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THE HAWAIIAN MONK SEAL IN THE NORTHWESTERN HAWAIIAN ISLANDS, 1994

Compiled and Edited by

Thea C. Johanos
Timothy J. Ragen

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

NOAA Technical Memorandum NMFS

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EXECUTIVE SUMMARY

During 1994, field studies of the endangered Hawaiian monk seal (*Monachus schauinslandi*) were conducted at most of its main reproductive sites in the Northwestern Hawaiian Islands, although Lisianski Island was only visited for a single day, and Pearl and Hermes Reef was not visited. Nihoa and Necker Islands (where limited pupping occurs) were also not visited in 1994. These studies provide information necessary to evaluate (1) the status and trends of monk seal populations, (2) natural history traits such as survival, reproduction, growth, behavior, and feeding habits, and (3) the success of various activities designed to facilitate population growth. The availability of up-to-date information is essential for ongoing efforts to mitigate the decline of this species and enhance its recovery.

Studies conducted during 1994 indicated that significant problems continued to impede the species' recovery. The total number of births at all main reproductive sites except Pearl and Hermes Reef was 181 pups, well above the marked low of 142 pups born at all main reproductive sites during 1990. However, mortality of immature seals remained extremely high at French Frigate Shoals, the largest population, and the total of mean beach counts remained well below counts in the mid 1980s. Mobbing continued to be a significant problem; at Laysan Island, three animals either died or disappeared after receiving mounting injuries.

In 1994, three management activities were conducted to enhance recovery of the species. First, weaned female pups were collected from French Frigate Shoals and transported to Oahu for rehabilitation to salvage the reproductive potential lost because of the high mortality of immature seals. Second, rehabilitated yearling females, collected from French Frigate Shoals in 1993, were released at Kure Atoll to enhance the recovery of its long-depleted population. Third, adult males were translocated from Laysan Island to the main Hawaiian Islands to correct the skewed sex ratio at Laysan, and thereby reduce the incidence of mobbing. This document describes these and other field studies conducted during 1994.

CONTENTS

Page

CHAPTER 1. GENERAL INTRODUCTION 1
MATERIALS AND METHODS 3
Censuses and Patrols 3
Reproduction 4
Factors Affecting Survival 5
Individual Identification 6
Measurements of Seals 7
Collection of Samples 7

CHAPTER 2. THE HAWAIIAN MONK SEAL ON FRENCH FRIGATE SHOALS, 1994 9
RESEARCH 11
Censuses and Patrols 11
Individual Identification 11
Collection of Samples 11
Special Studies 12
Seals Collected for Rehabilitation 12
RESULTS 12
Population Abundance and Composition 12
Reproduction 12
Interatoll Movement 13
Factors Affecting Survival 13
ACKNOWLEDGMENTS 13
TABLES 15

CHAPTER 3. THE HAWAIIAN MONK SEAL ON LAYSAN ISLAND, 1994 23
RESEARCH 25
Censuses and Patrols 25
Individual Identification 25
Collection of Samples 25
Special Studies 26
Collection of Adult Males for Translocation . 26
Survival of Oiled Seals 26
RESULTS 26
Population Abundance and Composition 26
Reproduction 26
Interatoll Movement 27
Factors Affecting Survival 27
ACKNOWLEDGMENTS 27
TABLES 29

CHAPTER 4. THE HAWAIIAN MONK SEAL ON LISIANSKI ISLAND, 1994 37
RESEARCH 39
Censuses and Patrols 39
Individual Identification 39
Collection of Samples 39
RESULTS 39
Population Abundance and Composition 39

(**CONTENTS**, continued)

Page

Reproduction 39
Interatoll Movement 40
Factors Affecting Survival 40
ACKNOWLEDGMENTS 40
TABLES 41

CHAPTER 5. THE HAWAIIAN MONK SEAL AT MIDWAY ISLANDS, 1994 49
RESEARCH 51
Censuses and Patrols 51
Individual Identification 51
Collection of Samples 52
Special Studies 52
Sighting Probability Calculations 52
RESULTS 52
Population Abundance and Composition 52
Reproduction 52
Interatoll Movement 52
Factors Affecting Survival 52
ACKNOWLEDGMENTS 52
TABLES 53
CHAPTER 6. THE HAWAIIAN MONK SEAL AT KURE ATOLL, 1994 61
RESEARCH 63
Censuses and Patrols 63
Individual Identification 63
Collection of Samples 63
Special Studies 64
Monitoring Impacts of Past Management Efforts 64
Introduction of Rehabilitated Seals 64
RESULTS 64
Population Abundance and Composition 64
Reproduction 64
Interatoll Movement 65
Factors Affecting Survival 65
ACKNOWLEDGMENTS 65
TABLES 67

REFERENCES 75

APPENDIXES 79
Appendix A.--Reports summarizing annual field research on the Hawaiian monk seal by the National Marine Fisheries Service and collaborating scientists . . 81
Appendix B.--Hawaiian monk seal census form and 1994 census form directions. 87

CHAPTER 1. GENERAL INTRODUCTION

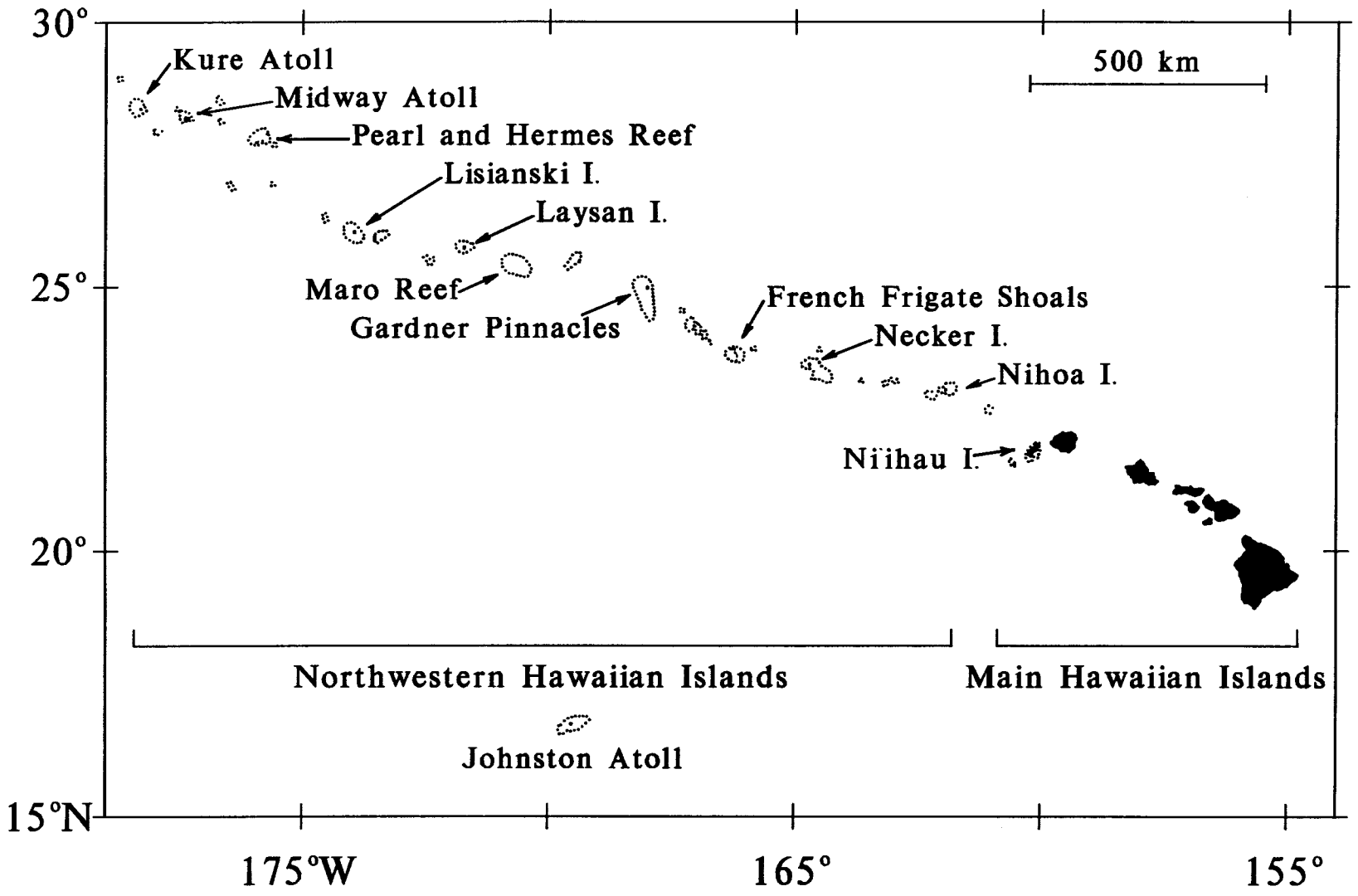

Fig. 1.1. The Hawaiian Archipelago.

The endangered Hawaiian monk seal (*Monachus schauinslandi*) hauls out and breeds in the Northwestern Hawaiian Islands, (NWHI, Fig. 1.1). The Southwest Fisheries Science Center, Honolulu Laboratory, National Marine Fisheries Service (NMFS), began research on Hawaiian monk seals at most major reproductive sites in the NWHI in 1981 (Kure Atoll, Laysan Island, and Lisianski Island) and 1982 (French Frigate Shoals (FFS) and Pearl and Hermes Reef). Nearly every year thereafter, field camps of several days to 9 months were established to monitor and enhance the recovery of this species. Limited population monitoring has also been conducted at Midway Islands, where current pup production is well below historical levels, and at Nihoa and Necker Islands, where pup production is limited by lack of suitable haulout area. Reports summarizing past NMFS research are listed in Appendix A.

In 1994, the objectives of Hawaiian monk seal research were to (1) conduct beach counts (censuses), (2) tag weaned pups and immature seals for permanent identification, (3) identify other seals by previously applied tags and by natural or applied markings, (4) monitor reproduction, survival, injuries, entanglements, interatoll movements, disappearances, and deaths, (5) perform necropsies, (6) collect scat and spew samples for food habit analysis, (7) collect tissue samples for DNA analysis of paternity patterns and genetic variation within and among populations, and (8) inventory, sample, and destroy debris capable of entangling seals. Location-specific objectives and summaries of data collected during the 1994 field season are described in the following chapters. Much of the information presented in this memorandum is incorporated into larger data sets for additional analysis and publication elsewhere.

MATERIALS AND METHODS

Censuses and Patrols

The primary means of data collection were censuses and patrols. Censuses consisted of timed, standardized beach counts during which an entire island or atoll was surveyed for seals. Although data were collected on all seals, animals that were in the water, captive, or dead were excluded from the beach count totals. Identified individuals were counted only once if they were resighted during the survey. The resulting counts did not reflect total population size but provided an index of population size for comparison among years and locations. Data collected on each seal observed during censuses included size class (ranging from pup to juvenile, subadult, and adult size as described in Stone, 1984), sex, location on the island, beach position (indicating whether the seal was in the water or on land), body condition (a subjective estimate; e.g., fat or thin), identification information (permanent or temporary identification numbers and tag numbers), molting status (an estimate of the percentage an animal had molted), disturbance index (the extent

that the observer disturbed the seal), and time of day. Further data were collected if any of the following events occurred: (1) factors affecting survival (e.g., entanglements or mobbings), (2) animal handling, (3) photography, and (4) documentation of tag condition (e.g., good or broken). In addition, behavior data (focusing on associations and interactions between seals) were collected on Laysan Island and Kure Atoll, and vestibule status was recorded for adult and large subadult females on Laysan Island and Kure Atoll to determine its utility as an indicator of their reproductive status. A sample census form and guidelines for its completion are included in Appendix B. In 1994, censuses were conducted every 4 to 7 days (at all locations except Lisianski Island and Midway Islands), starting at 1300 Hawaii standard time when possible, using census methods and criteria outlined in Johanos et al. (1987). Atoll-wide counts for locations with more than a single island (French Frigate Shoals, Pearl and Hermes Reef, Midway Islands, and Kure Atoll) were completed within a 2-day period. The perimeter of each study area was divided into sectors to facilitate the analysis of data and detection of demographic trends in different geographic areas. Census methods specific to each location are detailed in the following chapters.

Patrols consisted of untimed surveys of all or a portion of an island perimeter. Information collected during patrols was similar to that collected during censuses. Because patrols were not timed, observers concentrated on documenting adult and subadult behavior, identifying and marking individuals, and collecting scat samples. Island-specific standardized patrols were conducted at some locations and are described in the following chapters.

During all observation periods (i.e., censuses, patrols, and incidental sightings), observers attempted to minimize seal disturbance by walking above the beach crest and using vegetation as a visual barrier. On census days, activities which could disturb the animals and bias the count were not conducted until after the count was completed. Additionally, special efforts were directed toward documentation of (1) births, pup exchanges, and weanings, (2) mating activities, adult male aggression, and post-mobbing aggregations, (3) entanglements in marine debris, (4) injuries, and (5) deaths.

Reproduction

Parturient females were identified, and birth and weaning information were recorded. Because parturient females will nurse pups other than their own (Boness, 1990), efforts were made to identify the pup and document changes in the nursing relationship from birth to weaning. A pup exchange occurred when the pups of two lactating females were switched. Most frequently, such exchanges occurred during an aggressive interaction between the two females. On other occasions, a mother and pup became separated, and one or both seals would then actively search for, and obtain, another nursing relationship.

The average nursing period was calculated for the pups at each location. In addition, the average lactation period of parturient females was calculated for the population at FFS because of difficulties in tracking pups (and obtaining nursing periods) at that site due to the higher population density and the resulting high number of pup exchanges (Boness 1990). Nursing or lactation periods were defined as the number of days from birth until the end of the last nursing relationship. Temporary breaks in nursing relationships were not subtracted from the total. When the exact birth or weaning date was not known, but occurred within a range of 4 days or less, then the midpoint of that range was used in the calculation of the average nursing or lactation period. Nursing or lactation data were not used if the range exceeded 4 days, or if the pup died or disappeared before weaning.

