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THE HAWAIIAN MONK SEAL ON LISIANSKI ISLAND: 1983

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1. Map of Lisianski Island showing 49 sectors and pupping sites, 1983.

ABSTRACT

A study of the endangered Hawaiian monk seal, Monachus schauinslandi, was conducted on Lisianski Island, in the Northwestern Hawaiian Islands, from 25 April to 9 August 1983. The entire monk seal population on Lisianski Island had been identified during 1982 by scars, natural markings, and applied bleach marks; this identification was carried through the 1983 field season. A census was conducted every other day, and the entire island was monitored daily for noteworthy events. Monk seal scats and spews were collected, and all net and fishing gear flotsam that washed ashore were sampled and then destroyed.

Excluding pups, beach counts on census ranged from 66 to 108 seals (average of 86). There were 258 individual seals identified on Lisianski during 1983. Twenty-five pups were born; 24 survived to weaning and all weaned pups were observed within 11 days before camp termination. In addition to the pup, another seal died during and one seal died just before the beginning of the field season.

During a 1-year period (August 1982 to August 1983), 9 seals immigrated to Lisianski, 3 seals emigrated from Lisianski, and 14 seals either disappeared or died.

INTRODUCTION

Lisianski Island, in the Northwestern Hawaiian Islands (NWHI), is one of eight major haul-out and pupping areas used by the Hawaiian monk seal, Monachus schauinslandi. A field camp was established by the National Marine Fisheries Service, Honolulu Laboratory on Lisianski Island from 17 March to 14 September, and from 26 October to 22 November 1982. The entire resident monk seal population was bleach-marked or scar-identified, and molting seals were rebleached to maintain their identity (Stone 1984). Frequent censuses documented individual haul-out patterns.

The information gathered in 1982 offered a unique opportunity to assess size- and sex-specific survivorship and to document movement between monk seal subpopulations during the 1983 field season.

Objectives of the 1983 Lisianski field study were to continue observations and data collection similar to that done during 1982: 1) census, 2) tag all weaned pups, 3) bleach- or scar-identify all individuals new to the population, 4) rebleach molting seals to maintain their identity, 5) continue individual scar card and photographic documentation, 6) monitor injuries and deaths, 7) perform necropsies, 8) monitor reproduction, 9) collect association data and monitor incidents of adult male harassment, 10) collect scat, spew, and necropsy samples, and 11) collect net samples and burn dangerous net and rope fragments capable of entangling seals.

This report summarizes findings of the 1983 field season on Lisianski Island.

AREA AND METHODS

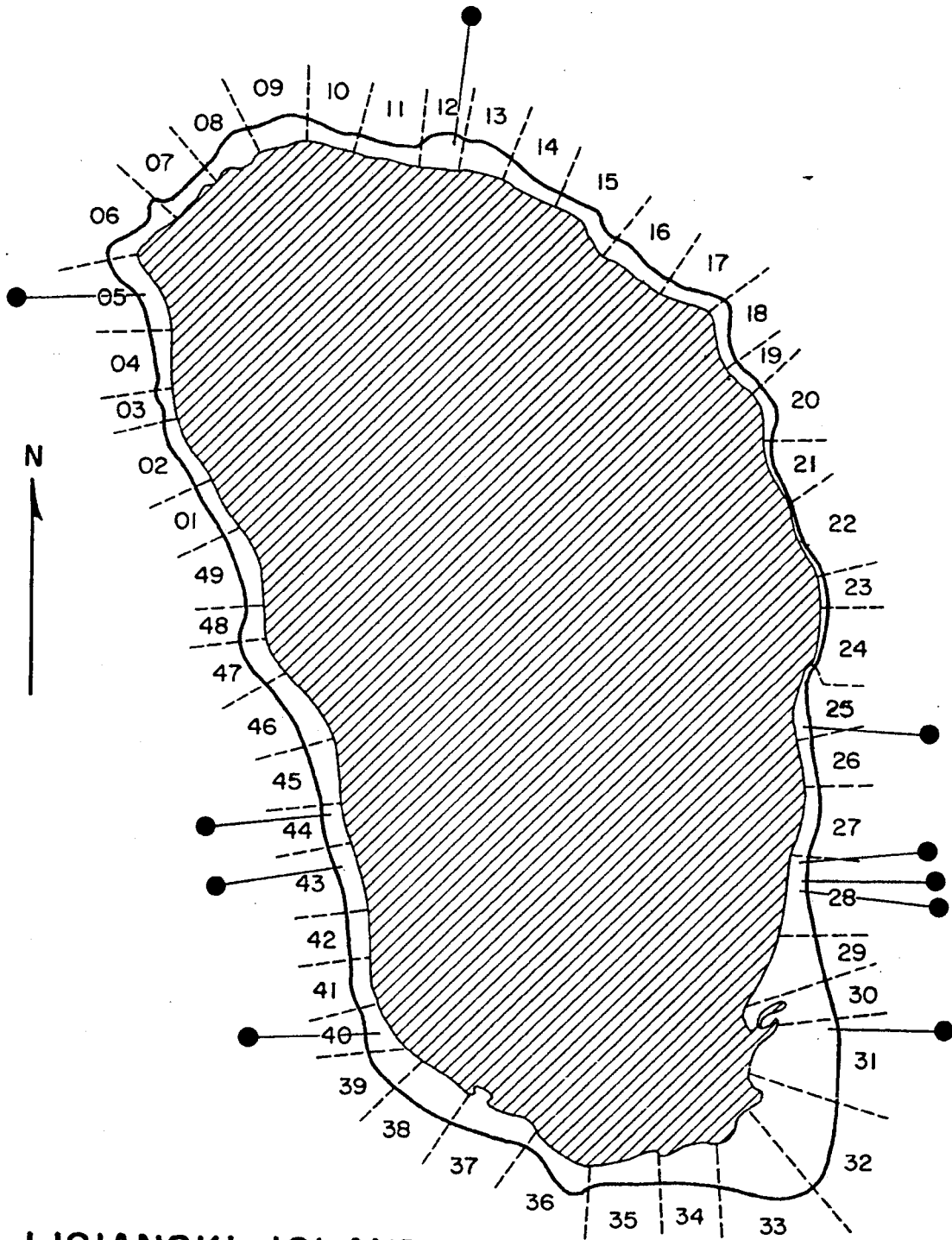
Area

Lisianski Island (lat. 26°02'N, long. 174°00'W) is a low, coral island located 925 nmi northwest of Honolulu, Hawaii. It is situated on the northern end of Neva Shoal, a shallow bank. Its closest neighbors are Laysan Island, 110 nmi to the southeast, and Pearl and Hermes Reef, 125 nmi to the northwest. Lisianski is approximately 1,800 m long and 1,000 m wide, oriented along a north-south axis. Its circumference is approximately 5.25 km.

The island has a 10 m band of open beach, except at a portion of the eastern coast where a rocky limestone ledge interrupts the beach and at the southern end of the island where a sand dune system creates a wide margin between vegetation and the ocean. The dominant vegetation is the bunchgrass, Eragrostis sp., and along the coastline in open patches the puncture vine, Tribulus cistoides, is common. Information covering the geology, vegetation and history of Lisianski Island is presented in Clapp and Wirtz (1975).

For the purpose of definition of beach location in data collection, the Lisianski Island perimeter was divided into 49 sectors of nearly equal size (Fig. 1). These are the same sectors used in the 1982 study (Stone 1984).

● = Birth Sector



LISIANSKI ISLAND

Figure 1.--Map of Lisianski Island showing 49 sectors and pupping sites, 1983. (● = pupping site.)

