NOAA Technical Memorandum NMFS-AFSC-504

Abundance and Distribution of Northern Elephant Seals in California

S. M. Chinn., P. J. Mahoney, E. Jaime, and S. R. Melin

December 2025

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

The National Marine Fisheries Service's Alaska Fisheries Science Center uses the NOAA Technical Memorandum series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible. Documents within this series reflect sound professional work and may be referenced in the formal scientific and technical literature.

The NMFS-AFSC Technical Memorandum series of the Alaska Fisheries Science Center continues the NMFS-F/NWC series established in 1970 by the Northwest Fisheries Center. The NMFS-NWFSC series is currently used by the Northwest Fisheries Science Center.

This document should be cited as follows:

Chinn, S. M., Mahoney, P. J., Jaime, E., and Melin, S. R. 2025. Abundance and distribution of northern elephant seals in California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-504, 24 p.

Cover photo: Adult female elephant seal and pup. S. Chinn (NOAA-NMFS-AFSC). MML Permit 373-1868-00.

This document is available online at:

Document available: https://repository.library.noaa.gov

NOAA FISHERIES

Abundance and Distribution of Northern Elephant Seals in California

S. M. Chinn[1], P. J. Mahoney[1], E. Jaime[2], and S. R. Melin[1]

[1]Marine Mammal Laboratory
Alaska Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way NE
Seattle WA 98115

[2]Ocean Associates, Inc.
Under contract to Marine Mammal Laboratory
Alaska Fisheries Science Center
National Oceanic and Atmospheric Administration
8901 La Jolla Shores Drive
La Jolla CA 92037-1022

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

NOAA Technical Memorandum NMFS-TM-AFSC-504

December 2025

ABSTRACT

NOAA, National Marine Fisheries Service has conducted aerial photographic surveys since 1990 to count West Coast pinniped populations in California and southern Oregon in order to monitor abundance, distribution, and trends of the U.S. stocks. In 2023, we conducted a complete survey of northern elephant seals (*Mirounga angustirostris*) along the coastlines of California and the California Channel Islands that comprise the U.S. breeding population. Here, we report northern elephant seal abundance estimates from the 2023 survey and present a revised method for estimating total population abundance.

Aerial photographic surveys of northern elephant seals were conducted during the peak birthing season in late January to document breeding season abundance and spatial distribution of all sex and age classes. The mainland California coastline was subdivided *a priori* into three sections (southern, central, and northern) with a subset of zones in each section. The California Channel Islands were also subdivided into distinct regions to document spatial abundances and intra-island differences. In 2023, we counted 22,670 northern elephant seal pups on the California Channel Islands and 5,713 at the California mainland rookeries. We counted 32,599 breeding females on the California Channel Islands and 7,473 at the mainland rookeries. From these counts, we estimated the total number of females as 45,535 across the entire California range and estimated 44,397 pups were born and used an updated population abundance method to estimate the total population. In 2023, the estimated total northern elephant seals in California, representing the U.S. breeding stock, was 194,903 (95% CI 170,185—233,677).

CONTENTS

INTRODUCTION

Six pinniped species utilize the U.S. West Coast, including the California Channel Islands located off the coast of southern California, for important life history events such as foraging, breeding, and hauling out. Overexploitation in the 19th and 20th centuries led to significant decreases of marine mammal populations, including pinnipeds. Consequently, enactment of the Marine Mammal Protection Act of 1972 (MMPA) established federal protection for all marine mammals inhabiting U.S. waters. As a result of many regulations implemented by the MMPA, pinniped populations that inhabit the U.S. West Coast have largely recovered from these depletions.

Populations of northern elephant seals in the United States and Mexico have recovered from near extinction in recent decades following the federal protections. Northern elephant seals are currently not listed as "endangered" nor "threatened" under the Endangered Species Act nor designated as "depleted" under the MMPA (Hückstädt 2015). In the early 1900s, following a prolonged period of unregulated hunting pressure, it was estimated that as few as 10 to 30 individuals remained, with breeding only occurring on Isla de Guadalupe, Mexico (Bartholomew and Hubbs 1960). With the establishment of a biological reserve on Isla de Guadalupe and protection under the MMPA in the United States, northern elephant seals showed signs of recolonizing some of their historical breeding sites (Rick et al. 2011, Lowry et al. 2014). However, research suggested that the small founder population resulted in a population bottleneck, resulting in substantial loss of genetic diversity (Hoelzel et al. 2002).

Northern elephant seals initially recolonized islands in Mexico and California (e.g., the California Channel Islands) and subsequently established breeding rookeries (defined as areas with > 50 births annually; Pitcher et al. 2007) on the mainland of California. The primary sites for breeding and pupping for northern elephant seals occur on offshore islands of California (U.S.) and Baja California (Mexico) (Le Boeuf et al. 2011). In addition to these major rookeries, there are a small number of pups born at haul-out sites in northern California and at Point Conception[1] which includes Rocky Point and Vandenberg Space Force Base; Oregon; Washington; and British Columbia (Hodder et al. 1998, Jeffries et al. 2000, Fletcher 2009). Except for the King Range rookery at Punta Gorda in northern California (Levy 2022), the remaining sites have shown little population growth and low births (< 30 pups per year) (Hodder et al. 1998, Jeffries et al. 2000, Townley 2020). Although movement and genetic exchange continue between rookeries, most northern elephant seals return to natal rookeries to breed as they reach reproductive maturity (Huber et al. 1991).

The breeding season for northern elephant seals typically spans from December to March (Stewart and Huber 1993). Males arrive at the rookeries in early December and establish territories (Le Boeuf and Laws 1994). Pregnant females arrive in mid-December and attendance of pregnant females peaks in late January-early February (Le Boeuf and Laws 1994, Condit et al. 2022). The long-term average peak number of females and pup births occur during the last week in January (Condit et al. 2022). Lactating females nurse their pups from birth to weaning,

[1] E.J. Derango, unpubl. data. Center for Environmental Management of Military Lands, Colorado State University, Vandenberg Space Force Base, 747 Nebraska Ave. Vandenberg Space Force Base, CA 93437.

approximately 28 days post-parturition (Stewart and Huber 1993, Le Boeuf and Laws 1994). After approximately 31 days on land (standard deviation of 4 days; Condit et al. 2022), females will copulate, wean their pup, and return to sea to forage (Le Boeuf and Laws 1994). During the non-breeding seasons, spatial segregation in foraging areas between males and females is evident from satellite tag data (Le Boeuf et al. 1993, Stewart and DeLong 1995, Le Boeuf et al. 2000).

Since 1990, NOAA's National Marine Fisheries Service (NMFS) has conducted aerial photographic surveys to count pinnipeds in California and southern Oregon to monitor population abundance, distribution, and trends (e.g., Orr et al. 2012, NMFS 2013, Lowry et al. 2017a, Laake et al. 2018). Here, we report on aerial photographic surveys of northern elephant seals conducted in 2023 during their winter breeding season and within the peak pupping period (Lowry 2002, Lowry et al. 2014, 2020) to reflect maximum population numbers of hauled out breeding adults and newborn pups. Previous methods to estimate population abundance included direct near-census counts when the population was small and confined to a few breeding rookeries (e.g., 1958 on San Miguel and San Nicolas Islands). As the population grew, methods shifted to using pup counts or estimates of total births (Lowry et al. 2014) to infer total population abundance. For the 2023 U.S. breeding population estimate, we improved upon the previous population model of Lowry et al. (2020) by incorporating an estimate of total female abundance using phenological curves for female attendance in relation to survey date and rookery location (Condit et al. 2022). Total female abundance was then used to estimate total births and in turn total population size.

