miguel Island (DeLong 1982, DeLong and Antonelis 1991, NMFS 2007); 3) Phenotypic data: unknown; and 4) Genotypic data: little evidence of genetic differentiation among breeding islands (Ream 2002, Dickerson *et al*. 2010). Based on this information, two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a California stock (including San Miguel Island and the Farallon Islands). The Eastern Pacific stock is reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

The population estimate for northern fur seals on San Miguel Island is calculated as the estimated number of pups at rookeries multiplied by an expansion factor. Based on research conducted on the Eastern Pacific stock of northern fur seals, Lander's (1981) life table analysis was used to estimate the number of yearlings, two-year-olds, three-year-olds, and animals at least four years old. The resulting population estimate was equal to the pup count multiplied by 4.475. The expansion factors are based on a sex and age distribution estimated after the commercial harvest of juvenile males was terminated in 1984. A more appropriate expansion factor for San Miguel Island is 4.0,

because immigration of recruitment-aged females is occurring in the population (DeLong 1982), as well as mortality and possible emigration of adults associated with the El Niño events in 1982-1983 and 1997-1998 (Melin *et al*. 2008). A 1998 pup count resulted in an 80% decrease from the 1997 count (Melin *et al*. 2005). In 1999, the population began to recover, and in 2010 the highest total pup count of 3,408 was recorded (Orr *et al*. in review). A possible cause for the decline in total pup counts from 2010 to 2011 was a combination of oceanographic events that occurred in the California Current in 2009, a coastal upwelling relaxation event in May and June and an El Niño event from Fall 2009 to Spring 2010. The oceanographic events caused fewer reproductive males and females to return to San Miguel Island to breed in 2010. During 2012, the population increased 9.4% from 2011 and this level was maintained during 2013. No counts were conducted at Castle Rock in 2014; however, a record number of pups (2,289) were counted at Adam's Cove that year. Additionally, the second highest number of territorial bulls (224) was observed in 2014 (Orr *et al*. in review). Based on these factors, and assuming the trends were similar at Castle Rock, the population size during 2014 would have been the highest recorded. However, based on the 2013 count (the most recent complete data set) and the expansion factor, the most recent population estimate of northern fur seals at San Miguel Island is 13,384 (3,346 x 4.0) northern fur seals (Orr *et al*. in review). Currently, a coefficient of variation (CV) for the expansion factor is unavailable; however, studies are underway to determine the accuracy and precision of the expansion factor.

The population estimate for northern fur seals on the Farallon Islands is calculated as the highest number of pups, juveniles, and adults counted at the rookery. The long-term population estimate at the Farallon Islands should be regarded as an index of abundance rather than a precise indicator of population size for several reasons: 1) population censuses are incomplete because researchers do not enter rookery areas until the end of the breeding/pupping season in order to reduce human disturbance to other breeding pinnipeds and nesting seabirds; 2) mortality occurring early in the season is not accounted for; and 3) estimates of the number of pups are compromised because by the time counts are conducted, many pups have learned to swim and may not be present at the rookery. Additionally, yearlings may be present at rookeries and misidentified as pups. Keeping these factors in mind, the peak counts of northern fur seals increased steadily from 1995 to 2006 and have increased exponentially from 2008 to 2013 (Tietz 2012, Berger *et al*. 2013). Based solely on the count, the population estimate of northern fur seals at the Farallon Islands was 666 in 2013 and increased to 1,019 in 2014 (Orr *et al*. in review).

The most recent population estimate for the entire stock of California northern fur seals, which incorporates estimates from San Miguel Island and the Farallon Islands in 2013, is 14,050 (13,384 + 666).

Minimum Population Estimate

Minimum population size is calculated as the sum of the minimum number of animals at San Miguel Island and the Farallon Islands in 2013 (Tietz 2012, Berger *et al*. 2013, Orr *et al*. in review). The minimum number of animals at San Miguel Island is twice the pup count (3,346 x 2 = 6,692), to account for pups and mothers, plus the number of territorial males (166) counted the same year (i.e., 2013), or 6,858 fur seals. The minimum number at the Farallon Islands is the total number of individuals (666) counted during the survey in 2013. It should be noted that 1,019 individuals were counted in 2014, but this number is not used here to be consistent with data collected at San Miguel Island. The total minimum population size is the sum of the minimum population sizes at San Miguel Island (6,858) and the Farallon Islands (666) in 2013, or 7,524 northern fur seals.

