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STUDIES OF MARINE MAMMALS AT THE FARALLON ISLANDS, CALIFORNIA, 1970-1975

DAVID G. AINLEY, ET AL

POINT REYES BIRD OBSERVATORY
BOLINAS, CALIFORNIA

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ABSTRACT

Five to six years of censuses and observations made at or from the South Farallon Islands, California, 1970 to 1975, are summarized for eight cetacean and five pinniped species. These islands provide a unique opportunity for comparative studies of colonization by pinnipeds and of long- and short-term fluctuations in the offshore pinniped populations of the North American Pacific Coast.

Cetacean information includes descriptions of annual occurrence patterns for species frequently observed, and sight records for those seen less frequently. For Gray Whales (Eschrichtius robustus) records are also presented of females with calves and of individuals in residence during most of the summer.

Steller Sea Lions (Eumetopias jubatus) have been declining in number. Causes may be the high incidence of pup mortality, mainly due to stillbirths, and a low pregnancy rate. California Sea Lions (Zalophus californianus) have been increasing in number. Pups were born at the Farallones in 1974 and 1975, the most northern pupping records for the species. Many more Zalophus occupy the Farallones during the spring than the fall, a pattern opposite from that of other sites north of major breeding areas where this species has been studied. Northern Fur Seal (Callorhinus ursinus), which breed on offshore islands both north and south of the Farallones, have visited at least three times during the study period. Harbor seal (Phoca vitulina) have been increasing. Having been recorded only during the winter previous to 1973, they now occur year round. One pup, the first known for the Farallones, was observed in 1974 and three pups were present in 1975. Northern Elephant Seal (Mirounga angustirostris) have been increasing rapidly in number having recently recolonized after an absence of about 150 years. The first pup was born in 1972, and by 1975, 35 were born. Changes in population size and structure and major events in the recolonization process are described.

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INTRODUCTION

Many reports describing the wildlife of the Farallon Islands, California, have appeared since 1854 (see review by Ainley and Lewis 1974), and most have briefly mentioned marine mammals. The first real census work on Farallon pinnipeds was done by Bonnot, and is summarized in Bonnot et al. (1938). Little attention has been paid these animals since then, yet interesting changes reported herein and in Le Boeuf et al. 1974, have been occurring in some of the populations. These changes provide insight into the biology and ecology of these species.

Three pinniped species have recently established or seem to be in the process of establishing breeding populations at the Farallones. This provides a unique opportunity to study comparatively colonization processes by pinnipeds. A fourth species has been declining rapidly in number, yielding another opportunity to learn about changes in wild populations. Since interested persons are present year round on this remote natural laboratory in the form of biologists from the Point Reyes Bird Observatory, these opportunities are not likely to be ignored. PRBO also looks forward, if possible, to maintaining a station on Southeast Farallon at the least for many more years, which will insure collection of long-term data, sorely needed if short- and long-term fluctuations in marine mammal populations are to be understood.

THE FARALLON ISLANDS

Southeast Farallon and West End, as shown in Figure 1, compose the South Farallon Islands (or South Farallones) which with several other large rocks close by comprise about 44 hectares (100 acres). The North Farallones, three large rocks, lie 8 km north. The South Farallones lie 43 km west of San Francisco, California, and 32 km from the closest land, Point Reyes directly north and Bolinas Point to the northeast. The islands lie on the very brink of the continental slope. Thus deep oceanic waters lie immediately westward and shallow inshore waters lie eastward. The islands are fortuitously positioned at the eastward edge of the cold, productive waters of the California Current.

Few other places in the eastern North Pacific can compare with the number and variety of wildlife that occur at the Farallones: twelve species of seabirds breed there, and their combined population of over 250,000 birds constitutes the largest seabird colony in the United States outside of Hawaii and Alaska; more than 325 species of birds have visited the islands; and five species of pinnipeds have occurred, at least four and perhaps all of which have bred

there. Sea otters also supposedly once bred at the Farallones.

During the 1800's and through the early 1900's the Farallones were subjected to much disturbance by human activity. Sealers exterminated fur seals, elephant seals, and sea otters, and hunted sea lions for food during the early 1800's (Scammon 1874; Riddell 1955; Doughty 1971). In 1854 a lighthouse was established and has been maintained continuously including the present. For most of that period at least four families, with their associated pets and mules, lived on the Farallones year round. In 1854 a commercial egg company began an unregulated harvest of seabird eggs that continued until the early 1900's. There was apparently little regard for other wildlife as the company went about the business of removing eggs. During recent years the presence of the U.S. Coast Guard has deterred visitors from the island, but the Coast Guard's present use of helicopters to maintain the automated navigational aids has not been beneficial to wildlife. The Farallones, with the exception of the South Farallones, have been a federal wildlife refuge since 1900. In 1969, the South Farallones were included. Because of the islands' relative remoteness not much active wildlife protection had been practiced until the Bird Observatory was allowed to set up a station in April 1968. On the occasion of the Coast Guard automating its equipment in 1972, PRBO entered into a cooperative agreement with the U.S. Fish and Wildlife Service whereby in return for the privilege of working there and aiding in maintenance of facilities, PRBO provided a "presence" and helped coordinate the activities of other persons wishing to conduct studies there. The seabird populations have responded dramatically to the gradually lessening disturbance over the past decade (Ainley and Lewis 1974).

METHODS

Little attention was paid the pinnipeds during the first few years of PRBO occupation, with the exception of Elephant Seal censuses. In 1971 and 1972 occasional counts of sea lions were made and in mid-1973 regular censuses were started. Since June 1974 censuses have been under contract from the Marine Mammal Commission. All sea lion census results since 1971 and up to September 1975 are included in this report. Elephant Seals have been counted regularly since 1970; daily during the breeding season and about weekly during other periods. The number of Harbor Seals hauled out varies greatly from one day to another. Whenever observed their numbers have been recorded. Beginning in 1973 a conscious effort was made to look for them.

Censuses of sea lions and Elephant Seals were made between 1400 and 1600 h. Twelve all-day watches in which sea lions were counted revealed that maximum numbers were hauled out during those hours (Figure 2). Part of each

regular pinniped census was accomplished using a 25X spotting scope from Lighthouse Hill (109.1 m). Animals in the water were included. During the sea bird breeding season from 15 April to 1 August, Elephant Seals were counted from the Lighthouse. This minimized disturbance both to the birds and the seals (who are adversely affected by the screams of gulls), but that vantage point renders counts slightly low as one of the seals' usual hauling out spots can only partly be seen from there. However, very few seals are present during that period and we believe the error to be relatively insignificant. During the rest of the year, Elephant Seals were counted from the Lighthouse. This minimized disturbance both to the birds and the seals (who are adversely affected by the screams of gulls), but that vantage point renders counts slightly low as one of the seals' usual hauling out spots can only partly be seen from there. However, very few seals are present during that period and we believe the error to be relatively insignificant. During the rest of the year, Elephant Seals were counted from blinds or from other vantage points near their preferred areas. The tag numbers of marked animals (tagged by University of California personnel) were read with binoculars and recorded when possible. Unmarked animals were often recognized by individual characteristics (scars, etc.), and "mug shots" and notes on anatomical peculiarities were kept on file.

Cetaceans were recorded whenever observed beginning in the fall of 1970. The ocean to the south and west was watched during the course of other activities for a minimum of about two hours each day. On many days observations totaled as much as three to four hours and sometimes more. Most cetacean observations were made when the island's wildlife (primarily visiting migrant birds) was censused and the general well being of the island and its facilities were surveyed. Weather permitting, those tours were conducted daily without fail.

CETACEANS

California Gray Whale (Eschrichtius robustus)

Gray whales were observed each year usually from late November until June or July, but at times well into August. Maximum numbers, sometimes reaching 30 per day, were counted during December and early January during the animals' southward migration. Far fewer numbers were observed during the whales' northward movement probably because that migration is more spread out in time (Rice and Wolman 1971). Rice and Wolman give the impression, in their Figure 2 (p. 16), that a definite break in numbers of whales present occurs between the southward and northward migrations. No such break, however, occurred in our records at the Farallones. Gray whales were seen continually during their period of presence.

Definite differences exist from one year to the next in the timing and intensity of migrations, as revealed in Figure 3.

Southward migrating animals appeared much earlier in the year (early November) during 1971 and 1972 than in 1970, 1973 or 1974 (mid to late December). The southward migration of 1970-71 and of 1971-72 were steady but drawn out; in 1972-73 it came in large, sporadic "bursts"; in 1973-74 it was steady but concentrated during a rather short interval after a late start; and in 1974-75 it was practically non-existent near the Farallones. It is difficult to assess differences in northward migrations because during the spring individuals tend to remain near the islands for long periods (see below). The reasons for the yearly differences may become clearer when more years of information are available. It seems likely that oceanographic conditions play a role, especially in the subarctic areas where the bulk of the population summers.

During the spring of 1971 we observed cows with calves. On 2 May two cows each with a calf were observed heading north. On three days, between 26 and 31 May, a single cow with a calf thought to be the same individuals, were present. On 22 June another female with a calf was observed. These dates of cow/calf sightings are later than those recently reported by Baldridge (1974) for the point Pinos area, 200 km south. During the spring in other years we have not noticed cows and calves near the Farallones.

Somewhat perplexing are observations during January 1972 when we saw adults clearly accompanied closely by much smaller individuals. These appeared to be cows with calves. The observations are as follows: On 5 January included in a pod of four animals were one adult with a calf; on 6 January included in a loose group of eight Gray Whales were two adults each with a calf; on 14 January included in a pod of five were again two adults each with a calf; and on 28 January in a pod of three was one adult with a calf. The only other such instance known to us (of adults with calves in Central California during January) is that reported by Sund (in Baldridge 1974) who saw an adult with a small nursing calf during an aerial census near Point Sur on 23 January 1973. We leave speculation concerning the significance of these observations to those having more knowledge of Gray Whales.

Beginning in 1970, at least one and sometimes two Gray Whales were seen repeatedly for long periods during the late spring and summer. The first such observation was of a single whale seen on 7 days between 14 and 30 June 1970. Based on the distinctive white patch on one of its flukes, observers felt it to be the same individual seen on 5 June as well. During the spring and summer of following years, one to two whales reside near the Farallones for two to three months. One of these spring-summer residents has been the same individual in all years from 1972 through 1975 and is recognized by the distinctive white markings on its flukes. These animals seem rarely to move more than five or six km from the island during their stay. Mostly they remain in waters over the continental slope lying immediately west of the Farallones. Most Gray Whales

migrate to the arctic for the summer and such summer residents in California have not been reported in recent decades, if ever. Pike and McCaskie (1969) report for British Columbia that strays are sometimes seen along the coast from June through October some probably remaining for long periods. The Farallon animals can hardly be termed strays, so predictable are the occurrences. More recently, Hatler and Darling (1974) reported that Gray Whales are regularly found during summer in certain of British Columbia waters. They know for sure that the same individual, recognized by distinctive coloration, summered in successive years (1973 and 1974) at one specific locality. They suggest that as the Gray Whale population recovers from former near-extinction they are beginning to "re-discover" patches of suitable summer habitat elsewhere than the Arctic.