Population estimates based on the most current and best available data are important for monitoring trends and productivity rates. These are important data that must be updated regularly to inform the status of stocks and aid in understanding anthropogenic impacts to this species. NMFS uses these assessments to evaluate the effectiveness of conservation and recovery actions, and to adjust management policies and practices.

METHODS

Study Area

The aerial survey of northern elephant seals was conducted between 23 and 28 January 2023. The survey area included the California Channel Islands (hereafter Channel Islands) in southern California and the mainland California coastline, from Point Conception northward to the California/Oregon border and included the Farallon Islands off the coast of San Francisco Bay (Fig. 1). All islands, rocks, pinnacles, islets, and mainland coastal zones potentially used by northern elephant seals were photographed if seals were present.

The perimeter of each of the Channel Islands was divided *a priori* into small, coded areas to describe intra-island distribution of northern elephant seals (Figs. 2 and 3). The codes for the areas followed either the Bureau of Land Management (BLM) numerical system in Bonnell et al. (1980) or new alphabetical codes that were created to divide or group the BLM areas into smaller or larger areas (Lowry et al. 2021).

The California coast was divided into three sections: (1) southern California, which included the continental coast and all the Channel Islands; (2) central California, which included the continental coastline, offshore rocks, and islands between Point Conception (34° 26.8' N, 120° 28.0' W) and Point Reyes (38°00.0' N, 123°00.0' W) and the San Francisco Bay estuary; and (3) northern California, which included the continental coastline, offshore rocks, and islands between Point Reyes and the California-Oregon border (42° 0' N, 124° 12.7' W). Counts were summarized separately for each of the Channel Islands. Only Southeast Farallon Island was surveyed for northern elephant seals.

Survey Methods

Survey methods followed those described in Lowry et al. (2017b). Briefly, we conducted aerial photographic surveys for northern elephant seals using a twin-engine, high-winged Partenavia P-68 Observer aircraft flown at a ground speed of 185 km/h (100 knots) and at 244 m (800 ft) altitude where permitted. Higher altitudes were required over some areas due to seabird colony restrictions (244-427 m). When necessary, we made multiple passes over haul-out areas to photograph all individuals that were hauled out. We conducted surveys without regard to tidal conditions and at any time of day between approximately 2 hours after sunrise and 2 hours before sunset.

Individual northern elephant seals were hand-counted by 1-3 NMFS personnel from aerial photographs taken with a Canon EOS 5D Mark IV (Canon U.S.A. Inc., Huntington, New York, USA), full-frame 30.4 megapixel digital single lens reflex (DSLR) camera mounted with either a Zeiss 85 mm or a Zeiss 135 mm lens (Carl Zeiss AG, Germany). Image motion compensation was achieved by using a custom-made forward-motion compensation mechanism (FMC) in the camera mount manufactured by Aerial Imaging Solutions, LLC (Old Lyme, CT, USA). The focus ring of the Zeiss 85 mm lens was immobilized with tape when focused at 244 m and the Zeiss 135 mm lens was focused in the same manner at 427 m. A laptop computer was connected to the camera and a GPS receiver to record accurate location data for each photograph. Software developed by Aerial Imaging Solutions controlled the camera's FMC mechanism and triggered the camera at preset intervals. A video camera and monitor provided a live feed through the camera's viewfinder. For each photograph, the computer recorded the focal length of the lens, geographical position, date, and time the photograph was taken in a comma-separated values (.csv) file.

The DSLR camera was attached to a gimbal camera mount that positioned the camera vertically downward (nadir) over a camera port in the belly port of the aircraft, and the camera was manually leveled at the nadir position with a bubble level. Camera aperture was set at f/5.6 in aperture priority shooting mode and shutter speed was set at or above 1/800 second by changing the ISO image sensor setting between 100 and 1000. Photographs were overexposed by +1/3 f-stop (for sunny conditions) or +2/3 f-stop (for overcast conditions). White balance in the camera was set on automatic, and all photographs were taken in JPEG image file format set at fine image quality and a 3:2 aspect ratio. The camera was operated at a cycle rate that achieved 40% overlap between adjacent photographs, and occasionally 60% overlap for short photographic passes.

Adobe Bridge CS5 (Adobe Inc., Mountain View, CA, USA) was used to review and select digital photographs which were then sent to Adobe Photoshop Creative Cloud (2015) for creating photographic mosaics from multiple overlapping digital photographs of beach and rock sections. While creating the mosaics, photographs were merged manually using the move and transpose tools. Under-exposed or over-exposed images were brightened or darkened, respectively, with image tools in Adobe Photoshop. The brush tool was used to draw a line to separate and mark animals and to code areas on the mosaic that would be counted. Adjacent mosaic files of photographs were compared, and a brush-line was inserted onto the mosaic to separate counted animals from uncounted ones, and to demarcate areas where animals should or should not be counted. Age/sex class categories were manually counted using the count tool in Adobe Photoshop with each class tabulated and marked with a unique colored dot using custom Adobe macros. The total counts for age/sex class were exported as a comma separated file and manually merged with a master spreadsheet in Microsoft Excel along with all relevant survey metadata (e.g., island, date, area codes, and mosaic file name) and then imported into a Microsoft Access database.

Species Identification and Counting Categories

All images were reviewed for the presence of pinnipeds. Identification of pinniped species from aerial photographs and age/sex class descriptions are described in Lowry et al. (2017b). The following age/sex classes were enumerated: 1) live pups, 2) dead pups, 3) juveniles, 4) adult females, 5) young males, 6) sub-adult males, and 7) adult males.

Estimation of Population Abundance

A census of northern elephant seals is not possible because all age classes are not simultaneously observable. Historically, the U.S. stock size was estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985) or by a correction factor to account for reproductive female arrival date (e.g., attendance) based on the best available data at the time (Boveng 1988, Barlow et al. 1993). More recently, pup births were estimated using aerial and/or ground counts of adult females present on the rookery during the breeding season (Le Boeuf et al. 2011, Lowry et al. 2014). The adult female count was multiplied by a correction factor based on rookery arrival dates and tenure to estimate the total number of adult females. The total number of births (N_{Births}; Eq. 1) was estimated by multiplying the estimated number of adult females ($N_{AdultFemales}$) by the fecundity rate among females that appear during a given breeding season (F). The fecundity rate was derived from reproductive data collected from the Año Nuevo rookery (Condit et al. 2007, Le Boeuf et al. 2011, Lowry et al. 2014) and was applied to all rookeries because there were no available reproductive data for other rookeries.

