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POPULATION SIZE AND REPRODUCTIVE SUCCESS OF
NORTHERN ELEPHANT SEALS ON
THE SOUTH FARALLON ISLANDS 2005-2006



Report to US Fish and Wildlife Service
Farallon National Wildlife Refuge

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INTRODUCTION

Northern elephant seals, *Mirounga angustirostris*, were hunted to near extinction in the late 1800s, but with the end of commercial sealing and the institution of legal protection for the species, the population has grown from a low of 20-100 individuals *circa* 1900 to an estimated 127,000 in 1991 (Stewart et al. 1994). California stock was estimated at 101,000 in 2001 (Carretta et al. 2002). Northern elephant seals recolonized the South Farallon Islands in 1972 (LeBoeuf et al. 1974) and from 1973-1983 the number of pups born increased at an average rate of 56.5% per annum (Sydeman and Allen 1999). Since 1983, the population has declined steadily (Sydeman and Allen 1999, PRBO unpublished data). This report contains a summary of results from the winter 2005-2006 season of an ongoing study of the population size and reproductive success of the northern elephant seals on Southeast Farallon Island (SEFI) and West End Island, (WEI) California.

METHODS

Individual seals were identified by scars or tags, aged where possible, marked with hair dye to facilitate tracking, and monitored on a daily basis. Records were kept of the arrival, parturition and departure dates of all cows, as well as the fate of all pups. When pups died on the colony the cause was noted as well as could be determined. The studies concentrated on two breeding areas on SEFI, Sand Flat (SF), and Mirounga Beach (MB). In addition, some use was made of smaller beaches at Garbage Gulch (GG), Sea Lion Cove (SLC), and North Landing (NL). Seals were also monitored on West End Island (WEI) at Indian Head Beach (IHB) and Shell Beach (SB), but these areas were only monitored at 10- to 15-day intervals so data from WEI lack the precision of SEFI. An attempt was made to tag all adult and sub-adult males as well as known age cows. All pups were tagged when weaned, if possible.

Twice a week, the elephant seal population of SEFI was censused on foot. All individuals were assigned to a sex and age class (cow, pup, weaner, immature, subadult male (sa) 1, sa2, sa3, sa4, bull). WEI was censused approximately every 10 days, when the colonies there were monitored for reproductive success.

Weanling captures on Sand Flat and Mirounga Beach were initiated when 1/3 of the breeding population of females had departed from those breeding areas. During capture, one person acted as a dedicated lookout to warn the others of the approach of any cow to within 15m. A hoop net made of knotted nylon with 1/2" openings was looped over the weanling's head, and it was herded into the foot of the net. Once the weanling was immobilized in the hoop net, it was rolled onto a stretcher of 2" knotted nylon netting and two carrying poles. All available personnel lifted the weanling in the stretcher and it was carried to the tripod-mounted scale erected just off the breeding beach to minimize carrying distance and disturbance to any cows still present. All personnel were instructed in proper lifting technique and closely monitored to avoid injuries. Weanlings were weighed in their hoop net and stretcher to the nearest 0.5 kg using an Artech load cell and digital indicator from Bay City Scale, Inc. We measured axillary girth of all

weanlings to the nearest cm, and released them at their site of capture. Nets and stretchers were weighed before and after each set of weanlings and that weight subtracted from the raw weights.

RESULTS

The elephant seal population of SEFI has been declining since 1983, but seems to have stabilized somewhat since 1999 (Figure 1). The cow population of SEFI and WEI combined was 203 this season. The majority of the reproduction is coming from the Sand Flat, with Mirounga Beach and the two West End beaches each having about 25 pups (Table 1). Productivity (weaners / cow) on SEFI alone (due to data precision) for 2006 was slightly below the 14-year average since 1993 (Figure 2).

SEFI

MB- Mirounga beach is a small beach that provides the main access to Sand Flat, the main breeding area on SEFI. As such, it was transited by most of the cows, but 35 were observed to remain on MB for five days or longer. These 35 cows produced 26 pups, of which 10 (38 %) survived to weaning. The crowded conditions and disturbances due to transiting cows led to much mother-pup separation on MB. Most pup deaths were due to being bitten in the head by a cow or crushed to death. This beach had its own bull for the season, named Dingle.