Methods

We were present on Lisianski Island from 25 April to 9 August 1983. Continuity in census methods, individual identifications of seals, and sector boundaries were maintained between the 1982 and 1983 field camps so that comparisons between years would be valid.

Bleach and Scar Identification

New arrivals to the population were bleach- and scar-identified. Molting seals, when about 70% or more molted, were rebleached to maintain their identity. Bleach (Ultra-Blue¹ or Clarolite), mixed with 20-35% peroxide and powdered protenator, was applied with a squeeze bottle to the fur of sleeping seals. Numbers and letters were bleached on the pelage for unique identification, and a line or "girdle" transversing the pelvic region was also applied. This "girdle" could be easily seen in most positions assumed by a seal and helped observers recognize a seal as marked.

Bleach marks, scars, and natural markings were sketched on a card (Alcorn and Buelna²) 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.

Marking and Tagging Pups

Pups were bleach-marked and tagged as soon as possible postweaning. Bleach was applied while the pups were asleep. Pups were approached for tagging while they were asleep and relatively isolated from other seals. During tagging, one observer restrained the weaned pup while the other observer inserted a green plastic Temple Tag into a 5.0 mm hole punched into the innermost web of each hind flipper. Axillary girth and standard length measurements were taken. Newly tagged pups were released in the wave wash zone and their responses were monitored for 5-15 min following tagging to determine whether tagging caused any obvious adverse reaction.

Census

Censuses were made every second day from 27 April to 7 August, starting at 1300 (Hawaii standard time) and lasting from 1-3/4 to 3-1/4 h

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

²Alcorn, D. J., and E. K. Buelna. The Hawaiian monk seal on Laysan Island: 1983. Manuscr. in prep. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812.

each. We began the census at Sector 1 and proceeded around Lisianski in an opposite direction until we met on the far side (usually Sectors 23-28). We alternated direction of travel on each census. One census was postponed on 5 August, followed by consecutive censuses on 6 and 7 August, and two censuses began off schedule due to logistical difficulties. Fifty-two monk seal censuses were conducted.

The census-patrol form and coding instructions are included in Alcorn and Buelna (footnote 2). The following general information was recorded: island, date, observer, type of data (census or patrol), time begin and end, and average weather conditions of the day, up to and including the observation period. Data recorded for each animal on census are as follows: sector location, size class, sex, individual identification, beach position, percent molt, disturbance by observer (if any), association with other individuals, and association with objects that could entangle a seal. 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 were also recorded if they interacted with individuals on the beach or could be positively identified, but they were not included in the census totals.

Patrol

Patrols followed census procedure except for the following differences: 1) one observer proceeded around the island, beginning in Sector 1 and alternated direction of travel on each patrol, and 2) only molting seals, yearlings, nursing mothers, pups, and "associated" individuals were recorded.

Patrol days occurred two and three times a week on alternate weeks. From 28 April to 13 June, 3-4 h morning and evening patrols were conducted starting at 0900 and 1600, respectively. From 15 June to 21 July, only evening patrols were conducted on patrol days. Forty-three patrols were conducted on off census days.

Daily Monitoring

The perimeter of Lisianski Island was walked at least twice daily. We minimized disturbance by staying above the beach crest and using the vegetation as cover. In addition to formal censuses and patrols, 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 illnesses, and presence of seals marked at other atolls. The rebleaching of molting seals and scar or photographic documentation of individuals were done opportunistically on a daily basis.

Incidental data collected daily from 26 April to 8 August and entered on the census-patrol form include sightings of molting seals, yearlings, nursing mothers, and pups not already recorded on census or patrol for that day.

Collection of Materials

Necropsy.--An external examination was made, photographs taken, and external measurements and observations recorded for each dead seal recovered. The skulls were flensed and staked until completely dried.

If the death was recent, an internal examination was made. Blood samples were collected, hematocrit determinations were made in the field, and serum was frozen for later testing. Blubber thickness was measured at three points along the ventral surface. Major body organs were weighed and samples preserved in 10% Formalin. Endoparasitic, stomach, and fecal samples were collected and preserved in 70% alcohol.

Scats and spews.--Scats and spews were collected from seals of known age class or sex. Information recorded for each scat or spew is shown on the data card (footnote 2). Processing involved soaking the scat or spew in a mild detergent solution, and then washing it through a set of nested sieves (mesh sizes 2.80, 1.18, and 0.71 mm). Material left on the screens was subsampled to collect items for later analysis and identification. Items recovered and preserved in 70% alcohol included parasites, fish parts (bones, otoliths, lenses, scales, and teeth), crustacean parts, cephalopod beaks, and lenses. Tissue samples from fresh spews were frozen for later analysis for ciguatoxin by an enzyme-linked immunoassay procedure. Identification of the fish, crustacean, and cephalopod parts is ongoing at the Honolulu Laboratory.

Entanglement and net accumulation.--Fishing gear, cargo netting, and other man-made debris have been implicated in NWHI marine mammal and turtle entanglements (Balazs 1979; Henderson 1983; Alcorn 1984; Stone 1984). On Lisianski Island, we continued the 1982 practice of monitoring net and other debris, that washed ashore, capable of entangling seals. Net and rope samples were collected. Information recorded concerning the debris included: a) date washed ashore, b) location, c) type of material (plastic, nylon, polypropylene, etc.), d) dimensions, e) mesh size or rope diameters, f) condition of the material (frayed, brittle, etc.), and g) color (yellow, white, yellow-black, etc.).

All nets, lines, ropes, and other items that had entanglement potential were removed from the beach and burned before we left Lisianski in August 1983.

If an entanglement was observed, information was collected on the census-patrol form and the event was documented by photographs. The object was subsequently removed and saved.

RESULTS AND DISCUSSION

Census Counts

Over 5,200 monk seal census sightings were made during the 1983 Lisianski field season. Sex was determined in 98% of these sightings, either by direct observation or by positive identification of an individual of known sex. Table 1 gives the 1983 census counts broken down by age and sex class. Identified individuals were placed within their assigned size classes whereas unidentified seals retained the size classification given by the census observer.

The total number of seals observed on a census beach count ranged from 74 to 124 individuals (average 101). Excluding pups of the year, census beach counts ranged from 66 to 108 individuals (average 86).

Population Structure and Changes

There were 258 individual seals identified on Lisianski during the 1983 field season. Table 2 shows individual monk seal haul-out patterns on Lisianski by date observed on shore in 1983. The numbers of individuals observed during 1982 and 1983 are listed in Table 3 by sex and estimated midsummer size class. Excluding pups of the year, there was an increase of 18 individuals observed using Lisianski between the entire 1982 and entire 1983 field seasons. The 1982 and 1983 field seasons lasted 208 days and 106 days, respectively. There were 236 identified individuals present in the Lisianski population in August 1982 and 253 in August 1983. The changes by size and sex within the Lisianski population over this period are shown in Table 4. One year later, 222 of the original 236 individuals present in August 1982 still frequented Lisianski beaches; 17 individuals were lost from the population due to emigration, death, or disappearance, and 34 individuals entered the population either by immigration or birth. Observers were not present on Lisianski from 23 November 1982 to 24 April 1983, therefore any individual that entered and left the Lisianski population between these two dates is not included in the analysis.

Reproduction

Pup Production and Survival

At least 25 pups were born in 1983 (Table 5); 11 weaned pups and 5 nursing pups were present on Lisianski when we arrived on 25 April, and 9 pups were born thereafter. The sex ratio of the 1983 pup cohort was heavily skewed toward females: 18 females: 7 males (1:0.4). Pup survival was high: 24 of 25 pups survived to weaning, and all weaned pups were sighted within the last 11 days before camp termination. One male pup died 7 days after parturition. It is unlikely that any pups were born after we left the island on 9 August, since all nonparturient adult females had completed molt by that date.

