

## HISTORICAL AND RECENT COLONIZATION OF THE SOUTH FARALLON ISLANDS, CALIFORNIA, BY NORTHERN FUR SEALS (*CALLORHINUS URSINUS*)

Large numbers of breeding fur seals were harvested from the South Farallon Islands (SFI; 37°42'N, 123°00'W) off San Francisco, California, in the early nineteenth century (Bancroft 1886, Starks 1922, Townsend 1931, Busch 1985). Although harvest records are poor and perhaps unreliable, they suggest that well over 100,000 fur seals were taken by American and British sealers between 1807 and 1812, and smaller numbers were harvested by Russian sealers through 1834. The colony was extirpated, and no fur seals were recorded at the islands through the 19th and early 20th centuries (Bancroft 1886, Starks 1922, Ainley and Lewis 1974, York 1987).

Despite this substantial harvest, no scientific specimens or taxonomic notes were taken; thus, the identity of this fur seal population remains uncertain (Peterson and Le Boeuf 1969). The colony was initially thought to represent the northern range extent of Guadalupe fur seal (*Arctocephalus townsendi*) or an undescribed congener (Starks 1922, Townsend 1931, Scheffer 1958), an opinion supported by Riddell (1955) based on examination of bones collected in 1949 from Russian sealers' middens on Southeast Farallon Island (SEFI; Fig. 1). The discovery of a northern fur seal (*Callorhinus ursinus*) colony on San Miguel Island off southern California (Peterson *et al.* 1968) prompted a re-identification of these bones as those of northern fur seal (Schonewald in Reppening *et al.* 1971), but uncertainty has remained (*e.g.*, King 1983, Orr and Helm 1989). Guadalupe fur seals apparently dominated historic colonies on San Miguel Island (Lyon 1937, Walker and Craig 1979), and have recently bred there (Melin and DeLong 1999). Guadalupe fur seals also have been recorded recently on SEFI (Hanni *et al.* 1997).

Here we present results from an examination of additional faunal material from SFI, indicating the historic presence of a northern fur seal colony, and we describe the recolonization and breeding of northern fur seals on SFI in 1996–2000.

### *Historic Colony*

Archeological and historic faunal material was recovered by the California Academy of Sciences (CAS) from Russian middens near the western end of an extensive marine terrace on SEFI (Fig. 1) in the 1940s and 1970s (CAS specimen #16161). Bone assemblages in this collection, including teeth, jaws, limb bones, and cranial pieces from a minimum of five adults and twelve pups, reveal a mixed population of northern fur seals characteristic of a rookery. Taxonomic identifications were made based on bone morphology and osteological and mensural comparisons with complete skeletons of pup, immature,

