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WINTER SURVEYS AT THE CHANNEL ISLANDS AND POINT CONCEPTION REVEAL POPULATION GROWTH OF NORTHERN ELEPHANT SEALS AND RESIDENCE COUNTS OF OTHER PINNIPEDS

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Winter surveys at the Channel Islands and Point Conception reveal population growth of northern elephant seals and residence counts of other pinnipeds

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ABSTRACT

Winter surveys of the Channel Islands and Point Conception were conducted during 2002-2018 to (1) derive estimates of northern elephant seal (*Mirounga angustirostris*) births for estimating population growth rates and abundance, (2) estimate pre-census pup mortality for mid-to-late February surveys, (3) document breeding season abundance and distribution of elephant seals, and (4) document non-breeding season abundance and distribution of California sea lions (*Zalophus californianus*), Pacific harbor seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), and northern fur seals (*Callorhinus ursinus*). Data were obtained from ground counts conducted at San Clemente Island during 2002-2015 and 2017-2018, and from aerial photographic surveys conducted at all Channel Islands and Point Conception in 2005, 2010, and 2013. Northern elephant seal births were estimated from (1) counts of live plus dead pups, or (2) by applying the 97.5% fecundity rate of Año Nuevo rookery to counts of adult females or to estimates of the asynchronous population of adult females derived from multiple breeding season surveys conducted at the three largest Channel Islands rookeries during January, February, and March at San Nicolas Island in 2010, and at San Miguel, San Nicolas, and Santa Rosa Islands in 2013. Pre-census pup mortality was estimated for mid-to-late February surveys because they could be applied to previous surveys made during that time and because multiple-surveys are too costly to conduct for the Channel Islands (making it likely that single mid-to-late February surveys will be conducted in the future). Pre-census pup mortality for the mid-to-late-February surveys was higher in 2010 (7.1%) than it was in 2013 (2.7% to 3.6%). Multipliers for estimating pre-census pup mortality from dead pups counted in mid-to-late February surveys ranged from 2.40 to 3.36, with a 2013 mean multiplier of 2.93. Multipliers converted dead pup counts from mid-to-late-February surveys into an estimate of total pre-census pup mortality, then added to the count of live pups to estimate total births. Elephant seal birth estimates indicated that the population at the Channel Islands increased at an average annual rate of 3.1% during 1989-2013 with an abundance of 153,387 (95%CI: 132,509 to 175,506) individuals in 2013. San Miguel, San Nicolas, and Santa Rosa Islands accounted for 99.6% to 99.8% of elephant seal births at the Channel Islands. During 2013 surveys, California sea lions were found at all of the Channel Islands, and Pacific harbor seals were found at all islands except Anacapa and Santa Catalina Islands. Steller sea lions were found at San Miguel, Anacapa, and San Clemente Islands, and northern fur seals were found only at San Miguel Island.

INTRODUCTION

The Channel Islands, located in the Southern California Bight, (SCB; Figure 1), are inhabited by large populations of pinnipeds. Northern elephant seals (*Mirounga angustirostris*), California sea lions (*Zalophus californianus*), and Pacific harbor seals (*Phoca vitulina richardsi*) are the most numerous pinniped species (Lowry et al., 2008; Lowry et al., 2014; Lowry et al., 2017a). California sea lions and Pacific harbor seals are found at all of the Channel Islands, and elephant seals are found at five of the Channel Islands (Lowry et al., 2008; Lowry et al., 2014; Lowry et al., 2017a). Northern fur seals (*Callorhinus ursinus*) have only been observed at San Miguel Island (Orr, et al., 2012), and Steller sea lions (*Eumetopias jubatus*) and Guadalupe fur seals (*Arctocephalus townsendi*) are rare visitors to the Channel Islands (Bonnell et al., 1980; Stewart and Yochem, 1984).

In the SCB, eight of the twelve Channel Islands are located in the U.S., and a group of four islands, known as Islas Coronados, are located in Mexico (Figure 1). Only the islands

located in the U.S. are discussed here. The eight islands in the U.S. are Anacapa Island (AI), Santa Cruz Island (SCruzI), Santa Rosa Island (SRI), San Miguel Island (SMI), Santa Barbara Island (SBI), San Nicolas Island (SNI), Santa Catalina Island (SCatI), and San Clemente Island (SCI). Three islets that have pinnipeds are Castle Rock (located 1 km from the NW shoreline of SMI), Richardson Rock (located 10 km NW from Point Bennett, SMI), and Gull Island (located 1.4 km from Punta Arena, SCruzI). SMI and SNI have the largest number of pinnipeds of all the Channel Islands (Bonnell et al., 1980; Lowry, 2002; Lowry et al., 2014; Lowry et al., 2017a).

Government agencies and private organizations are responsible for managing resources and activities at each of the Channel Islands. The U.S. Navy manages the island and surrounding waters of SNI and SCI. Channel Islands National Park manages AI, SCruzI (the National Park Service owns 24% of the island), SRI, SMI, and SBI. The Nature Conservancy also manages SCruzI (it owns 76% of the island). Channel Islands National Marine Sanctuary manages the surrounding waters from the mean high tide mark to six nautical miles offshore of AI, SCruzI, SRI, SMI, and SBI. The Catalina Island Conservancy manages SCatI. These agencies and organizations require island pinniped distribution data to manage activities that could impact pinnipeds within their respective jurisdictions. Additionally, NOAA Fisheries is responsible for assessing the status of marine mammal stocks, including pinnipeds, in the U.S. under authority of the Marine Mammal Protection Act and Endangered Species Act.

Northern elephant seals (henceforth referred to as elephant seals) were nearly extirpated in the 19th century, with a few (~100 individuals) surviving at Guadalupe Island, Mexico (Bartholomew and Hubbs, 1960; Hoelzel et al., 1993). Subsequently, the current population shows low genetic diversity because of the genetic bottleneck (Bonnell and Selander, 1974; Hoelzel et al., 1993). Despite low genetic diversity, the northern elephant seal population expanded its range and increased in population through the 20th century (Stewart et al., 1994). By 2010, the northern elephant seal population in Mexico and the U.S. occupied seventeen rookeries (Figure 2) and was estimated to have 201,300 individuals, with 179,000 (95% CI: 159,000 to 199,000) residing in the U.S. (Lowry et al., 2014) and 22,300 individuals (95% CI: 18,575 to 25,974) residing in Mexico (Garcia-Aguilar, 2018). The U.S. population grew at an estimated average annual rate of 3.8% during 1988-2010 (Lowry et al., 2014), but the Mexico population decreased at an average rate of 1.0% during 1970-2009 (Garcia-Aguilar, 2018). The largest rookeries in the U.S. population are located at San Miguel, San Nicolas, and Santa Rosa Islands, three of the Channel Islands in southern California (Lowry et al., 2014). Southern California rookeries accounted for 81.5% of births in the U.S. in 2010, and the remaining 18.5% of births mostly occurred at Piedras Blancas, Año Nuevo, and Point Reyes in central California (Figure 2; Lowry et al., 2014). Elephant seals are also found in small numbers at San Clemente Island, Santa Barbara Island, and South Farallon Islands, and on the mainland coast at Point Conception and Cape San Martin/Gorda, (Lowry et al., 2014). Continued monitoring of the elephant seal population provides updated life history data for estimating birth rates, population growth, and distribution, which are crucial to their conservation and management. Surveys of breeding individuals provide a unique opportunity to collect abundance and distribution data on other pinniped species during their respective non-breeding seasons. Understanding how populations shift throughout the year during both breeding and non-breeding seasons provides greater insight into spatial habitat use. However, inter-island distribution studies are rarely conducted during the non-breeding season, and those that have been conducted in the past are outdated (e.g., Bonnell et al., 1980) or only cover one season (e.g., Lowry et al., 2017b).

In 1987, the Southwest Fisheries Science Center (SWFSC) began using aerial photography at the Channel Islands to census pinnipeds. Winter aerial surveys began at SMI in 1988, then expanded to include additional islands, until 1992 when all the Channel Islands were included in elephant seal aerial surveys (Lowry et al., 1996; Lowry, 2002). Winter surveys were intended to census elephant seals during peak breeding season (December to mid-March; Le Boeuf and Laws, 1994) after all pups had been born, because pup counts were used to monitor population trends and abundance of the U.S. population. Prior to 2013, only elephant seals were counted during winter surveys. However, in winter 2013, all pinnipeds were counted at the Channel Islands to document inter and intra-island distribution of all species. These winter surveys provide data for estimating population trends and abundance of elephant seals at the Channel Islands during their breeding season, and provide residence count-data for California sea lions, Pacific harbor seals, northern fur seals, and Steller sea lions in southern California during their non-breeding period. However, it is important to note that these non-reproductive season residence counts currently can be used to infer regional and seasonal use of islands, but new methods are needed to estimate seasonal population abundance.

Here, we use a combination of ground and aerial surveys conducted during the winter months to provide counts of elephant seals, California sea lions, Pacific harbor seals, northern fur seals, and Steller sea lions hauled out at the Channel Islands during 2013, as well as provide distribution data on elephant seals from 2002-2018. Our primary goals are to 1) describe the distribution of elephant seals at SCI during 2002-2015 and 2017-2018, and at all Channel Islands and Point Conception in 2005, 2010, and 2013; 2) use estimated elephant seal births for each rookery in 2005, 2010, and 2013 to estimate average annual population growth rates and population abundance for the Channel Islands during those years; and 3) provide total counts and inter-island distributions of California sea lions, Pacific harbor seals, northern fur seals, and Steller sea lions at the Channel Islands during a portion of their non-breeding period (winter 2013) by species and among various age/sex classes.

METHODS

Study Area

Surveys were conducted in southern California at the Channel Islands and along the mainland coast between Ventura and Oceano (Figure 1). Ground surveys were conducted at and near Mail Point, SCI (where the elephant seal rookery is located) during January 2002-2015 and 2017-2018. Aerial photographic surveys at all Channel Islands and between Ventura and Oceano were conducted during mid-February 2005, 2010, and 2013. Additional aerial surveys were conducted during January, February, and March at SNI in 2010 and at SMI, SNI, and SRI in 2013. Pinniped counts for Castle Rock were included in counts of SMI and counts for Gull Island were included in counts of SCruzI, but no counts were obtained for Richardson Rock.

Survey methods

Biologists on the ground counted elephant seals using mechanical hand-counters while observing them directly or through a hand-held binocular during surveys at San Clemente Island. For aerial photographic counts, elephant seals and other pinnipeds were counted from vertical aerial photographs taken with a high-resolution large-format film camera during 2005 or with a digital single lens reflex (DSLR) camera during 2010 and 2013.

Aerial photographic surveys were conducted with a twin-engine, high-winged Partenavia

P-68 Observer model aircraft (Figure 3). The glass nose of the Partenavia P-68 Observer model aircraft provided the pilot with excellent forward and downward views for aligning the aircraft over beaches and rocks. The aircraft was flown at a ground speed of 185 km/h (100 knots) and 213 m (700 ft.) altitude during 2005 and at 244 m (800 ft.) altitude during 2010 and 2013. At SBI, the aircraft was flown at approximately 396 m (1300 ft.) due to seabird colony restrictions. The low altitude and lens configuration ensured that California sea lions and Pacific harbor seals could be detected on rocky substrates (especially when animals were wet and consequently darkly colored), aided in identification of different pinniped species and age/sex classes, and enabled accurate counts of all pinniped species from aerial photographs. The aircraft was flown directly over the coastline to locate and photograph pinnipeds onshore. Multiple overlapping photographic passes were made over large rocks and portions of island coastlines and beaches to ensure that all hauled-out pinnipeds were photographed. Surveys were conducted without regard to tidal conditions and at any time of day between approximately 2 hours after sunrise and 2 hours before sunset.

In 2005, elephant seals and other pinnipeds were photographed with a 126-mm-format Chicago Aerial Industries, Inc. KA-76 military reconnaissance camera equipped with forward motion compensation and operated at a cycle rate that achieved 67% overlap between adjacent frames. The location of each photograph was recorded by linking the camera to a laptop computer and Global Positioning System (GPS) receiver. Image motion compensation and camera operations were achieved by using custom-made software within an electronic control module manufactured by Aerial Imaging Solutions[1]. The camera was attached to a gimbal camera-mount placed vertically over a camera port inside the aircraft and was manually leveled with a bubble level to obtain a vertical image. A 152-mm-focal-length lens was used for low altitude photography (i.e., altitude of approximately 213 m [700 ft.]) and a 305-mm-focal–length lens was used for higher altitude photography (i.e., altitude of approximately 396 m [1300 ft.]). The camera was set at an aperture of f/5.6 with a shutter speed between 1/400 second and 1/3000 second. KODAK Aerochrome HS Film SO-359, a very fine-grained, high-speed, color transparency film, was used in 2005.

In 2010 and 2013, elephant seals and other pinnipeds were photographed with a Canon EOS 1Ds Mark III, full-frame 21.1-megapixel DSLR camera. A Zeiss 50-mm-focal-length lens or 85-mm-focal-length lens was used in 2010 and 2013, respectively. Image motion compensation was achieved by using a custom-made rocking mechanism in the camera mount manufactured by Aerial Imaging Solutions[1]. The focus ring of the 50mm lens and the 85mm lens was immobilized with tape when focused at 213 m or 244 m, respectively. A laptop computer was connected to the camera, along with a GPS receiver and radar altimeter, and software developed by Aerial Imaging Solutions controlled the camera's forward motion compensation mechanism and fired the camera on command. A video camera and monitor provided a view through the camera's viewfinder, which allowed the operator to see what was being photographed. 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 faced the camera vertically downward over a camera port inside the aircraft, and the camera was manually leveled

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at the vertical position with a bubble level. The computer controlled all camera functions. 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) for detecting wet sea lions on dark rocks. 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.

Elephant seals in 126-mm-format transparencies were counted through a 7-70X zoom binocular microscope with back-illumination on a light table. Animals were counted and marked on a clear acetate overlay with a different colored pen for each age/sex class category. Marks on the acetate were compared and verified with overlapping photographs. If all animals could not be counted in one photograph, another photograph was overlaid at the exact location where the count ended previously, and the count continued on this overlaid photograph. Seals swimming in the water within approximately 30 meters of land were included in the count.

Adobe Bridge CS5 was used to review and select digital photographs which were then sent to Adobe Photoshop CS5 Extended, version 12.1 x64 on Windows 7 64-bit operating system for 2010 survey photographs or to Photoshop Creative Cloud 2015 for 2013 survey photographs for creating photographic mosaics from multiple overlapping digital photographs of beach- and rock-sections which were projected onto a 24-inch or 27-inch Dell ultra-sharp computer monitor. 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. As age/sex class categories were manually counted using the count tool in Adobe Photoshop Extended, each animal was automatically marked with a unique colored dot and number. Adobe Photoshop software maintained a running total of each age/sex class category. The total counted for each age/sex class category would then be manually recorded into a Microsoft Excel spreadsheet along with other data identifying the counts (e.g., island, date, area codes, and mosaic file name), then transferred into a Microsoft Access database.

Species identification and counting categories

For ground counts of elephant seals at SCI, seals were identified, assigned an age-sex class category, and counted from a nearby vantage point. Identification of pinniped species from aerial photographs and age-sex class descriptions are described in Lowry et al. (2017b). Only elephant seals were counted from aerial photographs taken in 2005 and 2010, but all pinniped species were counted from aerial photographs taken in 2013.

Age/sex class counts were made for elephant seals, California sea lions, Steller sea lions, and northern fur seals, but not for Pacific harbor seals. The following age/sex classes were counted: (1) live pups, (2) dead pups, (3) juveniles, (4) adult females, (5) young males, (6) sub-adult males, and (7) adult males.

Intra-island distribution

The perimeter of each island was divided into small area-coded units to describe intra-

island distribution of elephant seals, California sea lions, Pacific harbor seals, northern fur seals, and Steller sea lions. These area-code units 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 codes (Figures 4 and 5). Additionally, area H at SMI, which includes Point Bennett, was further divided into numerical haulout sites (Figure 6) because it is densely populated by various pinniped species whose distribution varies within that area.

Estimate of Births

Births were estimated for all northern elephant seal rookeries in southern California during the 2005, 2010, and 2013 winter breeding seasons. Births are defined as the sum of suckling, weaned, and dead pups near the end of the breeding season, after all pups have been born and before they have departed to sea (Le Boeuf et al. 2011). Recently, births have been estimated from an estimate of the total number of adult females present on the rookery during the breeding season (Le Boeuf et al. 2011, Lowry et al. 2014). Adult females arrive and begin pupping in mid-December, depart after the first week in March, and are most abundant at the end of January to early February. Adult females present at the rookery during the breeding season give birth to a single pup. The total number of births was estimated by taking the fecundity rate estimated for Año Nuevo rookery (97.5%; Le Boeuf et al. 2011) from the total estimated number of adult females. This birth estimate corrects negatively biased counts of adult females because not all adult females are present at the same time during the pupping-breeding season (referred to as an asynchronous population). The total number of adult females was estimated with a model that incorporates data on arrival times and tenure at rookeries based on three or more censuses of adult females during the breeding season (Condit et al., 2007).

We adopted a method described in Lowry et al. (2014) for estimating total births from a mid-to-late-February aerial photographic survey. Mid-to-late-February aerial photographic surveys of Channel Islands elephant seal rookeries usually produce the largest breeding season count of live pups because all pups have been born by that time, as well as provide a count of dead pups. However, the dead pup count requires a correction factor (i.e., multiplier) to compensate for dead pups washed off the beach or buried prior to the survey to derive a pre-census pup mortality estimate and, subsequently, a birth estimate. The correction factor was applied to years where only a mid-to-late-February survey was made. The correction factor has been calculated for 2010 SNI surveys (Lowry et al., 2014). The following describes methodology used in Lowry et al. (2014) for deriving the correction factor to estimate pre-census pup mortality in mid-to-late-February surveys from multiple surveys conducted at SNI, SMI, and SRI in 2010 and 2013:

1. Four or more aerial photographic surveys of an elephant seal rookery were conducted during early, mid, and late breeding season (a minimum of three are required) at SNI in 2010 (six total surveys) and SNI, SMI, and SRI in 2013 (four surveys at each island).
2. Total number of adult females (with 95% CI) present during the breeding season was estimated from the count of adult females from multiple surveys at each rookery using the model described in Condit et al. (2007), then taking 97.5% (the fecundity rate for Año Nuevo rookery) of the estimated total number of adult females as an estimate of total births.
3. The mid-to-late-February count of live pups was subtracted from the birth estimate for that years' rookery survey to yield total pre-census pup mortality.
4. The proportion of dead pups counted to total pre-census pup mortality in mid-to-late-February surveys was calculated for 2010 and 2013 multiple surveys. The inverse of that

proportion yields a dead pup multiplier for estimating total pre-census pup mortality from the count of dead pups in mid-to-late-February surveys.

5. To estimate total births for a rookery where only a mid-to-late-February survey is conducted, the total number of live pups counted is added to the mortality estimate derived by multiplying the count of dead pups with the dead pup multiplier.

Pre-census pup mortality estimates were calculated for mid-to-late-February surveys conducted at SNI for 2010 and 2013, and at SMI and SRI for 2013. Mid-to-late-February dead-pup count multipliers were calculated for SNI, SMI, and SRI, and for the three combined. Birth estimates prior to 2013 were previously estimated in Lowry et al. (2014). Elephant seal rookeries a SBI, SCI, and Point Conception were very small. For these rookeries surveyed during the breeding season, the larger count of either the maximum count of live plus dead pups, or the count of adult females was used.