Factors Affecting Survival

Mobbing and other mating-related male aggressions were observed and recorded. By definition, mobbing occurred when multiple males attempted to mate with a single seal, usually an adult female or immature seal of either sex, causing injury or death of that seal (e.g., Alcorn 1984). Mating-related aggression was defined as any incident where an adult or subadult male repeatedly bit the dorsum, attempted to mount, and tried to prevent the escape of another seal. These incidents were summarized if they simultaneously involved more than one male aggressor or resulted in at least one puncture or gaping wound (missing skin or extending into the fat layer) or 15 scratches to the dorsum or flanks. Post-mobbing aggregations were also summarized: these were groups of males congregated on the beach, attending a seal with new mounting injuries as described above.

A wide range of injuries was observed. The origins of these injuries were distinguished based upon characteristic wound patterns described in Hiruki et al. (1993). Injuries were documented if they were related to mounting or entanglement or if they were considered severe enough to possibly affect survival. Injuries were considered severe, and were summarized, if they consisted of (1) three or more abscesses, each <5 cm in diameter, or one abscess with a diameter ≥5 cm; (2) an amputation of more than one digit (either foreflipper or hindflipper); (3) at least three punctures or gaping wounds, if largest dimension was <5 cm, or one gaping wound with a maximum diameter-largest dimension ≥5 cm; or (4) densely spaced (overlapping) scratches, abrasions, or lacerations covering an area equivalent to half the dorsum, or evidence of extensive underlying tissue damage (e.g., an uneven or darkened surface of the injured area, leaching fluids, or impaired seal movement). We did not include injuries that were already healed when they were first observed.

A seal was listed as dead if its death or carcass was observed. Deaths summarized here include carcasses found at the beginning of the field season if the seal had clearly died during the calendar year. A seal was listed as probably dead if it

sustained severe injuries or was emaciated (with skeletal structure clearly evident) and subsequently disappeared. In addition, one of the following conditions must have been satisfied to place a seal in the "probably dead" category: (1) the seal was lethargic, had difficulty moving, or floated listlessly in the water, and disappeared more than a week before the end of data collection, or (2) the seal was in deteriorating condition (loss of weight, enlargement of abscesses, sloughing of skin) and disappeared at least 10 surveys or 1 month before the end of data collection (whichever was longer). Nursing pups were listed as probably dead if they disappeared within 3 weeks of birth.

Individual Identification

During censuses and patrols, individual seals were identified by tags, applied bleach marks, scars, or natural markings. As soon after weaning as possible, all pups were tagged on each hind flipper with a colored plastic Temple Tag,®[1] uniquely coded to indicate island or atoll population, year of birth, and individual ID (Gilmartin et al., 1986). In addition, two passive integrated transponder (PIT) tags were implanted subcutaneously in the dorsum of each weaned pup (see Lombard et al., 1994, for detailed tagging procedures).

Most immature seals were tagged as weaned pups, and therefore were of known age. Temple Tags have been applied to nearly all weaned pups, beginning in 1981 at Kure Atoll, 1982 at Lisianski Island, 1983 at Laysan Island and Pearl and Hermes Reef, and 1984 at French Frigate Shoals. Temple Tags were applied to weaned pups opportunistically at Midway Islands, Necker and Nihoa Islands, and the main Hawaiian Islands beginning in 1983. In addition, PIT tags have been implanted into most weaned pups since 1991. In 1994, untagged immature seals were tagged with Temple Tags which were uniquely coded to indicate that their ages and birth locations were unknown, and sometimes also received PIT tags. Immature seals, and adult males on Laysan Island, with lost or broken tags, were retagged with Temple Tags or PIT tags, or both, to maintain their identities.

At three locations (Laysan Island, Midway Islands, and Kure Atoll), adult, subadult, and untagged immature seals were bleach-marked for individual identification (Stone, 1984), using the solution described in Johanos et al. (1987). Molting adult females and untagged weaned pups on Laysan Island were re-marked to maintain their identities. At Laysan Island, nursing pups were also bleached prior to molt.

Tags, scars, natural markings, and any applied bleach marks were sketched on an individual scar card, which was revised throughout the field season to maintain a current description of the identifying marks of each seal. Photographs of scars and

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

natural markings were added to individual identification files begun during 1981 or 1982.

Population size and composition were determined at locations where all seals were identified; partial composition was determined where all seals within certain size and sex classes were identified. These statistics included all individuals seen alive and in the wild at each location from March through August and all pups born during the calendar year. If a seal was seen at more than one location during March-August, it was included in the population where it was first seen unless it pupped at another location. A parturient female was always included in the population where it pupped, if it was seen there anytime during March-August.

Measurements of Seals

Straight dorsal length (Winchell, 1990) and axillary girth (American Society of Mammalogists, 1967) were measured on weaned pups at the time of tagging to determine monk seal growth patterns and to assess the effects of size on survival. At French Frigate Shoals, weights of juvenile seals were measured by suspending the seal in a net from a spring scale.

Collection of Samples

Samples were collected for DNA analysis, pathology analysis, investigation of food habits, and documentation of marine debris. Tissue samples for DNA analysis were collected during tagging efforts for all newly tagged or retagged seals, and during necropsies on recently dead seals. The primary objectives of these genetic analyses are to investigate paternity patterns and determine genetic variability within and among populations.

For each dead seal recovered, an external examination was made, photographs were taken, external measurements and observations were recorded. The skull was collected for all seals except nursing pups. For a recent death, an internal examination was made, and samples of tissue, organs, parasites, and stomach contents were collected. Detailed descriptions of necropsy procedures and sample collection methods are in Winchell (1990).

Scat and spew samples from seals were collected, following the methods in Alcorn (1984) for analysis of food habits. Emphasis was placed on collecting scat and spew samples from seals of known size and sex class, but samples from seals of unknown size and sex class were also collected.

Nets, lines, ropes, and other debris items capable of entangling seals and turtles were inventoried and destroyed, following the methods in Johanos and Kam (1986).

CHAPTER 2. THE HAWAIIAN MONK SEAL ON FRENCH FRIGATE SHOALS, 1994

Mitchell P. Craig, Suzanne S. Romain, Steve S. Kirkland, and Tanya H. Goodwin

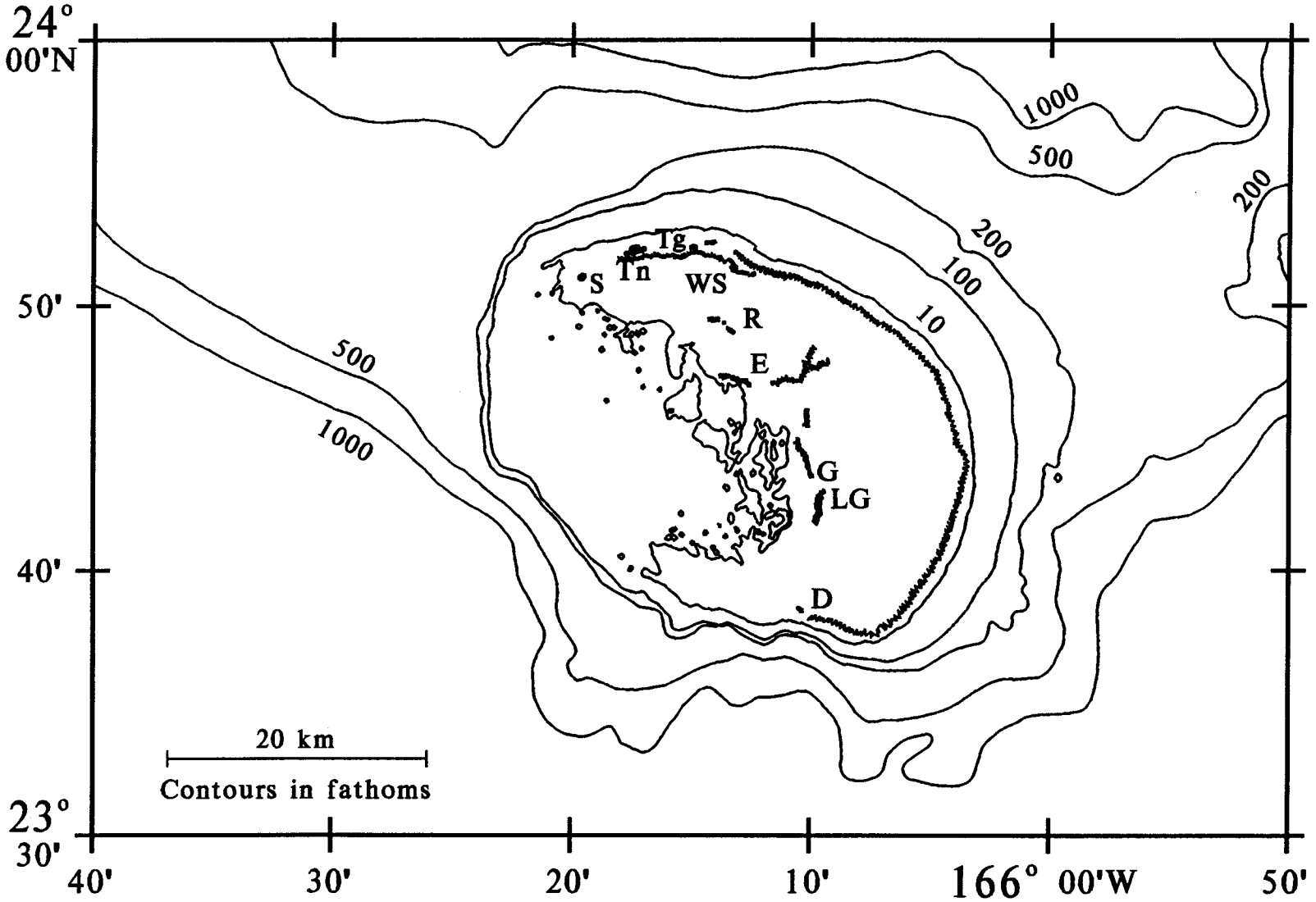

Fig. 2.1. French Frigate Shoals in the Northwestern Hawaiian Islands. Islands are: Disappearing (D), East (E), Gin (G), Little Gin (LG), Round (R), Shark (S), Tern (Tn), Trig (Tr), and Whaleskate (WS).

The largest island population of Hawaiian monk seals is located at French Frigate Shoals (FFS, lat. 23°45'N, long. 166°10'W), ca. 830 km northwest of Oahu in the Northwestern Hawaiian Islands. This atoll is part of the Hawaiian Islands National Wildlife Refuge (Fig. 1.1), and consists of 10 permanent islands and 7 semi-permanent sand spits (Fig. 2.1).

RESEARCH

Research was conducted by the National Marine Fisheries Service (NMFS) during February 6-17 and March 29-September 17. In addition, incidental observations were recorded by U.S. Fish and Wildlife Service personnel during the rest of the year. The perimeters of six of the larger islands were divided into sectors using artificial or natural landmarks. In 1994, research objectives specific to this population included capture of undersized weaned pups for rehabilitation and translocation.

Censuses and Patrols

Atoll censuses (n = 10) were conducted every 7 d, on average, from May 16 to July 26. Each atoll census began between 0900 and 1100 Hawaii standard time and ended between 1500 and 1800. Round Island and Mullet Island were censused from a boat, while the remaining islands were censused on foot by one or two persons. From February 12 to September 10, 1994, NMFS personnel conducted 15 censuses of seals on Tern Island.

Patrols were conducted on non-census days. East, Mullet, Round, and Whaleskate Islets were visited every 6 d during May through August to monitor pupping activity. Patrols of Tern Island were conducted every 3 d during April through August.

Individual Identification

A total of 460 individuals (349 excluding pups) were identified by existing or applied tags, scars, or natural markings. Most weaned pups were tagged (n = 95; 92 in 1994 and 3 in early 1995) with Temple Tags; 81 of these same pups were tagged with passive integrated transponder (PIT) tags. Two immature female seals were retagged with Temple Tags.

Collection of Samples

One hundred and twenty six scat and spew samples were collected. Eighty tissue samples were collected from weaned pups and other seals during tagging. Necropsies were performed on four dead seals, and tissue samples and skulls were collected from all necropsied seals. In total, 76 pieces of potentially entangling debris were inventoried and destroyed.

Special Studies

Seals Collected for Rehabilitation

Since 1984, NMFS has collected female pups whose size at weaning indicated their chance of survival to age 1 was low relative to survival of larger seals (Gilmartin and Gerrodette, 1986). From 1984 to 1991, female pups with an axillary girth <90 cm at weaning were captured and transported by airplane or ship to rehabilitation facilities on Oahu. After 8-12 mo of rehabilitation, they were reintroduced at Kure Atoll or Midway Islands. In 1992, the collection criteria (axillary girth at weaning) was raised to ≤95 cm because recent survival data (NMFS unpublished data) revealed that pups with girths of 90-95 cm also had substantially lower survival rates than larger seals.

Eight female pups were collected for rehabilitation in 1994, and were held on Tern Island for up to 9 days before transport to Oahu. During the holding period, they were treated for dehydration and were tube-fed fluids, including a milk replacer formula, and force-fed herring. One weaned pup died on Oahu and the other seven pups remained in rehabilitation for the rest of 1994.

RESULTS

Population Abundance and Composition

The means (±SD) for 10 atoll censuses were 208 seals (± 21.2) including pups, and 158 seals (± 15.0) excluding pups (Table 2.1). The total spring-summer population included 225 immature individuals (subadults, juveniles, and pups), of which 114 were subadults or juveniles (Table 2.2). The numbers of tagged known-age seals born at FFS during the period from 1984 to 1993 and resighted there in 1994 are summarized in Table 2.3.