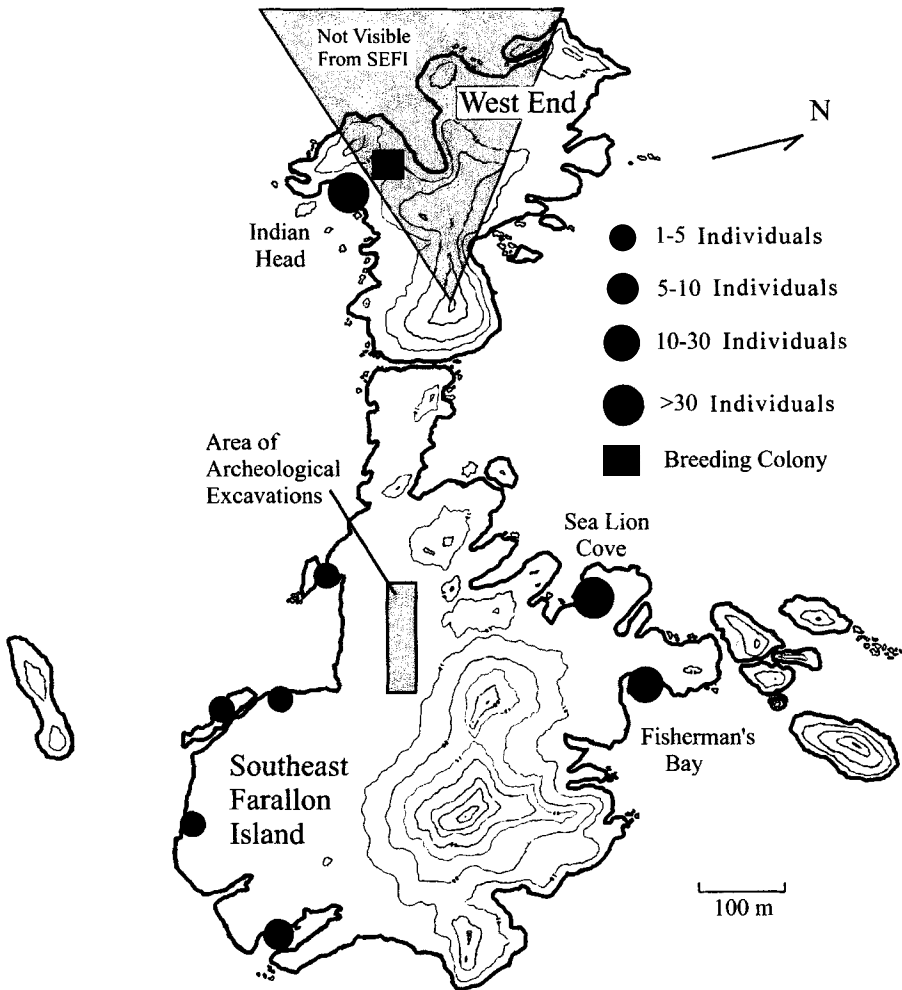


Figure 1. South Farallon Islands including Southeast Farallon Island, West End, site of archeological collections by CAS in the 1940s and 1970s, haul-out areas of northern fur seals during 1974–1999, and location of northern fur seal breeding colony in 1996–1999.

and adult male and female specimens of *C. ursinus*, *A. townsendi*, *A. australis*, and *A. galapagoensis* housed at CAS. Several mandibles collected from SEFI included jaws with deciduous teeth and early-erupting hollow tooth crowns comparable in size and dental development with jaws of pups from birth to three months of age (Scheffer and Kraus 1964).

No bones of Guadalupe fur seals were identified from the SEFI samples. It is possible that both species may have given birth at SFI, as occurred on San Miguel Island (DeLong *et al.* 1999), but evidence collected thus far indicates that the colony consisted of northern fur seals which were harvested during the early 1800s. No historic native Californian implements or artifacts have

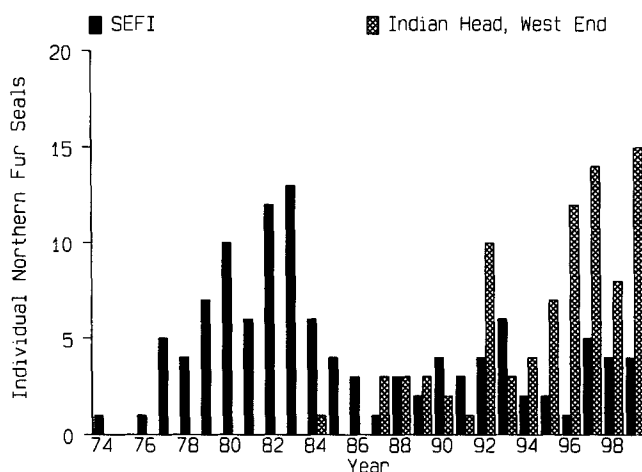


Figure 2. Individual northern fur seals recorded on Southeast Farallon Island (SEFI) and Indian Head, West End, by year, 1974–1999.

been collected from SEFI (Riddell 1955), indicating that the fur seal bones were not transported by humans. Evidence collected along the Oregon and central California coasts also indicates breeding of northern fur seals in these areas (Hildebrandt 1984, Lyman 1988, Hildebrandt and Jones 1992).

#### Recent Colonization

In 1968 a permanent biological research station was established on Southeast Farallon Island (SEFI) by the Point Reyes Bird Observatory (PRBO) and continuous, year-round observations by PRBO personnel on the vertebrate ecology of the islands have subsequently occurred (DeSante and Ainley 1980). Fur seals have been censused during weekly counts of all pinnipeds hauled out on SFI (Sydeman and Allen 1999). The age, sex (if possible), location, and any characters allowing individual identification (*e.g.*, scars and coloration of pelage) were recorded.

Northern fur seals were observed shortly after the station was established; *e.g.*, an adult female was found dead on 5 February 1970 (Museum of Vertebrate Zoology specimen # 140846) and an immature was photographed on 20 July 1974. Between 1974 and 1995 there were 861 observations of northern fur seals on SEFI, consisting of 180 individuals (defined as animals of the same age-sex group seen at the same location within a year). The number of individuals varied annually, showing a peak between 1976 and 1987 (Fig. 2). Northern fur seals were recorded during every month of the year, with 63.3% occurring during autumn (August–October).

