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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). Males feed near the eastern Aleutian Islands and in the Gulf of Alaska, and females feed further south, south of 45°N (Stewart and Huber 1993; Le Boeuf et al. 1993). 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.

Populations of northern elephant seals in the U.S. and Mexico were all originally derived from a few tens or a few hundreds of individuals surviving in Mexico after being nearly hunted to extinction (Stewart et al. 1994). Given the very recent derivation of most rookeries, no genetic differentiation would be expected. Although movement and genetic exchange continues between rookeries, most elephant seals return to their 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.

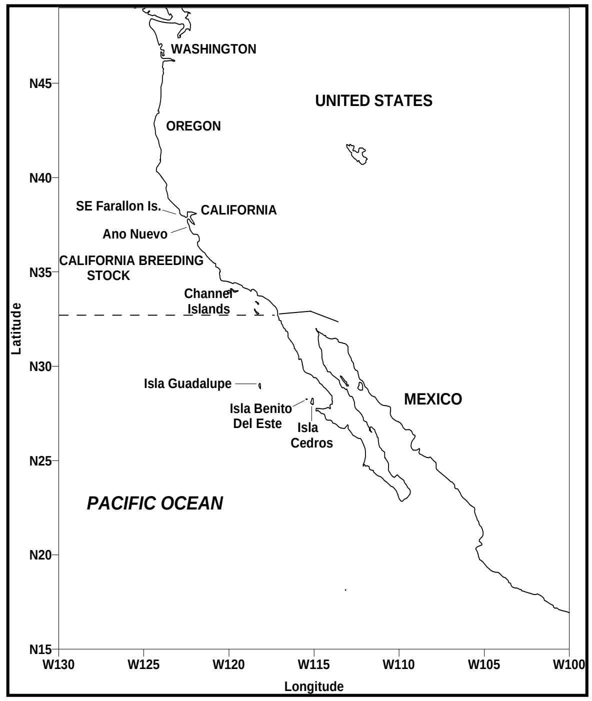

Figure 1. Stock boundary and major rookery areas for northern elephant seals in the U.S. and Mexico.

POPULATION SIZE

A complete population count of elephant seals is not possible because all age classes are not ashore at the same time. Elephant seal population size is typically estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985). Stewart et al. (1994) used McCann's multiplier of 4.5 to extrapolate from 28,164 pups to a population estimate of 127,000 elephant seals in the U.S. and Mexico in 1991. The multiplier of 4.5 was based on a non-growing population. Boveng (1988) and Barlow et al. (1993) suggest that a multiplier of 3.5 is more appropriate for a rapidly growing population such as the California stock of elephant seals. Based on the estimated 35,549 pups born in California in 2005 (Fig. 2) and this 3.5 multiplier, the California stock was approximately 124,000 in 2005.

Minimum Population Estimate

The minimum population size for northern elephant seals can be estimated very conservatively as 74,913, which is equal to twice the observed pup count (to account for the pups and their mothers) plus 3,815 males and juveniles counted at the Channel Islands and central California sites in 2005 (Mark Lowry, NMFS unpubl. data) . More sophisticated methods of estimating minimum population size could be applied if the variance of the multiplier used to estimate population size were known.

Current Population Trend

Based on trends in pup counts, northern elephant seal colonies were continuing to grow in California through 2005 (Figure 2), but appear to be stable or slowly decreasing in Mexico (Stewart et al. 1994).

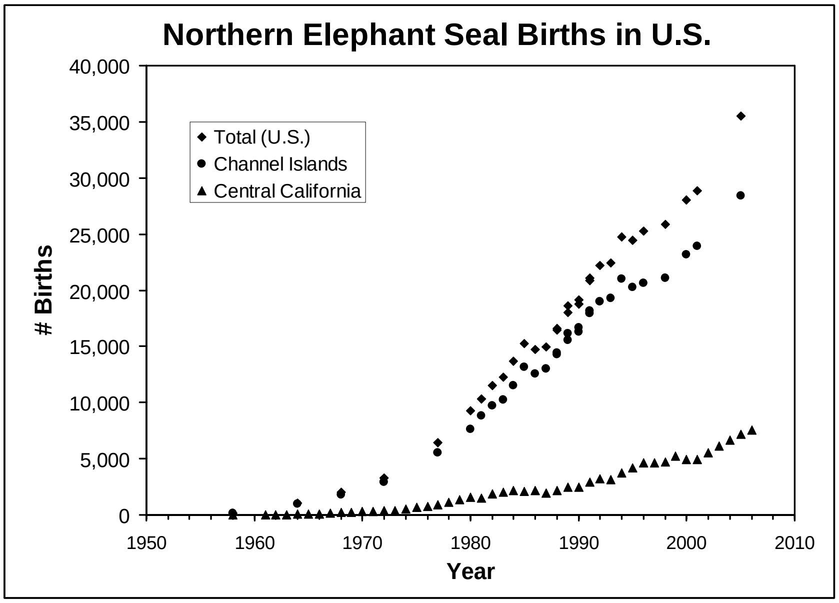

Figure 2. Estimated number of northern elephant seal births in California 1958-2005. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart et al. (1994), Lowry et al. (1996), Lowry (2002) and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, Ron Jameson, Bernie Le Boeuf, Mark Lowry, Pat Morris, Guy Oliver, Derek Lee, and William Sydeman.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATE

