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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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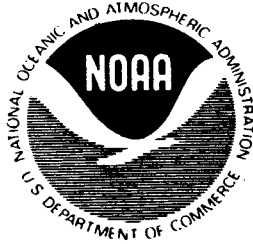
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ABSTRACT

A study of the endangered Hawaiian monk seal, Monachus schauinslandi, was conducted on Laysan Island, in the Northwestern Hawaiian Islands, from 29 March to 7 August 1984. Pertinent population data from a short-term field camp lasting from 22 October to 6 November are also included.

Excluding pups, beach counts on 45 censuses conducted 7 May to 3 August ranged from 65 to 101 seals (average of 82). The entire subpopulation at Laysan Island (269 individual seals) was identified during 1984. At least 31 pups were born. Six seals (including 2 pups) either died or probably died during the 1984 field season, and at least 22 seals sustained injuries.

Two adult male mobbing incidents (collective acts of aggression by adult male seals towards other individual seals where obvious injury is inflicted) were observed. Three single aggressive male incidents, where obvious injury is inflicted by a single male, were also observed. Fourteen seals were observed with dorsal wounds typical of bites inflicted by adult males during mating attempts; one of these seals subsequently died and two others disappeared.

At least 13 seals immigrated to or emigrated from Laysan Island between July 1983 and October 1984.

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INTRODUCTION

Laysan Island, in the Northwestern Hawaiian Islands (NWHI), is one of four major haul out and pupping areas used by the endangered Hawaiian monk seal, Monachus schauinslandi, in 1984. Extensive research has been conducted on the Laysan population since 1977 during 3- to 7-month field camps (Johnson and Johnson 1978, 1981a, 1981b, 1984; Alcorn 1984; Knudtson¹; Alcorn and Buelna²).

The primary purposes of this study were to: 1) determine the subpopulation size and composition at Laysan Island, 2) monitor incidents of adult male aggression towards adult female and immature seals, and 3) collect adult male association data. Additional objectives were to continue other work similar to that done during field camps established on Laysan Island in 1982 and 1983: 1) conduct frequent censuses, 2) tag all weaned pups, 3) identify all individuals in the population by applied or natural markings, 4) re-mark molting seals to maintain identification, 5) continue photographic identification, 6) monitor injuries and deaths, 7) perform necropsies, 8) monitor reproduction, and 9) collect net samples and burn dangerous net and rope fragments.

Field camps were established on Laysan Island by National Marine Fisheries Service (NMFS) personnel from 29 March to 7 August and from 22 October to 6 November 1984. The itinerary of the 1984 Laysan Island field work summarized in this report is presented in Appendix A. Other monk seal studies conducted concurrently by NMFS researchers at Laysan Island from 22 October to 6 November are summarized in Gilmartin.³

AREA AND METHODS

Area

Laysan Island (lat. 25°42'N, long. 171°44'W) is a low, coral-sand island located 815 nmi northwest of Honolulu, Hawaii. Information covering the geology, flora, fauna, and history of Laysan Island is presented in Ely and Clapp (1973).

¹Knudtson, E. P. 1981. Hawaiian Monk seal observations at Laysan Island, March-July 1981. Unpubl. manuscr. Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, 2570 Dole Street, Honolulu, HI 96822-2396, 23 p.

²Alcorn, D. J., and E. K. Buelna. The Hawaiian monk seal on Laysan Island: 1983. In prep. Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, 2570 Dole Street, Honolulu, HI 96822-2396.

³Gilmartin, W. G. Translocation of adult male Hawaiian monk seals from Laysan Island to Johnston Atoll. In prep. Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, 2570 Dole Street, Honolulu, HI 96822-2396.

For the purpose of defining location of an animal in data collection, the perimeter of Laysan Island was divided into 20 sectors (Fig. 1). The same sectors have been used in all monk seal studies on Laysan since 1982 (Alcorn 1984; footnote 2).

Methods

Where possible, continuity in data collection methods and individual identification of seals was maintained for the 1982, 1983, and the 1984 field camps so that comparisons between years would be valid. All individual seals mentioned in this report are referred to by their permanent identification (ID) number and are directly comparable between islands and years unless otherwise noted.

Marking and Scar Identification

Some seals had bleach marks at the beginning of the field season because 69 individuals were bleach-marked on Laysan Island after they molted in 1983 (footnote 2). All unmarked seals were identified by applied bleach or natural markings. Molting seals were re-marked to maintain their identity when about 70% or more molted. A combination of Ultra Blue⁴ and Instant Whip bleach, mixed with 20% hydrogen peroxide and powdered pro-tenator or Wella Frost bleach mixed with 20% hydrogen peroxide was applied with a squeeze bottle to the fur of sleeping seals. The technique of bleach application is described in detail in Stone (1984).

Bleach marks, scars, and other natural markings were sketched on a card for each seal, and cards were updated and revised to maintain a current file. Scars and natural markings were photographed. The film was processed in Honolulu after the field season, and photographs were added to the identification file begun in 1982.

Tagging

Pups were bleach-marked and tagged with a tan colored plastic Temple Tag in each hind flipper as soon as possible postweaning. Pup tagging procedure is described in detail in Gilmartin et al. (1986). Yearlings that only had one tag received a second tag in their untagged hind flipper. The procedure for tagging yearlings was the same as for tagging pups with the exception that yearlings were not measured. Adult males observed to be highly aggressive toward adult females or immature seals received a Monel tag in one of their hind flippers. Adult male tagging is described in detail in Alcorn and Buelna (footnote 2).

⁴Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

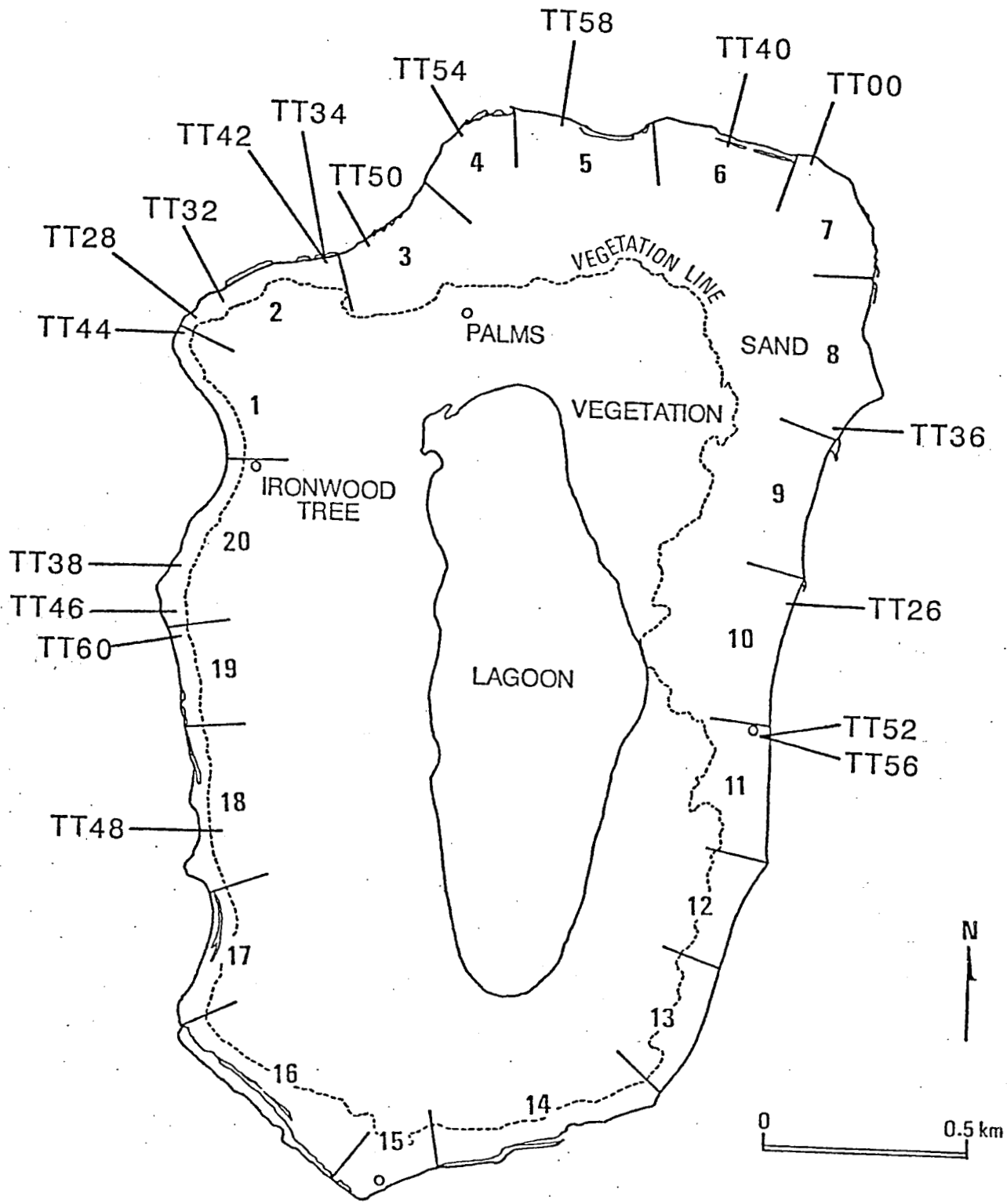


Figure 1.--Map of Laysan Island showing 20 sectors and known pupping sites, 1984 (numbers represent the ID numbers of the pups).

Census

Forty-five Hawaiian monk seal censuses were conducted on Laysan Island in 1984. Censuses were conducted every other day between 7 May and 3 August, starting at 1200 Hawaii standard time, and lasting approximately 3 h each. Two observers began in Sector 01 and proceeded in opposite directions until they met on the other side of the island, usually in Sectors 08 or 09. Observers alternated direction of travel on each census. Census duties were rotated among three observers until 2 July, when one observer left.

The census form is included in Alcorn and Buelna (footnote 2) and the 1984 coding instructions are included in Appendix B. Size classification and the process of seal identification are described in detail in Stone (1984).

All seals with 50% or more of their body out of the water were recorded on census, and known resightings of the same individual in a single census are not included in the census totals. Individuals in the water or on offshore reefs were also recorded if they interacted with individuals on the beach or could be positively identified, but they are not included in the census totals.