SF- 113 cows were seen to stay on the Sand Flat and Marine Terrace for five days or more, and these cows produced 106 pups of which 77 (73 %) survived to weaning. Giovanna replaced First Cow in earliest breeder category this year with the earliest pup ever recorded at SEFI. J.D. was the alpha bull at the beginning of the season, but was displaced by Nero. Don was alpha for the 16-cow Marine Terrace harem, which is a subgroup of the SF site.

OTHER AREAS- No breeding was observed at Sea Lion Cove and North Landing only had 1 cow that lost her pup to the sea immediately after birth. GG produced 4 pups from 6 cows, with only 1 successfully weaned.

WEI

West End is a separate island, reached by means of a cable across a narrow channel. It is considered a “wilderness area”, and is visited only at approximately ten day intervals. This means that we do not know with accuracy the number of cows who arrive and leave, and our figures on this island are necessarily approximate. This island comprises two major areas where elephant seals breed, Shell Beach (SB) and Indian Head Beach (IHB).

IHB- The cows reach this area by means of an approach of about 50 m. up a steep, rocky slope. Nevertheless, each year a number of cows make the climb in order to pup.

Extrapolating from numbers collected on 4 visits, it appears that a minimum of 25 cows produced 25 pups, of which 23 (92 %) successfully weaned. An untagged bull was alpha here.

SB- In the beginning of the last decade, Shell Beach was the major breeding area on both islands, being a large, relatively flat area, accommodating as many as 250 breeding cows. The disappearance of the small beach which was the main access route is probably responsible for a 90% decline in numbers. This year, a minimum number of 23 cows produced 23 pups, of which 21 (91 %) survived to weaning. Altamont was alpha bull here again this year.

MALES

This year we observed a maximum count of 45 males over 4 years of age. At the end of the season, only 14 males were seen with regularity. A total of 6 bulls were identified during the season, up from 5 last year.

WEANLING WEIGHTS

We weighed 11 weanlings on SF during 2 days of effort in February and March. We spent 3 hours of field time each day of weanling weighing, and all island personnel were used in the process. Average weight was 94 kg (SD = 16 kg). In 2005, we weighed 19 weanlings (mean = 98 kg, SD = 18 kg). There is no significant difference in average weanling weight between these two years.

DISCUSSION

The northern elephant seal population on the south Farallon Islands appears to be slowly growing. SEFI numbers are still increasing and IHB had a jump in numbers this year as well. Weanling weight data collection went smoothly and we have found that the axillary girth measurement explains 91% of the variation in weight, meaning we can get an accurate condition index for all weanlings by simply measuring them, without subjecting all to the stress of weighing. The 2006 season could be characterized as positive in terms of population size, and average in terms of productivity and weanling/cow body condition.

RESEARCH / MANAGEMENT RECOMMENDATIONS

After substantial population growth immediately following their recolonization of the islands in 1971, northern elephant seals on the Farallones declined precipitously from the peak of 475 pups born in 1983. Our preliminary modeling efforts have determined that the number of shark attacks recorded at the Farallones is theoretically sufficient to have caused the seal population slide. However, the sharks and seals do not exist in stable ocean conditions from year to year, and the annual variability in the ecosystem also plays an important role in determining how many elephant seal pups survive to become breeding adults. By distinguishing how much variation in the survival of immature seals can be explained by predation pressure and oceanographic conditions, we can better

understand what factors govern the northern elephant seal population at the Farallones, and also how the shark population is affected by seal numbers.

We hope to analyze our 35 years of demographic data on elephant seals and 17 years of individual shark photo identification data to assess the effects of climate and predation on elephant seal population dynamics. The population model will include an estimate of annual survival rates of immature elephant seals from weaning to breeding age and an annual index of shark abundance around the Farallones.

