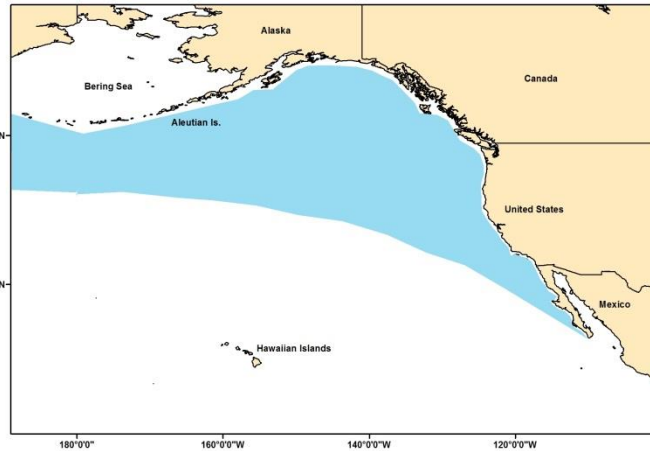


## NORTHERN ELEPHANT SEAL (*Mirounga angustirostris*): California Breeding Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern elephant seals breed and give birth in California (U.S.) and Baja California (Mexico), primarily on offshore islands (Stewart et al. 1994), from December to March (Stewart and Huber 1993). Spatial segregation in foraging areas between males and females is evident from satellite tag data (Le Boeuf et al. 2000). Males migrate to the Gulf of Alaska and western Aleutian Islands along the continental shelf to feed on benthic prey, while females migrate to pelagic areas in the Gulf of Alaska and the central North Pacific to feed on pelagic prey (Le Boeuf et al. 2000). Adults return to land between March and August to molt, with males returning later than females. Adults return to their feeding areas again between their spring/summer molting and their winter breeding seasons.



**Figure 1.** Pelagic range of northern elephant seals in the eastern North Pacific. Major breeding rookeries occur along the west coast of Baja California and the California coast, as described in Lowry et al. (2014).

Populations of northern elephant seals in the U.S. and Mexico have recovered after being nearly hunted to extinction (Stewart et al. 1994). Northern elephant seals underwent a severe population bottleneck and loss of genetic diversity when the population was reduced to an estimated 10-30 individuals (Hoelzel *et al.* 2002). Although movement and genetic exchange continues between rookeries, most elephant seals return to natal rookeries when they start breeding (Huber et al. 1991). The California breeding population is now demographically isolated from the Baja California population. No international agreements exist for the joint management of this species by the U.S. and Mexico. The California breeding population is considered here to be a separate stock.

### POPULATION SIZE

A complete population count of elephant seals is not possible because all age classes are not ashore simultaneously. Elephant seal population size is estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985). Based on counts of elephant seals at U.S. rookeries in 2010, Lowry *et al.* (2014) reported that 40,684 pups were born. Lowry *et al.* (2014) applied a multiplier of 4.4 to extrapolate from total pup counts to a population estimate of approximately 179,000 elephant seals. This multiplier is derived from life tables based on published elephant seal fecundity and survival rates, and reflects a population with approximately 23% pups (Cooper & Stewart, 1983; Le Boeuf & Reiter, 1988; Hindell, 1991; Huber et al., 1991; Reiter & Le Boeuf, 1991; Clinton & Le Boeuf, 1993; Le Boeuf et al., 1994; Pistorius & Bester, 2002; McMahon et al., 2003; Pistorius et al., 2004; Condit et al., 2014).

### Minimum Population Estimate

The minimum population size for northern elephant seals in 2010 can be estimated very conservatively as 81,368 seals, which is equal to twice the observed pup count (to account for the pups and their mothers).

**Current Population Trend**

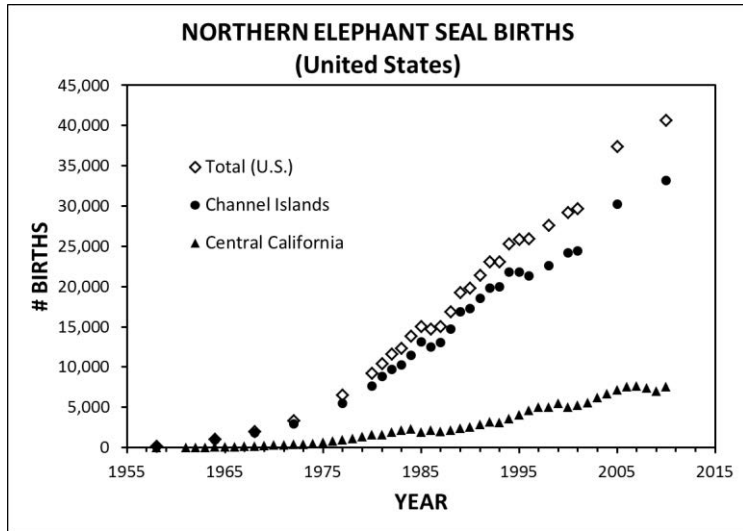
The population is reported to have grown at 3.8% annually since 1988 (Lowry *et al.* 2014).