Reproduction

At least 110 pups were born: 103 weaned, 6 died or disappeared prior to weaning, and the fate of 1 pup was unknown (Table 2.4a). Nursing periods and measurements of weaned pups are summarized in Table 2.4b.

A total of 176 adult-sized females were identified and at least 90 (51%) of those were parturient. An unknown number of adult-sized females remained unidentified at FFS. The birth rate was 63% (66/105) for untagged adult females (>10 years old) and 34% (24/71) for tagged females of adult size (≤10 years old). Parturient females were more likely to be identified during lactation, which probably biased the estimates of birth rate upward. The mean (±SD) lactation period for 22 females was 39.4 d (±5.1).

Interatoll Movement

Interatoll movement was documented for four seals that made a total of nine movements between FFS and Laysan Island (Tables 2.5a and b).

Factors Affecting Survival

Attacks by large sharks, emaciation, and other unknown factors resulted in 32 life-threatening conditions, which led to the confirmed deaths of seven seals and the probable death of six other seals (Table 2.6). No incidents of adult male aggression were observed, and no seals were known to have died following unobserved male mounting incidents. Two of the confirmed deaths were seals that were emaciated. One seal was entangled and subsequently released by observers. One seal was found with a large fishing hook embedded in its jaw. The hook was not removed because the seal appeared to be pregnant and subsequently pupped. A second adult seal was reported by a fisherman to have been hooked. The fisherman cut the leader to free the seal. In addition to the deaths listed in Table 2.6, an aborted fetus was found on Tern Island in January.

ACKNOWLEDGMENTS

We acknowledge the support of the U.S. Fish and Wildlife Service, Hawaiian Islands National Wildlife Refuge staff. We thank the captains, officers, and crew of the NOAA ship *Townsend Cromwell* for logistical assistance.

TABLES

Table 2.1.--Summary statistics for atoll censuses (n = 10) of Hawaiian monk seals at French Frigate Shoals from May 16 to July 26, 1994.

Size/Sex	Mean number of individuals	Standard deviation
Adults	118.1	10.0
Male	29.1	7.1
Female	70.2	5.8
Unknown	18.8	7.6
Subadults	23.4	6.2
Male	9.8	3.5
Female	9.2	2.9
Unknown	4.4	2.3
Juveniles	16.9	3.4
Male	5.4	1.5
Female	9.1	2.8
Unknown	2.4	1.8
Pups	50.0	10.6
Male	10.9	6.9
Female	6.9	3.8
Unknown	32.2	6.0
Non-pup Total	158.4	15.0
Grand Total	208.4	21.2

Table 2.2.--Composition of the Hawaiian monk seal population at French Frigate Shoals during the spring and summer of 1994. Includes all pups born during the calendar year. Dashed lines indicate that the number of seals in a size-sex class was undetermined.

	Number of seals				
Size	Male	Female	Unknown	Total	Sex ratio male:female
Adults	--	--	--	--	--
Subadults	39	30	-	69	1.3:1
Juveniles	15	30	-	45	0.5:1
Pups	49[a]	54[b]	7	110	0.9:1
Non-pup Total	--	--	--	--	--
Grand Total	--	--	--	--	--

[a]One neonatal death.
[b]Two neonatal deaths. Number includes 8 weaned pups collected for rehabilitation in 1994.

Table 2.3.--Summary of tagged known-age seals born at French Frigate Shoals and resighted there in 1994.

Age (years)	Sex	Number originally tagged	Number resighted in 1994
10	Male	49	14
	Female	43	24
9	Male	48	10
	Female	38	16
8	Male	52	13
	Female	48	20
7	Male	55	17
	Female	51	17
6	Male	52	9
	Female	62	9
5	Male	51	10
	Female	50	8
4	Male	41	2
	Female	38	2
3	Male	24	2
	Female	44	6
2	Male	36	2
	Female	55	15
1	Male	40	12
	Female	39	10

Table 2.4a.--Summary of Hawaiian monk seals born at French Frigate Shoals in 1994.

Event	Number of pups			
	Male	Female	Unknown	Total
Born	49	54	7	110
Died/probably died prior to weaning	1	2	3	6
Fate unknown	0	0	1	1
Weaned	48	52	3	103
Tagged	47	48[a]	0	95

[a]Number includes three pups that were tagged as yearlings in early 1995; two tagged at French Frigate Shoals, and a third seal, collected for rehabilitation, tagged in captivity prior to release at Kure Atoll.

Table 2.4b.--Summary of nursing periods and measurements of weaned pups at French Frigate Shoals in 1994. Nursing periods were calculated where both birth and weaning date ranges were ≤4 d. All measurements were taken within 2 weeks after weaning. Measurements include 28 pups with an axillary girth of ≤95 cm.

	Nursing period (d)	Axillary girth (cm)	Straight dorsal length (cm)	Weight (kg)
Mean	36.0	100.1	124.8	43.7
St. Dev.	1.4	9.8	7.0	8.8
n	2	80	80	7[a]

[a]These 7 pups were collected for rehabilitation.

Table 2.5a.--Known movement of Hawaiian monk seals to French Frigate Shoals from other locations in 1994, summarized by movements between two locations. Some seals made more than one trip.

Original location	Number, size, and sex class
Laysan Island	3 Adult females

Table 2.5b.--Known movement of Hawaiian monk seals from French Frigate Shoals to other locations in 1994, summarized by movements between two locations. Some seals made more than one trip.

Destination	Number, size, and sex class
Laysan Island	6 Adult females

Table 2.6.--Factors affecting Hawaiian monk seal survival at French Frigate Shoals in 1994. Does not include captive seals.

Size	Sex	Total	Outcome		
			Injured	Died	Probably died
Attack by Large Shark					
Adult	Male	3	3	0	0
	Female	4	4	0	0
Subadult	Male	1	1	0	0
Weaned pup	Male	2	2	2	0
	Female	3	3	0	1
	Unknown	1	1	0	1
Nursing pup	Male	1	1	0	0
Mounting by Males					
Adult	Female	2	2	0	0
Weaned pup	Male	3	3	0	0
Entanglement					
Adult	Female	1[a]	1	0	0
	Unknown	1[b]	1	0	0
Subadult	Male	1[c]	1	0	0
Emaciation					
Adult	Male	1	0	1	0
Weaned pup	Female	2	0	1	1
Other/Unknown					
Nursing pup	Male	1	1	1	0
	Female	2	1	2	0
	Unknown	3	0	0	3

[a]An adult female was found on 4 June with a fishing hook in its jaw. The hook was not removed.
[b]An adult seal was reported by a fisherman to have been hooked on 19 December. A hooked seal has not yet been observed on land.
[c]Released by observers.

CHAPTER 3. THE HAWAIIAN MONK SEAL ON LAYSAN ISLAND, 1994

Brenda L. Becker, Heather L. Johnston, Lucy W. Keith,
and Cynthia A. Vanderlip

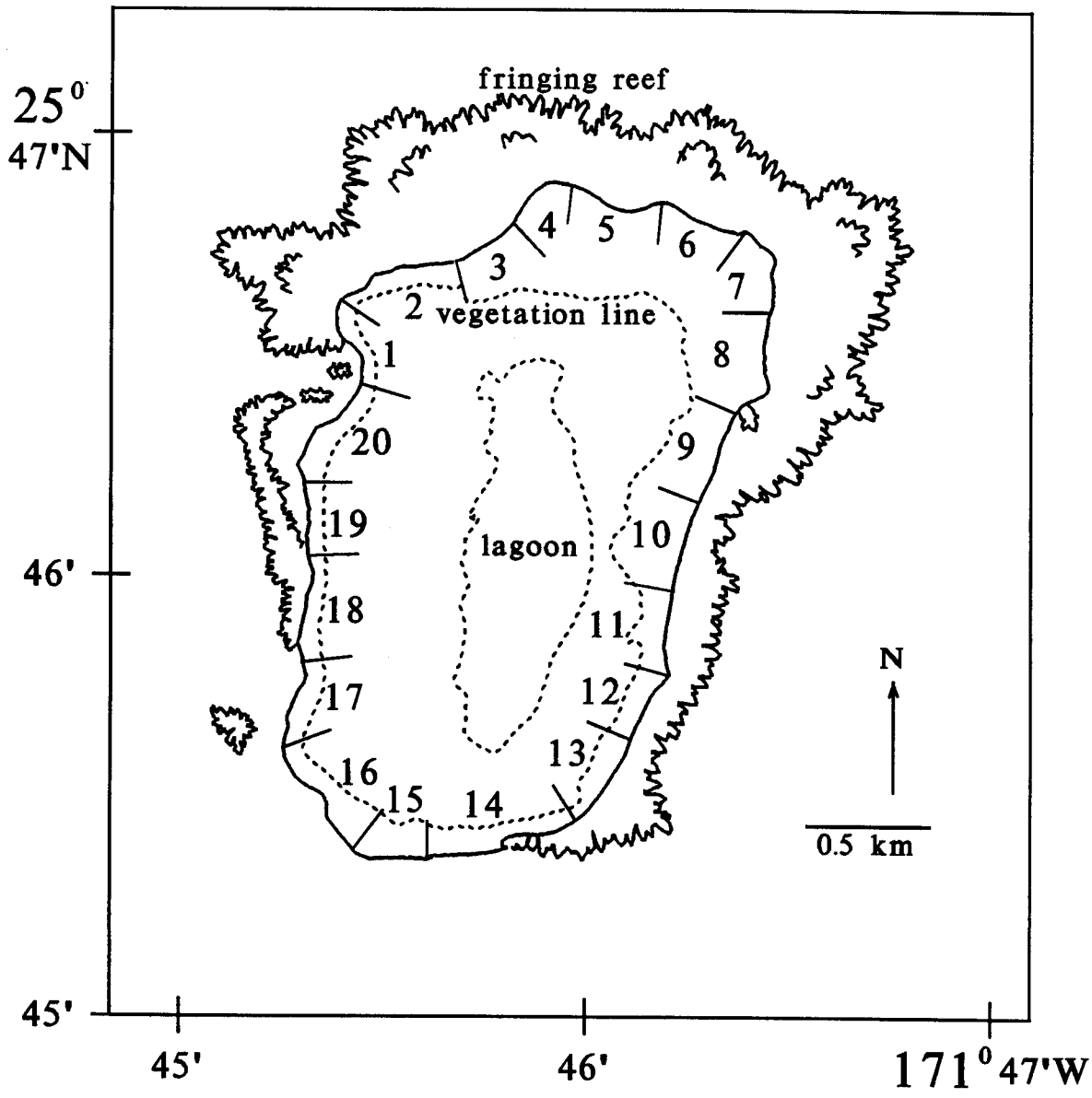

Fig. 3.1. Laysan Island in the Northwestern Hawaiian Islands.

Laysan Island (lat. 25°42'N, long. 171°44'W) is located ca. 1300 km northwest of Oahu in the Northwestern Hawaiian Islands (Fig. 1.1). This island lies within the Hawaiian Islands National Wildlife Refuge, and is one of the major haulout and pupping locations of the Hawaiian monk seal.

RESEARCH

Research was conducted by the National Marine Fisheries Service during March 25-July 30, and incidental observations were recorded by U.S. Fish and Wildlife Service personnel during the rest of the year. The perimeter of the island (ca. 11 km) was divided into 20 sectors using artificial or natural landmarks (Fig. 3.1). In 1994, research objectives specific to this population included identification of all seals, documentation of male behavioral patterns and aggression, assessment of maternity and pup exchanges, and collection and translocation of adult males to correct the skewed sex ratio of adults at this site.

Censuses and Patrols

Censuses and patrols were scheduled to ensure that the entire island perimeter was monitored at least once each day during March 26-July 7. Twenty censuses were conducted by two observers every fifth day from March 26 to June 29. Each census began at 1300 Hawaii standard time and continued for 1.4 to 2.6 h.

Standardized behavior patrols were conducted on 53 non-census days to assess activity patterns of adults and large subadults, document male aggression, and detect mobbing incidents. During behavior patrols, attention was directed out to sea as much as possible, because mobbings have been documented to occur most frequently in the water.

Individual Identification

A total of 273 individuals (224 excluding pups) were identified by existing or applied tags, bleach marks, scars, or natural markings. Bleach marks were applied to 228 seals, including 36 nursing pups. All 47 weaned pups, 4 immature females, and 1 adult male were tagged with Temple Tags; the majority of those also were tagged with passive integrated transponder (PIT) tags. One immature female and 16 adult males were retagged with Temple Tags, PIT tags, or both.

Collection of Samples

One hundred-twenty scat and spew samples were collected. Tissue samples were collected from 50 seals during tagging. Blood samples were collected from 6 adult males captured for translocation. Necropsies were performed on 4 dead seals and tissue samples and skulls were collected from all necropsied

seals. In total, 598 pieces of potentially entangling debris were inventoried and destroyed with the exception of one that was removed from a seal and collected.

Special Studies

Collection of Adult Males for Translocation

Twenty-two adult male seals were collected from Laysan Island; 1 male died shortly after capture, and the remaining 21 males were translocated to the main Hawaiian Islands. The purpose of the translocation was to correct the skewed adult sex ratio on Laysan Island, and thereby reduce the incidence of mobbing. Translocated seals were held in an enclosure for 7 to 14 days, and then transported on board the NOAA ship *Townsend Cromwell*. The animals were retagged with Temple Tags and PIT tags as needed and were tagged with additional red Temple Tags to indicate that they had been translocated to the main Hawaiian Islands. They were released separately offshore of the main islands. Five males were instrumented with satellite transmitters to facilitate monitoring of their movements after release.