Finally, a density-dependent multiplier (C_{Pop}) was applied to the estimated pup births to produce a total population estimate (N_{Total}; Eq. 2). Starting in 2013, the multiplier was based on life table data (Lowry et al. 2020) constructed from elephant seal fecundity and survival rates,

where approximately 23% of the population is comprised of pups (Cooper and Stewart 1983, Hindell 1991, Huber et al. 1991, Reiter and Le Boeuf 1991, Clinton and Le Boeuf 1993, Le Boeuf and Laws 1994, Pistorius and Bester 2002, McMahon et al. 2003, Pistorius et al. 2004, Condit et al. 2014, Le Boeuf et al. 2019). Assuming a total population growth rate of 1.038 based on the most recently published abundance data (Lowry et al. 2014), we used a range-wide multiplier (C_{Pop}) of 4.39 (95% CL 3.87—4.92; Table 3 and 4 in Lowry et al. 2014) to estimate the total population size from the number of adult females and estimated number of births.

$$N_{Births} = N_{AdultFemales} * F \quad \text{(Eq. 1)}$$

$$N_{Total} = C_{Pop} * N_{Births} \quad \text{(Eq. 2)}$$

RESULTS

In 2023, we counted 40,072 adult females along the mainland California coast and on the Channel Islands (Table 1). After applying date and location-dependent correction factors to the adult female counts using table 2 in Condit et al. (2022), we estimated a total of 45,536 adult females ($N_{AdultFemales}$). Based on a fecundity rate of 0.975, we estimated 44,397 births (N_{Births}; 95% Confidence Range of 42,876—46,308) in 2023. After correcting for age structure by applying a birth rate multiplier (C_{Pop} = 4.39; 95% CL 3.87 – 4.92) to the estimated adult female population, we derived a total population of 194,903 (95% CL 170,185—233,677) northern elephant seals in 2023. The previous population estimate in 2013 was 187,387 individuals (Fig. 4). The northern elephant seal population increased 4% over the last 10 years, representing an average annual growth rate of 0.39%.

The majority of seals counted (81%) were observed on the Channel Islands, followed by the central (15%) and the northern (4%) California sections of the mainland coast (Table 1). On the Channel Islands, no northern elephant seals were counted on Anacapa Island, Santa Catalina Island, Santa Cruz Island, or Richardson Rock (Table 1). Of the 81,857 elephant seals counted on the Channel Islands, San Nicolas Island represented 47%, followed by San Miguel (27%), Santa Rosa (26%), San Clemente (< 1%), and Santa Barbara (< 1%) Islands (Table 1).

On San Nicolas Island, we counted 38,356 northern elephant seals, where 34% were located on the northern coast (areas M-Q) and 48% were on the southeast coast (areas A-E). On San Miguel, we counted 21,978 elephant seals. The densest areas were Cardwell Point (area A) and Point Bennett (area H), though seals were found around the entire island in relatively ample abundance except for at Castle Rock (no seals) and areas B, I, L, and M (cumulatively 3% of the counted seals). We counted 21,354 elephant seals on Santa Rosa Island. The densest areas were 621D, 624C, and 625A-C, though seals were present in all areas. Areas 614, 621D, 622C, 622E, 624A, and 629 cumulatively had < 2% of the seals counted on the island.

DISCUSSION

Northern elephant seals are abundant in the California Channel Islands and along some sections of the mainland California coast in areas that tend to have wide, low-sloping, sandy beaches. We conducted our survey during the breeding season and to coincide with peak parturition (i.e., births) to capture the maximum number of adult females on rookeries (Lowry et al. 2020). We found that the total northern elephant seal population increased by 4% since the last full range survey in 2013.

By using the model described in Condit et al. (2022), we were able to greatly reduce survey costs by focusing our effort on a single survey timed with peak abundance of adult females. In the past, up to four surveys were conducted to encompass the entire breeding season to estimate the population size. Notably, the constant used in the model for the fecundity rate (F; proportion of females that give birth annually) is based on data from the Año Nuevo rookery collected nearly two decades ago when the population was rapidly growing (17% per year). The current rate for the Año Nuevo population may be lower given the recent slowing of the overall population growth rate (3.8%). Further, fecundity may vary by rookery due to density dependence, variation in human disturbance, and environmental factors, particularly at the larger colonies on the Channel Islands. Unfortunately, current reproduction data are not available for the Channel Islands colonies and are incomplete for most of the other breeding rookeries. Therefore, the Año Nuevo Island rate is currently the best available data for use in the model. Given that the population increased 4% in the past decade, fecundity is likely still high but could be lower than 0.975 used in the model. If so, our estimate for the total population would be biased high; a lower value for F would result in a lower abundance estimate but we believe that the estimate would fall within the estimated uncertainty of the model.

The southern California section of the California coast remains an important breeding area for northern elephant seals, as greater than 80% of the population was counted on the Channel Islands. San Nicolas, San Miguel, and Santa Rosa Islands are the most important Channel Islands for breeding. Along the mainland California coast, Piedras Blancas, Año Nuevo Point, and Año Nuevo Island in the central section, and Point Reyes in the northern section, are the main rookeries.

Continued monitoring of the northern elephant seal population across the species' range will provide information about population abundance, growth of established rookeries, establishment of new breeding sites and fluctuations in abundance due to environmental factors. Continued monitoring of abundance and calculating current fecundity rates at key colonies will be important to understand how northern elephant seals respond to the changing climate. These data are vital for monitoring population trends, understanding demography, and evaluating the efficacy of management measures for this species.

ACKNOWLEDGMENTS

Aerial photographic surveys of pinnipeds at the Channel Islands were supported by the U.S. Naval Base Ventura County, NOAA-NMFS Alaska Fisheries Science Center, and NOAA-NMFS West Coast Region. Martin K. Ruane and Elizabeth Seacord (Naval Base Ventura County, U.S. Navy) provided chartered aircraft for the surveys and funds for counting the animals from digital aerial photographs of pinnipeds at the Channel Islands. NOAA-NMFS West Coast Region provided funds for the northern part of the survey. Aspen Helicopters provided the charter aircraft and pilot for the flights. The Alaska Fisheries Science Center's Marine Mammal Laboratory provided additional funds for digital image analysis and for aircraft hours. All surveys were conducted under NMFS Marine Mammal Research Permit 22678 issued to the Alaska Fisheries Science Center, Marine Mammal Laboratory, NMFS Alaska IACUC NWAK-20-01, and National Marine Sanctuary Permit MULTI-2022-010.

CITATIONS

Barlow, J. 1997. U.S. Pacific marine mammal stock assessments, 1996. NOAA, NMFS, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-248, 233 p.

Barlow, J., Boveng, P., Lowry, M., Stewart, B., Le Boeuf, B., Sydeman, W., Jameson, R., Allen, S., and Oliver, C. 1993. Status of the northern elephant seal population along the U.S. west coast in 1992 (LJ-93-01). NOAA, NMFS, Southwest Fisheries Science Center Administrative Report LJ-93-01, 32 p.

Bartholomew, G. A., and Hubbs, C. L. 1960. Population growth and seasonal movements of the northern elephant seal, *Mirounga angustirostris. Mammalia*, *24*(3), 313-324.

Bonnell, M. L., B. J. Le Boeuf, M. 0. Pierson, D. H. Dettman, G. D. Farrens, C. B. Heath, R. F. Gantt, and D. J. Larsen. 1980. Pinnipeds of the Southern California Bight. *In* Marine Mammal and Seabird Surveys of the Southern California Bight Area 1975-1978. Vol. 3, Investigator's Reports, Part 1. 535 p. NTIS PB81-248-71.

Boveng, P. L. 1988. Status of the northern elephant seal population on the U.S. west coast. NOAA, NMFS, Southwest Fisheries Science Center Administrative Report LJ-88-05, 35 p.

Clinton, W. L., and Le Boeuf, B. J. 1993. Sexual selection's effects on male life history and the pattern of male mortality. *Ecology 74*(6), 1884-1892.

Carretta, J. V. 2002. U.S. Pacific marine mammal stock assessments, 2002. Southwest Fisheries Science, Center, NOAA-TM-NMFS-SWFSC-346, 286 p.