This analysis and model will provide a detailed understanding of the elephant seal demography at the Farallones, fundamental to effective management of the species. By unlocking the ecological insights in our long-term datasets, managers and policymakers will have the understanding necessary to conserve the northern elephant seal and white shark populations.

In addition to the continuation of current research efforts, we recommend that additional efforts be made towards integrated analysis of the elephant seal and shark data. Analysis would yield comprehensive population parameters including estimates of age-specific survival, breeding propensity, and reproductive success as well as temporal variation in these parameters due to ocean climate fluctuations (e.g. El Niño), population density, and predation.

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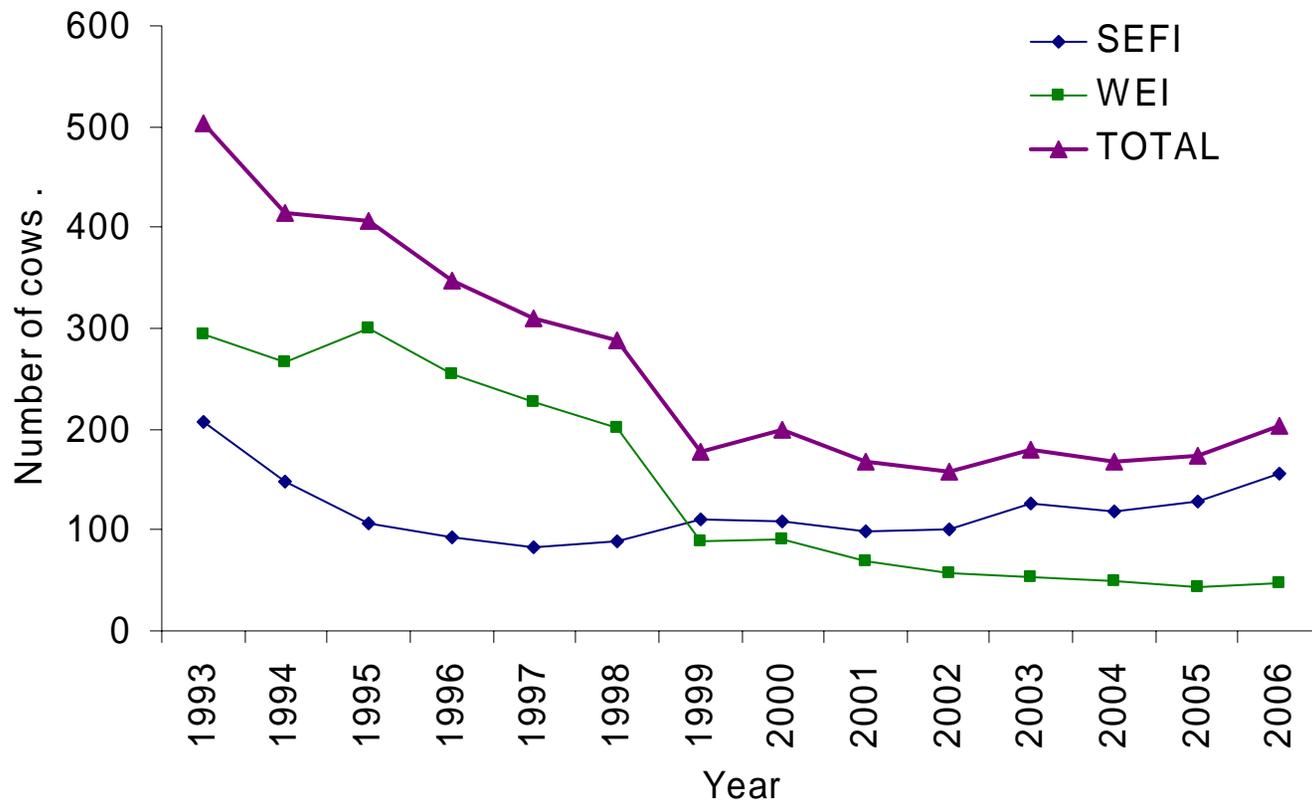


Figure I. Breeding population of northern elephant seals on SEFI and WEI from 1993-2006.