Survival of Oiled Seals

Sixteen of 17 seals observed with oiled pelage in the spring of 1993 on Laysan Island were sighted there in 1994. These seals seemed to be in good health; however, sublethal or long-term effects could not be evaluated.

RESULTS

Population Abundance and Composition

The means (±SD) for 20 censuses were 99 seals (±10.3) including pups, and 75 seals (±8.8) excluding pups (Table 3.1). The total spring-summer population was 270 individuals, 221 excluding pups (Table 3.2). The sex ratios of non-pup immature seals and adults were 0.9:1 (31 males: 34 females) and 1.2:1 (84 males: 71 females), respectively. Within the adult class, the male-skewed sex ratio was due to older (>11 years of age) seals, where the male to female ratio was 1.4:1 (52 males: 38 females); in adult-sized seals ≤11 years of age, the sex ratio was 1.0:1 (32 males: 33 females). The sex ratio at the end of the field season, after the removal of 22 adult males (including one that died) was 0.9:1 (62 males: 71 females). The numbers of tagged known-age seals born at Laysan Island during the period from 1983 to 1993 and resighted there in 1994, are summarized in Table 3.3.

Reproduction

At least 49 pups were born: 47 weaned and 2 died prior to weaning (Table 3.4a). Nursing periods and measurements of weaned pups are summarized in Table 3.4b. Forty-nine of 71 (69%) adult-sized females were parturient. At least 14 pup exchanges occurred between 14 nursing females; researchers observed two of these incidents. Two unusual temporary weanings (i.e., a nursing female abandoned her pup, and then returned) were documented.

Interatoll Movement

Interatoll movement was documented for 10 seals that made a total of 15 movements between Laysan Island and French Frigate Shoals or Lisianski Island (Tables 3.5a and b). A bleached seal of unknown size and sex from Laysan was sighted by a fishing boat at Raita Bank, possibly a foraging site.

Factors Affecting Survival

Attacks by large sharks, mounting attempts by males, entanglement, and other-unknown factors led to 21 life-threatening conditions, which resulted in the confirmed deaths of six animals and the probable deaths of two other seals (Table 3.6). One mobbing event was observed and resulted in injuries to the subject seal before researchers intervened, causing the seals to disperse. Three seals died or probably died following unobserved mobbing events. Three seals were entangled and were released by observers. In addition to the deaths listed in Table 3.6, two aborted fetuses were found.

ACKNOWLEDGMENTS

We acknowledge the support of the U.S. Fish and Wildlife Service, Hawaiian Islands National Wildlife Refuge staff and thank the captains and crew members of the NOAA ship *Townsend Cromwell*. William Gilmartin, Chad Yoshinaga, Michele Finn, Pam Frierson, Cindy Newton, Tanya Holonko, Jerry Kermode, Ramona Visnak, Victoria deBettencourt, John Henderson, Tim Ragen, and Thea Johanos also participated in the selection, capture, and translocation of adult males. Special thanks are extended to Josh Adams, Dick Bauer, Monette Boswell, Vanessa Gauger, Brad Keitt, and Hannah Nevins (all of the U.S. Fish and Wildlife Service) for assistance in data collection; and John Klavitter and NOAA Officer Brian Parker for field assistance on Laysan Island.

TABLES

Table 3.1.--Summary statistics for censuses (n = 20) of Hawaiian monk seals at Laysan Island from March 26 to June 29, 1994.

Size/Sex	Mean number of individuals	Standard deviation
Adults	53.2	7.6
Male	25.0	4.7
Female	26.3	4.9
Unknown	1.9	2.0
Subadults	9.4	3.0
Male	5.1	1.8
Female	4.1	1.7
Unknown	0.3	0.7
Juveniles	11.9	4.4
Male	4.4	2.4
Female	6.6	2.2
Unknown	0.9	1.0
Pups	24.2	9.2
Male	10.3	4.0
Female	12.4	6.3
Unknown	1.5	1.8
Non-pup Total	74.6	8.8
Grand Total	98.8	10.3

Table 3.2.--Composition of the Hawaiian monk seal population at Laysan Island during the spring and summer of 1994. Includes all pups born during the calendar year.

	Number of seals				
Size	Male	Female	Unknown	Total	Sex ratio male:female
Adults	84	71	1	156	1.2:1
Subadults	17	15	0	32	1.1:1
Juveniles	14	19	0	33	0.7:1
Pups	19[a]	29	1[a]	49	0.6:1
Non-pup Total	115	105	0	221	1.1:1
Grand Total	134	134	2	270	1.0:1

[a]One neonatal pup death.

Table 3.3.--Summary of tagged known-age seals born at Laysan Island and resighted there in 1994.

Age (years)	Sex	Number originally tagged	Number resighted in 1994
11	Male	10	1
	Female	10	6
10	Male	16	4
	Female	13	5
9	Male	16	5
	Female	14	5
8	Male	15	4
	Female	17	3
7	Male	13	3
	Female	15	6
6	Male	23	6
	Female	17	3
5	Male	16	4
	Female	13	4
4	Male	7	3
	Female	9	5
3	Male	18	8
	Female	13	10
2	Male	18	6
	Female	14	6
1	Male	23	7
	Female	14	8

Table 3.4a.--Summary of Hawaiian monk seals born at Laysan Island in 1994.

Event	Number of pups			
	Male	Female	Unknown	Total
Born	19	29	1	49
Died prior to weaning	1	0	1	2
Weaned	18	29	0	47
Tagged	18	29	0	47

Table 3.4b.--Summary of nursing periods and measurements of weaned pups at Laysan Island in 1994. Nursing periods were calculated where both birth and weaning date ranges were ≤4 days. All measurements were taken within 2 weeks after weaning. Measurements include seven pups with an axillary girth of ≤95 cm.

	Nursing period (d)	Axillary girth (cm)	Straight dorsal length (cm)
Mean	35.8	102.9	126.5
St. Dev.	4.2	6.9	5.4
n	25	46	29

Table 3.5a.--Known movement of Hawaiian monk seals to Laysan Island from other locations in 1994, summarized by movements between two locations. Some seals made more than one trip.

Original location	Number, size, and sex class
French Frigate Shoals	6 adult females
Lisianski Island	2 adult females, 3 subadult males, 1 subadult female

Table 3.5b.--Known movement of Hawaiian monk seals from Laysan Island to other locations in 1994, summarized by movements between two locations. Some seals made more than one trip.

Destination	Number, size, and sex class
French Frigate Shoals	3 adult females

Table 3.6.--Factors affecting Hawaiian monk seal survival at Laysan Island in 1994.

Size	Sex	Total	Outcome		
			Injured	Died	Probably died
Attack by Large Shark					
Adult	Male	1	1	0	0
	Unknown	1	0	0	1
Subadult	Female	2	2	0	0
Mounting by Males					
Adult	Female	5[a]	3	1	1
Juvenile	Male	1	0	1	0
Entanglement					
Juvenile	Female	1[b]	0	0	0
Weaned pup	Female	2[b]	0	0	0
Other/Unknown					
Adult	Male	2	1	1[c]	0
	Female	3	3	0	0
Weaned pup	Male	1	0	1	0
Nursing Pup	Male	1	0	1	0
	Unknown	1	0	1	0

[a]One female was observed in a mobbing aggregation of six adult males and sustained injuries.
[b]Seal(s) released by observers.
[c]Seal died during restraint.

CHAPTER 4. THE HAWAIIAN MONK SEAL ON LISIANSKI ISLAND, 1994

John R. Henderson

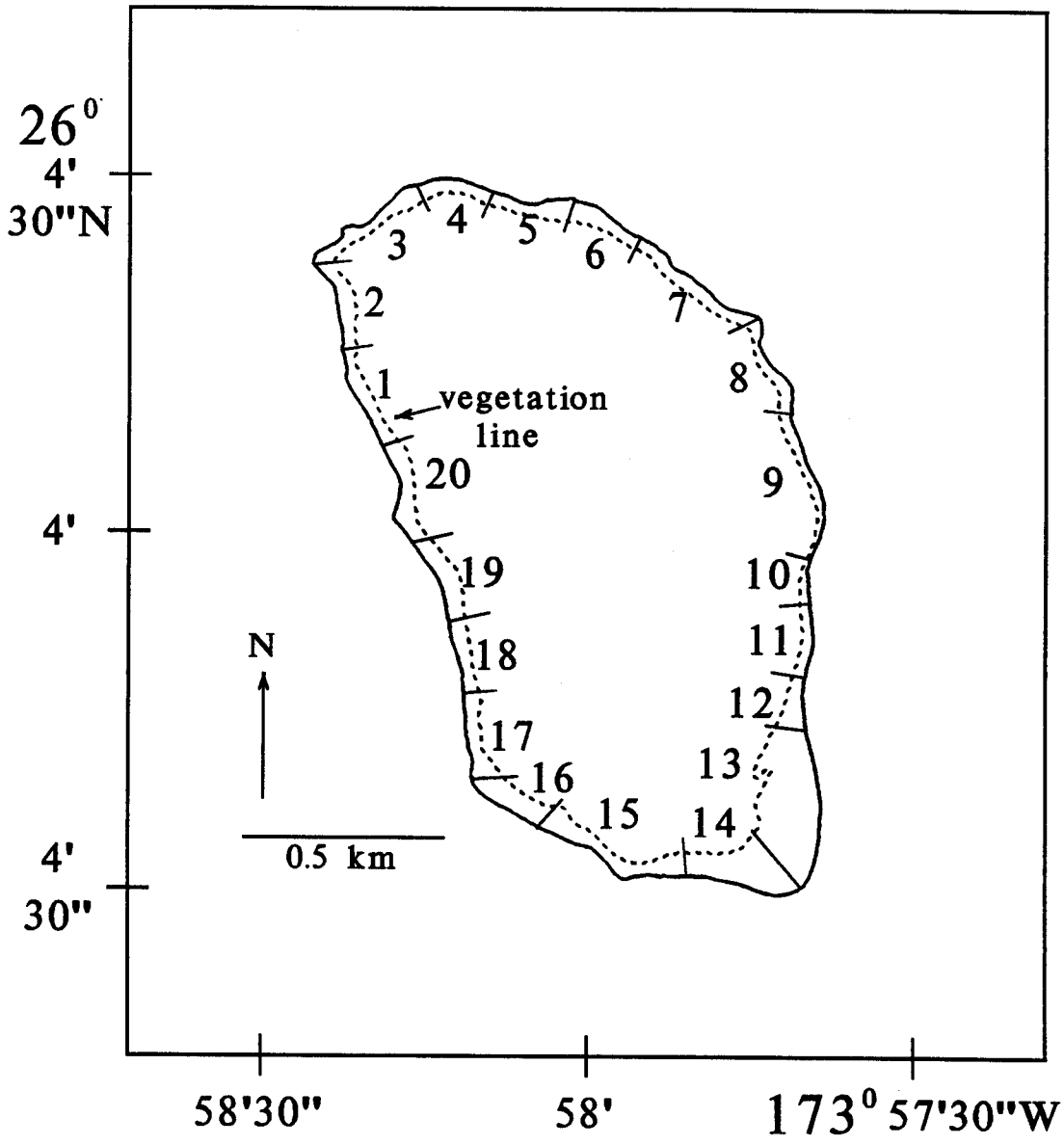

Fig. 4.1. Lisianski Island in the Northwestern Hawaiian Islands.

Lisianski Island (lat. 26°02'N, long. 174°00'W) is one of the major haulout and pupping locations of the Hawaiian monk seal. The island is located ca. 1760 km northwest of Oahu (Fig. 1.1), and is part of Neva Shoal, a shallow reef bank within the Hawaiian Islands National Wildlife Refuge.

RESEARCH

Research was conducted by the National Marine Fisheries Service for a single day, July 20. The perimeter of the island was divided into 20 sectors using artificial or natural landmarks (Fig. 4.1). In 1994, research objectives specific to this population were minimal; priorities were tagging pups and destroying debris.

Censuses and Patrols

No censuses were conducted. The island was patroled throughout the single day of field effort.

Individual Identification

A total of 44 individuals (35 excluding pups) were identified by existing or applied tags, and natural markings. Most weaned pups were tagged (n = 9) with Temple Tags and passive integrated transponder (PIT) tags. No other seals were tagged.

Collection of Samples

Six tissue samples were collected from weaned pups during tagging. No other samples were collected. Because of the limited time available, debris items were not inventoried. However, observers destroyed all potentially entangling marine debris found on approximately one-half of the island's perimeter.

RESULTS

Population Abundance and Composition

No information on population abundance or composition was obtained in 1994.

Reproduction

At least 12 pups were born; 11 were weaned and 1 was still nursing (Table 4.4). No information on nursing periods, number of reproductive females, or pup exchanges was collected.

Interatoll Movement

Interatoll movement was documented for six seals that made a total of six movements from Lisianski Island to Laysan Island.

Factors Affecting Survival

Entanglement of one seal was documented (Table 4.6). The seal was released uninjured by observers. The skeleton of a subadult and skull of a juvenile seal that had died of unknown causes since the 1993 field season were also found.

ACKNOWLEDGMENTS

I thank the field personnel who assisted in data collection: Lt. Michele Finn, Pamela Frierson, Lucy Keith, Steven Kirkland, and Cynthia Vanderlip. The support of the U.S. Fish and Wildlife Service, Hawaiian Islands National Wildlife Refuge staff is gratefully acknowledged. Logistical assistance was provided by the captains, officers, and crew of the NOAA ship *Townsend Cromwell*.

TABLES

Table 4.1.--Summary statistics for censuses of Hawaiian monk seals at Lisianski Island in 1994.