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATE**

An annual growth rate of 17% for elephant seals in the U.S. from 1958 to 1987 is reported by Lowry *et al.* (2014), but some of this growth is likely due to immigration of animals from Mexico and the consequences of a small population recovering from past exploitation. From 1988 to 2010, the population is estimated to have grown 3.8% annually (Lowry *et al.* 2014). For this stock assessment report, we use the default maximum theoretical net productivity rate for pinnipeds, or 12% (Wade and Angliss 1997).

**POTENTIAL BIOLOGICAL REMOVAL**

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (81,368) times one half the observed maximum net growth rate for this stock (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is increasing, Wade and Angliss 1997) resulting in a PBR of 4,882 animals per year.



**Figure 2.** Estimated number of northern elephant seal births in California 1958-2010. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart *et al.* (1994), Lowry *et al.* (1996), Lowry (2002), Lowry *et al.* (2014), and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, Ron Jameson, Bernie Le Boeuf, Mark Lowry, Pat Morris, Guy Oliver, Derek Lee, and William Sydeman.

**HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

**Serious Injury Guidelines**

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al.* 2008, NOAA 2012). NMFS defines serious injury as an “injury that is more likely than not to result in mortality”.

**Fisheries Information**

A summary of known commercial fishery mortality and serious injury for this stock of northern elephant seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1.

**Table 1.** Summary of available information on the mortality and serious injury of northern elephant seals (California breeding stock) in commercial fisheries that might take this species (Carretta and Enriquez 2009, 2010, 2012a, 2012b, Carretta *et al.* 2014a). n/a indicates information is not available. Mean annual takes are based on 2008-2012 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA thresher shark/swordfish drift gillnet fishery	2008	observer data	13.5%	0	0	0 (n/a)
	2009		13.3%	0	0	
	2010		11.9%	0	0	
	2011		19.5%	0	0	
	2012		18.6%	0	0	

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA halibut and white seabass set gillnet fishery	2008	observer data	0%	n/a	n/a	0 (n/a)
	2009		0%	n/a	n/a	
	2010		12.5%	0	0	
	2011		8.0%	0	0	
	2012		5.5%	0	0	
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2010	observer data	0.7%	0	0	0 (n/a)
	2011		3.3%	0	0	
	2012		4.6%	0	0	
WA, OR, CA domestic groundfish trawl fishery (includes at-sea hake and other limited-entry groundfish sectors)	2005	observer data	98% to 100% of tows in at-sea hake fishery	0	0 (n/a)	3 (n/a)
	2006			1	1 (n/a)	
	2007		Generally less than 30% of landings observed in other groundfish sectors	3	3 (n/a)	
	2008			7	9 (n/a)	
	2009			2	2 (n/a)	
Unknown gillnet fishery	2008-2012	stranding	n/a	1	1 (n/a)	≥1
<b>Total annual takes</b>						≥4.0 (n/a)

Although all of the mortality in Table 1 occurred in U.S. waters, some may be of seals from Mexico's breeding population that are migrating through U.S. waters.

### Other Mortality

For the period 2008-2012, mortality and serious injuries from the following non-commercial fishery sources were documented: shootings (9); marine debris entanglement (7); hook and line fisheries (3); power plant entrainment (2); research-related (1); tar/oil (1); and vessel strike (1) (Carretta *et al.* 2014b). These non-commercial fishery sources of mortality and serious injury total 24 animals, or an average of 4.8 elephant seals annually (Carretta *et al.* 2014b).

### STATUS OF STOCK

Northern elephant seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor designated as "depleted" under the MMPA. Because their annual human-caused mortality ( $\geq 8.8$ ) is much less than the calculated PBR for this stock (4,882), northern elephant seals are not considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock over the last five years ( $\geq 4.0$ ) also appears to be less than 10% of the calculated PBR; therefore, the total fishery mortality appears to be insignificant and approaching a zero mortality and serious injury rate. The population growth rate between 1958 and 1987 was 17% annually (Lowry *et al.* 2014). From 1988 to 2010, the population grew at an annual rate of 3.8% (Lowry *et al.* 2014). The population continues to grow, with most births occurring at southern California rookeries (Lowry *et al.* 2014). No estimate of carrying capacity is available for this population and the population status relative to OSP is unknown. There are no known habitat issues that are of concern for this stock. However, expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta *et al.* 2014b).