Table 1.--Lisianski Island, 1983: monk seal size and sex class totals/census (AF = adult female; AM = adult male; AU = adult, sex unknown; SF = subadult female; SM = subadult male; SU = subadult, sex unknown; JF = juvenile female; JM = juvenile male; JU = juvenile, sex unknown; WF = weaned female pup; WM = weaned male pup; WU = weaned pup, sex unknown; NF = nursing female pup; NM = nursing male pup).

Census date 1983	Size and sex class totals/census															Nonpup total	Pup total	Grand total
	Nonpups									Pups								
	AF	AM	AU	SF	SM	SU	JF	JM	JU	WF	WM	WU	NF	NM				
4/27	13	39	1	5	4	3	4	7	2	1	2	1	3	1	78	8	86	
4/29	16	28	1	2	6	0	4	9	0	8	3	0	3	1	66	15	81	
5/01	19	39	2	12	10	0	6	9	0	4	2	0	3	1	97	10	107	
5/03	15	44	0	6	9	0	9	8	0	5	3	2	4	1	91	16	107	
5/05	12	44	2	10	13	0	7	10	1	6	3	1	4	1	99	15	114	
5/07	15	40	4	7	9	2	6	7	0	3	2	0	5	0	89	10	99	
5/09	16	38	1	5	12	1	5	6	0	8	3	0	4	1	84	16	100	
5/11	21	30	4	6	13	1	9	12	0	9	1	0	5	0	96	15	111	
5/13	16	24	3	5	3	2	6	8	0	9	3	0	2	3	67	17	84	
5/15	13	29	2	8	8	0	7	10	1	8	2	2	2	2	78	16	94	
5/17	18	35	3	7	6	0	9	6	0	8	1	0	3	3	84	15	99	
5/19	21	39	0	11	14	3	8	9	0	7	1	0	1	3	105	12	117	
5/21	21	37	1	8	10	1	5	11	1	11	3	0	3	2	95	19	114	
5/23	18	42	1	11	13	1	9	13	0	11	3	0	0	2	108	16	124	
5/25	21	30	2	12	12	0	8	9	0	12	3	0	2	2	94	19	113	
5/27	17	33	1	11	8	1	7	12	0	8	2	0	3	1	90	14	104	
5/29	19	36	1	12	11	1	9	6	0	11	2	0	2	1	95	16	111	
5/31	18	37	1	14	12	1	5	13	1	11	1	0	1	2	102	15	117	
6/02	15	31	1	12	11	1	6	9	0	11	2	0	2	1	86	16	102	
6/04	23	33	0	14	12	1	5	6	0	10	4	0	3	1	94	18	112	
6/06	15	31	0	12	13	1	6	10	0	8	3	0	2	1	88	14	102	
6/08	16	28	1	13	14	1	5	8	0	12	2	0	2	1	86	17	103	
6/10	16	34	1	8	14	1	5	6	0	9	2	0	1	1	85	13	98	
6/12	18	30	2	13	12	2	4	14	0	10	3	0	0	0	95	13	108	
6/14	13	26	1	13	17	0	8	8	0	12	2	0	1	1	86	16	102	
6/16	14	28	1	13	16	0	5	12	0	15	2	0	1	1	89	19	108	
6/18	20	34	1	16	16	1	6	9	1	12	3	0	1	1	104	17	121	
6/20	17	33	1	14	18	1	10	8	0	13	4	0	2	0	102	19	121	
6/22	13	27	1	13	15	0	5	14	0	9	3	0	2	0	88	14	102	
6/24	13	34	1	14	15	1	5	10	0	11	4	0	2	0	93	17	110	
6/26	12	30	1	11	16	0	4	10	0	12	2	0	1	0	84	16	100	
6/28	17	34	2	10	14	1	7	12	0	13	4	0	1	0	97	18	115	
6/30	17	29	0	8	17	1	5	11	0	10	3	0	0	0	88	13	01	
7/02	13	29	0	10	15	0	5	10	0	10	2	0	1	0	82	13	95	
7/04	17	33	0	9	10	0	3	10	0	7	3	0	1	1	82	12	94	
7/06	14	24	1	11	16	1	6	12	1	10	2	0	1	1	86	14	100	
7/08	13	23	0	9	13	0	4	11	0	12	3	0	1	1	73	17	90	
7/10	18	18	1	9	11	0	6	11	0	9	4	0	1	1	74	15	89	
7/12	11	26	0	6	12	0	4	8	0	5	1	0	1	0	67	7	74	
7/14	19	31	0	6	14	0	5	12	1	10	1	0	2	1	88	14	102	
7/16	19	26	0	4	13	0	1	12	0	9	2	0	2	1	75	14	89	
7/18	18	33	0	6	12	0	3	11	0	11	2	0	1	1	83	15	98	
7/20	19	31	0	3	14	0	4	9	0	8	2	0	2	1	80	13	93	
7/22	17	31	0	7	14	1	5	9	0	9	3	0	2	1	84	15	99	
7/24	16	34	0	3	11	0	6	10	0	9	1	1	2	0	80	13	93	
7/26	19	29	0	3	14	0	6	8	0	8	3	0	1	1	79	13	92	
7/28	14	35	0	8	13	0	4	12	0	9	2	0	0	0	86	11	97	
7/30	12	36	0	4	12	0	5	8	0	6	3	0	0	1	77	10	87	
8/01	12	34	1	5	15	0	6	10	0	8	1	0	1	1	83	11	94	
8/03	11	36	0	1	10	0	5	10	0	8	4	0	1	1	73	14	87	
8/06	9	32	0	5	13	0	3	5	0	5	4	0	1	0	67	10	77	
8/07	9	35	1	7	15	0	7	10	0	7	4	0	0	0	84	11	95	

Table 2.--Individual monk seal sightings by date observed, Lisianski Island, 1983.
 (M = molting, B = first time pup observed with mother, P = mother-pup pairs, and
 D = last observation--seal died or disappeared.)

IDENTIFICATION NUMBER 1 ADULT MALE (PART 1 OF 2 PARTS)

IDENTIFICATION NUMBER 1	JULIAN DATE	MAY	JUNE	JULY	AUG.
A04 +	110				
A05 +	114				
A06 +	118				
A07 +	126				
A08 +	130				
A09 +	134				
A10 +	138				
A11 +	142				
A12 +	146				
A13 +	150				
A14 +	154				
A15 +	158				
A16 +	162				
A17 +	166				
A18 +	170				
A19 +	174				
A20 +	178				
A21 +	182				
A22 +	186				
A23 +	190				
A24 +	194				
A25 +	198				
A26 +	202				
A27 +	206				
A28 +	210				
A29 +	214				
A30 +	218				
A31 +	222				
A32 +	226				
A33 +	230				
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A87 +					
A88 +					
A89 +					
A90 +					
A91 +					
A92 +					
A93 +					
A94 +					
A95 +					
A96 +					
A97 +					
A98 +					
A99 +					
Y63 +					
100 +					
107 +					

Table 2.--Continued.

ADULT MALE
(PART 2 OF 2 PARTS)

IDENTIFICATION
NUMBER

IDENTIFICATION NUMBER	JULIAN DATE															
	APR.			MAY				JUNE				JULY			AUG.	
109 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
110 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
112 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
113 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1142 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
115 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
117 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
118 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
119 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
121 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
123 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
124 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
125 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
128 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
129 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
134 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
135 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
136 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
137 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
138 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
141 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
142 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
143 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
144 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
145 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
146 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
147 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
148 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
149 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
150 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
151 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
152 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
153 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
154 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
155 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
156 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
157 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
158 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
159 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
160 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
161 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
162 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
163 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
164 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
170 +	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

110 114 118 122 126 130 134 138 142 146 150 154 158 162 166 170 174 178 182 186 190 194 198 202 206 210 214 218 222 226 230

Table 3.--The numbers of individuals observed using Lisianski Island during the 1982 and 1983 field seasons, by sex and estimated midsummer size class. The 1982 data are from Stone (1984).