Humpback Whales (Megaptera novaeangliae)

Humpbacks were observed on occasion each year during the late summer and fall and were seen rather frequently in 1973 and 1974. All sightings but a few were between August and November (Fig. 4). The most seen at any one time was 20 individuals on 2 November 1973. Their occurrence pattern in some way must relate to movements between the Arctic and winter breeding grounds in waters off Mexico (Leatherwood et al. 1972). Based on the pattern described by Kellogg (1929), most sightings of this species at the Farallones coincide with their southward movement. The period of Humpback occurrence near the Farallones also corresponds closely to the annual period when oceanic waters move into the area and maximum temperatures are reached (see Bolin and Abbott 1963). Perhaps Humpbacks are associated with the oceanic water. Interestingly, the "resident" Gray Whales disappear from the area when this warmer, less productive water, and Humpback Whales, move in.

Killer Whales (Orcinus orca)

This species has been recorded during the period from mid-May to early December. The maximum number seen in one pod (on 25 May 1974) was six including three cows, two calves, and one bull. On 4 August 1974, a pod of four was seen: two cows, a possible calf and a bull. Usually only one or two animals are seen at any one time. Two were observed in what was interpreted as an unsuccessful attack of a Gray Whale on 22 May 1972. We happened to be watching an adult Gray Whale about 1 km southeast of the island through a 25X spotting scope when two Killer Whales appeared alongside it. There commenced a great deal of splashing by which nothing could be discerned. The Gray Whale sounded for about two minutes and surfaced a few hundred meters away with no Killer Whales in attendance. On 13 October 1972 a male Killer Whale surfaced in an area of bloody water 150 m off the southern shore of the island. A flock of screaming gulls first alerted us to the area. We assumed the animal had just made a meal of a pinniped (?), many

of which frequent that particular area.

Other Cetaceans

Finback Whales (Balaenoptera physalus) have been positively identified on nine occasions between 1 April and 9 September, 1969-1974. The most seen at any one time was six animals on 1 April 1971, and five on 1 July 1975. This period of occurrence corresponds with that described by Kellogg (1929) based on his review of whaling records and with that alluded to more recently by Fiscus and Niggol (1965). Sei Whales (Balaenoptera borealis) were seen for sure on two occasions: 10 June 1974 and 29 June 1972. A whale, most likely a Sperm Whale (Physeter catodon) was seen 6 January 1973, and two Sperm Whales (a cow with calf) were observed 15 May 1970. On at least six occasions large but unidentifiable whales (not Gray Whales, because they possessed dorsal fins) were seen. All these records are summarized in Figure 4.

We rarely see dolphins from Southeast Farallon. Dall Porpoises (Phocoenoides dalli) were seen twice, six animals south of the island on 19 December 1971 and six or seven in the same vicinity on 18 August 1973. A Risso's Dolphin (Grampus griseus) washed ashore on 20 May 1973. Its skeleton, reproductive organs (a female), and stomach contents are preserved in the Museum of Vertebrate Zoology, Berkeley (Field No. REJ 659).

PINNIPEDS

Steller Sea Lion (Eumetopias jubatus)

The population of Steller Sea Lions changed little during the period 1971 to 1975 compared to a marked reduction in numbers during the preceding four decades (Table 1). During the period 1971-75 maximum numbers ranged from 120 to 216 animals, many fewer than the 700 to 900 animals recorded by Bonnot et al. (1938) during June censuses of the 1920's and early 1930's.

Maximum numbers occurred in May (Figure 5), similarly to populations in Oregon studied by Mate (1973) during the period 1968-1971. These data contrast with the observations made by Orr and Poulter (1967) and Gentry (1970) for the population at Ano Nuevo Island, 89 km south of the Farallones, where peak numbers occur during June and July. The annual curve in numbers is similar in shape for the Oregon, Farallon, and Ano Nuevo populations. The Steller Sea Lion breeding groups gather in two places at the South Farallones: Sea Lion Cove and Saddle Rock.

In May 1974, seven adult bulls possessed harems, three did not and 12 subadult males were also present. In 1975 a

maximum of 8 adult bulls and 11 subadults were recorded. We counted a maximum of 110 adult females in 1974 and 98 in 1975. Averaging these figures for each sex for the two years gives a female:male ratio of 5.1:1 which is similar to the 4.3:1 ratio determined by Gentry (1970) for Ano Nuevo. The ratio of adult males to females was 11.5:1, again similar to the 10.3:1 at Ano Nuevo Island. On 27 June 1975 a census at the North Farallones revealed 17 females and one pup. Whether these females account for the difference in the number of females at the South Farallones between 1974 and 1975, we do not know. At least one of the leading territorial bulls has been the same individual, recognized by distinctive morphology, for four years, 1972 to 1975. In all years, the first adult bulls were noted in mid-April and were last seen in August.

Pupping data are available for three years. A total of 9 pups were produced in 1973, three of which were prematurely stillborn; a total of 10 pups were produced in 1974, four of which were prematurely stillborn; and a total of 19 were produced in 1975, four of which were again prematurely stillborn. Five of the 15 pups born in 1975 died within several days of birth. One, born 17 May, was probably premature as it died four days later and was born a full two weeks before the first surviving pup. Another was seen in the process of birth on 18 May when heavy seas lashed by 45 kt winds were threatening. It was never seen again and, if not stillborn, presumably drowned. A third disappeared following another period of heavy seas (50 kt winds). A fourth suffered a large bruise on its rump, possibly as a victim of being trampled, and disappeared two days later. Circumstances associated with the death of the fifth pup in 1975 are not known. The first time it was seen (1 July) it was dead. During the three years just reviewed all pups born before the first week of June have either been stillborn or if born alive have not survived.

The mortality rate within two weeks of birth, including stillborns, was 42.1% for the three years. Discounting stillborns the mortality was 13.2% for the three years and 33.3% for 1975 alone. The latter figure is much higher than the "below 10%" assigned by Gentry (1970) to the Ano Nuevo population during his study. Earlier researchers (Evermann 1921, Orr and Poulter 1967) gave the impression of higher mortality at Ano Nuevo. Gentry felt that storms, which were insignificant during his study, could conceivably produce higher mortality during some years. If 1975 is an indication, then that seems to be the case for the Farallones.

Sandegren (1970) determined a mortality rate during the first two weeks to be 12.5-14.0% for a population in Alaska. Mate (1973) found that mortality over the first few months of life for Eumetopias in Oregon varied between 22 and 83% depending on the severity of storms.

Premature stillbirths accounted for 28.9% of total births for the three years. Delong et al. (1973) suggested on the basis of their studies that organochlorine pollutants are responsible for a high rate of premature births among Zalophus in Southern California. No similar information exists for Eumetopias. The fact that 63% of the 11 premature births recorded at the Farallones during 1973-75 occurred within the period 8-13 April seems to indicate that females abort at a specific stage of fetal development. The earlier known stillbirth at the Farallones occurred on 7 February 1973. Gentry mentions that stillbirths occur at Ano Nuevo but quantitative data are not available. Mate (1973) figured that about 4% of pups in Oregon are born prematurely.

At the Farallones, nine pups were born to 73 females in 1973, giving a pregnancy rate of 12.3%. 110 females gave birth to 19 pups in 1975 (19.5%). We probably missed some pups. Orr and Poulter (1967) and Gentry (1970) explain why this is likely in any census study of Eumetopias. For instance Gentry failed to count from 32 to 68% of the pups in his various study areas. Since we are censusing a much smaller population it seems likely that we miss fewer pups in our counts, but even by increasing our 1975 pup totals by 68% gives a pregnancy rate of only 33%. That is about half the rate figured by Gentry for Ano Nuevo using this particular method of calculation (number of pups born/ number of females); and is much lower than the 44-78% ($\bar{X}$=62%) figured by Mate (1973) for two Oregon rookeries during three successive years.

High pup mortality and low pregnancy rates seem to occur among Eumetopias at the Farallones. Whether or not these have contributed directly to the population decline that has occurred since the 1920's, or whether they are phenomena indirectly related to a more general condition in the population is difficult to say. A decline in population size, exact in timing and extent to that at the Farallones, has also been reported for Steller Sea Lions in the northern Channel Islands, 400 km south of the Farallones (Bartholomew and Boolootian 1960; Bartholomew 1967; Odell 1971). The population at Ano Nuevo, a mainland rookery, has remained large and stable during the same period. The declines thus have occurred only in California's offshore populations suggesting that some environmental change has rendered islands far from the mainland coast less optimal as rookery sites but has apparently not affected mainland sites (see section discussing California Sea Lion population changes pp. 23-24).

Current harassment from fishermen is affecting Steller Sea Lions at the Farallones. Thirteen instances of sea lion shootings were recorded during the period 1970 to mid-1975. Those since 1972 were reported immediately to wildlife authorities or the Coast Guard via radio-telephone but no action was taken. Recent pressure from the Marine Mammal Commission has primed law enforcement personnel from National Marine Fisheries Service and California Department of Fish and Game to be ready for action when the next incident occurs. Another problem is the disturbance caused by abalone divers working within 100m of one rookery site. Each time a boat moves in to anchor, the sea lions stampede from the rocks. At least one pup was probably trampled during such an incident in 1975. More importantly, during a prolonged period of abalone harvest in 1975 lasting about a week, the animals were "kept" in the water and thus a breakdown in normal social behavior resulted. The animals eventually moved to another site where abalone are not taken.

California Sea Lion (Zalophus californianus)

The status and populations of California Sea Lions on the Farallones changed markedly during the period 1971 to 1975. Single females gave birth to live pups on 31 May 1974 and 20 May 1975, normal pupping dates for this species (Peterson and Bartholomew 1967). These are the first Zalophus births ever recorded on the Farallones and are the northernmost ever recorded for the species by some 250 km. These records are, in fact, the northernmost for live Zalophus females by approximately the same margin (see Morejohn 1968). While one birth might be construed an accident, a second birth one year later suggests much more. The pups were observed accompanying their mothers into July. In both years at least one bull remained with the female for as long as she and her pup were present. It seems likely that in both years the same female was involved and that the second Farallon birth was the result of sexual behavior at the Farallones in 1974. The second birth occurred in a spot within 5m of the first; and in both years after about six weeks the female moved her pup 50m away to precisely the same place.

The vast majority of Zalophus at the Farallones each year are adult males. In most years 10 to 15 yearlings and many subadults also haul out, but in 1975 a marked deviation from this pattern occurred when a maximum of 152 yearlings (almost all males) were present during the spring. Many remained for several weeks after the adult males departed for the south. The influx of yearlings may indicate recent high breeding success, low juvenile mortality, or an irregular shift in the normal dispersal pattern for young animals.