Although growth rates as high as 16% per year have been documented for elephant seal rookeries in the U.S. from 1959 to 1981 (Cooper and Stewart 1983), much of this growth was supported by immigration from Mexico. The highest growth rate measured for the whole U.S./Mexico population was 8.3% between 1965 and 1977 (Cooper and Stewart 1983). A generalized logistic growth model indicates that the maximum population growth rate (R_{max}) is 11.7 percent (SE = 2.7) (Figure 3).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (74,913) times one half the observed maximum net growth rate for this stock (½ of 11.7%) 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 4,382.

HUMAN-CAUSED MORTALITY

Fisheries Information

A summary of known fishery mortality and injury for this stock of northern elephant seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Stranding data reported to the California, Oregon, and Washington Marine Mammal Stranding Networks in 2000-2004 include elephant seal injuries caused by hook-and-line fisheries (two injuries) and gillnet fisheries (one injury).

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 Chivers 2004, Carretta et al. 2005a, 2005b, Perez 2003 , Perez 2003; Perez, in prep.; NMFS unpubl. data). n/a indicates information is not available. Mean annual takes are based on 2000-2004 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/OR thresher shark/swordfish drift gillnet fishery	2000 2001 2002 2003 2004	observer data	22.9% 20.4% 22.1% 20.2% 20.6%	6 1 1 1 0	26 (0.39) 5 (0.94) 5 (0.92) 5 (1.00) 0	8 (0.40)
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery[1]	2001[1] 2002[1] 2003[1] 2004[1] 2005[1]	observer data	0% 0% 0% 0% 0%	n/a n/a n/a n/a n/a	n/a n/a n/a n/a n/a	n/a
WA, OR, CA domestic groundfish trawl (At-sea processing Pacific whiting fishery only)	2000 2001 2002 2003 2004	observer data	80.6% 96.2% 100% 100% 100%	1 0 0 0 3	1 (n/a) 0 (n/a) 0 (n/a) 0 (n/a) 3 (n/a)	0.8 (n/a)
WA, OR, CA domestic groundfish trawl fishery (bottom trawl)	2000-2004	observer	n/a	0	0	0 (n/a)
Total annual takes						> 8.8 (0.40)

[1] The most recent observer data for the halibut set gillnet fishery is from 2000 in Monterey Bay only and there has not been a fishery-wide observer program since 1990-94. There are no current estimates of mortality for this fishery, as this would require assuming that current kill rates are comparable to kill rates observed between 1990-94 and extrapolation of mortality estimates using current estimates of fishing effort.

Although all of the mortalities 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. Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from this population. Quantitative data are available only for the Mexican swordfish drift gillnet fishery, which uses vessels, gear, and operational procedures similar to those in the U.S. drift gillnet fishery, although nets may be up to 4.5 km long (Holts and Sosa-Nishizaki 1998). The fleet increased from two vessels in 1986 to 31 vessels in 1993 (Holts and Sosa-Nishizaki 1998). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2700, with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-95 (0.14 marine mammals per set; Julian and Beeson, 1998), but species-specific information is not available for the Mexican fisheries. Previous efforts to convert the Mexican swordfish driftnet fishery to a longline fishery have resulted in a mixed-fishery, with 20 vessels alternately using longlines or driftnets, 23 using driftnets only, 22 using longlines only, and seven with unknown gear type (Berdegué 2002). The number of set-gillnet vessels in this part of Mexico is unknown. The take of northern elephant seals in other North Pacific fisheries that have been monitored appears to be trivial (Barlow et al. 1993, 1994).

Other Mortality

Stranding databases for California, Oregon, and Washington states that are maintained by the National Marine Fisheries Service contain the following records of human-related elephant seal mortalities and injuries in 2000-2004: (1) boat collision (three mortalities), (2) power plant entrainment (1 mortality),

(3) shootings (four mortalities) and (4) entanglement in marine debris (10 injuries). This results in a minimum annual average of 1.6 non-fishery related mortalities for 2000-2004.

STATUS OF STOCK

A generalized logistic growth model of pup counts indicated that the population reached its Maximum Net Productivity Level (MNPL) of 19,000 pups in 1992, but has not reached carrying capacity (K) at 38,200 pups per year (z = 1, R_{max} = 0.117, n0 = 1,000, SE = 3,376, AICc = 500.3) (Figure 3). They are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Because their annual human-caused mortality is much less than the calculated PBR for this stock (4,382), they would not be considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock over the last five years (>8.8) 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. This annual rate of fishery mortality is negatively biased because it excludes mortalities that likely occur in the unobserved set gillnet fishery for halibut and angel shark, where average annual mortality was estimated at approximately 60 animals annually during the period 1996-2000. The population is continuing to grow and fishery mortality is relatively constant. There are no known habitat issues that are of particular concern for this stock.