Population growth and trends

Elephant seal birth estimates documented in Lowry et al. (2014) and those documented in this report were used to estimate Channel Islands population growth rate and the growth rate of each rookery in southern California. The annual rate of increase (λ) is calculated by the equation $\lambda=e^r$ where r is the slope of the linear regression from a series of natural log transformed (ln) counts (Eberhardt and Simmons, 1992) obtained at the same time each year.
A posteriori examination of northern elephant seal birth estimates indicated non-linear growth of birth estimates over time for individual elephant seal rookeries and for regional summations of birth estimates (e.g., Channel Islands). While some rookeries showed an increase in births, others showed a slowing of the growth rate over time. Piecewise linear regression analysis of natural log-transformed birth estimates identified breakpoints in time series data. The program SegReg (http://www.waterlog.info/segreg.htm) was used to determine the location of the breakpoints in the time series of birth estimates and performed linear regression analysis ($y=a+bx$) on each segment time-interval from which the growth rate could be calculated. In some cases, no breakpoints were detected. For each time-interval segment, the following is provided: (1) the average annual rate of increase (λ) calculated from the slope of the regression, (2) the number of observations (years) having birth estimates used in the analysis, (3) the coefficient of determination (R^2), and (4) the coefficient of variation (CV) of the average annual growth rate (slope of the regression divided by the standard error of the slope).

Total population size from birth estimates

A correction factor for estimating total population size from birth estimates in Lowry et al. (2014) was used to estimate population size at each rookery and for all Channel Islands. The most recent annual rate of increase (λ) for each rookery and for all Channel Islands was used to determine which correction factor was used.

Lowry et al. (2014) found that 81.5% of the U.S. population resided at the Channel Islands. A multiplier derived from the inverse of that value (1/0.815 = 1.227) makes it possible to estimate the U.S. total population from the Channel Islands population total estimate.

RESULTS

Elephant seals

During elephant seal breeding season aerial surveys, elephant seals were found at Point Conception and five of the Channel Islands (SMI, SNI, SRI, SBI, and SCI) in 2005, 2010, and 2013, and at AI in 2013 (Table 1). A total of 33,813 elephant seals were counted in mid-February surveys of the Channel Islands in 2005, 43,193 in 2010, and 50,407 in 2013. Multiple surveys at SNI, SMI, and SRI in 2010 and 2013 indicated that more elephant seals were present at the rookeries in late-January (Table 1, Figure 7).

Birth estimates for SMI, SNI, and SRI were estimated from multiple aerial surveys conducted in 2010 at SNI and 2013 at SMI, SNI, and SRI (Table 2). Pre-census pup mortality for the mid-to-late-February surveys was higher in 2010 (7.1%) than it was in 2013 (2.7% to 4.7%; Table 3). Multipliers for estimating pre-census pup mortality from dead pups counted in mid-to-late February surveys ranged from 2.40 to 3.36, with a 2013 mean multiplier of 2.93 (Table 3). Elephant seal births at SMI decreased in 2013 compared to 2005 and 2010, while they increased at SNI, SRI, and SBI (Figure 8). The proportion of elephant seal pups born at SMI compared to other Channel Islands' rookeries declined from 90% in 1964 to 36% in 2013, while they increased at SNI and SRI (Figure 9).

The average annual rate of increase (λ) of birth estimates showed that SCI ($\lambda = 0.965$) and SBI ($\lambda = 0.993$) experienced negative growth, while elephant seal rookeries at SMI ($\lambda = 1.011$), SNI ($\lambda = 1.037$), and SRI ($\lambda = 1.102$) and all Channel Islands combined ($\lambda = 1.031$) experienced positive growth (Table 4). Although the average annual rate of increase at SMI, SNI, and SRI showed an increasing trend in population growth, this increase is slowing. In 2013, the elephant seal population at the Channel Islands was estimated to number 152,719 (95% CI: 131,928 to 174,744) individuals (Table 5). With 81.5% of the U.S. population residing at the Channel Islands, the 2013 Channel Islands population estimate (Table 5) converts to 187,386 individuals in the U.S. (95%CI: 161,876 to 214,418).

Northern elephant seals were not uniformly distributed around the perimeter of each of the Channel Islands (Table 6). Areas A, C, D. E, F, and K at SNI had the most elephant seals on island. Areas 622D, 624B, 624C, 625A, 625B, and 626 at SRI had the most elephant seals on island. Areas A, C, and H at SMI had more elephant seals on island than any other island-area. Within Area H at SMI, haulout sites 54, 58, and 60 had more elephant seals than other sites (Table 7, Figure 10).

California sea lions

In winter 2013, California sea lions were found at all Channel Islands (Table 8). When all islands were surveyed during February 13-15, 2013, a total of 73,485 California sea lions (32,269 pups and 41,216 non-pups) were counted on island. During that period, more non-pups were counted on island at SMI, than were counted on other islands. However, more non-pups were counted on island at SNI and SMI in late January 2013 than were counted at those islands in early-January, mid-February, and early-March (Table 9).

California sea lions were not uniformly distributed around the perimeter of each of the Channel Islands, nor did they have the same number of individuals during each of the four surveys conducted in the January-March 2013 time period (Table 9; Figure 11). Area H at SMI had more California sea lions on island (6,539 to 8,714 pups, and 4,411 to 7,945 non-pups) than any other island-area at SMI (Table 9; Figure 11). Within area H at SMI, haulout sites 54 and 56 had the most sea lions on island than other haulout sites within Area H (Table 7, Figure 10).

Area 406 at SCI had the most California sea lions on island and areas D, H, J, and L at SNI had the most California sea lions on island (Table 9). Area A at SBI had the most sea lions on island.

Pacific harbor seals

Pacific harbor seals were found on island at all of the Channel Islands except SCatI and AI (Table 8) during winter 2013 surveys. There were 622 Pacific harbor seals counted on island at the Channel Islands in mid-February 2013 when all islands were surveyed. SMI, SNI, and SRI had the largest number of Pacific harbor seals of all the Channel Islands (Table 8). In winter 2013 there were 205 to 391 harbor seals counted at SMI, 169 to 556 counted at SNI, and 69 to 268 counted at SRI (Table 8).

Harbor seals were not uniformly distributed around the perimeter of each of the Channel Islands (Table 9; Figure 12). Harbor seals at SMI were found in all areas except K, O, and P; but area J had more than other areas. At SNI, they were found in all areas except K; but areas D, L, N, and Q had more than other areas. At SRI, areas 626, 615A, 621C, 622E, and 625B had the most harbor seals.

Northern fur seals

Northern fur seals were only found on island at SMI during winter 2013 surveys. During four surveys of SMI, 54 to 322 fur seals were counted (Table 8). They were found in haulout sites 54, 58, and 60 within area H, and at area O (Tables 7 and 9).

Steller sea lions

During winter 2013, two juvenile Steller sea lions were counted at area 680 of AI, one young male was counted at area 406 of SCI, two to four sub-adult and adult males were counted at haulout site 55 within area H of SMI, one adult male was counted at area 617 of SRI, and one juvenile was counted at area B of SNI (Tables 7 and 9).

DISCUSSION

Northern elephant seal abundance

The 2013 elephant seal survey at the Channel Islands indicated that the population in southern California continues to grow. However, not all rookeries in southern California are expanding at the same rate. Historically, SMI produced nearly all elephant seal pups within the Channel Islands, but the Channel Islands' proportion from that island steadily declined through time (Lowry et al., 2014, Figure 9). In 2013, SMI had a decrease in births since the 2010 census, but births at SNI and SRI increased.

Elephant seal births can be estimated from multiple surveys of adult females during the breeding season (Le Boeuf et al., 2011; Lowry et al., 2014), as was done for 2010 and 2013 for SNI, SMI, and SRI. From those surveys, the total number of adult females present during the breeding season was estimated based on methodology described in Condit et al. (2007) that estimate total number of adult females. At this time, it is not known whether all rookeries have the same fecundity rate as that of Año Nuevo rookery where the fecundity rate used to convert total number of adult females to births comes from, nor how much it differs between years at other rookeries.

It is impractical to continue to conduct multiple aerial surveys for estimating number of adult females and, subsequently, births at the Channel Islands. Multiple surveys of Channel

Island rookeries are costly to conduct and staff, and take much time to count the animals from photographs collected during those surveys. Here, we also used a second method for estimating births, first described in Lowry et al. (2014), that estimates total pre-census pup mortality for mid-to-late-February aerial photographic surveys of large elephant seal rookeries like those found at the Channel Islands. The pre-census mortality estimate plus the total number of live pups counted from those surveys gives total births during that year's breeding season. This method relies on pre-census pup mortality estimates derived from multiple surveys of adult females. Pre-census pup mortality in 2010 and 2013 at SNI, SMI, and SRI shows that it differs by island and year. Until more data is collected, those pre-census pup mortality estimates will need to be used on mid-to-late-February surveys to estimate births for Channel Islands' rookeries.

We propose a third method for estimating elephant seal births (see Appendix 2), which uses the proportion of adult females present at peak breeding season during late-January to early-February to estimate the total number during the breeding season. An example of this is provided in Table 2 for a survey conducted in January 29-30. However, the number of days that a Channel Islands survey can be conducted could exceed this two-day period due to weather, naval operations, or aircraft availability. By modeling proportions of adult females present during various times of the breeding season using data from multiple surveys, a Gaussian equation derived from them will predict the proportion of adult females present on a given day during the peak adult female abundance period. Adding data from future surveys could increase the accuracy of the equation that produces the predicted values. It must be noted, however, that the proportions prior to the peak exceeded the Gaussian estimated regression line. More analysis will be required before this method is adopted.

Presence of other pinnipeds

California sea lions were present at all of the Channel Islands during winter 2013 surveys, but were not as abundant as they are during summer. On island sea lion counts of non-pups from the mid-February 2013 survey of the Channel Islands were 50.6% (SD = 5.4%) of what were on island during July 2011-2015 surveys described by Lowry et al. (2017b). Also, on island sea lion abundance varied during the four 2013 elephant seal breeding season surveys conducted during winter at SMI, SNI, and SRI.

Pacific harbor seals were also less abundant in our winter surveys than during the spring molt period when harbor seal surveys are conducted in California (Lowry et al., 2008). Steller sea lions were found at some of the Channel Islands, but their low numbers indicate they are rare visitors. Northern fur seals only were found on island at SMI, but at greatly reduced population levels than are found in July surveys conducted during their breeding season.

Intra-island distributions

Intra-island distribution of elephant seals and California sea lions at the larger rookeries was very different from intra-island distributions described since the late 1970s (Bonnell et al., 1980; Stewart and Yochem, 1984). As populations of elephant seals and California sea lions grew, coastal occupation of the islands increased and spread around each of the main rookery-islands. At SNI, elephant seals increased eastward along the southern shoreline and, eventually, occupied portions of the northern shoreline. At SMI, they increased along the northwestern shoreline from Point Bennett to Otter Harbor (Areas I and J), and on the southeastern and eastern end of the island (Areas A, B, and C). At SRI, elephant seals have spread throughout the

southern shoreline of the island, with the highest concentrations found on the western end of the island, and in the larger sandy coves found along the southern shoreline to the east.

Since 1927, pinniped surveys conducted at the Channel Islands, most of which took place during summer, documented pinniped inter-island distribution (for lists refer to Lowry et al., 2017a). The most thorough intra-island study of pinniped distribution at the Channel Islands included 24 surveys during 1975-1977 (Bonnell et al., 1980). Since then, smaller-scale intra-island pinniped distribution studies have been published for some or all of the Channel Islands (e.g., Stewart and Yochem, 1984; Stewart, 1989; Lowry, 2002; Lowry et al., 2017b). Previous descriptions of intra-island pinniped distribution during winter are currently obsolete for all pinnipeds due to the amount of time that lapsed since they were conducted and to increased population levels.

Conclusions

Past intra-island surveys demonstrate that abundance and distribution of various pinniped species shift from breeding to non-breeding activities on the islands during the year, suggesting that there is a need for multi-year surveys for the winter, spring, and autumn at the Channel Islands to document how pinnipeds utilize island coastal areas seasonally. In addition to estimating abundance of elephant seals, our study provides updated, detailed information on intra-island distribution of five pinniped species at the Channel Islands. The data tables and figures in this report provide information for managing human activities along the coastline of each of the Channel Islands during the winter season. Pinniped surveys conducted during additional seasons and years would provide additional data for managing coastal use by humans.

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Table 1. Elephant seals counted at the Channel Islands and the mainland at Point Conception in southern California during breeding season surveys conducted in 2002-2015 and 2017-2018. All Channel Islands were surveyed in 2005, 2010, and 2013. Only San Clemente Island was surveyed during 2002-2015 and 2017-2018. Grd = Ground count, Ph = Count from 126 mm-format color film, and DPh = Count from digital photograph. No count was obtained in blank cells.

Rookery	Year	Survey date	Method	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
Anacapa Island	2013	Feb 13	DPh	1	0	0	1	0	0	0	1	2
Point Conception	2005	Feb 26	Ph	6	0	0	1		1[a]		2	8
	2010	Feb 20	DPh	8	0	0	2		1[a]		3	11
	2013	Feb 15	DPh	16	0	0	7	0	0	1	8	24
San Clemente Island	2002	Jan 29	Gr	18	0	2	21	0	1	2	26	44
	2003	Jan 23	Gr	9	0	2	19	0	0	2	23	32
	2004	Jan 13	Gr	11	0	5	25	0	0	3	33	44
	2005	Jan 25	Gr	19	7	3	47	0	1	3	54	73
	2006	Jan 12	Gr	7	2	6	30	0	1	2	42	49
	2007	Jan 24	Gr	29	0	7	47	0	2	3	59	88
	2008	Jan 30	Gr	43	1	0	65	0	3	3	71	114
	2009	Jan 28	Gr	48	1	9	58	0	0	3	70	118
	2010	Jan 26	Gr	54	3	1	57	0	7	5	70	124
		Feb 20	DPh	53	3	0	9		10[a]		19	72
	2011	Jan 26	Gr	42	0	1	47	0	0	0	57	99
	2012	Jan 24	Gr	42	1	9	51	0	4	8	72	114
	2013	Jan 15	Gr	25	1	3	45	0	3	5	56	81
		Feb 15	DPh	46	2	0	12	0	3	4	19	65
	2014	Jan 28	Gr	37		2	42	0	3	4	51	88
	2015	Jan 23	Gr	31	0	0	46	0	2	5	53	84
	2017	Jan 27	Gr	49		2	47	0	0	3	52	101
	2018	Jan 29	Gr	30	1	0	37	0	0	2	39	69
San Miguel Island	2005	Feb 24	Ph	13,931	453	1	1,758		1,699[a]		3,458	17,389
	2010	Feb 16	DPh	14,802	374	4	4,653		1,733[a]		6,390	21,192
	2013	Jan 09	DPh	2,720	50	417	5,234	8	1,110	835	7,604	10,324
		Jan 30	DPh	11,212	154	20	11,001	0	541	1,017	12,579	23,791
		Feb 14	DPh	11,884	172	3	5,023	5	552	759	6,342	18,226
		Mar 07	DPh	11,615	216	44	152	1	197	416	810	12,425
Santa Barbara Island	2005	Feb 24	Ph	55	0	0	13		8[a]		21	76
	2010	Feb 17	DPh	51	0	0	20		10[a]		30	81
	2013	Feb 15	DPh	74	0	1	34	0	1	3	39	113

Table 1. (Continued)

Rookery	Year	Survey date	Method	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
San Nicolas Island	2005	Feb 25	Ph	9,591	174	1	910		799[a]		1,710	11,301
	2010	Jan 08	DPh	2,652	22	61	4,813		1,033[a]		5,907	8,559
		Jan 23	DPh	7,899	98	17	9,945		1,058[a]		11,020	18,919
		Jan 29	DPh	9,808	172	6	9,537		1,084[a]		10,627	20,435
		Feb 04	DPh	10,252	201	8	8,061		1,014[a]		9,083	19,335
		Feb 17	DPh	10,089	211	2	2,838		929[a]		3,769	13,858
		Mar 01	DPh	9,781	151	1	235		751[a]		987	10,768
	2013	Jan 12	DPh	4,156	72	190	6,687	0	428	574	7,879	12,035
		Jan 29	DPh	11,563	135	29	11,447	1	405	585	12,467	24,030
		Feb 15	DPh	12,247	195	4	5,037	7	293	561	5,902	18,149
		Mar 05	DPh	12,251	157	42	224	7	172	369	814	13,065
Santa Rosa Island	2005	Feb 24	Ph	4,148	21	0	345		481[a]		826	4,974
	2010	Feb 16	DPh	5,709	63	2	1,741		785[a]		2,528	8,237
	2013	Jan 09	DPh	2,046	26	199	3,923	4	400	433	4,958	7,004
		Jan 30	DPh	8,514	51	5	8,397	0	223	544	9,169	17,683
		Feb 14	DPh	9,197	88	3	3,787	2	221	514	4,527	13,724
		Mar 07	DPh	8,775	28	39	116	2	125	178	460	9,235

[a] Young males, sub-adult males, and adult males were not differentiated.

Table 2. Model estimates of number of adult female elephant seals present at San Nicolas, San Miguel, and Santa Rosa Islands from multiple aerial photographic censuses conducted during pupping-breeding season, including multipliers for estimating total number of adult females during the breeding season from surveys conducted on 29-30 January.

		Total adult female estimate (n)			Adult female count for 29-30 January (n)	Multiplier		
Site	Year	Total	Lower 95% CI	Upper 95% CI		Best estimate	Lower 95% CI	Upper 95% CI
San Nicolas Island	2010	11,161[a]	10,873	11,461	9,537	1.1703	1.1401	1.2017
	2013	13,170	12,877	13,494	11,447	1.1505	1.1249	1.1788
San Miguel Island	2013	12,804	12,567	13,034	11,001	1.1639	1.1424	1.1848
Santa Rosa Island	2013	9,706	9,520	9,899	8,397	1.1559	1.1337	1.1789
Mean multiplier:						1.1601	1.1353	1.1861

[a]Lowry et al. (2014)

Table 3. Estimated northern elephant seal pre-census pup mortality derived from the multi-survey model birth estimates of adult females present during the breeding season and from counts of live pups obtained from mid-February surveys at San Nicolas Island (SNI) in 2010 and 2013, and San Miguel Island (SMI) and Santa Rosa Island (SRI) during 2013. Also included are multipliers for estimating total pre-census pup mortality from counts of dead pups made during mid-February surveys.

		Multi-survey model birth estimate[a]			Live pups counted mid-Feb	Estimated total pre-census pup mortality[b]			Estimated pre-census pup mortality rate (%)			Dead pups counted mid-Feb	Dead pup multiplier		
Island	Year	Estimate	L95% CI	U95% CI		Estimate	L95% CI	U95% CI	Estimate	L95% CI	U95% CI		Estimate	L95% CI	U95% CI
SNI	2010	10,882[c]	10,601	11,174	10,089	793	512	1,085	7.1[c]	4.7	9.5	211	3.76[c]	2.43	5.14
SNI	2013	12,841	12,555	13,157	12,373	468	182	784	3.6	1.4	5.8	195	2.40	0.93	4.02
SMI	2013	12,484	12,253	12,708	11,884	600	369	824	4.7	2.9	6.3	172	3.49	2.15	4.79
SRI	2013	9,463	9,282	9,652	9,197	266	85	455	2.7	0.9	4.6	88	3.02	0.97	5.17
SNI+SMI+SRI	2013	34,788	34,090	35,517	33,454	1,334	636	2,063	3.8	1.9	5.8	455	2.93	1.40	4.53

[a]Births equals 97.5% of the number of adult females estimated from multi-survey model of breeding season surveys (Refer to Table 2).