Zalophus are present year round at the Farallones (Figure 6). The animals prefer to haul out along the circumference

of Fisherman's Bay and on Aulon Peninsula, sites more protected than those preferred by Steller Sea Lions. During 1974 and 1975, the population of California Sea Lions reached record numbers, 1403 and 1374 animals, respectively, for the two years. On a subjective basis, this represented a spectacular increase over numbers present the previous three years. During the three earlier years when censuses were less regular, and when in 1972 and 1973 we may have missed censusing at the time of peak Zalophus numbers (late April-early May), maximum counts ranged 196 to 561 animals.

The annual cyclic changes in numbers exhibited expected and unexpected trends when compared with observations by Bartholomew (1967), Lance and Peterson (1968), and Mate (1973). Spring and fall peaks and a general, but not total, absence during the summer followed expected trends. Unexpectedly, during all years maximum numbers occurred during the spring which contrasts with all other census studies conducted north of the species' breeding areas (see Lance and Peterson 1968; Orr and Poulter 1967; Mate 1973). Several authors have contributed ideas and data from which an understanding of how various peaks in nonbreeding populations correspond to the migratory pattern of the species can be gleaned (see Fry 1939; Bartholomew 1967; Orr and Poulter 1965; Lance and Peterson 1968; and Mate 1973). The fall peak represents a rapid post-breeding movement north by male Zalophus. The Farallon data show a definite peak in August or September, especially noticeable in 1971. The fall maximum, however, is much less than the spring maximum. Why an atypical pattern shows up at the Farallones is a question difficult to answer, but several explanations are conceivable. First, during the spring the animals should be, with only a little doubt, on their way south for the summer breeding season. Perhaps this prebreeding migration, in contrast to the post-breeding one, is well offshore. Hence it would be detected at the Farallones but not at coastal sites where all other census studies have been conducted. Second, the extent of seasonal and annual variations in patterns of dispersal and migration are unknown. The few year-round census studies of sea lions on the Pacific coast of North America, the present study included, have gone on for too few years to determine the range of variation. Third, it may be that the Farallon Islands, a rare offshore site, are not typical of coastal sites, and the recent births by Zalophus have already set these islands apart from other sea lion sites in northern California and Oregon in one respect. Finally, and perhaps underlying the above explanations, movements of California Sea Lions may be dependent upon vagaries of distribution in favored prey. Our present studies are aimed at defining whether or not any possibility for this relationship exists.

During the past 40 years the numbers of Zalophus visiting

the Farallones during the spring have gradually increased (Table 1). The trend is exactly opposite that of Eumetopias at the Farallones and is similar to that recorded at the Channel Islands (Bartholomew and Boolootian 1960; Bartholomew 1967; and Odell 1971). Without too much doubt the increase in numbers of Zalophus in Northern California is a result of the larger breeding populations to the south (see above references plus Rice et al. 1965). The question of whether Zalophus is displacing or replacing Eumetopias in the southern part of the latter's range as yet cannot be answered. One hypothesis that attempts to explain the afore-mentioned pinniped population changes and to relate these changes to changes in populations of other higher marine vertebrates in Central California has been suggested by Ainley and Lewis (1974). The disappearance of some offshore fish populations (sardines, Sardinops caerulea; and here must be added at least one other population as well, e.g., Pacific Mackerel, Scomber japonicus) from the 1930's into the 1950's, precisely the same period during which pinniped populations have been changing, may be an influence. Some evidence indicated that Steller Sea Lions, particularly offshore populations, would more likely have fed on these fish than would California Sea Lions. The loss of these important fish may have upset a balance of environmental factors, which become more important to these sea lions at the extremes of their respective ranges, the same area where the changes in fish and sea lion populations have been taking place.

Northern Fur Seal (Callorhinus ursinus)

The facts that Northern Fur Seals recently established a breeding population in the Channel Islands (Peterson et al. 1968) and that a fur seal population probably bred at the Farallones within historical time (Peterson and Cooper 1968; Starks 1922) justifies interest in Farallon occurrences of these mammals. Since April 1968, Northern Fur Seals have hauled out and have been positively identified on three occasions. On 5 February 1970, a female was found dead on the rocks at Fisherman's Bay and was deposited as a specimen in the Museum of Vertebrate Zoology (MVZ 140846). On 23 September 1972 one animal, sex or age unknown, hauled out for a few hours at Sea Lion Cove. Another female hauled out at the same location for four days, 23-26 August 1974.

Harbor Seal (Phoca vitulina)

The status of the Harbor Seal on the South Farallon Islands changed greatly during the period 1971 through mid-1975, from apparent winter visitor to year-round resident and breeder. Maximum numbers during the period 1973 to 1975 have reached 15-17 animals. Censuses are summarized in Figure 7. The animals prefer two areas for hauling out: Mussel Flat on Southeast Island, and Indian Head Beach on West End. Mussel Flat, their preferred area, is flown over at an altitude of 30m

by Coast Guard helicopters making landings at Southeast Island. The seals flee into the water. PRBO, through the U.S. Fish and Wildlife Service, has recommended that helicopters not be landed from 15 March to 15 August, the period when maximum numbers of Harbor Seals haul out, and when the sea bird breeding season is at its height.

Few of the earlier reports on Farallon wildlife mention much about Harbor Seals. Gruber (1884) who visited in the 1860's noted the presence of "small seals" during the winter; Blankinship and Keeler (1893), quoting the lighthouse keepers, mention that 'leopard seals' occasionally visit the islands during the winter; and Ray (1934) mentioned that Harbor Seals were only occasionally encountered. Records of Harbor Seals in the Farallon Journal (PRBO) between April 1968 and 1970 are very few. None were reported in 1971 until one was seen the second week of August. One animal was then observed on occasion until December when four were noted. In the following winter months of 1972 the numbers seen at any one time grew less. None were noted from late March through July 1972 but in the fall and winter they were again observed. Maximum numbers in 1972 reached five animals. In 1973 from January into March the numbers increased from seven to 17 animals. That year was also the first in which they were seen during the summer but by September only one to three animals were seen at any given time. Numbers again began to increase in January 1973 and by the summer the maximum count reached 15.

On 11 May 1974, the second summer during which Harbor Seals were observed at the Farallones, a newly born pup was observed and photographed (Figure 8) at Garbage Gulch. That represented the first Harbor Seal birth known for the Farallon Islands. During the remainder of 1974 and the first half of 1975 the census pattern exhibited in the previous few years again occurred: low numbers September through November and high numbers January through July with the peak from March through June. This is a pattern similar to that described by Gentry (1968) for the species at Ano Nuevo Island, and by Strong (unpubl. field notes) for the large rookery at Double Pt., Marin County, 20 km. northeast of the Farallones. On 3 July 1975 another pup was observed and on 9 July 1975 three young Harbor Seals were hauled out at the same time on Mussel Flat. These animals were probably about four weeks of age judging from size and the growth the pattern described by Fisher (1952). All pups so far recorded at the Farallones were born during May and June, the period of pupping at Ano Nuevo (Gentry 1968) and elsewhere on the Pacific Coast (Scheffer and Slipp 1944; Fisher 1952).

Elephant Seal (Mirounga angustirostris)

Before the 1800's colonies of Northern Elephant Seals extended from the Point Reyes Peninsula in Northern California

south to the islands off the lower Baja Peninsula in Mexico (Scammon 1874). Exploitation of the elephant seals for their oil reduced the population to fewer than 100 individuals by the end of the nineteenth century (Bartholomew and Hubbs 1960). These were concentrated on remote Isla Guadelupe, 190 km off the Mexican coast and it was feared that the species would become extinct. Through the protection of the Mexican and U.S. governments the population has steadily grown until by 1974 the Northern Elephant Seal had recolonized most of its former range island by island. The population was recently estimated at over 30,000 animals (Bonnell and Selander 1974). The only colony where the history of recolonization is fully known is that at the South Farallon Islands.

Use of the Island

The observation by Thoresen (1959) of a single Elephant Seal on South Farallon Island in July 1959 marks the known beginning of recolonization at the Farallones. In the early years of recolonization the Elephant Seals concentrated on Mirounga Beach (Low Arch), a small sand gulch (5 x 8 m) on the island's south side (Figure 1). As the number of animals increased they began to haul out on other parts of the island as well - North Landing, East Landing, Mussel Flat, Sea Lion Cove and Breaker Cove. However, the highest concentration of animals was still at Mirounga Beach.

Breeding began in 1972 when the first cow pupped on Mirounga Beach. The following year two pups were born, the first on Mirounga Beach and the second on the large Sand Flat (50 x 15 m), 35 m NW of Mirounga Beach. The Sand Flat had not been used by elephant seals before. The Sand Flat was again used in 1974 when two cows pupped there. However 15 cows pupped on Mirounga Beach where 71% of the pups died due to overcrowding. PRBO biologists removed an enormous pile of debris separating the beach from the Sand Flat and by spring many of the cows and juveniles had moved up to the flat to molt, thus relieving some of the crowding at the beach. By 1975 when 21 cows used the Sand Flat to pup, only 12 pupped on Mirounga Beach. The Sand Flat had replaced Mirounga Beach as the main breeding and hauling out area on the South Farallones.

During 1974 some of the subordinate bulls began to use West End as a hauling out place during the breeding season. Subordinate bulls and cows are now using two areas there- Shell Beach on the NW part of the island and Indian Head Beach on the SW. Two pups were born on West End in 1975. Although juveniles have been molting on South Farallon for some time, breeding cows only began to molt on the island in spring 1973. In July 1974, two years after the initial birth, the breeding bulls molted on the Farallones for the first time.

Population Dynamics

Although the first Elephant Seal was observed in 1959, there are few records of Elephant Seals on the South Farallones until PRBO personnel began censusing during fall 1969 and began regular censuses in April 1970. During censuses animals were counted and divided into age and sex categories whenever possible. Tags identifying individuals by number, and identifying the place of birth by color were recorded: red= San Nicolas Island (SNI), yellow= San Miguel Island (SMI), green= Ano Nuevo Island (ANI), and pink= Farallon Islands (FAR). To facilitate communication among biologists, many animals were given names.

Sighted tags indicate that Elephant Seals immigrating to the Farallones come from the three closest rookeries to the south: 37% from ANI (89 km away), 9% from SNI (617 km away) and 54% from SMI (497 km away) (LeBoeuf et al. 1974). All pups born on the Farallones that survived to weaning have been tagged, a total of 36 animals since 1972. But tagging of breeding animals did not begin until 1975 when 10 cows and 7 bulls were tagged.

The number of Elephant Seals has increased steadily to a high of 300 in spring 1975 (Figure 9). Spring and fall are the periods of maximum numbers. The spring peak may occur slightly later than the graph indicates because of censusing restrictions. In an established breeding colony the spring peak is higher (Le Boeuf et al. 1974). On the Farallones, however, the spring peak was higher in only two of the past five years.