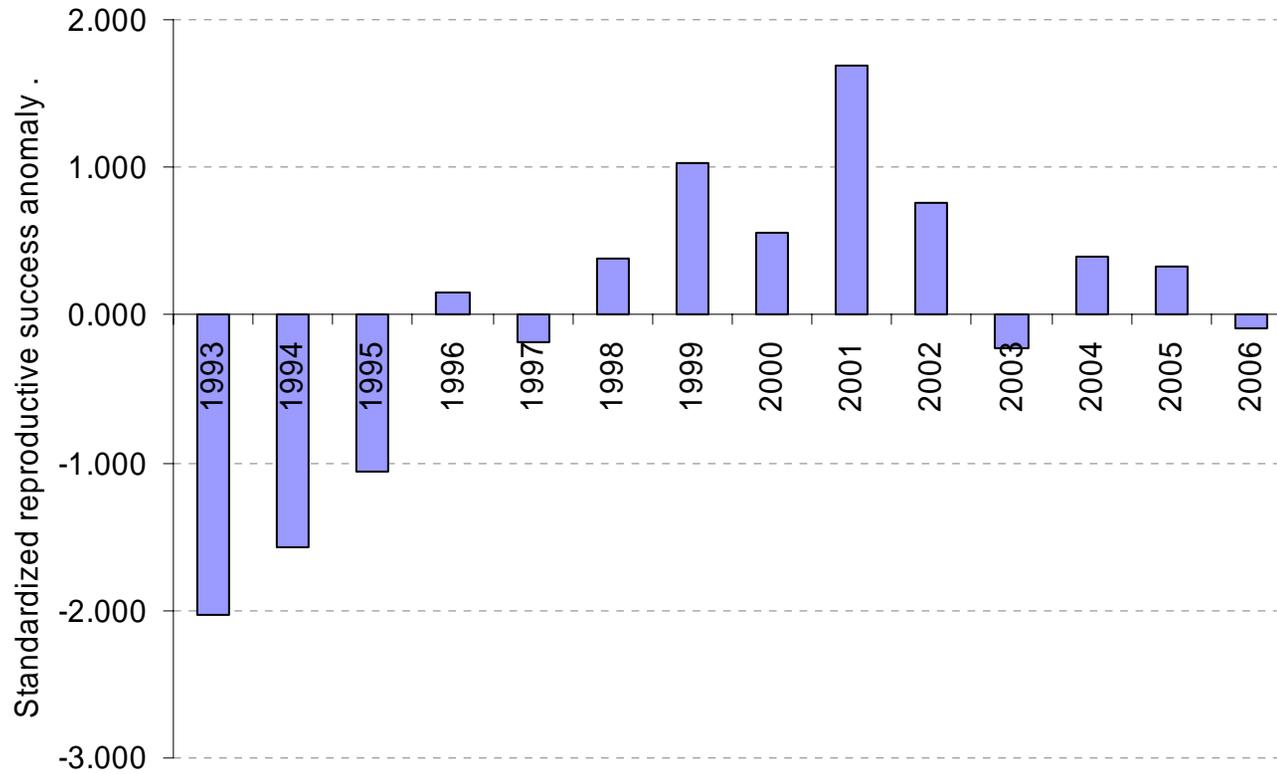


Figure 2. Standardized productivity (weaners / cow) anomalies ($[\text{annual value} - 14\text{-year mean}] / \text{SD}$) for northern elephant seals breeding at Southeast Farallon Island, California 1993-2006.

Table 1. Number of cow, pup, and weaner northern elephant seals at each breeding beach of Southeast Farallon and West End Islands 1993-2006.