Monk seals	Males		Females		Total		Sex ratio	
	1982	1983	1982	1983	1982	1983	1982	1983
Adults	101	101	41	40	142	140	2.5	2.5
Subadults	24	30	21	23	45	53	1.2	1.3
Juveniles	18	24	10	16	28	40	1.8	1.5
Pups	16	7	11	18	27	25	1.5	0.4
Total	159	162	83	97	242	258	1.9	1.7
Total excluding pups	143	155	72	79	215	233	2.0	2.0

Table 4.--Population changes on Lisianski Island over a 1-year period, August 1982 to August 1983 (numbers in parentheses indicate the identification number of the individuals). The 1982 data are derived from Stone (1984:table 2).

Size class	August 1982 population	Number born	Observed change			August 1983 population
			Number immigrated	Number emigrated	Number disappeared or died	
<u>Males</u>						
Adult	99	--	3 (166), (114) (Y63)	0	2 (151), (166)	100
Immature (age unknown)	41	--	3 (J45) (S25) (S92)	1 (S33)	3 (J09) (J13) (S28)	40
1982 pup	14	--	0	0	1 (23)	13
1983 pup	--	7	0	0	1 (68)	6
Total	154	7	6	1	7	159
<u>Females</u>						
Adult	41	--	3 (165) (P82) (A10)	1 (165)	3 (A61) (104) (131)	40
Immature (age unknown)	30	--	0	1 (J02)	4 (S10) (S02) (S54) (S17)	25
1982 pup	11	--	0	0	0	11
1983 pup	--	18	0	0	0	18
Total	82	18	3	2	7	94
Grand total	236	25	9	3	14	253

Table 5.--Summary of Lisianski Island pups, 1983. (F = female, M = male,
Sec = sector, ID = identification, SL = standard length.)

Tag		ID No. bleach	Sex	Birth		Weaning		Nursing period (days)	Tagging date	Measurement (cm)		Mother ID
Left	Right			Date	Sec	Date	Sec			Axillary girth	SL	
A52	A51	51	F	--	--	--	--	--	4/27	--	--	--
A53	A54	53	F	--	--	--	--	--	4/27	--	--	--
A56	A55	55	F	--	--	--	--	--	4/27	--	--	--
A58	A57	57	F	--	--	--	--	--	4/27	--	--	--
A59	A60	59	M	--	--	--	--	--	4/29	--	--	--
A62	A61	61	M	--	--	--	--	--	4/29	--	--	--
A63	A64	63	F	--	--	--	--	--	4/29	--	--	--
A65	A66	65	M	--	--	--	--	--	4/29	--	--	--
A67	A68	67	F	--	--	--	--	--	4/29	--	--	--
A69	A70	69	F	--	--	4/30	21	--	5/03	--	--	¹ A34
A11	A12	71	F	--	--	5/23	22	--	5/29	105.0	145.5	¹ A01
A04	A03	73	F	--	--	--	--	--	5/09	--	--	--
A01	A02	75	F	--	--	--	--	--	5/09	--	--	--
A05	A06	77	F	--	--	5/12	43	--	5/13	110.0	131.0	A21
A07	A08	79	F	--	--	5/15	26	--	5/19	106.0	127.0	A38
A09	A10	50	F	--	--	5/19	25	--	5/19	125.5	144.0	A35
A14	A13	52	M	4/27	40	6/01	47	35	6/02	107.0	129.5	A29
A15	A16	54	F	5/04	05	6/08	04	35	6/08	103.0	125.0	106
A18	A17	56	F	5/09	31	6/09	28	31	6/10	100.5	128.0	102
A19	A20	58	M	5/13	44	6/20	40	38	6/22	113.0	125.5	103
A22	A21	60	F	5/23	12	7/04	20	42	7/10	129.0	142.0	A20
A24	A23	62	F	6/20	28	7/26	28	36	7/28	96.0	121.0	A44
A27	A28	64	M	7/04	28	8/06	28	33	8/08	99.0	117.0	A79
A25	A26	66	F	7/11	25	8/07	25	27	8/07	84.0	116.0	A16
--	--	² 68	M	5/13	28	--	--	--	--	--	--	101

¹ Pup switch = A01 seen with both pups 69 and 71 after A34 weaned.

² Pup mortality 5/20/85.

Time and Location of Births

In 1983, 16 of 25 pups were born before the field season began on 25 April and the last pup was born on 11 July. Most pups were born from March through May in 1982³; the first pups were born at least as early as February, and the last pup was born on 21 June.

Births occurred night and day. Five pups were probably born at night and four during the day. Birth date was defined as the date on which the new pup was first seen. Possible error in assignment of birth time is not more than 12 h. Although the moment of birth was not observed in any of the 1983 births, probable birth time can be assessed using information such as last sighting of the mother prepartum and condition of the mother, pup, and afterbirth when first sighted postpartum.

Pupping occurred primarily along the southeast coast, an area characterized by the only rocky ledges and tide pools on Lisianski (Fig. 1). In 1982 and 1983, 34% of all observed birth or weaning locations were within two sectors; these sectors have a sheltered cove (Sector 25) and a large protected tide pool (Sector 28). Dividing the coast into roughly equal thirds (Sectors 1-16, 17-32, and 33-49), 74% of all observed birth or weaning locations occurred in Sectors 17-32.

Females showed a tendency for parturition site "fidelity" (see Table 6). Of the 12 females for which there are data on birth or weaning sectors for successive years, 3 gave birth in the same sector in 1982 and 1983, and 6 gave birth or weaned their pup within five sectors of that used in the preceding year. The last three females gave birth in 8, 10, and 17 sectors away from where they gave birth the preceding year.

Pupping

Although no births were observed, three mother-pup pairs were sighted immediately following parturition:

1. A female (101) hauled up on the reef ledge in Sector 29 at approximately 1440 on 13 May. She extended her head high, looked around intently, and abruptly swam away. She was resighted at 1503 under a low Tournefortia sp. bush (Sector 27-28 border) at the water's edge with a newborn pup. The pair vocalized back and forth, and the mother looked repeatedly back at her neonate. The pup, attached to the afterbirth, moved up to its mother's head and they nuzzled each other. As the pup moved back toward the mother's hind flippers at 1505, the mother probed at the umbilical cord and it either broke or was bitten in two. The pup investigated the mother's ventral surface but did not successfully nurse during the first 3 h postpartum.

³All 1982 data in this section is based on manuscript in preparation, Hawaiian monk seal reproduction and injuries on Lisianski Island, 1982, by T. C. Johanos and J. R. Henderson, Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812.

Table 6.--Parturient females on Lisianski Island, 1982 and 1983. Numbers in parentheses indicate the sector of weaning when the pupping sector is unknown (ID = identification).

