Northwest and
Alaska
Fisheries Center

National Marine
Fisheries Service

U.S. DEPARTMENT OF COMMERCE

NWAFC PROCESSED REPORT 79-1

FUR SEAL INVESTIGATIONS

March 1979

FUR SEAL INVESTIGATIONS, 1978

Prepared

by

Marine Mammal Division*

* Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E,, Seattle, Washington 98115

CONTENTS

CONTENTS -- continued

TABLES

FIGURES

APPENDIX A TABLES

APPENDIX A TABLES -- continued

FUR SEAL INVESTIGATIONS, 1978

by

National Marine Fisheries Service
Northwest and Alaska Fisheries Center
Marine Mammal Division
Seattle, Washington 98115

INTRODUCTION

The National Marine Fisheries Service, in cooperation with Canada, Japan, and the USSR, is the federal agency responsible for carrying out obligations of the United States with respect to northern fur seals under terms of the Interim Convention on Conservation of North Pacific Fur Seals. The National Marine Fisheries Service is also responsible for managing this species on the Pribilof Islands in Alaska.

In 1978, the National Marine Fisheries Service, through its Northwest and Alaska Fisheries Center(NWAFC) Marine Mammal Division (MMD), conducted studies on several aspects of the life history of the northern fur seal on land and at sea.

In this report, "Pribilof Islands" includes St. Paul Island (Figure 1) and St. George Island (Figure 2), and, at times, Sea Lion Rock. Two of the five Pribilof Islands, Walrus and Otter, do not have fur seal rookeries or hauling grounds. Two fur seal populations are associated with San Miguel Island,California (Figure 3),one at Adams Cove and another on nearby Castle Rock.

Terms having special meanings in fur seal research are described in the glossary.

Part I. POPULATION ASSESSMENT, PRIBILOF ISLANDS

Several parameters are measured annually to monitor changes within the population of the Pribilof Islands fur seals as they relate to an overall objective of building a data base for managing the resource for maximum sustainable productivity. In addition, marks applied by the United States and the USSR to fur seals during their summer of birth are recovered at the ages of harvest (2-6 years), and the numbers of harvested seals entangled in fishing debris and other materials are recorded.

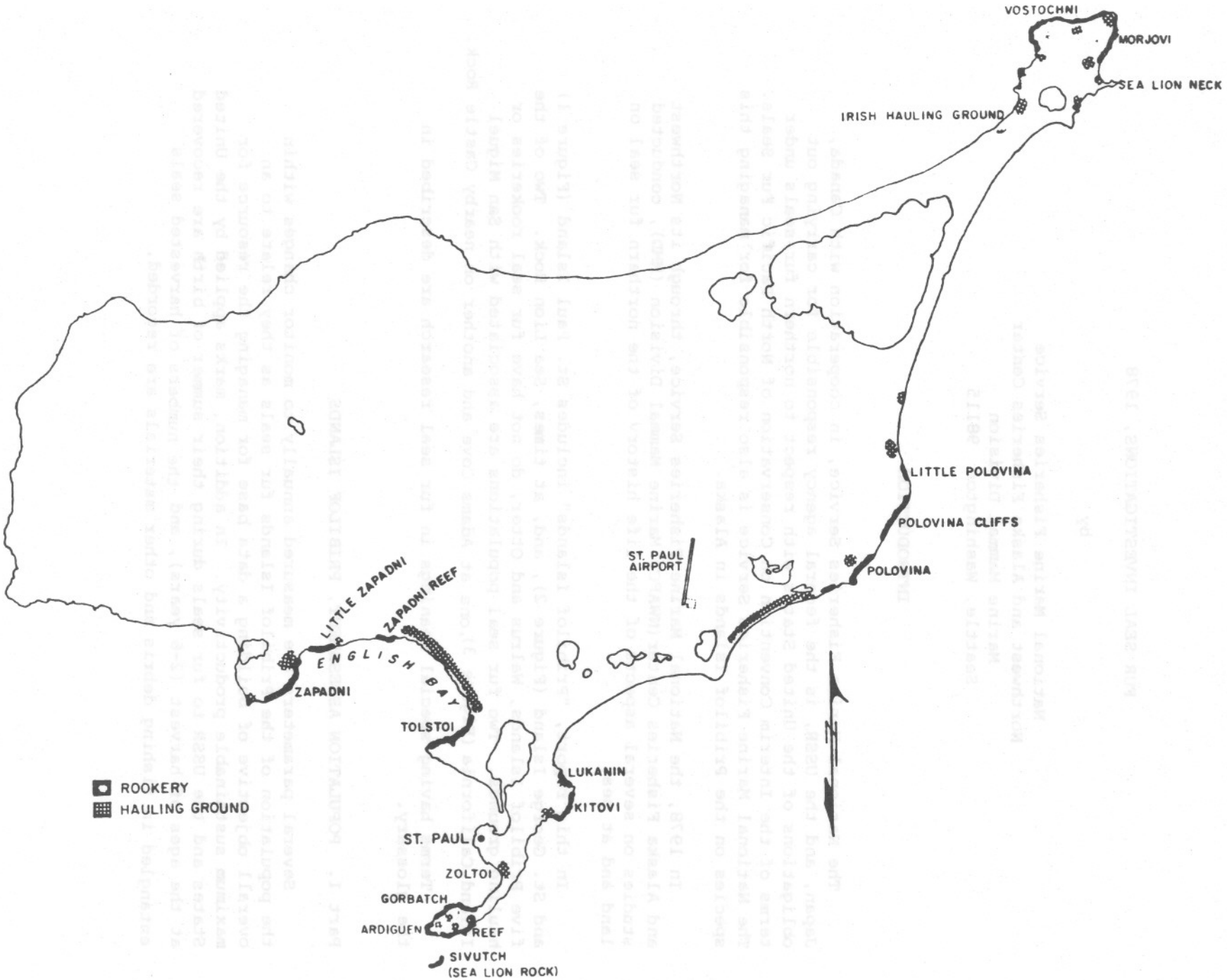


Figure 1.--Location of rookeries and hauling grounds, St. Paul Island, Alaska.

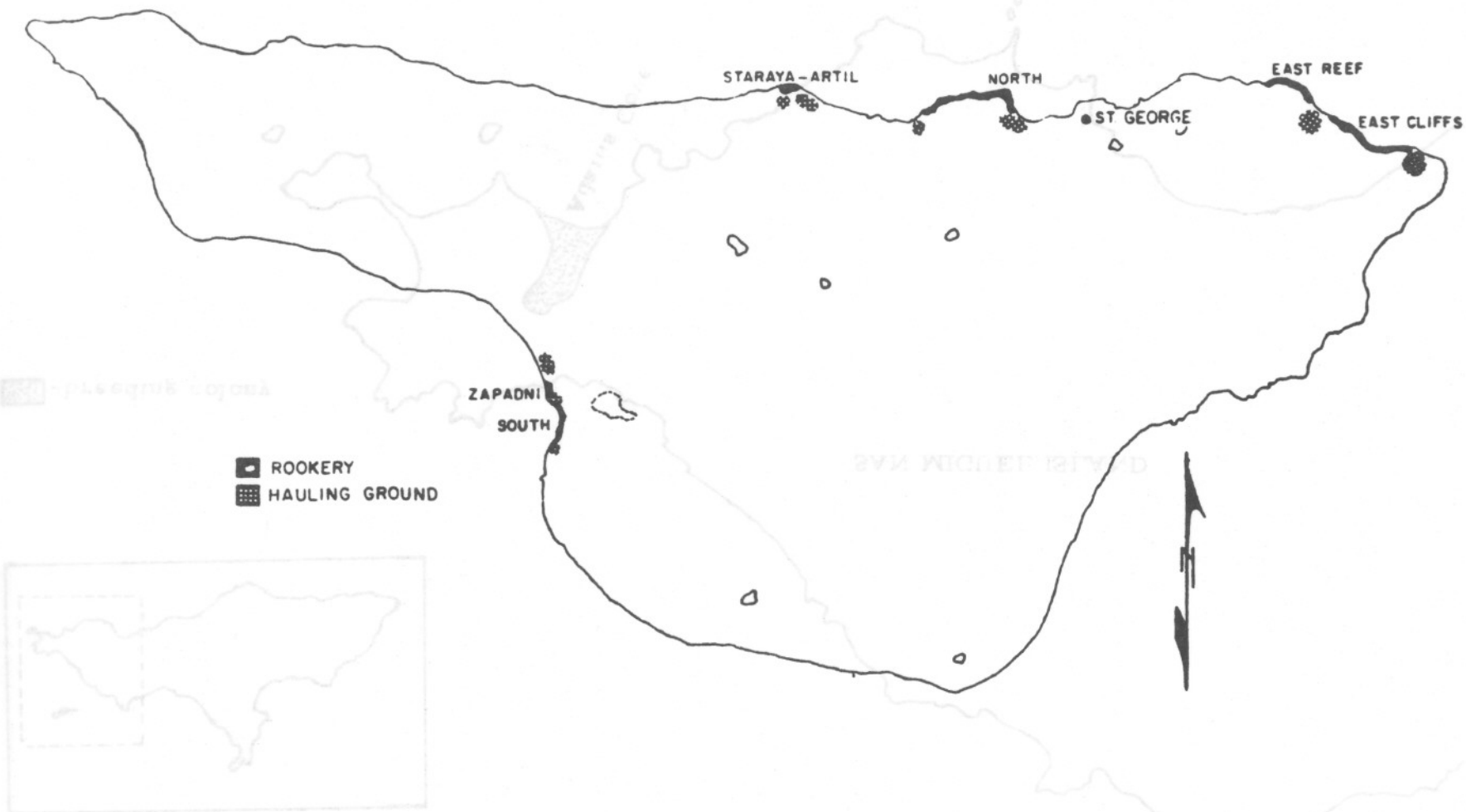


Figure 2. --Location of rookeries and hauling grounds, St. George Island, Alaska.

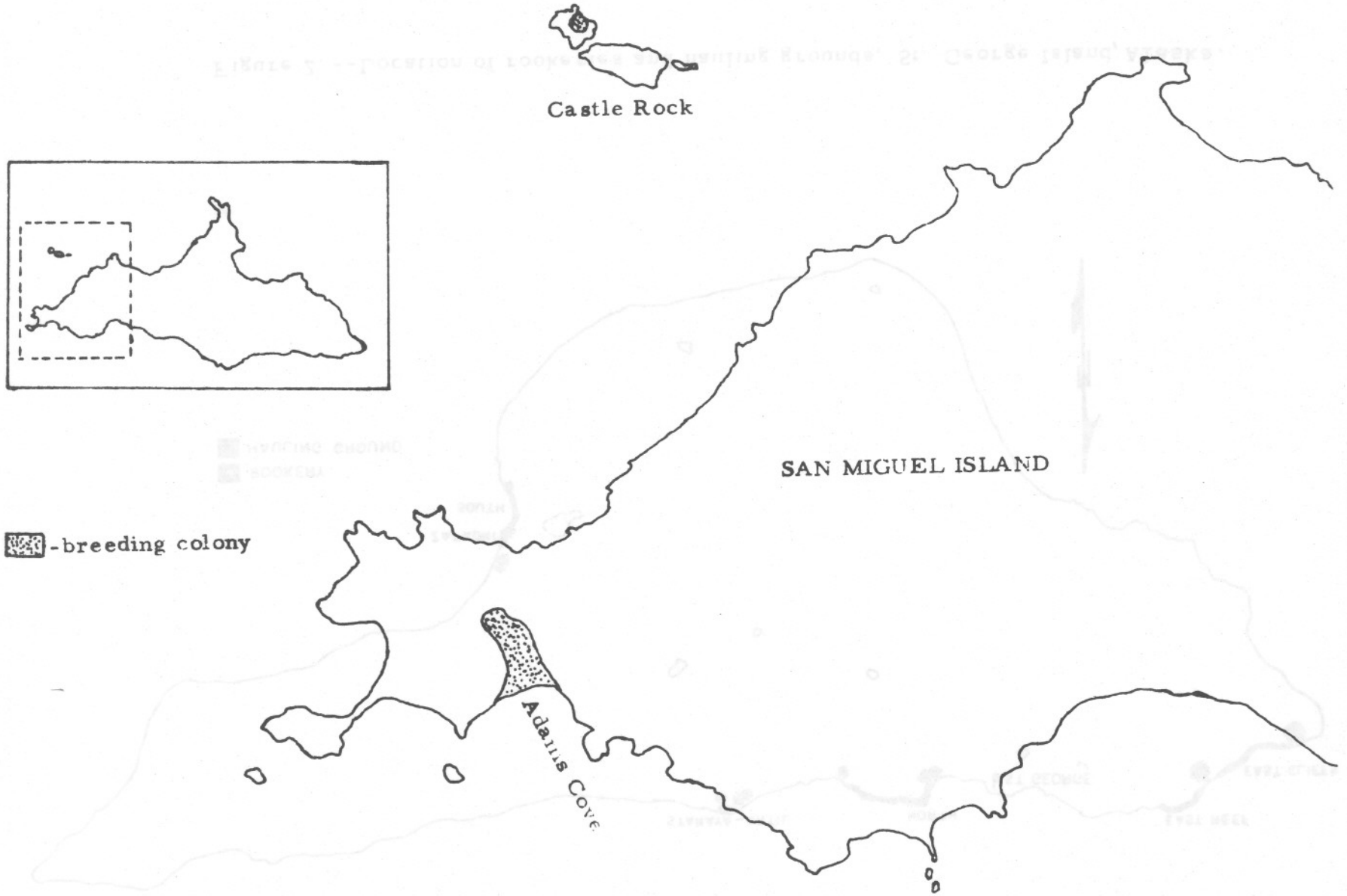


Figure 3. Location of northern fur seal breeding colonies, San Miguel Island, California.

Population Parameters

Values monitored on the Pribilof Islands in 1978 included: (1) age and sex composition of seals harvested; (2) number of adult males on the rookeries and hauling grounds; and (3) number of pups and older seals found dead. In addition, the number of pups born on St. George Island was calculated.

Age and Sex Composition of Seals Killed

The harvest of male seals on St. Paul Island in 1978 was regulated through imposition of a maximum body length limit of 47 inches (119.4 cm), tip of nose to tip of tail, which was extended to 49 inches (124.5 cm) beginning 11 July to lessen the escapement of young males into the breeding reserve. There was no minimum length limit. A total of 24,829 males was taken Mondays through Fridays (except for the holiday 4 July) during a 25-day sealing season between 26 June and 31 July. The sealing crew left the village at 5 a.m., drove the animals from the hauling grounds, and began the harvest between 6 and 6:30 a.m.

Maxillary canine teeth were collected from 20% of the harvested males to determine the age composition of the total number of males taken (Table A-1). Figure 4 shows the kill of 3- and 4-year-old males by round[1/], and Figure 5 and Table 1 give the number of males killed, by year class, since 1964. The age composition of males killed on the Pribilof Islands since 1969 is given in Table 2. A total of 56 females was accidentally taken during the male harvest on St. Paul Island and the genital tracts and maxillary canine teeth from some of these were saved for studies of reproduction and age.

A moratorium on the commercial harvest of fur seals on St. George Island, begun in 1973, continued in 1978. A small subsistence harvest for local consumption was permitted, which included 292 males and 6 females taken on the dates listed below:

Date	Males	Females
July 11	25	-
14	25	-
18	25	-
21	25	-
25	25	-
28	25	-
Aug 1	26	-
4	27	3
15	25	-
18	25	-
22	15	3
25	24	-
	292	6

1/ See glossary for definition of round.

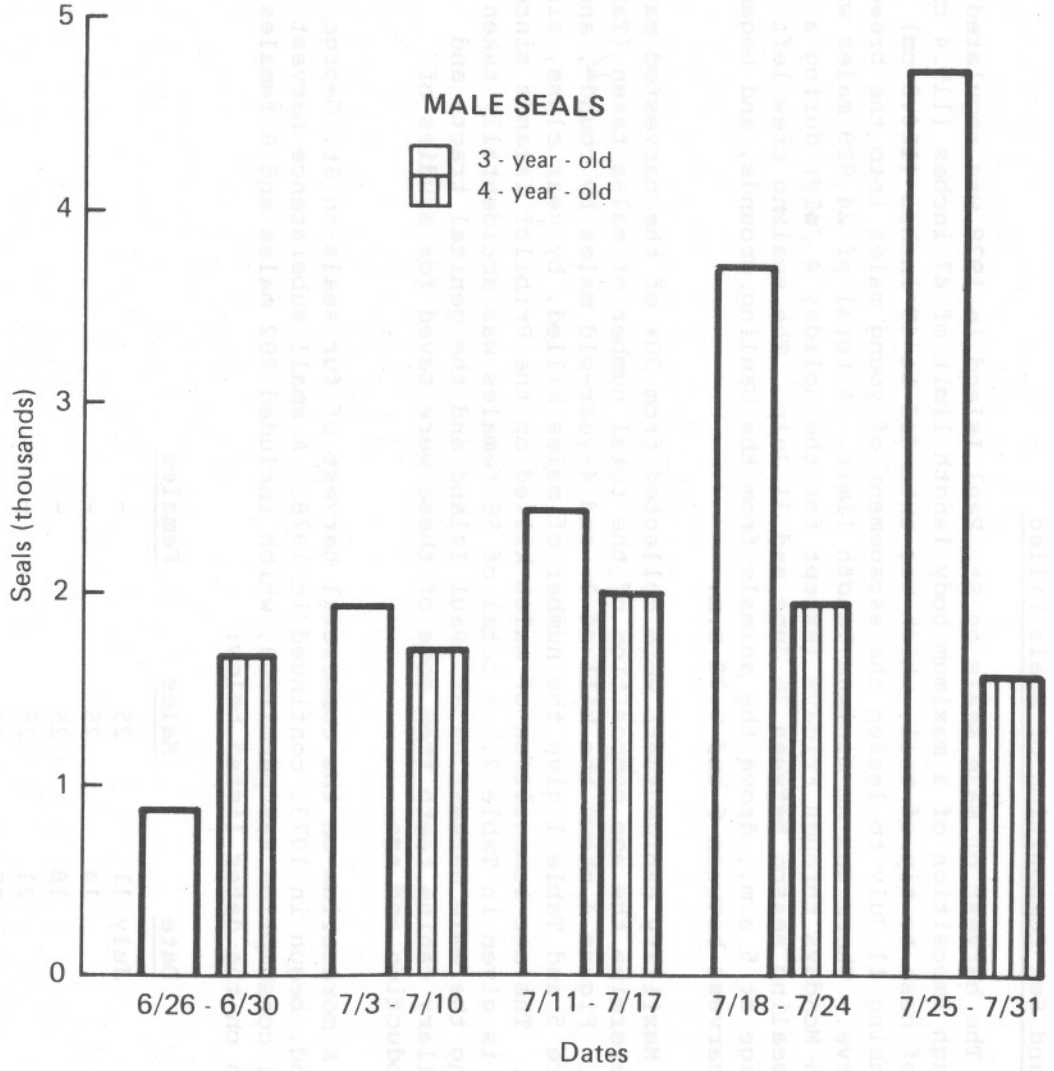


Figure 4.--Three-and four-year-old male seals killed, St. Paul Island, 26 June to 31 July 1978.