Between 1976 and 1987, 58 of 69 (84.1%) fur seals occurred in Sea Lion Cove and Fisherman's Bay, on the northwest coast of SEFI (Fig. 1). A recognizable adult male returned to Sea Lion Cove each summer from 1977 to 1984, and another recognizable adult male returned to Fisherman's Bay each

summer from 1980 to 1983. Although several adult females and immatures accompanied these males, no evidence of breeding was observed. An immature female present on the island's southwest coast on 7 January 1979 was tagged as a pup on San Miguel Island in September 1978.<sup>1</sup>

Although the western island of SFI, West End (Fig. 1), was restricted to human access, much of the island was censused for pinnipeds from SEFI using 20–80× telescopes. An adult female northern fur seal was collected near Indian Head (Fig. 1) in 1964 (CAS #24936), but no fur seals were observed by PRBO biologists on West End until 1984 (Fig. 2). Between 1987 and 1995 from one to ten animals were observed at Indian Head (Fig. 2), with the number generally increasing during this period.

The area of subsequent breeding was not visible from SEFI (Fig. 1); however, three and one adult males were present in this area during one-day trips on 6 September 1989 and 30 August 1991, respectively. One of the males in 1989 had been tagged as a pup at San Miguel Island in 1980.<sup>1</sup> During additional trips to the colonization area one (1996), four (1997), one (1998), three (1999), and four (2000) pups were photographed and video-recorded. Two to four adult males, two to five adult females, and two to six immatures accompanied the pups in the colonization area during these years. An immature male observed there in 1996 had been tagged as a pup on San Miguel Island in 1993.<sup>1</sup> An immature and an adult female in 1997 and an adult female in 1999 also had tags from San Miguel Island, but the tag numbers could not be ascertained. Thus, it appears that some if not all of the fur seals colonizing SFI originated from San Miguel rather than Alaskan stock.

In all five years (1996–2000) pups were observed in the Indian Head area from SEFI in October and as late as 25 November. It is possible that breeding had occurred on West End between 1991 and 1996; however, the increasing pattern of occurrence in the colony area and the fact that we observed no pups from SEFI prior to 1996 suggests that the first recent successful breeding occurred that year. Throughout the observation period there was a pattern of increased arrivals during years preceding major El Niño events (1982–1983, 1992–1993, 1997–1998) followed by decreased arrivals and/or breeding activity during and after these events (Fig. 2). We will continue to monitor the northern fur seal colony, as well as subsequent impacts to breeding seabirds should it increase toward historical size (*cf.* Ainley and Lewis 1974, Warheit and Lindberg 1988).

#### ACKNOWLEDGMENTS

We thank the U.S. Fish and Wildlife Service/Farallon National Wildlife Refuge, for facilitating and supporting PRBO research on the island and for permitting access to West End to document the fur seal colonization. E. Ueber first observed the pup in 1996, and he and N. Cosentino assisted us with its documentation. We thank R. L. DeLong for information on the tagged fur seals from San Miguel Island, and G. A.

<sup>1</sup> Personal communication from Robert L. DeLong, National Marine Fisheries Service, 7600 Sand Point Way, Seattle, WA 98115, January 1999.

Antonelis for reviewing documentation of the breeding fur seals and the manuscript. Comments from E. Ueber and two anonymous reviewers also improved the presentation. This is PRBO contribution #749.

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PETER PYLE, Point Reyes Bird Observatory, 4990 Shoreline Hwy., Stinson Beach, California 94970, U.S.A.; e-mail: ppyle@prbo.org; DOUGLAS J. LONG and JACQUELINE SCHONEWALD, Department of Ornithology and Mammalogy, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, U.S.A.; ROBERT E. JONES, Museum of Vertebrate Zoology, University of California, Berkeley, California 94720, U.S.A.; JAN ROLETTO, Gulf of the Farallones National Marine Sanctuary, Fort Mason Building 201, San Francisco, California 94123, U.S.A. Received 31 December 1999. Accepted 3 August 2000.

MARINE MAMMAL SCIENCE, 17(2):402–414 (April 2001)  
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## DETECTING BIOLUMINESCENCE WITH AN IRRADIANCE TIME-DEPTH RECORDER DEPLOYED ON SOUTHERN ELEPHANT SEALS

While at sea, elephant seals (*Mirounga* spp.) spend 90% of their time underwater, at mean depths of 400–500 m while foraging during both daytime and nighttime (Le Boeuf 1994). Although most surface light is lost before reaching these depths, elephant seals have adaptations to low light levels that suggest visual predation. They have large eyes with a wide range of pupillary dilation (Levenson and Schusterman 1997), rapid adjustment to darkness (Levenson and Schusterman 1999) and a retina that has a peak sensitivity shifted to the blue-green (Lythgoe and Dartnall 1970, Carlson and Le Boeuf 1998). At depths where seals spend most of their time, bioluminescence is the main source of light (Seliger and McElroy 1965, Young 1983, Widder *et al.* 1989, Case *et al.* 1994), and it is produced at levels and wavelengths (Herring 1983, Haddock and Case 1999) that can be detected by the elephant seal eye (Le-