Throughout the year the age and sex of animals on the island fluctuates. The breeding season begins in late November with the arrival of the first breeding bulls. As more bulls arrive the immature animals which had hauled out during the fall begin to leave. Early in January the breeding cows haul out and give birth several days later. During this time only a few juveniles remain. The cows leave about a month after they arrive, and the last bull leaves a few days after the last cow, about mid-March. As the cows and bulls leave juvenile animals begin to haul out for the spring molt. The breeding cows return to molt in mid-April, and leave before the bulls return to molt in late June. When by August the bulls' molt is finished, they leave to build up the fat reserves needed to maintain them during the breeding period to follow.

Breeding Activities

The following is a description of major events during initial breeding seasons at the Farallon colony. Summaries of these data are presented in tables 2 and 3.

The Farallones became the northernmost Elephant Seal breeding colony in 1972, 13 years after the first Elephant Seal was seen there. This pup was the first born on the Farallones in more than 150 years. The cow was not tagged, so her age and place of birth are not known. A subadult bull, L.P. Bonus, named and tagged at ANI and estimated to be six years old, arrived 18 days after the cow pupped. Presumably he copulated with the cow since he was sexually mature. Copulation was not observed, but he was present when the cow was supposed to have come into estrus (LeBoeuf et al. 1974). He was the only bull present.

In 1973 one cow pupped on Mirounga Beach and another at the Sand Flat. That year four sub-adult bulls were present: the now seven-year-old L.P. Bonus; two tagged five-year-olds from ANI; and a younger, untagged sub-adult. L.P. Bonus was dominant, and commuted between the two cows when they came into estrus.

In 1974, fifteen cows pupped on tiny Mirounga Beach and two pupped on the large Sand Flat. There were seven bulls present; L.P. Bonus, the alpha bull, accomplished 80% of the observed copulations and F_4, the untagged beta bull performed in the other 20% of observed copulations. Seventeen cows pupped and of those, three were tagged. Two of those were born on Ano Nuevo Island; one was four years old but the other's tag was unreadable. The third tagged cow was born on San Miguel Island and was five years old. Pups were born between 15 January and 6 February. Because of over-crowding on Mirounga Beach only 5 pups were weaned of the 17 born.

In 1975 twelve cows pupped on Mirounga Beach, 21 pupped on the Sand Flat, and two pupped on West End, giving a total of 35 pups. Five cows with pups later moved from the beach to the Sand Flat. Six of the breeding cows were tagged. Of the five born at ANI, three were age four, one was age three and one was five years old. The sixth was born on SNI four years before. There were seven bulls active: L.P. Bonus, the five bulls of the previous year and a new immigrant from ANI called Juan. Juan was responsible for 68% of the copulations, L.P. Bonus for 14%, F_4 for 14%, F_1 for 2% and Dimple for 2%. The other bulls were not observed to copulate. L.P. Bonus was alpha bull until February eighth, when he was deposed by Juan. F_4 was beta bull throughout. Pups were born between 31 December and 10 February. Twenty-eight pups survived to weaning. Details on known breeding individuals can be found in Appendix A.

As colonization has proceeded several trends have become evident (Table 3). Both bulls and cows have arrived earlier in the breeding season, and both have departed progressively later. A close look at Appendix A reveals that these changes in the population correspond to

similar changes in individual animals that have returned in successive years. Finally, the range in pupping dates has broadened, and first pups have arrived earlier each year.

Striking differences exist between the 1974 and the 1975 breeding seasons in the behavior of both the bulls and the cows, and in the survival of pups. In 1974 L.P. Bonus was the alpha bull throughout the season, but the relationship of the subordinate bulls changed from F_2 F_4 Deadeye in the beginning of January, to F_2 F_1 Deadeye at the end of January. There were seven bulls present but not all participated in the fighting. All copulations observed were by L.P. Bonus (8/10) and by F_4 (2/10).

Five of the eight bulls present in 1974 were also present in 1975, including L.P. Bonus, F_4, F_2, F_1 and Deadeye. One was a previously unknown bull and two were refugees from the Ano Nuevo breeding herd. L.P. Bonus was the alpha bull until 8 February when he was deposed by Juan, one of the ANI bulls. F_4 was the beta bull throughout the season. The hierarchy was L.P.B., F_4 F_1 F_2 Deadeye, until L.P. Bonus was replaced by Juan. The subordinate bulls remained the same. Five of the bulls participated in copulations: Juan (38/56), L.P. Bonus (8/56), F_4 (8/56), F_1 (1/56), and Dimple (1/56).

Seventeen cows pupped in 1974, 15 on Mirounga Beach and two on the Sand Flat above. The crowded conditions on the small beach and the added confusion of bulls chasing each other through the colony caused pups to become separated from their mothers. Normally, the mother-pup bond is maintained because the pup answers only its mother's warble, and the cow responds only to her pup's cries. In the crowded confusion most of the pups never correctly oriented to their own mothers, because they were separated shortly after birth. As a result some were attacked by alien cows and bitten. Others oriented to and were suckled by alien cows who had lost their pups. Additional confusion came from one of the cows, Redeye, who warbled to all the pups. On one occasion she had two pups suckling from her and two other pups answering her warble.

On January 25, during the peak crowding on Mirounga Beach, there were 15 cows, 10 pups and one bull. In the 10 days between January 24 and February 2, nine pups were born and ten died. L.P. Bonus at first remained almost exclusively on Mirounga Beach but by mid-February became much more mobile, commuting often to receptive cows on the Sand Flat.

Twelve of the 17 pups (71%) born died before weaning. Of these, deaths were attributed to: bites in the head received from alien cows-7, washed away by high tides-2, stillbirth-1, abandoned-1, and weak from birth, never

observed to suckle-1. As pups died on Mirounga Beach, cows moved up to the Sand Flat leaving their dead pups behind.

In 1975 the breeding population doubled when 35 cows pupped. However the overcrowding of the previous year was avoided because 21 of the cows pupped on the Sand Flat, 2 cows pupped on West End and only 12 pupped on Mirounga Beach. When it was most crowded 12 cows were at Mirounga Beach, but within a week five of these moved with their pups to the Sand Flat. Two others also moved up after their pups were lost during a storm. Since most of the cows moved up to the Sand Flat, pup mortality was reduced to 20% from 71% in the previous year. Of the seven pups that died, three were washed away by high tides, one was stillborn, two were crushed by bulls (one while Juan was copulating with the mother), and one never learned to suckle and died after eight days.

In the 1974 breeding season there were 3 tagged cows--one from SMI, age six, one from ANI, age four, and another from ANI whose tag was not readable. The cow born on San Miguel was seen as a two-year-old on the Farallones during the spring molt. Two untagged cows with distinctive marks, which pupped in 1974, appeared again in 1975. Neither of the tagged cows from 1974 showed up in 1975, but six new tagged animals appeared. Five were from ANI and one was from SNI. Of these, four were four years old, one was three and the other, five. Of the six tagged cows, five of them (red 821, green 976, green 1060, green 1224, and UC 4763) had been seen on the Farallones as immature animals during censuses. In general the tagged returns show that at the Farallones, cows are usually in their first breeding year and that most started coming to these islands as juveniles.

During 1975 all breeding females were identified as individuals either through distinctive scars, bleach marks, tag numbers, or all three. Aggressive and defensive interactions between individual cows on the Sand Flat were recorded from 0800 to 1800 for the 30 days during the peak of the breeding season. From our observations it appears that the aggressiveness of the cow is dependent upon the age of the pup. She is most defensive immediately after the pup's birth. This defensiveness does not decrease until after the pup is 15 days of age. It also appears that certain cows are more aggressive than others, regardless of their pup's age. Pregnant cows and cows that lost their pups were almost always subordinate to cows with pups.

The pup mortality caused by cows biting alien pups was density dependent. Without the problems of over-crowded conditions an aggressive cow is able to maintain a protective space around herself and her pup. The consistently more aggressive cows appear to be more successful in raising their pups to weaning age than less aggressive cows. These observations, and those planned for the future, help

to clarify the relationship between pup mortality, cow behavior, and animal density. These should be applicable to the remote colony at Isla Guadalupe where high pup mortality and over-crowding have also been reported (see Rice et al. 1965).

Comparison of Breeding Animals on Ano Nuevo and the Farallones

A comparison of breeding animals on Ano Nuevo Island, an established colony, to those on the Farallones, an establishing colony, shows several differences. Many comparisons were made by LeBoeuf et al. (1974), and others are described below.

In general the breeding animals on the Farallones are younger and less experienced than those at Ano Nuevo. As discussed earlier, known-age females at the Farallones are only three to five years of age. Few older females are present. The bulls too begin to breed earlier on the Farallones. The alpha bull was a six-year-old in 1972, a seven-year-old in 1973 and an eight-year-old in 1974. Sexual maturity is reached at five or six, but males less than eight years old are rarely successful on an established rookery (LeBoeuf and Peterson 1969).

The amount of time spent on land by cows during breeding was similar between Ano Nuevo in 1970 and 1971 (LeBoeuf 1972) and the Farallones in 1975. At Ano Nuevo cows spent an average 34.3 days in the colony and at the Farallones they spent an average 31.9 days. From arrival to parturition the mean was 6.5 days at ANI and 4.1 days on the Farallones. From parturition to departure the mean was 28.5 days for ANI and 27.8 days for the Farallones, and from the first copulation to departure the mean was 4.2 days on ANI and 2.8 on the Farallones. All of the figures are very close, but the time spent on the Farallones is consistently shorter for each comparison. The range of parturition was very similar on both islands, 23 December to 10 February for ANI and 31 December to 10 February for the Farallones.

There was a marked difference in the number of daylight births observed. On ANI only 81 out of 1050 births (7.7%) occurred during daylight (LeBoeuf 1972), whereas 16 out of 35 births (45.7%) occurred during daylight at the Farallones ($P < .001$). The presentation of the pup at birth at Ano Nuevo was 18 cephalic (63.1%) and 11 caudal of 29 observed. The ratios were 6 cephalic (42.9%) and 8 caudal out of 14 births witnessed at the Farallones. The sex ratio at weaning was approximately 1:1 at ANI and other established rookeries. At the Farallones in 1975 the sex ratio was 1:2.2 at birth and 1:1.8 at weaning.

Pup mortality on Ano Nuevo between 1969 and 1972 ranged from 13.0% to 14.5% (LeBoeuf 1972). On the Farallones it was

71% in 1974 and 20% in 1975. The extremely high mortality in 1974 was a result of overcrowding on a small beach, accentuated perhaps by the fact that most of the cows on the Farallones are young and inexperienced breeders.

It will be interesting to see whether these relationships change as the Farallon colony matures, or whether they will remain characteristic of that population.

The Future for Elephant Seals at the Farallones

The number of Elephant Seals in the breeding population on the Farallones has increased steadily since 1972. The breeding colony's presence on the island has extended from the exclusive use of Mirounga Beach to the Sand Flat area as well as to West End. As a result, pup mortality from crowding has been reduced. There are many indications that the breeding population will continue to grow. Although the number of animals present at the spring and fall census peaks seems to be levelling off, more of these animals are approaching breeding age. The breeding bulls have returned to molt for the second year, two of the known cows that pupped in 1974 returned to pup in 1975, and at least 17 of the 35 cows that pupped on the Farallones in 1975 returned to molt in the spring. Three of the five pups weaned in 1974 have since been seen on the Farallones, an indication that they may return to mate and to complete the last step in producing an established breeding colony.