### REFERENCES

- Carretta, J.V., L. Enriquez, and C. Villafana. 2014a. Marine mammal, sea turtle, and seabird bycatch in California gillnet fisheries in 2012. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-526. 16p.
- Carretta, J.V., S.M. Wilkin, M.M. Muto, K. Wilkinson, and J. Rusin. 2014b. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2008-2012. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-533. 110 p.
- Carretta, J.V., L. Enriquez, and C. Villafana. 2014. Marine mammal, sea turtle, and seabird bycatch in California gillnet fisheries in 2012. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-526. 16 p.
- Carretta, J.V. and L. Enriquez. 2012a. Marine mammal and seabird bycatch in California gillnet fisheries in 2011. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-500. 14p.
- Carretta, J.V. and L. Enriquez. 2012b. Marine mammal and seabird bycatch in California gillnet fisheries in 2010. Administrative Report LJ-12-01. NOAA Fisheries, Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, CA 92037. 14 p.
- Carretta, J.V. and L. Enriquez. 2010. Marine mammal and sea turtle bycatch in the California/Oregon swordfish and thresher shark drift gillnet fishery in 2009. Administrative Report LJ-10-03, available from Southwest Fisheries Science Center, 3333 North Torrey Pines Ct., La Jolla, California, 92037. 11p.
- Carretta, J.V. and L. Enriquez. 2009. Marine mammal bycatch in the California/Oregon swordfish and thresher shark drift gillnet fishery in 2008. Administrative Report LJ-09-03, available from Southwest Fisheries Science Center, 3333 North Torrey Pines Ct., La Jolla, California, 92037. 10 p.
- Clinton, W. L., & Le Boeuf, B. J. 1993. Sexual selection's effects on male life history and the pattern of male mortality. *Ecology*, 74, 1884-1892.
- Condit, R., Reiter, J., Morris, P. A., Berger, R., Allen, S. G. and Le Boeuf, B. J. 2014, Lifetime survival rates and senescence in northern elephant seals. *Marine Mammal Science*, 30: 122-138.
- Cooper, C.F. and B.S. Stewart. 1983. Demography of northern elephant seals, 1911-1982. *Science* 219:969-971.
- Hindell, M. A. 1991. Some life-history parameters of a declining population of southern elephant seals, *Mirounga leonina*. *Journal of Animal Ecology*, 60, 119-134.
- Hoelzel, A. R., Fleischer, R. C., Campagna, C., Le Boeuf, B. J., & Alvord, G. 2002. Impact of a population bottleneck on symmetry and genetic diversity in the northern elephant seal. *Journal of Evolutionary Biology*, 15(4), 567-575.
- Huber, H. R., A. C. Rovetta, L. A. Fry, and S. Johnston. 1991. Age-specific natality of northern elephant seals at the South Farallon Islands, California. *J. Mamm.* 72(3):525-534.
- Le Boeuf, B. J., & Reiter, J. 1988. Lifetime reproductive success in northern elephant seals. In T. H. Clutton-Brock (Ed.), *Reproductive success: Studies of individual variation in contrasting breeding systems* (pp. 344-362). Chicago and London: The University of Chicago Press.
- Le Boeuf, B. J., and Laws, R. M. 1994. Elephant seals: An introduction to the genus. In B. J. Le Boeuf & R. M. Laws (Eds.), *Elephant seals: Population ecology, behavior, and physiology* (pp. 1-28). Berkeley: University of California Press.
- Le Boeuf, B. J., Crocker, D. E., Costa, D. P., Blackwell, S. B., Webb, P. M., & Houser, D. S. 2000. Foraging ecology of northern elephant seals. *Ecological monographs*, 70(3), 353-382.
- Le Boeuf, B. J., D. Crocker, S. Blackwell, and P. Morris. 1993. Sex differences in diving and foraging behaviour of northern elephant seals. In: I. Boyd (ed.). *Marine Mammal: Advances in Behavioural and Population Biology*. Oxford Univ. Press.
- Lowry, M.S., R. Condit, B. Hatfield, S.G. Allen, R. Berger, P.A. Morris, B.J. Le Boeuf, and J. Reiter. 2014. Abundance, Distribution, and Population Growth of the Northern Elephant Seal (*Mirounga angustirostris*) in the United States from 1991 to 2010. *Aquatic Mammals* 40(1):20-31.
- McCann, T.S. 1985. Size, status and demography of southern elephant seal (*Mirounga leonina*) populations. In J. K. Ling and M. M. Bryden (eds.), *Studies of Sea Mammals in South Latitudes*. South Australian Museum. 132 pp.
- McMahon, C.R., Burton, H.R., & Bester, M.N. 2003. A demographic comparison of two southern elephant seal populations. *Journal of Animal Ecology*, 72, 61-74.
- Pistorius, P.A., & Bester, M.N. 2002. A longitudinal study of senescence in a pinniped. *Canadian Journal of Zoology*, 80, 395-401.

- Pistorius, P. A., Bester, M. N., Lewis, M. N., Taylor, F. E., Campagna, C., & Kirkman, S. P. (2004). Adult female survival, population trend, and the implications of early primiparity in a capital breeder, the southern elephant seal (*Mirounga leonina*). *Journal of Zoology*, 263, 107.
- Reiter, J., and Le Boeuf, B. J. 1991. Life history consequences of variation in age at primiparity in northern elephant seals. *Behavioral Ecology and Sociobiology*, 28, 153-160.
- Stewart, B. S., B. J. Le Boeuf, P. K. Yochem, H. R. Huber, R. L. DeLong, R. J. Jameson, W. Sydeman, and S. G. Allen. 1994. History and present status of the northern elephant seal population. In: B. J. Le Boeuf and R. M. Laws (eds.) Elephant Seals. Univ. Calif. Press, Los Angeles.
- Wade P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12 available from Office of Protected Resources, National Marine Fisheries Service, Silver Springs, MD. 93pp.