Behavior Patrol

Behavior patrols were designed to collect systematic data on seal association patterns. Behavior patrols followed census procedure, including the use of census forms, with the following difference: Data were only collected on "associated" individuals, molting seals, yearlings, nursing mothers, and pups. Seals were defined as associated if: 1) haul-out distances were ≤ 5 m apart as the observer came abreast of the subjects, or 2) behavioral interactions occurred within 30 m of the observer. Association data collection is described in detail in Appendix B.

Twenty-nine behavior patrols were conducted from 25 April to 29 June 1984. These patrols were made on every noncensus day (with the exception of 1 day per week). Two observers conducted each behavior patrol, one covered Sectors 01 through 08 and the other covered Sectors 09 through 20. Direction of travel varied. Beginning time varied and was usually either 0900 or 1600. Patrol duration ranged from 2-1/2 to 6-1/2 h and averaged approximately 4 h each.

Mobbing Patrol

Mobbings are defined as instances in which adult male seals collectively commit acts of aggression toward other seals and inflict obvious injury. Mobbing patrols were designed to detect incidents of adult male aggression. These surveys were conducted in Sectors 01-06 and 18-20, areas where adult male mobbings have been observed in the past (Johnson and Johnson 1981a; Alcorn 1984; footnote 2). Mobbing patrols were conducted from 25 April until 29 June, 6 days per week. This patrol was conducted by one observer who walked the beach crest observing and noting interactions between seals. Attention was primarily directed out to sea and each mobbing patrol lasted approximately 4 h.

The mobbing patrol observer carried a VHF radio and kept in close contact with another observer located at camp. If an aggressive incident was observed during patrol, the other monk seal researchers were alerted. In the event of an offshore mobbing, one observer followed the incident from shore while two researchers proceeded to the scene in an inflatable boat. Observers in the boat identified seals with the aid of binoculars and documented the mobbing with photographs. Data were recorded in a water-proof notebook and narrated into a tape recorder. Researchers stayed on station near the mobbing for as long as possible.

Mobbing patrols began at 0900 on census days and at either 0900 or 1600 on behavior patrol days. If the behavior patrol began at 0900 then the mobbing patrol would begin at 1600, or vice versa. The combination of census, behavior patrols, and mobbing patrols insured that the beach and nearshore waters of Sectors 18-20 and 01-06 were monitored at least twice daily 6 days per week.

Daily Monitoring

Incidental data collected daily from 30 March to 6 August and from 23 October to 4 November on the census-patrol form included sightings of molting seals, yearlings, nursing female-pup pairs, and pups not already recorded on census or behavior patrol. The island was monitored daily for noteworthy events such as births, weanings, deaths, adult male harassment, shark-seal interactions, entanglements, appearance and progress of wounds and illness, and presence of seals marked at other atolls. Bleaching and tagging of seals, and scar or photographic documentation of individuals were done opportunistically on a daily basis. The entire perimeter of Laysan Island was walked at least once 6 days per week from 6 April until 6 August and daily from 24 October until 3 November. On days when the island was not completely surveyed, an observer checked the major pupping areas (Sectors 18 through 03) for births or weanings. Disturbance was minimized by staying above the beach crest and using vegetation for cover, where possible.

Collection of Materials

Necropsy.--Necropsy procedure and the collection of samples are described in detail in Johanos and Kam (1986).

Entanglement and net accumulation.--The collection and destruction of fishing gear and other dangerous debris are described in detail in Johanos and Kam (1986).

Scats and spewing.--The collection of scats and spewing are described in detail in Alcorn 1984.

RESULTS AND DISCUSSION

Census Counts

Total beach counts between 7 May and 3 August, excluding pups of the year, ranged from 64 to 101 seals (average of 82). Total beach counts including pups of the year ranged from 81 to 120 (average of 99). Census summaries by size and sex class are presented in Appendix C. Identified individuals were placed within their assigned size classes for the season whereas unidentified seals retained the size classification given by the census observer.

Population Structure

During the 1984 field season 269 individuals were identified by applied bleach or natural markings. Appendix D shows known individual monk seal sightings on Laysan Island by date observed in 1984. A summary of the composition of the 1984 population, by sex and estimated midsummer size class, is presented in Table 1. The ratio of males to females is near equal in the immature size classes, but increases to 2:1 in the adult size class.

Table 1.--The numbers of seals observed on Laysan Island during the 1984 field season, by sex and estimated midsummer size class (M = male, F = female).

Size class	Males	Females	Total	Sex ratio (M/F)
Adults	96	47	143	2.0
Subadults	23	¹ 27	50	0.9
Juveniles	20	25	45	0.8
Pups	16	15	31	1.1
Total	155	114	269	1.4
Total excluding pups	139	99	238	1.4

¹Number assumes that an unidentified subadult female that disappeared and probably died was subadult female TP86.

Reproduction

Pup Production and Survival

At least 31 pups were born in 1984 (Appendix E). The sex ratio of the 1984 pup cohort was near equal: 15 females:16 males. Early pup survival was

high: 30 of 31 pups survived to weaning, and 26 of 30 weaned pups were sighted within the last 6 days before termination of the first field camp on 7 August. One female pup (TT00) died at birth and another female pup (TT32) prematurely weaned after 23 days of nursing and subsequently disappeared 23 days postweaning. In addition, three other weaned pups disappeared. Female pup TT18 and male pup TT44 disappeared 86 and 52 days postweaning, respectively, and female pup TT12 disappeared more than 98 days postweaning. The four pups that disappeared were not resighted during the second 1984 field camp.

Date and Location of Births

In 1984, 13 pups (4 weaned and 9 nursing) were present on Laysan when observations began 30 March, and 18 pups were born thereafter. The last pup was born 13 July. Two pups were still nursing at the end of the first field camp. Pupping occurred primarily along the midwest and northwest coasts of Laysan (Sectors 18-20 and 01-03), as reported in previous years (Johnson and Johnson 1978, 1984; Alcorn 1984; footnote 1; footnote 2). In 1984, 55.6% of all observed births occurred within this preferred pupping area (Fig. 1).

Pup Exchange

One exchange of pups between mothers was observed in 1984. This exchange resulted in the early weaning and disappearance of one female pup (TT32) and the unusually long nursing duration of a second female pup (TT42). The two mothers had pups of different ages; adult female T09F gave birth to TT42 on 7 April and adult female T15F gave birth to TT32 on 18 April. Both pups were born in Sector 02 and remained there throughout their nursing period. Female T09F and her older pup, TT42, remained to the north of female T15F and her younger pup, TT32, through 4 May. On 5-6 May, T09F crossed to the south of T15F and, during that time, the two females exchanged pups. The pup exchange was not directly observed, but was detected because the mother of the older, larger pup was observed nursing a smaller pup, and vice versa. Female T09F lactated a total of 34 days and weaned her foster pup (TT32) on 11 May. Prematurely weaned pup TT32 actively sought out other lactating females in the vicinity but was driven off. On 12 May, T15F and her foster pup (TT42) swam south toward T15F's offspring (TT32) which was asleep on the wet sand. The mother approached pup TT32 twice and on the second approach the pup awoke, vocalized, and attempted to flee. Adult female T15F and foster pup TT42 subsequently entered the water and swam north. No further interactions were observed between the mother and her offspring. Prematurely weaned pup TT32 only nursed a total of 23 days; 17 or 18 days with her natural mother (T15F) and 5 or 6 days with her foster mother (T09F). Pup TT32 was very small, and became progressively thinner and less active until she disappeared on 3 June, 23 days postweaning. Female T15F lactated a total of 39 days and weaned her foster pup (TT42) on 27 May. Weaned pup TT42 nursed a total of 50 days; 28 or 29 days with her natural mother (T09F) and 21 or 22 days with her foster mother (T15F).

Nursing Duration

Complete nursing duration was observed for 15 mother-pup pairs in 1984. Average nursing duration was 40.8 days and ranged from 23 to 50 days. Excluding the pups involved in the exchange discussed above (pups TT32 and TT42), average nursing duration was 41.5 days and ranged from 34 to 46 days (Appendix E).

Parturient Females

Twenty-five of the 27 females known to have given birth in 1984 had been identified in previous years; 17 of these females were identified on Laysan Island in 1982 (Alcorn⁵), and 7 additional females were identified on Laysan Island in 1983 (footnote 2). One 1984 parturient female (with no prior pupping history) was identified on Lisianski Island in 1982 (Stone 1984) and 1983 (Johanos and Kam 1986) (see Interatoll Movement). Parturition dates were known in 1983 (footnote 2) and 1984 for five adult females that gave birth on Laysan Island; average duration between successive births was 375.0 days, and ranged from 348 to 389 days.

The reproductive rate was typical for monk seals. Excluding adult female Y156, which pupped at French Frigate Shoals (see Interatoll Movement), at least 67.4% of the adult females in the population pupped in 1984.

Deaths

Three dead seals (necropsy reports are in Appendix F) were found during the 1984 field season (Table 2):

1. On 11 April a perinatal female pup, TT00 (necropsy No. 01LA84), was found in Sector 7 at 1655, 10 m from sleeping mother T16F. It had been dead for a short time. The umbilical cord and amniotic sac were tightly wrapped around the pup's upper torso, neck, and head. Although there was a small tear in the portion of the sac that covered the pup's mouth, the cause of death was probably strangulation.

⁵D. J. Alcorn, Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, HI 96822-2396, pers. commun. Sept. 1982.

Table 2.--Monk seal deaths at Laysan Island, 1984 (A = adult, P = nursing pup, F = female, M = male, ID = identification).

Date 1984	Size	Sex	Necropsy ID	No.	Probable cause
4/11	P	F	TT00	01LA84	Strangulation
7/06	A	F	T32F	02LA84	Adult male
<10/23	A	M	--	03LA84	Unknown

2. On 6 July a dead adult female, T32F (necropsy No. 02LA84), was found in Sector 18 at 1222. The bloated carcass was floating in the wave wash accompanied by an adult male (bleach No. P33). On 5 July T32F had been observed floating on her back in the same general vicinity, accompanied by an adult male, and it is possible that she was dead at that time. She had been seen alive on the beach in Sector 18 on 4 July with numerous small gaping wounds through the skin of her midback and was classified as possibly pregnant due to her large size. Necropsy revealed that T32F was not pregnant. The cause of death was probably related to adult male induced injuries.
3. On 23 October during a preliminary patrol at the onset of the fall field camp, a dead adult male (necropsy No. 03LA84) was found in Sector 02. It had been dead for an undetermined length of time. The dead seal was on the midbeach, approximately 1 m from the vegetation line, and was half buried in the sand. Due to the mummified condition of the carcass, the animal's identity and cause of death could not be determined.