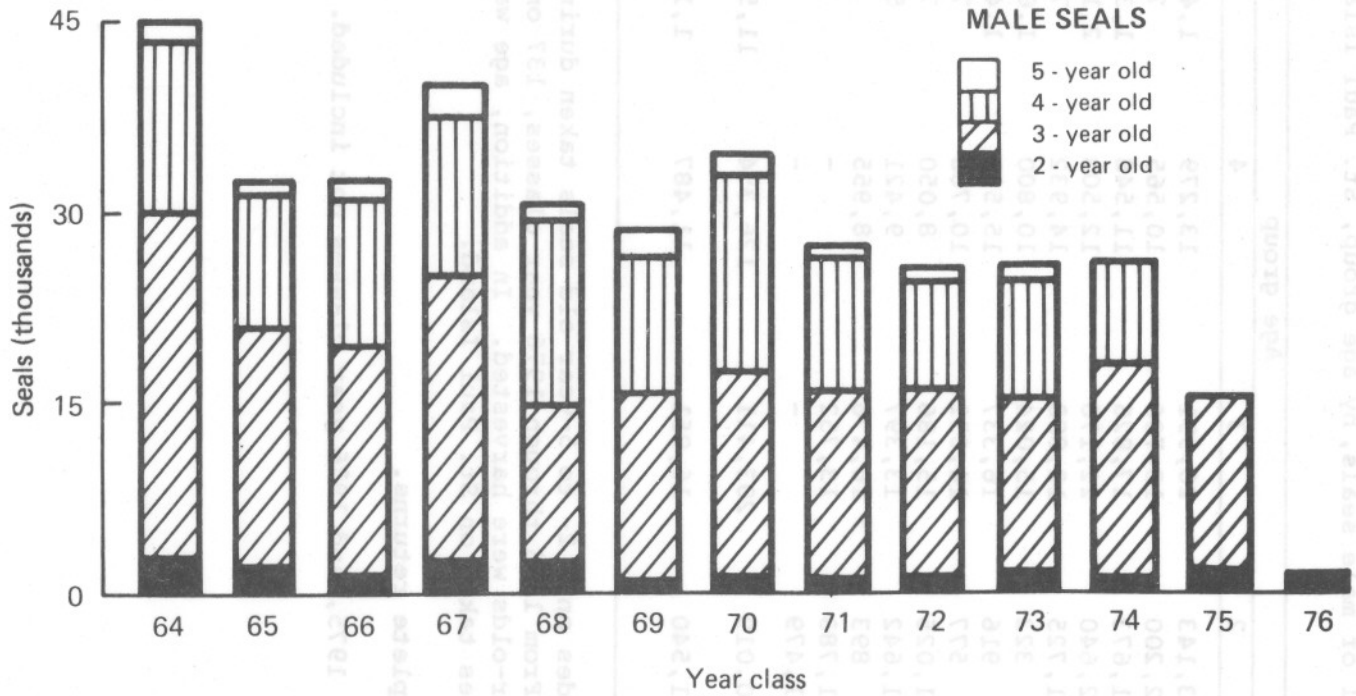


Figure 5.--Kill of male seals, by year class, St. Paul Island, 1964-76.

TABLE 1.--Kill of male seals, by age group, St. Paul Island, 1964-76 year classes[1/]

Year class	Age group 2	3	4	5	Total
1964	3,143	26,991	13,279	1,469	44,882
1965	2,200	18,706	10,565	731	32,202
1966	1,673	17,826	11,548	1,338	32,385
1967	2,640	22,176	12,503	2,185	39,504
1968	1,725	12,888	14,932	721	30,266
1969	323	15,024	10,800	1,631	27,778
1970	916	16,337	15,533	1,402	34,188
1971	577	14,652	10,768	722	26,719
1972	1,025	15,186	8,050	707	24,968
1973	1,642	13,397	9,421	598	25,058
1974[2/]	893	16,476	8,955	-	26,324
1975[2/]	1,783	13,752	-	-	15,535
1976[2/]	1,479	-	-	-	1,479
Total	20,019	203,411	126,354	11,504	361,288
Mean	1,540	16,951	11,487	1,150	31,795[3/]

1/ Includes only 2- to 5-year-old seals taken during the kill of male seals. From 1956 through 1976 year classes, 137 one-year-olds and 1,270 six-year-olds were harvested. In addition, age was not determined for 4,919 males taken on St. Paul Island.

2/ Incomplete returns.

3/ 1974, 1975, and 1976 year classes not included.

TABLE 2.--Age classification of male seals killed, Pribilof Islands, Alaska, 1969-78.

Year of harvest	St. Paul Island						St. George Island[1/]					
	Age group					Total no. killed	Age group					Total no. killed
	2	3	4	5	6		2	3	4	5	6	
	Number											
1969	2,640	17,826	10,565	1,469	121	32,621	411	2,645	2,204	680	117	6,057
1970	1,725	22,176	11,548	731	17	36,197	98	2,916	2,274	547	89	5,924
1971	323	12,888	12,503	1,338	190	27,242	32	1,456	2,517	467	81	4,553
1972	916	15,024	14,932	2,185	53	33,110	57	1,442	2,125	559	21	4,204
1973	577	16,337	10,800	721	22	28,457	-	-	-	-	-	-
1974	1,025	14,652	15,533	1,631	135	32,976	-	-	-	-	-	-
1975	1,642	15,186	10,768	1,402	95	29,093	-	-	-	-	-	-
1976	893	13,397	8,050	722	19	23,081	-	-	-	-	-	-
1977	1,783	16,476	9,421	707	9	28,396	-	-	-	-	-	-
1978	1,479	13,752	8,955	598	45	24,829	-	-	-	-	-	-

1/ No commercial fur seal harvest on St. George Island, 1973-78.

All kills were on Staraya Artil Rookery except one on North Rookery. None of the animals was classified by age. Ninety percent or more of them were probably of ages 3 and 4, as in other years of subsistence harvests (Marine Mammal Division 1977 and 1978).

Living Adult Male Seals Counted

Adult males on the rookeries and hauling grounds were counted[2/] in June and July (Tables A-2 to A-7). There were 9,013 adult males on St. Paul Island in June and 10,404 in July. St. George Island had 2,817 and 2,810, respectively, for those two months. On the rookeries, all males with territories are counted regardless of age. Most of these animals are age 10 years and older (Johnson 1968). All males found on the hauling grounds are counted as adults at estimated ages of 7 years and older. The relative locations of the different classes of adult males on a rookery/hauling ground complex are illustrated in Figure 6.

Dead Seals Counted That Were Older Than Pups

From 28 to 31 August, counts of fur seals older than pups that died on the rookeries and hauling grounds of St. Paul Island in 1978 totaled 57 males and 87 females (Table 3). In addition, canine teeth were collected from the dead animals for age and mortality studies.

Dead Pups Counted

In 1978, 8,073 dead pups were counted on St. Paul Island from 21 to 25 August, the lowest number counted since 1924. Counts of dead pups on St. George Island totaled 2,518 on 15 August. Tables A-8 and A-9 list the respective numbers of pups that died on the Pribilof Islands in 1978 and since 1967.

Number of Pups Born

In 1978, the number of live fur seal pups on St. George Island was estimated by shearing the guard hair from the heads of 5,300 living pups during 7 to 10 August, then sampling the total population on two different days, 13 and 15 August, for marked-to-unmarked ratios. The number of pups marked on each rookery was based on the number of territorial males with females counted there in mid-July. Dead pups were counted on each rookery soon thereafter and added to the estimate of living animals to arrive at the number of pups born (Table 4).

2/ See Table A-2 or glossary for a description of the classes of adult male seals.

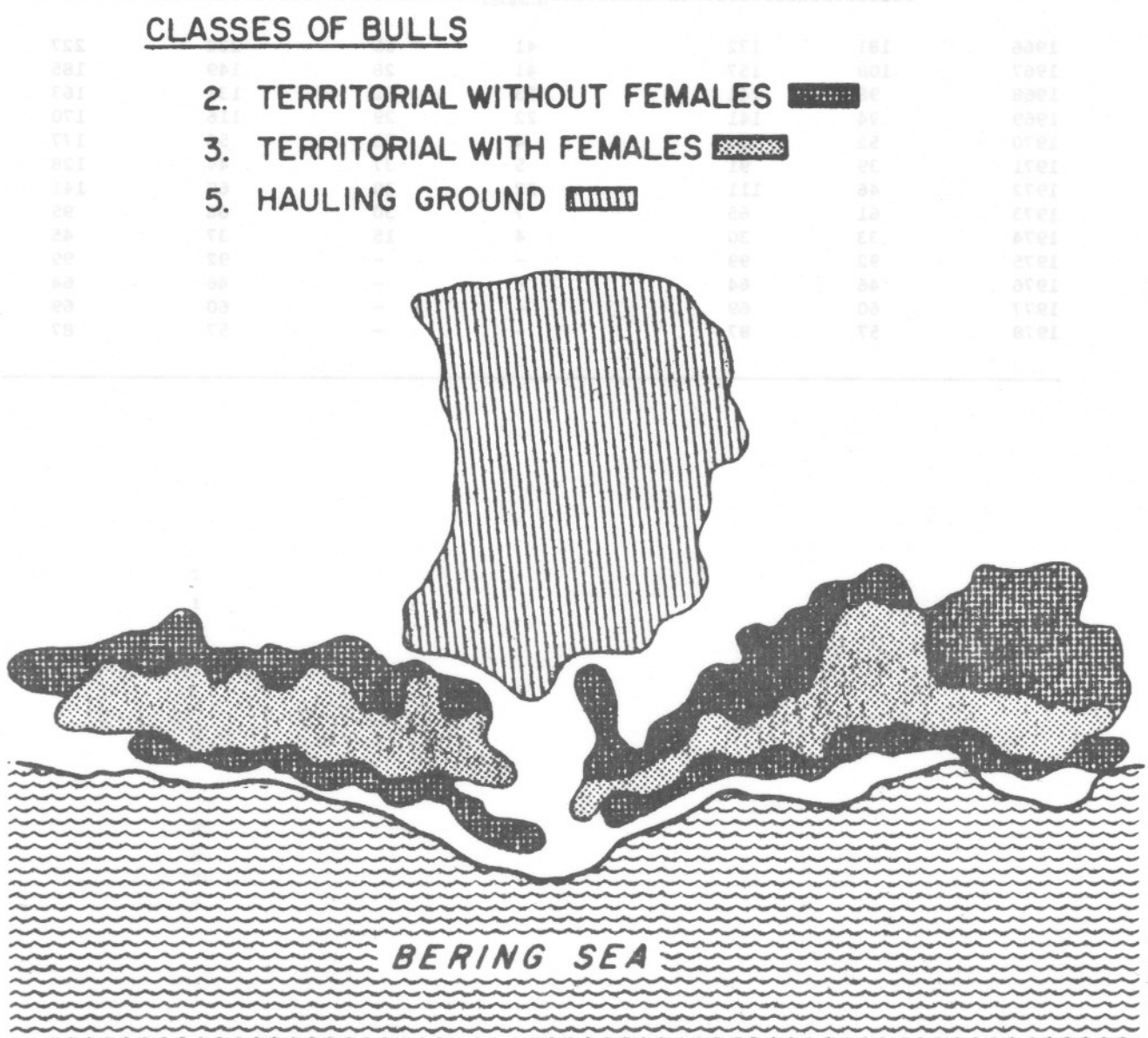


Figure 6. --General composition of a typical fur seal rookery.

TABLE 3.--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1966-78. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	Number					
1966	181	172	41	55	222	227
1967	108	157	41	28	149	185
1968	98	141	33	22	131	163
1969	94	141	22	29	116	170
1970	52	124	4	53	56	177
1971	39	91	5	37	44	128
1972	46	111	22	30	68	141
1973	61	65	7	30	68	95
1974	33	30	4	15	37	45
1975	92	99	-	-	92	99
1976	46	64	-	-	46	64
1977	60	69	-	-	60	69
1978	57	87	-	-	57	87

TABLE 4.--Estimated number of seal pups in 1978 at times of shearing and birth on St. George Island, Alaska. Pups were sheared 7-10 August; sampling periods 1 and 2 were 13 and 15 August, respectively.

Item	Rookery						
	South	Zapadni	East Cliffs	East Reef	Staraya Artil	North	Total
No. pups sheared	1,087	574	728	364	696	1,851	5,300
No. 25-pup samples							
Period 1	55	41	63	26	67	97	-
Period 2	41	34	44	23	63	124	-
No. Sheared pups counted							
Period 1	215	100	185	73	192	267	-
Period 2	176	101	109	75	196	361	-
Total no. pups counted[1/]							
Period 1	1,375	1,025	1,575	650	1,675	2,425	-
Period 2	1,025	850	1,100	575	1,575	3,100	-
Estimated no. live pups[2/]							
Period 1 Sampling	6,952	6,641[3/]	6,198	3,241	6,072	16,812	45,916
Period 2 Sampling	6,331	5,588[3/]	7,347	2,791	5,593	15,895	43,545
Mean, both periods	6,642	6,114	6,772	3,016	5,832	16,354	44,730
No. dead pups counted	225	179[4/]	292	164	590	1,068	2,518
Estimated no. pups born[5/]	6,867	6,293	7,064	3,180	6,422	17,422	47,248

1/ Number of samples x 25 = total number of sheared and unsheared pups.

2/ Estimated from $\hat{N} = MC/R$ (M = number sheared, C = Total no. pups counted, and R = count of sheared pups.

3/ Includes 757 live pups that were actually counted on rookery study area that was not disturbed during shearing and sampling survey.

4/ Partial count, does not include rookery study area; however, the number that died there would not appreciably affect the estimated number of pups born.

5/ Sum of dead pups and pups alive at time of sampling.

The estimate of the number born in 1978 was similar to the estimated number born in 1977. Since 1973, however, the number born has declined by about 22%. Table 5 lists the number of pups born in 1973, 1977, and 1978.

Marking

Fur seals have been marked in several ways over the years to provide a basis for estimating year class size and studying the biology of the species. Large-scale marking of fur seals was last done on the Pribilof Islands in 1975. The USSR has continued a tagging program on Robben Island and the Commander Islands.

Mark Recoveries

A total of 721 marked seals ranging in age from 3 through 6 years was recovered during the commercial harvest on St. Paul Island (Table A-10). These animals had been marked as pups on the Pribilof Islands. In addition, eight 3-year-old males marked as pups by the USSR on Medny and Bering Islands were harvested (Table A-11).

Seals given tags and other marks on the Pribilof Islands since 1966 are listed in Table A-12 and illustrated in Figure 7, and those given freeze marks since that year are presented in Table A-13.

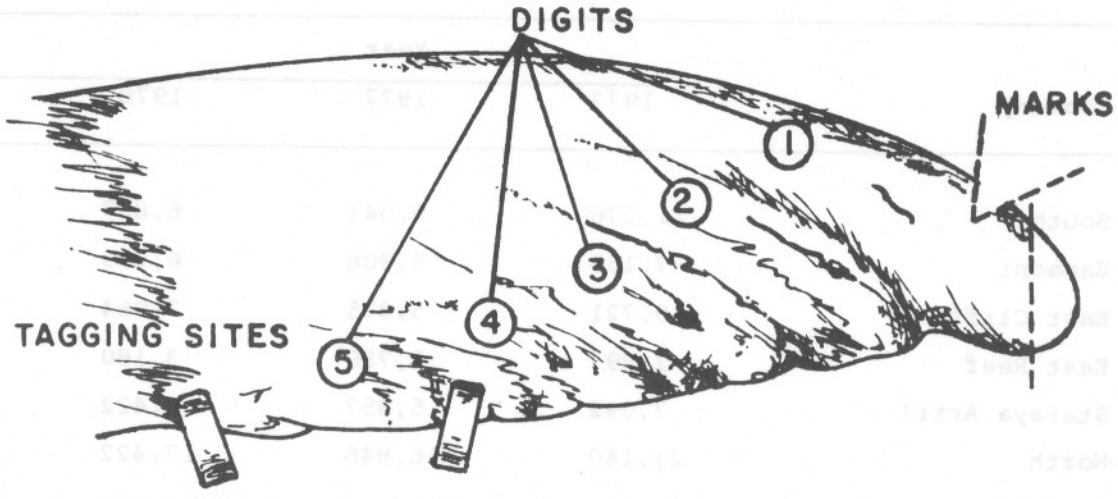
Seal Entangled in Net Fragments and Other Materials

Harvested seals that were entangled in net fragments and other materials are given in Table A-14 for the years 1967-78.