Size/Sex	Mean number of individuals	Standard deviation
Adults		
Male		
Female		
Unknown		
Subadults		
Male		
Female		
Unknown		
Juvenile	(Census counts were not conducted as described on page 39.)	
Male		
Female		
Unknown		
Pups		
Male		
Female		
Unknown		
Non-pup Total		
Grand Total		

Table 4.2.--Composition of the Hawaiian monk seal population at Lisianski Island during the spring and summer of 1994.

Size	Number of seals			Sex ratio male:female
	Male	Female	Total	
Adults				
Subadults				
Juveniles	(Composition not determined as described on page 39.)			
Pups				
Non-pup Total				
Grand Total				

Table 4.3.--Summary of tagged known-age seals born at Lisianski Island and resighted there in 1994.

Age (years)	Sex	Number originally tagged	Number resighted in 1994
12	Male	7	0
	Female	6	1
11	Male	6	0
	Female	18	3
10	Male	10	0
	Female	5	1
9	Male	5	1
	Female	9	0
8	Male	11	0
	Female	9	1
7	Male	12	1
	Female	6	1
6	Male	10	0
	Female	8	1
5	Male	0	--
	Female	0	--
4	Male	9	3
	Female	8	2
3	Male	9	3
	Female	6	1
2	Male	13	3
	Female	8	1
1	Male	4	1
	Female	9	2

Table 4.4.--Summary of Hawaiian monk seals born at Lisianski Island in 1994.

Event	Number of pups			
	Male	Female	Unknown	Total
Born	4	5	3	12
Died prior to weaning	0	0	0	0
Still nursing	0	0	1	1
Weaned	4	5	2	11
Tagged	4	5	0	9

Table 4.5a.--Known movement of Hawaiian monk seals to Lisianski Island from other locations in 1994, summarized by movements between two locations.

Original location	Number, size, and sex class
No immigrations to Lisianski were documented.	

Table 4.5b.--Known movement of Hawaiian monk seals from Lisianski Island to other locations in 1994, summarized by movements between two locations. No seals made more than one trip.

Destination	Number, size, and sex class
Laysan Island	2 adult females, 3 subadult males, 1 subadult female

Table 4.6.--Factors affecting Hawaiian monk seal survival at Lisianski Island in 1994.

Size	Sex	Total	Outcome		
			Injured	Died	Probably died
Attack by Large Shark					
(none observed)					
Mounting by Males					
(none observed)					
Entanglement					
Weaned pup	Unknown	1[a]	0	0	0

[a]Seal released by observers.

CHAPTER 5. THE HAWAIIAN MONK SEAL AT MIDWAY ISLANDS, 1994

L. L. Eberhardt and K. V. Eberhardt

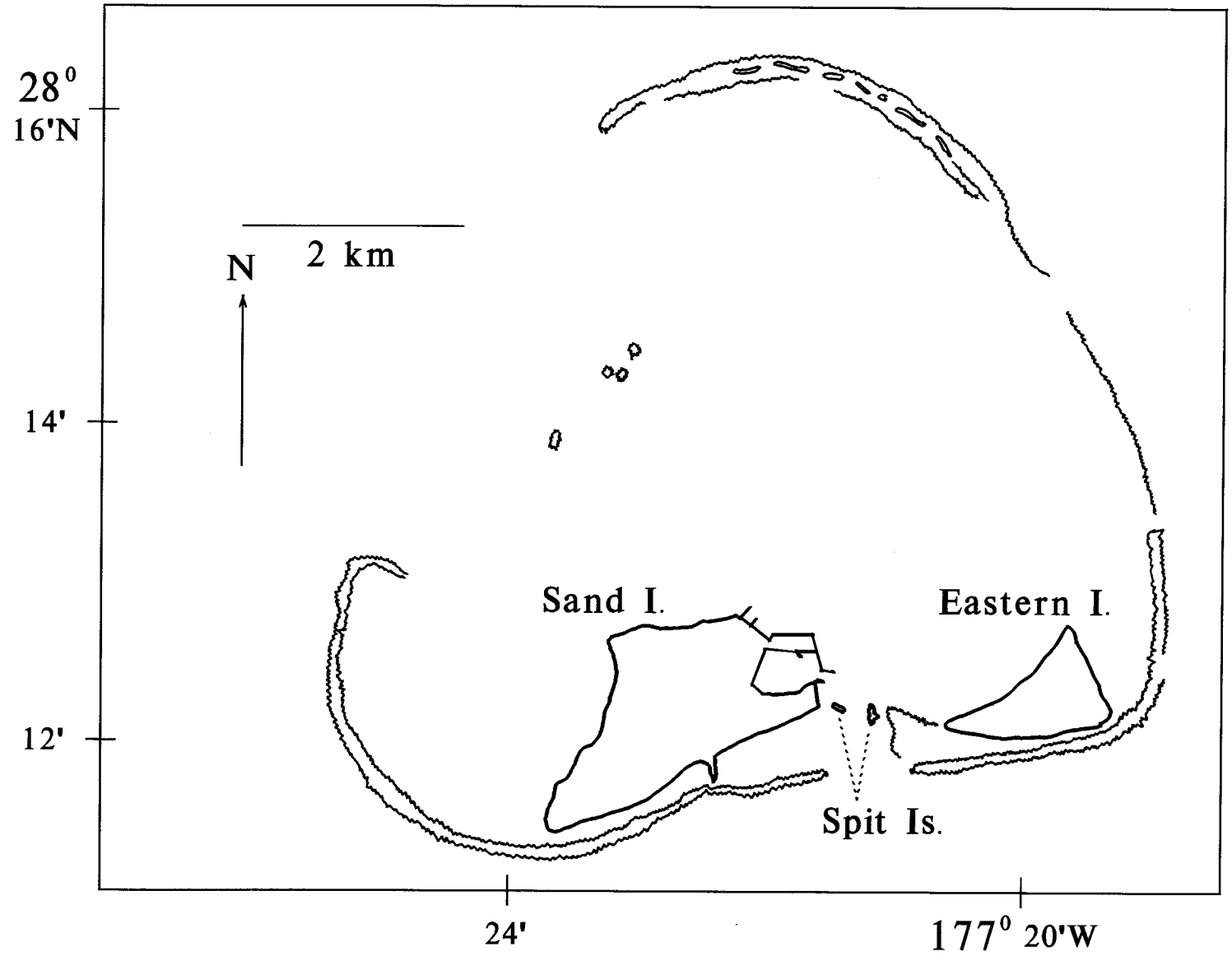

Fig. 5.1. Midway Islands in the Northwestern Hawaiian Islands.

Midway Islands (lat. 28°15'N, long. 177°35'W) has historically been one of the major haulout and pupping locations of the endangered Hawaiian monk seal, although current population levels and pup production are low. This atoll is located 2100 km northwest of Oahu in the Northwestern Hawaiian Islands (Fig. 1.1) and comprises a circular fringing reef approximately 9 km in diameter, enclosing a lagoon and three permanent islands (Sand, Spit, and Eastern Islands) inside the southern part of the reef (Fig. 5.1). Eastern and Spit Islands are uninhabited. Sand Island was the site of a U.S. Naval Air Facility until 1993, when the facility was closed. The Navy is in the process of vacating the atoll, and primary management authority will be transferred to the U.S. Fish and Wildlife Service (FWS), which has maintained a refuge (Midway Atoll National Wildlife Refuge) at the site since 1988.

Beach counts of the Hawaiian monk seal at Midway Atoll averaged 56 animals in the late 1950s (Kenyon, 1972), but declined severely by the late 1960s; a single seal was observed during an aerial survey in 1968 (Kenyon, 1972). Since the late 1960s, the population has failed to recover, and the majority of the seals currently at the site appear to be immigrants or offspring of immigrants. However, the earlier counts indicate that the Midway population has significant potential for growth, and recovery of this population is an important management goal.

RESEARCH

Research was not conducted by the National Marine Fisheries Service at Midway Islands in 1994, but censuses and incidental observations were recorded by collaborating scientists during March 5-31. In addition, incidental observations were recorded by FWS personnel during the rest of the year. The perimeters of the three permanent islands were divided into sectors using artificial or natural landmarks. In 1994, research objectives specific to Midway Islands included the identification of all seals in the resident population, and estimation of the proportion identified using sighting probability calculations.

Censuses and Patrols

Atoll censuses were not conducted at Midway Islands in 1994. Beach counts of Sand Island (n = 19), Eastern Island (n = 9), or Spit Island (n = 3) were conducted during March 5-30 to identify and resight seals.

Individual Identification

A total of 29 individuals (25 excluding pups) were identified by existing tags, bleach marks, scars, or natural markings. No seals were tagged.

Collection of Samples

No samples were collected at Midway Islands in 1994.

Special Studies

Sighting Probability Calculations

Probability calculations suggested that the 29 seals identified may have been the entire "population" using Midway Islands at the time of the study (Eberhardt and Eberhardt, 1994).

RESULTS

Population Abundance and Composition

Atoll censuses were not conducted in 1994. The total spring-summer resident population was 29 individuals, 25 excluding pups (Table 5.2). The sex ratios of non-pup immatures and adults were 0.2:1 (2 males: 10 females) and 0.3:1 (3 males: 10 females), respectively. The numbers of tagged known-age seals born at Midway during the period from 1988 to 1993 and resighted there in 1994, are summarized in Table 5.3.

Reproduction

At least four pups were born: two were weaned and two were still nursing at the end of this study (Table 5.4).

Interatoll Movement

Interatoll movement was documented for eight seals that made a total of eight movements between Midway Islands and Kure Atoll (Tables 5.5a and b).

Factors Affecting Survival

Mounting attempts by males resulted in one life-threatening condition (Table 5.6).

ACKNOWLEDGMENTS

We acknowledge the support of the U.S. Fish and Wildlife Service, Midway Atoll National Wildlife Refuge.

TABLES

Table 5.1.--Summary statistics for atoll censuses of Hawaiian monk seals at Midway Islands in 1994.

Size/Sex	Mean number of individuals	Standard deviation
Adults		
Male		
Female		
Unknown		
Subadults		
Male		
Female		
Unknown		
Juvenile	(Atoll counts were not conducted as described on page 51.)	
Male		
Female		
Unknown		
Pups		
Male		
Female		
Unknown		
Non-pup Total		
Grand Total		

Table 5.2.--Composition of the Hawaiian monk seal population at Midway Islands during the spring and summer of 1994. Includes all pups born during the calendar year.

	Number of seals				
Size	Male	Female	Unknown	Total	Sex ratio male:female
Adults	3	10	0	13	0.3:1
Subadults	2	8	0	10	0.3:1
Juveniles	0	2	0	2	NA
Pups	1	0	3	4	NA
Non-pup Total	5	20	0	25	0.3:1
Grand Total	6	20	3	29	0.3:1

Table 5.3.--Summary of tagged known-age seals born at Midway Islands and resighted there in 1994.

Age (years)	Sex	Number originally tagged	Number resighted in 1994
6	Male	0	NA
	Female	1	0
3	Male	1	1
	Female	1	1
2	Male	0	NA
	Female	1	1
1	Male	1	0
	Female	0	NA

Table 5.4.--Summary of Hawaiian monk seals born at Midway Islands in 1994.

Event	Number of pups			
	Male	Female	Unknown	Total
Born	1	0	3	4
Died prior to weaning	0	0	0	0
Still nursing	0	0	2	2
Weaned	1	0	1	2
Tagged	0	0	0	0

Table 5.5a.--Known movement of Hawaiian monk seals to Midway Islands from other locations in 1994, summarized by movements between two locations. No seals made more than one trip.

Original location	Number, size, and sex class
Kure Atoll	1 adult male, 1 adult female, 2 subadult females, 2 juvenile females

Table 5.5b.--Known movement of Hawaiian monk seals from Midway Islands to other locations in 1994, summarized by movements between two locations. No seals made more than one trip.

Destination	Number, size, and sex class
Kure Atoll	2 subadult females

Table 5.6.--Factors affecting Hawaiian monk seal survival at Midway Islands in 1994.