Carretta, J. V., Forney, K. A., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., and Muto, M. 2007. U.S. Pacific marine mammal stock assessments, 2007. Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-414, 316 p.

Clinton, W. L., and Le Boeuf, B. J. 1993. Sexual selection's effects on male life history and the pattern of male mortality. *Ecology, 74*(6), 1884-1892.

Condit, R., Allen, S. G., Costa, D. P., Codde, S., Goley, P. D., Le Boeuf, B. J., Lowry, M. S., and Morris, P. 2022. Estimating population size when individuals are asynchronous: A model illustrated with northern elephant seal breeding colonies. *PLOS ONE, 17*(1), e0262214.

Condit, R., Le Boeuf, B. J., Morris, P. A., and Sylvan, M. 2007. Estimating population size in asynchronous aggregations: a Bayesian approach and test with elephant seal censuses. *Marine Mammal Science, 23*(4), 834-855.

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*(1), 122-138.

Cooper, C. F., and Stewart, B. S. 1983. Demography of northern elephant seals, 1911-1982. *Science, 219*(4587), 969-971.

Fletcher, G. 2009. First elephant seal pup born at Race Rocks: January 2009. Race Rocks Ecological Reserve. http://racerocks.ca. Accessed 7 October 2024.

Hindell, M. A. 1991. Some life-history parameters of a declining population of southern elephant seals, *Mirounga leonina*. *The Journal of Animal Ecology 60*, 119-134.

Hodder, J., Brown, R. F., and Cziesla, C. 1998. The northern elephant seal in Oregon: A pupping range extension and onshore occurrence. *Marine Mammal Science 14*(4), 873-881.

Hoelzel, A. R., Fleischer, R., Campagna, C., Le Boeuf, B., and 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., Rovetta, A. C., Fry, L. A., and Johnston, S. 1991. Age-specific natality of northern elephant seals at the South Farallon Islands, California. *Journal of Mammalogy 72*(3), 525-534.

Hückstädt, L. 2015. *Mirounga angustirostris*. *The IUCN Red List of Threatened Species 2015*: e.T13581A45227116. https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T13581A45227116.en. Accessed on 24 November 2025.

Jeffries, S. J., Gearin, P. J., Huber, H. R., Saul, D. L., and Pruett, D. A. 2000. *Atlas of seal and sea lion haulout sites in Washington*. Washington Department of Fish and Wildlife, Wildlife Science Division, 600 Capitol Way North, Olympia, WA 98501.

Laake, J. L., Lowry, M. S., DeLong, R. L., Melin, S. R., and Carretta, J. V. 2018. Population growth and status of California sea lions. *The Journal of Wildlife Management*, *82*(3), 583-595.

Le Boeuf, B. J., Condit, R., Morris, P. A., and Reiter, J. 2011. The northern elephant seal (*Mirounga angustirostris*) rookery at Año Nuevo: a case study in colonization. *Aquatic Mammals*, *37*(4), 486.

Le Boeuf, B. J., Condit, R., and Reiter, J. 2019. Lifetime reproductive success of northern elephant seals (*Mirounga angustirostris*). *Canadian Journal of Zoology*, *97*(12), 1203-1217.

Le Boeuf, B. J., Crocker, D. E., Blackwell, S. B., Morris, P. A., and Thorson, P. H. 1993. Sex differences in diving and foraging behaviour of northern elephant seals. *Symposia of the Zoological Society of London 66*, 149-178.

Le Boeuf, B. J., Crocker, D. E., Costa, D. P., Blackwell, S. B., Webb, P. M., and Houser, D. S. 2000. Foraging ecology of northern elephant seals. *Ecological Monographs*, *70*(3), 353-382.

Le Boeuf, B. J., and Laws, R. M. 1994. *Elephant Seals: an Introduction to the Genus*. University of California Press.

Levy, E. H. 2022. Northern elephant seal (*Mirounga angustirostris)* colony establishment and growth in the King Range National Conservation Area, California. Master's thesis, California State Polytechnic University, Humboldt, CA.

Lowry, M. S., Perryman, W. L., Lynn, M. S., Westlake, R. L., and Julian, F. 1996. Counts of northern elephant seals, *Mirounga angustirostris*, from large-format aerial photographs in southern California during the breeding season. *Fishery Bulletin*, *U.S. 94*, 176-185.

Lowry, M. S. 2002. Counts of northern elephant seals at rookeries in the Southern California Bight: 1981—2001. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-345, 64 p.

Lowry, M. S., Condit, R., Hatfield, B., Allen, S. G., Berger, R., Morris, P. A., Le Boeuf, B. J., and Reiter, J. 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.

Lowry, Mark S., Elizabeth M. Jaime, and Jeffrey E. Moore. 2021. Abundance and distribution of pinnipeds at the Channel Islands in southern California, central and northern California, and southern Oregon during summer 2016–2019. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-656. https://doi.org/10.25923/6qhf-0z55

Lowry, M. S., Jaime, E. M., Nehasil, S. E., Betcher, A. E., and Condit, R. 2020. Winter surveys at the Channel Islands and Point Conception reveal population growth of northern elephant seals and residence counts of other pinnipeds. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-627, 68 p.

Lowry, M. S., Melin, S. R., and Laake, J. L. 2017a. Breeding season distribution and population growth of California sea lions, *Zalophus californianus*, in the United States during 1964-2014. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-574, 63 p.

Lowry, M. S., Nehasil, S. E., and Jaime, E. M. 2017b. Distribution of California sea lions, northern elephant seals, Pacific harbor seals, and Steller sea lions at the Channel Islands during July 2011-2015. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-578, 64 p.

McCann, T.S. 1985. Size, status and demography of southern elephant seal (*Mirounga leonina*) populations. *In* Ling, J.K., and Bryden, M.M., (eds.) *Studies of sea mammals in south latitudes. Proceedings of a symposium of the 52nd. ANZAAS Congress in Sydney, May 1982.* Adelaide, South Australian Museum, 1-17.

McMahon, C. R., Burton, H. R., and Bester, M. N. 2003. A demographic comparison of two southern elephant seal populations. *Journal of Animal Ecology*, *72*(1), 61-74.

National Marine Fisheries Service (NMFS). 2013. Status review of the eastern distinct population segment of Steller sea lion (*Eumetopias jubatus*). NMFS Alaska Region, Protected Resources Division, 709 West 9th Street, Juneau, AK 99802.

Orr, A. J., Melin, S. R., Harris, J. D., and DeLong, R. L. 2012. Status of the northern fur seal population at San Miguel Island, California during 2010 and 2011, p. 41-48. *In* J. W. Testa (ed.), *Fur seal investigations, 2010-2011*. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-AFSC-241.

Pistorius, P. A., and Bester, M. N. 2002. A longitudinal study of senescence in a pinniped. *Canadian Journal of Zoology*, *80*(3), 395-401.

Pistorius, P. A., Bester, M. N., Lewis, M. N., Taylor, F. E., Campagna, C., and 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*(2), 107-119.

Pitcher, K.W., Olesiuk, P.F., Brown, R.F., Lowry, M.S., Jeffries, S.J., Sease, J.L., Perryman, W.L., Stinchcomb, C.E. and Lowry, L.F., 2007. Abundance and distribution of the eastern North Pacific Steller sea lion (*Eumetopias jubatus*) population. *Fishery Bulletin*, U.S. *105*(1), 102-116.

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.