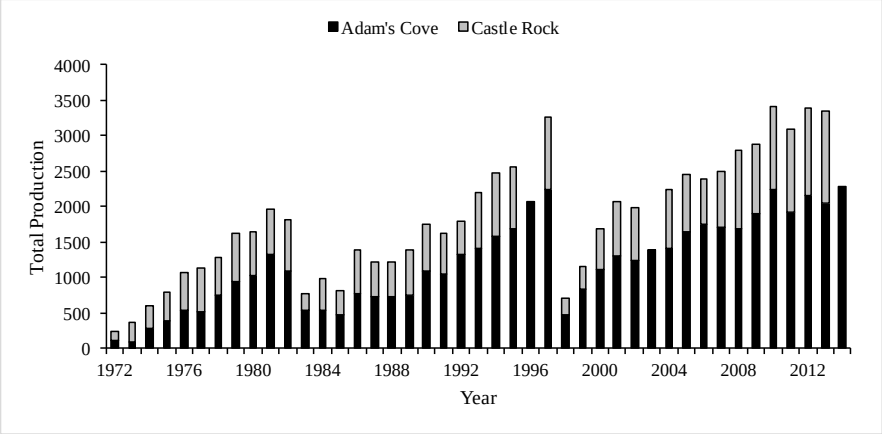

Figure 2. Total production of northern fur seal pups counted on San Miguel Island, including the mainland (Adam's Cove) and the offshore islet (Castle Rock), 1972-2014.

Current Population Trend

Northern fur seals were extirpated on San Miguel Island and the Farallon Islands during the late 1700s and early 1800s. Immigrants from the Pribilof Islands and Russian populations recolonized San Miguel Island during the late 1950s or early 1960s (DeLong 1982). The colony has increased steadily, since its discovery in 1968, except for severe declines in 1983 and 1998 associated with El Niño events in 1982-1983 and 1997-1998 (DeLong and Antonelis 1991, Melin *et al*. 2005). El Niño events impact population growth of northern fur seals at San Miguel Island and are an important regulatory mechanism for this population (DeLong and Antonelis 1991; Melin and DeLong 1994, 2000; Melin *et al*. 1996, 2005, 2008; Orr *et al*. 2012, in review).

Live pup counts increased about 24% annually from 1972 through 1982 (Fig. 2), partly due to immigration of females from the Bering Sea and the western North Pacific Ocean (DeLong 1982). The 1982-1983 El Niño event resulted in a 60% decline in the northern fur seal population at San Miguel Island (DeLong and Antonelis 1991). It took the population 7 years to recover from this decline, because adult female mortality or emigration occurred in addition to pup mortality (Melin and DeLong 1994). The 1992-1993 El Niño resulted in reduced pup production in 1992, but the population recovered in 1993 and increased during 1994 (Melin *et al*. 1996).

The northern fur seal population appears to be greatly affected by El Niño events. These events cause changes in marine communities by altering sea-level height, sea-surface temperature, thermocline and nutricline depths, current-flow patterns, and upwelling strength. Fur seal prey generally move to more productive areas farther north and deeper in the water column and, thereby, become less accessible for fur seals. Consequently, fur seals at San Miguel Island are in poor physical condition during El Niño events and the population experiences reduced reproductive success and high mortality of pups and, occasionally, adults. From July 1997 through May 1998, the most severe El Niño event in recorded history affected California coastal waters (Lynn *et al*. 1998). In 1997, total fur seal pup production was the highest recorded since the colony has been monitored. However, it appears that up to 87% of the pups born in 1997 died before weaning, and total production in 1998 declined 80% from 1997 (Melin *et al*. 2005). Total production increased to a record high of 3,408 in 2010 and, except for a slight decrease during 2011, levels have remained around 3,350 individuals in subsequent years (Orr *et al*. in review). The total production of northern fur seals has exceeded the 1997 levels during three of the last four years with complete counts; therefore, the San Miguel Island population has recovered from the 1997-1998 El Niño event.

Compared to San Miguel Island, less information is known about the population of northern fur seals on the Farallon Islands. Based on tag-resight data, it appears that the population originated from emigrants from San Miguel Island. The first pup was observed on the Farallon Islands in 1996 (Pyle *et al*. 2001). After this discovery, annual ground surveys were conducted in early fall to document population trends of the colony (Tietz 2012). The colony increased steadily from 1996 to the early 2000s. However, the population has grown exponentially during the past several years, with an occasional decline (Tietz 2012). Because counts are conducted during the fall after the breeding season, population trends and demographic information are less clear than for San Miguel Island.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Currently, productivity rates for northern fur seals on the Farallon Islands are unknown. A growth rate of 20% was calculated for northern fur seals on San Miguel Island in 1972-1982 by linear regression of the natural logarithm of pup count against year. However, it is clear that this rate of increase was due in part to immigration of females from Russian and Pribilof Islands populations (DeLong 1982). Immigration was also occurring from the early 1980s to 1997. In the absence of a reliable estimate of the maximum net productivity rate for the California stock of northern fur seals, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% (Wade and Angliss 1997) is used as an estimate of R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (7,524) times one-half the default maximum net growth rate (½ of 12%) times a recovery factor of 1.0 (for stocks of unknown status that are increasing in size: Wade and Angliss 1997), resulting in a PBR of 451 northern fur seals from the California stock per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Northern fur seals taken by commercial fisheries during the winter/spring along the west coast of the continental U.S. could be from either the Eastern Pacific or California stock; therefore, any mortality or serious injury of northern fur seals reported off the coasts of California, Oregon, or Washington during December through May will be assigned to both the Eastern Pacific and California stocks of northern fur seals. There were no observer reports of northern fur seal deaths or serious injuries in any observed fishery along the west coast of the continental U.S. in 2009-2013 (Carretta and Enriquez 2010, 2012a, 2012b; Jannot *et al*. 2011; Carretta *et al*. 2014a, 2015).