Disappearance

Between July 1983 and August 1984, 16 unexplained disappearances occurred. Monitoring of disappearances between July 1983 and March 1984 was limited to seals identified during the 1983 field season (and not known to have died, disappeared, or emigrated) that had legible postmolt bleach marks, distinctive scars, or tags at the end of the 1983 field season.

Between July 1983 and March 1984 nine unexplained disappearances occurred. Two adult females (T18F and T35F) had very distinctive natural markings and thus probably would have been recognized if they were seen on Laysan Island in 1984. A tagged adult male (right hind flipper tag X029) also had a high probability of recognition and either lost his tag or left the Laysan population. The remaining six seals had legible bleach marks at the end of the 1983 field season, but it is unknown if all marks remained conspicuous. These individuals are adult females TP42 and TY51, adult male TY52, subadult female T337, subadult male TP10, and juvenile female T385.

Seven seals disappeared during the 1984 field season. In addition to the four pups of the year (see Pup Production and Survival), two subadult females (TP86 and GJ02) and an unbleached subadult male (T12M) disappeared in March, April, and May, respectively. Subadult female GJ02 has a history of interatoll movement (Johanos and Kam 1986; footnote 2) and may be a transient which simply moved on. Three of the seven seals that disappeared during the 1984 field season are probably dead based upon circumstantial evidence:

1. On 4 April at 0946 an unmolted bleach-marked subadult female (probably TP86) was observed lying in the wave wash in Sector 19, accompanied by an unbleached adult male (probably later bleached No. 399). The female was lethargic and had numerous gaping wounds through the blubber on her back. The dimensions of the largest wound was 10 x 15 cm. Bloody fluid leached from the wounds and nearshore fish investigated the seal's exposed flesh. The female attempted to haul out several times but was unable due to her weakened condition. The defending male actively patrolled the area and drove off 10 challenging males between 0946 and 1200. During this time the male only touched the female once; at 1039 he vocalized, mounted, and bit the subadult female on her back, and she responded by struggling free and rolling on her back. At 1052 the subadult entered a reef pocket and was followed by the adult male. Observation ended at 1200.

At 1306, when observations resumed, the adult male and subadult female were in the same location. At 1315 the male mounted and bit the female again. The subadult left the reef pocket at 1317, slowly swam 100 m north along the shoreline, and then drifted out to sea through a deep channel in the fringing reef, accompanied by the male. At 1347 a shark was sighted 100 m away from the floating pair. The wounded subadult was last seen at 1444 when observation ended. The observer returned to the area at 1800 but was unable to locate the adult male-subadult female pair. The identity of the wounded subadult female was not confirmed, but by elimination of animals through recurring sightings on monk seal censuses and patrols, it is believed that the animal was TP86.

2. On 4 May at 1621 an unbleached subadult male (T12M) was observed on the wet sand in Sector 20, accompanied by adult male TY90. The subadult was lethargic and had numerous serious dorsal wounds. The dimensions of the largest wound was 5 x 10 cm and several wounds extended into musculature. Adult male TY90 vocalized and nudged the subadult repeatedly and mounted him once. Between 1621 and 1745 the adult male drove off two challenging males. By 1745 the tide rose, forcing the subadult to enter the water. Once in the water, the adult male mounted and bit the subadult repeatedly. At 1757 two adult males challenged TY90, but he was able to chase them away from the subadult. The subadult male swam slowly north into Sector 1. Adult male TY90 mounted, and bit the subadult, which weakly rolled to protect his back or jostled in response. The subadult attempted to haul out of the wave wash but could not. Observers

intervened between adult male TY90 and the subadult male at 1828. The adult male was persistent and did not leave until 1900.

The injured subadult was observed the next day at 0911 in the same area. He was approximately 10 m offshore in a reef pocket, accompanied by a different adult male (TP35). Between 0913 and 1423 on four separate occasions adult male TP35 mounted and bit the subadult and also drove off three single and one pair of challenging males.

A 4-5 ft gray reef shark was sighted at 1115, and single sharks were sighted in the area seven times from then until 1423. At 1423 the injured subadult drifted out of the reef pocket and into open water approximately 5 m from the shore. A gray reef shark approached within 5 m of the subadult at 1440 and was chased off by male TP35, but the shark remained in the area until 1451.

At 1520 challenging male TP67 approached, displaced adult male TP35, and then mounted and bit the subadult. Male TP67 remained mounted until 1538 and was joined by adult male TP35 which mounted the subadult male three times during this period. By 1537 there were four adult males in the vicinity; two were mounted on the subadult male and two floated alongside. At least six individual adult males were involved in the mobbing incident between 1520 and 1753.

The subadult male was mounted repeatedly by one to two adult males as the group of seals drifted out through the landing cove, and by 1753 they were 150 m offshore. Visibility was poor due to the distance, glare, and choppy waves. At 1753 a 12 ft tiger shark thrashed in the vicinity of the seals and a slick formed on the water. A tiger shark was sighted again at 1755, traveling north approximately 150 m from shore. The injured subadult male was never seen again.

3. On 11 May, female pup TF32 prematurely weaned in Sector 02 after nursing only 23 days. She remained in the vicinity and was sighted every day until she disappeared on 3 June (see Pup Exchange for further details).

Factors Affecting Survival

Injuries

At least 22 animals were injured by shark attack, adult male aggression, reef, debris, or unknown causes (Appendix G). The wounds of three seals (13.6% of total) appeared to be caused by sharks: either a large clean laceration or circular "cookie cutter" wounds. Thirteen seals (59.1% of total) had dorsal wounds typical of bites inflicted by adult male seals during mating attempts and one animal had wounds around the head probably inflicted by another seal. Five seals (22.7% of total) had minor wounds that were probably caused by the seals coming into contact with the reef or debris.

Three of the above seals had injuries that appeared to be life threatening and were caused by multiple adult male bites. In addition to the subadult female (TP86) and subadult male (T12M) that disappeared and probably died (see Disappearance), an adult female, T06F, was observed with a deep dorsal injury covering 30% of her back on 1 June. Adult female T06F's wound was still open but healing when the field season ended on 7 August, and was completely healed when she was first observed in 1985.

Adult Male Aggression

One adult female, T32F, died from multiple adult male bites (see Deaths) and a subadult female (probably TP86) and male (T12M) disappeared immediately after sustaining major adult male bite wounds (see Disappearance). See the Injuries section for information on all adult male related wounds observed in 1984.

All adult male mobbings and single aggressive male incidents (defined as acts of aggression by a single adult male seal towards other individual seals where obvious injury is inflicted) observed on Laysan Island in 1984 are summarized in Appendix H. Some prolonged adult male harassments of immature seals and nursing female-pup pairs are also included in Appendix H, but should be viewed as a minimum number reflecting only the more intense incidents observed. In addition to the two disappearances reported earlier, an adult female and a weaned female pup were injured in an observed mobbing and single aggressive male incident, respectively. Details are presented below:

1. Adult female T26F was first observed with serious back wounds on 2 May. On 13 May at 0920 in Sector 01, she was observed moving down the beach slope. As she entered the water, four males immediately approached her. The female fled into the water but was caught and repeatedly mounted and bitten by one to two males at a time. Another male joined the group at 0924. After the female hauled out on an exposed reef 30 m from shore at 1008, four of the five males departed. The last adult male, TP83, remained in the water near the female and drove off two challenging males before he swam away at 1116. The female left the area shortly thereafter with numerous additional minor wounds after this mobbing. Her wounds healed before the end of the field season.
2. On 16 May at 0918 in Sector 02 prematurely weaned female pup TT32 was observed in the wave wash accompanied by large subadult male TY33. The male rolled the pup over and pinned her repeatedly. Pup TT32 hauled out at 0922 but then reentered the water at 0924 and approached the male. The male nudged the pup. The pup then fled, followed by the male. Pup TT32 hauled out again at 0925 but then reentered the water and again approached the male. Male TY33 nipped the pup repeatedly on the back. The pup hauled out at 0930 and subadult male TY33 left the area. Female pup TT32 had numerous dorsal abrasions and welts resulting from this incident.

The incident described above may have been initiated by the pup, and was certainly prolonged by her actions. Pup TT32 was prematurely weaned 5 days before this event and appeared to be searching for a receptive lactating female (see Pup Exchange for further details).

Interatoll Movement

Interatoll movement of 13 monk seals (9 females and 4 males) was observed among Laysan Island, Lisianski Island, and French Frigate Shoals (FFS) during the 1984 field season (see Appendix I).

Ten seals moved between Laysan and Lisianski Islands. A juvenile male (TA34) tagged as a pup on Laysan Island in 1983 (footnote 2) was observed on Lisianski Island in 1984 (Alcorn et al.⁶). Five adult females (GA10, GA59, T08F, T57F, and G130), a subadult female (GJ31) and a subadult male (GS45) bleached on Lisianski Island in 1983 (Johanos and Kam 1986) were observed on Laysan Island in 1984. In addition, two tagged juvenile females, G027 (a Lisianski Island 1982 pup) and G055 (a Lisianski Island 1983 pup), were observed on Lisianski Island in 1984 (footnote 6) and were then observed on Laysan Island later in 1984. Two of the adult females mentioned above (GA59 and T08F) made a round trip. They began from Lisianski Island in 1983 (Johanos and Kam 1986), immigrated to Laysan Island where female GA59 pupped, and then returned to Lisianski Island (footnote 6). Adult female T08F was observed on Lisianski Island later in 1984. Although GA59 was not observed on Lisianski Island until 1985, she probably left the Laysan population in 1984; she was last observed on Laysan Island on 2 April 1984, immediately before weaning her pup.

Three seals moved between Laysan Island and FFS. A subadult male (GS33) observed at FFS in October 1983 (Fairaizl⁷) was observed at Laysan Island in 1984. A subadult male (TY63) was identified and bleached on Laysan Island in 1984 and was then observed at FFS later in 1984 (Eliason⁸). An adult female

⁶Alcorn, D. J., R. G. Forsyth, and R. L. Westlake. Hawaiian monk seal and green turtle research on Lisianski Island, 1984 and 1985. In prep. Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, 2570 Dole Street, Honolulu, HI 96822-2396.