Interspecific Behavior

In 1965 Orr published his observations on overlap of hauling out areas in pinnipeds at Ano Nuevo Island. His notes were for the same species that haul out regularly at the Farallones. Ano Nuevo is slightly less than one-tenth the size of the South Farallones (12 vs 100 acres), and because more room is available at the latter, some of our observations on interspecific relationships differ from those made by Orr.

As noted by Orr, the species have different habitat preferences, with greatest similarlity being between the two sea lions. The California and Steller Sea Lions both prefer rocky shoreline where they can lie about well above any splash from breaking swells. California Sea Lions exhibit more of a tendency to haul out in more protected areas, and also to haul out further from the water. To a large extent both species intermingle except that Zalophus distinctly avoid Eumetopias breeding groups during late May and June, the height of the Eumetopias breeding season. During that period non-breeding Steller bulls and subadults freely intermingle among concentrations of California Sea Lions.

Harbor Seals haul out on low reefs exposed at low tide. They are quite distinct in this preference. They are rarely seen in association with any other species, as also noted by Orr.

Elephant Seals prefer sandy areas for breeding but readily haul out in large numbers on cobble stone beaches as well. Zalophus, however, also like the cobblestone beaches and observations indicate fairly clearly that Mirounga, given the opportunity, prefer not to associate with sea lions. Up until 1973 almost all of the Elephant Seals at the Farallones could usually be found in two places during any given period of their presence—at the sandy breeding area near Low Arch and on the cobblestone beach at North Landing. Much more recently their rapidly expanding numbers have moved into other places as well. In spring 1973 a spectacular increase over previous years' numbers occurred among Zalophus. They took over the cobblestone beach at North Landing and the Mirounga moved away in spite of the fact that their numbers too had increased sharply over those of the previous year. The reason probably lies in the fact that during the spring Mirounga haul out to molt. They remain on land close to the same spot for several weeks and prefer not to be disturbed. During spring most Zalophus at the Farallones go to sea (probably to feed) almost every evening and they return to haul out after dawn. Thus every evening and morning the Elephant Seals would have to contend with sea lions jostling and climbing over them. To avoid that they moved elsewhere.

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TABLE 1

The number of sea lions at the Farallon Islands. All censuses were taken during the first two weeks of June in each year except as noted. [1]Data from California Dept of Fish and Game, summarized by Bonnot et al. 1938; [2]Data from aerial counts by California Dept of Fish and Game, with species counts combined, summarized by Ripley et al. 1962 and Carlisle and Aplin 1971; [3]Data from Point Reyes Bird Observatory; [a]1930 count made 11 July, 1936 count made 23 June, 1947 count made ca. 27 June; [b]extrapolation, figure 6.

Date	NUMBER OF Eumetopias	NUMBER OF Zalophus	TOTAL NUMBER OF SEA LIONS
1927[1]	700	6	706
1928[1]	540	?	540+
1930[1,a]	900	28	928
1936[1,a]	500	25	525
1938[1]	357	90	457
1946[2]			950
1947[2,a]			750
1958[2]			941
1960[2]			1290
1961[2]			703
1965[2]			311
1968[3]	69	232	301
1969[2]			855
1970[2]			585
1971[3]	114	392	506
1972[3]	131	ca.250?[b]	ca.380
1973[3]	112	7	119
1974	115	159	274
1975	124	359	483

TABLE 2

A summary of animals involved in the first four Elephant Seal breeding seasons on the South Farallon Islands.

Year	Number Bulls	Number Cows	Pups Born	Pups Weaned	Pups Died
1972	1	1	1	1	0
1973	4	2	2	2	0
1974	7	17	17	5	12
1975	8	35	35	28	7

TABLE 3

A summary of breeding chronology in the first four Elephant Seal breeding seasons on the South Farallon Islands.

Year	Bulls		Cows		
	Arrival	Departure	Arrival	Departure	Pupping
1972	6 Feb	16 Feb	20 Jan	12 Feb	20 Jan
1973	18 Jan-	16 Feb	13-14 Jan	10-12 Feb	17-19 Jan
1974	27 Nov- 18 Jan	28 Jan- 23 Mar	8-28 Jan	9 Feb- 16 Mar	15 Jan- 6 Feb
1975	26 Nov- 17 Jan	13 Feb- 15 Mar	25 Dec- 4 Feb	27 Jan- 11 Mar	31 Dec- 10 Feb

APPENDIX A 29

A summary of information on recognizable Elephant Seal individuals.

MALES

Tag or name	Tagging Information: When	Where[1]	Age	Sightings	Notes
L.P.Bonus				1972:ANI 23 Dec-4 Feb	Not in hier-
G1159	Dec 71	ANI	Est.6	9,10;20,21 Feb	archy at ANI;
P28	Jan 75	FAR	Est.9	27 Feb-3 Mar	Only bull at
				FAR 6-9,13-16,	FAR.
				18-20,22 Feb	
				1973:ANI 10-31 Dec,	
				intermit. to	
				14 Jan	
				FAR 18 Jan-16	Alpha bull
				Feb	at FAR.
				1974:FAR 1 Jan-23 Mar	Alpha bull;
				17 July-	80% cop'ns.
				1975:FAR 11Dec-26 Feb	Alpha bull
					to 8 Feb;
					14% cop'ns.
UC 1614	Mar 68	ANI	Pup	1971:FAR 26 May,	
				22-26 Oct	
				1973:FAR 5 Jan-12 Feb	Beta bull at
					age 5.
UC 1604	Mar 68	ANI	Pup	1971:FAR 26,27 May	
				10-13,22 Oct	
				1973:FAR 13-15 Feb	
Deadeye					
P14	Jan 75	FAR	Est.7	1972:FAR 23 Dec	
				1973:FAR 2 Apr,	
				27 Nov-31 Dec	
				1974:FAR 1 Jan-1 Feb	Subordinate
				17 July,	bull.
				26 Nov-31 Dec	
				1975:FAR 1 Jan-5 Mar	Subordinate
				20 July-	bull.

CONTINUED NEXT PAGE

Gull					
G1168	Dec 71	ANI	Est.5	1974:ANI present to mid-Jan FAR 18 Jan-26 Feb	Subordinate bull at both localities.
F1				1973:FAR ?-31 Dec	
P16	Jan 75	FAR	Est.7	1974:FAR 1 Jan-6 Mar Aug, 18-31 Dec	
				1975:FAR 1 Jan-10 Mar	Gamma bull; 2% cop'ns.
F2					
P15	Jan 75	FAR	Est.6	1973:FAR ?-31 Dec	
				1974:FAR 1-28 Jan 17-20 Jul 19-31 Dec	1974 and 1975 subordinate bull.
				1975:FAR 1 Jan-15 Mar	
F4					
P11	Feb 74	FAR	Est.7	1973:FAR ?-31 Dec	
				1974:FAR 1 Jan-15 Mar 17 Jul-22 Aug 11-31 Dec	1974 beta bull; 20% cop'ns.
				1975:FAR 1 Jan-15 Mar	1975 beta bull; 14% cop'ns.
Dimple					1975 subordinate
P18	Jan 75	FAR	Est.6	1974:FAR 19-31 Dec 1975:FAR 1 Jan-5 Mar	bull, 2% cop'ns.
Juan				1975:FAR 17,23,25,26,	1975 alpha bull
G161-P73	? Mar 75	ANI FAR	? Est.8	28 Jan; 1,3 Feb 5 Feb-15 Mar	after 8 Feb; 68% cop'ns.
DDI G1122	Dec 71	ANI	Est.5	1975:FAR 17-19 Jan	Subordinate bull.

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FEMALES

Tag or name	Tagging Information: When	Where	age	Sightings	Notes
G1096	Nov 71	ANI	1	1974:FAR 19 Jan-?	1974 pupped 22 Jan.
Redeye				1974:FAR 11 Jan-14 Feb	1974 pupped 21 Jan, nursed two weaners
				1975:FAR 14 Jan-21 Feb	1975 pupped 24 Jan (died 25 Jan), raised pup born 28 Jan.
Cow#5				1974:FAR 22 Jan-15 Feb	1974 pupped? but pup lost.
				1975:FAR 10 Jan-15 Feb, 1 May	1975 pupped 14 Jan
Y927	Mar 69	SMI	pup	1971:FAR 23,29 Apr, 21,29 May	
				1974:FAR 20 Jan-18 Feb, 13 Apr, 2,6 May	1974 pupped 21 Jan; pup died 26 Jan.
G919	Feb 71	ANI	pup	1975:FAR 17 Jan-?	1975 pupped 21 Jan.
G976	Feb 71	ANI	pup	1972:FAR 22-26 Mar, 13-16 Apr, 31 Oct, 3,30 Nov	
				1974:FAR 2 May	
				1975:FAR 19 Jan-21 Feb, 17-24 Apr.	1975 pupped 23 Jan (died 24 Jan).

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APPENDIX A---4

G1060	Mar 71	ANI	pup	1971:ANI 3 Nov FAR 27 Oct 1972:FAR 24,30 Mar 1975:FAR 21 Jan-23 Feb	1975 pupped 25 Jan.
G1224	Feb 72	ANI	pup	1972:FAR 2 May 1975:FAR 21 Jan-18 Feb	1975 pupped 23 Jan.
R821	Feb 71	SNI	pup	1971:FAR 5 Dec 1972:FAR 19-24 Apr, 8, 6,23 May, 22-25 Sep,30 Nov 1973:FAR 1,2 Apr 1974:FAR 13 Apr 1975:FAR 19 Jan-23 Feb, 17-24 Apr	1975 pupped 21 Jan.
UC4763	Mar 70	ANI	pup	1971:FAR 26 May 1972:FAR 21 Apr,23 May 1975:FAR 12 Jan-23 Feb, 1 May	1975 pupped 20 Jan (died 21 Jan).

[1]Rookery sites are as follows: ANI=Ano Nuevo Island, San Mateo Co., California; FAR=Farallon Islands; SMI=San Miguel Island, Southern California; SNI=San Nicholas Island, Southern California.

FIGURE CAPTIONS

Figure 1. The South Farallon Islands showing the usual areas where various pinnipeds haul out.

Figure 2. The number of Zalophus and Eumetopias hauled out on three sites at the Farallon Islands relative to time of day. Data are from twelve all-day censuses during May 1974.

Figure 3. The occurrence pattern of Gray Whales near the Farallones, 1970-1975.

Figure 4. The occurrence pattern of large cetaceans near the Farallones, 1969-1975. In the bottom segment of the figure the following symbols denote these species: △ - Balenoptera physalus, ○ - B. borealis, □ - Physeter catodon, ● - unknown species possessing dorsal fin.

Figure 5. The annual fluctuations in numbers of Eumetopias at the Farallones, 1971-1975.