Size	Sex	Total	Outcome		
			Injured	Died	Probably died
Attack by Large Shark					
(none observed)					
Mounting by Males					
Adult	Female	1	1	0	0
Entanglement					
(none observed)					
Unknown					
(none observed)					

CHAPTER 6. THE HAWAIIAN MONK SEAL AT KURE ATOLL, 1994

Mitchell P. Craig, Lucy W. Keith, and Cynthia A. Vanderlip

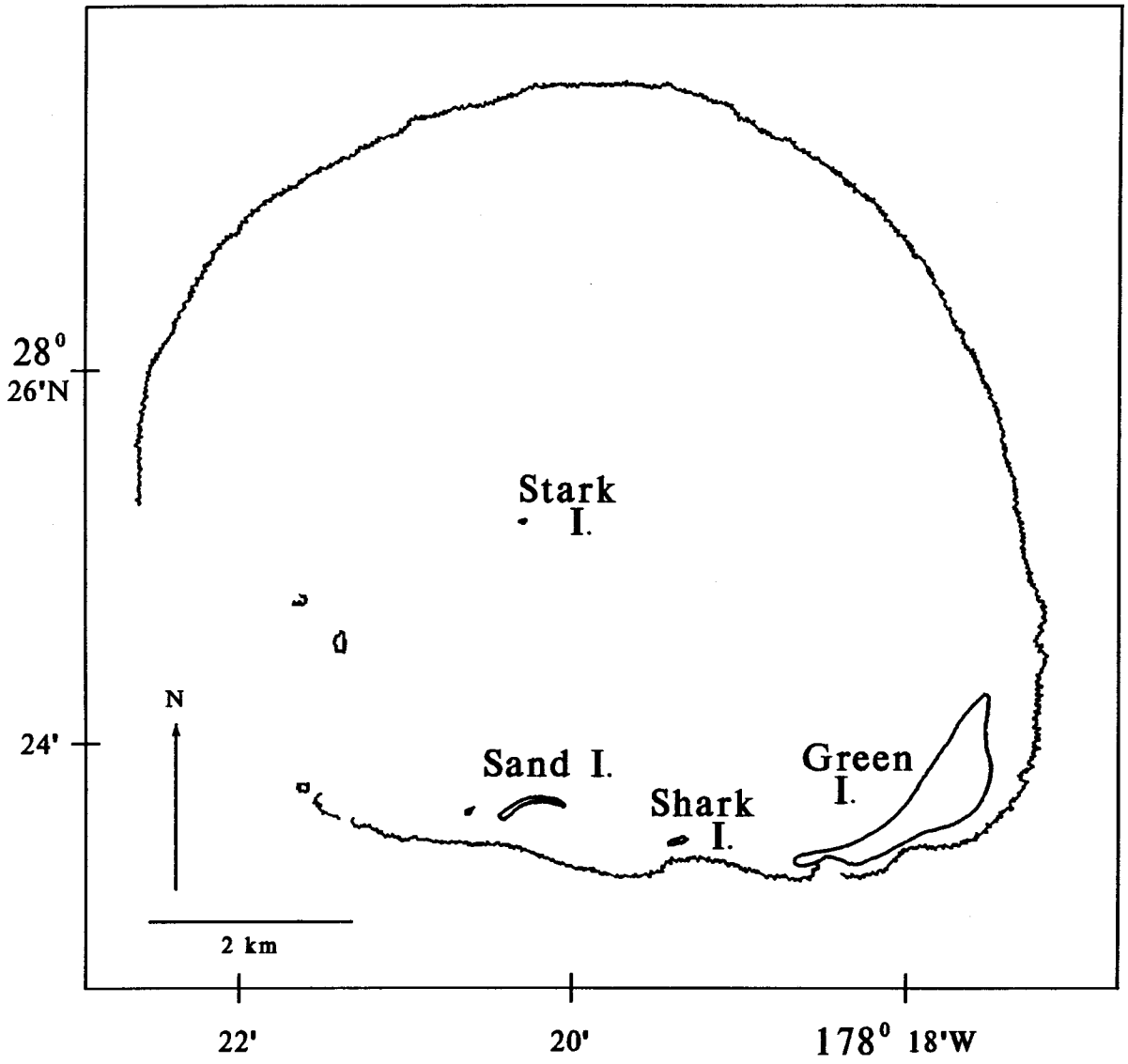

Fig. 6.1. Kure Atoll in the Northwestern Hawaiian Islands.

Kure Atoll (lat. 28°25'N, long. 178°10'W) is one of the major haulout and pupping locations of the Hawaiian monk seal. The atoll is located ca. 2300 km northwest of Oahu in the Northwestern Hawaiian Islands (Fig. 1.1) and is a seabird sanctuary of the State of Hawaii. The atoll consists of a circular fringing reef approximately 9 km in diameter, enclosing a lagoon, one permanent vegetated island (Green Island), two sand islets (Sand and Shark Islets), and a sometimes emergent area known locally as Stark Reef (Fig. 7.1). Until 1992, Green Island was the site of a U.S. Coast Guard (USCG) LORAN station, commissioned in 1961 and staffed by 20-30 USCG personnel. In July 1992, this station was closed and vacated by the USCG, leaving the atoll uninhabited.

RESEARCH

Research was conducted by the National Marine Fisheries Service during February 9-March 25. The perimeter of the largest vegetated island was divided into eight sectors, using artificial or natural landmarks. In 1994, research objectives specific to this population included assessing the impacts of past management efforts and release of seals translocated from French Frigate Shoals (FFS).

Censuses and Patrols

Atoll censuses (n = 8) were conducted approximately every 4 days, weather permitting, from February 19 to March 22. Each census began between 1300 and 1400 Hawaii standard time and ended between 1500 and 1600. Stark Reef was not censused. The remaining islands were censused on foot by one or two persons.

In addition, patrols were conducted on non-census days to identify seals and monitor locations where females pupped.

Individual Identification

A total of 119 individuals (113 excluding pups) were identified by existing or applied tags, bleach marks, scars, or natural markings. All weaned pups were tagged (n = 3) with Temple Tags and also received passive integrated transponder (PIT) tags.

Collection of Samples

No tissue samples were collected. In total, 40 pieces of potentially entangling debris were inventoried and destroyed with the exception of one that was removed from a seal and collected.

Special Studies

Monitoring Impacts of Past Management Efforts

The Head Start Project (1981-91) and the Rehabilitation Project (1984-91) used a temporary beach enclosure, stocked with locally trapped live reef fish to enhance first year survival of weaned female pups and to introduce rehabilitated yearlings from French Frigate Shoals (FFS) (Gilmartin and Gerrodette, 1986). Due to logistical constraints imposed by closure of the USCG LORAN Station on Kure in 1992, both projects were discontinued and the enclosure was permanently removed. The Rehabilitation Project was resumed in 1993 with the introduction of yearling females from FFS. These animals were not maintained in a beach enclosure, but were released directly from their cages onto the west beach of Green Island. In 1994, observers assessed the survival of weaned female pups and seals that had gone through the Head Start and Rehabilitation Projects in previous years, to determine the effectiveness of these past management efforts.

Introduction of Rehabilitated Seals

The Rehabilitation Project was continued in 1994 with the introduction of eight yearling females. These animals were not maintained in a beach enclosure but were released directly from their cages onto the west beach of Green Island. Six animals were released in February and two were released in March.

RESULTS

Population Abundance and Composition

The means (±SD) for eight atoll censuses were 62 seals (±7.3) including pups, and 58 seals (±7.4) excluding pups (Table 6.1). The total spring population was 118 individuals, 112 excluding pups (Table 6.2). The numbers of tagged known-age seals born at Kure Atoll during the period from 1981 to 1993 and resighted there in 1994, are summarized in Table 6.3.

Reproduction

At least six pups were born: three were weaned, one disappeared prior to weaning, and two were still nursing at the end of this study (Table 6.4a). Field studies occurred before the main reproductive period, and additional pups were probably born after the field season. Nursing periods and measurements of weaned pups are summarized in Table 6.4b. One parturient female had been temporarily maintained as a pup in the Kure Atoll Head Start enclosure, and two were rehabilitated seals from FFS that were introduced to Kure as yearlings via the Head Start enclosure.

Interatoll Movement

Interatoll movement was documented for nine seals that made a total of nine movements between Kure Atoll and Pearl and Hermes Reef or Midway Islands (Table 6.5a and b).

Factors Affecting Survival

Attacks by large sharks, mounting attempts by males, entanglement, and unknown factors led to four life-threatening conditions, which resulted in the death of one seal (Table 6.6). One seal was entangled and subsequently released by observers.

ACKNOWLEDGMENTS

We acknowledge the State of Hawaii, Department of Land and Natural Resources, Division of Forestry and Wildlife.

TABLES

Table 6.1.--Summary statistics for atoll censuses (n = 8) of Hawaiian monk seals at Kure Atoll from February 19 to March 22, 1994.

Size/Sex	Mean number of individuals	Standard deviation
Adults	23.9	4.3
Male	12.9	1.8
Female	9.1	3.6
Unknown	1.9	2.4
Subadults	12.8	3.6
Male	4.9	1.9
Female	7.6	1.8
Unknown	0.3	0.5
Juveniles	21.5	2.6
Male	8.5	2.4
Female	12.8	1.5
Unknown	0.3	0.7
Pups	3.9	0.8
Male	3.6	0.7
Female	0.0	0.0
Unknown	0.3	0.5
Non-pup Total	58.1	7.4
Grand Total	62.0	7.3

Table 6.2.--Composition of the Hawaiian monk seal population at Kure Atoll during the spring of 1994. Includes all pups known to be born during the calendar year, but field studies occurred before the main reproductive period.

	Number of seals				
Size	Male	Female	Unknown	Total	Sex ratio male:female
Adults	23	22	0	45	1:1
Subadults	8	20	0	28	0.4:1
Juveniles	14	25[a]	0	39	0.6:1
Pups	5	0	1	6	NA
Non-pup Total	45	68	0	112	0.7:1
Grand Total	50	68	1	118	0.7:1

[a]Number includes 8 rehabilitated yearlings released at Kure Atoll in February and March, 1994.

Table 6.3.--Summary of tagged known-age seals born at Kure Atoll and resighted there in 1994.

Age (years)	Sex	Number originally tagged	Number resighted in 1994
13	Male	3	2
	Female	5	2
12	Male	1	0
	Female	3	3
11	Male	4	2
	Female	0	NA
10	Male	4	2
	Female	2	2
9	Male	2	1
	Female	3	2
8	Male	1	1
	Female	0	NA
7	Male	1	1
	Female	3	2
6	Male	2	2
	Female	5	2
5	Male	5	3
	Female	4	1
4	Male	3	0
	Female	3	2
3	Male	7	5
	Female	6	4
2	Male	5	4
	Female	8	5
1	Male	9	8
	Female	4	3

Table 6.4a.--Summary of Hawaiian monk seals born at Kure Atoll in 1994.

Event	Number of pups			
	Male	Female	Unknown	Total
Born	5	0	1[a]	6
Probably died prior to weaning	1	0	0	1
Still nursing	1	0	1	2
Weaned	3	0	0	3
Tagged	3	0	0	3

[a]Unusually small pup born to thin mother.

Table 6.4b.--Summary of nursing periods and measurements of weaned pups at Kure Atoll in 1994. Nursing periods were calculated where both birth and weaning date ranges were ≤4 d. All measurements were taken within 2 weeks after weaning. Measurements include two pups with an axillary girth of ≤95 cm.

	Nursing period (d)	Axillary girth (cm)	Straight dorsal length (cm)	Weight (kg)
Mean	--	96.8	117.0	--
St. Dev.	--	9.0	7.2	--
n	--	3	3	--

Table 6.5a.--Known movement of Hawaiian monk seals to Kure Atoll from other locations in 1994, summarized by movements between two locations. No seal made more than one trip.

Original location	Number, size, and sex class
Pearl and Hermes Reef	1 Adult female
Midway Islands	2 Subadult females

Table 6.5b.--Known movement of Hawaiian monk seals from Kure Atoll to other locations in 1994, summarized by movements between two locations. No seal made more than one trip.

Destination	Number, size, and sex class
Midway Islands	1 Adult male, 1 Adult female, 2 Subadult females, 2 Juvenile females

Table 6.6.--Factors affecting Hawaiian monk seal survival at Kure Atoll in 1994.

Size	Sex	Total	Outcome		
			Injured	Died	Probably died
Attack by Large Shark					
Subadult	Male	1	1	0	0
Mounting by Males					
Adult	Female	1	1	0	0
Entanglement					
Juvenile	Female	1[a]	0	0	0
Unknown					
Adult	Unknown	1[b]	-	1	-

[a]Seal released by observers.
[b]Seal found recently dead at beginning of field season, cause of death unknown.

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APPENDIXES

Appendix A.--Reports summarizing annual field research on the Hawaiian monk seal by the National Marine Fisheries Service and collaborating scientists.

All islands

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French Frigate Shoals

Craig, M. P., J. L. Megyesi, C. S. Hall, J. L. Glueck, L. P. Laniawe, E. A. Delaney, S. S. Keefer, M. A. McDermond, M. Schulz, G. L. Nakai, B. L. Becker, L. M. Hiruki, and R. J. Morrow.
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Eliason, J. J., and J. R. Henderson.
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Becker, B. L., P. A. Ching, L. M. Hiruki, and S. A. Zur.
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Appendix B.--Hawaiian monk seal census form and 1994 census form directions.

(See following pages.)

SEAL CENSUS FORM

ENTERED ☐

DATA TYPE _____ COMPUTER PAGE NO. ☐☐☐☐ PAGE _____ OF _____

ISLAND _____ OBSERVER ☐☐☐ TIME BEGIN ☐☐☐☐ END ☐☐☐☐

DATE _____ NUMBER _____ TEMP. ☐☐ WIND ☐☐☐ CLOUD ☐☐ Prec. ☐

Line No.	Continue	Time	Sector	Size	Sex	Beach Pos	Condition	ID T/P	ID No.	ID ?	TAG No.	TAG L/R	TAG Col	TAG ?	MOLT %	MOLT ?	Disturb	ASSOCIATION Line No.	ASSOCIATION Dist	ASSOCIATION Behavior	Notes	Notes	EVENT Type	EVENT Codes
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								

NOTES:

CENSUSFM.GED Rev. 3/93

Line No.	Continue	Time	Sector	Size	Sex	Beach Pos	Condition	ID			TAG				MOLT		Disturb	ASSOCIATION			Notes	Notes	EVENT	
								T/P	No.	?	No.	L/R	Col	?	%	?		Line No.	Dist	Behavior			Type	Codes
15																								
16																								
17																								
18																								
19																								
20																								
21																								
22																								
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28																								
29																								
30																								

NOTES:

1994
CENSUS FORM DIRECTIONS

Entry	Description
DATA TYPE	**C** = Census: a complete count on an island begun around 1300 **A** = Atoll: atoll-wide census (must be completed within 2 days) **B** = Behavior patrol: a former patrol where associations are recorded (Laysan Island only) **P** = Patrol: any other observation not on a timed census **I** = Incidental: incidental observations *Other letters may be used at your discretion to indicate specific kinds of noncensus data,* e.g., **M** *for male observations.*
COMPUTER PAGE NO.	Leave this blank during data collection. It will be assigned and displayed on the screen when you enter the data. At that time, *be sure* to fill in the computer page number on your census form, as this number is needed for data retrieval.
PAGE	Page number within a census or patrol. For example, if the census (or patrol) requires three pages, then mark the first page as " page 1 of 3" and so on. If more than 1 person conducts the census, then combine page numbers; person A has pages 1 and 2, while person B has pages 3 and 4 of a four-page census day.
ISLAND	Name of island and atoll, *e.g.*, **East, FFS**.
OBSERVER	Three initials. If no middle initial, use the first and last block.
TIME BEGIN and **END**	On a 24-h clock, *e.g.*, 6 p.m. = 1800, for the group of pages.
DATE	The date that data are collected (in YYMMDD format).
NUMBER	Censuses and patrols may be assigned numbers at your discretion (3 digits). Atoll counts must be numbered, starting with **001**.
TEMP.	Temperature in degrees Celsius at beginning of census or patrol.