⁷G. W. Fairaizl, Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, HI 96822-2396, pers. commun. Nov. 1983.

⁸Eliason, J. J. Hawaiian monk seal observations at French Frigate Shoals, 1984. In prep. Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, 2570 Dole Street, Honolulu, HI 96822-2396.

(Y156) made a round trip; she was bleached on Laysan Island in 1983 (footnote 2), immigrated to FFS where she pupped on East Island in the spring of 1984 (footnote 8) and then returned to Laysan Island later in 1984.

In addition to the 13 seals mentioned above, 1 other individual probably moved between islands. Adult female T39F, which pupped on Laysan in 1983 (footnote 2), was not observed on Laysan Island in 1984 until 12 July, immediately before her parturition. This female is readily identifiable by distinctive natural markings and was probably not at Laysan earlier in the field season.

Five of the 14 individuals described above have a prior history of interatoll movement (see Appendix I).

Status of the Marked Population

Tags

All pups were weaned before 22 October (the beginning of the second field camp), and 29 of the 30 weaned pups were tagged once on each hind flipper and bleach-marked (see Appendix E). The female pup (TT32) that prematurely weaned and subsequently disappeared (see Pup Exchange) was not tagged but was readily identifiable because of two natural bleach marks.

Three seals other than pups of the year were tagged during 1984 (Table 3). A 1983 female pup (TA40) that initially received only one tag in 1983 (footnote 2) was given a second tag in 1984. Also, a 1983 male pup (TA23) lost a right hind flipper tag before 30 March 1984 and was retagged in 1984. An adult male (TP46) that was observed harassing nursing female-pup pairs for prolonged periods on two occasions received a Monel tag on the left hind flipper.

Table 3.--Seals other than pups that received tags on Laysan Island in 1984 (A = adult, J = juvenile, M = male, F = female, ID = identification).

Tag		ID No.	Size	Sex	Tagging date 1984	Notes
Left	Right					
A51	¹ A40	TA40	J	F	5/08	Temple tag, Laysan 1983 pup.
A52	¹ A24	TA23	J	M	7/22	Temple tag, Laysan 1983 pup.
X030	--	TP46	A	M	7/30	Monel tag.

¹Existing tag applied in 1983.

Tag loss was rare. All 1984 tagged pups still retained both hind flipper tags when last examined in 1984. Only one of the resighted Laysan Island 1983 tagged pups (TA23) lost a tag between 1983 and the end of the 1984 field season. Two juvenile females tagged as pups on Lisianski Island in 1982 and 1983 (G027 and G055, respectively) moved from Lisianski Island to Laysan Island in 1984 (see Interatoll Movement). These two juveniles still retained both hind flipper tags when last examined in 1984.

An adult female, T27F, tagged with a right hind flipper Monel tag (A5) as a yearling at FFS in 1967, and observed on Laysan Island since 1982 (Alcorn 1984, footnote 2) still retained her tag when last examined in 1984. Furthermore, two of the three adult males tagged in 1983 (footnote 2) were resighted in 1984 and still retained their Monel tags. Adult males TP35 and TY18 were observed with right hind flipper tag X026 and left hind flipper tag X028, respectively. The adult male tagged X029 in the right hind flipper in 1983 either lost his tag or left the Laysan population.

Postmolt marks

One hundred and seventeen individuals other than pups were legibly rebleached postmolt on Laysan Island before the end of the first field camp on 7 August. One of these seals, adult female T08F, subsequently left the population (see Interatoll Movement). An additional 27 molted seals were identified by distinctive natural markings and rebleached postmolt during the second 1984 field camp. Including 10 unbleached seals with distinctive natural markings (adult females T01F, T06F, T14F, T24F, T29F, T34F, and T39F, adult males T03M and T07M, and juvenile female TP29), pups of the year (total = 26) and tagged animals that did not receive a postmolt bleach (total = 4), 183 of the 257 individuals identified in 1984 (and not known to have died, disappeared, or emigrated) were marked postmolt.

Forty-six molted seals were bleached during the second 1984 field camp but were not matched with a premolt identity. Table 4 gives the status of the marked population at the end of the 1984 field season.

ACKNOWLEDGMENTS

We would like to acknowledge the support of the U.S. Fish and Wildlife Service and extend our thanks to Steve Fairaizl and the other personnel at FFS who monitored our radio communications. We would like to thank the U.S. Coast Guard for providing air drops to the field camp. Thanks are extended to Capt. Edward Shallenberger of the FV Feresa and Capt. Mark Hoepfner of the FV Daystar and their crews for their help and generosity. We also wish to thank Stewart I. Fefer and Jane M. Packard for their critical reviews of this manuscript.

Table 4.--Status of the marked population at the end of the field season, Laysan Island, 1984 (ID = identification number).

Size class	Sex	Total ¹	Marked postmolt		² No mark postmolt
			Premolt ID known	Premolt ID not known	
Adult	Male	96	26	39	31
	Female	44	44	³ 1	0
Subadult	Male	21	20	⁴ 3	0
	Female	25	25	³ 1	0
Juvenile	Male	12	10	1	1
	Female	15	14	1	0
1983 pup	Male	8	8	0	0
	Female	10	10	0	0
1984 pup	Male	15	15	0	0
	Female	11	11	0	0
Total		257	183	⁵ 46	32
Total excluding 1984 pups		231	157	⁵ 46	32

¹All seals identified on Laysan Island in 1984 that are not known to have died, disappeared, or emigrated.

²Number assumes that there are no undetected changes in the population between the end of the first field camp and the end of the field season (7 August-6 November).

³These unmatched females (adult T411 and subadult T443) are either double bleached or new to the population, since all adult and subadult females were marked postmolt in 1984.

⁴Two of these three unmatched subadult males are either double bleached, placed in a lower size class postmolt, or new to the population since only one subadult male was not marked postmolt in 1984.

⁵This total includes four seals that are either double bleached, placed in a lower size class postmolt, or new to the population.

LITERATURE CITED

- Alcorn, D. J.
1984. The Hawaiian monk seal on Laysan Island: 1982. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-42, 37 p.
- Ely, C. A., and R. B. Clapp.
1973. The natural history of Laysan Island, Northwestern Hawaiian Islands. Atoll Res. Bull. 171, 361 p.
- Gilmartin, W. G., R. J. Morrow, and A. M. Houtman.
1986. Hawaiian monk seal observations and captive maintenance project at Kure Atoll, 1981. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-59, 9 p.
- Johanos, T. C., and A. K. H. Kam.
1986. The Hawaiian monk seal on Lisianski Island: 1983. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-58, 37 p.
- Johnson, B. W., and P. A. Johnson.
1978. The Hawaiian monk seal on Laysan Island: 1977. U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, Va. PB-285-428, 38 p.
- 1981a. The Hawaiian monk seal on Laysan Island: 1978. U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, Va. PB-82-109661, 17 p.
- 1981b. Estimating the Hawaiian monk seal population on Laysan Island. U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, Va. PB82-106113, 29 p.
1984. Observations of the Hawaiian monk seal on Laysan Island from 1977 through 1980. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-49, 65 p.
- Stone, H. S.
1984. Hawaiian monk seal population research, Lisianski Island, 1982. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-47, 33 p.

Appendix A.--Itinerary of the Laysan Island field work summarized in this report, conducted in 1984 by the National Marine Fisheries Service.

Date	Event
3/29	The <u>Feresia</u> disembarks T. Johanos and U.S. Fish and Wildlife Service personnel. Field camp established on Laysan Island.
3/30	Intensive bleaching and incidental data collection begins.
4/06	The <u>Daystar</u> arrives and disembarks R. Forsyth and A. Kam. Complete island patrols begin (6 days per week).
4/25	Behavior patrols and mobbing patrols begin.
5/07	Censuses begin.
6/29	Last behavior patrol and mobbing patrol are conducted.
7/01	The <u>Townsend Cromwell</u> arrives and embarks R. Forsyth.
8/03	Last census is conducted.
8/06	Last complete island patrol is conducted.
8/07	The Laysan Island field camp is disbanded. T. Johanos and A. Kam depart aboard the <u>Townsend Cromwell</u> .
10/22-23	The <u>Townsend Cromwell</u> disembarks W. Gilmartin, R. Forsyth, T. Johanos, S. Minasian, and R. Morrow. Field camp established on Laysan Island.
10/24	Complete island patrols begin (daily).
10/29	The <u>Townsend Cromwell</u> arrives and disembarks A. Kam.
11/06	The Laysan Island field camp is disbanded. W. Gilmartin, R. Forsyth, T. Johanos, A. Kam, S. Minasian, and R. Morrow depart aboard the <u>Townsend Cromwell</u> .

Appendix B.--The Hawaiian monk seal census form coding instructions, 1984.

CENSUS FORM EXPLANATION

18 March 1984

- OBSERVER - Three initials
- CENSUS - Checked when conducting census
- PATROL - Checked when walking the beach to bleach, collect scats, etc, but not on a timed/scheduled census
- PAGE - If census (or patrol) requires three pages, then mark first page as "Page 1 of 3", etc. If two people census with separate sheets then combine page numbers: person A has page 1 and 2, while person B has 3 and 4 of a 4 page census day.
- TIME - Noted by a 24-h clock; e.g., 6 p.m. = 1800
- TEMPERATURE - Noted in degrees Celsius at beginning of census/patrol
- WIND - 0 - no wind, calm DIRECTION - NW, NN, NE, EE, SE,
1 - light breeze SS, SW, WW
2 - strong wind
- Example: 2 | N | E = strong wind from NE
- CLOUD - cloud cover 0 - no clouds
1-9 - 10 to 90% cover
10 - 100% cover
- PRECIPITATION - 0 - no precipitation
1 - mist/drizzle
2 - rain
3 - intermittent rain

WEATHER INFORMATION SHOULD BE RECORDED AS A SUMMARY OF THE ENTIRE DAY UP UNTIL THE END OF CENSUS, NOT MERELY AN INSTANTANEOUS OBSERVATION!!!!

SECTOR - Location of island by region (e.g., on Lisianski from 1 to 49)

- AGE:
- | | | |
|--------------------------------|---|-----------------|
| P1 - nursing pup, wrinkles | } | P - nursing pup |
| P2 - nursing pup, no wrinkles | | |
| P3 - nursing pup, blimp, black | | |
| P4 - nursing pup, molting | | |
| P5 - nursing pup, molted | | |
| W - weaned pup | | |
| J1 - juvenile I | } | J - juvenile |
| J2 - juvenile II | | |
| S3 - subadult III | } | S - subadult |
| S4 - subadult IV | | |
| A - adult | | I - immature |

Appendix B.---Continued.