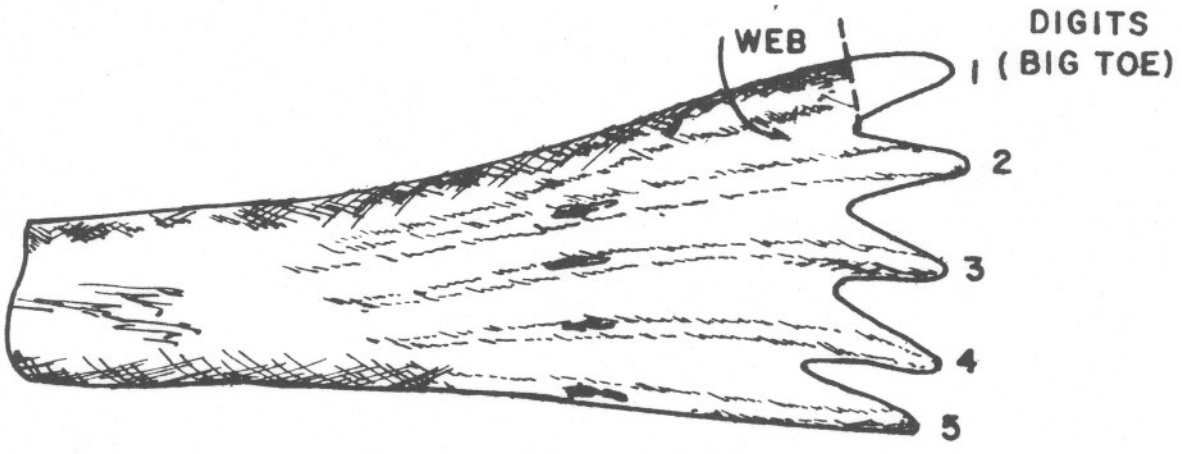
Alton Roppel
Patrick Kozloff

TABLE 5.--Estimated number of fur seal pups born on St. George Island, Alaska, 1973, 1977, and 1978.

Rookery	Year		
	1973	1977	1978
South	11,276	6,041	6,867
Zapadni	7,159	5,908	6,293
East Cliffs	10,721	5,975	7,064
East Reef	2,997	2,780	3,180
Staraya Artil	7,092	5,857	6,422
North	21,140	16,846	17,422
All	60,385	43,407	47,248



FRONT FLIPPER
TAGS CLINCHED AT THE HAIRLINE AND BETWEEN THE FOURTH AND THE FIFTH DIGIT.
MARKS MADE BY CUTTING A V-NOTCH AND REMOVING THE TIP.



HIND FLIPPER
MARK MADE BY REMOVING THE TIP OF THE FIRST DIGIT.

Figure 7. -- Examples of marks used on northern fur seals and their locations on the flippers, Pribilof Islands, Alaska.

Part II. BEHAVIOR AND BIOLOGY, PRIBILOF ISLANDS

Routine monitoring of behavioral characteristics,discussed in previous annual reports (Marine Mammal Division 1974-1977), was continued at Zapadni and East Reef Rookeries on St. George Island and at Kitovi Rookery on St. Paul Island in 1978. An experiment on the behavioral basis of site fidelity, started in 1976, was finished at St. George Island in 1978. A new program of marking peripheral males adjacent to rookeries was begun, and will be described below. A new project on the land-sea movements and social behavior of juvenal males was also started. The results of this project will constitute the bulk of the following report.

Work Plan

Observational research was conducted at East Reef and Zapadni Rookeries, St. George Island, and on Kitovi Rookery, St. Paul Island, from 23 June to 13 August 1978. Approximately 1100 observer hours were spent collecting behavioral data at these rookery sites.

Hot iron brands applied to females and to juvenal males in 1977 were closely examined in 1978. In all observed cases, the brand wound had healed cleanly, and in most cases the letter-number brand was clearly readable. The return rate of 137 branded adult females was 45.3%, whereas that of 180 branded juvenal males was 78%. The rate for females seems somewhat low, but is within the range of variability for returns of females marked by noninjurious (bleaching) methods. More branding of females should be done to determine whether branding adversely affects survival. Branding apparently does not affect male survival.

In 1978, a method was devised for marking small (weighing 160 kg or less) males peripheral to breeding areas. These animals, censused as Class 2 males (territorial without females), have not been marked previously. Their small size and tendency to flee from experimenters has made use of the restraint cage for marking (Gentry and Johnson 1978) impossible. In the new method a three-person team captures these animals using a hoop net which has a canvas sleeve around the pursed end of the net. This sleeve prevents the animal from seeing while experimenters apply tags and temporary marks through the net mesh. The 56 animals marked this year will be studied to determine how males are incorporated into the breeding aggregation.

Only 108 new animals were marked in 1978. Table 6 gives the age-sex class, tag numbers, application of other marks, and location of tagging.

TABLE 6.--Tags applied to fur seals for behavioral study, Pribilof Islands, 1978.

Type of tag	Tag number	Age - sex class	Number	Rookery
Monel, silver	X-1785 - 1791 X-1793 - 1817	Adult male	17	Zapadni
Plastic, white	501 - 519 521 - 527	Adult female	26	Various rookeries
	401 - 409, 418	Adult female	10	Kitovi 1/
Plastic, green	1, 2	Non-territorial adult male	2	East
	3 - 12, 15, 17, 18 20 - 54	Non-territorial adult male	46	Zapadni
	102 - 108, 110	Non-territorial adult male	8	Kitovi 1/

1/ St. Paul Island. All others applied on St. George Island rookeries.

Data Analysis

Land-Sea Movements of Juvenal Males

Juvenal males have been harvested annually since the discovery of the Pribilof Islands in 1786-87, though little has been learned since about the seasonal and daily movements of individuals. Such data are needed if the escapement rate from the harvest is ever to be preselected and actively maintained by management, rather than merely increased or decreased as in the present system. Five attempts to collect movement data have been made by instrumenting juvenal males with radio transmitters. Although some data have resulted (Marine Mammal Division 1975), the movement patterns remain largely unknown because radios have been attached for only small portions of the season. It is unlikely that telemetery will ever produce data on movements of individuals from season to season.

In the present study, 180 juvenal males (81-152 cm long, and weighing 25 - 125 kg) were marked with yellow, numbered plastic tags at Zapadni and North Hauling Grounds (St. George Island) in 1977. Each male was given a hot iron brand on one shoulder, and a "hair brand" (guard hair singed away to expose the lighter-colored underfur) on the other shoulder. By marking the animals in 1977 and observing them in 1978,disturbance, instrumentation, or injury to the animals in the year the data were collected were avoided, and all animals were followed from their first day of arrival in the 1978 season.

Presence and absence of marked animals were recorded by five observers. Once every day from 9 June to 16 October (and sporadically from 24 May to 9 June) each of the 15 possible landing sites (8 hauling grounds and 7 rookeries) used by juvenal males was surveyed for marked animals. Each area was scanned with binoculars from several different viewpoints, and the identities of marked animals confirmed by reading their tags with a spotting telescope. Observations began at 0800 hours, except on days of disturbance (such as the subsistence kill) when they began earlier. One to four hours were required to survey each site, depending on weather conditions and on the number of animals present. An estimated 3,100 hours were spent collecting these data. Observers from another research project made some sightings of these same animals landing on St. Paul Island. Their observations, made on weekends only during June and July with all landing sites surveyed every third day in August and September, were not frequent enough to add meaningfully to ours. Their sightings are used here only to calculate total return rate.

The data were recorded directly on computer code sheets in the field. Each entry included the alphanumeric identity of the animal, its tag number, the site number, date and time, the animal's behavior, weather conditions, and any disturbance on that site within 24 hours. The analysis appearing in this report is based on cumulative tally sheets made in the field. A report based on computer analysis will follow at a future date.

The return rate of animals branded in 1977 was similar to the survival rate of juvenal males estimated by Chapman (1964). Of 180 juvenal males branded, 111 (62%) were seen on St. George Island only, 11 (6%) were seen on St. Paul Island only, 18 (10%) were seen on both islands at least once, and 40 (22%) were not seen on either island. Thus, it appears that the return rate was 78%. Since some of the above animals were seen only once, it is possible that others returned but were not seen, especially at St. Paul Island. Therefore, the actual survival rate among the 180 subjects may have exceeded 78%. Note that 6% of the animals marked on St. George Island in 1977 were seen only on St. Paul Island in 1978, despite an intensive observation effort on St. George Island. It is likely that these animals originated on St. Paul Island and were visiting St. George Island on the days that marking occurred in 1977.

Juvenal males began arriving on St. George Island in mid-May, and new arrivals continued all through the summer into the autumn. Dates of first sighting in 1978 ranged from 24 May (first day of observations) to 3 September. However, as part (a) of Table 7 shows, 90% of the arrivals occurred between 1 June and 10 July. The dates of last sighting ranged from 19 June through 16 October (date of last observation). As part (b) of Table 7 also shows, 81% of the last sightings occurred after 1 September.

The length of the season over which juvenal males visited St. George Island was relatively long (range 1 -144 days). For 129 males seen there, the mean duration from the first to the last sighting of the season was 78 days (S.D. = 38, including sightings for 9 males seen only once). Only 21% of the males had a season that was shorter than 51 or longer than 126 days. Since observations covered neither the very first arrival nor the very last departure, the ranges in length of season and some values appearing in parts (a) and (b) of Table 7 are slightly inaccurate. However, the mean values are probably not affected by these errors.

There was wide variability in the total number of days throughout the season that individual males were observed on shore. Table 8 shows that the mean number of days on shore was approximately 20, and that the distribution is slightly skewed to the right. Days on shore were not uniformly distributed throughout the male's season, but were clustered toward the start of the season. For example, 33% of the sightings occurred from 26 June through 31 July (dates of the 1978 harvest), which amounted to only 28% of the observation period. That is, the harvest occurs when juvenal males are using land somewhat more frequently than they do later in the season.

Days on shore were not randomly distributed throughout a seal's season, but occurred in stages. Visual inspection of the presence-absence (land-sea) patterns of the marked population suggests that most seals are either at sea for large blocks of time, during which they are not seen on shore, or that they visit the island in blocks of time during which they may have short absences. This tendency is seen in Figure 8 for selected males. For this

TABLE 7.--Dates of first and last sighting for juvenal males, St. George Island, 1978

(a) Frequency Distribution: Dates of arrival for 114 marked animals seen five times or more.

Arrival Dates	May 21-31	June 1-10	11-20	21-30	July 1-10	11-20	21-31	Aug 1-10	11-20	21-31	Sep 1-10
No. of males	2	16	40	26	21	3	3	1	1		1
Percent	1.8	14.0	35.1	22.8	18.4	2.6	2.6	0.0	0.9		0.9

/ ——— 90.3% ——— /

(Median Arrival Date: 20 June)

(b) Frequency Distribution: Dates of departure for 114 marked animals seen five times or more.

Dept Dates	June 11-20	21-30	July 1-10	11-20	21-31	Aug 1-10	11-20	21-31	Sep 1-10	11-20	21-31	Oct 1-10	11-20
No. of males	3	1	1	2		1	2	8	18	19	28	7	24
Percent	2.6	0.9	0.9	1.8		0.9	1.8	7.0	15.8	16.7	24.6	6.1	21.1

(Median Departure Date: 22 September)

/ ——— 80.6% ———

TABLE 8.--Cumulative days on shore throughout the season for 129 marked juvenal males, St. George Island, 1978

Days	1-10	11-20	21-30	31-40	41-45	Sum
No. of Males	27	41	41	16	4	129
Percent	21	32	32	12	3	100

$\bar{X}$ = 19.6 days; S.D. = 10.7

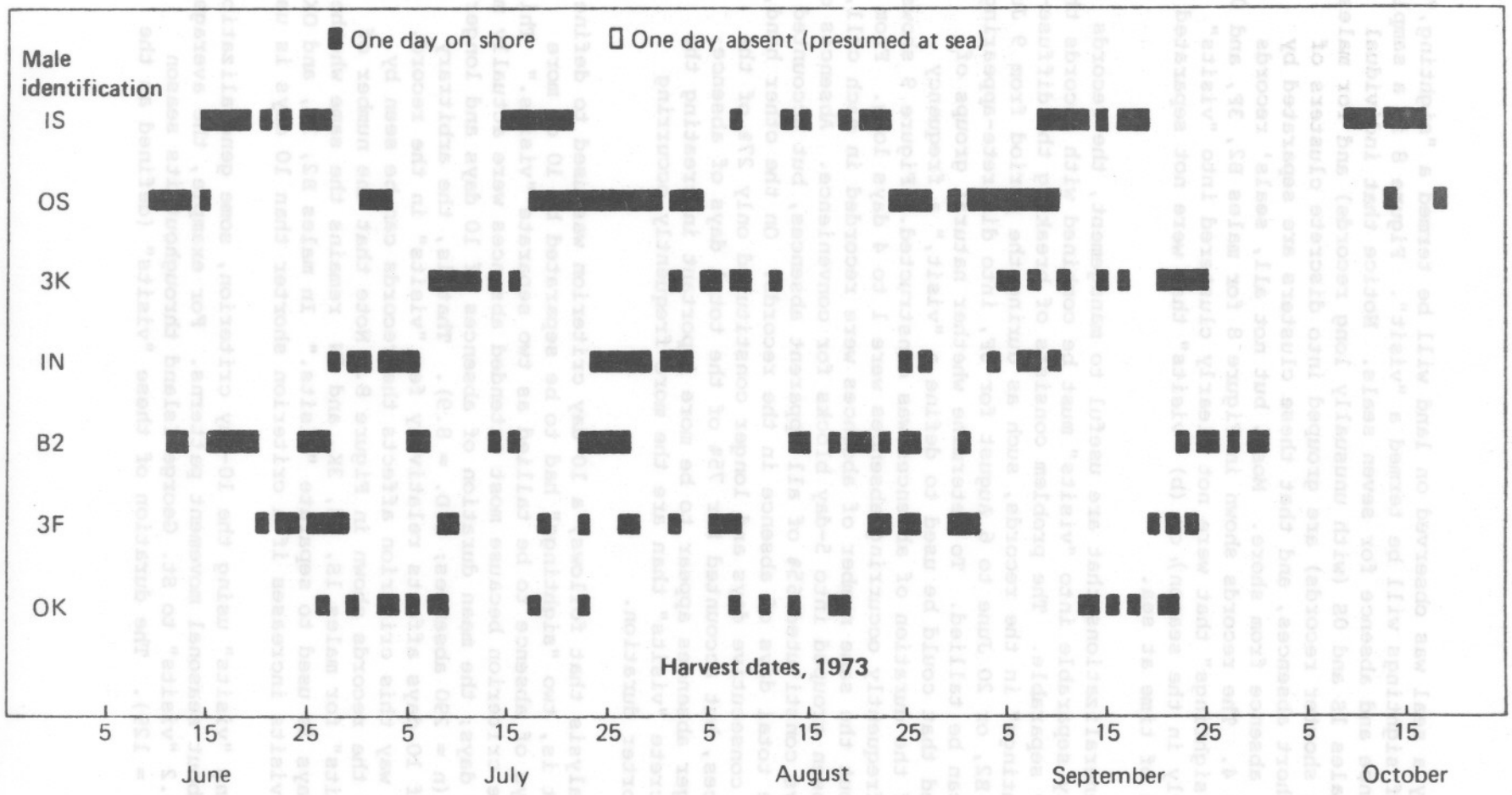


Figure 8.--Seasonal movement pattern of 7 selected juvenal males.

report, each day a seal was observed on land will be termed a "sighting," and a cluster of sightings will be termed a "visit". Figure 8 is a sample record of presence and absence for seven seals. Notice that individual sightings for males 1S and 0S (with unusually long records) and for males 3K and 1N (with shorter records) are grouped into discrete clusters of presences and short absences, and that these clusters are separated by long periods of absence from shore. Most, but not all, seals' records resembled these 4. The records shown in Figure 8 for males B2, 3F, and 0K exemplify (a) "sightings" that were not clearly clustered into "visits" (especially early in the season), or (b) "visits" that were not separated by large blocks of time at sea.

To draw generalizations that are useful to management, the records that are clearly separable into "visits" must be combined with records that are not clearly separable. The problem consists of breaking the diffuse-appearing "sightings" in the records, such as during the period from 9 June to 26 July for B2, or 20 June to 6 August for 3F, into discrete-appearing "visits" that can be tallied. To determine whether natural groups of absences existed that could be used to define a "visit," a frequency distribution of the duration of absences was constructed. Figure 9 shows that the most frequently occurring absences were 1 to 4 days long. From 5 to 27 days, about the same number of absences were recorded in each cell, so these have been grouped into 5-day blocks for convenience. Absences of 1 through 4 days constituted 65% of all apparent absences, but accounted for only 16% of the total days of absence in the records. On the other hand, absences of 10 consecutive days and longer constituted only 27% of the recorded absences, but accounted for 75% of the total days of absence. Therefore, longer absences appear to be more important in creating the pattern of discrete "visits" than are the more frequently occurring absences of shorter duration.

In the analysis that follows, a 10-day criterion was used to define "visits." That is, two "sightings" had to be separated by 10 or more consecutive days of absence to be tallied as two separate "visits." This is a reasonable criterion because most extended absences were actually much longer than 10 days; the mean duration of absences of 10 days and longer was 19.9 days (n = 290 absences; S.D. = 8.9). That is, the arbitrary cutoff point of 10 days affects relatively few "visits" in the record. An example of the way this criterion affects the records can be seen by applying it to the records shown in Figure 8. Note that the number of different "visits" for males 1S, 0S, 3K, and 2N remains the same whether 5 days or 10 days is used to separate "visits." In males B2, 3F, and 0K, the number of visits increases if a criterion shorter than 10 days is used.