[b]Pre-census pup mortality equals multi-survey model birth estimate minus the number of live pups counted in mid-February census.

[c]Used in Lowry et al. (2014).

Table 4. Average annual rate of increase (λ) of northern elephant seal birth estimates, number of observations (n), coefficient of determination (R^2), coefficient of variation (CV) for the rate of increase that were computed for year-intervals chosen by breakpoint regression analysis of log-transformed northern elephant seal birth estimates for rookeries at the Channel Islands and at Point Conception in the United States. Birth estimates prior to 2011 from Lowry et al. (2014).

Rookery	Year interval	n	R^2	λ	CV
Point Conception	2005-2013	3	0.86	1.123	0.397
San Miguel Island	1958-1984	15	0.91	1.169	0.085
	1985-2013	18	0.35	1.011	0.341
Santa Rosa Island	1985-2013	17	0.86	1.397	0.103
	2005-2013[a]	3	0.95	1.102	0.236
San Nicolas Island	1964-1995	21	0.98	1.151	0.035
	1996-2013	7	0.79	1.037	0.230
Santa Barbara Island	1964-1984	6	0.49	1.067	0.510
	1985-2013	18	0.02	0.993	-1.964
San Clemente Island	1977-2008	22	0.85	1.156	0.093
	2009-2018	9	0.59	0.965	-0.315
Channel Islands	1958-1988	14	0.92	1.159	0.088
	1989-2013	14	0.97	1.031	0.047

[a] Interval chosen arbitrarily.

Table 5. Northern elephant seal birth and population estimates for rookeries at the Channel Islands and at Point Conception for surveys conducted during the breeding season in 2005, 2010, and 2013.

			Birth estimates			Population estimates		
Year	Rookery	Method	Best estimate	L95% CI	U95% CI	Best estimate	L95% CI	U95% CI
2005	Point Conception	Mid-February survey	6	6	6	26	23	29
	San Clemente Island	97.5% of adult females	46	46	46	202	180	224
	Santa Barbara Island	Mid-February survey	55	55	55	237	197	276
	San Miguel Island	Mid-February survey	15,634	15,032	16,259	68,164	55,919	81,132
	San Nicolas Island	Mid-February survey	10,245	10,014	10,485	44,976	38,754	51,586
	Santa Rosa Island	Mid-February survey	4,227	4,199	4,256	18,599	16,418	20,769
	Channel Islands		30,161	29,300	31,055	132,407	113,391	152,791
2010	Point Conception	Mid-February survey	8	8	8	35	31	39
	San Clemente Island	Late-January survey	57	57	57	237	187	287
	Santa Barbara Island	Mid-February survey	51	51	51	220	183	256
	San Miguel Island	Mid-February survey	16,208	15,711	16,724	70,667	58,445	83,453
	San Nicolas Island	Multi-survey	10,882	10,602	11,174	47,772	41,030	54,976
	Santa Rosa Island	Mid-February survey	5,946	5,862	6,033	26,162	22,920	29,441
	Channel Islands		33,144	32,283	34,039	145,502	124,935	167,472
2013	Point Conception	Mid-February survey	16	16	16	70	63	78
	Anacapa Island	Mid-February survey	1	1	1	4	4	5
	San Clemente Island	Mid-February survey	53	49	56	220	161	282
	Santa Barbara Island	Mid-February survey	74	74	74	319	266	371
	San Miguel Island	Multi-survey	12,484	12,253	12,708	54,430	45,581	63,413
	San Nicolas Island	Multi-survey	12,841	12,555	13,157	56,372	48,588	64,732
	Santa Rosa Island	Multi-survey	9,463	9,282	9,652	41,637	36,293	47,102
	Channel Islands		34,788	34,090	35,517	152,719	131,928	174,744

Table 6. Northern elephant seal breeding season island-area counts by age-sex class and category totals obtained from ground counts at San Clemente Island during 2002-2015, 2017, and 2018, and from aerial photographs taken at the Channel Islands during 2005, 2010, and 2013. Counts are provided only for island-areas having elephant seals. Refer to Figures 3 and 4 for location of island-areas. Gr = ground count, Ph = aerial color film photograph, and DPh = digital aerial color photograph.

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
Anacapa Island	680	DPh	2013	Feb 13	1	0	0	1	0	0	0	1	2
San Clemente Island	406	Gr	2002	Jan 29	18	0	2	21	0	1	2	26	44
			2003	Jan 23	9	0	2	19	0	0	2	23	32
			2004	Jan 13	11	0	5	25	0	0	3	33	44
			2005	Jan 25	19	7	3	47	0	1	3	54	73
			2006	Jan 12	7	2	6	30	0	1	3	42	49
			2007	Jan 24	29	0	7	47	0	2	3	59	88
			2008	Jan 30	43	1	0	65	0	3	3	71	114
			2009	Jan 28	48	1	9	58	0	0	3	70	118
		Gr	2010	Jan 26	54	3	1	57	0	7	5	70	124
		DPh	2010	Feb 20	53	3	0	9		10[a]		19	72
		Gr	2011	Jan 26	42	0	1	47	0	0	0	54	96
		Gr	2012	Jan 24	42	1	9	51	0	4	8	72	114
		Gr	2013	Jan 15	25	1	3	45	0	3	5	56	81
		DPh	2013	Feb 15	46	2	0	12	0	2	4	18	64
		Gr	2014	Jan 28	37		2	42	0	3	4	51	88
			2015	Jan 23	0	0	0	0	0	1	0	1	1
			2017	Jan 27	49		2	47	0	0	3	52	101
			2018	Jan 29	30	1	0	37	0	0	2	39	69
	407	Gr	2011	Jan 26	0	0	0	0	0	0	0	3	3
		DPh	2013	Feb 15	0	0	0	0	0	1	0	1	1
		Gr	2015	Jan 23	31	0	0	46	0	1	5	52	83
San Miguel Island	A	Ph	2005	Feb 24	2,802	73	0	323		222[a]		545	3,347
		DPh	2010	Feb 16	3,412	109	1	1,451		307[a]		1,759	5,171
			2013	Jan 09	373	12	31	778	0	81	90	980	1,353
				Jan 30	1,801	30	4	1,812	0	29	176	2,021	3,822
				Feb 14	1,976	35	1	943	0	66	106	1,116	3,092
				Mar 07	1,899	51	5	20	0	17	63	105	2,004
	B	Ph	2005	Feb 24	490	2	0	72		27[a]		99	589
		DPh	2010	Feb 16	356	9	0	19		33[a]		52	408
			2013	Jan 09	268	1	13	498	0	41	34	586	854
				Jan 30	875	2	1	797	0	8	52	858	1,733

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Miguel Island (continued)	B	DPh	2013	Feb 14	907	10	0	256	0	21	24	301	1,208
				Mar 07	944	5	1	14	0	8	16	39	983
	C	Ph	2005	Feb 24	3,276	200	0	455		322[a]		777	4,053
		DPh	2010	Feb 16	2,923	118	0	790		240[a]		1,030	3,953
			2013	Jan 09	654	9	43	1,227	0	124	126	1,520	2,174
				Jan 30	2,538	29	1	2,464	0	41	197	2,703	5,241
				Feb 14	2,686	40	0	1,089	0	85	122	1,296	3,982
				Mar 07	2,491	42	7	30	0	43	78	158	2,649
	D	Ph	2005	Feb 24	441	3	0	57		124[a]		181	622
		DPh	2010	Feb 16	554	15	0	324		76[a]		400	954
			2013	Jan 09	41	2	9	80	0	56	36	181	222
				Jan 30	190	6	0	181	0	34	40	255	445
				Feb 14	199	0	0	61	0	37	23	121	320
				Mar 07	304	5	0	4	0	14	14	32	336
	E	Ph	2005	Feb 24	1,363	19	0	172		90[a]		262	1,625
		DPh	2010	Feb 16	1,261	41	0	486		98[a]		584	1,845
			2013	Jan 09	167	2	20	309	0	45	44	418	585
				Jan 30	790	17	1	795	0	16	48	860	1,650
				Feb 14	859	17	1	396	0	13	45	455	1,314
				Mar 07	843	32	5	7	0	1	17	30	873
	F	Ph	2005	Feb 24	1,090	42	0	143		97[a]		240	1,330
		DPh	2010	Feb 16	1,260	29	0	173		99[a]		272	1,532
			2013	Jan 09	204	1	27	394	0	76	65	562	766
				Jan 30	964	8	4	947	0	29	86	1,066	2,030
				Feb 14	993	7	0	452	0	47	55	554	1,547
				Mar 07	989	10	0	4	0	15	27	46	1,035
	G	Ph	2005	Feb 24	739	10	0	70		64[a]		134	873
		DPh	2010	Feb 16	666	4	0	155		65[a]		220	886
			2013	Jan 09	146	1	35	247	0	33	31	346	492
				Jan 30	502	13	4	479	0	23	52	558	1,060
				Feb 14	532	3	0	223	0	26	34	283	815
				Mar 07	505	7	2	15	1	13	17	48	553
	H	Ph	2005	Feb 24	2,076	95	1	304		475[a]		780	2,856
		DPh	2010	Feb 16	2,149	27	0	671		468[a]		1,139	3,288
			2013	Jan 09	334	18	105	639	5	369	204	1,322	1,656
				Jan 30	1,423	28	5	1,428	0	224	157	1,814	3,237

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Miguel Island (continued)	H	DPh	2013	Feb 14	1,515	47	1	675	5	156	170	1,007	2,522
			2013	Mar 07	1,494	37	7	27	0	46	103	183	1,677
	I	Ph	2005	Feb 24	85	1	0	5		15[a]		20	105
		DPh	2010	Feb 16	55	0	0	3		21[a]		24	79
			2013	Jan 09	50	0	17	87	0	13	12	129	179
				Jan 30	162	0	0	152	0	4	20	176	338
				Feb 14	157	0	0	67	0	2	21	90	247
				Mar 07	169	1	0	0	0	4	3	7	176
	J	Ph	2005	Feb 24	615	4	0	71		87[a]		158	773
		DPh	2010	Feb 16	916	9	1	243		143[a]		387	1,303
			2013	Jan 09	211	2	63	423	3	131	82	702	913
				Jan 30	788	8	0	768	0	40	78	886	1,674
				Feb 14	827	4	0	311	0	52	67	430	1,257
				Mar 07	837	5	9	5	0	18	42	74	911
	K	Ph	2005	Feb 24	191	2	0	16		81[a]		97	288
		DPh	2010	Feb 16	339	2	2	91		99[a]		192	531
			2013	Jan 09	53	0	11	104	0	81	41	237	290
				Jan 30	277	1	0	259	0	50	47	356	633
				Feb 14	352	2	0	135	0	30	44	209	561
				Mar 07	341	10	3	3	0	3	11	20	361
	L	Ph	2005	Feb 24	169	0	0	13		8[a]		21	190
		DPh	2010	Feb 16	166	0	0	37		7[a]		44	210
			2013	Jan 09	59	0	8	127	0	15	14	164	223
				Jan 30	191	0	0	205	0	6	9	220	411
				Feb 14	147	0	0	73	0	0	6	79	226
				Mar 07	165	1	1	10	0	5	4	20	185
	M	Ph	2005	Feb 24	442	1	0	49		68[a]		117	559
		DPh	2010	Feb 16	671	11	0	208		64[a]		272	943
			2013	Jan 09	127	2	22	252	0	29	48	351	478
				Jan 30	594	10	0	599	0	14	45	658	1,252
				Feb 14	627	5	0	305	0	17	39	361	988
				Mar 07	536	9	2	10	0	5	15	32	568
	N	Ph	2005	Feb 24	152	1	0	8		19[a]		27	179
		DPh	2010	Feb 16	74	0	0	2		13[a]		15	89
			2013	Jan 09	33	0	13	69	0	16	8	106	139

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Miguel Island (continued)	N	DPh	2013	Jan 30	117	2	0	115	0	23	10	148	265
				Feb 14	107	2	0	37	0	0	3	40	147
				Mar 07	98	1	2	3	0	5	6	16	114
San Nicolas Island	A	Ph	2005	Feb 25	1,186	8	0	124		82[a]		206	1,392
		DPh	2010	Jan 08	231	1	9	370		62[a]		441	672
				Jan 23	708	13	3	1,040		76[a]		1,119	1,827
				Jan 29	1,050	17	0	1,032		101[a]		1,133	2,183
				Feb 04	1,095	31	0	917		88[a]		1,005	2,100
				Feb 17	1,103	33	0	411		97[a]		508	1,611
				Mar 01	1,100	26	0	29		69[a]		98	1,198
			2013	Jan 12	377	7	17	572	0	17	47	653	1,030
				Jan 29	1,022	19	2	1,023	0	24	58	1,107	2,129
				Feb 15	1,057	21	2	505	0	9	65	581	1,638
				Mar 05	822	12	5	15	0	14	28	62	884
	B	Ph	2005	Feb 25	106	2	0	6		12[a]		18	124
		DPh	2010	Jan 08	27	0	2	71		18[a]		91	118
				Jan 23	82	1	0	89		14[a]		103	185
				Jan 29	82	3	0	78		20[a]		98	180
				Feb 04	87	3	0	54		28[a]		82	169
				Feb 17	111	3	0	5		22[a]		27	138
				Mar 01	147	3	0	1		11[a]		12	159
			2013	Jan 12	86	5	12	167	0	28	11	218	304
				Jan 29	215	4	0	184	0	10	14	208	423
				Feb 15	252	6	0	45	0	7	12	64	316
				Mar 05	414	1	0	8	0	7	10	25	439
	C	Ph	2005	Feb 25	1,091	103	0	137		80[a]		217	1,308
		DPh	2010	Jan 08	364	5	1	586		52[a]		639	1,003
				Jan 23	1,003	16	2	1,283		93[a]		1,378	2,381
				Jan 29	1,282	23	1	1,201		82[a]		1,284	2,566
				Feb 04	1,325	22	1	1,023		77[a]		1,101	2,426
				Feb 17	1,227	22	0	394		86[a]		480	1,707
				Mar 01	988	17	0	30		58[a]		88	1,076
			2013	Jan 12	475	14	8	756	0	16	56	836	1,311
				Jan 29	1,239	16	3	1,210	0	12	60	1,285	2,524
				Feb 15	1,322	23	0	513	1	10	55	579	1,901
				Mar 05	1,094	23	0	20	0	2	26	48	1,142

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Nicolas Island (Continued)	D	Ph	2005	Feb 25	1,019	6	0	77		90[a]		167	1,186
		DPh	2010	Jan 08	264	2	2	466		145[a]		613	877
				Jan 23	717	7	0	926		137[a]		1,063	1,780
				Jan 29	901	20	1	881		140[a]		1,022	1,923
				Feb 04	964	22	0	743		126[a]		869	1,833
				Feb 17	990	18	0	295		88[a]		383	1,373
				Mar 01	1,218	17	0	25		93[a]		118	1,336
			2013	Jan 12	437	11	10	682	0	56	68	816	1,253
				Jan 29	1,142	14	5	1,112	0	46	68	1,231	2,373
				Feb 15	1,247	17	0	496	3	34	67	600	1,847
				Mar 05	1,606	14	2	22	0	21	54	99	1,705
	E	Ph	2005	Feb 25	839	11	0	68		49[a]		117	956
		DPh	2010	Jan 08	229	1	4	363		46[a]		413	642
				Jan 23	633	6	0	796		59[a]		855	1,488
				Jan 29	782	12	0	748		67[a]		815	1,597
				Feb 04	830	11	1	632		64[a]		697	1,527
				Feb 17	813	13	0	247		58[a]		305	1,118
				Mar 01	762	8	0	26		35[a]		61	823
			2013	Jan 12	291	3	7	453	0	11	36	507	798
				Jan 29	791	10	0	776	0	27	42	845	1,636
				Feb 15	804	11	0	377	0	7	44	428	1,232
				Mar 05	744	10	0	15	1	4	24	44	788
	F	Ph	2005	Feb 25	709	3	0	61		66[a]		127	836
		DPh		Jan 08	196	1	7	352		87[a]		446	642
				Jan 23	526	3	1	607		85[a]		693	1,219
				Jan 29	612	6	1	574		90[a]		665	1,277
				Feb 04	617	10	0	458		60[a]		518	1,135
				Feb 17	631	13	1	124		62[a]		187	818
				Mar 01	639	15	0	4		80[a]		84	723
			2013	Jan 12	253	7	19	393	0	30	54	496	749
				Jan 29	795	11	1	804	0	33	44	882	1,677
				Feb 15	828	18	0	406	0	18	44	468	1,296
				Mar 05	1,114	10	4	10	0	9	36	59	1,173
	G	Ph	2005	Feb 25	666	3	0	83		34[a]		117	783
		DPh	2010	Jan 08	98	2	0	174		30[a]		204	302
				Jan 23	373	8	0	533		51[a]		584	957
				Jan 29	521	13	0	566		58[a]		624	1,145

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Nicolas Island (Continued)	G	DPh	2010	Feb 04	582	16	0	510		51[a]		561	1,143
				Feb 17	575	13	0	237		54[a]		291	866
				Mar 01	564	6	0	19		31[a]		50	614
			2013	Jan 12	120	0	2	197	0	12	17	228	348
				Jan 29	387	0	0	411	0	8	23	442	829
				Feb 15	438	5	0	229	0	6	25	260	698
				Mar 05	422	7	0	6	0	4	9	19	441
	H	Ph	2005	Feb 25	337	2	1	28		39[a]		68	405
		DPh	2010	Jan 08	116	1	5	203		48[a]		256	372
				Jan 23	261	5	0	262		48[a]		310	571
				Jan 29	265	5	0	225		39[a]		264	529
				Feb 04	278	5	2	168		46[a]		216	494
				Feb 17	265	5	0	24		34[a]		58	323
				Mar 01	276	1	0	4		24[a]		28	304
			2013	Jan 12	151	4	16	219	0	31	37	303	454
				Jan 29	451	5	3	467	0	29	23	522	973
				Feb 15	527	12	1	230	3	15	24	273	800
				Mar 05	541	10	3	7	0	4	18	32	573
	I	Ph	2005	Feb 25	606	4	0	59		41[a]		100	706
		DPh	2010	Jan 08	109	3	1	194		66[a]		261	370
				Jan 23	397	3	0	492		46[a]		538	935
				Jan 29	445	11	0	479		39[a]		518	963
				Feb 04	477	14	1	404		41[a]		446	923
				Feb 17	471	10	0	126		36[a]		162	633
				Mar 01	443	4	0	10		27[a]		37	480
			2013	Jan 12	155	5	7	252	0	10	26	295	450
				Jan 29	428	10	1	465	0	12	23	501	929
				Feb 15	489	19	0	234	0	14	23	271	760
				Mar 05	470	7	1	6	0	6	19	32	502
	J	Ph	2005	Feb 25	372	2	0	44		24[a]		68	440
		DPh	2010	Jan 08	160	0	1	283		27[a]		311	471
				Jan 23	252	7	0	230		13[a]		243	495
				Jan 29	260	6	0	195		18[a]		213	473
				Feb 04	256	9	0	130		16[a]		146	402
				Feb 17	227	9	0	14		16[a]		30	257
				Mar 01	232	4	0	13		14[a]		27	259

