

NOTES

**PUP PRODUCTION, ABUNDANCE, AND BREEDING DISTRIBUTION OF NORTHERN ELEPHANT SEALS ON SAN NICOLAS ISLAND, WINTER 1981**

A major breeding colony of northern elephant seals, *Mirounga angustirostris*, occurs on San Nicolas Island, California. Due to commercial hunting, elephant seals were extinct on San Nicolas Island by the end of the 19th century. Subsequent recovery of the population has been well documented (Table 1). Census data collected since 1949 indicate that the colony has been growing rapidly in numbers after breeding began again in the late 1940's.

**TABLE 1. Summary of *Mirounga angustirostris* Censuses On San Nicolas Island, 1949 to 1981.**

Date	Number of Pups	Source	Total population estimate based on pup count extrapolations
1949 May 11-12		Bartholomew 1951	159 <sup>1</sup>
1959 Jan 23	48 <sup>2</sup>	Bartholomew and Booloottian 1960	160 <sup>1</sup>
1964 Feb 9	78	Odell 1972	312
1971 Feb 6-7	344 <sup>3</sup>	Odell 1974	1376
1972 Feb 8	399	Antonelis <i>et al.</i> 1981	1596
1977	693	Le Boeuf and Bonnell 1980	2772 <sup>4</sup>
1981 Mar 14	1523 <sup>3</sup>	This study	6092

<sup>1</sup> Actual count of seals.  
<sup>2</sup> First account of pupping.  
<sup>3</sup> Includes dead pups of the year.  
<sup>4</sup> Authors estimated 2960.

We surveyed the beaches of San Nicolas Island on 19-21 January, 16-17 February, and 14 March, 1981, counting all pups of the year and noting their locations on each survey. Adult elephant seals were not included in the counts. Additional incidental observations were made in February 1982. Our purpose was to estimate the size of the island population on the basis of pup production and to compare locations of pupping activity with those described in previous surveys. All counts were made by direct observation on foot at close range; hand counters and 9X binoculars were used when necessary.

Our highest pup count was 1,523 in March (Table 1). From this number we estimate the 1981 elephant seal population on San Nicolas to be 6,092 animals. The estimate is based on the assumption that the ratio of the total colony size to annual pup production is 4:1 (Peterson and Le Boeuf 1969, DeLong and Johnson 1976). Our estimate indicates that the island population has grown an average of 16% per year since 1971 and at about 22% per year since 1977. This is in general agreement with published growth rates of other growing elephant seal populations (Bonnell *et al.* 1981; Antonelis, Leatherwood and Odell 1981). Our estimated population growth rate represents the combined effects of pupping and recruitment within the San Nicolas Island breeding population, immigration from other breeding sites to San Nicolas Island, and emigration from San

Nicolas to other breeding sites. The relative contributions of immigration and emigration to the growth of the San Nicolas population are unknown, but we have evidence that both processes occur. During our February census eight tagged female seals with newborn pups were observed. Four had been tagged at San Miguel Island, California, three at San Nicolas Island, and one at Isla de Guadalupe, Mexico. All were located within the 1971 breeding area. Female elephant seals tagged as pups on San Nicolas have joined other breeding colonies, primarily to the north (Reiter, Panken, and Le Boeuf 1981). A consistent trend of northerly movement of elephant seals involved in establishment of new colonies has been observed (Le Boeuf, Ainley, and Lewis 1974; Reiter *et al.* 1981).

The total linear distance of beach used for pupping increased from 5 km in 1971 (Odell 1974) to 11 km of shoreline in 1981 (Figure 1). The western limit of the pupping area changed little between 1971 and 1981, although the number of pups born near the west end was substantially higher in 1981 than in 1971 (Figure 1). Between 1971 and 1981 there was an increase in the utilization of beaches used for breeding of about 5 km to the east. In February 1982, two dependent pups were observed on the northwest side of the island (Figure 1), which extended the breeding range by another 5 km. Much of the northwest end of San Nicolas Island is characterized by rocky shoreline of a type seldom used by elephant seals for breeding. In 1982 the seals also extended their breeding area 1.2 km to the east. The total breeding range on the island is now about 17 km.

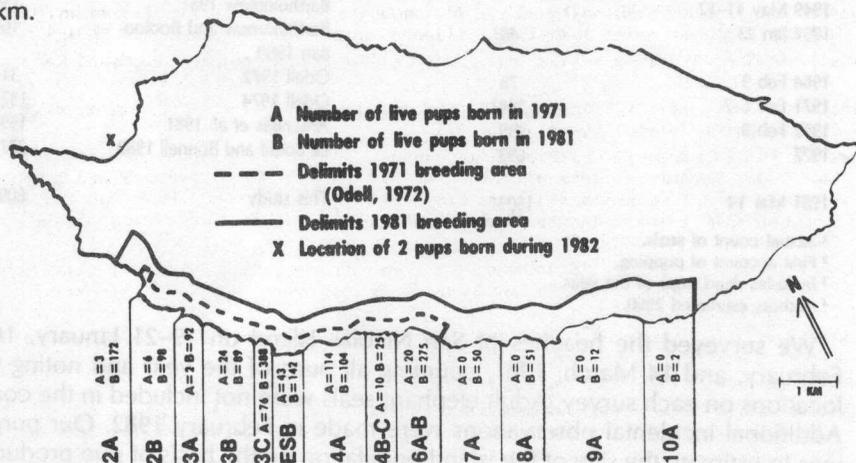


FIGURE 1. Distribution of elephant seal pups, March 1971 and 1981, San Nicholas Island. (area designations from Odell 1972)

Although expansion of the pupping area has been primarily eastward since 1971, only 115 pups in 1981 were produced beyond the eastern limits of the 1971 pupping area. While the number of pups born in the center of the breeding range has increased substantially over the past 10 years, those beaches lying in the periphery of the 1971 pupping range have experienced the largest increases in pup production (Figure 1). A number of sand and cobble beaches, apparently suitable for pupping but presently unused, occur on the northern, eastern, and southeastern shores of the island.