By defining "visits" using the 10-day criterion, some generalizations can be drawn about seasonal movement patterns. For example, the average animal makes 3.2 "visits" to St. George Island throughout its season (S.D. = 1.3; n = 129). The duration of these "visits" (defined as the

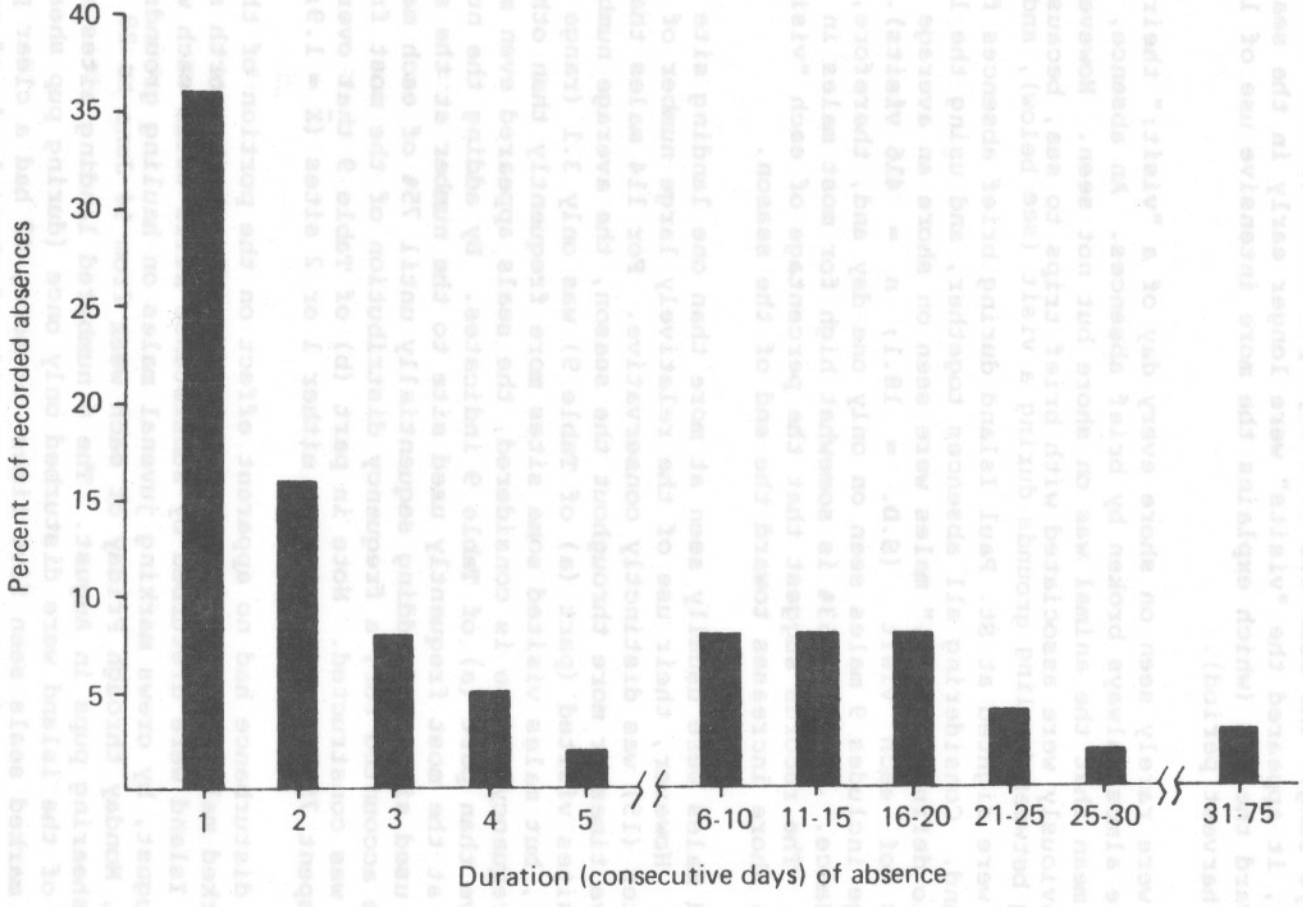


Figure 9.--Frequency distribution; percent of recorded absences by number of consecutive days of absence for 129 marked males.

duration from the first to the last sighting) varies greatly; 55% (of 416 visits) were 1 to 10 days long, 30% were 11 to 20 days, and 9% were 21 to 48 days long. The mean was 10.3 days per visit (S.D. = 8.3). In all records, it appeared the "visits" were longer early in the season and shorter toward the end (which explains the more intensive use of land sites during the harvest period).

Males were rarely seen on shore every day of a "visit;" their attendance records were almost always broken by brief absences. An absence, however, may simply mean that the animal was on shore but not seen. However, some absences obviously were associated with brief trips to sea, because males often moved between hauling grounds during a visit (see below), and because some males were sighted at St. Paul Island during brief absences from St. George Island. Considering all absences together, and using the 10-day criterion to define "visits," males were seen on shore an average of 63% of the days of each visit (S.D. = 18.1; n = 416 visits). This average includes 9 males seen on only one day and, therefore, having 100% attendance. That is, 63% is somewhat high for most males in the population. The records suggest that the percentage of each "visit" that is spent on shore increases toward the end of the season.

Marked males were usually seen at more than one landing site throughout the season. However, their use of the relatively large number of potential landing sites (15) was distinctly conservative. For 114 males that were sighted five times or more throughout the season, the average number of different sites visited (part (a) of Table 9) was only 3.1 (range 1-6; S.D. = 1.2), but males visited some sites more frequently than others. When the frequency of use is considered, the seals appeared even more conservative than part (a) of Table 9 indicates. By adding the number of days spent at the most frequently used site to the number at the second most frequently used site, and adding sequentially until 75% of each male's days ashore were accounted for, a frequency distribution of the most frequently used sites was constructed. Note in part (b) of Table 9 that over 80% of all males spent 75% of their time at either 1 or 2 sites ($\bar{X}$ = 1.9; S.D. = 0.7).

Human disturbance had no apparent effect on the portion of the island used by marked males. The 9 numbered landing sites on the north side of St. George Island were disturbed by subsistence kills twice each week in July and August, by crews marking juvenal males on hauling grounds (one site daily, Monday through Friday of each week from 14 June to 28 July), and by a crew shearing pups in August. The 6 numbered landing sites along the south side of the island were disturbed only once (during pup shearing). Of the 114 marked seals seen five times or more, 42 had a clear preference for landing sites on the disturbed north side of the island and spent 93.9% of their days ashore there; 81% of these animals were never seen or were seen only once on the undisturbed south side. For comparison, 72 seals had a clear preference for landing sites on the undisturbed south side and spent 94.4% of their days on shore there; 75% of these animals were never seen, or were seen only once on the north side. Therefore, there was no apparent shift of seals from disturbed to undisturbed areas. Disturbances may have

TABLE 9.--Use of numbered landing sites by marked juvenal males, St. George Island, 1978.

(a) Frequency Distribution: Total number of sites visited at least once by juvenal males.

No. of sites used	1	2	3	4	5	6
No. of males using "n" sites	5	33	38	23	10	5
Percent	4.4	28.9	33.3	20.2	8.8	4.4
Cumulative percent	4.4	33.3	66.6	86.8	95.6	100.0

$\bar{X}$ = 3.13; S.D. = 1.18; n = 114

(b) Frequency Distribution: Number of sites utilized by males on 75% of days ashore.

No. of sites used	1	2	3	4
No. of males using "n" sites	38	56	17	3
Percent	33.3	49.1	14.9	2.6
Cumulative percent	33.3	82.4	97.3	99.9

$\bar{X}$ = 1.9; S.D. = 0.7; n = 114

affected the number of different sites used, the length of "visits," or other parameters, but these trends have not yet been analyzed.

Daily Movements of Juvenal Male Population

Seasonal movements of individuals on and off the island were discussed in the previous section. It is apparent from watching hauling grounds that the movements of individuals onto land or to sea occurs in a predictable pattern, and that the total number of animals on a hauling ground reflects these individual movements. Data on these movement patterns could be important for modifying the harvesting system, maintaining a selected escapement level, or developing a method of censusing juvenal males. For these reasons, intensive observations were made at the Zapadni Hauling Ground in 1978.

During four days in different parts of the season, observations were maintained during all daylight hours (0600 to 2200 hours) from a blind overlooking the hauling ground. Markers laid out in an 80 by 100 meter grid facilitated the counts of animals there. Once each hour, records were kept on the number of animals on the grid, the percent of animals that were active (that is, with head off the ground), and the weather. In addition, a constant tally was kept of the number of animals arriving from and departing for the sea.

Daily changes on the hauling ground can be characterized by hourly censuses. Figure 10 (plotted as a percentage figure to compensate for different population sizes on different days) shows a general increase in numbers before 1200 hours, maximum numbers on shore from approximately 1300 to 1900 hours, and a decline from 1900 to 2200 hours. Usually the increase in numbers during the morning is continuous, as on 13 July (Figure 10). However, heavy rains, such as occurred 29 July and 14 August, may cause temporary morning departures from which the population later recovers if the rain ceases (the apparent decrease on 12 July resulted from experimenter error).

Censuses of a hauling ground show only the net result of arrivals minus departures, and, therefore, only partly characterize the population. Actually, some animals arrive and depart at all hours, as a plot for two successive days shows (Figure 11). Note that the most precipitous change in the population is caused by departures in the evening hours, and that animals never stop arriving on shore. Figure 11 suggests that total movement slows from 1400 to 1700 hours. The arrivals and departures usually amount to less than 15% of the on-shore population at any hour of the day (Figure 12). Note that only the departure of animals in the evening (Figure 11) causes this rate to exceed 20%. Figure 12 also shows an apparent low point in movements between 1500 and 1700 hours.

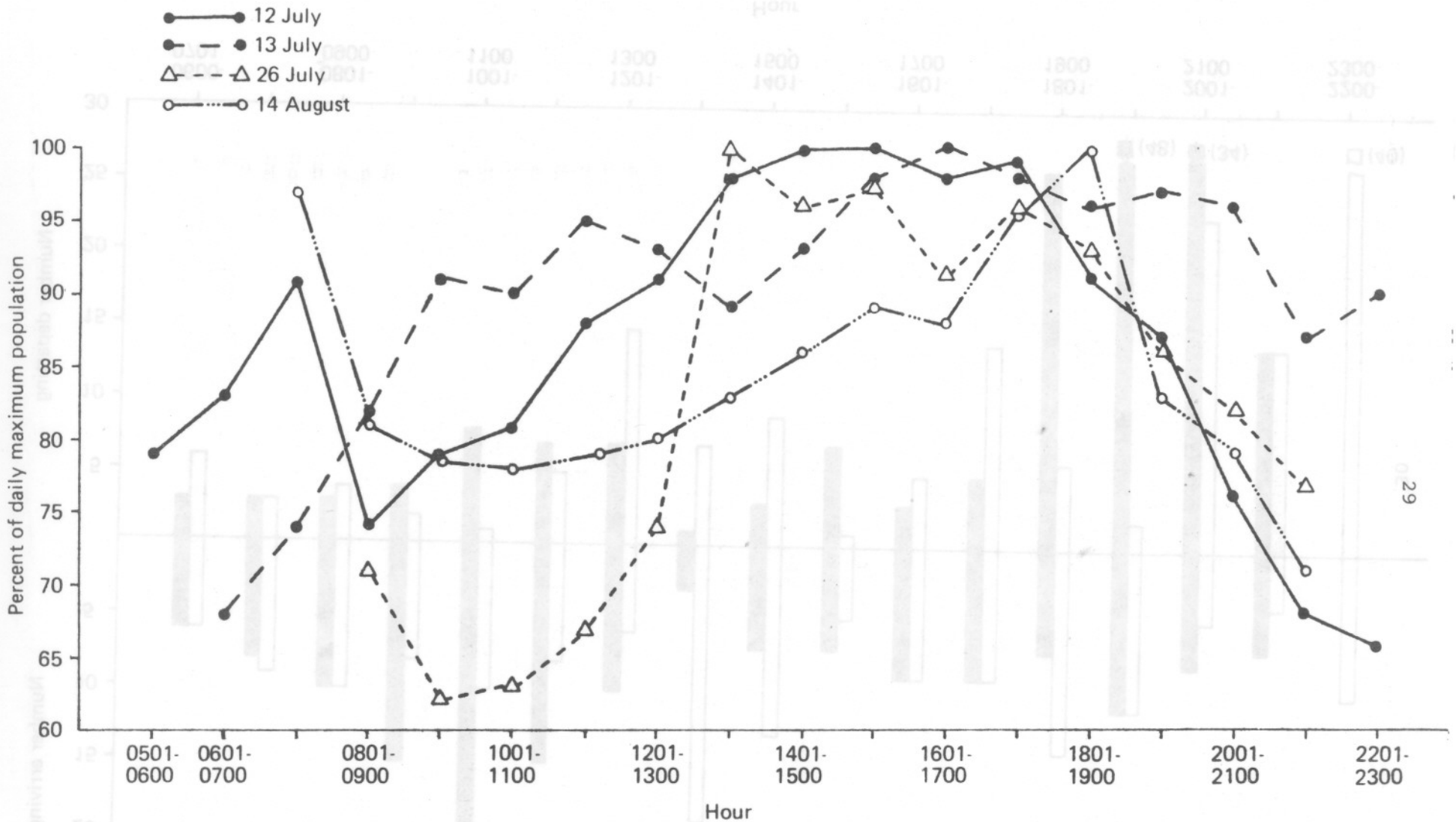


Figure 10.--Hourly censuses of Zapadni Hauling Ground plotted as a percent of the maximum population onshore for each day.

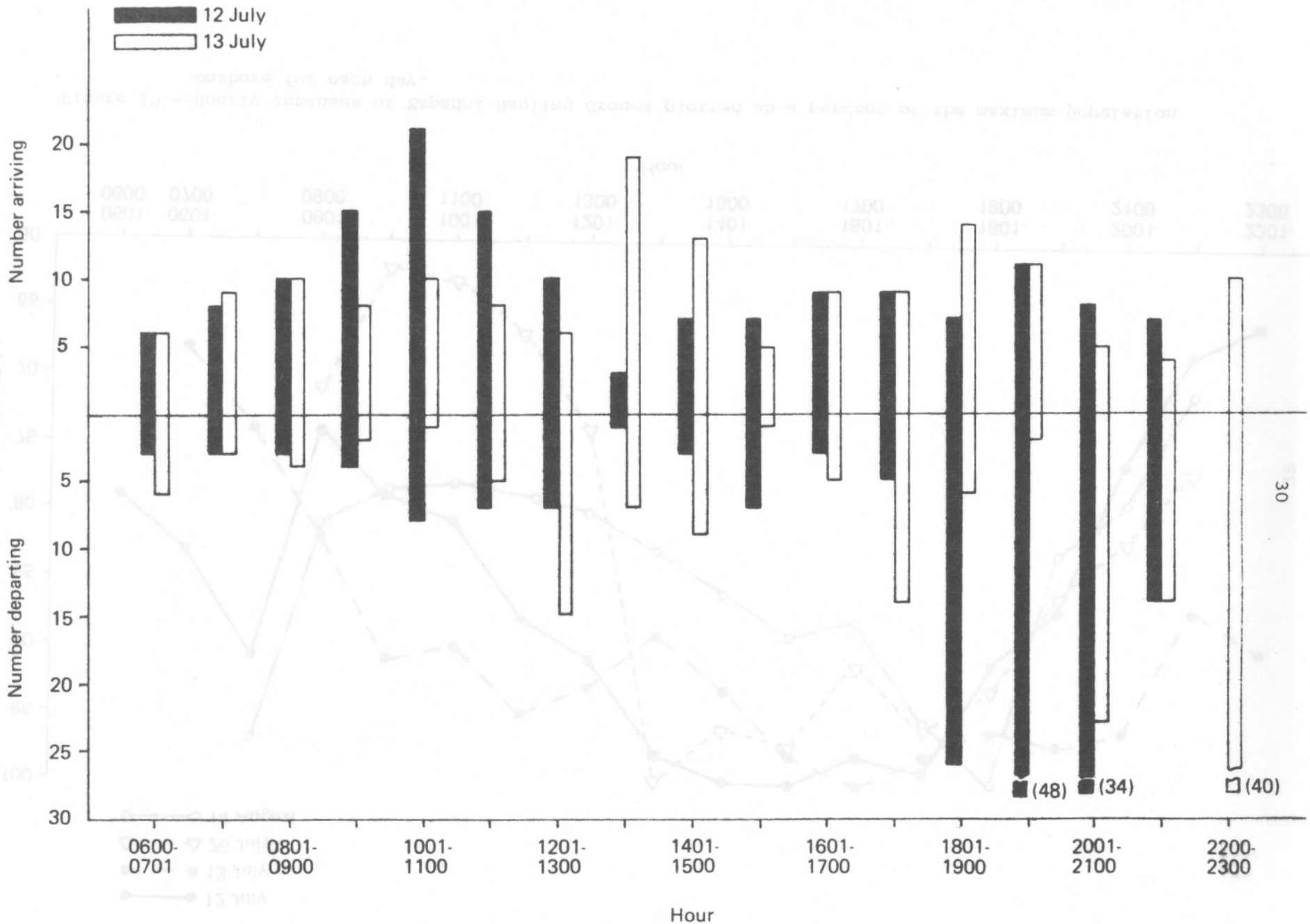


Figure 11.--Number of seals arriving and departing from Zapadni Hauling Ground for each daylight hour of 2 days.