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Nicolas Island (Continued)	J	DPh	2013	Jan 12	249	1	9	369	0	8	13	399	648
				Jan 29	550	3	3	513	0	13	16	545	1,095
				Feb 15	547	3	0	191	0	3	17	211	758
				Mar 05	545	2	3	14	0	12	13	42	587
	K	Ph	2005	Feb 25	1,120	14	0	96		117[a]		213	1,333
		DPh	2010	Jan 08	199	2	3	378		112[a]		493	692
				Jan 23	645	7	2	839		106[a]		947	1,592
				Jan 29	786	17	0	794		92[a]		886	1,672
				Feb 04	842	8	0	666		92[a]		758	1,600
				Feb 17	818	21	0	242		77[a]		319	1,137
				Mar 01	823	8	0	27		85[a]		112	935
			2013	Jan 12	295	4	14	488	0	43	38	583	878
				Jan 29	800	7	4	768	0	41	36	849	1,649
				Feb 15	841	8	0	307	0	25	37	369	1,210
				Mar 05	789	5	4	24	0	16	21	65	854
	L	Ph	2005	Feb 25	13	0	0	3		41[a]		44	57
		DPh	2010	Jan 08	6	0	2	28		50[a]		80	86
				Jan 23	12	0	0	13		25[a]		38	50
				Jan 29	9	0	0	7		36[a]		43	52
				Feb 04	10	1	0	7		33[a]		40	50
				Feb 17	10	0	0	2		30[a]		32	42
				Mar 01	11	0	0	8		19[a]		27	38
			2013	Jan 12	11	0	10	20	0	37	14	81	92
				Jan 29	26	0	1	30	0	28	11	70	96
				Feb 15	25	0	0	10	0	15	3	28	53
				Mar 05	26	0	3	8	4	33	2	50	76
	M	Ph	2005	Feb 25	522	4	0	34		45[a]		79	601
		DPh	2010	Jan 08	156	1	4	328		79[a]		411	567
				Jan 23	576	4	2	709		66[a]		777	1,353
				Jan 29	694	9	1	687		65[a]		753	1,447
				Feb 04	721	15	0	588		66[a]		654	1,375
				Feb 17	712	11	0	180		56[a]		236	948
				Mar 01	634	15	0	11		38[a]		49	683
			2013	Jan 12	284	2	10	487	0	56	39	592	876
				Jan 29	849	3	0	906	1	39	42	988	1,837
				Feb 15	923	13	0	406	0	47	33	486	1,409
				Mar 05	929	28	1	18	0	12	34	65	994

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Nicolas	N	Ph	2005	Feb 25	99	3	0	7		16[a]		23	122
Island		DPh	2010	Jan 08	40	0	1	93		17[a]		111	151
(Continued)				Jan 23	214	0	0	297		46[a]		343	557
				Jan 29	292	1	0	306		38[a]		344	636
				Feb 04	307	3	1	279		31[a]		311	618
				Feb 17	306	7	1	111		30[a]		142	448
				Mar 01	225	4	0	4		30[a]		34	259
			2013	Jan 12	142	0	7	254	0	8	26	295	437
				Jan 29	461	5	0	489	0	19	28	536	997
				Feb 15	451	4	1	216	0	12	31	260	711
				Mar 05	295	3	2	7	0	3	10	22	317
	O	Ph	2005	Feb 25	60	0	0	5		14[a]		19	79
		DPh	2010	Jan 08	36	0	1	95		21[a]		117	153
				Jan 23	168	1	1	210		33[a]		244	412
				Jan 29	244	0	1	235		41[a]		277	521
				Feb 04	247	2	0	201		41[a]		242	489
				Feb 17	237	2	0	57		35[a]		92	329
				Mar 01	181	0	0	1		34[a]		35	216
			2013	Jan 12	165	1	3	267	0	31	23	324	489
				Jan 29	461	3	0	436	0	14	19	469	930
				Feb 15	517	7	0	179	0	24	20	223	740
				Mar 05	509	8	0	11	0	6	15	32	541
	P	Ph	2005	Feb 25	1	0	0	0		0[a]		0	1
		DPh	2010	Jan 08	69	0	5	146		34[a]		185	254
				Jan 23	218	1	2	269		25[a]		296	514
				Jan 29	257	0	0	249		25[a]		274	531
				Feb 04	264	5	0	207		24[a]		231	495
				Feb 17	247	5	0	53		24[a]		77	324
				Mar 01	231	3	0	2		14[a]		16	247
			2013	Jan 12	51	0	1	101	0	5	10	117	168
				Jan 29	384	3	2	381	0	12	21	416	800
				Feb 15	409	1	0	151	0	13	18	182	591
				Mar 05	301	3	1	5	0	5	13	24	325
	Q	Ph	2005	Feb 25	845	9	0	78		49[a]		127	972
		DPh	2010	Jan 08	352	3	13	683		139[a]		835	1,187
				Jan 23	1,114	16	4	1,350		135[a]		1,489	2,603
				Jan 29	1,326	29	1	1,280		133[a]		1,414	2,740

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
San Nicolas Island (Continued)	Q	DPh	2010	Feb 04	1,350	24	2	1,074		130[a]		1,206	2,556
				Feb 17	1,346	26	0	316		124[a]		440	1,786
				Mar 01	1,307	20	1	21		89[a]		111	1,418
			2013	Jan 12	614	8	38	1,010	0	29	59	1,136	1,750
				Jan 29	1,562	22	4	1,472	0	38	57	1,571	3,133
				Feb 15	1,570	27	0	542	0	34	43	619	2,189
				Mar 05	1,630	14	13	28	2	14	37	94	1,724
Santa Barbara Island	A	Ph	2005	Feb 24	51	0	0	9		1[a]		10	61
		DPh	2010	Feb 17	44	0	0	14		5[a]		19	63
			2013	Feb 15	51	0	0	19	0	1	1	21	72
	B	Ph	2005	Feb 24	0	0	0	1		0[a]		1	1
	C	Ph	2005	Feb 24	1	0	0	1		4[a]		5	6
		DPh	2010	Feb 17	0	0	0	0		4[a]		4	4
			2013	Feb 15	13	0	0	5	0	0	1	6	19
	D	Ph	2005	Feb 24	3	0	0	2		3[a]		5	8
		DPh	2010	Feb 17	7	0	0	6		1[a]		7	14
			2013	Feb 15	10	0	1	10	0	0	1	12	22
Santa Rosa Island	611	Ph	2005	Feb 24	282	4	0	23		36[a]		59	341
		DPh	2010	Feb 16	0	0	0	0		1[a]		1	1
			2013	Jan 09	49	0	6	103	0	14	15	138	187
				Jan 30	295	1	0	314	0	1	12	327	622
				Feb 14	325	4	1	161	0	4	21	187	512
				Mar 07	307	2	0	5	0	0	6	11	318
	612	Ph	2005	Feb 24	45	0	0	9		18[a]		27	72
		DPh	2010	Feb 16	298	4	0	118		75[a]		193	491
			2013	Jan 09	19	0	13	40	0	7	21	81	100
				Jan 30	105	0	0	97	0	13	12	122	227
				Feb 14	94	0	0	55	0	15	6	76	170
				Mar 07	100	0	0	2	0	1	1	4	104
	613	Ph	2005	Feb 24	0	0	0	0		11[a]		11	11
		DPh	2010	Feb 16	16	0	0	7		37[a]		44	60
			2013	Jan 30	10	0	0	9	0	23	17	49	59
				Feb 14	5	0	0	1	0	8	7	16	21
				Mar 07	10	0	0	0	0	3	7	10	20
	614	DPh	2013	Jan 09	0	0	0	0	0	0	1	1	1
				Feb 14	0	0	0	0	0	2	3	5	5

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
Santa Rosa Island (Continued)	615A	DPh	2013	Jan 30	0	0	0	0	0	2	0	2	2
	616	DPh	2013	Jan 30	0	0	0	0	0	1	0	1	1
	619	DPh	2010	Feb 16	12	0	0	11		11[a]		22	34
			2013	Jan 09	6	0	2	25	0	0	6	33	39
				Jan 30	45	0	0	46	0	5	3	54	99
				Feb 14	47	0	1	18	0	2	16	37	84
				Mar 07	42	0	0	0	0	1	4	5	47
	621A	DPh	2010	Feb 16	2	0	0	2		18[a]		20	22
			2013	Jan 09	7	0	3	31	0	2	12	48	55
				Jan 30	56	1	0	63	0	22	21	106	162
				Feb 14	46	0	0	26	0	7	15	48	94
				Mar 07	44	0	0	2	0	1	4	7	51
	621B	DPh	2010	Feb 16	41	0	0	4		23[a]		27	68
			2013	Jan 09	39	0	4	72	0	7	8	91	130
				Jan 30	241	0	0	250	0	10	18	278	519
				Feb 14	253	1	0	121	0	3	26	150	403
				Mar 07	234	1	1	8	0	2	4	15	249
	621C	DPh	2010	Feb 16	0	0	0	0		1[a]		1	1
			2013	Jan 09	44	0	6	67	0	10	5	88	132
				Jan 30	100	0	0	87	0	2	8	97	197
				Feb 14	105	1	0	27	0	0	10	37	142
				Mar 07	86	0	0	1	0	0	2	3	89
	621D	DPh	2010	Feb 16	340	2	0	117		30[a]		147	487
			2013	Jan 09	88	0	11	155	0	7	12	185	273
				Jan 30	394	1	0	382	0	0	14	396	790
				Feb 14	415	5	0	176	0	1	14	191	606
				Mar 07	640	1	2	9	0	2	14	27	667
	622	Ph	2005	Feb 24	407	2	0	32		34[a]		66	473
	622A	DPh	2010	Feb 16	0	0	0	0		1[a]		1	1
			2013	Feb 14	0	0	0	0	0	3	4	7	7
				Mar 07	7	0	0	2	0	0	0	2	9
	622B	DPh	2010	Feb 16	148	1	0	64		17[a]		81	229
			2013	Jan 09	119	2	16	222	4	14	10	266	385
				Jan 30	388	2	0	377	0	8	13	398	786
				Feb 14	391	5	0	133	0	2	16	151	542
				Mar 07	339	1	3	6	0	0	1	10	349

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
Santa Rosa Island (Continued)	622C	DPh	2010	Feb 16	2	0	0	0		1[a]		1	3
			2013	Jan 09	13	0	0	43	0	6	5	54	67
				Jan 30	96	0	0	97	0	0	5	102	198
				Feb 14	107	0	0	37	0	0	7	44	151
				Mar 07	68	0	0	2	0	0	1	3	71
	622D	DPh	2010	Feb 16	360	4	1	16		37[a]		54	414
			2013	Jan 09	296	4	21	500	0	58	38	617	913
				Jan 30	1,014	3	0	953	0	1	49	1,003	2,017
				Feb 14	1,040	6	1	403	0	9	42	455	1,495
				Mar 07	945	0	5	14	2	12	14	47	992
	622E	DPh	2013	Jan 09	85	1	21	146	0	45	10	222	307
				Jan 30	172	4	0	161	0	5	11	177	349
				Feb 14	164	1	0	30	0	3	3	36	200
				Mar 07	147	0	6	6	0	0	1	13	160
	624	Ph	2005	Feb 24	1,321	7	0	113		125[a]		238	1,559
	624A	DPh	2010	Feb 16	15	0	0	0		18[a]		18	33
			2013	Jan 09	156	3	27	220	0	29	21	297	453
				Jan 30	281	0	0	248	0	0	12	260	541
				Feb 14	332	1	0	126	0	9	12	147	479
				Mar 07	320	1	4	5	0	12	6	27	347
	624B	DPh	2010	Feb 16	534	5	0	6		17[a]		23	557
			2013	Jan 09	316	6	11	612	0	17	29	669	985
				Jan 30	1,177	7	0	1,107	0	1	43	1,151	2,328
				Feb 14	1,224	11	0	404	0	10	32	446	1,670
				Mar 07	1,175	3	4	11	0	12	9	36	1,211
	624C	DPh	2010	Feb 16	1,092	19	0	399		126[a]		525	1,617
			2013	Jan 09	203	2	15	447	0	51	40	553	756
				Jan 30	1,222	12	0	1,259	0	39	69	1,367	2,589
				Feb 14	1,288	19	0	650	0	26	75	751	2,039
				Mar 07	1,340	9	6	11	0	14	24	55	1,395
	625	Ph	2005	Feb 24	1,248	3	0	102		202[a]		304	1,552
	625A	DPh	2010	Feb 16	865	3	0	391		138[a]		529	1,394
			2013	Jan 09	145	2	17	337	0	50	62	466	611
				Jan 30	950	2	2	977	0	32	74	1,085	2,035
				Feb 14	1,270	5	0	518	0	39	74	631	1,901
				Mar 07	943	3	4	4	0	18	19	45	988

Table 6. (Continued)

Island	Area	Method	Year	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pups	Total live
Santa Rosa Island (Continued)	625B	DPh	2010	Feb 16	877	8	0	336		136[a]		472	1,349
			2013	Jan 09	130	1	11	285	0	40	66	401	531
				Jan 30	802	5	2	845	0	44	72	963	1,765
				Feb 14	854	12	0	431	1	39	69	540	1,394
				Mar 07	838	2	1	8	0	23	19	51	889
	625C	DPh	2010	Feb 16	300	5	1	43		36[a]		80	380
			2013	Jan 09	80	1	2	176	0	24	24	226	306
				Jan 30	402	4	1	424	0	13	36	474	876
				Feb 14	442	8	0	223	0	24	26	273	715
				Mar 07	431	0	1	2	0	8	17	28	459
	626	Ph	2005	Feb 24	845	5	0	66		55[a]		121	966
	626	DPh	2010	Feb 16	807	12	0	227		62[a]		289	1,096
			2013	Jan 09	251	4	13	442	0	19	47	521	772
				Jan 30	764	9	0	701	0	1	51	753	1,517
				Feb 14	795	9	0	247	1	15	36	299	1,094
				Mar 07	759	5	2	18	0	16	25	61	820
	629	DPh	2013	Jan 09	0	0	0	0	0	0	1	1	1
				Jan 30	0	0	0	0	0	0	4	4	4

[a] Young males, sub-adult males, and adult males were not differentiated.

Table 7. Number of elephant seals, California sea lions, northern fur seals, Pacific harbor seals, and Steller sea lions counted by age/sex class and category total from photographs of haulout sites within Area H at San Miguel Island taken during aerial photographic surveys conducted in Jan 9 and 30, February 14, and March 9, 2013. nc = No counts obtained; only sites with animals are included. Refer to Figure 5 for location of haulout sites.

Haulout	Date	Pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion										
40	9 Jan 2013	949	nc	221	504	0	7	3	735	1,684
	30 Jan 2013	769	nc	146	674	7	10	1	838	1,607
	14 Feb 2013	783	2	47	667	0	11	16	741	1,524
	7 Mar 2013	793	nc	69	318	4	2	0	393	1,186
41	9 Jan 2013	413	nc	68	180	0	2	0	250	663
	30 Jan 2013	282	nc	104	293	3	2	1	403	685
	14 Feb 2013	353	2	9	211	0	5	1	226	579
	7 Mar 2013	295	nc	12	123	1	1	0	137	432
52	9 Jan 2013	426	nc	72	163	0	3	3	241	667
	30 Jan 2013	366	nc	46	190	0	1	0	237	603
	14 Feb 2013	265	5	10	177	0	2	2	191	456
	7 Mar 2013	277	nc	34	88	6	1	0	129	406
53	9 Jan 2013	1,164	nc	167	530	0	11	3	711	1,875
	30 Jan 2013	820	nc	160	596	4	1	0	761	1,581
	14 Feb 2013	962	29	29	597	1	8	1	636	1,598
	7 Mar 2013	915	nc	78	301	3	3	0	385	1,300
54	9 Jan 2013	2,176	nc	325	1,133	0	22	7	1,487	3,663
	30 Jan 2013	1,584	nc	305	1,329	0	23	2	1,659	3,243
	14 Feb 2013	1,671	168	74	1,348	3	20	36	1,481	3,152
	7 Mar 2013	1,489	nc	131	616	14	23	1	785	2,274
55	9 Jan 2013	123	nc	31	120	0	3	4	158	281
	30 Jan 2013	135	nc	66	246	0	7	1	320	455
	14 Feb 2013	81	0	17	244	0	1	4	266	347
	7 Mar 2013	120	nc	28	174	4	7	1	214	334
56	9 Jan 2013	1,752	nc	257	909	0	22	3	1,191	2,943
	30 Jan 2013	1,489	nc	307	1,420	1	23	6	1,757	3,246
	14 Feb 2013	1,407	52	78	1,474	4	26	26	1,608	3,015
	7 Mar 2013	1,286	nc	174	720	11	35	5	945	2,231
57	9 Jan 2013	89	nc	17	67	0	1	1	86	175
	30 Jan 2013	66	nc	36	176	0	2	0	214	280
	14 Feb 2013	57	2	3	111	1	0	1	116	173
	7 Mar 2013	59	nc	11	81	0	7	0	99	158

Table 7. (Continued)

Haulout	Date	Pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)										
58	9 Jan 2013	495	nc	150	355	7	27	8	547	1,042
	30 Jan 2013	456	nc	173	426	0	45	6	650	1,106
	14 Feb 2013	649	48	151	1,259	96	164	52	1,722	2,371
	7 Mar 2013	523	nc	142	487	44	50	10	733	1,256
59	9 Jan 2013	134	nc	43	106	0	4	1	154	288
	30 Jan 2013	136	nc	51	280	0	7	2	340	476
	14 Feb 2013	132	2	3	139	1	0	2	145	277
	7 Mar 2013	104	nc	21	98	2	9	1	131	235
60	9 Jan 2013	993	nc	134	411	0	20	4	569	1,562
	30 Jan 2013	560	nc	103	440	0	26	1	570	1,130
	14 Feb 2013	652	44	17	681	40	56	19	813	1,465
	7 Mar 2013	678	nc	81	322	12	37	8	460	1,138
Northern elephant seal										
40	9 Jan 2013	0	0	0	1	0	7	0	8	8
	30 Jan 2013	0	0	2	0	0	3	0	5	5
41	9 Jan 2013	1	1	0	1	0	2	1	4	5
	30 Jan 2013	4	1	0	4	0	1	2	7	11
	14 Feb 2013	4	0	0	1	0	0	1	2	6
	7 Mar 2013	5	0	0	0	0	1	0	1	6
52	9 Jan 2013	0	0	1	0	0	0	0	1	1
53	9 Jan 2013	0	0	6	1	0	2	3	12	12
	30 Jan 2013	1	0	0	1	0	8	2	11	12
	14 Feb 2013	1	0	0	0	0	6	0	6	7
	7 Mar 2013	12	0	0	0	0	1	0	1	13
54	9 Jan 2013	59	1	51	135	4	207	69	466	525
	30 Jan 2013	427	7	1	437	0	117	58	613	1,040
	14 Feb 2013	407	13	1	224	4	87	55	371	778
	7 Mar 2013	503	20	3	15	0	20	44	82	585
55	7 Mar 2013	0	0	1	0	0	1	0	2	2
56	9 Jan 2013	22	0	16	32	0	10	7	65	87
	30 Jan 2013	40	1	0	41	0	3	7	51	91
	14 Feb 2013	39	0	0	10	0	11	8	29	68
	7 Mar 2013	45	0	0	0	0	5	0	5	50
57	9 Jan 2013	0	0	0	0	0	0	1	1	1
	14 Feb 2013	0	0	0	0	0	1	0	1	1

Table 7. (Continued)

Haulout	Date	Pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
Northern elephant seal (Continued)										
58	9 Jan 2013	71	5	7	148	0	91	61	307	378
	30 Jan 2013	238	5	0	246	0	38	34	318	556
	14 Feb 2013	391	6	0	108	1	31	50	190	581
	7 Mar 2013	339	7	0	1	0	12	17	30	369
59	14 Feb 2013	0	0	0	0	0	1	0	1	1
60	9 Jan 2013	181	11	24	321	1	50	62	458	639
	30 Jan 2013	713	14	2	699	0	54	54	809	1,522
	14 Feb 2013	673	28	0	332	0	19	56	407	1,080
	7 Mar 2013	590	10	3	11	0	6	42	62	652
Northern fur seal										
54	14 Feb 2013	0	0	3	nc	nc	0	0	1	1
58	14 Feb 2013	0	0	1	nc	nc	0	1	2	2
	7 Mar 2013	0	0	7	nc	nc	4	5	20	20
60	9 Jan 2013	0	0	3	nc	nc	3	1	20	20
	30 Jan 2013	0	0	3	nc	nc	3	0	15	15
	14 Feb 2013	4	0	5	nc	nc	74	6	172	176
	7 Mar 2013	0	0	15	nc	nc	20	3	66	66
Pacific harbor seal										
40	30 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	1
	14 Feb 2013	nc	nc	nc	nc	nc	nc	nc	nc	1
53	9 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	8
	7 Mar 2013	nc	nc	nc	nc	nc	nc	nc	nc	2
55	30 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	1
56	9 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	12
	30 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	8
	14 Feb 2013	nc	nc	nc	nc	nc	nc	nc	nc	20
	7 Mar 2013	nc	nc	nc	nc	nc	nc	nc	nc	16
57	9 Jan 2013	nc	nc	nc	nc	nc	nc	nc	nc	1
	7 Mar 2013	nc	nc	nc	nc	nc	nc	nc	nc	3
58	14 Feb 2013	nc	nc	nc	nc	nc	nc	nc	nc	1
	7 Mar 2013	nc	nc	nc	nc	nc	nc	nc	nc	2
Steller sea lion										
55	9 Jan 2013	0	0	0	0	0	1	3	3	3
	30 Jan 2013	0	0	0	0	0	1	3	4	4
	14 Feb 2013	0	0	0	0	0	1	1	2	2
	7 Mar 2013	0	0	0	0	0	0	4	4	4

Table 8. California sea lions, northern fur seals, Pacific harbor seals, and Steller sea lions counted on island during surveys conducted at the Channel Islands, California in January, February, and March 2013. No count was obtained in blank cells.