Figure 6. The annual fluctuations in numbers of Zalophus at the Farallones, 1971-1975.

Figure 7. The annual fluctuations in numbers of Phoca hauled out at the Farallones, 1971-1975.

Figure 8. Photograph of newly born Harbor Seal on Southeast Farallon Island, 11 May 1974.

Figure 9. Numbers of Mirounga at the Farallones, 1970-1975.

Figure 1

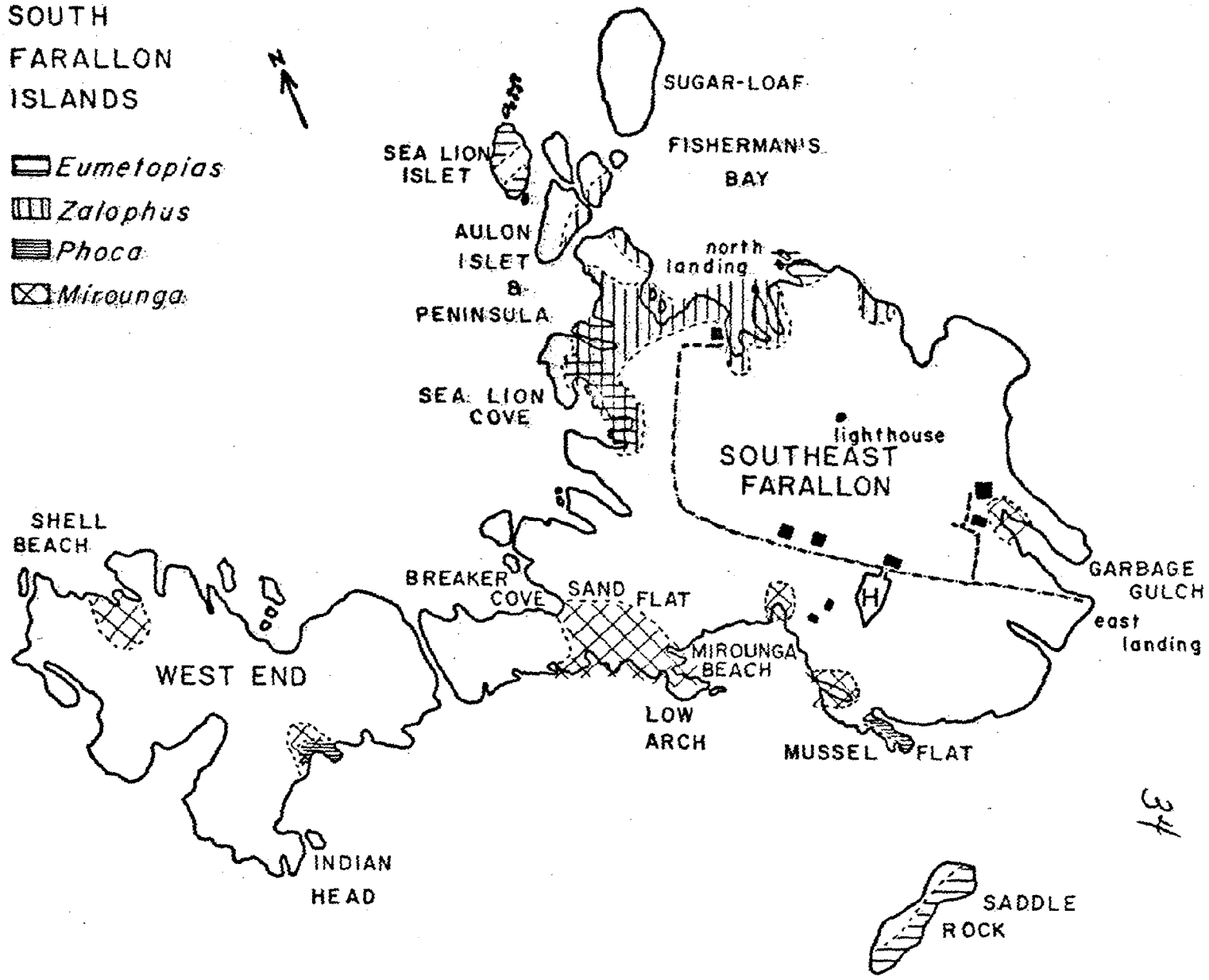

SOUTH
FARALLON
ISLANDS
Eumetopias
Zalophus
Phoca
Mirounga
N
SUGAR-LOAF
SEA LION
ISLET
FISHERMAN'S
BAY
AULON
ISLET
&
PENINSULA
north
landing
SEA LION
COVE
lighthouse
SOUTHEAST
FARALLON
SHELL
BEACH
BREAKER
COVE
SAND FLAT
GARBAGE
GULCH
east
landing
MIROUNGA
BEACH
WEST END
LOW
ARCH
MUSSEL FLAT
INDIAN
HEAD
SADDLE
ROCK

Figure 2

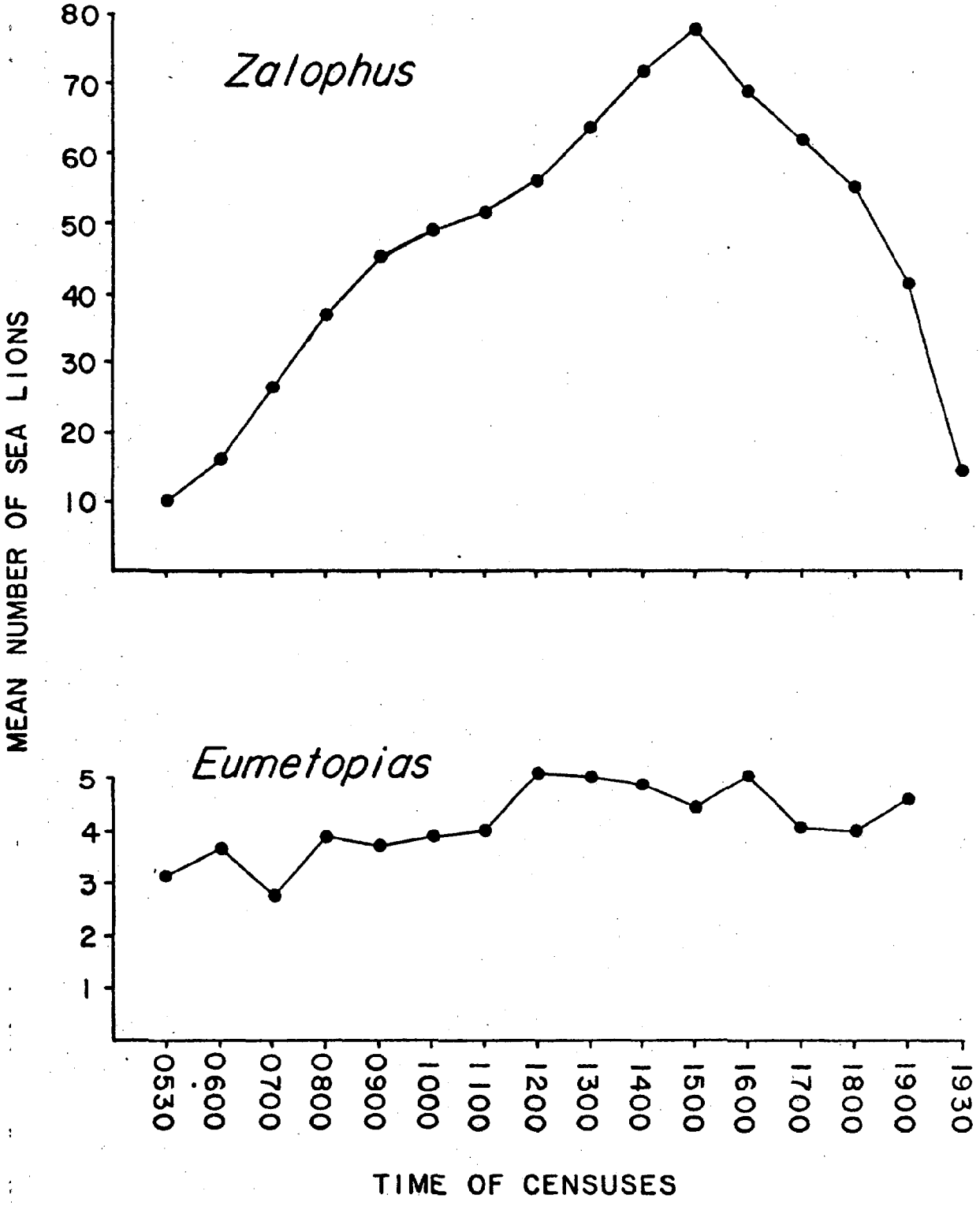

Zalophus
Eumetopias
MEAN NUMBER OF SEA LIONS
80
70
60
50
40
30
20
10
5
4
3
2
1
0530
0600
0700
0800
0900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
1930
TIME OF CENSUSES

Figure 3

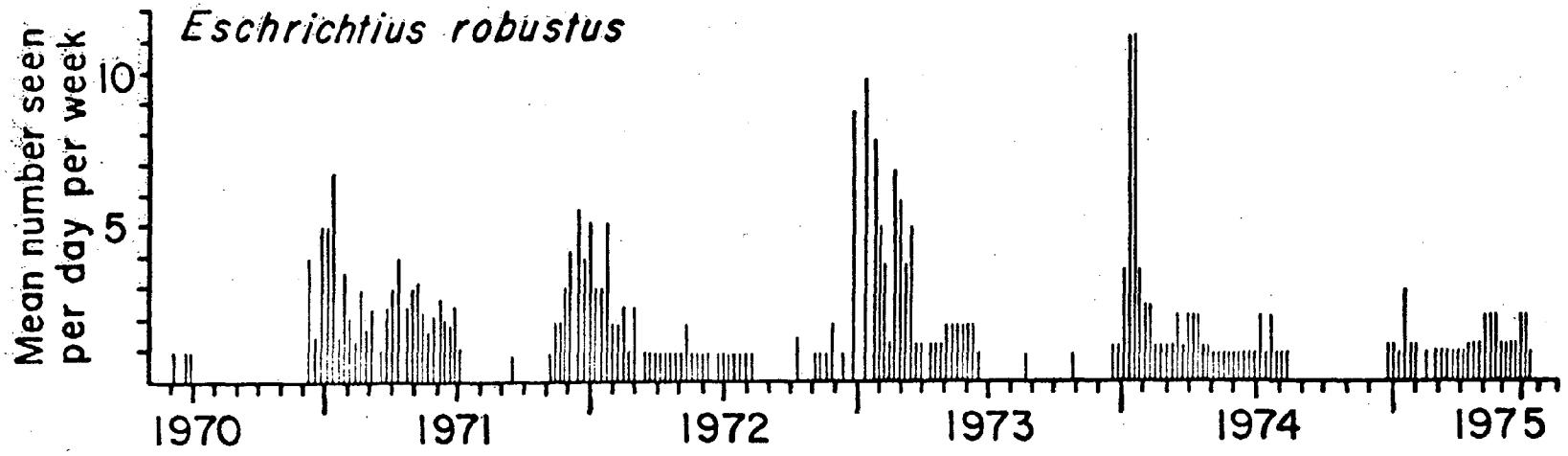

Eschrichtius robustus
Mean number seen per day per week
10
5
1970
1971
1972
1973
1974
1975