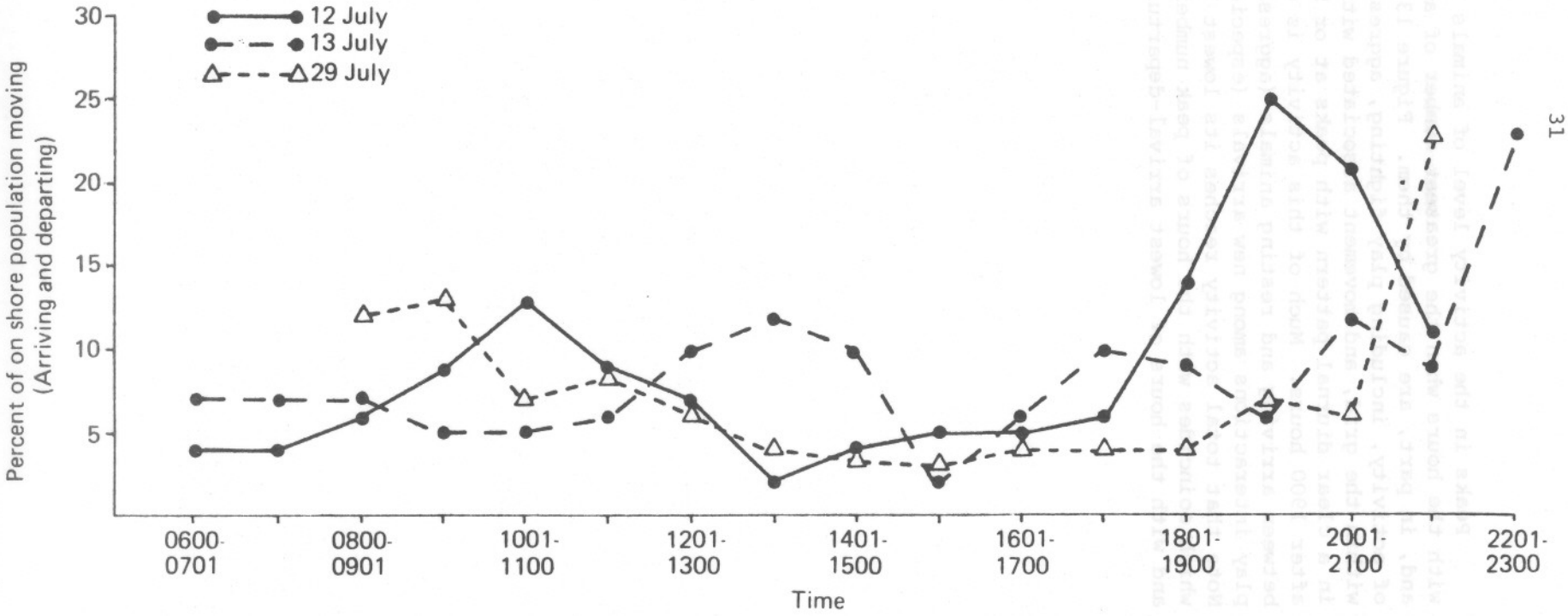


Figure 12.--Movements of juvenal males (arriving and departing) for each hour of three days, plotted as a percentage of the onshore population of each hour.

Peaks in the activity level of animals on the hauling ground coincide with the hours when the greatest number of arrivals and departures occur, and, in part, are caused by them. Figure 13 indicates that the total amount of activity, including play fighting, aggression, grooming, random movements within the grid, and movement associated with arrivals and departures, occur in a clear diurnal pattern with peaks at or before 0800 hours, and at or after 1900 hours. Much of this activity is caused by aggressive interactions between arriving and resting animals (aggression over rest sites), or by play interactions among new arrivals (especially for small juvenal males). Note that total activity reaches its lowest level from 1400 to 1700 hours, which coincides with the hours of peak numbers of seals on shore (Figure 10), and with the hours of lowest arrival-departure rates (Figures 11 and 12).

Roger Gentry
John Holt
John Francis

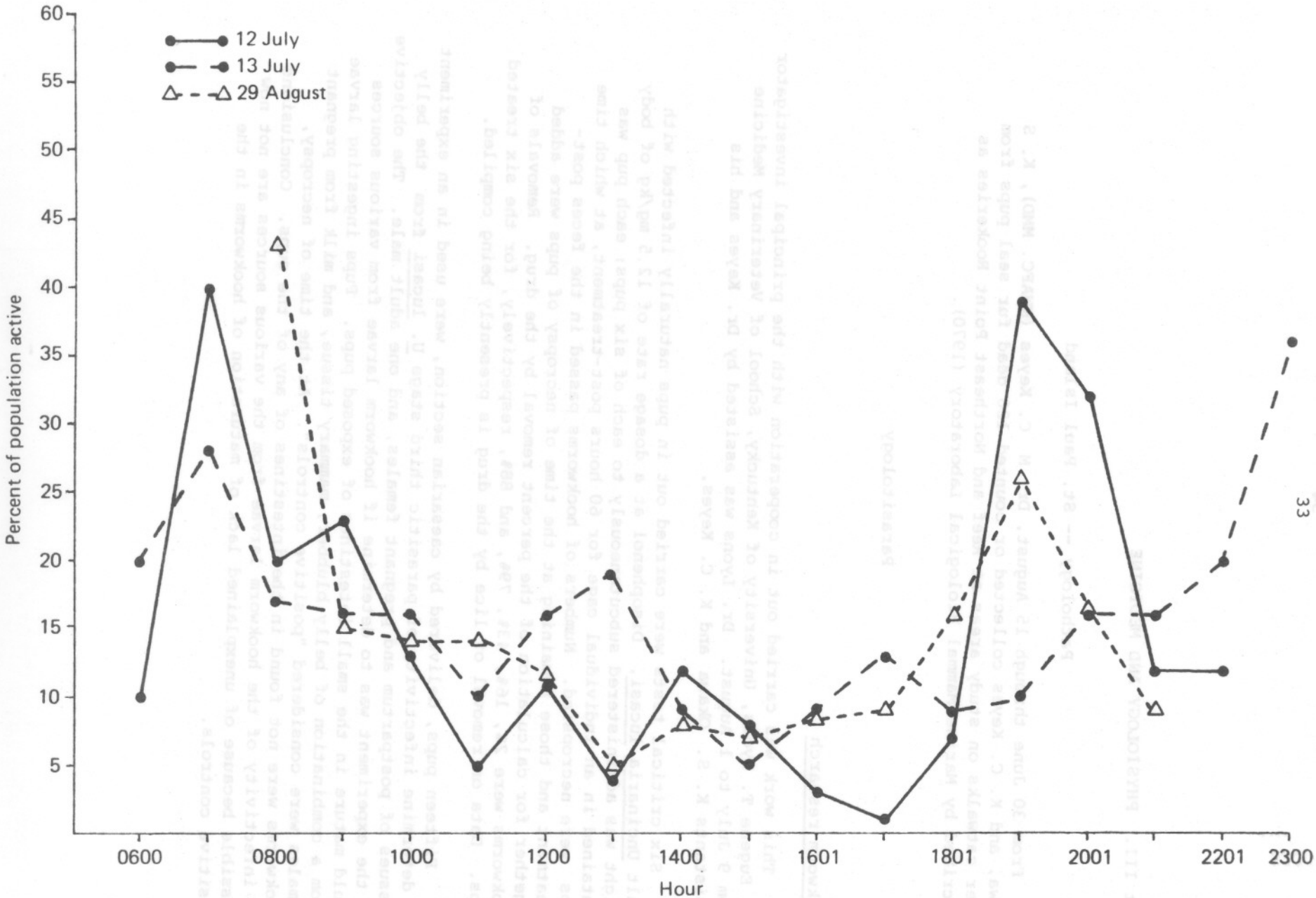


Figure 13.--Activity level (% of juvenal males with head up off the ground) per hour of day for 3 days at Zapadni Hauling Ground.

Part III. PHYSIOLOGY AND MEDICINE

Pathology -- St. Paul Island

From 30 June through 15 August, Dr. M C. Keyes (NWAFC. MMD), K. S Okawa, and K. C. Keyes collected or counted 126 dead fur seal pups from under catwalks on study areas at Reef and Northeast Point Rookeries as described by Marine Mammal Biological Laboratory (1970).

Parasitology

Hookworm research

This work was carried out in cooperation with the principal investigator Dr. Eugene T. Lyons, University of Kentucky, School of Veterinary Medicine from 9 July to 1 August. Dr. Lyons was assisted by Dr. Keyes and his assistants K. S. Okawa and K. C. Keyes.

Six critical tests were carried out in pups naturally infected with adult Uncinaria lucasi. Disophenol at a dosage rate of 12.5 mg/kg of body weight was administered subcutaneously to each of six pups; each pup was contained in an individual cage for 60 hours post-treatment, at which time pups were necropsied. Numbers of hookworms passed in the feces post-treatment and those remaining at the time of necropsy of pups were added together for calculation of the percent removal by the drug. Removals of hookworms were 2%, 16%, 43%, 79%, and 88%, respectively, for the six treated pups. Data on removal of lice by the drug is presently being compiled.

Fifteen pups, delivered by caesarian section, were used in an experiment to determine infectivity of parasitic third stage U. lucasi from the belly tissues of postpartum and pregnant females, and one adult male. The objective of the experiment was to determine if hookworm larvae from various sources would mature in the small intestines of exposed pups. Pups ingesting larvae from a combination of belly blubber, mammary tissue, and milk from pregnant females were considered "positive controls". At the time of necropsy, hookworms were not found in the intestines of any of the pups. Conclusions on infectivity of the hookworm larvae from the various sources are not now possible because of unexplained lack of maturation of hookworms in the positive controls.

Respiratory mite research

This work was carried out by Dr. Ke Chung Kim, and his assistant, Steven N. Istvan, Department of Entomology, Pennsylvania State University. They were assisted by Dr. M. C. Keyes and his assistants, K. S. Okawa and K. C. Keyes.

The objectives of the study were to determine the (1) density and structure of the population of Orthohalrarchne attenuata and O. diminuata on northern fur seals, (2) relationship between O. attenuata and O. diminuata, (3) behavioral and pathological effects of nasal mites on the host, particularly the respiratory system, and (4) describe the life cycle and mode of transmission of the nasal mites. Samples were taken for different stages of the research as follows:

1. Population density and structure of Orthohalrarchne attenuata and O. diminuata on northern fur seals.

Snouts and respiratory organs were collected for this study and shipped to the Pennsylvania State University as follows:

Adult males - 4 samples
Adult females - 28 samples
Juvenile males - 20 samples
Black pups - 26 samples

2. Life cycle and mode of transmission of nasal mites.

Eight larvae of each species, O. attenuata and O. diminuata, were reared in physiological saline at room temperature. Development of protonymph and deutonymph was confirmed for both species. Within 2 days the larva molted twice to become the adult.

Samples were taken from caged females and caesarian-sectioned pups for studying the mode of mite transmission.

3. Relationship between O. attenuata and O. diminuata.

The larvae of both species inhabit the turbinates and nasal meatuses among nasal mucosa. Each turbinate sheet will be carefully studied for microhabitat or resource partition.

4. Behavioral and Pathological Effects of Nasal Mites on the Host.

A. Hypothesis: Expiratory dyspnea is correlated with the level of mite infestation.

Expiratory dyspnea counts were made for each of the following animals with 3 readings for each animal, and snout and respiratory organ samples were taken for these animals:

Adult females - 12 samples
Pups - 11 samples
Adult males - 4 samples

B. Tissue samples from turbinates, nasopharynx, tracheae and lungs were taken for histopathology from the following animals:

Adult females - 20 samples
Adult males - 4 samples
Juvenile males - 20 samples
Black pups - 11 samples

Future work and additional samples needed:

The following snout samples will be needed for study to understand development and seasonal fluctuation in population structure of the nasal mites:

St. Paul Island - 5 silver pups and 4 juvenile males in November.
Pelagic - 4 juvenile males or adult females in March or April.

Tunic worm research

The tunic worm, Dipetalonema odendhali, is a filariid worm that resides in the subcutaneous tissues of fur seals, and frequently next to the tunica vaginalis in male fur seals; hence the name tunic worm. The effect such resident adult worms have on the host is unknown but circulating larvae (microfilariae) are probably present in the majority of adult and subadult fur seals. In 1963, Dr. M. C. Keyes (1964) found microfilariae in 35 of 40 samples from subadult males from the harvest (87.5%). The life cycle has not been worked out. The single most important part, identity of the intermediate host, is unknown but believed to be a biting insect or arachnid.

G. Conlogue, Washington State University, began working on the problem in the summer of 1977. His primary accomplishment was in working out methods, techniques, and approaches required in planning research for 1978. During the summer of 1978, he collected ectoparasites from 177 fur seals including harem males, subadult males, adult females and pups. Eleven foxes were also examined for parasites in common with fur seals.

Blood from 164 fur seals (129 subadult males, 26 adult females, 4 adult males, and 5 pups) were examined. The incidence of microfilariae in these samples was as follows: 113 subadult males (87.6%), 20 adult females (75.9%), and 4 adult males (100.0%).

As yet no intermediate stages of D. odendhali have been found in any of the ectoparasites collected.

Immunology and Infectious Disease Research in Cooperation with the Naval Bioscience Laboratory (NBL)

H. Bray collected samples to support studies of cell mediated immunity and immune and nonimmune competence related to disease resistance in northern fur seals; 400 ml of pooled serum was collected for fractionation of immunoglobulins, and ten samples of sera from each rookery were collected for complement-lytic studies. Biphasic media were inoculated with seal blood to detect and isolate any bacteria in the blood stream. Band T cells were separated from blood in a Ficoll-Hypage gradient centrifuge. Blood from fur seals was preserved in glycerol for antigen matching studies at NBL. Throat swabs of 25 fur seals were streaked on Thayer-Martin media for selective culture of Neisseria sp. (related to the human gonorrhea organism).

Pathology - St. George Island

A second year of baseline data on causes of death in newborn fur seals was collected for eventual evaluation of the effects of a peak male population on pup mortality. We expect this peak to occur no later than 1984, at which time the study will be repeated and the comparison made.

From 1 July to 15 August, Dr. R. K. Stroud and M. M. Booth collected 218 dead fur seal pups from under catwalks on the study area at Staraya Artil Rookery as described earlier (Marine Mammal Division 1978). Of these pups, 209 were necropsied and 9 were discarded as unsuitable for examination because of advanced post mortem degeneration.

Necropsy results

Tabulation of the primary diagnoses for pups necropsied showed that the main cause of death was emaciation syndrome which accounted for 44.5% of the deaths on the Staraya Artil study area. Hookworm disease (15.6%) and and microbial infection (13.8%) were of about equal importance in a secondary role, andtrauma (8.5%), and miscellaneous causes (6.6%) were of lesser importance. Undetermined causes and pups unsuitable for examination accounted for 11.4% of the sample (Table 10). Considering the possible

TABLE 10.--Primary diagnosis of causes of death among seal pups on Staraya Artil Rookery, mortality study area 4, St. George Island, Alaska, by weekly intervals from 28 June to 15 August 1978.

Primary diagnosis	28 June-4 July		5-11 July		12-18 July		19-25 July		26 July-1 Aug		2-8 Aug		9-15 Aug		Total	Percent
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Emaciation syndrome	2	5.9	5	16.1	17	43.6	20	54.1	17	63.0	23	65.7	13	86.5	97	44.5
Hookworm disease	0	0.0	6	19.3	6	15.4	9	24.3	6	22.2	7	20.0	0	0.0	34	15.6
Microbial infection	2	5.9	6	19.3	11	28.2	4	10.8	2	7.4	5	14.3	0	0.0	30	13.8
Peritonitis	-	-	-	-	-	-	-	-	-	-	(1)	(2.9)	-	-	(1)	(0.5)
Pleuritis-pyothorax	-	-	-	-	(1)	(2.6)	-	-	-	-	-	-	-	-	(1)	(0.5)
Absess cellulitis	-	-	(1)	(3.2)	(1)	(2.6)	-	-	-	-	-	-	-	-	(2)	(0.9)
Leptospirosis, (perinatal-complex)	(2)	(5.9)	(5)	(16.1)	(9)	(23.0)	(4)	(10.8)	(2)	(7.4)	(4)	(11.4)	-	-	(26)	(11.9)
Trauma	9	26.5	3	9.7	1	2.6	3	8.1	0	0.0	0	0.0	2	13.4	18	8.3
Bite wound	(2)	(5.9)	(1)	(3.3)	(1)	(2.6)	(1)	(2.7)	-	-	-	-	-	-	(5)	(2.3)
Organ rupture	(4)	(11.8)	(1)	(3.2)	-	-	(1)	(2.7)	-	-	-	-	-	-	(6)	(2.7)
Skull fracture	(3)	(8.8)	(1)	(3.2)	-	-	(1)	(2.7)	-	-	-	-	(2)	(13.4)	(7)	(3.2)
Miscellaneous	3	8.8	8	25.8	1	2.6	1	2.7	1	3.7	0	0.0	0	0.0	14	6.4
Congenital heart defect	(1)	(2.9)	(2)	(6.5)	-	-	-	-	-	-	-	-	-	-	(3)	(1.4)
Congenital goiter	-	-	(1)	(3.2	-	-	-	-	(1)	(3.7)	-	-	-	-	(2)	(0.9)
Anemia	-	-	-	-	-	-	(1)	(2.7)	-	-	-	-	-	-	(1)	(0.5)
Dystocia-stillbirth	(2)	(5.9)	(2)	(6.5)	-	-	-	-	-	-	-	-	-	-	(4)	(1.8)
Suffocation	-	-	(3)	(9.7)	(1)	(2.6)	-	-	-	-	-	-	-	-	(4)	(1.8)
Undetermined	11	32.3	3	9.7	1	2.6	0	0.0	1	3.7	0	0.0	0	0.0	16	7.3
Unsuitable for examination	7	20.6	0	0.0	2	5.0	0	0.0	0	0.0	0	0.0	0	0.0	9	4.1
Total	34	100.0	31	100.0	39	100.0	37	100.00	27	100.0	35	100.0	15	100.0	218	100.0

diagnoses for this latter category, it is safe to rule out emaciation syndrome and hookworm disease because the former cause is obvious even in partly decomposed cadavers, and the latter cause does not occur until about mid-July, well after most pups in this category have been collected. Causes that are compatible with rapid decomposition and a lack of definitive lesions are septicemia (microbial infection in the blood stream), and suffocation by being laid on by a harem male, respectively.