-
- T1 - turtle, juvenile (<65 cm)
 T2 - turtle, subadult (65-80 cm)
 T3 - turtle, adult (>80 cm)
- SEX: F - Female
 M - Male
 U - Unknown
- ID No. - record ID number of seal if known: seal No. 25 = 025 in blanks
 - ? column checked if ID number is questionable
- BLEACH No. May be same as ID number on some islands
 ? column: checked - if there is bleach, but the number is
 questionable. 0 - if animal is definitely unmarked
- TAG No. - Three to five numbers or number/letter combinations, right
 justify numbers, e.g., tag No. 023 is recorded as 00023
 - L/R column: if tag on left flipper mark as "L", etc., if
 tags on both flippers, can mark "B" for both
 - COL: color code G - green T - tan
 K - Kure gray R - red
 M - metal Y - yellow
 B - blue
 - ? column: checked - if animal is tagged, but the number is
 questionable, 0 - if animal is definitely not tagged
- BEACH POSITION - Location of seal (turtle) when observer comes abreast of
 animal (i.e., seal may be seen midbeach from a distance
 and yet be at waterline when observer comes abreast; seal
 would be recorded as at waterline)
- 0 - animal in water (which means it will not be included
 in census tally but used for behavioral info)
 1 - along waterline
 2 - midbeach, dry sand
 3 - vegetation zone or beach crest; permanent beach
- MOLT STATUS - space left blank if no molting evident
 1-99 - 1-99% molted right justify)
 100 - 100% molted, freshly molted
 - ? column checked - if animal molting but % questionable
 2 - if animal 15-99% molted but %
 questionable
- DISTURBANCE The degree the subject may have been disturbed by
 presence of observer
 - space left blank signifies no disturbance or seal
 merely looked at the observer
 1 - seal vocalized, gestured, or moved, two body lengths
 2 - seal alerted to observer and moved more than two body
 lengths
 3 - Seal alerted to observer and flees into water

Appendix B.--Continued.

TIME - Included at observer's option to note time of a behavior, etc.

ASSOCIATION DATA: There's room to describe two different associations (A and B).

ASSOCIATIONS RECORDED:

ACTIVE ASSOCIATIONS (noted for all but mother-pup pairs):

- 1) must take place within 30 m of observer
- 2) subjects may be any distance apart

SPATIAL ASSOCIATIONS:

- 1) noted as observer comes abreast of the subject
- 2) entangleable object: distances <2 m away
- 3) individual seal (turtle)
 - mother-pup pair: any distance
 - all others: distances <5 m away, record two nearest neighbors in straight line of sight

LINE No. Identity of the other party

- 1) entangleable object:
 - NR - net and/or rope
 - FL - flotsam other than above
- 2) individual seal (turtle): put it's line number here

CLOSEST DISTANCE

- 0 - body contact
- 1 - <2 m
- 2 - 2-5 m
- 3 - >5 m

BEHAVIOR

- 1) entangleable object (<2 m away)
 - L - association by location on beach only
 - E - subject is entangled
- 2) individual seal (turtle)
 - a) active association:
 - A - approach/investigate
 - B1 - bite, nip
 - B2 - bite, draws blood/breaks skin
 - C1 - chase, <2 body lengths
 - C2 - chase, >2 body lengths
 - D - displace
 - F1 - flee/move away, <2 body lengths
 - F2 - flee/move away, >2 body lengths
 - J1 - joust <30 sec
 - J2 - joust >30 sec
 - B - bite
 - C - chase
 - F - flee/move away
 - J - joust/spar/fight

Appendix B.--Continued.

M1 - mount/attempted mount <30 sec M - mount/attempted
M2 - mount/attempted mount > 30 sec
R - roll/present ventral
V - vocalize

Example:

1
B

b) spatial associations:

N - mother/pup pair (any distance)
L - if associated by location only (distance <5 m
apart, for all except mother-pup pairs)

CONTINUE

- If more space is needed to record an additional tag or association, put the line number you're continuing from here (only continue within 1 census sheet)

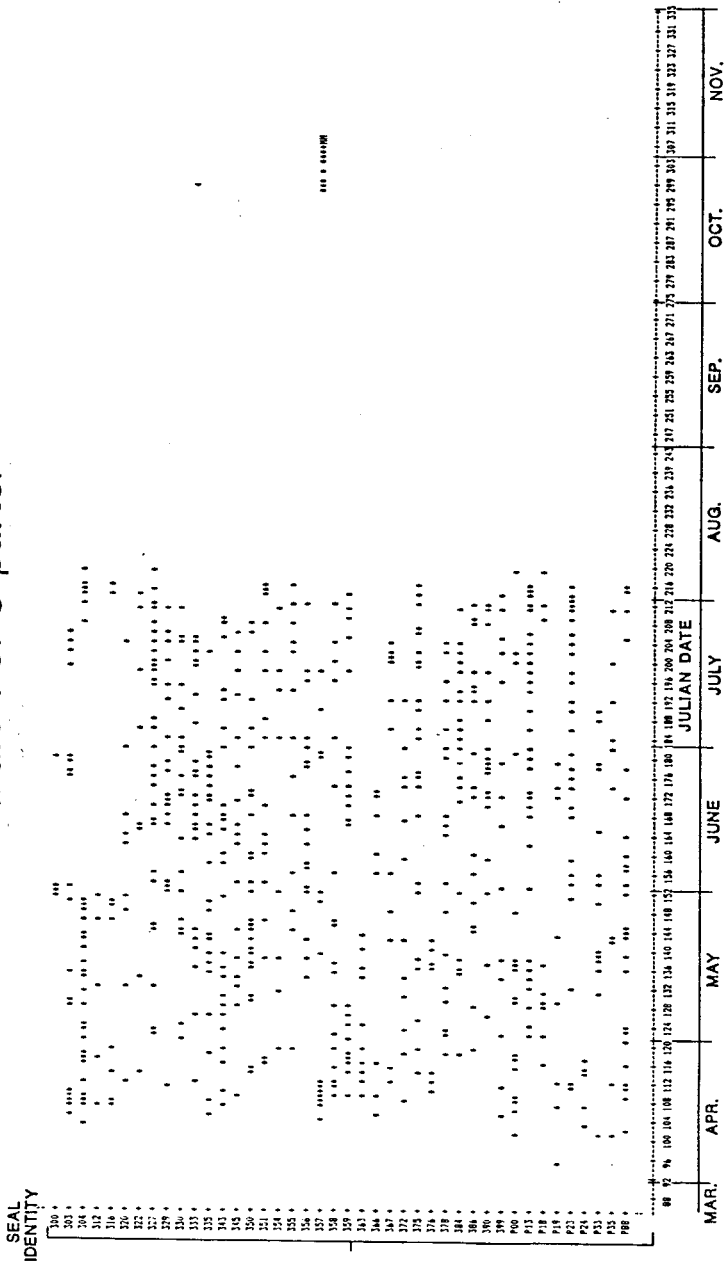
NOTES

- Checked - if you have handwritten notes on the observation. Put handwritten notes on the back of the form, labeled by line number.
L - If the observation is purely incidental.

Appendix C.--Monk seal size and sex class total/census, Laysan Island, 1984.

Date	Non-pups									Pups						Totals		
	Adult			Subadult			Juvenile			Weaned			Nursing			Non-pup	Pup	Grand
	M	F	?	M	F	?	M	F	?	M	F	?	M	F	?			
5/ 7	29	19	4	6	6	2	3	3	0	5	5	0	5	5	1	72	21	93
5/ 9	23	24	1	5	9	0	5	1	0	3	4	0	3	2	6	68	18	86
5/11	21	20	6	3	8	0	5	4	0	4	4	0	4	2	2	67	16	83
5/13	21	21	3	3	9	2	4	3	1	6	6	1	5	1	3	67	22	89
5/15	32	22	2	4	12	0	6	3	0	4	4	0	4	1	2	81	15	96
5/17	24	20	1	7	10	1	7	3	0	7	7	0	4	0	0	73	18	91
5/19	23	22	4	7	14	2	5	5	0	5	6	0	7	1	1	82	20	102
5/21	25	20	0	7	11	1	4	5	0	4	7	0	5	1	3	73	20	93
5/23	18	22	3	4	16	1	5	3	0	6	9	0	4	1	2	72	22	94
5/25	16	19	3	7	13	2	4	5	0	8	5	0	3	1	1	69	18	87
5/27	18	17	5	6	14	4	9	7	0	6	4	1	2	1	2	80	16	96
5/29	22	19	1	6	11	1	4	9	0	9	8	0	2	1	0	73	20	93
5/31	17	16	0	5	11	3	10	7	0	5	5	0	2	0	0	69	12	81
6/ 2	28	17	1	6	14	1	7	8	1	6	4	0	0	0	0	83	10	93
6/ 4	23	13	1	7	13	2	4	5	0	8	4	0	1	1	0	68	14	82
6/ 6	13	13	0	5	13	0	8	12	0	7	7	0	3	0	0	64	17	81
6/ 8	19	18	2	7	13	0	10	14	0	7	6	0	3	0	0	83	16	99
6/10	20	13	0	9	14	1	6	10	0	7	6	0	3	0	0	73	16	89
6/12	24	12	1	9	14	2	10	8	1	7	6	0	1	0	0	81	14	95
6/14	24	20	3	11	11	1	10	11	0	10	6	1	2	0	0	91	19	110
6/16	25	12	2	10	14	2	11	10	0	8	7	0	1	0	0	86	16	102
6/18	22	15	1	10	13	0	10	11	0	7	6	0	1	0	0	82	14	96
6/20	32	16	1	9	11	0	10	11	2	11	8	0	1	0	0	92	20	112
6/22	28	12	2	13	12	0	8	14	1	10	9	0	1	0	0	90	20	110
6/24	27	16	2	9	10	0	12	13	1	12	8	0	0	0	0	90	20	110
6/26	26	16	3	12	15	1	12	10	1	8	5	0	1	0	0	96	14	110
6/28	24	16	1	13	13	0	9	10	0	12	5	0	0	0	0	86	17	103
6/30	26	13	1	10	9	4	10	12	1	9	6	0	0	0	0	86	15	101
7/ 2	20	14	1	13	8	1	11	13	1	11	5	0	0	0	0	82	16	98
7/ 4	25	15	0	14	11	0	13	12	0	11	6	0	0	0	0	90	17	107
7/ 6	19	10	1	13	9	2	12	9	2	13	5	0	0	0	0	77	18	95
7/ 8	22	16	1	12	10	2	16	12	3	10	5	0	0	1	0	94	16	110
7/10	29	18	0	17	6	4	12	14	1	12	6	0	0	1	0	101	19	120
7/12	21	19	1	16	9	0	13	9	0	11	8	0	0	1	0	88	20	108
7/14	23	18	1	16	6	2	12	10	1	8	7	0	0	2	0	89	17	106
7/16	34	18	0	11	6	2	16	10	0	8	5	0	0	2	0	97	15	112
7/18	20	17	1	15	5	0	8	13	1	11	5	0	0	2	0	80	18	98
7/20	29	20	0	16	6	0	11	12	0	11	6	0	0	2	0	94	19	113
7/22	33	15	0	14	8	1	13	10	1	8	7	0	0	1	0	95	16	111
7/24	20	16	1	15	4	2	14	10	0	10	4	0	0	2	0	82	16	98
7/26	27	17	2	9	5	1	13	11	2	10	3	0	0	1	0	87	14	101
7/29	25	18	0	13	4	1	10	10	0	7	6	0	0	1	1	81	15	96
7/30	28	14	1	12	4	2	11	11	2	8	6	0	0	2	0	85	16	101
8/ 1	29	10	1	10	6	1	16	11	0	12	6	0	0	2	0	84	20	104
8/ 3	21	14	0	10	4	1	12	11	0	8	5	0	0	2	0	73	15	88