Entry	Description
WIND	Speed: **0** = no wind, calm (< 5 knots) **1** = light breeze (5-15 knots) **2** = strong wind (>15 knots) Direction: **NW, NN, NE, EE, SW, SS, SE, WW** Thus: **2 N N** = strong wind from north
CLOUD	Cloud cover: **00** = no clouds **01-09** = 10 to 90% cover **10** = 100% cover
PREC.	Precipitation: **0** = no precipitation or trace **1** = mist/drizzle **2** = rain **3** = intermittent rain
CONTINUE	If the *same seal sighting* is recorded on several lines for any reason (*e.g.*, additional tag or association, behavior at a later time, change of beach position), put the *original* line number your are continuing *from* here. Lines may be continued only within the same page. All fields from **SECTOR** through **MOLT** will be copied from the original line if left blank on the continuation line. Several lines can have the same continuation line number.
TIME	The time should be recorded for each seal sighting, on a 24-h clock.
SECTOR	Location on island (*e.g.*, **1-20** on Laysan) Special codes as follows: **00** = Unknown sector **77** = Pen **88** = Offshore spit **99** = Island not present

Entry	Description
SIZE	**P** = Nursing pup: **P1** = wrinkles **P2** = no wrinkles **P3** = blimp, black **P4** = molting **P5** = molted **PW** = Prematurely weaned/undersized weaned pup (weaned ≤2 weeks ago and <90 cm girth) **W** = Weaned pup **J** = Juvenile and **I** = Immature: **J1** = Juvenile I **J2** = Juvenile II **S** = Subadult and **I** = Immature: **S3** = Subadult III **S4** = Subadult IV **A** = Adult **T** = Turtle: **T1** = Juvenile (<65 cm) **T2** = Subadult (65-80 cm) **T3** = Adult (>80 cm) **U** = Seal of unknown size
SEX	**M** = Male **F** = Female **U** = Unknown
BEACH POS.	Location of seal or turtle *when observer comes abreast of animal* (*e.g.*, if seal is seen in the water from a distance and yet is on the beach when the observer comes abreast, the seal is recorded as being on the beach). When recording male-male interactions (at Laysan Island and Kure Atoll in 1994), make a continuation line previous to the original line to indicate that the seal changed beach position before you come abreast of it. **0** = Animal floating or swimming in water (not included in census tally but may be used for behavioral data or other analysis). **1** = On the beach. **9** = On an offshore rock (not included in census tally). **X** = Data not taken.

Entry	Description
CONDITION	Condition must be recorded for all seals (except nursing pups) on census or atoll count. During census or atoll count, record the condition of nursing pups on their first sighting post-partum, using the codes **N** or **A**. During patrol or incidental data collection, note the condition of the mom and pup on their first sighting post-partum or post-weaning, and note the condition of seals that are injured or in unusual condition. Condition codes: **P** = Probably pregnant **F** = Fat **M** = Medium **T** = Thin **E** = Emaciated **N** = Normal (for nursing pups) **A** = Abnormal/sick (primarily for nursing pups) **X** = Data not taken
ID DATA	These fields can be used to record either a temporary or permanent ID number. Use continuation lines to record both a temporary and permanent number, or two temporary numbers.
T/P	Indicate whether the number in the subsequent field is a temporary or permanent ID number. **T** = Temporary ID number (or bleach number) **P** = Permanent ID number

(*Next entry on following page*)

Entry	Description
TEMPORARY ID NO.	Record the temporary ID number (or bleach number) or seal if known; right justified. This field may be used for any temporary number. Use separate number series for bleach and various types of temporary numbers. If a number is incompletely read, use dashes as place-holders within the number to indicate missing digits (*e.g.*, incompletely read bleach 152 may be coded -52, 1-2, or 15-). **?** column: **0** = Seal is definitely unmarked; can coexist with a temporary number, or with a bleach number if bleach hasn't taken yet or the number has molted off. **1** = Bleach is present, but the number is questionable. **4** = Partially read bleach number completed from other data. **5** = Incompletely read bleach number, but partial data are certain (if seal can't be identified by ID or Tag #). **<blank>** = Number is certain and complete if present.
PERMANENT ID NO.	Record the 4-digit permanent ID number of seal if known (put both the island-specific prefix and next digit in the first box provided). **?** column: **0** = seal is definitely not an IDed animal. **1** = ID number is questionable. **<blank>** = ID number is certain and complete if present.

Entry	Description
TAG NO.	Tag number if known; right justified. If a number is incompletely read, use dashes as place-holders within the number to indicate missing digits. Put the alpha prefix of the temple tag (combined with tag **?** column code = **5**) if you can determine the hole drilling pattern, but can't decipher the number (*e.g.*, A--RT5 for a right tan tag with a 1983 drill pattern). Record the last 5 digits of a 10-digit PIT tag (put all 10 digits in the notes). **L/R** is the tag position: **L** = Tag on *left* flipper. **R** = Tag on *right* flipper. **B** = Tags on *both* flippers (enter one tag number). **COL** = Color: color code. See the Tag Sample Kit if unsure of the colors. **Temple Tags** / **Other tag types** **Y** = Yellow (FFS) — **M** = Metal, Monel **T** = Tan/brown (Laysan) — **P** = Plastic, Riese **G** = Green (Lisianski) — **C** = Clear, PIT tag **B** = Blue (Pearl & Hermes) **K** = Silver/gray (Kure) **R** = Red (Midway, Necker, Nihoa, Main Islands) **?** column: **0** = Seal is definitely not tagged. **1** = Seal is tagged, but the number is questionable. **4** = Partially read tag completed from other data. **5** = Incompletely read tag, but partial data are certain (if seal can't be identified by ID or Temporary #). **8** = Tag lost. Fill out tag position (**L/R/B**) and the tag condition event. Complete the tag number and color from other data before entry. (**TAG NO.** *continued on following page*)

Entry	Description
(**TAG NO.**, *Continued*)	**<blank>** = Tag information is certain if present. Partial data (either Tag #, position, or color not filled) are OK and will be completed by computer if the seal is identified by ID, Temporary #, or Tag #. The computer will *only* fill blank fields, so an incomplete Tag # must be completed by hand (use a **4** in the tag **?** column).
MOLT	Percentage of old pelage lost, optional for nursing pups. **0** or ***<blank>*** = No molting evident. **0-9** = 1 to 99% molted: **0** = molting, but less than 10%; **1** = 10-19%; ... **9** = 90-99%. The first record of a ≥ 2 molt is considered the first day of true molt. **10** = 100% molted, freshly molted, required for the first month after molt. Put both digits of the **10** in the single box provided. **?** column: **0** = Seal is definitely not molting. **1** = Seal is molting, but % molt estimate is questionable. May or may not include an estimate in the molt column.
DISTURB	The degree to which the seal may have been disturbed by observer. **0** or ***<blank>*** = No disturbance, or seal merely looked at observer. **1** = Seal vocalized, gestured, or moved ≤2 body lengths. **2** = Seal alerted to observer and moved >2 body lengths. **3** = Seal alerted to observer and fled into water.

Entry	Description
ASSOCIATION DATA	Use continuation lines to record more than one association. Don't record associations involving turtles. Record detailed association data at Laysan Island and Kure Atoll in 1994. At other locations, record mother-pup pairs and unusual events. At all locations except Laysan Island and Kure Atoll, the **X** code will be filled in back in Honolulu to indicate that standard association data was not recorded on Census or Atoll Count. **Active** associations: 1) Noted for all except behaviors between mother and nursing pup. 2) Must take place within 30 m of observer. 3) Subjects may be any distance apart. **Spatial** associations: 1) Noted as observer comes abreast of the subject. 2) Individual seals: . Mother-pup pair (**N**): any distance. . All others (**L**): distances ≤10 m away, record two nearest neighbors in straight line of sight, can be on opposite sides of a log.
LINE NO.	Identity of the other seal in the association. Put its line number here (note line number refers to within same census page only).
DIST.	Closest distance during behavior. **0** = body contact **1** = <2 m **2** = 2-5 m **3** = >5 m (>5 m but ≤10 m in the case of **L** behavior code)

Entry	Description
BEHAVIOR	Up to four behaviors may be recorded for each association, but **N**, **X**, and **O** should not appear together with other behaviors. Behaviors **B** and **M** require distance = **0**. With the exception of Chases, Jousts, and Mounts, only record repetitive, sequential behaviors once (for example, if an animal approaches three times in a row, code one **A**). If vocalizations occur, only code **V** once (whether or not they are sequential). 1) Individual seal a) Active behavior **A** = approach/investigate/sniff/nudge **B** = Bite: **B1** = nip **B2** = draws blood/breaks skin **C** = Chase:* **C1** = ≤2 body lengths* **C2** = >2 body lengths* **D** = Seal displaces another (see CONTEST RULES)* **F** = Flee/move away: **F1** = ≤2 body lengths **F2** = >2 body lengths **J** = Joust/spar/fight:* **J1** = ≤30 s* **J2** = >30 s* **M** = Mount/attempted mount **M1** = ≤30 s **M2** = >30 s **P =** Play* **R** = Submissive roll/present ventral **V** = Vocalize **Z** = Cruising A/S4 male only behavior (actual sex may be unknown). Does not require a line number reference to another seal, but may have one.

(**BEHAVIOR** *continued on following page*)

Entry	Description
(**BEHAVIOR**, *continued*)	(1) Individual seal, *continued)*

b) Spatial association

N = Mother-pup pair (any distance). Does not imply nursing behavior. This is the only association recorded between mother-pup pairs.

L = Association by location only (distance ≤10 m apart, for all except mother-pup pairs)

c) Optional codes

L1 = Pair association* A/S4 male paired with/defending an adult female or immature of either sex (actual sex may be unknown).

Q = Loser*
W = Winner*
Y = Tie*

} Codes used for A/S4 male-male contests only (actual sexes may be unknown). See the attached **CONTEST RULES**.

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* Requires a corresponding code on the line of the associated seal:

Code	*Corresponding code*
C, **C1**, **C2**	**F**, **F1**, or **F2**
D.	**F**, **F1**, or **F2**
J, **J1**, **J2**	**J**, **J1**, and **J2**, respectively
P	**P**
L1	**L1**
Q	**W**
W	**Q**
Y	**Y**

---

2) Nothing nearby

O = No behavior or association.

3) No data

X = No association data recorded on Census or Atoll Count.

Entry	Description
NOTES	There is room to code 2 different notes. Always use the first column first. Code an **H** if you have handwritten notes on the observaion. Put handwritten notes on the bottom of the census form, labeled by line number. If more than two note codes apply, use continuation lines. However, the **D** code must appear on the original line. **A** = Artwork (scars down) **B** = Birth, first sighting post-partum (mom and pup) **D** = Seal is dead **G** = Seal is green with algae **H** = Handwritten notes **I** = First sighting after an interatoll movement **M** = Marked, bleach number first applied/reapplied post-molt **W** = Weaning, first sighting post-weaning (pup) **X** = Pup exchange, first sighting after a pup exchange

Entry	Description
EVENT	These columns are used to record a variety of data. The codes used will depend upon the type of event that you wish to record. Left justify your coding:
TYPE	**CODES** **COLUMN** **CONTENT**
M = Mobbing/harassment	**1-3** Mobbing/harassment number
N = Necropsy	**1-3** Necropsy number
E = Entanglement	**1-3** Entanglement number **4** New/resight? **(N/R**
W = Wound	**1-3** Injury number **4** New/resight? **(N/R)**
H = Animal handling	**1** Handling type **T** = Tagging **M** = Measuring (includes weighing) **A** = All (both tagging and measuring) **R** = Remote tagging **B** = Bleeding **O** = Other
P = Photo	**RECORD NON-SEAL PHOTOS IN THE HANDWRITTEN NOTES.**
	1 Type of photo **S** = Slide **P** = Print
	2-3 Roll number (pad with zeros)
	4-5 Frame number (pad with zeros)
	6 Side **L** = Left lateral or flipper **R** = Right lateral or flipper **D** = Dorsal side **V** = Ventral side **B** = Both (used for rear flippers only) **X** = Other; describe in handwritten **NOTES**

(**PHOTO** *continued on following page*)

Entry	Description

TYPE

(**PHOTO**, *continued*)

S = Specimen/sample

CODES COLUMN **CONTENT**

7 Part

- **H** = Head
- **A** = Anterior body (neck and shoulders)
- **M** = Midbody (behind foreflippers and before posterior)
- **P** = Posterior body (behind midbody and before rear flippers)
- **F** = Foreflipper
- **R** = Rearflipper

} write whether dorsal/ventral in hand-written **NOTES**

- **O** = Overall view of a particular side
- **X** = Other, describe in handwritten **NOTES**

8 Purpose

- **I** = Identification
- **W** = Wound (link with wound **EVENT** using continuation lines)
- **N** = Necropsy (link with necropsy **EVENT** using continuation lines)
- **E** = Entanglement (link with entanglement **EVENT** using continuation lines)
- **X** = Other, describe in handwritten **NOTES**

DON'T RECORD SPECIMEN COLLECTION HERE IF YOU ARE CONDUCTING A NECROPSY--USE THE NECROPSY FORM.