Included in the miscellaneous category were five deaths attributable to congenital anomalies which are incompatible with life. Three of these were congenital heart defects (endocardial fibroelastosis, aortic-pulmonary artery transposition with ventricular septal defect and hypotrophy of the left ventricle), and two congenital goiters. Four pups did not survive apparent dystocia (difficult births) as indicated by the severe bruising of the head and the poorly inflated or non-inflated lungs. One case of non-hookworm anemia was observed.

Death rate

Total live pup counts within the study area were made as follows: 5 July, 917; 10 July, 1,091; 17 July, 1,311; 24 July, 1,606; 2 August, 711; 7 August, 595; and 14 August, 981. The average number of pups in the study area over the seven week period was 1,030. Based on this figure, 218 dead pups represents a mortality of 21.2%. In 1977, the rate was 12.3%.

Epizootiology

Mortality from emaciation syndrome in 1978 was greater (44.5%) than in 1977 (38.2%). This increase was apparently offset by a decrease in deaths from hookworm disease; 15.6% in 1978 compared to 31.4% in 1977. Weather, which was milder in 1978 than in 1977, is an important secondary factor in deaths from hemorrhagic anemia brought about by hookworms.

The incidence of hemorrhagic perinatal complex (leptospirosis) increased markedly in 1978 over 1977, 26 cases compared to 10. Premature pups, a feature of leptospirosis and characterized by weights under 2 kg and with underdeveloped pelage, were observed more frequently in 1978 than in 1977. A mean decrease in adult females and pups on the rookery, along with an increased incidence of leptospirosis suggests the distinct possibility of an increased rate of abortion at sea.

In 1977, the total number of deaths attributable directly to traumatic causes was five (2.4%). In 1978, 18 deaths (8.3%) were attributed to fractured skulls, bite wounds, or ruptured internal organs. Most of these occurred during the first three weeks of July when fighting among males was most prevalent and the harem areas most congested. Not included in this number were four deaths of pups in which inhalation of large quantities of

milk from a full stomach was the only observed lesion. These pups may have been stepped or layed on. Although counts of adult males and females were not made in 1977, there seemed to be an obvious increase in males, particularly those on the periphery of the study area, in 1978. For the record, there were 71 adult males within the study area on 10 July 1978. There already appears to be a relationship between increased numbers of injuries to pups and an increase in the number of adult males.

Bacteriology

Tissues and exudates from necropsied pups were cultured aerobically on tetrathionate, brilliant green,and 5% seal blood or McConkey's agar at 37°C when an infectious process was suspected. Only isolates tentatively identified as Salmonella were saved for further culture and identification. A supplemental report on Salmonella will be submitted when this work is completed.

Parasitology

Fecal samples were collected from the colons of 35 pups and ten subadult males and placed in potassium permanganate solution for shipment to Dr. F. Fitzgerald at the University of Illinois for possible detection of protozoan parasites.

Mark C. Keyes
Richard K. Stroud
Eugene T. Lyons
K. C. Kim

Part IV. POPULATION GROWTH - SAN MIGUEL ISLAND (Adams Cove and Castle Rock)

Adams Cove

The population of fur seals breeding in Adams Cove on the west end of San Miguel Island, discovered in 1968, has been monitored daily during each breeding season from 1969 to 1978. A summary of population information is presented in Table 11 and described below.

The adult males and females haul out in mid to late May, and the mean pupping date occurs in late June. In 1978, 635 pups were born at the Adams Cove Rookery and in 1977, 421 pups were born (Table 11). This represents the greatest single successive year increase in pup production (50.8%) since studies of the colony began in 1969. The dramatic increase in pup production in 1978 over 1977 is probably the result of a large increase in the number of females on the rookery during the latter year. Apparently, many of these females were non-parturient in 1977, but bred that year and returned to Adams Cove and gave birth to pups in 1978.

In addition to female recruitment from within the population, large increases in the number of females at Adams Cove was caused partly by the immigration of females from other rookeries. Females that had been tagged or checkmarked as pups on the Pribilof, Commander, and Robben Islands have been observed frequently at the Adams Cove rookery. Females could also be immigrating from the nearby Castle Rock population into the Adams Cove colony, although at this time there is no evidence to confirm that such movement is occurring.

Since 1969 there has been an increasing trend in the number of males of all ages at the Adams Cove Rookery, and by 1978 their total was the largest recorded. Unlike the females, however, the number of males has increased slowly, apparently the result of male recruitment only from within the Adams Cove population. This is exemplified by our records of identifiable subadult males later classified as large territorial males. The large number of males observed in 1978 is the result of recruitment of males born after 1973 when pup production began to increase dramatically. Marked males from northern populations have never been observed at San Miguel Island.

In addition to the total number of males, there has been an increasing trend in the number of territorial males, with the highest count in 1978. In that year,the percent of small adult males that were classified as territorial changed from what had been observed during previous breeding seasons. In the past all large and small adult males were classified as territorial during the peak of the breeding season, but only 50% of the small males were territorial in 1978. This decrease in the percent of small territorial males is apparently the result of an increase in the number of large territorial males displacing the smaller animals. Small

TABLE 11. --Summary of some observations of the northern fur seal colony in Adams Cove on San Miguel Island, California, 1969-78.

Observation	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Season span										
Beginning date[1]	16 May	23 May	15 May	16 May	9 May	20 May	19 May	29 May	18 May	17 May
Ending date	1 Oct.	20 Sept.	6 Sept.	7 Sept.	15 Aug.	9 Sept.	6 Sept.	14 Sept.	22 Sept.	9 Sept.
First male	16 May	29 May	24 May	16 May	26 May	20 May	12 May	29 May[2]	18 May[9]	17 May[3]
First female	27 May	28 May	25 May	22 May	17 May	20 May[3]	19 May	29 May[2]	18 May[9]	17 May[11]
First birth	6 June	28 May	31 May	22 May	7 June[4]	27 May	27 May	29 May[5]	29 May[10]	30 May
Mean birth date	24 June	21 June	26 June	22 June	24 June	23 June	27 June	29 June	25 June	24 June
Total births	28	33	45	70	68	220	329	417	421	635
Total pup deaths	2	14	15	21	17	52	46	91	64	77
Total females (maximum counted and date)[6]	175	179	274	310	394	551	563	495	681	584
	23 Aug.	23 Aug.	2 Sept.	16 Aug.	4 Aug.	8 Sept.	24 Aug.	14 July	26 Aug.	18 Aug
Total large adult males	4	2	4	6	6	6	10[7]	7	7	13[7]
Total small adult males	4	4	6	7	5	6	6	5	3	12[12]
Total bachelors[8]	4	5	6	10+	6	8	7	11	7+	19

1/ Beginning and ending dates of continuous observations.
2/ Four males, nine females present 29 May==arrived prior to 29 May.
3/ May have arrived earlier.
4/ One still birth occurred on 19 May.
5/ One pup present 29 May--born prior to 29 May.
6/ A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
7/ Includes two males who arrived in late August and were not territorial (probably from Castle Rock).
8/ Animals about 104-127 cm in body length, tip of nose to tip of tail.
9/ Three males and 2 females present 18 May==arrived prior to 18 May.
10/ Estimated from previous breeding season information.
11/ Two females present 17 May == arrived prior to 18 May
12/ Includes six small adult males who were not territorial.

adult males are then forced to the periphery of the rookery area. These males are analagous to idle males counted on the Pribilof Islands.

Tagging Records

Records have been kept of each tagged or checkmarked seal observed ashore in Adams Cove starting in 1968 with the discovery of this colony on San Miguel Island. As stated earlier, some of these females had been tagged as pups on the Pribilof, Commander, and Robben Islands (Tables A-15), and some had been tagged as adult females or pups at Adams Cove on 20 July 1968 (Table A-16). Records have also been kept of sightings of adult females tagged on San Miguel Island during tagging projects begun in 1975 (Table A-17). In 1976, 1977, and 1978 combined we resighted 39 of 50 females (78%) tagged in 1975; however, during each separate season we resighted only about 50% of these individuals (Table A-17).

Two fur seals tagged as pups in 1975 were resighted in 1977 as 2-year-olds and in 1978, we resighted 19 tagged 3-year-olds from the 1975 year class. One 2-year-old from the 1976 year class was sighted in 1978 (Table A-18). Similar patterns of returns have been reported on the Pribilof Islands with more fur seals returning at age 3 than at age 2 (North Pacific Fur Seal Commission, 1969 and 1971). The rates of tag returns for each age class are also similar for the Adams Cove Rookery and rookeries on the Pribilof Islands. At Adams Cove the percent tagged resightings for seals of ages 2 and 3 years was 1.5% and 19.0% respectively ; on the Pribilof Islands, tag returns for for seals of these ages averaged 1.2%[1/] and 10.0%[1/], respectively (North Pacific Fur Seal Commission, 1969 and 1971).

On 14 September 1978, 100 fur seal pups were single tagged with modified monel cattle ear tags and checkmarked by removal of the cartilaginous extension of the 4th digit of the left hind flipper (Table A-19).

Mortality

In 1978, 77 fur seal pups (12% of the total born) died on land in Adams Cove; these deaths were distributed throughout the breeding season. By contrast, a large percentage of mortality in 1976 and 1977 occurred during a few days of abnormally hot weather. The weather conditions in 1978 were never as warm as during the two previous seasons and apparently few, if any, pups died from heat stress. Consequently, a death rate of 12% in 1978 was less than that those observed in 1976 (22%) and 1977 (15%). Pup mortality caused from falling earth embankments was not observed during the 1978 field season. In addition, one adult female and one subadult male died at Adams Cove in 1978.

1/ Tag recovery rates were corrected for the exclusion of females in the harvest by assuming a 1:1 sex ratio (i.e., 2x male tag recoveries=assumed number of tagged males and females, excluding tagged individuals which are not harvested but are permitted to escape).

Castle Rock

A summary of the Castle Rock census information from 1972 to 1978 is shown in Table 12. These data have been obtained from afoot, from aerial photographs, and from offshore using a small skiff. In 1978, a count of 533 pups (507 living and 26 dead) was obtained during a census from afoot on 2 August. This represents a decrease in pup production of 76 animals from 1977 to 1978. The reason for this decrease is not now understood, although two possible explanations are: 1) undetected pup mortality during the 2 August census, and 2) movement of females from Castle Rock to Adams Cove to give birth to pups. There may be female emmigration from Castle Rock to Adams Cove as a result of both overcrowding and competition for space with California sea lions (Zalophus californianus) and northern sea lions (Eumetopias jubata) utilizing the same habitat. Additional studies on Castle Rock are being planned for the 1979 field season to obtain a better understanding of the reason for this decline in pup production.

Twenty breeding males were counted on Castle Rock from aerial photographs taken 1 July 1978 (Table 12). This is the largest number of territorial males recorded since discovery of the colony in 1972.

On 13 September 1978, 100 fur seal pups were tagged on Castle Rock (Table A-20) and checkmarked in the same manner as described for animals of the Adams Cove population given marks.

George Antonelis
Robert DeLong
Clifford Fiscus

TABLE 12.--Summary of northern fur seal censuses on Castle Rock (adjacent to San Miguel Island), California, 1972-78[1/].

Fur seals	Numbers observed, methods and date of observation						
	1972	1973	1974	1975	1976	1977	1978
Females	223[a] 1 Aug.	345[a] 11 Jul.	301(+)[d]	396(+)[d]	526[c] 27 Jun.	617(+)[d]	533(+)[d]
Pups Total observed[2/]	95[a] 1 Aug.	193[b] 28 Jul.	301(+)[b] 2 Aug.	396[b] 2 Aug.	521[b] 25 Jul.	617[b] 29 Jul.	533[b] 2 Aug.
Pups Dead observed	- -	33[b] 28 Jul.	21[b] 2 Aug.	28[b] 2 Aug.	27[b] 25 Jul.	20[b] 29 Jul.	26[b] 2 Aug.
Reproductive males[3/]	9[a] 1 Aug.	13[a] 11 Jul.	11[a] 2 Jul.	15[a] 1 Jul.	16[c] 27 Jun.	9(+)[a] 26 Jul.	20[a] 1 July
Total males	10[a] 1 Aug.	14[a] 11 Jul.	20[a] 2 Jul.	20[a] 1 Jul.	18[c] 27 Jun.	9(+)[a] 26 Jul.	25[a] 1 July

1/ Methods by which counts were obtained
a - Aerial photographs.
b - Land based counts from afoot.
c - Offshore counts from skiff.
d - Minimum estimate from pup count.

2/ Includes dead pup count

3/ Territorial adult males with females in territories.

Part V. PELAGIC ECOSYSTEM

A progress report on pelagic data analysis is scheduled to be submitted to the North Pacific Fur Seal Commission in April 1979. Summary highlights of the above report on pup-yearling migration, reproduction, growth and feeding are presented here. Because the migration and distribution pattern of fur seals (older than pup-yearlings) is complex, a complete analysis on migration (incorporating sighting data as well as biological information on age, sex, reproductive condition, and feeding) will be reported on in 1979.

Migration (pup-yearling)

Fur seal pups first arrive on the west coast of North America by mid-December, according to catch data and beach strandings. Most yearlings were taken during March and April from the La Perouse Bank - Cape Flattery area. The age and sex composition of fur seals, including yearlings collected in the eastern Pacific, varies considerably by month and area; the younger ages are not fully represented in the catch. By area, yearling representation to the total catch is as follows: California, 1%; Oregon, 6%; Washington, 15%; British Columbia, 34%; Gulf of Alaska, 3%; Western Alaska, 0.6%; and in the eastern Bering Sea, 0.2%. The yearling sex ratio was approximately 40% males from British Columbia south and 60% (or more) males in Alaskan waters.

Reproduction

Analysis of reproductive data indicated that pregnancy rates vary considerably by season and area, which suggests differential migration patterns for pregnant versus nonpregnant females. The highest pregnancy rate (87-95%) occurs near the breeding islands during summer and the lowest rates are found off Washington (75-80%) during winter and spring. Seasonal changes are pronounced in the Gulf of Alaska, increasing from 65 to 70% in February to 80-85% in April, then decreasing thereafter.

The average age at first reproduction based on primiparous pregnant animals appears to have declined between the 1956 and 1964 year classes. An analysis suggested that age at first reproduction is inversely related to early survival in these year classes.

Growth

Annual and seasonal changes in body size including the size differences between males and females were summarized. Most growth in females is attained by 4-5 years of age. Males begin to grow rapidly between 4 and 5 years of age when they attain sexual maturity and continue to do so until they reach sociological maturity at about 10 years of age. Data on size increments indicated that growth in 1960-61 and 1969-70 was better than in other years,

although the available samples are small. Seasonal growth appears to occur progressively earlier in animals older than yearlings; fastest growth is in mid-August in 1-year-olds but in mid-July in 4-year-olds. Mean body lengths of fetuses indicate that their size tends to increase with the age (size) of mothers.

Food

An analysis of feeding habits by fur seals in the eastern Bering Sea and North Pacific Ocean is currently in progress. The index of relative importance (which utilizes percentage by volume, number of specimens of each food type, and frequency of occurrence) is being used to assess the importance of each food species. Preliminary results using this method for the eastern Bering Sea show that capelin (Mallotus villosus) is important in June; squids of the Family Gonatidae and walleye pollock (Theragra chalcogramma) in July; Gonatid squids, capelin and walleye pollock in August; and walleye pollock and Gonatid squids in September.

Diel feeding patterns indicate that fur seals feed primarily during the hours of darkness and that the percentage of empty stomachs generally increases throughout the day. The largest stomach content weighed 9.8 kg (9175 cc) from a 17-year-old male taken in the eastern Bering Sea during September. The contents represented 6.5 percent of the animal's body weight. However, the largest stomach (5.6 kg or 5330 cc) by percent of body weight was from a 9-year-old pregnant female taken off California. The contents represented 18.2 percent of the body weight.

Hiroshi Kajimura
Michael Perez
Anne E. York
Robert H. Lander

ACKNOWLEDGEMENTS

Research on the Pribilof Islands in 1978 was completed with the cooperation of the staff of the Pribilof Islands Program: Walter Kirkness, Director, Richard A. Hajny, Resource Management Specialist, and Harold A. Thayer, Facilities Management Officer. Others who cooperated on St. Paul Island were Vyacheslav Melovidov, Sealer Foreman, and the Tanadgusix Corporation. On St. George Island, fur seal investigations were completed with the cooperation of Richard M. Frazier, Engineer, Pribilof Island Program.

Research on San Miguel Island was completed with the cooperation of the staff of the Channel Islands National Monument, National Park Service, Ventura, California; and Bill Owens, Public Works Engineering Officer, Pacific Missile Range Headquarters, U.S. Navy, Point Mugu, California.

GLOSSARY

The following terms used in fur seal research and management on the Priblof Islands have special meanings or are not readily found in standard dictionaries.

Drive — The act of surrounding and moving groups of seals on land from one location to another.

Escapement — Seals that were not killed because they were too old, too large, or were not available.

Hauling Ground — An area, usually near a rookery, on which nonbreeding seals congregate. See ROOKERY.

Haul Out — The act of seals moving from the sea to a rookery or hauling ground on shore.