Rick, T. C., DeLong, R. L., Erlandson, J. M., Braje, T. J., Jones, T. L., Arnold, J. E., Des Lauriers, M. R., Hildebrandt, W. R., Kennett, D. J., and Vellanoweth, R. L. 2011. Where were the northern elephant seals? Holocene archaeology and biogeography of *Mirounga angustirostris. The Holocene*, *21*(7), 1159-1166.

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

Stewart, B. S., Le Boeuf, B. J., Yochem, P. K., Huber, H. R., DeLong, R. L., Jameson, R. J., Sydeman, W. J., and Allen, S. G. 1994. History and present status of the northern elephant seal population, p. 29-48. *In* B. Le Boeuf and R. Laws (eds.), *Elephant Seals: Population Ecology, Behavior, and Physiology*. University of California Press.

Stewart, B. S., and DeLong, R. L. 1995. Double migrations of the northern elephant seal, *Mirounga angustirostris*. *Journal of Mammalogy*, *76*(1), 196-205.

Townley, N. (21 January 2020) Fourth Elephant Seal Pup. Race Rocks Ecological Reserve. The LOG. http://racerocks.ca. Accessed 23 August 2024.

Table 1. -- Number of northern elephant seals counted from photographs taken during fixed-wing aerial surveys of California colonies and haul-outs between 23 and 28 January 2023. Counts for the California Channel Islands are subdivided into areas (Refer to Figs. 2 and 3 for locations).

Location	Area	Dead pups	Live pups	Juveniles	Adult females	Young males	Subadult males	Adult males	Total live	Non-pup total live
Point Reyes		3	902	19	1231	0	100	71	2323	1421
Southeast Farallon Island		10	49	7	80	0	10	8	154	105
Punta Gorda		0	198	8	224	0	21	11	462	264
Northern CA Total		**13**	**1149**	**34**	**1535**	**0**	**131**	**90**	**2939**	**1790**
Point Conception		0	25	1	36	0	1	1	64	39
Piedras Blancas		6	3099	27	4103	0	188	161	7578	4479
Año Nuevo Island and Point		25	1440	12	1799	1	123	73	3448	2008
Central CA Total		**31**	**4564**	**40**	**5938**	**1**	**312**	**235**	**11090**	**6526**
Anacapa Island										
	680	0	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
San Clemente Island										
	406	0	26	7	36	0	2	2	73	47
	407	0	0	0	0	0	0	0	0	0
	407	0	0	0	0	0	0	0	0	0
Total		**0**	**26**	**7**	**36**	**0**	**2**	**2**	**73**	**47**
San Miguel Island										
	A	8	1256	7	1664	0	11	130	3068	1812
	B	0	15	1	44	0	9	34	103	88
	C	7	900	5	1198	0	10	81	2194	1294
	D	0	188	2	266	0	8	58	522	334
	E	1	254	5	358	0	16	56	689	435
	F	2	241	6	297	0	9	30	583	342

Table 1. -- (Cont.).

Location	Area	Dead pups	Live pups	Juveniles	Adult females	Young males	Subadult males	Adult males	Total live	Non-pup total live
San Miguel Island	G	0	278	12	329	0	1	17	637	359
	H	10	1014	21	1254	0	188	193	2670	1656
	I	0	32	13	65	0	6	26	142	110
	J	3	663	24	895	0	34	96	1712	1049
	K	1	723	6	963	0	47	121	1860	1137
	L	0	89	3	117	0	2	10	221	132
	M	1	488	7	700	0	8	51	1254	766
	N	0	40	1	42	0	13	13	109	69
	O	0	0	0	0	0	0	0	0	0
Total		**33**	**6181**	**113**	**8192**	**0**	**362**	**916**	**15764**	**9583**
Richardson Rock										
	103	0	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
San Nicolas Island										
	A	2	855	24	1254	0	0	33	2166	1311
	B	0	26	6	46	1	19	22	120	94
	C	11	1273	9	1732	0	2	55	3071	1798
	D	1	845	12	1248	0	47	93	2245	1400
	E	3	670	7	957	0	7	45	1686	1016
	F	1	410	8	627	0	53	56	1154	744
	G	2	462	0	784	0	6	28	1280	818
	H	0	57	7	101	0	29	37	231	174
	I	1	295	3	385	0	2	16	701	406
	J	0	155	4	208	0	6	8	381	226
	K	1	439	14	601	0	13	51	1118	679
	L	0	1	11	6	0	48	21	87	86

Table 1. -- (Cont.).

Location	Area	Dead pups	Live pups	Juveniles	Adult females	Young males	Subadult males	Adult males	Total live	Non-pup total live
San Nicolas Island	M	0	938	10	1292	0	36	71	2347	1409
	N	1	1006	0	1509	0	1	77	2593	1587
	O	1	893	15	1226	0	24	83	2241	1348
	P	0	480	8	595	0	3	30	1116	636
	Q	13	2009	39	2732	0	44	144	4968	2959
Total		**37**	**10814**	**177**	**15303**	**1**	**340**	**870**	**27505**	**16691**
Santa Barbara Island										
	A	0	11	2	31	0	0	1	45	34
	B	0	0	1	0	0	0	1	2	2
	C	0	0	0	0	0	0	1	1	1
	D	0	2	5	2	0	0	0	9	7
	E	0	0	0	0	0	0	0	0	0
Total		**0**	**13**	**8**	**33**	**0**	**0**	**3**	**57**	**44**
Santa Catalina Island										
	502C	0	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Santa Cruz Island										
	653	0	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Santa Rosa Island										
	611	0	205	3	280	0	6	14	508	303
	612	0	37	1	42	0	15	10	105	68
	613	0	35	1	66	0	30	37	169	134
	614	0	0	2	0	0	3	3	8	8
	619	1	361	16	485	0	3	28	893	532
	626	2	348	0	517	0	0	27	892	544

Table 1. -- (Cont.).

Location	Area	Dead pups	Live pups	Juveniles	Adult females	Young males	Subadult males	Adult males	Total live	Non-pup total live
Santa Rosa Island	629	0	25	6	29	0	3	5	68	43
	621A	0	16	2	106	0	7	18	149	133
	621B	0	458	4	760	0	19	34	1275	817
	621C	0	88	1	101	0	11	4	205	117
	621D	1	751	7	1145	0	1	36	1940	1189
	622A	0	2	0	2	0	4	5	13	11
	622B	2	148	6	239	0	18	27	438	290
	622C	0	7	5	35	0	8	12	67	60
	622D	0	139	3	218	0	28	23	411	272
	622E	0	22	4	42	0	8	1	77	55
	624A	0	1	9	5	0	30	9	54	53
	624B	0	135	4	163	0	0	8	310	175
	624C	2	1062	3	1585	0	7	83	2740	1678
	625A	1	1045	23	1773	0	38	118	2997	1952
	625B	0	670	10	1262	0	28	118	2088	1418
	625C	0	81	4	180	0	10	27	302	221
Total		**9**	**5636**	**114**	**9035**	**0**	**277**	**647**	**15709**	**10073**
Southern CA Total		**79**	**22670**	**419**	**32599**	**1**	**981**	**2438**	**59108**	**36438**
Grand Total		**123**	**28383**	**493**	**40072**	**2**	**1424**	**2763**	**73137**	**44754**