1-2 Specimen type

- **SC** = Scat
- **SP** = Spew
- **T** = Tissue
- **M** = Molt
- **P** = Parasites
- **D** = Debris
- **Z** = Other

Entry	Description

TYPE

T = Tag condition

CODES

COLUMN **CONTENT**

1 Web

- **A-D** = From inner (medial) to outer web
- **E** = Ankle
- **P** = Posterior
- **U** = Unknown

2 Side of *tag*, the dorsal tag side is on the dorsal flipper surface unless the tag is reversed. For Temple Tags, the dorsal side is the bigger side; for Riese and Metal (Monel) tags the dorsal side is the *male* side. For PIT tags, code the side as **B** (both).

- **D** = Dorsal
- **V** = Ventral
- **B** = Both
- **U** = Unknown

3 Condition

- **B** = Broken
- **F** = Faded color
- **G** = Good
- **L** = Tag lost
- **N** = No/partial resin
- **P** = Pulling out
- **R** = Recovered
- **U** = Unreadable
- **V** = Tag side reversed
- **W** = No. worn/ abraded
- **O** = Other

V = Vestibule

ONLY NOTE VESTIBULE STATUS AT LAYSAN ISLAND AND KURE ATOLL IN 1994

1 Vestibule code

- **0** = No swelling, normal
- **1** = Slight swelling, puffy
- **2** = Extensive swelling, dark protruding tissue

ADDITIONAL PROTOCOL

1. All original monk seal data should be coded in pencil. Never erase data once you have left the recording site. Instead, cross errors out with a single line. Field editing is editing before running the data entry and checking program. All field editing by the data collector should be in blue, and field editing by others should be in red. As soon as you begin the entry and checking program, the computer will assign the computer page number and display it on the screen. At this point, *be sure* to fill it in on your census form. All editing after this point should be in orange. After completing the entry and checking program, check off and initial the **ENTERED** box on the census form.

2. A separate data sheet should be filled out for each date, observer, data type, and island within an atoll. If no seals are present, you should still fill out the information at the top of the census form and write **No seals** in the data area (only enter the header information). If the island itself is not present, indicate this by using **99** for the sector code, leaving the rest of the (first) line blank. To save paper, you should use a census form with multiple headers if you only have a few seals to record (*i.e.*, at some islands within an atoll, or when recording incidental sightings before or after census or formal patrol). In essence, on a census form with multiple headers, each header and its associated lines represents a separate data sheet.

3. If two people conduct the census, they should have the same weather and the same begin and end time (*i.e.*, both begin at the same time and place, and proceed in opposite directions until they meet on the other side of the island or islet).

4. Weather information (except temperature) should be a summary of the entire day up until the end of the census or patrol, not merely an instantaneous observation.

5. Make a new original line (*i.e.*, do not use continuation lines) for a seal each time that you come abreast of it on census or patrol. If the seal is identified, it will not be counted twice on census. To link two sightings of an unidentified seal (*i.e.*, a cruiser moving ahead of you on census), assign it a unique temporary number in a series reserved for unidentified seals.

6. Only code the sex as known if the ventral is seen or if the seal is the mother in a mother/pup pair, even if you *know* the sex because of the tag, bleach, scars, or behavior.

7. Record all tag sightings explicitly (*i.e.*, both left and right tag numbers) at least once during your stay. When a pup is tagged, record the first occurrence of each tag on a census data sheet for that date as well as on a tagging card. If a seal is identified via a tag, it is not necessary to determine and enter its ID number on the census form. The ID number will be added by computer later.

8. Be sure to code the *original* tag color—not the color that a tag has faded to. See the Tag Sample Kit in the Bible.

Original Tag Color	Faded Tag May Appear As
Temple Tags	
Light Tan (**A**, **T**, **K**, **L** series @ Laysan)	Gray, Light Yellow, White
Dark Tan/Brown (later series @ Laysan)	Red
Gray (**A**, **T**, **K**, **L**, **N**, **F**, **U**, **G** series @ Kure)	Light Tan
Silver Gray (**600-900**, **O**, **Z** and later @ Kure)	Metal
Red	Orange
Yellow	White, Light Yellow
Green (dark forest)	Dark Blue, Navy
Blue (light)	—
Riese Tags (colors almost completely faded--just note presence if you can ID by other means):	
White	Yellow
Red	Orange
Orange	Red
Yellow	White
Green	Blue
Blue	Green

9. On a census or atoll count, it is assumed that condition, molt and disturbance data will be taken. At locations other than Laysan Island and Kure Atoll, it *is not* assumed that association data will be taken on census or atoll count in 1994. Thus, on a census or atoll count sheet from these other locations, no code in any of the association columns means that data was not taken, and an **X** code will be filled in by computer back in Honolulu. If you wish to indicate that a seal was alone, use the **O** behavior code. At Laysan Island and Kure Atoll in 1994, it *is* assumed that behavioral data will be taken on census (and during behavior patrol). Thus, on a census or behavior patrol data sheet from Laysan Island or Kure Atoll, no code in any of the association columns means that the seal was alone, whereas on a regular patrol data sheet from the same location, no code may simply mean that no data were taken. It is not necessary to put an **O** code for each unassociated animal on census or during behavior patrol at these locations because it will be filled in by computer back in Honolulu. If you are unable to record association data on a census or behavior patrol at Laysan Island or Kure Atoll for any reason, indicate this with an **X** for the behavior code.

10. An association should *either* be all blank *or* have the **O**, **Z**, or **X** behavior only, with no line number or distance, *or* have a line number, a distance, and some behavior code (other than **O** or **X**) all present. Don't record behaviors of an animal after it has been disturbed by the observer.

11. All associations should be in pairs, *i.e.*, between animals on two different lines. If the behavior is active, you should fill in the line numbers, distances, and behavior codes for both animals involved in the association. If the behavior is **N** or **L**, however, you may record the association on only one of the lines, and the entry/checking program will fill in the other line. When recording an active behavior that requires a corresponding code, the association line number should refer directly to the line where the corresponding behavior is coded (*i.e.*, if the corresponding code is on a continuation line, refer to that particular line, not to the original line or a different continuation line).

12. During the first weeks of the field camp, note tag condition each time that a tag is sighted. Once the majority of tags have been resighted, observers can carry a list of tags/individuals that haven't been seen, and only note tag condition if these tags/individuals are resighted. Also, carry a list of broken or lost tags so that you will be aware, and can record, if a specific tag breaks or is lost during the field season.

13. At Laysan Island and Kure Atoll, note vestibule status for all S4 and adult females, except nursing moms, whenever you can get the information. Make a special effort to determine vestibule status for post-weaning moms.

14. *Do not* make up additional codes. If the need for an additional code arises, contact Honolulu.

CONTEST RULES

1. Size class collapse for contests: all subadults = adults (both sexes)

2. Definition of pair type (depends on associate of adult male):

   - Pair type **#1**: adult male with adult female (**L1**)
   - Pair type **#2**: adult male with juvenile or pup of either sex (**L1**)
   - Pair type **#3**: *single* adult male not pair type **#1** or **#2**

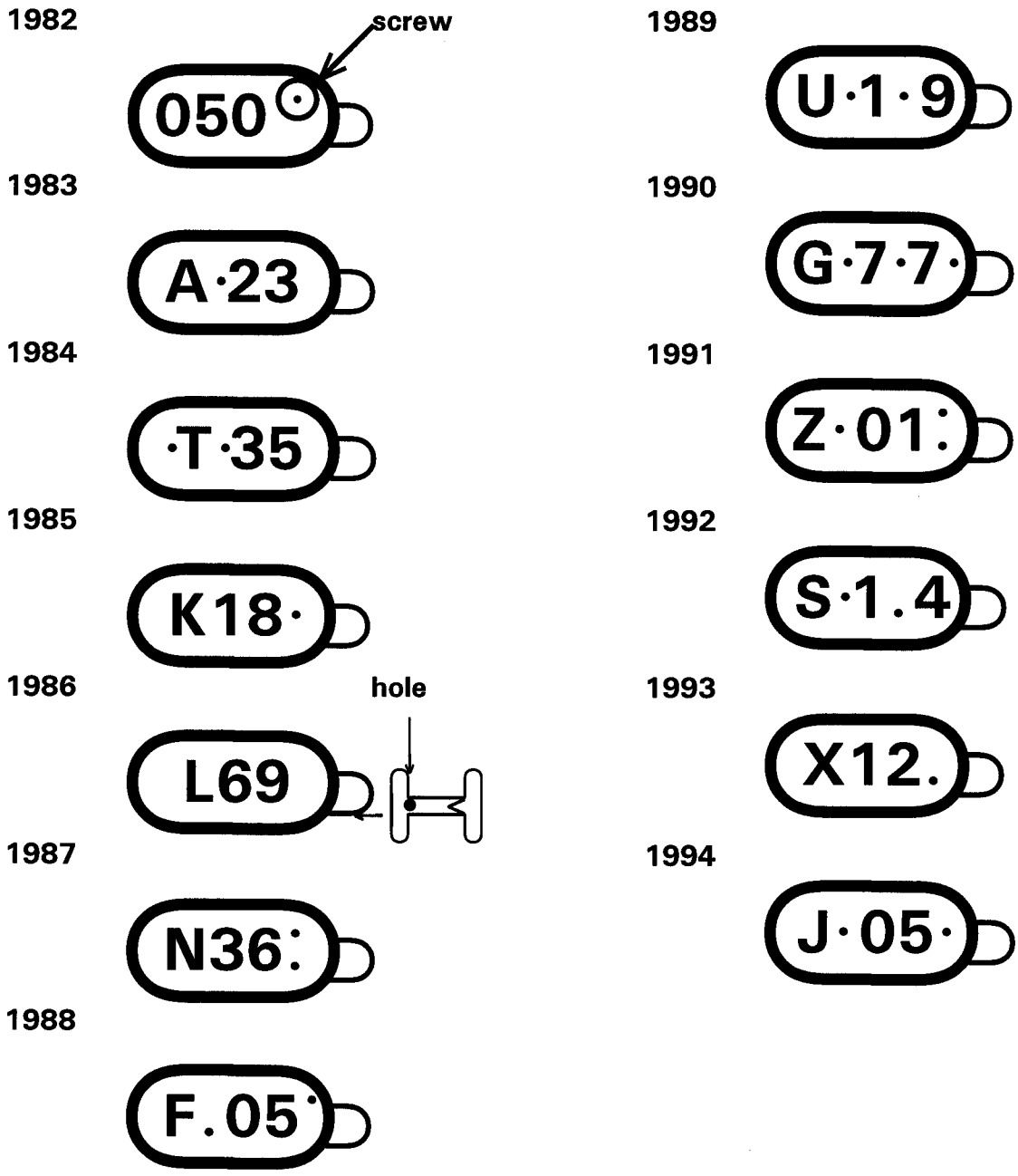
3. Definition of a male-male contest (must conform to at least one condition below):

   - Distance between males = 0
   - Either adult male vocalizes (**V**) or performs a **C**, **D**, or **J**
   - If cruiser approaches to beach position ≥1, regardless of other behaviors

4. Definition of winner or loser adult male:

Case	Winner (W)	Loser (Q)	Tie (Y)
Paired Male *vs.* Single Male: (**#1** or **#2** *vs.* **#3**)	i) Original Single Male if has **D**	Has **F**	No Ties
	ii) Original Paired Male otherwise		No Ties
Male Paired with Adult Female *vs.* Male Paired with Juvenile Seal: (**#1** *vs.* **#2**)	i) Original Male Paired with Juvenile if has **D**	Has **F**	No Ties
	ii) Original Male Paired with Adult Female otherwise		No Ties
Paired Male *vs.* Paired Male where both pairs are same type: (**#1** *vs.* **#1** or **#2** *vs.* **#2**)	Has **D**	Has **F**	Tie if no **D**
Single Male *vs.* Single Male: (**#3** *vs.* **#3**)	Has **D** or **C**	Has **F**	Tie if no **D** or **C**

HAWAIIAN MONK SEAL TEMPLE TAGS
NUMBERING SCHEME AND HOLE DRILLING SEQUENCE FOR WEANED PUPS



DIRECTIONS FOR RECORDING RIESE TAG NUMBERS AND COLORS ON THE CENSUS FORM

Beginning in 1988, we will be using Riese tags on adults at Laysan. The tags will have letters on them, but the combination of multiple tag colors, flipper position, and presence or absence of holes in the tags will also enable a seal to be individually identified. To record this information on the census form requires some modifications of our method of recording tags. The rules for recording Riese tags are:

1. The *color* of a Riese tag is **P** (plastic).

2. The tag position of a Riese tag is either **L** or **R** (not **B**).

3. The *number* of a Riese tag may be *either*:

   a. the 2 letters printed on the tag; or

   b. a combination of 3 letters which indicate presence or absence of a hole in the tag and colors of the 2 halves of the Riese tag. Codes for hole condition are:

H	=	Hole present
N	=	No hole present

Codes for colors are:

B	=	Blue
G	=	Green
O	=	Orange
R	=	Red
W	=	White
Y	=	Yellow

Hole condition is codes first, then 2 colors. Example of recording a red and green Riese tag, with hole, on the left flipper:

TAG								
No.						L/R	Col	?
		H	R	G	L	P		

4. For each sighting, use either method **a** with 2 letters, or **b** with 3 letters, *but not both.* The computer will know the difference according to whether you enter 2 letters or 3. In method **a**, the combination of 2 letters printed on each tag is unique, so tag position and color merely provide a check for consistency. Tags are printed on only one side, however. In method **b**, the combination of 2 colors, hole condition, and tag position also identifies an individual seal. The order in which the 2 colors are recorded does not matter. In the example above, **HRG** and **HGR** would mean the same. Hole condition (**H**) or **N**) and tag position (**L** or **R**) *do* matter, however, so these must be seen and recorded correctly.

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