Island	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lions										
Anacapa Island	13 Feb 2013	18	0	507	867	30	52	36	1,492	1,510
San Clemente Island[a]	15-16 Jan 2013	1,883	0	252	4,370	11	221	33	4,887	6,770
	15 Feb 2013	2,265	5	1,184	5,227	57	177	144	6,789	9,054
San Miguel Island	09 Jan 2013	13,243		4,771	8,071	71	388	139	13,442	26,685
	30 Jan 2013	9,921		4,005	9,733	184	474	83	14,479	24,400
	14 Feb 2013	9,995	357	2,028	10,299	296	754	297	13,674	23,669
	07 Mar 2013	10,657		3,064	6,782	475	572	155	11,048	21,705
San Nicolas Island	12 Jan 2013	22,509		4,259	8,046	111	434	73	12,923	35,432
	29 Jan 2013	22,015		6,578	11,034	0	704	268	18,621	40,714
	15 Feb 2013	17,384	152	1,028	7,730	199	515	393	9,865	27,249
	05 Mar 2013	17,980		2,641	7,377	188	531	88	10,825	28,805
Santa Barbara Island	15 Feb 2013	2,544	3	202	1,630	25	60	54	1,971	4,515
Santa Catalina Island	15 Feb 2013	34	0	2,615	851	719	188	53	4,426	4,460
Santa Cruz Island	13 Feb 2013	0	0	525	444	1	9	3	982	982
Santa Rosa Island	09 Jan 2013	0	0	0	0	0	0	1	1	1
	30 Jan 2013	0		537	719	32	20	16	1,324	1,324
	14 Feb 2013	29	0	590	1,337	7	67	16	2,017	2,046
	07 Mar 2013	0	0	828	1,439	26	9	6	2,308	2,308
Northern fur seals										
San Miguel Island	09 Jan 2013	0	0	3	40[b]		8	3	54	54
	30 Jan 2013	0	0	32	110[b]		30	8	180	180
	14 Feb 2013	4	0	14	188[b]		103	15	318	322
	07 Mar 2013	0	0	36	60[b]		55	19	170	170
Pacific harbor seals										
San Clemente Island	15 Feb 2013									11
San Miguel Island	09 Jan 2013									205
	30 Jan 2013									243
	14 Feb 2013									217
	07 Mar 2013									391
San Nicolas Island	12 Jan 2013									359
	29 Jan 2013									556
	15 Feb 2013									169
	05 Mar 2013									379
Santa Barbara Island	15 Feb 2013									2

Table 8. (Continued)

Island	Survey date	Live pups	Dead pups	Juveniles	Adult females	Young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seals (Continued										
Santa Cruz Island	13 Feb 2013									2
Santa Rosa Island	09 Jan 2013									219
	30 Jan 2013									69
	14 Feb 2013									221
	07 Mar 2013									268
Steller sea lions										
Anacapa Island	13 Feb 2013	0	0	2	0	0	0	0	1	1
San Clemente Island	15 Feb 2013	0	0	0	0	1	0	0	1	1
San Miguel Island	09 Jan 2013	0	0	0	0	0	1	3	3	3
	30 Jan 2013	0	0	0	0	0	1	3	4	4
	14 Feb 2013	0	0	0	0	0	1	1	2	2
	07 Mar 2013	0	0	0	0	0	0	4	4	4
San Nicolas island	15 Feb 2013	0	0	1	0	0	0	0	1	1
Santa Rosa Island	14 Feb 2013	0	0	0	0	0	0	1	1	1

[a]Counts only include Area 406 and 407 (remainder of island was not surveyed).

[b]Adult females and young males total; unable to differentiate.

Table 9. Island-area counts by age-sex class and category total for California sea lions, northern fur seals, Pacific harbor seals, and Steller sea lions from a ground count survey at San Clemente Island in January and from aerial photographic surveys conducted at the Channel Islands during January, February, and March 2013. Counts are provided only for island-areas having animals. Refer to Figures 3 and 4 for location of island-areas. Blank fields were not counted. Multiple aerial photographic surveys were only conducted at San Miguel Island, San Nicolas Island, and Santa Rosa Island.

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion												
Anacapa Island	680	13 Feb 2013	18	0	507	867	30	897	52	36	1,492	1,510
San Clemente Island	404	15 Feb 2013	3	0	53	81	0	81	5	2	141	144
	406	15 Jan 2013[a]	1,360	0	106	2,587	0	2,587	126	15	2,834	4,194[1]
		15 Feb 2013	1,284	5	240	2,115	20	2,135	59	62	2,496	3,780
	407	15 Jan 2013[a]	523	0	146	1,783	11	1,794	95	18	2,053	2,576[1]
		15 Feb 2013	847	0	370	1,926	21	1,947	71	60	2,448	3,295
	410	15 Feb 2013	0	0	0	0	0	0	1	0	1	1
	411	15 Feb 2013	131	0	521	1,105	16	1,121	41	20	1,703	1,834
San Miguel Island	A	9 Jan 2013	256		1,433	844	19	864	14	0	2,312	2,568
		30 Jan 2013	239		870	842	6	848	16	1	1,735	1,974
		14 Feb 2013	24	0	581	426	12	438	9	2	1,030	1,054
		7 Mar 2013	740		1,186	1,052	111	1,163	11	1	2,361	3,101
	B	30 Jan 2013	0		0	1	0	1	0	0	1	1
		14 Feb 2013	0	0	1	0	0	0	0	0	1	1
	C	9 Jan 2013	499		432	540	6	546	15	0	993	1,492
		30 Jan 2013	319		407	668	20	688	5	0	1,100	1,419
		14 Feb 2013	349	2	362	661	20	681	10	3	1,056	1,405
		7 Mar 2013	459		255	534	37	571	6	3	835	1,294
	D	30 Jan 2013	0		1	0	0	0	0	0	1	1

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
San Miguel Island	D	7 Mar 2013	1		0	0	0	0	0	0	0	1
(Continued)	F	9 Jan 2013	4		4	29	15	44	80	45	173	177
		30 Jan 2013	13		7	50	29	79	149	50	285	298
		14 Feb 2013	23	0	20	58	29	87	215	43	365	388
		7 Mar 2013	31		28	111	111	222	226	71	547	578
	G	9 Jan 2013	1,053		296	563	12	575	25	3	899	1,952
		30 Jan 2013	681		266	681	41	722	33	7	1,028	1,709
		14 Feb 2013	698	0	165	820	35	855	77	16	1,113	1,811
		7 Mar 2013	816		155	440	25	465	35	6	661	1,477
	H	9 Jan 2013	8,714		1,485	4,478	7	4,485	122	37	6,129	14,843
		30 Jan 2013	6,663		1,497	6,070	15	6,085	147	20	7,749	14,412
		14 Feb 2013	7,012	354	438	6,908	146	7,054	293	160	7,945	14,957
		7 Mar 2013	6,539		781	3,328	101	3,429	175	26	4,411	10,950
	I	30 Jan 2013	1		0	0	0	0	0	0	0	1
		14 Feb 2013	0	0	0	0	0	0	0	1	1	1
		7 Mar 2013	3		0	0	0	0	1	3	4	7
	J	9 Jan 2013	1,648		684	1,017	10	1,027	124	52	1,887	3,535
		30 Jan 2013	1,287		567	949	69	1,018	113	3	1,701	2,988
		14 Feb 2013	1,226	0	242	885	50	935	146	61	1,384	2,610
		7 Mar 2013	1,316		392	842	78	920	105	39	1,456	2,772
	K	30 Jan 2013	1		1	0	0	0	0	0	1	2
		14 Feb 2013	457	1	30	339	2	341	1	6	378	835
		7 Mar 2013	2		0	0	0	0	0	0	0	2

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
San Miguel Island (Continued)	L	9 Jan 2013	348		286	177	0	177	1	0	464	812
		30 Jan 2013	93		263	84	1	85	2	0	350	443
		14 Feb 2013	206	0	189	202	2	204	3	5	401	607
		7 Mar 2013	95		224	184	12	196	2	0	422	517
	M	9 Jan 2013	2		0	0	0	0	0	0	0	2
		7 Mar 2013	63		4	1	0	1	0	2	7	70
	N	9 Jan 2013	1		0	0	0	0	0	0	0	1
		30 Jan 2013	0		0	0	1	1	0	0	1	1
		7 Mar 2013	592		39	290	0	290	11	4	344	936
	O	9 Jan 2013	718		151	423	2	425	7	2	585	1,303
		30 Jan 2013	624		126	388	2	390	9	2	527	1,151
San Nicolas Island	A	12 Jan 2013	534		925	628	16	644	47	13	1,629	2,163
		29 Jan 2013	629		1,522	1,614	0	1,614	90	16	3,242	3,871
		15 Feb 2013	621	0	202	393	28	421	41	20	684	1,305
		5 Mar 2013	812		353	702	21	723	41	1	1,118	1,930
	B	12 Jan 2013	424		128	188	1	189	9	3	329	753
		29 Jan 2013	469		187	274	0	274	23	5	489	958
		15 Feb 2013	363	0	11	191	2	193	5	11	220	583
		5 Mar 2013	351		37	162	0	162	12	1	212	563
	C	12 Jan 2013	200		19	49	2	51	8	5	83	283
		29 Jan 2013	182		36	65	0	65	6	4	111	293
		15 Feb 2013	153	0	2	47	1	48	5	5	60	213
		5 Mar 2013	141		14	55	5	60	18	3	95	236

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
San Nicolas Island (Continued)	D	12 Jan 2013	2,992		423	883	1	884	27	1	1,335	4,327
		29 Jan 2013	3,017		454	1,087	0	1,087	41	21	1,603	4,620
		15 Feb 2013	2,585	11	51	877	8	885	29	23	988	3,573
		5 Mar 2013	2,486		184	868	10	878	43	3	1,108	3,594
	E	12 Jan 2013	1,089		247	376	7	383	34	3	667	1,756
		29 Jan 2013	1,009		337	698	0	698	52	29	1,116	2,125
		15 Feb 2013	896	8	39	469	16	485	44	32	600	1,496
		5 Mar 2013	839		127	430	16	446	60	5	638	1,477
	F	12 Jan 2013	2,436		252	685	3	688	17	2	959	3,395
		29 Jan 2013	2,395		314	863	0	889	35	20	1,269	3,742
		15 Feb 2013	1,984	5	45	777	5	782	37	35	899	2,883
		5 Mar 2013	2,038		147	664	6	670	34	2	853	2,891
	G	12 Jan 2013	362		29	97	2	99	15	2	145	507
		29 Jan 2013	342		64	132	0	132	16	11	223	565
		15 Feb 2013	279	4	12	107	5	112	34	23	181	460
		5 Mar 2013	275		41	121	5	126	31	12	210	485
	H	12 Jan 2013	4,023		377	1,216	14	1,230	39	4	1,650	5,673
		29 Jan 2013	3,746		552	1,454	0	1,454	51	29	2,086	5,832
		15 Feb 2013	3,007	43	85	1,294	19	1,313	45	55	1,498	4,505
		5 Mar 2013	2,875		254	1,001	23	1,024	56	14	1,348	4,223
	I	12 Jan 2013	823		63	254	0	254	8	1	326	1,149
		29 Jan 2013	723		81	203	0	203	10	2	296	1,019
		15 Feb 2013	666	8	20	361	10	371	18	13	422	1,088

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
San Nicolas Island	I	5 Mar 2013	735		70	345	10	355	32	5	462	1,197
(Continued)	J	12 Jan 2013	3,215		373	1,365	10	1,375	59	15	1,822	5,037
		29 Jan 2013	3,013		412	1,349	0	1,349	55	31	1,847	4,860
		15 Feb 2013	1,997	37	114	1,084	19	1,103	75	50	1,342	3,339
		5 Mar 2013	2,280		243	962	19	981	70	9	1,303	3,583
	K	12 Jan 2013	1		0	0	0	0	1	0	1	2
		5 Mar 2013	0		1	2	0	2	2	0	5	5
	L	12 Jan 2013	4,145		404	1,254	6	1,260	15	3	1,682	5,827
		29 Jan 2013	4,282		455	1,365	0	1,365	40	20	1,880	6,162
		15 Feb 2013	3,268	30	129	1,277	24	1,301	46	44	1,520	4,788
		5 Mar 2013	3,491		394	997	9	1,006	30	6	1,436	4,927
	M	12 Jan 2013	1,654		166	441	9	450	19	4	639	2,293
		29 Jan 2013	1,576		176	410	0	410	26	18	630	2,206
		15 Feb 2013	1,192	5	49	343	9	352	20	29	450	1,642
		5 Mar 2013	1,151		145	345	3	348	24	3	520	1,671
	N	29 Jan 2013	2		0	0	0	0	0	0	0	2
		5 Mar 2013	1		0	0	0	0	0	0	0	1
	O	29 Jan 2013	1		0	0	0	0	0	0	0	1
		5 Mar 2013	1		0	0	0	0	0	0	0	1
	P	5 Mar 2013	1		0	0	0	0	0	0	0	1
	Q	12 Jan 2013	611		853	610	40	650	136	17	1,656	2,267
		29 Jan 2013	629		1,988	1,520	0	1,520	259	62	3,829	4,458
		15 Feb 2013	373	1	269	510	53	563	116	53	1,001	1,374

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
San Nicolas Island (Cont.)	Q	5 Mar 2013	503		631	723	61	784	78	24	1,517	2,020
Santa Barbara Island	A	15 Feb 2013	1,638	3	124	941	13	954	30	34	1,142	2,780
	B	15 Feb 2013	135	0	12	167	4	171	12	7	202	337
	C	15 Feb 2013	470	0	44	272	7	279	17	9	349	819
	D	15 Feb 2013	262	0	18	222	1	223	0	3	244	506
	E	15 Feb 2013	39	0	4	28	0	28	1	1	34	73
Santa Catalina Island	506	15 Feb 2013	4	0	150	103	0	103	6	1	260	264
	510	15 Feb 2013	0	0	16	14	0	14	0	0	30	30
	521	15 Feb 2013	0	0	38	33	0	33	0	0	71	71
	522	15 Feb 2013	12	0	1,065	268	28	296	68	23	1,452	1,464
	502C	15 Feb 2013	18	0	1,346	433	691	1,124	114	29	2,613	2,631
Santa Cruz Island	641	13 Feb 2013	0	0	128	198	0	198	0	0	326	326
	655	13 Feb 2013	0	0	397	246	1	247	9	3	656	656
Santa Rosa Island	617	30 Jan 2013	0		378	407	16	423	1	0	802	802
		14 Feb 2013	0	0	122	301	0	301	0	0	423	423
		7 Mar 2013	0	0	660	502	8	510	3	2	1,175	1,175
	621B	14 Feb 2013	0	0	0	2	0	2	0	0	2	2
	621C	9 Jan 2013	0	0	0	0	0	0	0	1	1	1
		30 Jan 2013	0		159	310	16	326	19	16	520	520
		14 Feb 2013	1	0	281	719	1	720	26	10	1,037	1,038
		7 Mar 2013	0	0	168	937	18	955	6	4	1,133	1,133
	621D	14 Feb 2013	1	0	0	0	0	0	0	0	0	1
	622D	30 Jan 2013	0		0	1	0	1	0	0	1	1

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
California sea lion (Continued)												
Santa Rosa Island	622E	14 Feb 2013	27	0	187	314	6	320	40	6	553	580
(Continued)	624A	14 Feb 2013	0	0	0	1	0	1	0	0	1	1
	624B	14 Feb 2013	0	0	0	0	0	0	1	0	1	1
	625B	30 Jan 2013	0		0	1	0	1	0	0	1	1
Pacific harbor seal												
San Clemente Island	406	15 Feb 2013										11
San Miguel Island	A	9 Jan 2013										17
		30 Jan 2013										10
		14 Feb 2013										6
	B	9 Jan 2013										11
		30 Jan 2013										9
		14 Feb 2013										15
		7 Mar 2013										48
	C	30 Jan 2013										1
		14 Feb 2013										5
		7 Mar 2013										12
	D	9 Jan 2013										10
		30 Jan 2013										7
		14 Feb 2013										4
		7 Mar 2013										11
	E	9 Jan 2013										6
		30 Jan 2013										5
		14 Feb 2013										6

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seal (Continued)												
San Miguel Island	E	7 Mar 2013										5
(Continued)	F	9 Jan 2013										8
		30 Jan 2013										13
		14 Feb 2013										12
		7 Mar 2013										28
	G	9 Jan 2013										7
		30 Jan 2013										5
		14 Feb 2013										12
		7 Mar 2013										7
	H	9 Jan 2013										21
		30 Jan 2013										10
		14 Feb 2013										22
		7 Mar 2013										23
	I	30 Jan 2013										1
	J	9 Jan 2013										74
		30 Jan 2013										121
		14 Feb 2013										116
		7 Mar 2013										85
	L	9 Jan 2013										9
		30 Jan 2013										11
		14 Feb 2013										7
		7 Mar 2013										22