ADULT MALE (Part 1 of 3 parts)



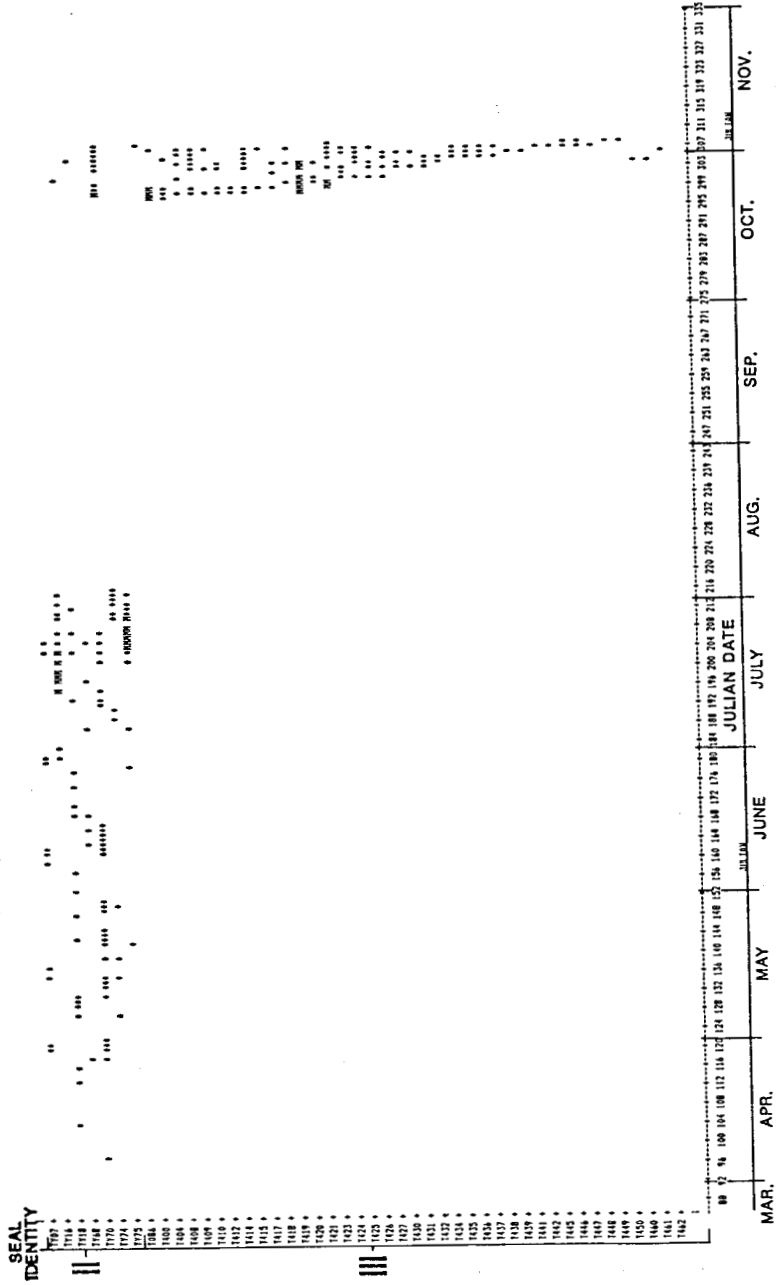
Appendix D.--Individual monk seal sightings by date observed, Laysan Island, 1984.
 (M = molting, B = first time pup observed with mother, P = mother-pup paid, and
 D = last observation, seal died or disappeared.)

ADULT MALE (Part 2 of 3 parts)

SEAL IDENTITY	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.
90									
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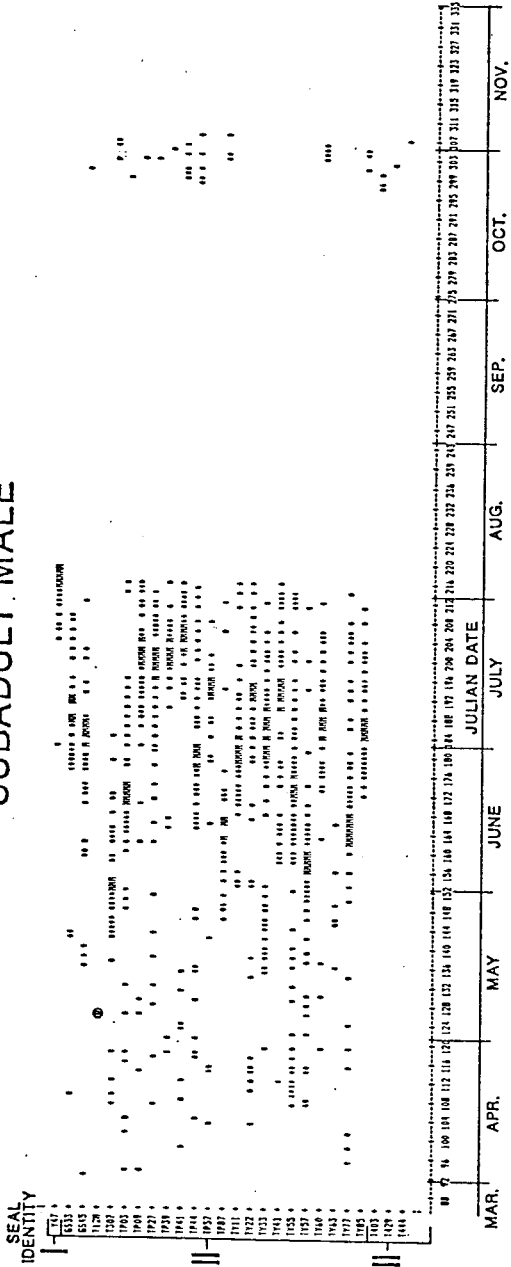
Appendix D.--Continued.

ADULT MALE
(Part 3 of 3 parts)

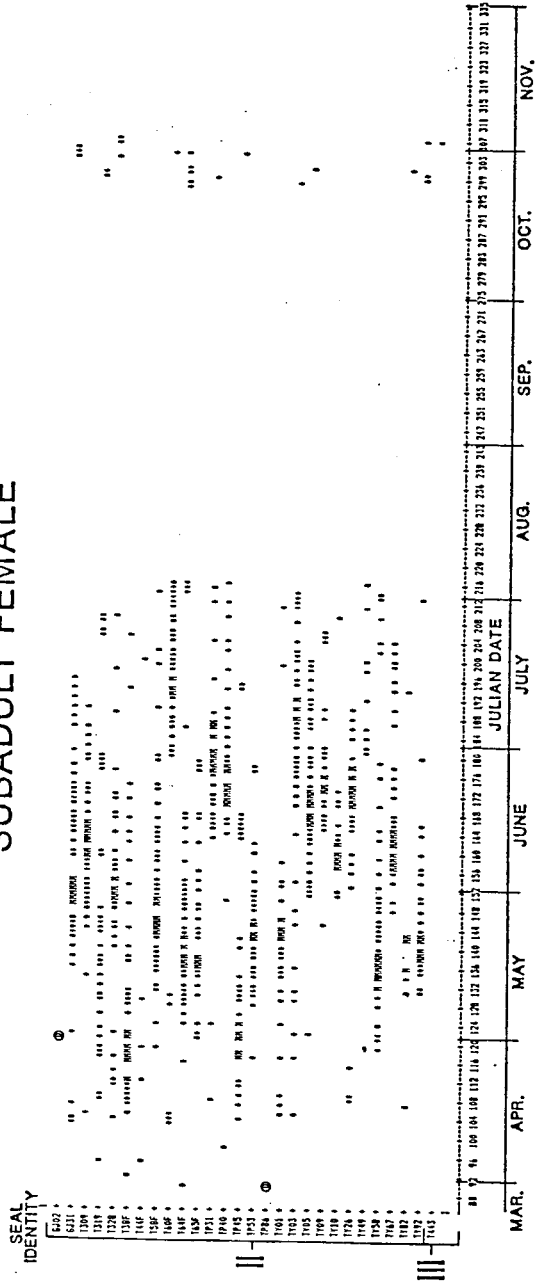


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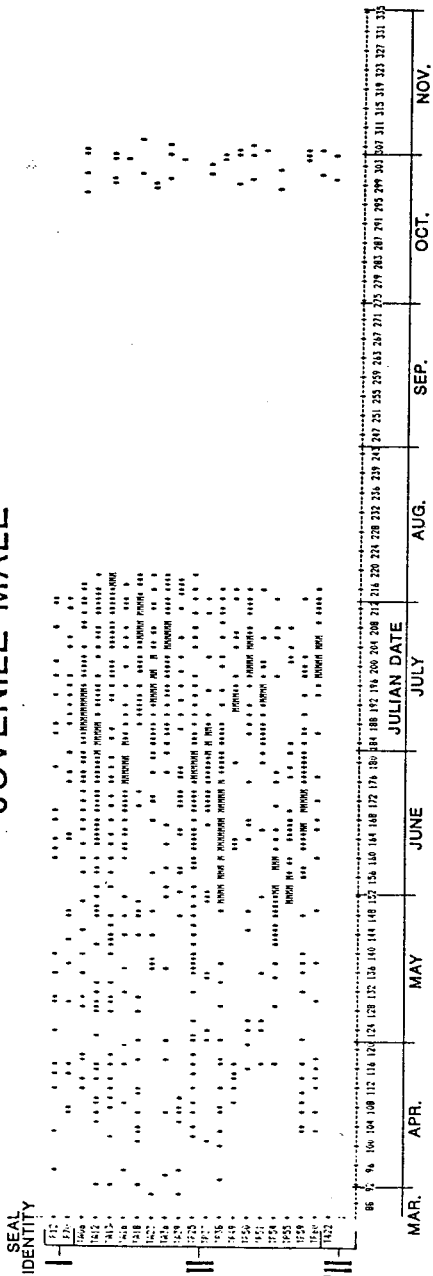
SUBADULT MALE