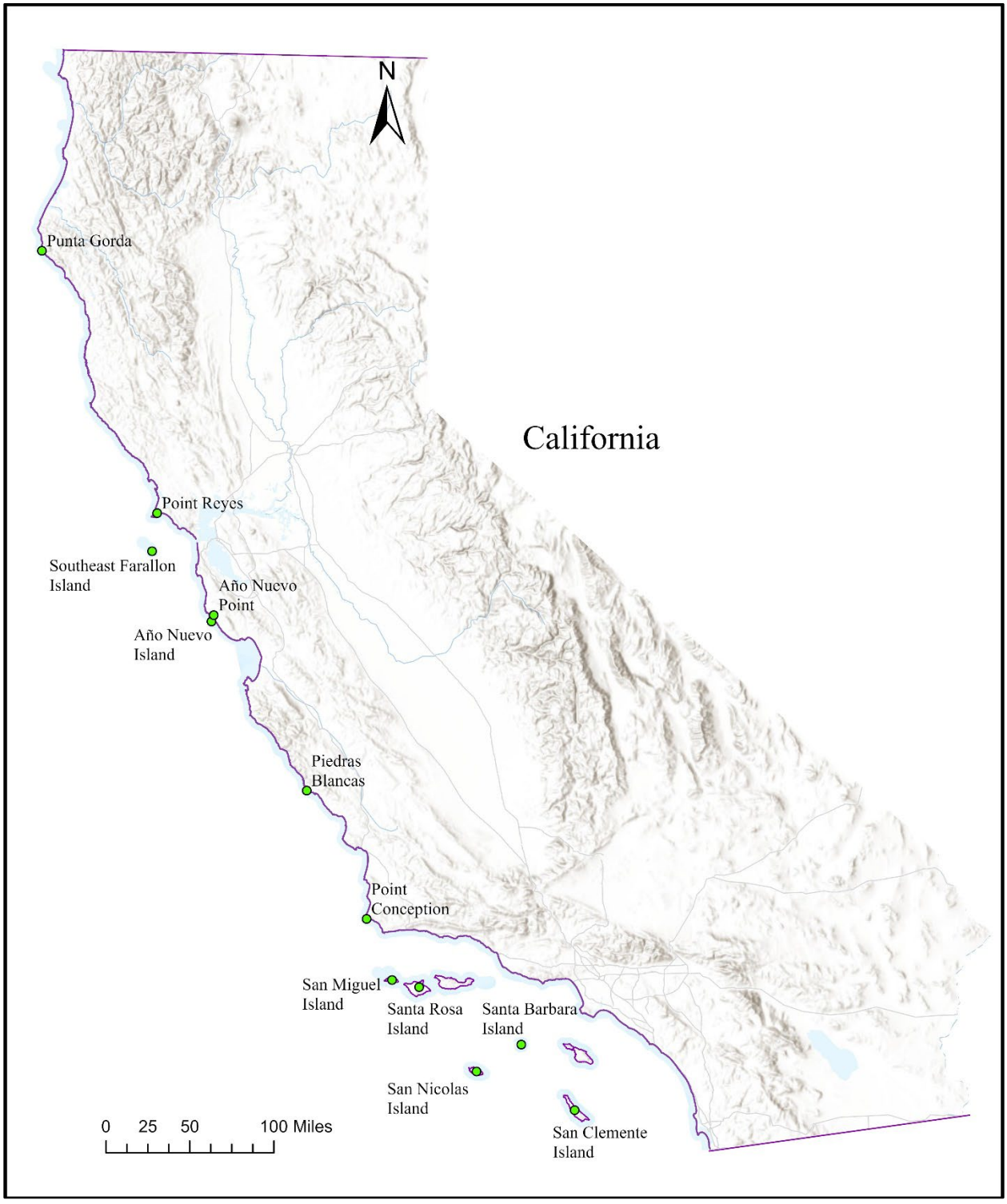

Figure 1. --Survey area and breeding rookeries (green dots) of northern elephant seals (*Mirounga angustirostris*) in California that were surveyed for this study and described in Lowry et al. (2014) and Levy (2022).

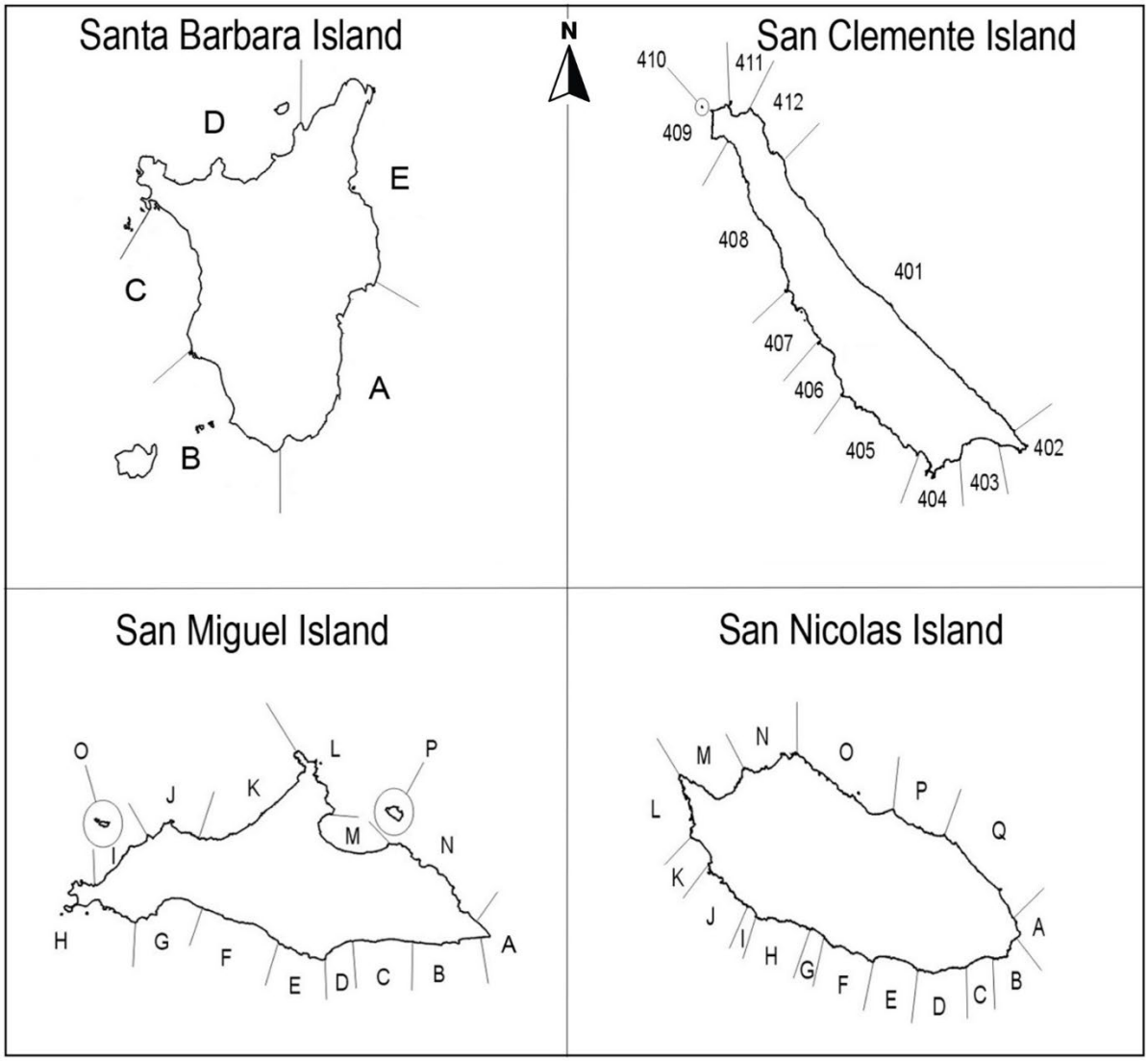

Figure 2. -- Area codes for Santa Barbara Island, San Clemente Island, San Miguel Island, and San Nicolas Island. Area codes for San Clemente Island are from Bonnell et al. (1980). Refer to Appendix for geographical positions (i.e., latitude and longitude) of area boundaries.