We counted 25 dead pups during our February census (1.7% of the February count). Heavy swells in January may have washed some dead pups out to sea

before our count. Odell (1974) estimated pup mortality to be 1.6 to 3.7% per year on San Nicolas Island during 1969–1971. Rates of pup mortality for Ano Nuevo Island, California, ranged from 13.0% to 40.0% per year from 1968 to 1980, (Le Boeuf and Briggs 1977, Reiter *et al.* 1981). On the Farallon Islands, one of the more recently reoccupied breeding areas, pup mortality has ranged from 7% to 71% during the period 1974–1976 (Ainley *et al.* 1977).

In summary, the colony of northern elephant seals on San Nicolas Island continues to grow exponentially. In recent years, pup production has increased most rapidly at the west end of the breeding area. Although the length of the breeding area has approximately tripled since 1971, many beaches which appear suitable for pupping remain unused. We feel that population growth should continue and that expansion of breeding areas will also continue as current breeding beaches become saturated.

### ACKNOWLEDGMENTS

We thank R. Dow and the Pt. Mugu Naval Air Station for their cooperation and D. Bodkin and S. Wright for their help in the preparation of this manuscript. We also thank R. L. Brownell, Jr., J. A. Estes, and K. S. Ralls for their contributions.

### LITERATURE CITED

- Ainley, D. G., H. R. Huber, R. P. Henderson, T. J. Lewis, and S. Morrell. 1977. Studies of Marine Mammals at the Farallon Islands, California, 1975–76. Final report to U. S. Marine Mammal Commission, Washington, D. C. (Contract MM5AC020). Natl. Tech. Info. Serv., PB266–249. 32 p.
- Antonelis, G. A., S. Leatherwood, and D. K. Odell. 1981. Population growth and censuses of the northern elephant seal (*Mirounga angustirostris*) on the California Channel Islands, 1958–1978. Fishery Bull., 79(3): 562–567.
- Bartholomew, G. A. 1951. Spring, summer, and fall censuses of the pinnipeds on San Nicolas Island, California. J. Mamm., 32: 15–21.
- Bartholomew, G. A., and R. A. Boolootian. 1960. Numbers and population structure of the pinnipeds on the California Channel Islands. J. Mamm., 41: 366–375.
- Bonnell, M. L., B. J. Le Boeuf, M. O. Pierson, D. H. Dettman, G. D. Farrens, C. B. Heath, R. F. Gantt, and D. J. Larsen. 1981. Summary of marine mammal and sea bird surveys of the Southern California bight area 1975–1978. Vol. 3, 214 p. Investigator's reports, Part I—Pinnipeds of the Southern California bight, Univ. Calif. Santa Cruz, Calif., Final Report to the Bureau of Land Management, Under Contract AA550–Ct7–36. Natl. Tech. Info. Serv., PB81–248171. 557 p.
- DeLong, R. L., and A. M. Johnson. 1976. Increase in the northern elephant seal population on San Miguel Island, California. Unpubl. Manuscr. Natl. Oceanic Atmos. Admin., Natl. Marine Fishery Serv., Northwest Fishery Center, Seattle, Washington. 10 p.
- Le Boeuf, B. J., D. G. Ainley, and T. J. Lewis. 1974. Elephant seals on the Farallons: Population structure of an incipient breeding colony. J. Mamm., 55: 370–385.
- Le Boeuf, B. J. and K. T. Briggs. 1977. The cost of living in a seal harem. Mammalia, 41: 167–195.
- Le Boeuf, B. J. and M. L. Bonnell. 1980. Pinnipeds of the California Islands: Abundance and distribution. p. 475–493. In D. M. Power (ed). The California Islands: Proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History, Santa Barbara, California. 787 p.
- Odell, D. K. 1972. Studies on the biology of the California sea lion and the northern elephant seal on San Nicolas Island, California. Dissertation. Univ. Calif., Los Angeles, XV + 168 p.
- Odell, D. K. 1974. Seasonal occurrence of the northern elephant seal, (*Mirounga angustirostris*), on San Nicolas Island, California. J. Mamm., 55: 81–95.
- Peterson, R. S., and B. J. Le Boeuf. 1969. Population study of seals and sea lions. Trans. North Am. Wildl. Nat. Resour. Conf., 34: 74–79.
- Reiter, J., K. J. Panken, and B. J. Le Boeuf. 1981. Female competition and reproductive success in northern elephant seals. Animal Behaviour, 29: 670–687.
- James L. Bodkin, Ronald J. Jameson. U. S. Fish and Wildlife Service, Denver Wildlife Research Center, Piedras Blancas Field Station, P. O. Box 70, San Simeon, CA 93452, and Glenn R. Van Blaricom, U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Center for Marine Studies, 273 Applied Sciences, University of California, Santa Cruz, CA 95064. Accepted for publication July 1983.