Known-age — Refers to a seal whose age is known because the animal bears an inscribed tag or other type of mark.

Male Seals, Adult

Class 1 (Shoreline)--Full-grown males apparently with established territories spaced along the water's edge at intervals of 10-15 meters. Most of these animals are wet or partly wet and some acquire harems of 1-4 females between 10 and 20 July. They would then be called harem males (class 3). Shoreline or class 1 males should not be confused with class 2 animals. The latter definitely have territories, whereas the shoreline males appear to be attached to such sites but may not be in all cases.

Class 2(Territorial without females)--Full-grown males that have no females but are actively defending territories. Most of these animals are located on the inland fringe of the rookery, some are between class-1(Shoreline) and class 3 (Territorial with females) males, and an occasional class 2 male may be completely surrounded by class-3 males and their harems.

Class 3 (Territorial with females)--Full-grown males actively defending territories and one or more females. Most class 3 males and their harems combine to form a compact mass of animals. Isolated individuals, usually with small harems, may be observed at each end of a rookery, or sand beaches, and in corridors leading to inland hauling grounds.

Class 4 (Back fringe)--Full- and partly grown males on the inland fringe of the rookery. A few animals too young and too small to include in the count may be found here. Though some class 4 males may appear to be holding territories, most will flee when approached or prodded with a pole.

Class 5 (Hauling ground)--The hauling grounds contain males from May to late July and a mixture of males and females from then on. The counts include males that obviously are adults and all others that have a mane and the body conformation of an adult. Males included in this count will be approximately age 7 and older.

Prior to 1966, class 3 males were formerly called harem bulls, and class 1, 2, 4, and 5 were collectively called idle bulls. From 1966 through 1974, the adult male seals were classified into 5 groups (Classes 1, 2, 3, 4, and 5). Beginning in 1975, classes 1 and 2 were combined and designated as class 2, class 3 remained the same, and classes 4 and 5 were combined and designated as class 5.

Mark Recoveries Includes the recoveries of seals marked by one of several methods. See Marked.

Marked Describes a seal that has been marked by removing the catilaginous tip of a digit from a hind flipper, by attaching an inscribed metal tag to one or more of its flippers, by freeze marking, or by hair-clipping and bleaching.

Rookery An area on which breeding seals congregate. See Hauling Ground.

Round The sequence in which hauling grounds on St. Paul Island are visited to harvest seals. A circuit or round of the hauling grounds is completed in 5 days and the procedure is repeated throughout the kill of males.

REFERENCES

Chapman, D.G. 1964. A critical study of Pribilof fur seal population estimates. Fish. Bull., U.S. 63(3): 657-669.

Gentry, R.L., and J. H. Johnson. 1978. Physical restraint for immobilizing fur seals. J. Wildl. Manage. 42(4): 944-946.

Johnson, A.M. 1968. Annual mortality of territorial male fur seals and its management significance. J. Wildl. Manage. 72(1):94-99.

Keyes, M. C. 1964. Research in fur seal mortality, St. Paul Island, Alaska. 8 July to 24 September 1963. U.S. Dep. Inter., U.S. Fish Wildl. Serv., Mar. Mamm. Biol. Lab., Seattle, Wash., 66 p. (Processed).

Marine Mammal Biological Laboratory. 1970. Fur seal investigations, 1967. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 597, vii - 104 p.

Marine Mammal Division. 1974. Fur seal investigations, 1973. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Fish. Cent., Seattle, Wash., vii - 96 p. (Processed).

_____. 1975. Fur seal investigations, 1974. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Fish. Cent., Seattle, Wash., vii - 125 p. (Processed).

_____. 1976. Fur seal investigations, 1975. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Fish. Cent., Seattle, Wash., vii - 115 p. (Processed).

_____. 1977. Fur seal investigations, 1976. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Alaska Fish. Cent., Seattle, Wash., v - 92 p. (Processed).

_____. 1978. Fur seal investigations, 1977. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Alaska Fish. Cent., Seattle, Wash., vi - 94 p. (Processed).

North Pacific Fur Seal Commission. 1969. North Pacific Fur Seal Commission report on investigation from 1964 through 1966. Kenkyusha Print Co., Tokyo, 161 p.

_____. 1971. North Pacific Fur Seal Commission report on investigation from 1962 to 1963. Kenkyusha Print Co., Tokyo, 96 p.

TABLE A-1.--Age classification of male seals killed on St. Paul Island, 26 June to 31 July 1978.

Date/Rookery[1]	Males killed	Tooth sample	Daily: Percent in each age class of sample					Daily: Estimated number killed from each age class					Total kill to date	Cumulative: Estimated number of killed from each age class					Cumulative: Percent killed from each age class				
			2	3	4	5	6	2	3	4	5	6		2	3	4	5	6	2	3	4	5	6
June 26 NEP (east)	340	81	2.5	24.7	69.1	3.7	0.0	8	84	235	13	0	340	8	84	235	13	0	2	25	69	4	0
26 NEP (west)	380	91	2.2	36.3	57.1	4.4	0.0	8	138	217	17	0	720	16	222	452	30	0	2	31	63	4	0
27 POL	246	58	0.0	22.4	69.0	8.6	0.0	0	55	170	21	0	966	16	277	622	51	0	2	29	64	5	0
28 TZR	353	86	1.2	27.9	67.4	3.5	0.0	4	99	238	12	0	1,319	20	376	860	63	0	2	28	65	5	0
29 ZAP	284	75	1.3	34.7	60.0	4.0	0.0	4	99	170	11	0	1,603	24	475	1,030	74	0	1	30	64	5	0
30 Reef	909	240	1.7	36.3	58.3	3.3	0.4	15	330	530	30	4	2,512	39	805	1,560	104	4	2	32	62	4	0
30 L-K	235	54	1.8	35.2	55.6	7.4	0.0	4	83	131	17	0	2,747	43	888	1,691	121	4	2	32	62	4	0
July 3 NEP (east)	279	57	1.7	47.4	47.4	3.5	0.0	5	132	132	10	0	3,026	48	1,020	1,823	131	4	2	34	60	4	0
3 NEP (west)	509	93	1.1	44.1	52.7	2.1	0.0	6	224	268	11	0	3,535	54	1,244	2,091	142	4	2	35	59	4	0
5 POL	478	81	0.0	35.8	61.7	2.5	0.0	0	171	295	12	0	4,013	54	1,415	2,386	154	4	1	35	60	4	0
6 TZR	963	206	2.4	53.9	40.8	2.9	0.0	23	519	393	28	0	4,976	77	1,934	2,779	182	4	1	39	56	4	0
7 ZAP	410	98	1.0	57.1	38.8	3.1	0.0	4	234	159	13	0	5,386	81	2,168	2,938	195	4	1	40	55	4	0
10 Reef	1,178	227	3.5	56.0	38.8	1.3	0.4	41	660	457	15	5	6,564	122	2,828	3,395	210	9	2	43	52	3	0
11 NEP (east)	550	119	1.7	47.9	49.6	0.8	0.0	9	264	273	4	0	7,114	131	3,092	3,668	214	9	2	43	52	3	0
11 NEP (west)	805	156	0.7	69.1	28.8	0.7	0.7	6	556	231	6	6	7,919	137	3,648	3,899	220	15	2	46	49	3	0
12 POL	519	95	0.0	43.2	55.8	1.0	0.0	0	224	290	5	0	8,438	137	3,872	4,189	225	15	1	46	50	3	0
12 L-K	421	83	1.2	39.8	54.2	4.8	0.0	5	168	228	20	0	8,859	142	4,040	4,417	245	15	1	46	50	3	0
13 TZR	679	132	3.0	47.7	43.2	5.3	0.8	20	324	293	36	6	9,538	162	4,364	4,710	281	21	2	46	49	3	0
14 ZAP	642	135	2.2	54.1	40.7	3.0	0.0	14	348	261	19	0	10,180	176	4,712	4,971	300	21	2	46	49	3	0
17 Reef	1,096	235	4.2	53.2	39.6	3.0	0.0	46	583	434	33	0	11,276	222	5,295	5,405	333	21	2	47	48	3	0
18 NEP (east)	513	91	3.3	57.1	31.9	7.7	0.0	17	293	164	39	0	11,789	239	5,588	5,569	372	21	2	48	47	3	0
18 NEP (west)	821	152	2.0	66.4	27.6	3.3	0.7	16	545	227	27	6	12,610	255	6,133	5,796	399	27	2	49	46	3	0
19 POL	633	113	8.0	58.4	33.6	0.0	0.0	50	370	213	0	0	13,243	305	6,503	6,009	399	27	2	49	46	3	0
19 L-K	592	127	3.9	59.1	36.2	0.8	0.0	23	350	214	5	0	13,835	328	6,853	6,223	404	27	2	50	45	3	0
20 TZR	1,564	295	5.1	63.0	29.2	2.4	0.3	80	985	457	37	5	15,399	408	7,838	6,680	441	32	3	51	43	3	0
21 ZAP	770	127	3.1	57.5	37.0	2.4	0.0	24	443	285	18	0	16,169	432	8,281	6,965	459	32	3	51	43	3	0
24 Reef	1,217	180	2.2	61.1	33.3	3.4	0.0	27	744	405	41	0	17,386	459	9,025	7,370	500	32	3	52	42	3	0
25 NEP (east)	661	94	9.6	60.6	26.6	3.2	0.0	63	401	176	21	0	18,047	522	9,426	7,546	521	32	3	52	42	3	0
25 NEP (west)	701	113	13.3	67.3	17.7	1.7	0.0	93	472	124	12	0	18,748	615	9,898	7,670	533	32	3	53	41	3	0
26 POL	981	122	9.8	58.2	29.5	2.5	0.0	96	571	289	25	0	19,729	711	10,469	7,959	558	32	4	53	40	3	0
26 L-K	689	85	8.2	71.8	17.6	2.4	0.0	56	495	121	17	0	20,418	767	10,964	8,080	575	32	4	54	39	3	0
27 TZR	1,426	211	5.7	67.3	25.6	0.5	0.9	81	960	365	7	13	21,844	848	11,924	8,445	582	45	4	54	39	3	0
28 ZAP	1,019	171	12.9	60.2	26.9	0.0	0.0	132	613	274	0	0	22,863	980	12,537	8,719	582	45	4	55	38	3	0
31 Reef	1,966	385	25.4	61.8	12.0	0.8	0.0	499	1,215	236	16	0	24,829	1,479	13,752	8,955	598	45	6	55	36	3	0

1/ NEP (east) = East or Morjovi side of Northeast Point; NEP (west) = West or Vostochni side of Northeast Point; TZR = Tolstoi, Zapadni Reef, and Little Zapadni; POL = Polovina, Polovina Cliffs, and Little Polovina; ZAP = Zapadni; REEF = Reef, Gorbatch, and Ardiguen; L-K = Lukanin and Kitovi.

TABLE A-2 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 21-23 June 1978.
A dash indicates no numbered sections.

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
2	28	33	-	-	-	-	-	-	-	-	-	-	-	-	61
3	21	30	-	-	-	-	-	-	-	-	-	-	-	-	51
5	70	0	-	-	-	-	-	-	-	-	-	-	-	-	70
Kitovi[2/]															
2	35(15)	9	47	40	36	-	-	-	-	-	-	-	-	-	182
3	13(12)	2	14	28	17	-	-	-	-	-	-	-	-	-	86
5	0(0)	0	1	0	71	-	-	-	-	-	-	-	-	-	72
Reef															
2	56	70	67	41	58	42	94	60	42	40	23	-	-	-	593
3	18	31	17	9	14	20	3	24	14	16	9	-	-	-	175
5	2	10	3	0	221	0	40	70	3	10	19	-	-	-	378
Gorbatch															
2	70	57	35	17	41	54	-	-	-	-	-	-	-	-	274
3	39	21	23	5	13	21	-	-	-	-	-	-	-	-	122
5	125	0	0	200	0	6	-	-	-	-	-	-	-	-	331
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Morjovi[3/]															
2	59(44)	50	32	49	51	70	-	-	-	-	-	-	-	-	355
3	15(9)	29	20	35	22	19	-	-	-	-	-	-	-	-	I49
5	100(30)	0	60	0	25	0	-	-	-	-	-	-	-	-	215
Vostochni															
2	48	37	30	34	26	106	57	65	50	27	35	52	94	46	707
3	16	7	18	16	10	25	11	29	24	9	15	19	32	14	245
5	145	6	4	0	180	5	0	1	8	13	3	55	40	30	490

See footnotes at end of table

TABLE A-2 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 21-23 June 1978--Continued.
A dash indicates no numbered sections.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Little Polovina															
2	39	45	-	-	-	-	-	-	-	-	-	-	-	-	84
3	17	11	-	-	-	-	-	-	-	-	-	-	-	-	28
5	6	165	-	-	-	-	-	-	-	-	-	-	-	-	171
Polovina															
2	63	27	-	-	-	-	-	-	-	-	-	-	-	-	90
3	10	16	-	-	-	-	-	-	-	-	-	-	-	-	26
5	197	0	-	-	-	-	-	-	-	-	-	-	-	-	197
Polovina Cliffs															
2	30	33	28	45	53	46	115	-	-	-	-	-	-	-	350
3	18	11	29	26	34	19	63	-	-	-	-	-	-	-	200
5	5	5	3	1	7	45	5	-	-	-	-	-	-	-	71
Tolstoi															
2	50	47	49	18	88	73	76	75	-	-	-	-	-	-	476
3	25	25	26	31	71	39	28	28	-	-	-	-	-	-	273
5	3	0	0	0	0	0	25	258	-	-	-	-	-	-	286
Zapadni Reef															
2	89	47	-	-	-	-	-	-	-	-	-	-	-	-	136
3	42	2	-	-	-	-	-	-	-	-	-	-	-	-	44
5	11	51	-	-	-	-	-	-	-	-	-	-	-	-	62
Little Zapadni															
2	18	26	67	70	68	42	-	-	-	-	-	-	-	-	291
3	15	32	36	54	57	30	-	-	-	-	-	-	-	-	224
5	2	4	6	10	7	108	-	-	-	-	-	-	-	-	137
Zapadni[4/]															
2	58(0)	77	101	124	73	77	76	18	-	-	-	-	-	-	604
3	27(0)	43	48	57	29	34	30	9	-	-	-	-	-	-	277
5	6(95)	8	10	9	50	0	0	151	-	-	-	-	-	-	329

See footnotes at end of table

Table A-2.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 21-23 June 1978--Continued
A dash indicates no numbered sections.

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														

1/ Class 1 Shoreline - Full-grown males about age 10 and older without females but apparently with established territories at the high tide mark.

Class 2 Territorial without females - Full-grown males about age 10 and older without females but with established territories on the rookery.

Class 3 Territorial with females - Full-grown males about age 10 and older with females and established territories on the rookery.

Class 4 Back fringe - Full-grown and partly grown males about age 7 and older, without females and without territories, that are found along the inland fringe of the rookery.

Class 5 Hauling ground - Full-grown and partly grown males about age 7 and older, without females, that are found on traditional hauling grounds.

Class 3 males were formerly called harem bulls, and Classes 1, 2, 4, and 5 were collectively called idle bulls. From 1966 through 1974, the adult male seals were classified into 5 groups (Classes 1, 2, 3, 4, and 5). Beginning in 1975, Classes 1 and 2 were combined and designated as Class 2, Class 3 remained the same, and Classes 4 and 5 were combined and designated as Class 5.

2/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.

3/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.

4/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

TABLE A- 3.--Adult male seals counted, by rookery, Pribilof Islands Alaska, June 1978

Island and rookery	Date	Class of adult male[1/] 2	3	5	Total
		Number			
St. Paul Island	June				
Lukanin	21	61	51	70	182
Kitovi	21	182	86	72	340
Reef	21	593	175	378	1,146
Gorbatch	21	274	122	331	727
Ardiguen	21	52	34	15	101
Morjovi	22	355	149	215	719
Vostochni	22	707	245	490	1,442
Little Polovina	21	84	28	171	283
Polovina	22	90	26	197	313
Polovina Cliffs	22	350	200	71	621
Tolstoi	21	476	273	286	1,035
Zapadni Reef	23	136	44	62	242
Little Zapadni	23	291	224	137	652
Zapadni	23	604	277	329	1,210
Total		4,255	1,934	2,824	9,013
St. George Island	June				
Zapadni	24	77	67	78	222
South	24	114	95	69	278
North	24	512	258	426	1,196
East Reef	24	129	41	12	182
East Cliffs	24	82	52	279	413
Staraya Artil	24	310	54	162	526
Total		1,224	567	1,026	2,817
Total both islands		5,479	2,501	3,850	11,830

1/ See Table A- 2 or glossary for a description of the classes of adult male seals.

TABLE A-4.--Adult male seals counted, by class[1] and rookery section, St. Paul Island, 10-15 July 1978. A dash indicates no numbered sections.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Lukanin															
2	12	10	-	-	-	-	-	-	-	-	-	-	-	-	22
3	56	64	-	-	-	-	-	-	-	-	-	-	-	-	120
5	40	10	-	-	-	-	-	-	-	-	-	-	-	-	50
Kitovi[2]															
2	9(6)	3	7	15	12	-	-	-	-	-	-	-	-	-	52
3	43(28)	19	57	74	61	-	-	-	-	-	-	-	-	-	282
5	0(1)	0	1	0	55	-	-	-	-	-	-	-	-	-	57
Reef															
2	14	33	13	10	8	26	23	14	10	14	9		-	-	174
3	73	94	103	68	81	65	82	70	85	58	31	-	-	-	810
5	20	10	6	10	194	0	20	60	2	18	12	-	-	-	352
Gorbatch															
2	17	4	9	7	17	20	-	-	-	-	-	-	-	-	74
3	127	91	73	30	66	68	-	-	-	-	-	-	-	-	455
5	99	6	5	135	1	0	-	-	-	-	-	-	-	-	246
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Morjovi[3]															
2	14(12)	23	15	28	18	19	-	-	-	-	-	-	-	-	129
3	75(50)	80	65	85	75	88	-	-	-	-	-	-	-	-	518
5	50(23)	8	40	20	5	0	-	-	-	-	-	-	-	-	146
Vostochni															
2	20	11	8	6	9	29	11	16	19	5	4	9	16	13	176
3	65	32	64	60	38	139	82	100	79	40	63	86	170	75	1,093
5	200	12	3	0	90	4	6	4	4	6	5	40	42	20	436

See footnotes at end of table.