Table 1. Summary of available information on the incidental mortality and serious injury of the California stock of northern fur seals in commercial fisheries that might take this species and calculation of the mean annual mortality and serious injury rate; n/a indicates that data are not available. Mean annual takes are based on 2009-2013 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Unknown West Coast fisheries	2009-2013	stranding data	n/a	1, 0, 2, 1, 0	n/a	≥0.8 (n/a)
Minimum total annual takes						≥0.8 (n/a)

Strandings of northern fur seals entangled in fishing gear or with serious injuries caused by interactions with gear are another source of fishery-related mortality information. According to stranding records for California, Oregon, and Washington (Carretta *et al*. 2014b, 2015), four fishery-related deaths (in unidentified net and unknown trawl fisheries) were reported between 2009 and 2013 (Table 1), resulting in a mean annual mortality and serious injury rate of 0.8 California northern fur seals. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). Two of the fishery-related deaths (one in an unidentified fishing net in February 2009 and one in trawl gear in April 2011) were also assigned to the Eastern Pacific stock of northern fur seals. Two additional northern fur seal strandings in 2012 (one in May and one in July) with serious injuries due to fishery interactions were treated and released with non-serious injuries (Carretta *et al*. 2014b). Both of these animals were assigned to the California stock of northern fur seals and the animal that stranded in May 2012 was also assigned to the Eastern Pacific stock.

Other Mortality

Since the Eastern Pacific and California stocks of northern fur seals overlap off the west coast of the continental U.S. during December through May, non-fishery mortality and serious injury reported off the coasts of California, Oregon, or Washington during that time will be assigned to both stocks. Mortality and serious injury of northern fur seals may occur incidental to research fishery activities. In 2007 and 2008, four northern fur seals were incidentally killed in California waters during scientific sardine trawling operations conducted by NMFS (Carretta *et al*. 2013): one death in 2007 and one in 2008 occurred before NMFS scientists implemented a mitigation plan to avoid future mortality. The initial mitigation plan included use of 162 dB acoustic pingers, a marine mammal watch, and scheduling trawls to occur when the ship first arrived on station to avoid attracting animals to a stationary vessel. Two additional northern fur seals were killed in subsequent 2008 trawls, so a marine mammal excluder device was added to the trawls in 2009 and no northern fur seal deaths or serious injuries were observed in this research fishery in 2009-2013. However, one northern fur seal was killed in a scientific rockfish trawling operation conducted by NMFS (Carretta *et al*. 2014b) in California waters in May 2009. This death was assigned to both the California and Eastern Pacific stocks of northern fur seals. The mean annual research-related mortality and serious injury rate of California northern fur seals from 2009 to 2013 is 0.2 northern fur seals.

According to stranding records for California, Oregon, and Washington (Carretta *et al*. 2014b, 2015), four human-caused northern fur seal deaths were reported from non-fisheries sources in 2009-2013. Three northern fur seals were entangled in marine debris in Oregon waters in April 2009 and one was entrained in the cooling water system of a California power plant in May 2012. All four of these deaths were assigned to both the California and Eastern Pacific stocks of northern fur seals. The mean annual mortality and serious injury rate from non-fishery sources in 2009-2013 is 0.8 California northern fur seals. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

STATUS OF STOCK

The California northern fur seal stock is not considered to be "depleted" under the Marine Mammal Protection Act (MMPA) or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the minimum annual level of total human-caused mortality and serious injury (1.8) does not exceed the PBR (451). Therefore, the California stock of northern fur seals is not classified as a "strategic" stock. The minimum annual commercial fishery mortality and serious injury rate for this stock (0.8) is not known to exceed 10% of the calculated PBR (45) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock (based on San Miguel Island data) decreased 80% from 1997 to 1998, began to recover in 1999, and currently has surpassed the 1997 level by 2%. The status of this stock relative to its Optimum Sustainable Population (OSP) is unknown, unlike the Eastern Pacific northern fur seal stock which is formally listed as "depleted" under the MMPA.

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