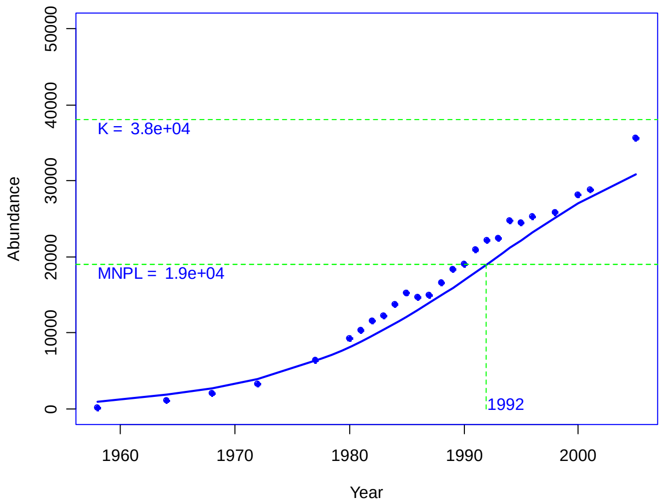

Figure 3. Generalized logistic growth model of elephant seal pup counts, 1958-2005.

REFERENCES

Barlow, J., R. W. Baird, J. E. Heyning, K. Wynne, A. M. Manville, II, L. F. Lowry, D. Hanan, J. Sease, and V. N. Burkanov. 1994. A review of cetacean and pinniped mortality in coastal fisheries along the west coast of the U.S. and Canada and the east coast of the Russian Federation. Rep. Int. Whal. Commn, Special Issue 15:405-425.

Barlow, J., P. Boveng, M. S. Lowry, B. S. Stewart, B. J. Le Boeuf, W. J. Sydeman, R. J. Jameson, S. G. Allen, and C. W. Oliver. 1993. Status of the northern elephant seal population along the U.S. west coast in 1992. Admin. Rept. LJ_93_01. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 32 pp.

Boveng, P. 1988. Status of the northern elephant seal population on the U.S. West Coast. Admin. Rep. LJ-88-05 Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 35pp.

Carretta, J.V. and S.J. Chivers. 2004. Preliminary estimates of marine mammal mortality and biological sampling of cetaceans in California gillnet fisheries for 2003. Paper SC/56/SM1 presented to the IWC Scientific Committee, June 2004 (unpublished). [Available from Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037, USA].

Carretta, J.V., S.J. Chivers, and K. Danil. 2005a. Preliminary estimates of marine mammal bycatch, mortality, and biological sampling of cetaceans in California gillnet fisheries for 2004. Administrative Report LJ-05-10, available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, California, 92037. 17 p.

Carretta, J.V., T. Price, D. Petersen, and R. Read. 2005b. Estimates of marine mammal, sea turtle, and seabird mortality in the California drift gillnet fishery for swordfish and thresher shark, 1996-2002. Marine Fisheries Review 66(2):21-30.

Cooper, C. F. and B. S. Stewart. 1983. Demography of northern elephant seals, 1911-1982. Science 219:969-971.

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. 1996. Northern elephant seals at Año Nuevo during the breeding seasons of 1992-1996. Admin. Rep. LJ-96-12C. Southwest Fisheries Science Center, National Marine Fisheries Service, P. O. Box 271, La Jolla, California, 92038. 8 pp.

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. 2002. Counts of northern elephant seals at rookeries in the southern California Bight: 1981-2001. NOAA Technical Memorandum NMFS, NOAA-TM-NMFS-SWFSC-345. Available at Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037 or at http://swfsc.noaa.gov/textblock.aspx?Division=PRD&ParentMenuId=148&id=1253#TechMemos.

Lowry, M. S., W. L. Perryman, M. S. Lynn, R. L. Westlake, and F. Julian. 1996. Counts of northern elephant seals, Mirounga angustirostris, from large-format aerial photographs taken at rookeries in southern California during the breeding season. Fish. Bull. 94:176-185.

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.

Perez, M. 2003. Compilation of marine mammal incidental take data from the domestic and joint venture groundfish fisheries in the U.S. EEZ of the North Pacific, 1989-2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-138. 145 pp.Sosa-Nishizaki, O., R. De la Rosa Pacheco, R. Castro Longoria, M. Grijalva Chon, and J. De la Rosa Velez. 1993. Estudio biologico pesquero del pez (*Xiphias gladius*) y otras especies de picudos (marlins y pez vela). Rep. Int. CICESE, CTECT9306.

Stewart, B. S., and H. R. Huber. 1993. Mirounga angustirostris. Mammalian Species 449:1-10.

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.