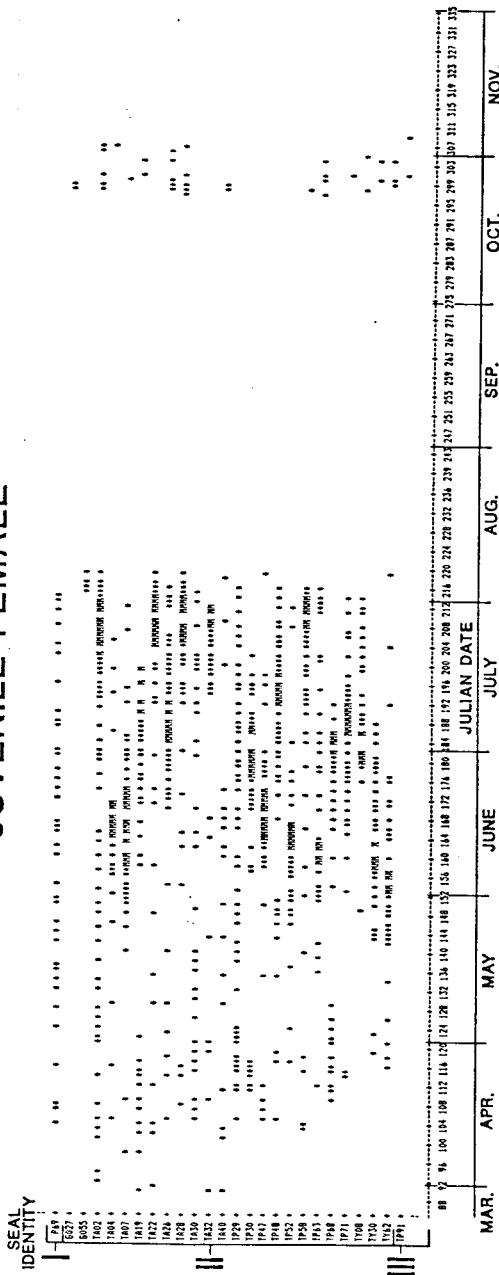
SUBADULT FEMALE



JUVENILE MALE



JUVENILE FEMALE



Appendix D.--Continued.

PUP MALE

SEAL IDENTITY	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.
	JULIAN DATE								
1104									
1108									
1110									
1114									
1122									
1124									
1126									
1128									
1130									
1132									
1134									
1136									
1138									
1140									
1142									
1144									
1146									
1148									
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1162									
1164									
1166									
1168									
1170									
1172									
1174									
1176									
1178									
1180									
1182									
1184									
1186									
1188									
1190									
1192									
1194									
1196									
1198									
1200									

PUP FEMALE

SEAL IDENTITY	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.
	JULIAN DATE								
1100									
1102									
1104									
1106									
1108									
1110									
1112									
1114									
1116									
1118									
1120									
1122									
1124									
1126									
1128									
1130									
1132									
1134									
1136									
1138									
1140									
1142									
1144									
1146									
1148									
1150									
1152									
1154									
1156									
1158									
1160									
1162									
1164									
1166									
1168									
1170									
1172									
1174									
1176									
1178									
1180									
1182									
1184									
1186									
1188									
1190									
1192									
1194									
1196									
1198									
1200									

Appendix D.--Continued.

Appendix E.--Summary of Laysan Island pup data, 1984 (F = female, M = male, Sec = sector, ID = identification, SL = standard length).

ID No.	Tan tag		Sex	Date tagged	Measurement (cm)		Birth		Weaning		Nursing period (days)	Mother ID
	Left	Right			Axillary girth	SL	Date	Sec	Date	Sec		
TT02	T02	T01	F	4/10	114.0	129.5	--	--	4/03	20	--	GA59
TT04	T04	T03	F	4/12	95.0	124.0	--	--	--	--	--	--
TT06	T05	T06	M	4/13	117.0	136.0	--	--	4/11	02	--	T66F
TT08	T08	T07	M	4/21	96.0	126.0	--	--	--	--	--	--
TT10	T09	T10	M	4/20	100.0	125.0	--	--	--	--	--	--
TT12	T12	T11	F	4/26	92.0	128.0	--	--	--	--	--	--
TT14 ¹	T14	T72	M	4/20	105.0	123.0	--	--	4/20	06	--	T391
TT16	T15	T16	M	4/21	108.0	131.0	--	--	4/21	13	--	T51F
TT18	T17	T18	F	4/21	105.5	128.5	--	--	4/21	12	--	TP85
TT20	T20	T19	F	4/26	111.0	132.0	--	--	4/25	03	--	T02F
TT22	T21	T22	M	5/30	122.0	133.0	--	--	4/29	02	--	T13F
TT24	T24	T23	F	6/16	77.5	109.0	--	--	5/05	20	--	T01F
TT26	T25	T26	F	5/10	111.0	131.0	3/30	10	5/08	11	39	T06F
TT28	T28	T27	F	5/23	99.0	126.0	3/30	02	5/11	02	42	T17F
TT30	T29	T30	F	5/11	125.0	143.0	--	--	5/11	02	--	T302
TT00 ²	--	--	F	--	--	--	4/11	07	--	--	--	T16F
TT32 ³	--	--	F	--	--	--	4/18	02	5/11	02	23	T15F
TT34	T34	T33	M	5/29	100.0	118.0	4/07	02	5/15	02	38	T45F
TT36	T35	T36	M	5/23	109.0	135.0	4/12	08	5/21	08	39	T12F
TT38	T38	T37	M	5/23	109.0	131.0	4/11	20	5/23	20	42	TY17
TT40	T40	T39	M	5/30	119.0	137.0	4/10	06	5/24	06	44	T27F
TT42	T42	T41	F	5/29	130.0	141.0	4/07	02	5/27	02	50	T09F
TT44	T43	T44	M	6/01	110.0	128.0	4/17	01	5/28	04	41	T03F
TT46	T46	T47	M	6/01	113.0	132.0	4/16	20	5/30	02	44	T11F
TT48	T45	T48	M	6/16	113.0	130.0	4/16	18	6/01	18	46	T22F
TT50	T49	T50	F	7/19	96.0	128.0	5/03	03	6/06	02	34	T04F
TT52	T52	T51	M	6/28	110.0	130.0	5/01	11	6/14	12	44	T14F
TT54	T53	T54	M	7/16	95.0	127.0	5/07	04	6/22	04	46	T29F
TT56	T56	T55	M	6/28	105.0	123.0	5/18	11	6/27	10	40	T36F
TT58	T58	T57	F	10/25	86.0	135.5	7/07-08	05	--	--	--	T24F
TT60	T60	T59	F	10/29	93.0	138.0	7/13	19	--	--	--	T39F

¹Lost original tag T13, retagged with tag T72 on 6 August 1984.

²Perinatal death of pup.

³Pup exchange resulted in the premature weaning and disappearance of pup TT32 and unusually long nursing duration of pup TT42.

Appendix F.--Monk seal necropsy reports, Laysan Island, 1984. (Pathologist was C. Hahn, State of Hawaii Department of Agriculture, Division of Animal Industry Veterinary Laboratory, Honolulu.)

Necropsy No.: 01LA84
Date of death: 11 April 1984
Date of necropsy: 11 April 1984
Sex: Female
Age: Pup, perinatal
Identification No.: TT00

- I. Circumstances of death: The dead pup was first observed at 1655, separated from it's mother by 10 m. The pup was on the midbeach approximately 10 m from the water's edge and the mother was asleep on the wet sand.
- II. External description: No external wounds. Umbilical cord still attached to the body. The umbilical cord and amniotic sac were tightly wrapped around the pup's upper torso, neck, and head. There was a small tear in the portion of the sac covering the mouth. Eyes cloudy and barely open. Fecal pellet partially extruded from the anus. No fly larvae or eggs. Carcass in fresh condition.

Measurements:

1. Standard length (dorsal side up)..... 91.5 cm
2. Blubber thickness..... 0.4 cm
3. Axillary girth..... 46.2 cm

- III. Internal: Body musculature in good condition. Stomach contains whitish fluid. Liver is decomposing and appears asymmetrical. Blood present in the pericardial cavity. Lungs do not float in salt water.
- IV. Samples collected: No ectoparasites or endoparasites found.

Heart	Pancreas	Adrenals
Lungs	Spleen	Skeletal: skull
Liver	Kidney	

V. Pathology report:

Microscopic:

kidney	- no significant lesions (NSL).	Others - NSL.
lung and liver	- congestion, acute, passive.	
pancreas	- hemorrhage, focal.	
lymphoid tissue	- lymphoid hypoplasia.	
heart	- pericardial hemorrhage, acute.	

Diagnosis: Hemorrhage, serosal, focal.
Comments: Cause of death undetermined.

Appendix F.--Continued.