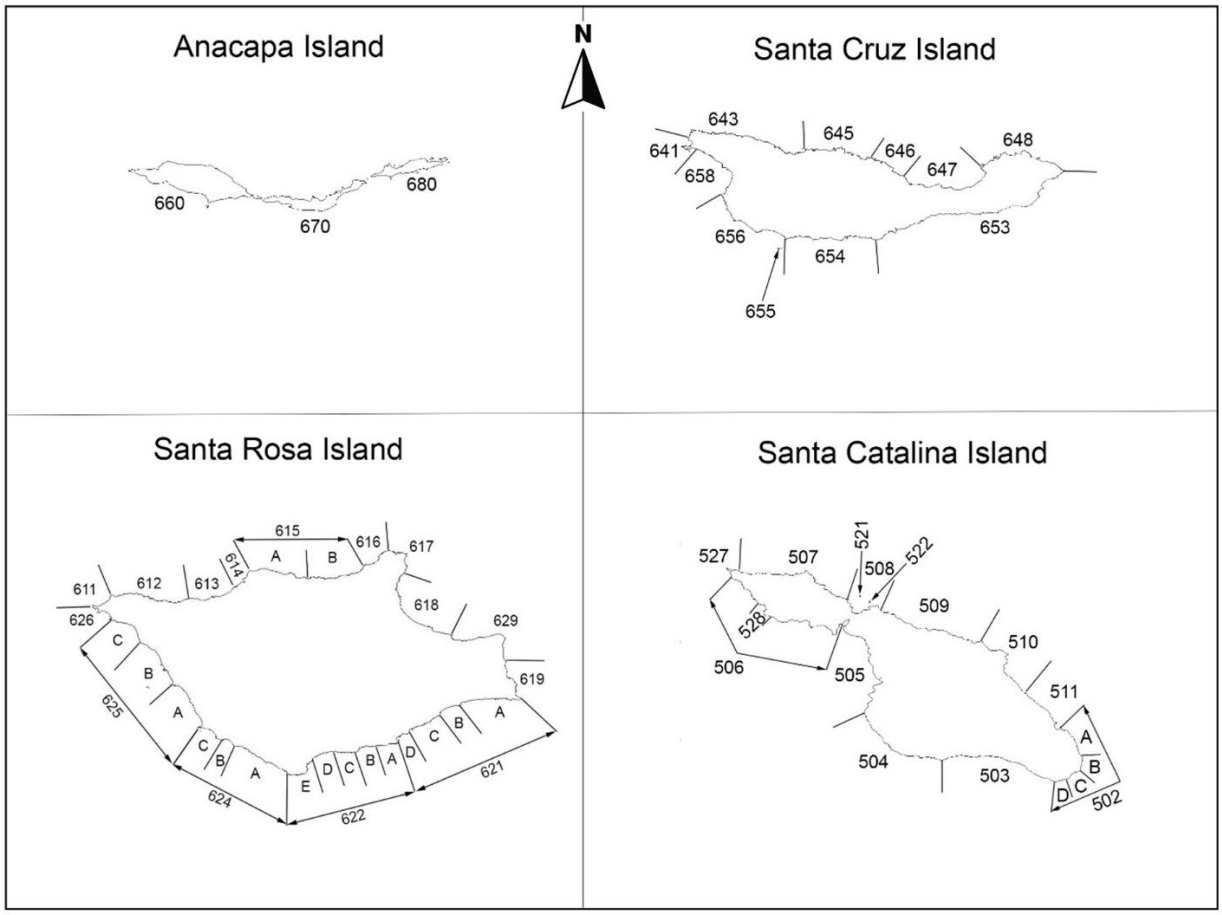

Figure 3. -- Area codes for Santa Catalina Island, Santa Cruz Island, Anacapa Island, and Santa Rosa Island from Bonnell et al. (1980). Areas 615, 621, 622, 624, and 625 at Santa Rosa Island and area 502 at Santa Catalina Island were further divided into subareas. Area 502C at Santa Catalina Island includes area 523 from Bonnell et al. (1980). Refer to Appendix 1 for geographical positions (i.e., latitude and longitude) of area boundaries.

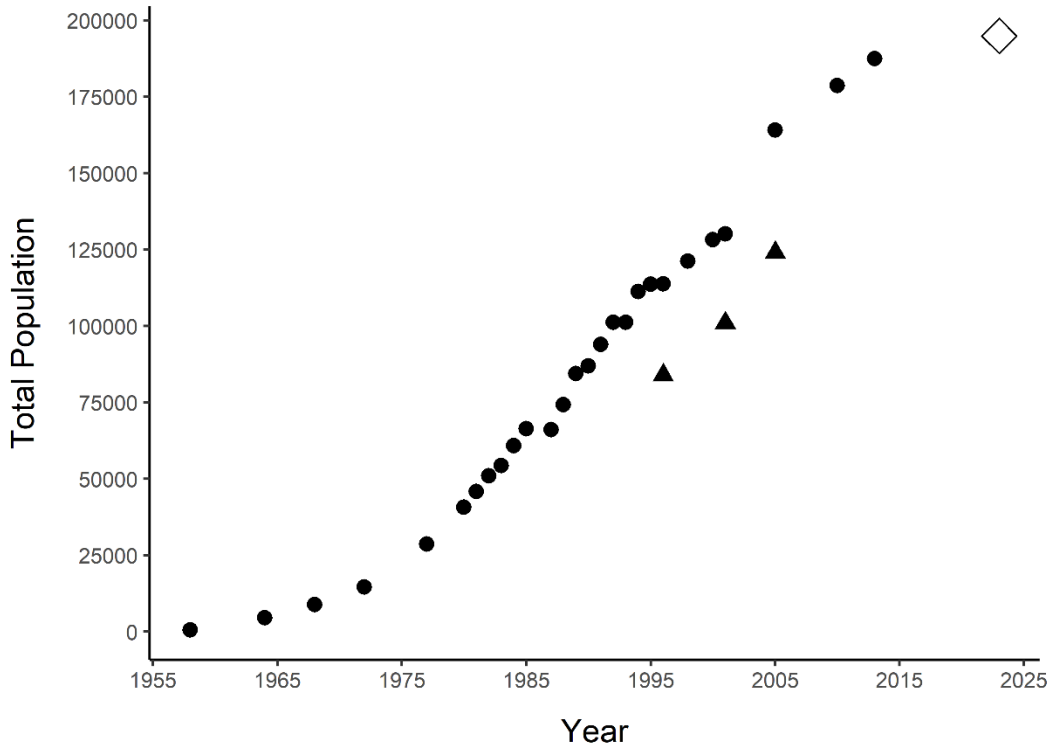

Figure 4. -- Estimated total U.S. population abundance of northern elephant seals (*Mirounga angustirostris*) in California, 1958–2023. Circles represent estimates from a population growth rate of 17% (multiplier 4.4; Lowry et al. 2014) from 1958 to 1987 and 3.8% (multiplier 4.39; Lowry et al. 2014) from 1988 to present. Pup births used to derive the total U.S. population estimate 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. Triangles represent estimates from previous Stock Assessment Reports (Barlow 1997, Carretta 2002, Carretta et al. 2007) that used a multiplier of 3.5 (Boveng 1988; Barlow et al. 1993). The open diamond represents the 2023 population estimate from this study derived from a published model (Condit et al. 2022) and an assumed population growth rate of 3.8% (Lowry et al. 2014).