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seal (Continued)												
San Miguel Island (Continued)	M	14 Feb 2013										1
		7 Mar 2013										32
	N	9 Jan 2013										42
		30 Jan 2013										50
		14 Feb 2013										11
		7 Mar 2013										118
San Nicolas Island	A	12 Jan 2013										2
		29 Jan 2013										1
		5 Mar 2013										2
	B	15 Feb 2013										1
		5 Mar 2013										1
	C	12 Jan 2013										2
		15 Feb 2013										4
		5 Mar 2013										4
	D	12 Jan 2013										43
		29 Jan 2013										66
		15 Feb 2013										16
		5 Mar 2013										22
	E	12 Jan 2013										2
		29 Jan 2013										17
		15 Feb 2013										5
		5 Mar 2013										49

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seal (Continued)												
San Nicolas Island (Continued)	F	12 Jan 2013										8
		29 Jan 2013										13
		15 Feb 2013										5
		5 Mar 2013										25
	G	5 Mar 2013										2
	H	5 Mar 2013										1
	I	29 Jan 2013										2
		5 Mar 2013										5
	J	12 Jan 2013										17
		29 Jan 2013										33
		15 Feb 2013										5
		5 Mar 2013										13
	L	12 Jan 2013										57
		29 Jan 2013										64
		15 Feb 2013										24
		5 Mar 2013										13
	M	12 Jan 2013										20
		29 Jan 2013										66
		15 Feb 2013										8
		5 Mar 2013										54
	N	12 Jan 2013										62
		29 Jan 2013										50
		15 Feb 2013										19

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seal (Continued)												
San Nicolas Island	N	5 Mar 2013										38
(Continued)	O	12 Jan 2013										4
		29 Jan 2013										38
		15 Feb 2013										22
	O	5 Mar 2013										48
	P	15 Feb 2013										1
	Q	12 Jan 2013										142
		29 Jan 2013										206
		15 Feb 2013										59
		5 Mar 2013										102
Santa Barbara Island	D	15 Feb 2013										2
Santa Cruz Island	655	13 Feb 2013										2
Santa Rosa Island	612	9 Jan 2013										9
		7 Mar 2013										8
	617	7 Mar 2013										3
	626	9 Jan 2013										29
		14 Feb 2013										49
		7 Mar 2013										57
	615A	9 Jan 2013										24
		30 Jan 2013										37
		7 Mar 2013										49
	621B	7 Mar 2013										5

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Pacific harbor seal (Continued)												
Santa Rosa Island (Continued)	621C	9 Jan 2013										48
		30 Jan 2013										32
		14 Feb 2013										62
		7 Mar 2013										54
	622B	14 Feb 2013										1
	622B	7 Mar 2013										1
	622E	9 Jan 2013										69
		14 Feb 2013										62
	624A	9 Jan 2013										3
		14 Feb 2013										3
		7 Mar 2013										1
	625A	9 Jan 2013										4
		14 Feb 2013										5
	625B	9 Jan 2013										33
		14 Feb 2013										20
		7 Mar 2013										18
	625C	14 Feb 2013										19
		7 Mar 2013										72

Table 9. (Continued)

Island	Area	Date	Live pups	Dead pups	Juveniles	Adult females	Young males	Adult females & young males	Sub-adult males	Adult males	Non-pup total	Total live
Steller sea lion												
Anacapa Island	680	13 Feb 2013	0	0	2	0	0	0	0	0	1	1
San Clemente Island	406	15 Feb 2013	0	0	0	0	1	0	0	0	1	1
San Miguel Island	H	9 Jan 2013	0	0	0	0	0	0	1	3	3	3
		30 Jan 2013	0	0	0	0	0	0	1	3	4	4
		14 Feb 2013	0	0	0	0	0	0	1	1	2	2
		7 Mar 2013	0	0	0	0	0	0	0	4	4	4
San Nicolas island	B	15 Feb 2013	0	0	1	0	0	0	0	0	1	1
Santa Rosa Island	617	14 Feb 2013	0	0	0	0	0	0	0	1	1	1

[a]In January 26, 2010 and January 15, 2013 only areas 406 and 407 at San Clemente Island were surveyed on the ground and remainder of island was not surveyed.

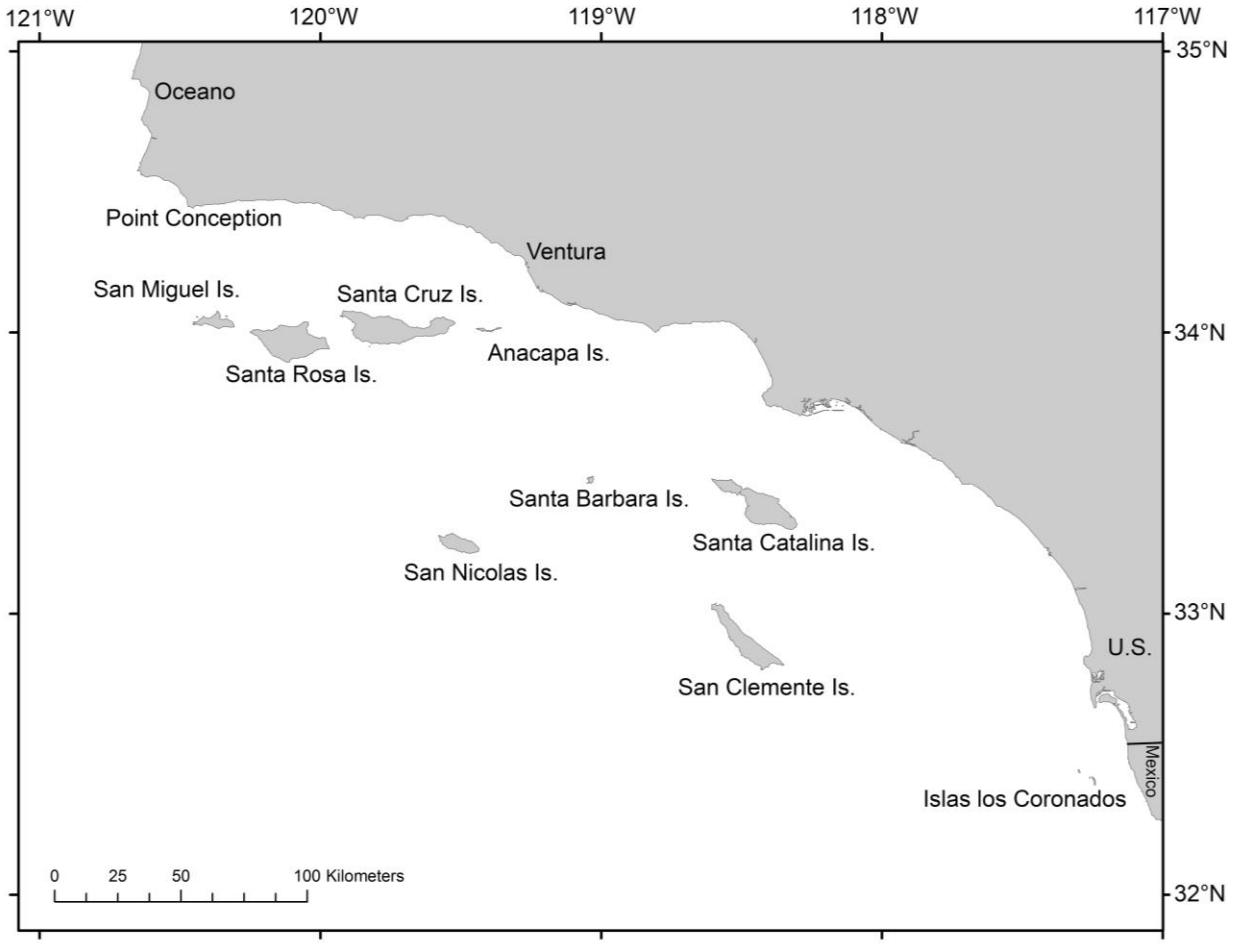

Figure 1. Map showing location of Point Conception and the Channel Islands within the Southern California Bight (SCB). Not shown are Castle Rock (located 1 km from the NW shoreline of San Miguel Island) and Gull Island (located 1.4 km from Punta Arena, Santa Cruz Island).

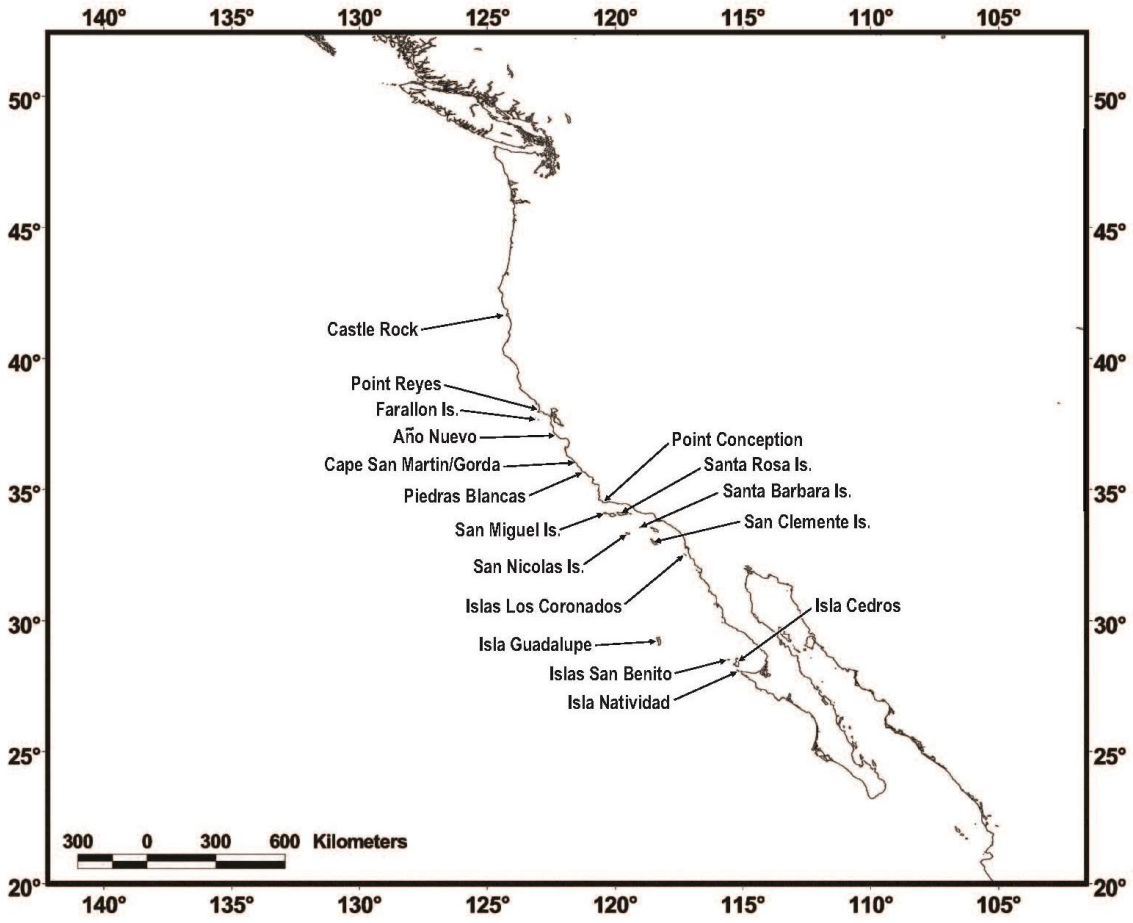

Figure 2. Northern elephant seal rookeries in the U.S. and Mexico (Lowry et al. 2014).

Figure 3. Mark Lowry standing next to Partenavia P-68 Observer chartered from Aspen Helicopters by the Southwest Fisheries Science Center (SWFSC) for conducting aerial photographic surveys of pinnipeds.

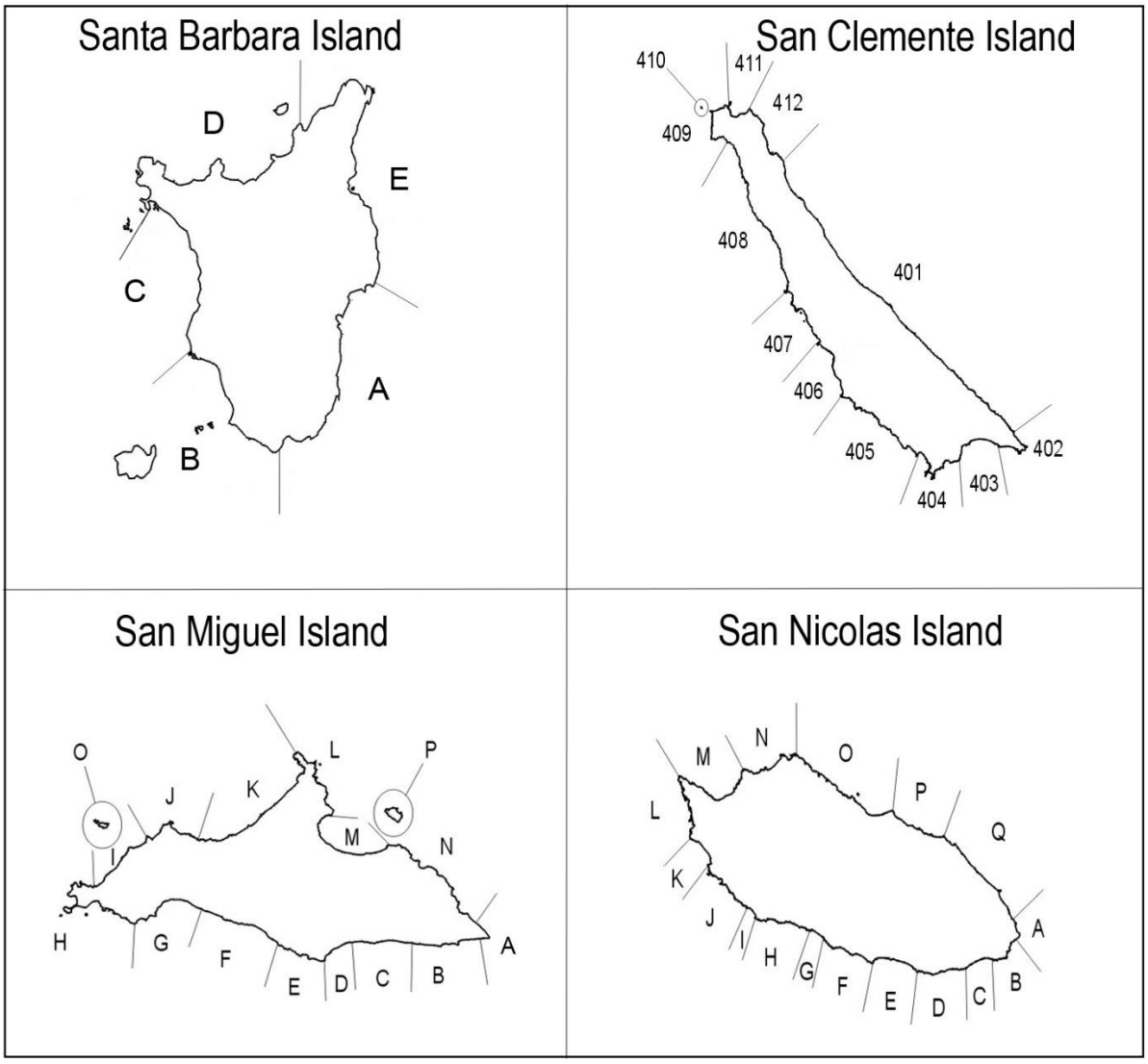

Figure 4. Maps showing locations of area codes for Santa Barbara Island, San Clemente Island, San Miguel Island, and San Nicolas Island. Area codes for San Clemente Island are from Bonnell et al. (1980). Refer to Appendix 1 for geographical positions (i.e., latitude and longitude) of area boundaries.

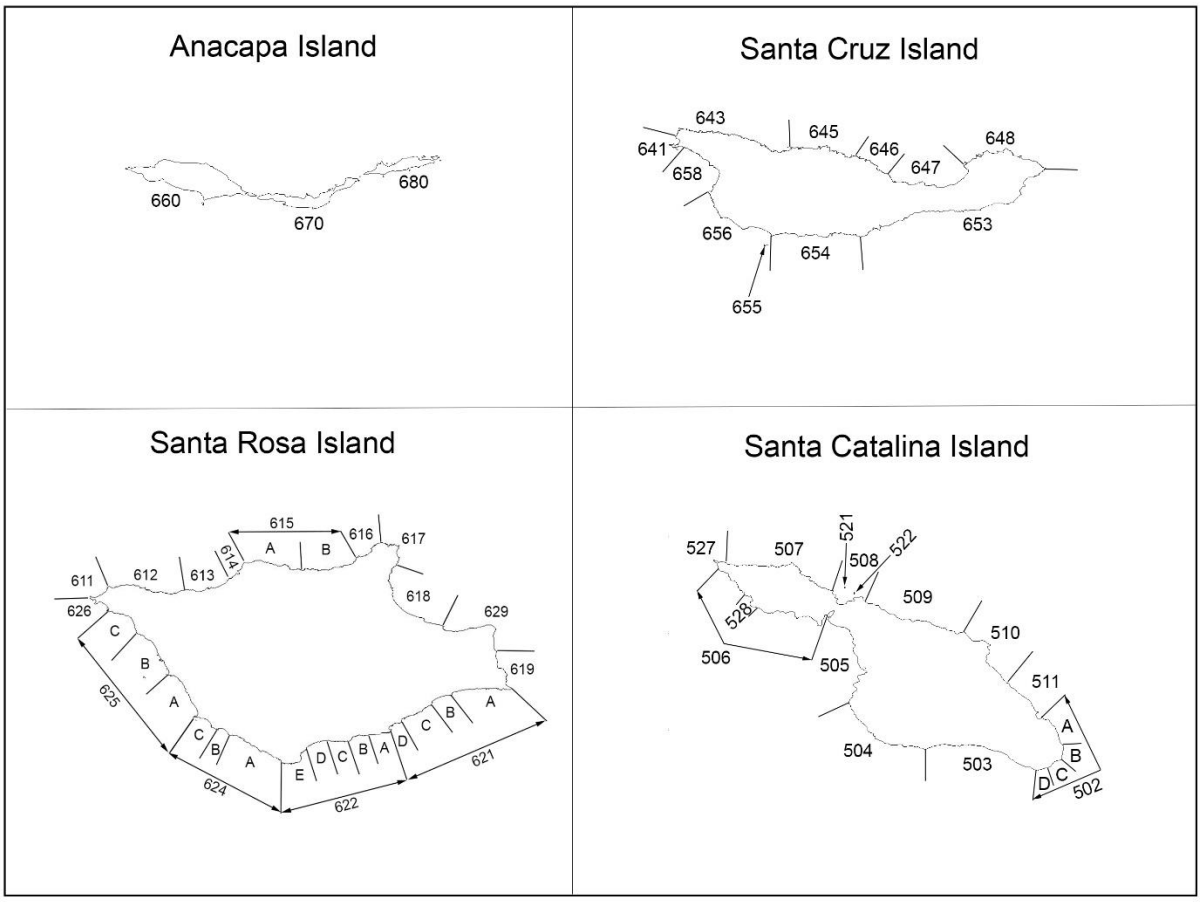

Figure 5. Maps showing locations of area codes for Santa Catalina Island, Santa Cruz Island, Anacapa Island, and Santa Rosa Island from Bonnell et al. (1980). Areas 615, 621, 622, 624, and 625 at Santa Rosa Island and area 502 at Santa Catalina Island (Bonnell et al., 1980) were divided into subareas areas. 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.