ID No.	1982			1983			Days between successive births
	Date pupped	Date weaned	Pupping location	Date pupped	Date weaned	Pupping location	
A01	<3/21	3/26	(20)	<4/27	5/23	(22)	--
A12	3/28	5/02	24	--	--	--	--
A16	5/31	7/04	25	7/11	8/07	25	406
A20	4/21	--	2-3	5/23	7/04	12	397
A21	--	--	--	<4/26	5/12	(43)	--
A29	4/12	5/21	23	4/27	6/01	40	380
A33	<3/26	3/28	(24)	--	--	--	--
A34	<3/23	4/02	(21)	<4/26	4/30	(21)	--
A35	<3/26	4/26	(20)	<4/26	5/19	(25)	--
A36	<3/23	4/20	(27)	--	--	--	--
A37	<3/26	4/11	(25)	--	--	--	--
A38	<3/23	4/19	(25)	<4/26	5/15	(26)	--
A42	4/13	5/16	11	--	--	--	--
A44	5/19	6/25	32	6/20	7/26	28	397
A55	5/08	6/18	29	--	--	--	--
A61 ¹	4/29	6/07	29	--	--	--	--
A79	6/21	7/26	28	7/04	8/06	28	378
101	5/13	6/20	28	5/13	--	28	365
102	4/20	5/27	28	5/09	6/09	31	384
103	5/03	6/07	36	5/13	6/20	44	375
104 ¹	4/20	5/26	39	--	--	--	--
105	4/23	6/03	28	--	--	--	--
106				5/04	6/08	5	--
131 ¹	5/17	6/29	28	--	--	--	--

¹Not seen in 1983.

2. A new mother-pup pair was sighted at 1437 on 20 June. The mother (A44) was at the water's edge in Sector 28, and the pup was attached to the afterbirth. The afterbirth was filled with water and anchored the pup in the wash zone. The pup was still attached at 1633, but the receding tide left the pup on wet sand and the afterbirth in a shallow tide pool.

3. A new mother-pup pair was sighted at 1732 on 11 July. The pair was at the water's edge in Sector 25, and the pup was attached to the afterbirth. The afterbirth was in the wash zone and exuded bloody fluids when roughly tossed. The mother (A16) and her pup vocalized back and forth, and the mother repeatedly raised her head to look at her neonate. The pup was impeded by the afterbirth but finally hauled up to its mother's head where they nuzzled each other.

Pup Exchange

Two pup exchanges, involving one pair of pups, were observed in 1983. Two nursing mothers, A01 and A34, with pups 71 and 69, respectively, were observed within 20 m of each other on 29 April. Both pups were small black females, although 69 was slightly larger. Only one mother, A01, was present on Lisianski Island the next day and she was with her pup, 71; pup 69 was alone, approximately 30 m away from the mother-pup pair, and was presumed weaned. On 1 May, A01 was observed with pup 69, and her own pup was alone approximately 50 m away. Pup 71 was bleached on 1 May and was subsequently observed vocalizing repeatedly and approaching various other seals in the vicinity; 71 ranged up to 20 m offshore to follow a group of adult males that was harassing a subadult female. Seal A01 and her pup, 71, were back together on 2 May, and pup 69 was subsequently tagged on 3 May. On 4 May, A01 was observed with her pup in the morning but was again with pup 69 when observed in the afternoon. The mother was with her pup when observed on 5 May, and remained with it until 23 May, when it was weaned.

Nursing Duration

Complete nursing duration was observed for 14 and 8 mother-pup pairs in 1982 and 1983, respectively. Combining years, average nursing duration was 36.4 d, and ranged from 27 to 43 d.

Parturient Females

All females known to have given birth in 1983 had been identified on Lisianski in 1982, and all but two were known to have given birth there in 1982. Three parturient females in 1982 were not observed on Lisianski in 1983. Parturition date was known in both years for eight adult females; average duration between successive births was 383.6 days, and ranged from 365 to 406 days (Table 6).

Although the minimum number of pups born was lower in 1983 than in 1982 (25 versus 28), reproductive rate remained fairly high: Excluding

adult female 165 who pupped on Laysan, at least 70% (Stone 1984) and 64% of the adult females in the population pupped in 1982 and 1983, respectively.

Mortality

Three dead seals were found during the 1983 season (Table 7):

1. On 26 April during a preliminary patrol for monk seals, a dead adult female was found in Sector 36. It had been dead for an undetermined length of time. The animal was lying supinely, three quarters buried in sand, its pelage slipping. Due to the decayed state of the carcass, it could not be identified. Cause of death was undetermined. This animal was either new to the population or was one of three adult female seals (A61, 104, or 131) observed in 1982 but not in 1983.

2. On 20 May, a 7-day old male monk seal pup was observed separated from its mother (female 101). Its body was convulsed with spasms. Three hours later the pup was found dead in the same spot in the vegetation. Its mother could not be located nearby. There was defecation on the pup's hind flippers and maggots present in the body orifices. A necropsy was performed and blood serum and subsamples of major organs were saved for analysis. Histological examination of the samples in Honolulu revealed the cause of death to be heart failure, as manifested by severe pulmonary and hepatic congestion (Appendix A). The pup probably starved; it was never observed nursing and the digestive tract was empty at the time of death.

3. On 22 May, an incident in which a dead seal was consumed by two tiger shark, Galeocerdo cuvieri, was observed off the western coast of Lisianski Island. At 1455, six adult male monk seals were observed attempting to mount and mate with a dead seal. The seal was presumed dead because of its unresponsiveness toward frequent mounting and attention directed at it, and because its head was continually underwater, therefore making respiration impossible. The seal was an unmolted bleach-marked adult or subadult of unknown sex. The "mobbing" behavior (for details see adult male aggression) occurred 20 m offshore, over a coral reef flat; visibility in the seawater was obscured by sediments from the rising tide.

Table 7.--Monk seal deaths at Lisianski Island, 1983. (A = adult, S = subadult, P = nursing pup, F = female, M = male.)

Date 1983	Size	Sex	ID	Necropsy No.	Cause	
					Probable	Known
<4/26	A	F	--	01MSLI83	Unknown	--
5/20	P	M	68	02MSLI83	Starvation	--
5/22	S/A	F?	S17?	03MSLI83	Adult male	--

By 1533, the seals were 40 m offshore, jousting to gain position over the carcass. One adult male (113) was positively identified. One animal usually mounted the carcass, clasping the carcass while the others waited, positioning themselves around the central body, fighting to gain possession.

The first tiger shark was seen at 1553. It was approximately 3 m long and swam along the coral margins of the reef investigating the commotion. The adult males ignored the tiger shark, even when it approached the congregation atop the reef. By this time, two more adult male seals (S21 and A98) were identified by bleach and scar patterns. At 1630, another tiger shark (est. 4 m long) began probing the shallow margins of the reef flat close to the activity.

Because the smaller tiger shark was able to swim in shallow water overlying the reef, it could approach closer to the site of activity than the larger shark could. As it explored various channels, the shark came to within 3 m of the group of seals. The seals continued to ignore the sharks, until at 1703 the smaller tiger shark made a pass within 2 m; one of the male seals broke from the group and headed towards the shark. At this time, seal A98 was observed mounting the corpse regularly. The number of adult males involved fluctuated, but new adult males joined the group at 1744, again bringing the total count of seals involved to six. The larger tiger shark appeared along the deep drop-off of the reef flat with the dorsal and upper lobe of its caudal fin out of the water, making species identification positive.

At 1800 the 3 m long tiger shark entered the group and vigorous thrashing ensued. The larger shark was attracted to the commotion and reached the shallow depression atop the reef flat. The adult male seals defended the carcass--their flippers and bodies rolling, fighting, splashing the water--either avoiding the shark's teeth or defending the dead seal. The tiger sharks did not appear to have bitten any seals because there was no blood apparent in the water. After a minute of splashing, the sharks left the immediate vicinity for deeper water. The six adult male seals were still in attendance but the carcass no longer rested in the reef depression; instead it drifted westward off the edge of the reef. The carcass was again mounted by a seal, while the other seals circled the pair. The activity slowly drifted over deeper water.