APPENDIX

Appendix Table 1. -- Geographical positions (expressed in degrees decimal) for area code boundaries used to subdivide the California Channel Islands coastlines for northern elephant seal counts from aerial fixed-wing surveys.

		Waypoint #1		Waypoint #2	
Island	Area	Latitude	Longitude	Latitude	Longitude
San Miguel Island	A	34.032	-120.31	34.019	-120.31
	B	34.019	-120.31	34.02	-120.33
	C	34.02	-120.33	34.019	-120.35
	D	34.019	-120.35	34.015	-120.36
	E	34.015	-120.36	34.02	-120.38
	F	34.02	-120.38	34.03	-120.4
	G	34.03	-120.4	34.025	-120.43
	H	34.025	-120.43	34.037	-120.44
	I	34.037	-120.44	34.051	-120.42
	J	34.051	-120.42	34.057	-120.38
	K	34.057	-120.38	34.076	-120.37
	L	34.076	-120.37	34.059	-120.36
	M	34.059	-120.36	34.049	-120.34
	N	34.049	-120.34	34.032	-120.31
	O	34.055	-120.44		
	P	34.058	-120.33		
San Nicolas Island	A	33.234	-119.44	33.223	-119.44
	B	33.223	-119.44	33.22	-119.45
	C	33.22	-119.45	33.217	-119.46
	D	33.217	-119.46	33.217	-119.48
	E	33.217	-119.48	33.219	-119.5
	F	33.219	-119.5	33.227	-119.52
	G	33.227	-119.52	33.23	-119.52
	H	33.23	-119.52	33.233	-119.55
	I	33.233	-119.55	33.237	-119.55
	J	33.237	-119.55	33.251	-119.56
	K	33.251	-119.56	33.259	-119.57
	L	33.259	-119.57	33.279	-119.58
	M	33.279	-119.58	33.28	-119.55
	N	33.28	-119.55	33.285	-119.53
	O	33.285	-119.53	33.267	-119.49

Appendix -- (Cont.).

		Waypoint #1		Waypoint #2	
Island	Area	Latitude	Longitude	Latitude	Longitude
San Nicolas Island	P	33.267	-119.49	33.259	-119.47
(Cont.)	Q	33.259	-119.47	33.234	-119.44
Santa Barbara Island	A	33.476	-119.03	33.465	-119.04
	B	33.465	-119.04	33.473	-119.04
	C	33.473	-119.04	33.481	-119.05
	D	33.481	-119.05	33.486	-119.03
	E	33.486	-119.03	33.476	-119.03
San Clemente Island	401	33.001	-118.55	32.83	-118.36
	402	32.83	-118.36	32.82	-118.37
	403	32.82	-118.37	32.812	-118.4
	404	32.812	-118.4	32.815	-118.44
	405	32.815	-118.44	32.852	-118.5
	406	32.852	-118.5	32.885	-118.52
	407	32.885	-118.52	32.918	-118.55
	408	32.918	-118.55	33.012	-118.59
	409	33.012	-118.59	33.036	-118.6
	411	33.036	-118.6	33.033	-118.58
	412	33.033	-118.58	33.001	-118.55
	410	33.034	-118.61		
Santa Rosa Island	611	34.001	-120.25	34.008	-120.24
	612	34.008	-120.24	34.007	-120.19
	613	34.007	-120.19	34.013	-120.16
	614	34.013	-120.16	34.024	-120.15
	615A	34.024	-120.15	34.02	-120.1
	615B	34.02	-120.1	34.029	-120.07
	616	34.029	-120.07	34.037	-120.06
	617	34.037	-120.06	34.023	-120.05
	618	34.023	-120.05	33.983	-120.01
	629	33.983	-120.01	33.967	-119.98
	619	33.967	-119.98	33.943	-119.97
	621A	33.943	-119.97	33.938	-120.01
	621B	33.938	-120.01	33.932	-120.02
	621C	33.932	-120.02	33.921	-120.04
	621D	33.921	-120.04	33.915	-120.05
	622A	33.915	-120.05	33.912	-120.07
	622B	33.912	-120.07	33.909	-120.08
	622C	33.909	-120.08	33.909	-120.09

Appendix -- (Cont.).

		Waypoint #1		Waypoint #2	
Island	Area	Latitude	Longitude	Latitude	Longitude
Santa Rosa Island	622D	33.909	-120.09	33.903	-120.11
(Cont.)	622E	33.903	-120.11	33.894	-120.12
	624A	33.894	-120.12	33.912	-120.16
	624B	33.912	-120.16	33.917	-120.17
	624C	33.917	-120.17	33.925	-120.18
	625A	33.925	-120.18	33.952	-120.2
	625B	33.952	-120.2	33.979	-120.22
	625C	33.979	-120.22	33.993	-120.24
	626	33.993	-120.24	34.001	-120.25
Santa Cruz Island	643	34.069	-119.92	34.057	-119.79
	645	34.057	-119.79	34.043	-119.71
	646	34.043	-119.71	34.029	-119.69
	647	34.029	-119.69	34.036	-119.61
	648	34.036	-119.61	34.053	-119.57
	649	34.053	-119.66	34.034	-119.52
	653	34.034	-119.52	33.96	-119.72
	654	33.96	-119.72	33.96	-119.82
	656	33.96	-119.82	34.008	-119.89
	658	34.008	-119.89	34.055	-119.91
	641	34.055	-119.91	34.069	-119.92
	655	33.951	-119.83		
Anacapa Island	660	34.01	-119.43		
	670	34.004	-119.39		
	680	34.015	-119.37		
Santa Catalina Island	507	33.477	-118.6	33.453	-118.5
	508	33.453	-118.5	33.443	-118.47
	509	33.443	-118.47	33.417	-118.39
	510	33.417	-118.39	33.373	-118.35
	511	33.373	-118.35	33.344	-118.32
	502A	33.344	-118.32	33.32	-118.3
	502B	33.32	-118.3	33.309	-118.31
	502C	33.309	-118.31	33.301	-118.32
	502D	33.301	-118.32	33.299	-118.33
	503	33.299	-118.33	33.317	-118.42
	504	33.317	-118.42	33.357	-118.49
	505	33.357	-118.49	33.432	-118.51

Appendix -- (Cont.).

		Waypoint #1		Waypoint #2	
Island	Area	Latitude	Longitude	Latitude	Longitude
Santa Catalina Island	506	33.432	-118.51	33.47	-118.6
(Cont.)	527	33.47	-118.6	33.477	-118.6
	528	33.434	-118.56	33.448	-118.58
	521	33.463	-118.49		
	522	33.451	-118.49		

U.S. Secretary of Commerce
Howard Lutnick

Under Secretary of Commerce
for Oceans and Atmosphere
Laura Grimm

Assistant Administrator, National
Marine Fisheries Service.
Eugenio Piñeiro Soler

December 2025

www.nmfs.noaa.gov

OFFICIAL BUSINESS

National Marine
Fisheries Service
Alaska Fisheries Science Center
7600 Sand Point Way N.E.
Seattle, WA 98115-6349