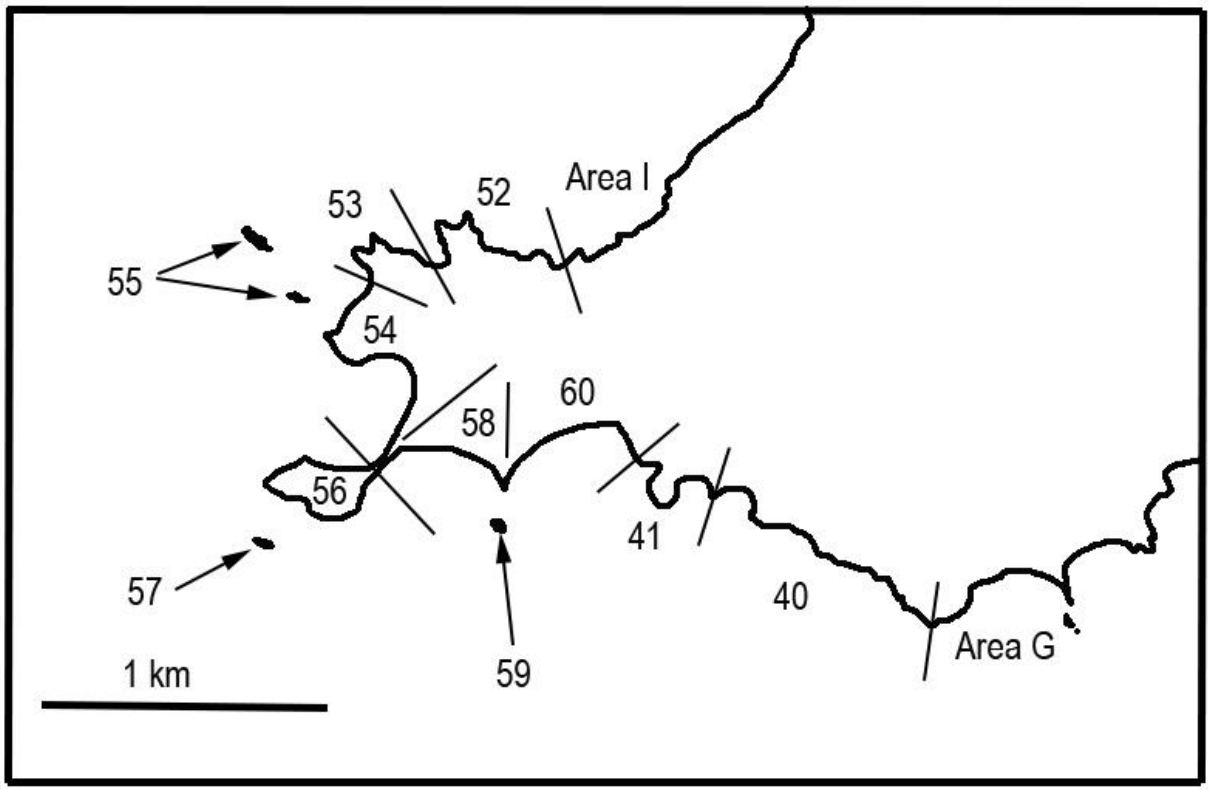

Figure 6. Haulout site codes within Area H (Point Bennett and southwest shoreline) at San Miguel Island, California.

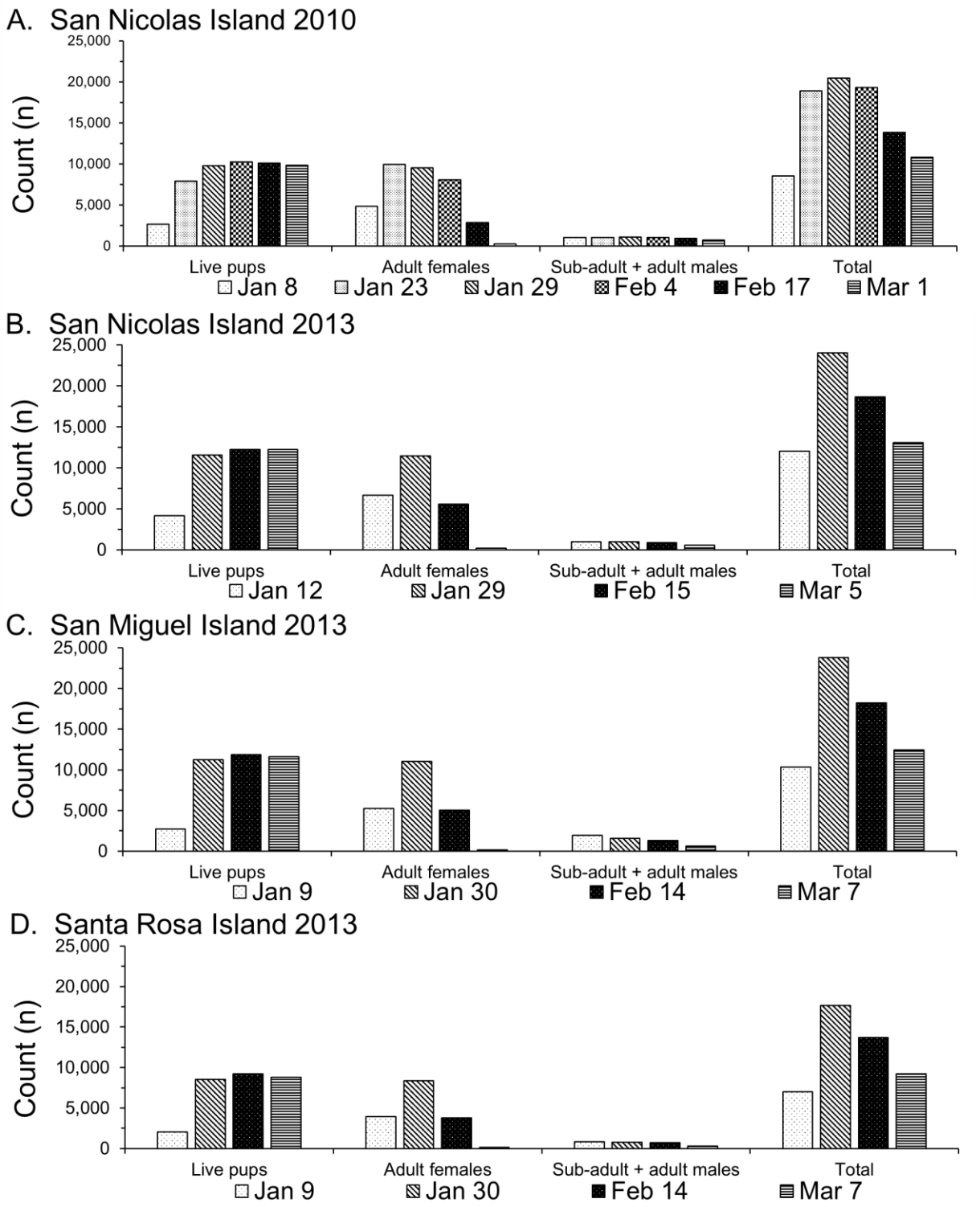

Figure 7. Elephant seals counted by age-sex class from aerial photographs taken at (A) San Nicolas Island during January 8, 23, and 29, February 4 and 17, and March 1, 2010, and at (B) San Nicolas Island, (C) San Miguel Island, and (D) Santa Rosa Island during January 9, 12, 29, and 30, February 14 and 15, and March 5 and 7, 2013.

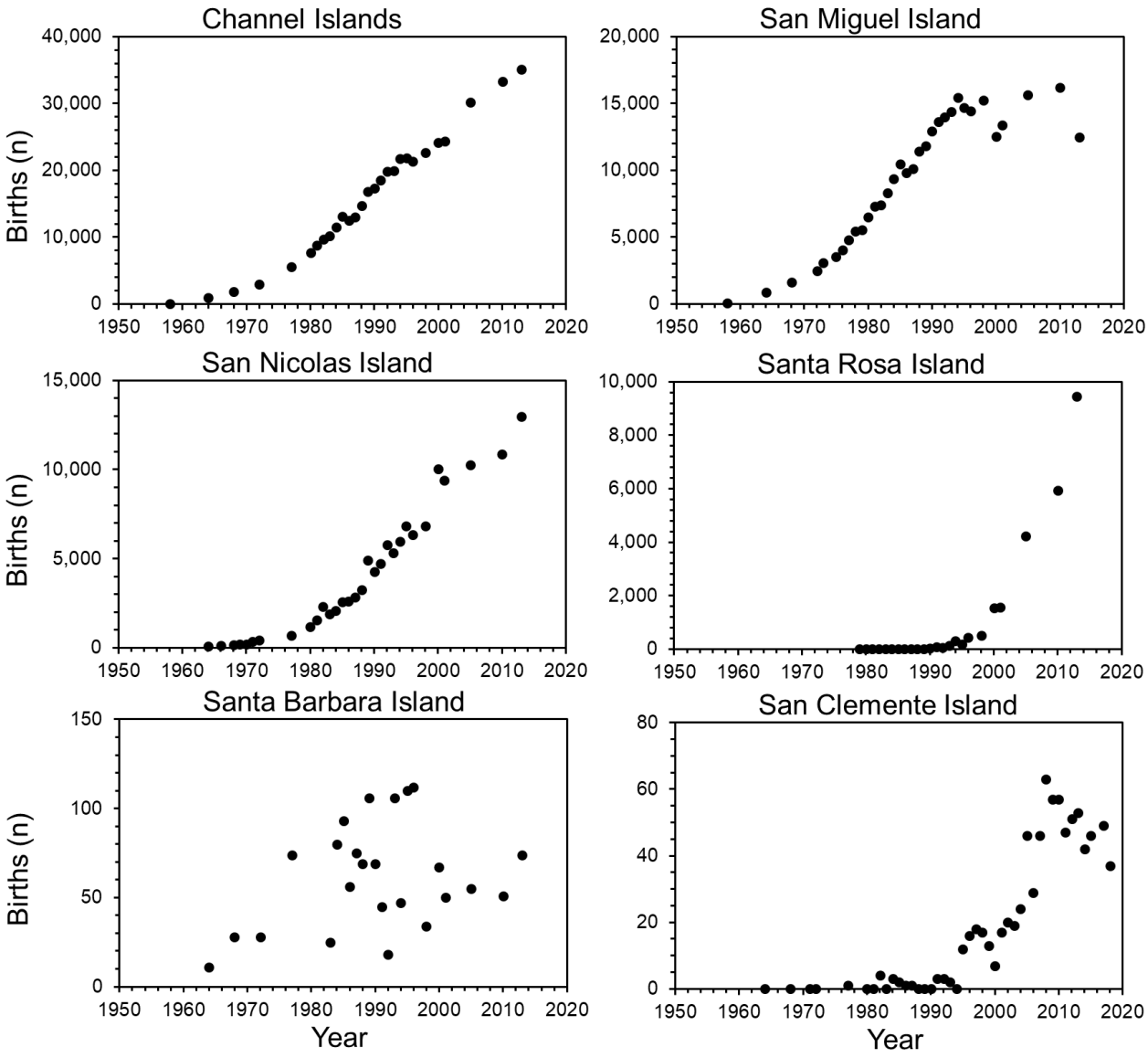

Figure 8. Elephant seal birth estimates for Channel Islands rookeries and for total of all Channel Islands. Data prior to 2011 are from Lowry et al. (2014).

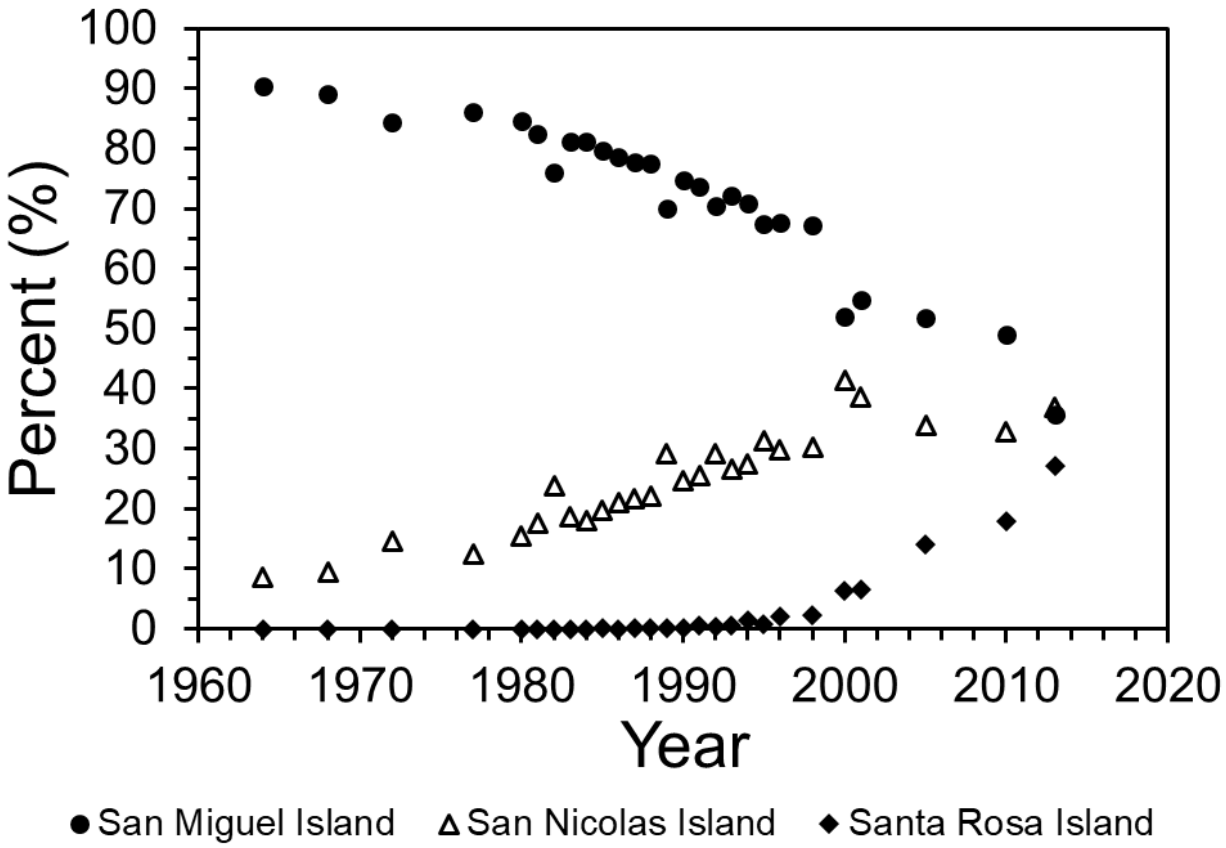

Figure 9. Percentages of northern elephant seal birth estimates represented by San Miguel, San Nicolas, and Santa Rosa Islands of all Channel Islands in southern California during 1964 to 2013.

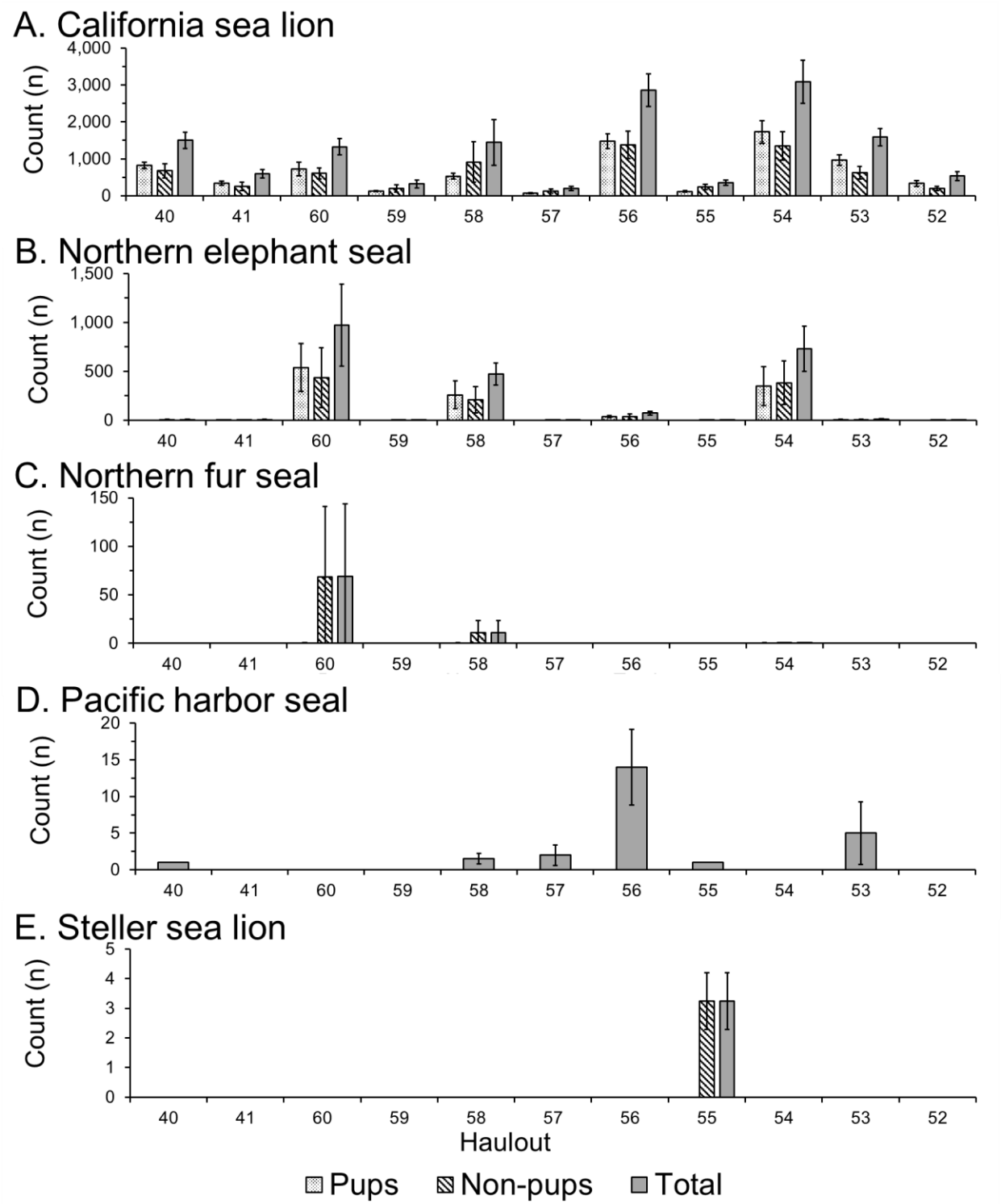

Figure 10. Mean number (±1 SD) of (A) California sea lion, (B) Northern elephant seal, (C) northern fur seal, (D) Pacific harbor seal, and (E) Steller sea lion pups, non-pups, and total (pups + non-pups) counted from aerial photographs taken of haulout sites within Area H at San Miguel Island during surveys conducted in January, February, and March 2013. Refer to Figure 6 for location of haulout sites within area H.