At 1820, blood appeared in the water, and the carcass was thrust to the surface revealing a foreflipper and then the hind flippers. Blood began to cloud the water as two tiger shark fins cut the surface. The adult male seals clustered within 2-3 m of the center of the bloodied water. They appeared to be rearing out of the water, avoiding the sharks' attack of the carcass. A tiger shark was observed rising above the surface with portions of a monk seal in its mouth. By 1824, the two tiger sharks were still in the area but no longer cutting vigorously through the water. Five seals were swimming in the large oil-blood slick resulting from the attack. No sharks were seen in the area after 1828. All seals began leaving the area at this time, swimming south along the coast. At 1835 observations were terminated.

The identity of the carcass was not confirmed, but by elimination of animals through recurring sightings on monk seal censuses, it is believed that the animal was S17, a subadult female.

Disappearance

Between August 1982 and August 1983, 13 unexplained disappearances of seals occurred within the Lisianski population (Table 4). Of the three deaths observed during the 1983 field season, only one dead seal was positively identified (68). The other two dead seals are probably included in the list of 13 absent individuals. Of the 13 absent individuals, 11 were clearly bleach-marked postmolt in 1982 and thus had a good chance of recognition if they were seen on Lisianski Island or at other locations in the NWHI where field camps were established in 1983.

Two individuals, an unmolted juvenile male (J13) and a male weaned pup (23), were sighted immediately before camp termination in September 1982 but not resighted during a field camp from 26 October to 22 November 1982 (Stone 1984). Neither of these immature seals were resighted in 1983.

Six individuals were sighted in October and November 1982 but not resighted during the 1983 field season: Three adult females (A61, 104, and 131), an adult male (166), a subadult female (S02), and a juvenile male (J09). All three adult females that disappeared gave birth on Lisianski in 1982, and one of the three was probably the unidentified adult female whose remains were found when observers arrived on Lisianski on 25 April 1983. The adult male (166) might be simply a transient who moved on; he first arrived on Lisianski on 4 September 1982 and was still unmolted when the fall field camp ended in November 1982 (Stone 1984).

Five individuals, which were seen at least once, disappeared before the final 2 months of the 1983 field season: An adult male (151), three subadult females (S10, S17, and S54) and one subadult male (S28). The three absent subadult females probably died based upon circumstantial evidence:

1. On 29 April at 1725, a subadult female (S10) was observed lying in the wave wash zone in Sector 15 accompanied by an unmarked adult male. The adult male vocalized and mounted the subadult female repeatedly. There were no back injuries evident on S10 at the time observation ended 15 min later.

On 1 May at 1020, S10 was observed 40 m offshore in Sector 19 in the company of four adult males (A56, A78, 156, and an unidentified seal). The males fought among themselves, bit, and mounted S10 repeatedly; she approached shore in Sector 21 but remained in the wave wash. When last observed at 1044, S10 was accompanied by one adult male (156) who kept his body between S10 and the beach. She had fresh surface wounds covering most of her back.

On 2 May at approximately 1630, a subadult whose size and remaining bleached pelage conformed to those of S10, was observed in Sector 15 with a severe back wound. The subadult, sex unknown, was hauled up into the vegetation with an alert adult male in attendance. Most of the skin and underlying blubber was missing from the subadult's back; the wound was more than 3 cm deep in places and extended through the blubber into muscle tissue. The subadult lay passively, its entire body quivering. The subadult (probably S10) was not observed again.

2. On 22 May, adult male "mobbing" behavior (see adult male aggression) was observed over a dead subadult or adult, sex unknown seal, which was later consumed by sharks (as described in Mortality). A subadult seal, sex unknown, was observed on 13 May with a large shark wound on the right shoulder. Subadult female S17 was last observed on 15 May and is the only subadult or adult individual that was sighted in 1983 and not seen after the 22 May shark attack. The dead seal was bleached and the bleach mark that was briefly seen conformed in position and orientation to those of S17.

3. On 3 June at approximately 0940, a subadult female (S54) was observed on the midbeach in Sector 13, closely attended by adult male A48. She had a large fresh wound on her left side. The wound was deep and probably caused by a shark bite.

On 4 June at approximately 1500, S54 was observed lying passively in the wave wash in Sector 20, attended by an adult male. The adult male repeatedly vocalized and attempted to mount the wounded subadult female. She vocalized whenever the male jarred her but did not attempt to flee. The pair was gone by 1600, and subadult female S54 was not observed again.

Factors Affecting Survival

Injuries

There were 32 animals that received injuries resulting from shark attack, adult male interaction, beach material, punctures, and unknown causes (Table 8). Only two wounded animals had injuries that could be considered life threatening. An adult male (156) was observed on 3 May with extensive lacerations on its two hind flippers, results from a shark attack. Movement along the sand during its haul out process produced trails of blood. On 16 May, the left hind flipper was amputated by necrosis, revealing the bare fibula. The right hind flipper was swollen and showed signs of healing. By 8 June the animal had begun to regain lost weight and the wound was completely healed by 28 July.

On 2 May, a subadult animal was observed hauled up into the vegetation, body "quivering" and its back torn, revealing the underlying muscle tissue. This seal subsequently disappeared (see Disappearances). The wounds of six animals (19% of total) appear to be the result of shark attacks: large open circular lacerations. Fifteen seals (47% of total) had wounds similar to ones caused by aggressive behavior of adult males. On adult females there were often extensive dorsal wounds apparently from the

Table 8.--Monk seal injuries at Lisianski Island, 1983. (A = adult, S = subadult, J = juvenile, W = weaned pup, F = female, M = male, U = sex unknown, 1 = slight, 2 = moderate, 3 = severe, 4 = fatal, P = probable cause, K = known cause.)

Field No.	Date 1983	Size class	Sex	ID.	Type	Description of initial injury		Severity	Location	P or K	Cause	Injury progression	
												1983	Description
1	4/27	A	M	A70	Laceration through fat and blubber, 15 cm		2	Neck	P	Shark		8/09	Healed
3	4/27	A	M	115	Gaping wound through fat, 10 x 40 cm		2	Dorsal	P	Shark		8/09	Healed
4	4/28	J	M	04	Gaping wound through skin, 10 cm diameter		2	Dorsal	P	Adult male		8/09	Healed
2	4/29	J	M	J28	Laceration through skin, 10 cm		1	Ventral	P	Reef/debris		8/09	Healed
5	5/01	S	F	S10	Numerous gaping wounds through skin, largest 3 cm diameter		2	Dorsal	K	Adult male		5/01	Last sighting of S10 probably same individual as field No. 9
9	5/02	S	F?	S10?	Gaping wound into muscle 30 x 60 cm		4?	Dorsal	K	Adult male		5/02	Last sighting of seal, probable mortality
8	5/03	A	M	156	Three lacerations through muscle, 5 x 15 cm, 3 x 8 cm		3	Dorsal and hind flipper	P	Shark		5/16	Left hind flipper amputated by necrosis
6	5/05	A	F	106	Gaping wound through skin, 7 cm diameter		1	Dorsal	P	Adult male		8/09	Healed
7	5/05	A	F	A88	Numerous gaping wounds through skin, largest 7 cm diameter		2	Dorsal	P	Adult male		8/09	Healed
21	5/06	J	M	39	Puncture		1	Shoulder	P	Shark		8/09	Healed
10	5/08	A	F	A62	Two gaping wounds through skin, 10 x 20 cm, 10 x 15 cm		2	Dorsal	P	Adult male		8/09	Healing
11	5/10	A	M	A57	Laceration through skin 15 cm		1	Dorsal	P	Reef/debris		8/09	Healed

Table 8.--Continued.