Necropsy No.: 02LA84
Date of death: 5-6 July 1984
Date of necropsy: 6 July 1984
Sex: Female
Size class: Adult
Identification No.: T32F

- I. Circumstances of death: Female T32F was observed alive on the beach accompanied by an adult male for several days prior to 5 July. She had numerous small gaping wounds through the skin of her midback. On 5 July, the adult female was sighted 5 m from shore accompanied by an adult male, and it is very possible that she was already dead. On 6 July, the carcass was observed floating in the wave wash accompanied by an adult male (bleach No. P33).
- II. External description: Numerous small gaping wounds through the skin of the midback. The carcass was extremely bloated; the eyes bulged and loops of intestine protruded from the right side of the dorsal injury. Pelage slipped in the vicinity of the fore and hind flippers. Bloody fluids leached into the water surrounding the carcass.
- Measurements:
1. Curvilinear length (dorsal side up).....254.0 cm
 2. Blubber thickness (midventral).....3.8 cm
- III. Internal: Heavy fat layer throughout body. Stomach empty except for parasitic worms. Organs distinguishable anterior to the dorsal injury. However, posterior to the wound, particularly on the right side, the tissue and organs were severely decomposed into a homogeneous mass of a different color from the organs anterior to the wound. No sign of pregnancy was revealed.
- IV. Samples collected: Organ samples were not taken due to the advanced state of deterioration of the carcass.

Endoparasites

Skeletal: skull

Appendix F.--Continued.

Necropsy No.: 03LA84
Date of death: Estimated 1-2 months
before necropsy
Date of necropsy: 25 October 1984
Sex: Male
Size class: Adult
Identification No.: Unknown

- I. Circumstances of death: The dead seal was found lying on the sand on the midbeach, approximately 1 m from the vegetation line, and was half buried in the sand.
- II. External description: No external marks or wounds visible. The carcass was mummified.
- Measurements: Measurements were not taken because carcass was not intact.
- III. Internal: Internal examination did not yield any information due to the mummified condition of the carcass.
- IV. Samples collected: Organ and parasitic samples were not taken due to the mummified condition of the carcass.

Skeletal: skull, baculum

Appendix G.--Monk seal injuries at Laysan Island, 1984 (A = adult, S = subadult, J = juvenile, W = weaned pup, PW = prematurely weaned pup, F = female, M = male, U = sex unknown, P = probable cause, K = known cause, ID = identification).

Field No.	Date 1984	Size class	Sex	ID	Description of initial injury	P or K	Cause
1	3/30	A	F	T15F	4 ventral lacerations through skin, largest 5 cm	P	Reef-debris
4	3/31	A	M	Bleach No. P00	2 lateral abrasions, both 2 cm long	P	Reef-debris
2	4/07	A	F	T17F	2 ventral lacerations through skin, both 10 cm	P	Reef-debris
3 ¹	4/04	S	F	--	Numerous dorsal gaping wounds through blubber, largest 10 x 15 cm	K	Adult male
5	4/14	A	U	--	Lateral gaping wound through fat, 2 x 15 cm	P	Shark
6	4/16	W	F	TT04	Several head lacerations through skin, largest 6 cm	P	Seal
7	4/25	W	F	TT08	Dorsal puncture	P	Adult male
8	4/30	A	F	T14F	2 dorsal punctures into the blubber, 1 ventral laceration	P	Shark
9 ²	5/02	A	F	T26F	5 dorsal gaping wounds through fat 10 x 15 cm	P	Adult male
10 ³	5/04	S	M	--	Numerous dorsal gaping wounds into muscle, largest 5 x 10 cm	K	Adult male
11	5/10	A	F	T34F?	Lateral laceration through skin, 10 cm	P	Reef-debris
--	5/16	PW	F	DTT32	Dorsal abrasions and welts	K	Adult male
12	5/18	A	F	T01F	3 dorsal gaping wounds through fat (old scars reopened) 2 x 6, 2 x 5, 2 x 3 cm	P	Adult male
13 ⁴	5/28	J	F	TP48	Dorsal gaping wound through skin, 2 cm diameter	P	Adult male

Appendix G.--Continued.

Field No.	Date 1984	Size class	Sex	ID	Description of initial injury	P or K	Cause
14	5/29	W	F	TT28	Dorsal gaping wound through skin, 2 cm diameter	P	Adult male
15	6/01	A	F	T06F	Dorsal gaping wound into blubber, 2 areas into muscle, 20 x 45 cm	P	Adult male
16	6/13	A	F	T34F	Numerous dorsal gaping wounds into fat largest 5 x 10 cm	P	Adult male
17	6/16	J	F	TP48	Lateral laceration through skin, 15 cm, 2 abscesses	P	Reef-debris
18	7/07	W	M	TT56	Numerous dorsal gaping wounds through skin, largest 3 x 10 cm	P	Adult male
20	10/23	A	F	T04F	Ventral puncture	P	Shark
21	10/25	J	M	TA13	Dorsal abscess 8 cm diameter	P	Adult male
22	10/26	W	M	TT36	Dorsal gaping wound through skin, 8 x 10 cm	P	Adult male

¹Last sighting of seal on 4 April, probable mortality.

²Mobbed on 13 May, received additional dorsal gaping wounds through skin.

³Last sighting of seal on 5 May, probable mortality.

⁴Abscess formed by 16 June.

Appendix H.--Adult male mobbings and single aggressive male incidents observed on Laysan Island, 1984. Some prolonged adult male harassments of immature seals and nursing female-pup pairs are also included but should be viewed as a minimum number reflecting the more intense incidents observed. (Size: A = adult, S = Subadult, J = Juvenile, W = weaned pup, P = nursing pup; Sex: M = male, F = female; Type: M = mobbing, S = single aggressive adult male incident, H = harassment; Beach position: 0 = in the water, 1 = on wet sand, 2 = on the midbeach, ID = identification.)

Field No.	Date 1984	Sector	Time		Initial beach position	Subject			Number of adult males	Type of inter-males action
			Begin	End		Size	Sex	ID		
1	4/04	19	0946	>1444	0	S	F	TP86?	1	S
2	4/23	01	0755	0808	0	J	M	TP38	1	H
3	4/23	20	1230	--	0	W	M	TT10	1	H
4	4/28	05	1143	1330	0	S	F	T44F	1	H
5a	5/04	20	1621	1900	1	S	M	T12M	1	S
5b	5/05	01	0913	1755	0	S	M	T12M	6+	M
6	5/08	02	0920	0935	0	J	F	TA22	2	H
7	5/08	08	1305	1339	0	A P	F M	T12F TT36	1	H
8	5/13	01	0920	1116	1	A	F	T26F	5+	M
9	5/16	02	0918	0930	0	W	F	TT32	1	S
10	5/18	17	1000	--	2	J	M	TA23	1	H
11	5/22	20	--	--	--	A P	F M	TY17 TT38	2	H
12	5/23	06	1044	1127	1	A P	F M	T27F TT40	1	H
13	5/24	17	1015	1053	0	J	M	TP50	1	H
14	5/25	08?	1737	1757	0	S	F	--	1	H
15	6/03	--	--	--	--	W	U	--	1	H
16	6/05	02	0848	0852	0	W W W W	F F M M	TT32 TT42 TT14 TT34	1	H

Appendix I.--Interatoll movements of monk seals to and from Laysan Island, observed during 1984 (A = adult, S = subadult, J = juvenile, M = male, F = female, FFS = French Frigate Shoals).

Seal ID	Size and sex	Emigration from		Immigration to		Notes
		Location	Date last seen	Location	Date first seen	
Y156 ¹	AF	Laysan FFS	06/27/83 04/28/84	FFS Laysan	05/16/84 06/13/84	Pupped on FFS, molted and re-marked on Laysan
GA59	AF	Lisianski	07/24/83	Laysan	03/30/84	Pupped on Laysan, not seen on Laysan post-weaning (see text)
GS45	SM	Lisianski	08/07/83	Laysan	04/01/84	Molted and re-marked on Laysan
GJ31	SF	Lisianski	07/26/83	Laysan	04/12/84	Molted and re-marked on Laysan
GA10 ²	AF	Lisianski	08/06/83	Laysan	04/13/84	Molted and re-marked on Laysan
T57F ³	AF	Lisianski	07/28/83	Laysan	04/16/84	Molted and re-marked on Laysan
GS33 ⁴	SM	FFS	10/31/83	Laysan	04/18/84	Molted and re-marked on Laysan
T08F ⁵	AF	Lisianski Laysan	07/24/83 06/15/84	Laysan Lisianski	04/20/84 08/01/84	Molted and re-marked on Laysan
G130	AF	Lisianski	07/30/83	Laysan	04/28/84	Molted and re-marked on Laysan
TA34	JM	Laysan	07/21/83	Lisianski	07/03/84	*Laysan 1983 pup tags: A34(LT), A33(RT)
TY63	SM	Laysan	06/14/84	FFS	08/21/84	No postmolt mark
G055	JF	Lisianski	07/23/84	Laysan	08/02/84	*Lisianski 1983 pup tags: A55(LG), A56(RG)
G027	JF	Lisianski	07/31/84	Laysan	10/25/84	*Lisianski 1982 pup tags: 027(LG), 028(RG)

¹Adult female Y156 was identified and pupped at FFS in 1982 (Fairaizl, G. W., 1984. Intra-atoll resightings of the Hawaiian monk seal Monachus schauinslandi at French Frigate Shoals, 1 January 1983-31 August 1983. Southwest Fish. Cent. Honolulu Lab., Natl., Mar. Fish. Serv., NOAA, Honolulu, HI 96812, Admin. Rep. H-84-5C, 27 p.) and was identified and bleached on Laysan Island in 1983 (text footnote 2).

²Adult female GA10 was not present on Lisianski Island in 1982 when the entire population was identified (Stone 1984). She emigrated from an unknown location and was first observed and bleached on Lisianski in 1983 (Johanos and Kam 1986).

³Adult female T57F was bleached on Laysan Island in 1983 (text footnote 2) and moved to Lisianski Island later that year (Johanos and Kam 1986).

⁴Subadult male GS33 was bleached on Lisianski in 1982 (Stone 1984) and observed and rebleached postmolt on Laysan Island in 1983 (text footnote 2) before immigrating to FFS in the fall of 1983.

⁵Adult female T08F was identified on Laysan Island in 1982 (text footnote 5) before being identified and bleached on Lisianski Island Later in 1982 (Stone 1984).

*Letters in parentheses indicate tag position and color, and are not part of the tag number (L = left, R = right, G = green, T = tan).

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