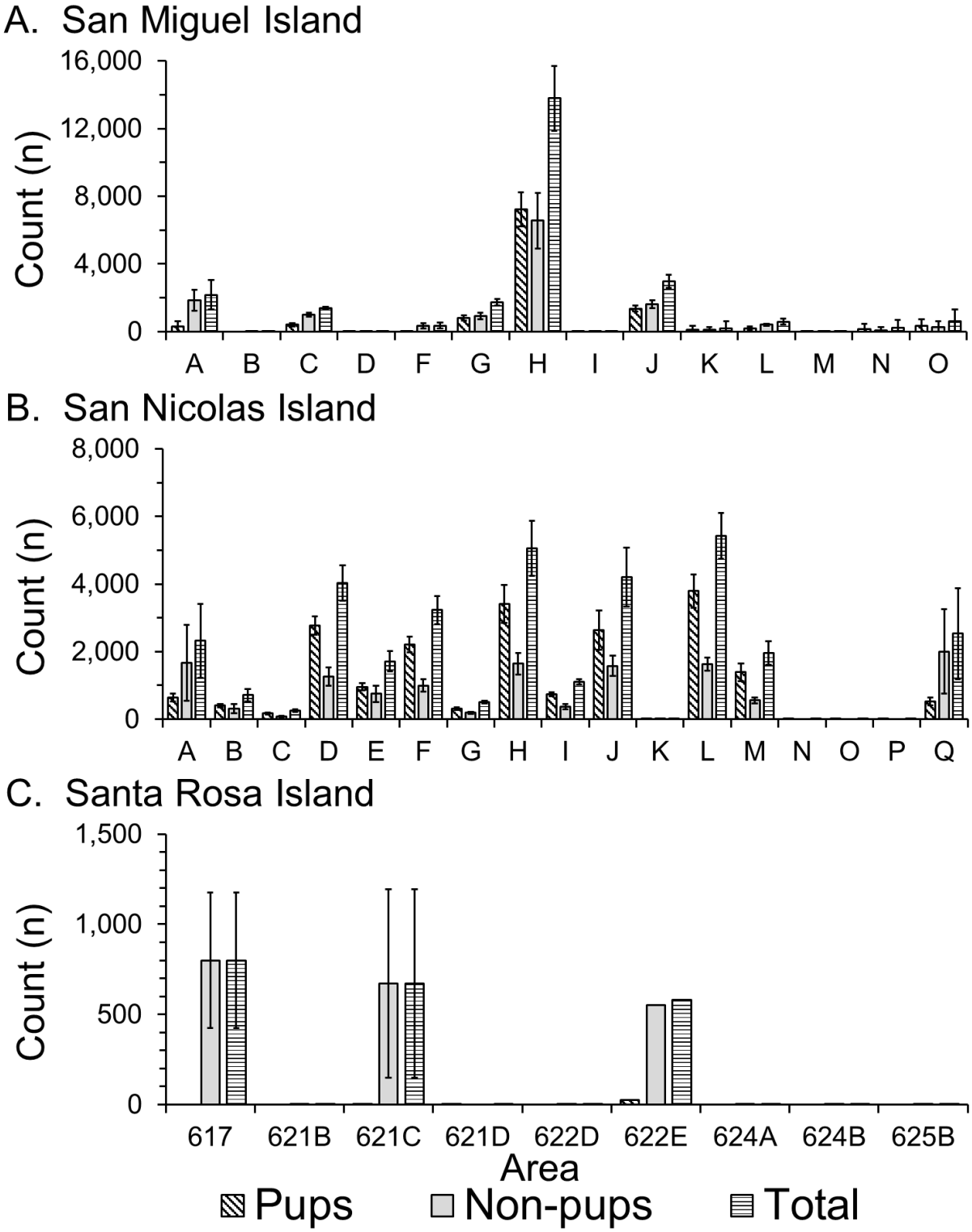

Figure 11. Mean number (±1 SD) of California sea lion pups, non-pups, and total (pups + non-pups) counted from aerial photographs taken at areas of (A) San Miguel Island, (B) San Nicolas Island, and (C) Santa Rosa Island, California during aerial surveys conducted in January, February, and March 2013. Refer to Figures 4 and 5 for location of areas.

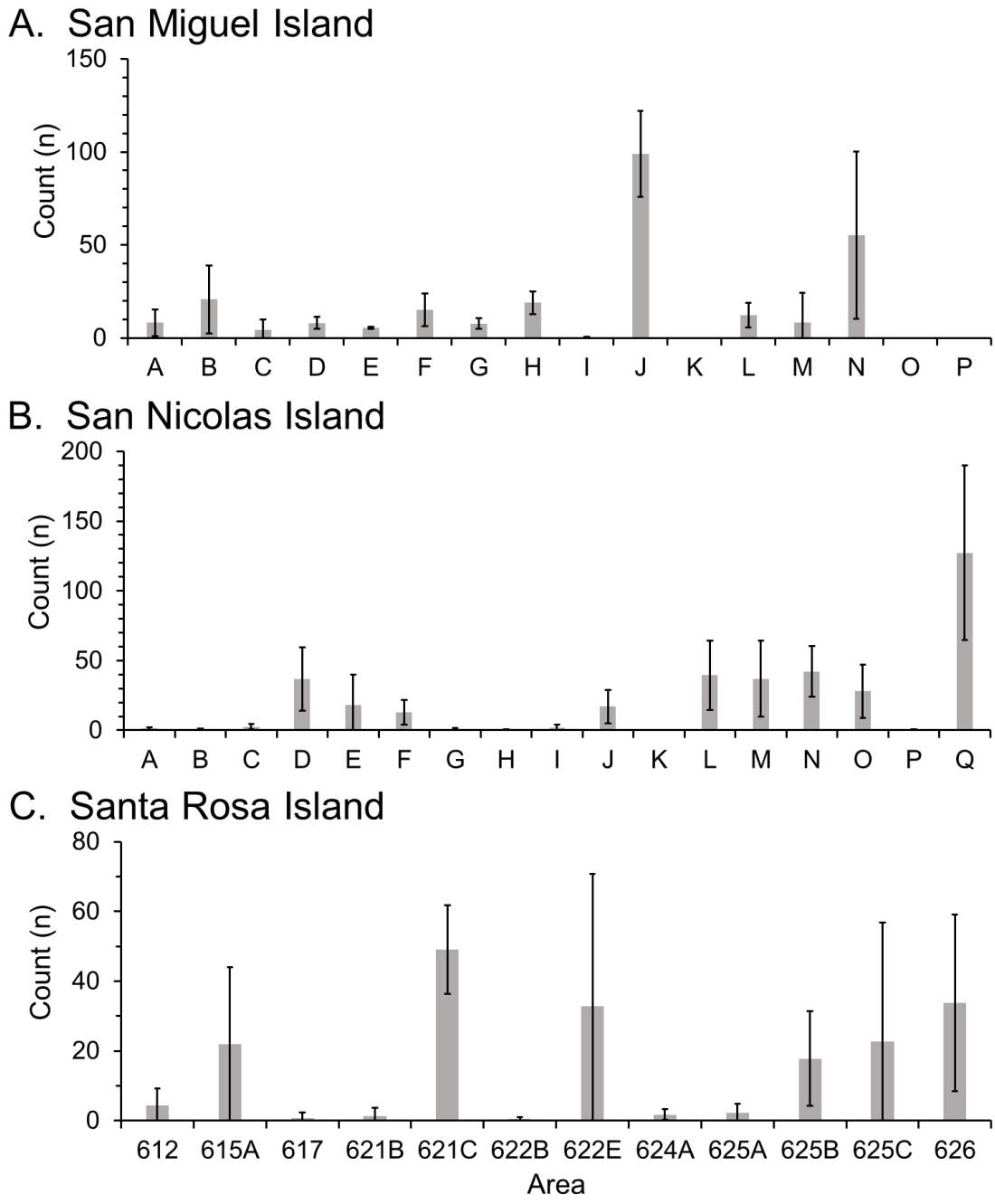

Figure 12. Mean number of Pacific harbor seals counted (±1 SD) from aerial photographs taken at areas of (A) San Miguel Island, (B) San Nicolas Island, and (C) Santa Rosa Island, California during surveys conducted in January, February, and March 2013. Refer to Figures 4 and 5 for location of areas.

Appendix 1. Geographical positions (expressed in degrees decimal) for area code boundaries within each of the Channel Islands.

		Waypoint #1		Waypoint #2	
Island	Area	Latitude	Longitude	Latitude	Longitude
San Miguel Island	A	34.032	-120.310	34.019	-120.311
	B	34.019	-120.311	34.020	-120.327
	C	34.020	-120.327	34.019	-120.354
	D	34.019	-120.354	34.015	-120.359
	E	34.015	-120.359	34.020	-120.376
	F	34.020	-120.376	34.030	-120.404
	G	34.030	-120.404	34.025	-120.428
	H	34.025	-120.428	34.037	-120.441
	I	34.037	-120.441	34.051	-120.423
	J	34.051	-120.423	34.057	-120.382
	K	34.057	-120.382	34.076	-120.369
	L	34.076	-120.369	34.059	-120.355
	M	34.059	-120.355	34.049	-120.336
	N	34.049	-120.336	34.032	-120.310
	O	34.055	-120.438		
	P	34.058	-120.334		
San Nicolas Island	A	33.234	-119.437	33.223	-119.438
	B	33.223	-119.438	33.220	-119.445
	C	33.220	-119.445	33.217	-119.456
	D	33.217	-119.456	33.217	-119.479
	E	33.217	-119.479	33.219	-119.496
	F	33.219	-119.496	33.227	-119.517
	G	33.227	-119.517	33.230	-119.522
	H	33.230	-119.522	33.233	-119.546
	I	33.233	-119.546	33.237	-119.550
	J	33.237	-119.550	33.251	-119.564
	K	33.251	-119.564	33.259	-119.573
	L	33.259	-119.573	33.279	-119.579
	M	33.279	-119.579	33.280	-119.550
	N	33.280	-119.550	33.285	-119.528
	O	33.285	-119.528	33.267	-119.486
	P	33.267	-119.486	33.259	-119.466
	Q	33.259	-119.466	33.234	-119.437
Santa Barbara Island	A	33.476	-119.028	33.465	-119.036
	B	33.465	-119.036	33.473	-119.044
	C	33.473	-119.044	33.481	-119.047
	D	33.481	-119.047	33.486	-119.034
	E	33.486	-119.034	33.476	-119.028
San Clemente Island	401	33.001	-118.548	32.830	-118.361
	402	32.830	-118.361	32.820	-118.371
	403	32.820	-118.371	32.812	-118.404
	404	32.812	-118.404	32.815	-118.439

Appendix 1. (Continued)

Island	Area	Waypoint #1		Waypoint #2	
		Latitude	Longitude	Latitude	Longitude
San Clemente Island (Continued)	405	32.815	-118.439	32.852	-118.500
	406	32.852	-118.500	32.885	-118.520
	407	32.885	-118.520	32.918	-118.546
	408	32.918	-118.546	33.012	-118.593
	409	33.012	-118.593	33.036	-118.596
	411	33.036	-118.596	33.033	-118.575
	412	33.033	-118.575	33.001	-118.548
	410	33.034	-118.614		
Santa Rosa Island	611	34.001	-120.250	34.008	-120.238
	612	34.008	-120.238	34.007	-120.186
	613	34.007	-120.186	34.013	-120.159
	614	34.013	-120.159	34.024	-120.147
	615A	34.024	-120.147	34.020	-120.097
	615B	34.020	-120.097	34.029	-120.070
	616	34.029	-120.070	34.037	-120.055
	617	34.037	-120.055	34.023	-120.045
	618	34.023	-120.045	33.983	-120.013
	629	33.983	-120.013	33.967	-119.978
	619	33.967	-119.978	33.943	-119.969
	621A	33.943	-119.969	33.938	-120.008
	621B	33.938	-120.008	33.932	-120.021
	621C	33.932	-120.021	33.921	-120.042
	621D	33.921	-120.042	33.915	-120.049
	622A	33.915	-120.049	33.912	-120.068
	622B	33.912	-120.068	33.909	-120.076
	622C	33.909	-120.076	33.909	-120.090
	622D	33.909	-120.090	33.903	-120.106
	622E	33.903	-120.106	33.894	-120.117
	624A	33.894	-120.117	33.912	-120.156
	624B	33.912	-120.156	33.917	-120.166
	624C	33.917	-120.166	33.925	-120.180
	625A	33.925	-120.180	33.952	-120.199
	625B	33.952	-120.199	33.979	-120.219
	625C	33.979	-120.219	33.993	-120.238
	626	33.993	-120.238	34.001	-120.250
Santa Cruz Island	643	34.069	-119.923	34.057	-119.791
	645	34.057	-119.791	34.043	-119.713
	646	34.043	-119.713	34.029	-119.693
	647	34.029	-119.693	34.036	-119.609
	648	34.036	-119.609	34.053	-119.565
	649	34.053	-119.656	34.034	-119.521
	653	34.034	-119.521	33.960	-119.722

Appendix 1. (Continued)

Island	Area	Waypoint #1 Latitude	Waypoint #1 Longitude	Waypoint #2 Latitude	Waypoint #2 Longitude
Santa Cruz Island (Continued)	654	33.960	-119.722	33.960	-119.818
	656	33.960	-119.818	34.008	-119.887
	658	34.008	-119.887	34.055	-119.911
	641	34.055	-119.911	34.069	-119.923
	655	33.951	-119.826		
Anacapa Island	660	34.010	-119.427		
	670	34.004	-119.393		
	680	34.015	-119.365		
Santa Catalina Island	507	33.477	-118.596	33.453	-118.502
	508	33.453	-118.502	33.443	-118.473
	509	33.443	-118.473	33.417	-118.390
	510	33.417	-118.390	33.373	-118.351
	511	33.373	-118.351	33.344	-118.318
	502A	33.344	-118.318	33.320	-118.303
	502B	33.320	-118.303	33.309	-118.305
	502C	33.309	-118.305	33.301	-118.317
	502D	33.301	-118.317	33.299	-118.327
	503	33.299	-118.327	33.317	-118.423
Santa Catalina Island	504	33.317	-118.423	33.357	-118.488
	505	33.357	-118.488	33.432	-118.507
	506	33.432	-118.507	33.470	-118.602
	527	33.470	-118.602	33.477	-118.596
	528	33.434	-118.563	33.448	-118.578
	521	33.463	-118.491		
	522	33.451	-118.487		

Appendix 2. Derivation of elephant seal adult female multiplier for single peak-season surveys

A method is proposed that allows someone to convert a single peak-season count of adult female elephant seals into an estimate of the total number of adult females present at a rookery in the Channel Islands. Aerial survey count data of adult female elephant seals obtained from multiple surveys at SNI, SMI, and SRI in 2010 and 2013 (Figure a1) was used to estimate the proportion of adult females present for each survey date. Proportions derived for each survey were estimated from the total number of adult females (including 95% confidence interval estimates) to derive a non-linear Gaussian equation for estimating the proportion present on a given day during the breeding-pupping season. The proportion of adult females present (dependent variable) at a Channel Island's rookery on a given date since Dec 1 (independent variable) during the breeding season can then be estimated. The Gaussian model provided the best fit for the proportions of adult female elephant seals present for various days within the breeding season (R^2 = 0.991, SE = 0.030; Figure a1). The proportion of adult females represented by those counted during a specific day of the breeding season can be determined from the following Gaussian equation:

$$y = ae^{\frac{-(x-b)^2}{2c^2}}$$

Where y = the proportion of adult female elephant seals present on a given day during the breeding season; e = the exponent; a = 0.885; b = 57.532; c = 14.391; and x = the number of days passed from the census date to and including December 1. The inverse of the estimated proportion gives a multiplier for converting the number of adult females counted on a given date during the breeding season (Table a1). At this time no 95%CIs were estimated because more data is needed. For now, the limited data available for deriving the Gaussian equation will make it possible to convert a single peak-season count of adult female elephant seals into an estimate of the total number of adult females present at a rookery in the Channel Islands. Adding data from other rookeries could increase the accuracy of the equation that produces the predicted values. Note, however, that the proportions prior to the peak exceeded the Gaussian regression line.

Table a1. Gaussian equation derived proportions of adult females present during pupping-breeding season at Channel Islands' rookeries with multipliers for estimating total number of adult females for surveys conducted during January 20 to February 2.

Survey date	Estimated proportion	Best estimate multiplier
Jan 20	0.799	1.252
Jan 21	0.822	1.217
Jan 22	0.843	1.186
Jan 23	0.859	1.164
Jan 24	0.872	1.147
Jan 25	0.880	1.136
Jan 26	0.885	1.130
Jan 27	0.885	1.130
Jan 28	0.881	1.135
Jan 29	0.873	1.145
Jan 30	0.860	1.163
Jan 31	0.844	1.185
Feb 01	0.824	1.214
Feb 02	0.800	1.250

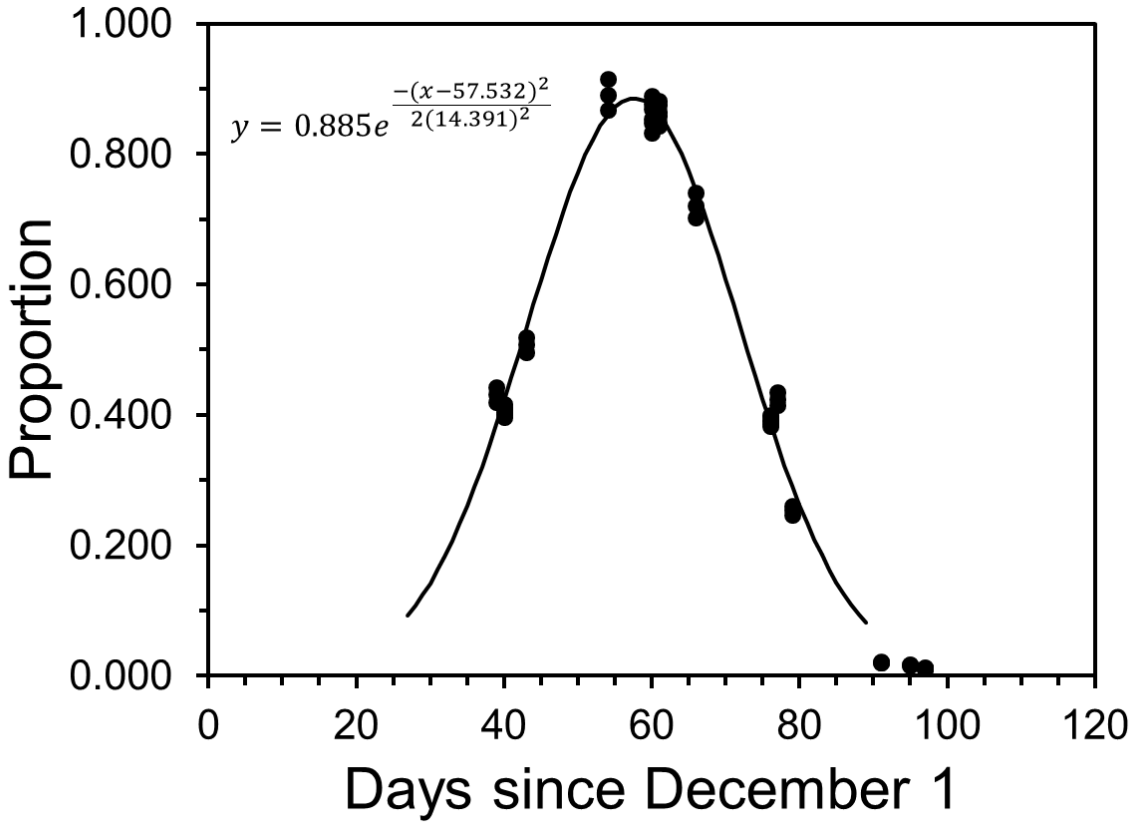

Figure a1. Gaussian distribution of the proportion of adult female elephant seals present on a Channel Islands' rookery during the pupping-breeding season estimated from counts and estimates derived from multiple aerial photographic surveys.