Field No.	Date 1983	Size class	Sex	ID.	Type	Description of initial injury			P or K	Cause	Injury progression	
						Severity	Location	1983			Description	
12	5/10	A	F	103	Numerous gaping wounds through skin, largest 5 cm diameter	2	Dorsal	P	Adult male	8/09	Healed	
13	5/11	A	F	A18	Gaping wound through skin, 15 x 60 cm	2	Dorsal	P	Adult male	8/09	Healing	
14	5/11	A	F	105	Two punctures	2	Dorsal	P	Adult male	5/25	Numerous abrasions over area 15x60 cm across 5 cm diameter	
										8/09	Healed	
15	5/13	S	F?	SI7?	Gaping wound through fat, 10 x 20 cm	2	Shoulder	P	Shark	5/15	Last sighting of SI7, probable mortality	
										5/22	Dead seal observed offshore, consumed by sharks, possibly SI7	
16	5/14	S	F	J40	Gaping wound through skin, 4 x 20 cm	2	Dorsal	P	Adult male	8/09	Healed	
17	5/18	S	M	S58?	Laceration through skin, 10 cm	1	Ventral	P	Reef/debris	8/09	Healed	
18	5/21	A	F	A12	Gaping wound through fat, 15 x 30 cm	2	Dorsal	P	Adult male	8/09	Healing	
19	5/21	A	M	A57	Two abrasions, 2 cm diameter each	1	Fore-flipper	P	Reef/debris	8/09	Healed	
20	5/22	A	F	A20	Puncture	1	Dorsal	P	Unknown	8/09	Healed	
23	5/23	A	F	A42	Two gaping wounds through fat, 10 x 20 cm each	2	Dorsal	P	Adult male	8/09	Healing	
24	5/29	A	M	112	Abrasion, 3 cm diameter	1	Fore-flipper	P	Reef/debris	8/09	Healed	

Table 8.—Continued.

Field No.	Date 1983	Size class	Sex	ID.	Type	Description of initial injury			P or K	Cause	Injury progression	
						Severity	Location	1983 Description			1983 Description	
25	5/31	A	F	101	Puncture	1	Dorsal	P	Adult male	8/09	Healed	
26	6/03	S	F	S54	Gaping wound through blubber, 10 x 20 cm	2	Lateral	P	Shark	6/04	Last sighting of S54 probable mortality	
34	6/09	W	M	52	Laceration through skin, 2 cm	1	Lip	P	Reef/debris	8/09	Healed	
7	6/27	A	F	A55	Two abrasions, 4 cm diameter, two abrasions, 2 cm diameter	1	Dorsal	P	Adult male	8/09	Healed	
28	6/29	J	F	J33	Laceration through muscle, 8 cm	1	Hind flipper	P	Reef/debris	8/09	Healed	
29	7/06	A	M	147	Gaping wound through fat, 3x8 cm	1	Hind flipper	P	Reef/debris	8/09	Healed	
31	7/21	J	M	10	Two punctures abscess, 20 x 30 cm	2	Dorsal	P	Adult male	8/09	Seal losing weight, area of infection spreading	
32	7/21	A	M	A95	Abrasion, 2 cm diameter	1	Hind flipper	P	Reef/debris	8/09	Healed	
33	8/01	J	F	35	Gaping wound through skin, 2 x 5 cm	1	Shoulder	P	Unknown	8/09	Healing	

repeated bitings by males in mating attempts. When these females were able to haul out, the wounds would dry, then heal and close.

The location and slighness of the injury on nine seals (28% of total) seem to indicate that the animals came into contact with the reef or with beach debris. These animals suffered short straight cuts.

The cause of wounds for two seals (6% of total) could not be determined from the general symptoms--a localized area (5 cm diameter) of swelling and a small amount of bloody fluid draining from edema. The injuries were on the dorsal surface between the shoulders and did not appear to hamper the movement of the seals.

Adult Male Aggression

Mobbings are defined as instances in which adult male seals collectively act aggressively toward other seals and inflict obvious injury. Two subadult females disappeared immediately following adult male aggressive incidents. One subadult female (S10) was severely injured in a series of adult male mobbings, and the other subadult female (S54) sustained a serious shark bite and was last observed being repeatedly mounted by an adult male (see Disappearances). Adult male mobbing was also observed over a dead subadult or adult which was later consumed by sharks. Adult males have been observed clasping and attempting to mount dead seals on Kure (Kenyon⁴), Laysan (Alcorn 1984), and Lisianski (Henderson⁵). In addition to the two disappearances and the death reported earlier, four incidents of adult male harassment were observed:

1. On 2 May at 1711, an adult was observed lying in the wave wash in Sector 18 while two adult males fought on the wet sand 4 m away. Suddenly the seal in the wave wash moved to deeper water. The two males on shore stopped fighting, chased the fleeing seal, and reached it 30 m offshore. Splashing, rolling, and mounting ensued for several minutes.

2. On 20 May at 1007, a nursing female (101) was observed lying in a tide pool in Sector 28 without her pup. Her pup was in convulsions in the vegetation 20 m away. At 1017 the mother was approached by an adult male, whereupon two other adult males lying nearby immediately approached her. The four seals rolled in a ball vocalizing, and all three adult males (A08, 153, and 157) either mounted or attempted to mount female 101. At least one successful mount was accompanied by a back bite. The female attempted to flee and was eventually able to haul out. By 1025, only one adult male (A08) remained, hauled out beside 101. No back injuries were evident on

⁴Kenyon, K. W. 1980. Hawaiian monk seal observations at Kure Atoll, 17 June-3 July 1980. U.S. Fish Wildl. Serv., Natl. Fish Wildl. Lab., Seattle, September 5, 1980, 35 p. + figs.

⁵J. R. Henderson, Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812, pers. commun. September 1983.

101 at this time. When observers returned at 1335, adult female 101 was gone from the area and her pup was dead.

3. On 31 May, an adult male (A17) and adult female (101) were hauled out on wet sand in Sector 28. The female moved toward the water at 1400 and the male followed. Much twisting and biting ensued when they reached the water and as the male chased the female to deeper water. This female was the same individual involved in incident number 2 above on 20 May. By 31 May, female 101 had a small fresh dorsal wound, and by 2 June her dorsal surface had numerous small wounds.

4. On 26 June, a subadult female (J32) was chased, mounted, and fought over by three adult males 25 m off Sector 2. The subadult hauled out accompanied by one of the males (A81). No injuries were apparent on the subadult, and the adult male left after several minutes.

Fifteen adult females and immature seals sustained injuries that were caused by aggressive adult males during the 1983 field season (Table 8).

Sharks

A dead seal was consumed by tiger sharks and six seals were injured by sharks during the 1983 field season. In addition to the shark attack on the seal carcass reported earlier (see mortality section) two encounters were observed between sharks and monk seals:

1. An adult male with severe shark injuries (156) (see Injuries) was observed floating listlessly off Sector 22 on 10-12 May, its left hind flipper necrotic and attached by only a few strands of tissue. A 2 m gray reef shark, Carcharhinus amblyrhynchus, was observed circling in the immediate vicinity of the wounded seal on 11 May at 1503. The shark came within 1 m of the seal twice but was vigorously charged and repulsed each time. The shark left the vicinity by 1518. The injured adult male floated 5 m from the coral ledge shoreline during and immediately following the shark incident, but was hauled out 50 m away from this location at 1627.