Figure 4

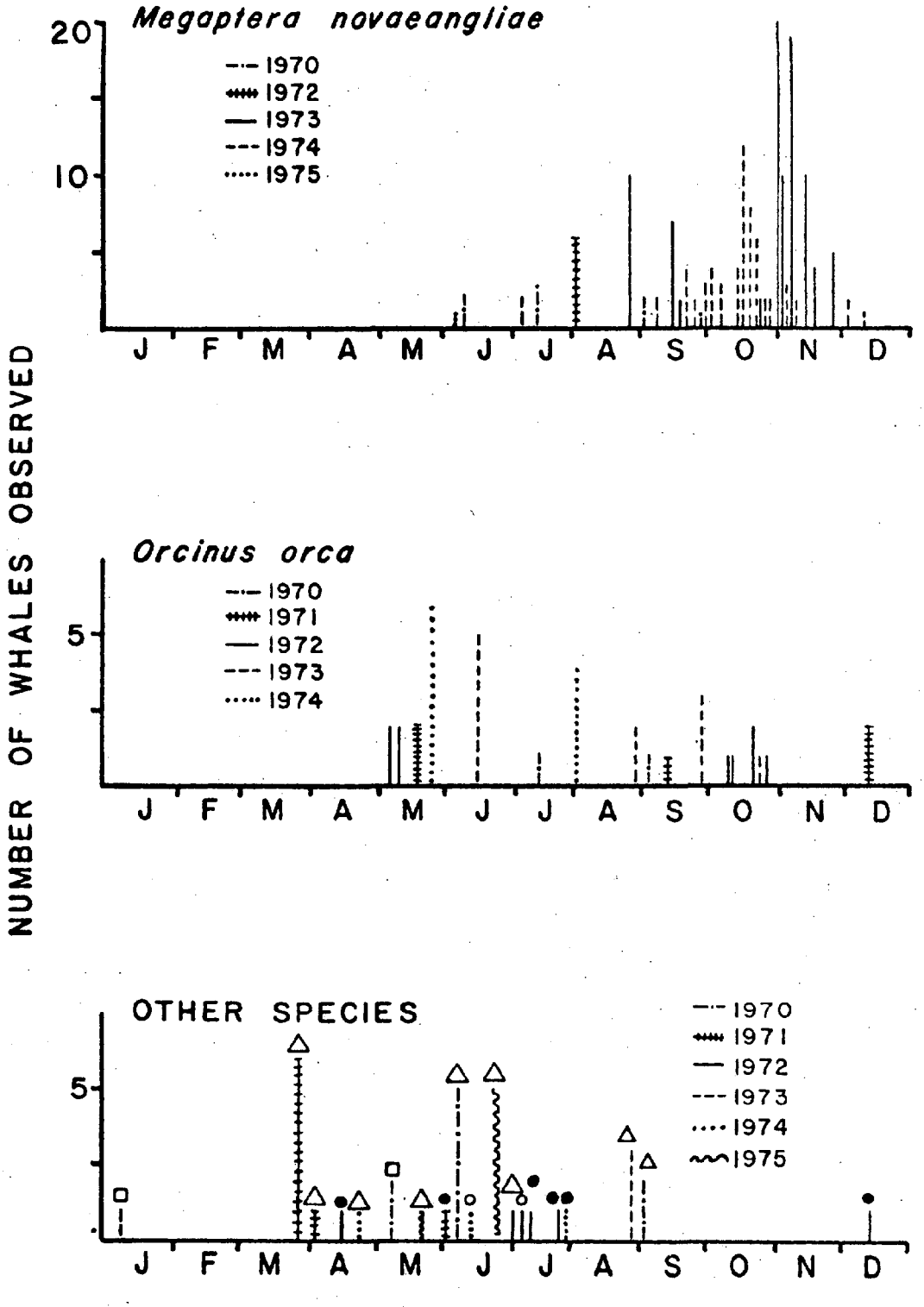

Megaptera novaeangliae
20
10
1970
1972
1973
1974
1975
J F M A M J J A S O N D
NUMBER OF WHALES OBSERVED
Orcinus orca
5
1970
1971
1972
1973
1974
J F M A M J J A S O N D
OTHER SPECIES
5
1970
1971
1972
1973
1974
1975
J F M A M J J A S O N D

Figure 5

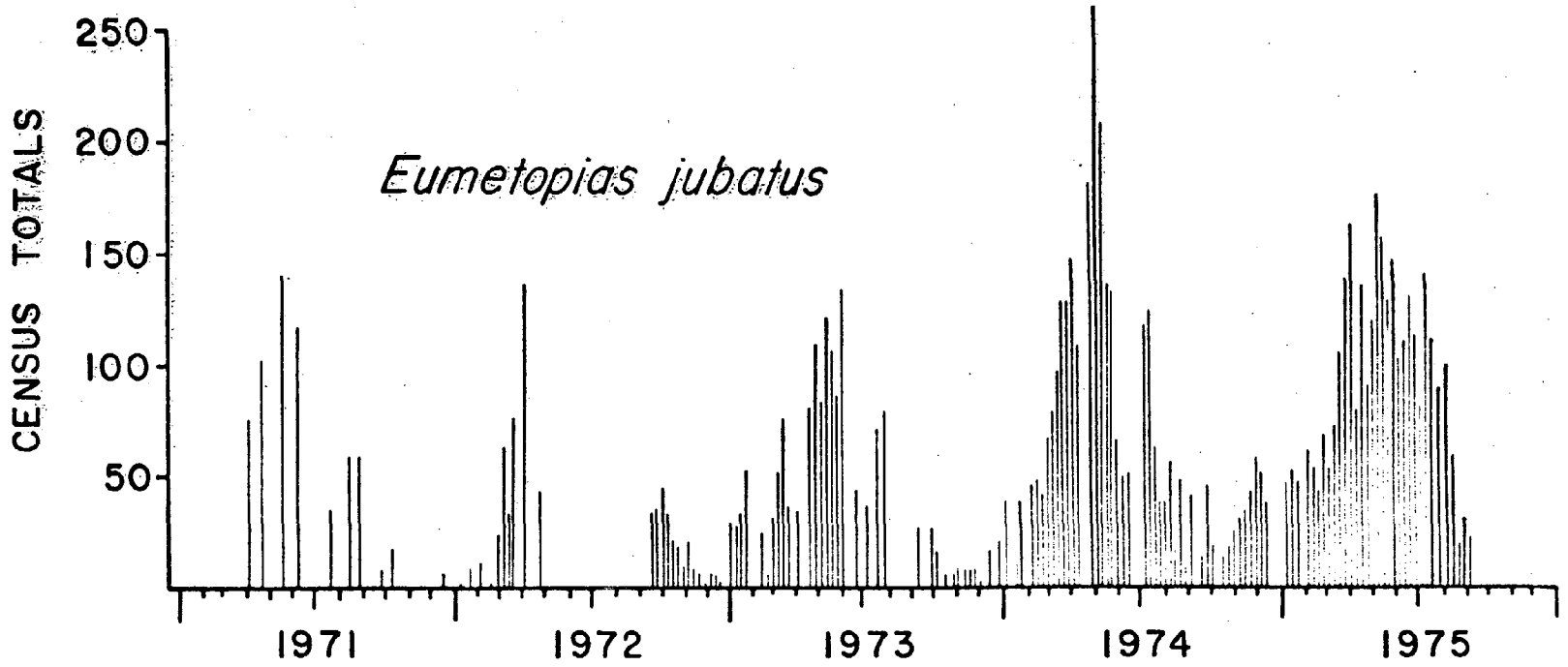

CENSUS TOTALS
250
200
150
100
50
Eumetopias jubatus
1971
1972
1973
1974
1975

Figure 6

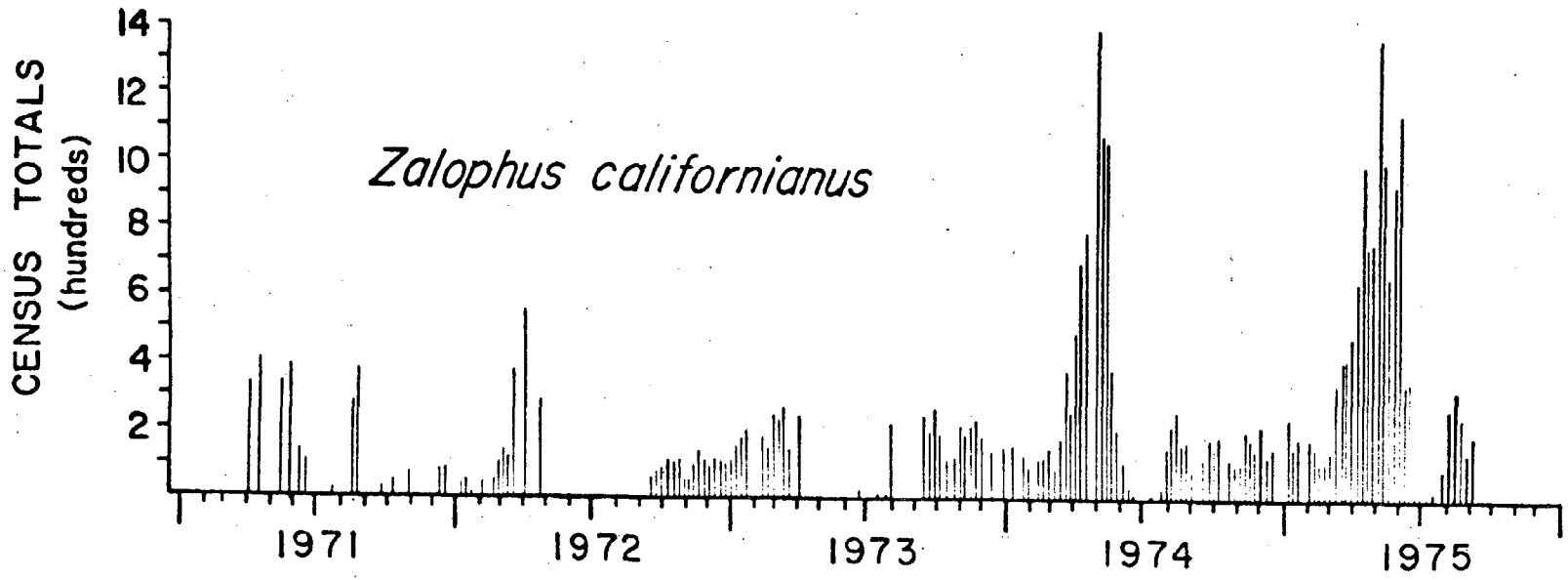
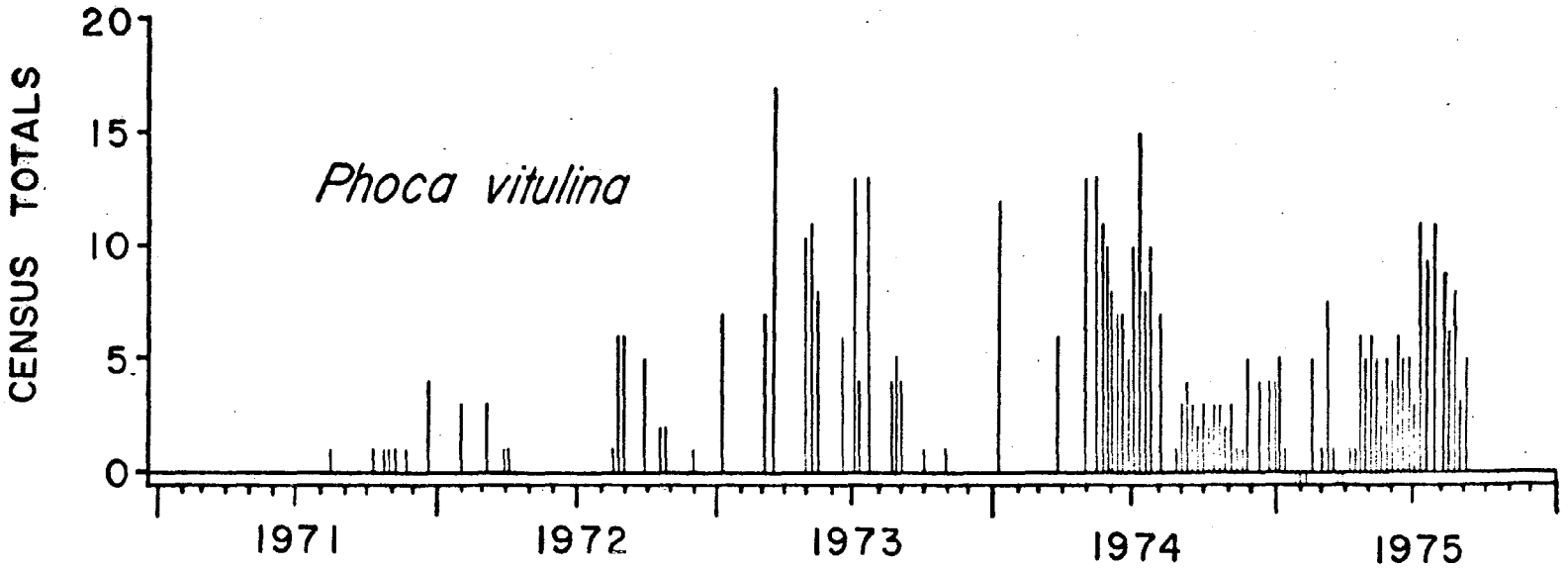