PRODUCTIVITY SEFI, 1993-2006

| <u>YEAR</u> | <u>NL</u> | | | <u>GG</u> | | | <u>MB</u> | | | <u>SF</u> | | |
|-------------|------------|------------|------------|------------|------------|------------|----------------|------------|------------|------------|------------|------------|
| | <u>cow</u> | <u>pup</u> | <u>wnr</u> | <u>cow</u> | <u>pup</u> | <u>wnr</u> | <u>cow</u> | <u>pup</u> | <u>wnr</u> | <u>cow</u> | <u>pup</u> | <u>wnr</u> |
| 1993 | 38 | 10 | 1 | 16 | 11 | 6 | 49 | 17 | 4 | 105 | 62 | 48 |
| 1994 | 31 | 15 | 0 | 8 | 3 | 1 | 26 | 14 | 5 | 83 | 60 | 46 |
| 1995 | 5 | 2 | 1 | 8 | 7 | 1 | 21 | 21 | 8 | 72 | 57 | 35 |
| 1996 | 15 | 15 | 2 | 6 | 4 | 2 | 14 | 12 | 8 | 58 | 51 | 44 |
| 1997 | 10 | 9 | 0 | 4 | 1 | 0 | 10 | 8 | 4 | 59 | 54 | 42 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | combined sf/mb | | | 88 | 77 | 56 |
| 1999 | 7 | 7 | 0 | 2 | 2 | 2 | 14 | 14 | 11 | 88 | 87 | 68 |
| 2000 | 5 | 5 | 0 | 1 | 1 | 0 | 8 | 8 | 5 | 95 | 83 | 67 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 6 | 6 | 90 | 86 | 75 |
| 2002 | 0 | 0 | 0 | 3 | 3 | 1 | 17 | 15 | 10 | 80 | 67 | 58 |
| 2003 | 9 | 5 | 1 | 5 | 5 | 1 | 21 | 15 | 5 | 91 | 80 | 62 |
| 2004 | 0 | 0 | 0 | 5 | 4 | 2 | 27 | 23 | 16 | 87 | 81 | 58 |
| 2005 | 0 | 0 | 0 | 8 | 7 | 4 | 23 | 21 | 9 | 98 | 93 | 68 |
| 2006 | 1 | 1 | 0 | 6 | 4 | 1 | 35 | 26 | 10 | 113 | 106 | 77 |

PRODUCTIVITY WEI, 1993-2006

| <u>YEAR</u> | <u>IHB</u> | | | <u>SB</u> | | | <u>TOTAL</u> | | |
|-------------|------------|------------|------------|------------|------------|------------|--------------|------------|------------|
| | <u>cow</u> | <u>pup</u> | <u>wnr</u> | <u>cow</u> | <u>pup</u> | <u>wnr</u> | <u>cows</u> | <u>pup</u> | <u>wnr</u> |
| 1993 | 55 | 42 | 25 | 240 | 187 | 132 | 503 | 329 | 216 |
| 1994 | 37 | 33 | 27 | 230 | 162 | 104 | 415 | 287 | 183 |
| 1995 | 30 | 27 | 20 | 270 | 185 | 125 | 406 | 299 | 190 |
| 1996 | 20 | | 16 | 235 | | 159 | 348 | 82 | 231 |
| 1997 | ? | 7 | 5 | 226 | 195 | 159 | 309 | 274 | 210 |
| 1998 | 13 | 13 | 11 | 188 | 160 | 125 | 289 | 250 | 192 |
| 1999 | ? | 28 | 25 | 67 | 60 | 52 | 178 | 198 | 158 |
| 2000 | 30 | 22 | 11 | 60 | 55 | 44 | 199 | 174 | 127 |
| 2001 | 22 | 20 | 19 | 48 | 44 | 39 | 168 | 156 | 139 |
| 2002 | 16 | 14 | 11 | 42 | 37 | 35 | 158 | 136 | 115 |
| 2003 | 14 | 11 | 9 | 39 | 33 | 31 | 179 | 149 | 109 |
| 2004 | 19 | 19 | 15 | 30 | 29 | 26 | 168 | 156 | 117 |
| 2005 | 19 | 15 | 13 | 25 | 22 | 19 | 173 | 158 | 113 |
| 2006 | 25 | 25 | 23 | 23 | 23 | 21 | 203 | 185 | 132 |