2. A mother (A44) and a 21-day-old nursing pup were observed 1 m outside a protecting coral ledge in Sector 28 when a 3 m tiger shark was observed swimming toward them on 11 July. The shark was first sighted approximately 40 m away from the mother-pup pair, traveling 10 m from shore. The tiger shark submerged when it was 25 m away from the pair; immediately afterwards the mother pushed her pup up onto the reef shelf and quickly followed. The mother repeatedly raised her head and looked back at the sea after reaching the protected tide pool. The tiger shark was not observed again.

Entanglement and Net Accumulation

There was only one observed instance of entanglement in 1983, although monk seals hauled up beside piles of debris and were observed with lengths of

line draped over or loosely encircling their bodies. On 22 May, weaned female pup 53 was observed with a blue rubber ring tightly encircling her neck. The pup was hauled up into the vegetation in Sector 25, fast asleep. Photographs were taken and then the ring was quickly pulled off and saved. Pup 53 woke up and vocalized when the ring was removed, but then went back to sleep.

There were 38 identified articles of net-fishing debris that washed ashore between 14 September 1982 and 9 August 1983.

Interatoll Movement

Interatoll movement was observed among Lisianski Island, Laysan Island, and French Frigate Shoals during the 1983 field season (see Table 9).

Two individuals (P82 and Y63) bleached on Laysan in May 1983 (Alcorn⁶) were subsequently observed on Lisianski. Three individuals (J02, S33, and 165) bleached on Lisianski in 1982 were observed on Laysan in 1983 (Alcorn and Buelna footnote 2), and one of these seals (S33) was also observed on French Frigate Shoals later in 1983 (Fairaizl⁷).

In addition to the two bleach marked Laysan immigrants, four unbleached individuals (A10, 114, S25, S92) were observed and bleached on Lisianski during 1983. These four could not be matched with the two members (J13 and 166) of the 1982 population that were not bleached post-molt.

Only one individual was observed to make a two-way trip; adult female 165 made a series of trips between Laysan and Lisianski.

Status of the Marked Population

Tags

All nursing pups were weaned before camp termination and double tagged. In addition, 22 of the 24 weaned pups were bleach marked.

No tag loss was observed in 1983. All 1983 pups and 1982 tagged pups still retained both hind flipper tags when last examined within the final month of the field season. An adult female, A77, observed with a right hind flipper tag (A1011) in 1982 (Stone 1984) still retained her tag when last examined in 1983. One tagged 1982 pup (23) and one tagged adult female (131) were part of the 1982 population but were not observed on Lisianski in 1983.

⁶D. J. Alcorn, Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812, pers. commun. September 1983.

⁷G. W. Fairaizl, Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96812, pers. commun. November 1983.

Table 9.--Interatoll movements of monk seals to and from Lisianski Island, observed during 1983.

Seal ID.	Size and sex	Emigration from		Immigration to		Notes
		Location	Date last seen	Location	Date first seen	
A10	AF	?	?	Lisianski	5/30/83	
114	AM	?	?	Lisianski	7/02/83	
S25	SM	?	?	Lisianski	5/29/83	
S92	SM	?	?	Lisianski	5/24/83	
P82	AF	Laysan ¹	05/12/83	Lisianski	5/30/83	Molted and rebleached on Lisianski (Laysan #57F)
Y63	AM	Laysan ¹	06/6/83	Lisianski	6/14/83	
J02	SF	Lisianski	11/2/82	Laysan ¹	4/23/83	Molted and rebleached on Laysan
S33	SM	Lisianski	10/31/82	Laysan ¹	5/20/83	Molted and rebleached on Laysan; observed at French Frigate Shoals on 10/30/83 ²
165	AF	Lisianski	05/12/83	Laysan ¹	5/22/83	Pupped on Laysan 1-2 days after arrival (Laysan #25F)
165	AF	Laysan ¹	07/03/83	Lisianski	7/18/83	Molted on Lisianski

¹D. J. Alcorn, Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, HI 96812, pers. commun., August 1983.

²G. W. Fairaizl, Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, HI 96812, pers. commun., November 1983.

Postmolt Bleach

Ninety-six individuals (excluding pups) completed molt before the end of the 1983 field season. Individual identity was maintained on all 96 molted seals through rebleaching and distinctive scars (J22 and S21). An additional seven molting seals were rebleached immediately before camp termination, although it is unknown if all these marks were retained.

Eight unmolted or molting juveniles were double tagged 1982 pups and can thus be easily reidentified postmolt. The remaining 118 unmolted or molting animals are untagged. It is estimated that 76 of these untagged individuals can be reidentified postmolt by distinctive scar patterns and natural markings. Table 10 gives the status of the marked population by size class and sex.

Table 10.--Status of the marked population at the end of the field season, Lisianski Island, 1983. (ID = Identification number.)

Size class	Sex	Bleached postmolt	Unmolted scar ID	Unmolted ID difficult	Unmolted tag ID	Total
Adult	Male	6	58	36	--	100
	Female	34	5	1	--	40
Subadult	Male	24	4	1	--	29
	Female	20	0	0	--	20
Juvenile	Male	8	3	0	--	11
	Female	4	1	0	--	5
82 pup	Male	3	5	1	4	13
	Female	4	0	3	4	11
83 pup	Male	5	0	0	1	6
	Female	17	0	0	1	18
Total		125	76	42	10	253
Total excluding pups		103	76	42	8	229

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Appendix A.--Monk seal necropsy reports, Lisianski Island, 1983.
(Pathologist was G. Stemmerman, Kuakini Medical Center, Honolulu.)

Field No.: 01MSLI83
Date of death: Estimated 3-4 weeks before
necropsy
Date of necropsy: 3 May
Sex: Female
Size class: Adult
Identification No.: Unknown

- I. Circumstances of death: Seal found lying on it's dorsal surface 4 m from the high tide mark. Carcass three quarters buried in the sand.
- II. External description: Seal's pelage had slipped. No external marks or wounds visible.

Measurements:

Standard length (dorsal side up).....213.0 cm

- III. Internal: Organs no longer distinguishable, no sign of pregnancy revealed.
- IV. Samples collected: Organ and parasitic samples were not taken due to the advanced state of deterioration of the carcass.

Skeletal: skull

Appendix A.--Continued.

Field No.: 02MSLI83
Date/time of death: 20 May between 1030 and
 1330
Date of necropsy: 20 May
Sex: Male
Age: Pup, 7 days old
Identification No.: 068

- I. Circumstances of death: Pup was observed at 1027; separated from its mother by 20 m. It's body was convulsed by spasms. The pup was dead by 1330 and it's mother had left the vicinity. The pup was never observed nursing and appeared weak prior to death.
- II. External description: No external marks or wounds. Fly larvae in mouth. Fecal matter on hind flippers. Eyes clouded and gums mottled pink in color.

Measurements:

1. Standard length (dorsal side up).....97.0 cm
2. Curvilinear length.....101.5 cm
3. Axillary girth.....34.8 cm

- III. Internal: Stomach contains white froth. Yellowish fluid in small intestine. No contents in large intestine or colon.
- IV. Samples collected: No ectoparasites or endoparasites found.

Heart	Pancreas	Adrenals	Blood plasma
Lung	Spleen	Lymph nodes	Skeletal: skull
Liver	Kidney	Intestinal contents	

V. Pathology report:

Heart: No inflammation. Very prominent conduction system (due to hypertrophy conduction cells?).

Gall bladder: No inflammation

Lymph nodes: Prominent sinuses, few stromal cells.

Spleen: Active hemopoiesis

Liver: Severely congested liver

Lungs: Marked distension of septal capillaries. No alveolar filling, but considerable atelectasis.

Adrenal: Persistent fetal zone.

Comment: The immediate cause of death would appear to be heart failure, as manifest by severe pulmonary and hepatic congestion. There is conspicuous swelling of the cardiac conduction cells.