CENSUS TOTALS
(hundreds)
14
12
10
8
6
4
2
Zalophus californianus
1971
1972
1973
1974
1975

Figure 7


CENSUS TOTALS
20
15
10
5
0
Phoca vitulina
1971
1972
1973
1974
1975

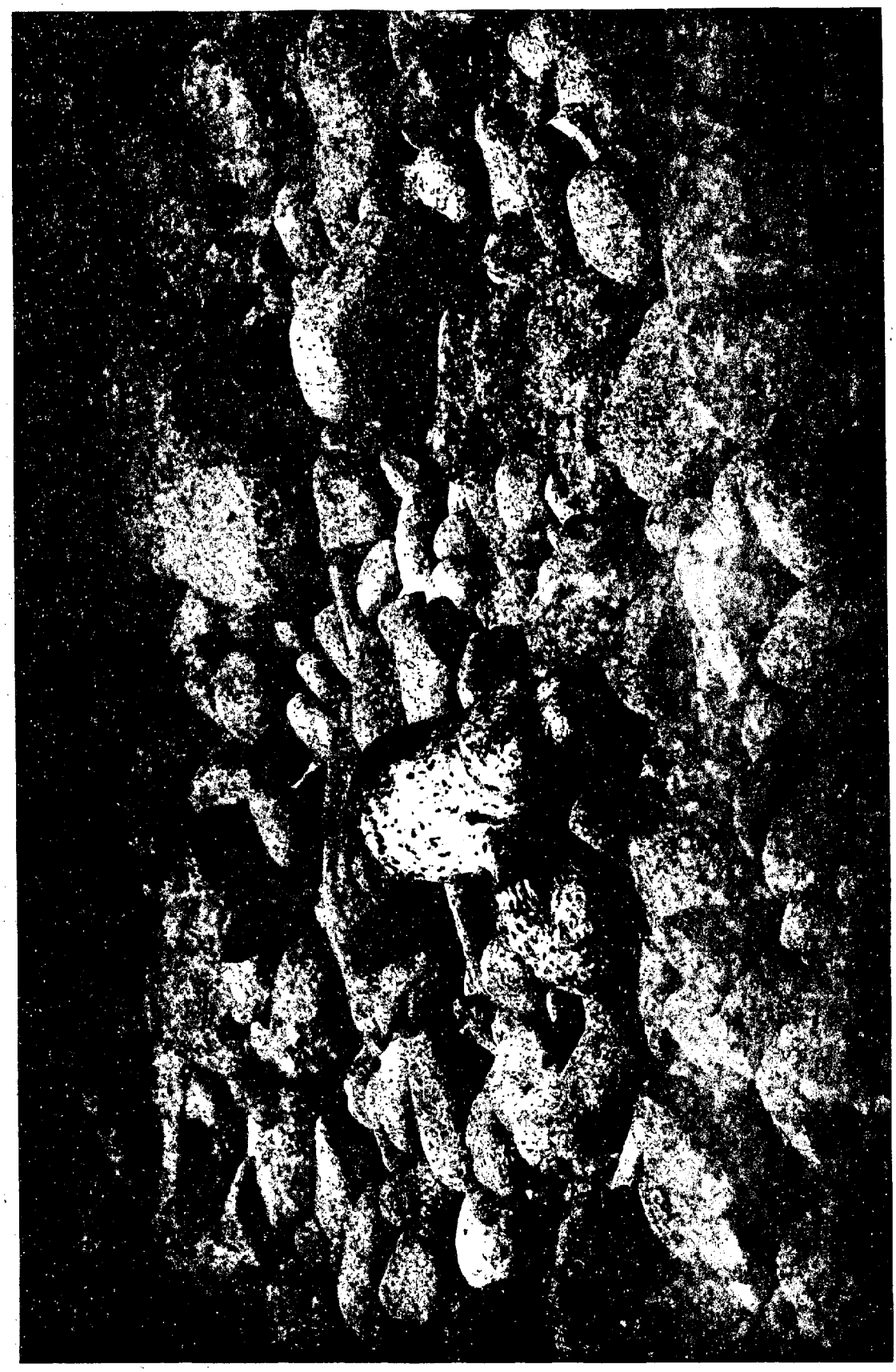


Figure 8

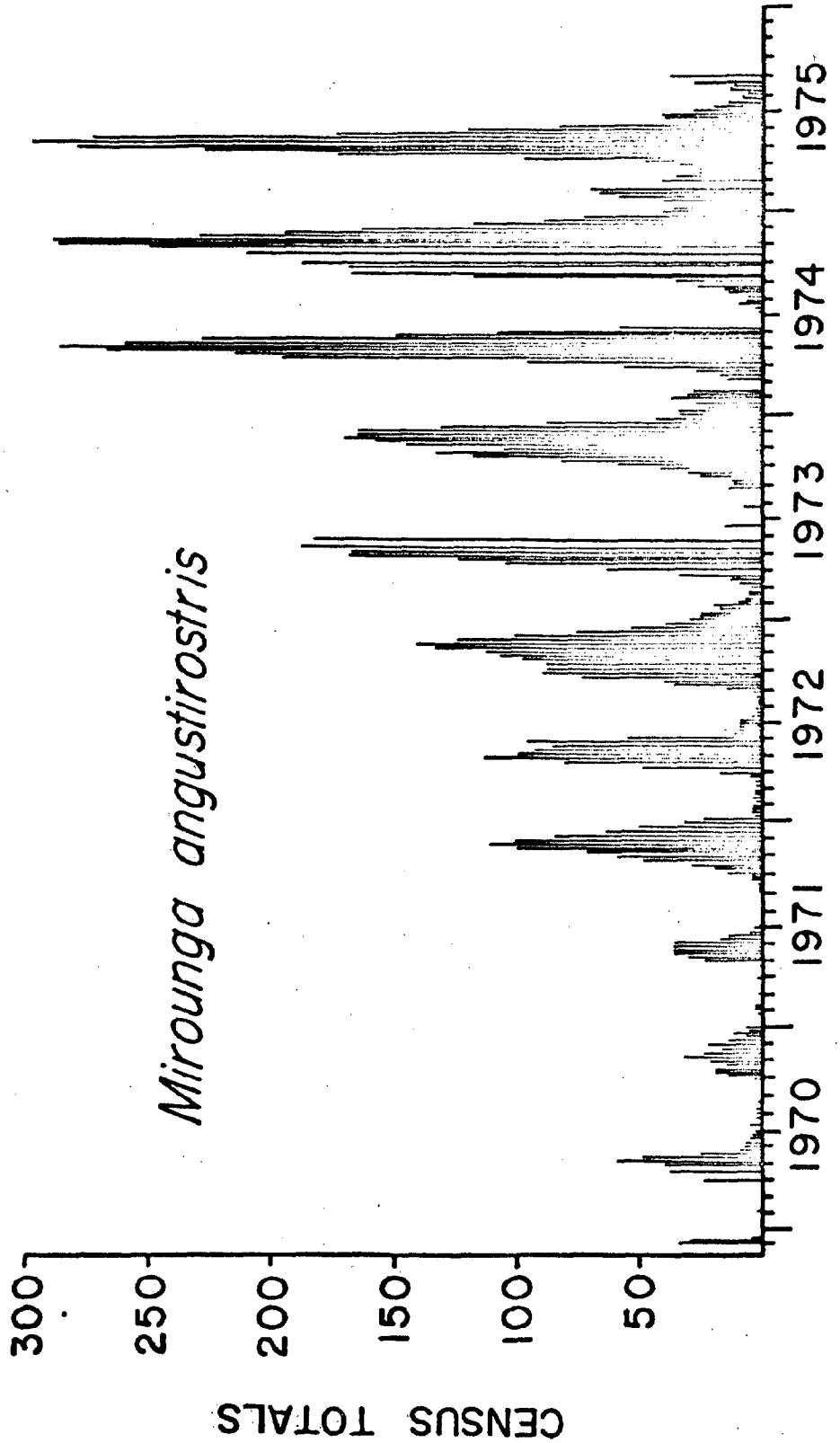

Mirounga angustirostris
CENSUS TOTALS
300
250
200
150
100
50
1970
1971
1972
1973
1974
1975

Figure 9

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