TABLE A-4 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-15 July 1978 --Continued.
A dash indicates no numbered sections.

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Little Polovina															
2	12	18	-	-	-	-	-	-	-	-	-	-	-	-	30
3	53	54	-	-	-	-	-	-	-	-	-	-	-	-	107
5	5	117	-	-	-	-	-	-	-	-	-	-	-	-	122
Polovina															
2	19	6	-	-	-	-	-	-	-	-	-	-	-	-	25
3	78	48	-	-	-	-	-	-	-	-	-	-	-	-	126
5	260	10	-	-	-	-	-	-	-	-	-	-	-	-	270
Polovina Cliffs															
2	8	16	7	17	10	13	17	-	-	-	-	-	-	-	88
3	51	52	48	75	91	89	163	-	-	-	-	-	-	-	569
5	8	2	2	0	3	20	20	-	-	-	-	-	-	-	55
Tolstoi															
2	10	9	11	7	20	17	26	25	-	-	-	-	-	-	125
3	75	80	80	58	118	113	112	83	-	-	-	-	-	-	719
5	5	4	5	0	3	6	17	200	-	-	-	-	-	-	240
Zapadni Reef															
2	32	11	-	-	-	-	-	-	-	-	-	-	-	-	43
3	144	59	-	-	-	-	-	-	-	-	-	-	-	-	203
5	40	50	-	-	-	-	-	-	-	-	-	-	-	-	90
Little Zapadni															
2	8	12	13	26	3	12	-	-	-	-	-	-	-	-	74
3	33	87	101	109	78	111	-	-	-	-	-	-	-	-	519
5	9	2	6	5	0	175	-	-	-	-	-	-	-	-	197
Zapadni[4/]															
2	14(0)	20	8	13	23	13	12	2	-	-	-	-	-	-	105
3	79(0)	130	151	168	100	110	115	29	-	-	-	-	-	-	882
5	8(142)	30	15	20	80	12	0	185	-	-	-	-	-	-	492

See footnotes at end of table.

TABLE A-4.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-15 July 1978 --Continued.
A dash indicates no numbered sections.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														

1/ See Table A-2 or glossary for a description of the classes of adult male seals.
2/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.
3/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.
4/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

TABLE A-5.--Adult male seals counted, by rookery, Pribilof Islands, Alaska, July 1978.

Island and rookery	Date	Class of adult male[1/] 2	3	5	Total
		Number			
St. Paul Island	July				
Lukanin	10	22	120	50	192
Kitovi	10	52	282	57	391
Reef	11	174	810	352	1,336
Gorbatch	11	74	455	246	775
Ardiguen	11	13	93	25	131
Morjovi	12	129	518	146	793
Vostochni	12	176	1,093	436	1,705
Little Polovina	13	30	107	122	259
Polovina	13	25	126	270	421
Polovina Cliffs	13	88	569	55	712
Tolstoi	10	125	719	240	1,084
Zapadni Reef	14	43	203	90	336
Little Zapadni	14	74	519	197	790
Zapadni	15	105	882	492	1,479
Total		1,130	6,496	2,778	10,404
St. George Island	July				
Zapadni	22	30	187	32	249
South	22	19	183	37	239
North	22	223	786	377	1,386
East Reef	22	56	107	24	187
East Cliffs	22	36	115	185	336
Staraya Artil	22	2/ 201	212	-	413
Total		565	1,590	655	2,810
Total both islands		1,695	8,086	3,433	13,214

1/ See Table A-2 or glossary for a description of the classes of adult male seals.

2/ Includes class 5 males.

TABLE A-6.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-78

Rookery and class of male	Year												
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	Number												
Lukanin													
1	13	12	8	4	10	6	2	0	1	-	-	-	-
2	83	93	62	51	24	22	36	36	66	65	69	54	61
3	67	53	45	34	59	58	39	26	29	52	45	58	51
4	0	4	1	2	0	0	1	0	0	-	-	-	-
5	84	51	15	28	45	54	44	21	40	80	50	48	70
Total	247	213	131	119	138	140	122	83	136	197	164	160	182
Kitovi													
1	22	17	31	10	5	8	7	6	3	-	-	-	-
2	229	211	179	156	69	96	95	86	143	151	174	173	182
3	193	144	122	76	137	136	96	63	45	120	87	121	86
4	4	4	0	2	0	0	0	1	5	-	-	-	-
5	102	91	49	52	45	51	66	69	44	45	68	32	72
Total	550	467	381	296	256	291	264	225	240	316	329	326	340
Reef													
1	119	72	57	77	26	33	16	22	7	-	-	-	-
2	852	752	616	508	401	522	431	375	376	410	454	534	593
3	333	272	255	222	206	110	142	103	137	230	251	210	175
4	0	18	42	11	29	4	4	3	11	-	-	-	-
5	425	241	400	175	313	229	239	236	163	336	488	395	378
Total	1,729	1,355	1,370	993	975	898	832	739	694	976	1,193	1,139	1,146
Gorbatch													
1	78	43	32	31	16	8	14	11	11	-	-	-	-
2	441	407	341	250	205	193	205	183	199	228	228	241	274
3	180	159	128	146	128	136	88	76	83	147	144	135	122
4	62	25	25	23	13	5	1	2	12	-	-	-	-
5	362	236	242	202	155	213	109	120	106	254	272	284	331
Total	1,123	870	768	652	517	555	417	392	411	629	644	660	727
Ardiguen													
1	8	6	2	3	1	0	6	3	2	-	-	-	-
2	40	49	62	59	107	46	44	46	62	45	30	37	52
3	53	39	42	27	43	24	38	24	31	34	39	40	34
4	9	0	0	0	0	0	0	0	0	-	-	-	-
5	50	58	50	64	62	40	47	23	0	27	29	32	15
Total	160	152	156	153	213	110	135	96	95	106	97	109	101

1/ See footnote at end of table.

TABLE A-6.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-78--Continued

Rookery and class of male	Year												
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	Number												
Morjovi													
1	108	41	35	30	22	13	11	0	11	-	-	-	-
2	452	394	309	236	167	133	129	179	220	225	268	338	355
3	230	189	228	160	139	124	97	92	89	182	205	135	149
4	3	73	21	3	5	2	0	2	6	-	-	-	-
5	464	249	146	191	190	160	91	180	216	292	224	366	215
Total	1,257	946	739	620	523	432	328	453	542	699	697	839	719
Vostochni													
1	92	109	67	39	23	17	15	7	17	-	-	-	-
2	1,019	940	804	605	420	330	373	463	478	508	476	607	707
3	522	333	462	360	289	254	187	171	181	348	479	291	245
4	18	147	11	11	1	4	5	3	8	-	-	-	-
5	542	557	389	306	164	194	187	375	153	125	622	263	490
Total	2,193	2,086	1,733	1,321	897	799	767	1,019	837	981	1,577	1,161	1,442
Little Polovina													
1	12	7	12	5	0	2	4	0	2	-	-	-	-
2	162	143	107	83	59	88	46	62	75	88	72	78	84
3	73	51	71	28	43	14	24	14	15	31	34	34	28
4	29	27	14	11	0	4	1	5	3	-	-	-	-
5	254	150	75	38	50	17	6	53	52	108	127	101	171
Total	530	378	279	165	152	125	81	134	147	227	233	213	283
Polovina													
1	75	27	8	15	3	4	3	3	1	-	-	-	-
2	168	150	89	89	44	51	35	40	50	54	55	67	90
3	65	43	68	25	31	4	13	8	19	42	40	26	26
4	0	25	1	1	2	0	0	7	1	-	-	-	-
5	253	185	177	43	61	80	41	80	64	170	189	184	197
Total	561	430	343	173	141	139	92	138	135	266	284	277	313
Polovina Cliffs													
1	48	38	52	33	15	7	19	2	8	-	-	-	-
2	494	408	315	295	192	245	186	200	249	262	291	441	350
3	202	192	256	105	150	49	70	85	75	193	159	140	200
4	5	68	16	3	7	4	3	3	6	-	-	-	-
5	81	47	74	65	58	101	67	107	71	97	100	114	71
Total	830	753	713	501	422	406	345	397	409	552	550	695	621

1/ See footnote at end of table.

TABLE A-6 .--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-78 --Continued

Rookery and class of male	Year												
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	Number												
Tolstoi													
1	65	80	49	40	25	12	15	33	13	-	-	-	-
2	622	455	350	411	269	270	273	291	305	269	387	434	476
3	233	251	309	130	240	198	187	136	124	329	262	291	273
4	0	24	25	0	0	10	3	2	3	-	-	-	-
5	131	472	150	133	125	140	96	115	90	508	327	262	286
Total	1,051	1,282	883	714	659	630	574	577	535	1,106	976	987	1,035
Zapadni Reef													
1	13	13	3	3	1	7	0	0	1	-	-	-	-
2	142	125	72	67	43	63	59	57	79	78	117	107	136
3	65	52	75	46	43	41	33	27	26	64	43	55	44
4	0	13	3	1	0	0	3	0	2	-	-	-	-
5	146	64	59	4	28	38	24	56	34	113	84	63	62
Total	366	267	212	121	115	149	119	140	142	255	244	225	242
Little Zapadni													
1	70	42	27	37	15	17	10	6	8	-	-	-	-
2	339	328	218	219	148	166	154	169	184	176	223	198	291
3	150	184	234	127	175	119	108	73	83	181	171	151	224
4	0	28	9	18	2	12	2	0	22	-	-	-	-
5	133	120	84	61	44	36	45	83	43	136	81	122	137
Total	692	702	572	462	384	350	319	331	340	493	475	471	652
Zapadni													
1	149	74	55	51	42	9	18	13	13	-	-	-	-
2	716	611	508	465	315	296	315	324	329	334	486	443	604
3	275	277	357	219	251	225	167	164	173	269	212	238	277
4	0	82	34	10	5	12	7	2	19	-	-	-	-
5	521	353	300	504	202	414	338	210	245	625	512	330	329
Total	1,661	1,397	1,254	1,249	815	966	845	713	779	1,228	1,210	1,011	1,210
Grand total	12,950	11,298	9,534	7,539	6,207	5,990	5,240	5,437	5,442	8,031	8,673	8,273	9,013

1/ See Table A-2 or glossary for a description of the classes of adult male seals.

TABLE A-7.--Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1969-78

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	-----Number-----		-----Number-----		-----Number----	
1969	1/ 5,928	1/ 2,535	1,457	677	7,385	3,212
1970	4,945	1,666	1,466	803	6,411	2,469
1971	2/ 4,200	2/ 1,900	1,235	534	5,435	2,434
1972 3/	3,738	2,384	1,153	328	4,891	2,712
1973	4/ 4,906	4/ 2,550	875	375	5,781	2,925
1974	5/ 4,563	5/ 1,782	822	481	5,385	2,263
1975	5,018	3,535	877	1,427	5,895	4,962
1976	5,324	4,041	1,093	996	6,417	5,037
1977	6,457	3,845	1,610	899	8,067	4,744
1978	6,496	3,908	1,590	1,220	8,086	5,128

1/ Includes harem and idle males counted on Sivutch Rookery (Sea Lion Rock).

2/ Harem and idle males on St. Paul Island were counted on Reef, Vostochni, Polovina Cliffs, and Zapadni Reef Rookeries in 1971. Estimates of total number were based on these counts, the counts on all rookeries in June, and counts made on all rookeries in 1970.

3/ Values for St. Paul Island are extrapolated from July counts on Northeast Point Rookeries in 1972 and counts on Northeast Point Rookeries and total counts on St. Paul Island in 1970. Values for St. George Island are extrapolated from July counts on Zapadni and South Rookeries and counts on Zapadni and South Rookeries and the total counts on St. George Island in 1971.

4/ Total numbers of harem and idle males in July were extrapolated from counts of harem and idle males on all rookeries in June and from counts of harem and idle males on sample rookeries (Zapadni, Little Zapadni, Zapadni Reef, and Tolstoi) in July using the following procedure:

(a) Assume $\frac{\text{June}(h+i)}{\text{July}(h+i)} = \frac{\text{June}(H+I)}{\text{July}(H+I}$,solve for July(H+I)

(b) Assume $\frac{\text{July}(h)}{\text{July}(h+i)} = \frac{\text{July}(H)}{\text{July}(H+I)}$,solve for July(H)

(c) Solve $\text{July}(H+I) - \text{July}(H) = \text{July}(I)$;

where h, H = respective counts of harem males on sample rookeries and all rookeries;

i, I = respective counts of idle males on sample rookeries and all rookeries.

5/ Total numbers of harem and idle males in July were extrapolated from counts of harem and idle males on all rookeries in June and from counts of harem and idle males on sample rookeries (Reef, Gorbatch, and Ardiguen) in July using the same procedure used in 1973(see footnote 4).

TABLE A-8.--Dead seal pups counted, by rookery section, Pribilof Islands, Alaska, 15-25 August 1978.

Island and rookery	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
St. Paul Island															
Morjovi	1/ 204	71	81	92	77	81	-	-	-	-	-	-	-	-	606
Vostochni	5	53	48	28	253	220	63	46	13	21	32	24	159	76	1,041
Little Polovina	47	43	-	-	-	-	-	-	-	-	-	-	-	-	90
Polovina Cliffs	71	92	63	108	217	210 2/	-	-	-	-	-	-	-	-	761
Polovina	93	58	-	-	-	-	-	-	-	-	-	-	-	-	151
Ardiguen 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Gorbatch	91	215	97	41	16	15	-	-	-	-	-	-	-	-	475
Reef	6	72	90	53	66	35	179	33	25	28	6	-	-	-	593
Kitovi	4/ 40	14	59	43	47	-	-	-	-	-	-	--	-	-	203
Lukanin	78	119	-	-	-	-	-	-	-	-	-	-	-	-	197
Tolstoi	54	83	148	86	115	189	393	420	-	-	-	-	-	-	1,488
Little Zapadni	14	61	157	213	85	144	-	-	-	-	-	-	-	-	674
Zapadni Reef	64	65	-	-	-	-	-	-	-	-	-	-	-	-	129
Zapadni	73	267	333	545	190	98	117	27	-	-	-	-	-	-	1,650
Total															8,073
St. George Island															
North	175	161	178	292	77	185	-	-	-	-	-	-	-	-	1,068
Zapadni 5/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	179
South	61	117	47	-	-	-	-	-	-	-	-	-	-	-	225
East Reef 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	164
East Cliffs	158	134	-	-	-	-	-	-	-	-	-	-	-	-	292
Staraya Artil	348	242	-	-	-	-	-	-	-	-	-	-	-	-	590
Total															2,518
Grand total															10,591

1/ Includes 57 dead pups counted on point south of Sea Lion Neck.
2/ Includes dead pups counted in section 7.
3/ No numbered sections.
4/ Includes 10 dead pups counted in Kitovi Amphitheater.
5/ Partial count, does not include rookery study site above cliffs. Counts of rookery's three sections combined.

TABLE A- 9.--Dead seal pups counted,[1/] by rookery, Pribilof Islands, Alaska, 1967-78

Island and rookery	1967	1968	1969	1970	1971	1972	1973[2/]	1974[2/]	1975	1976	1977	1978
	Number											
St. Paul Island												
Morjovi	1,072	2,285	734	1,618	4,773	2,187	-	-	1,765	1,829	870	606
Vostochni	1,969	4,195	1,711	3,330	8,280	4,701	-	-	3,259	3,826	2,021	1,041
Little Polovina	233	509	200	337	1,207	372	-	-	252	316	103	90
Polovina Cliffs	825	1,616	836	1,636	5,445	1,566	-	-	1,529	1,862	733	761
Polovina	319	487	327	475	980	345	-	-	419	378	160	151
Ardiguen	90	118	112	75	373	161	-	111	142	212	112	15
Gorbatch	874	1,446	823	974	2,405	1,332	-	1,188	1,025	1,341	860	475
Reef	2,008	3,064	1,365	2,221	4,103	1,686	-	1,580	1,837	2,055	1,233	593
Kitovi	522	755	652	679	1,854	559	-	-	787	846	331	203
Lukanin	240	597	460	401	1,224	494	-	-	505	385	250	197
Tolstoi	2,251	3,315	2,778	3,580	5,147	3,540	3,613	-	4,141	4,241	3,291	1,488
Little Zapadni	1,098	1,781	798	1,386	3,223	1,686	1,783	-	1,204	1,977	1,133	674
Zapadni Reef	380	685	177	308	673	505	661	-	508	638	427	129
Zapadni	2,195	4,445	2,306	3,561	6,752	3,515	3,851	-	3,252	3,770	2,559	1,650
Counted total	14,076	25,298	13,279	20,581	46,439	22,649	9,908	2,879	20,625	23,676	14,083	8,073
Estimated oversight 5%	704	1,265	664	1,029	2,322	1,132	495	144	1,031	1,184	704	404
Total	14,780	26,563	13,943	21,610	48,761	23,781	10,403	3,023	21,656	24,860	14,787	8,477
St. George Island												
North	971	1,567	444	866	1,862	1,032	1,153	545	1,230	791	408	1,068
Zapadni	578	1,197	260	636	1,058	464	450	474	814	653	190	404
East	201	824	187	522	638	372	506	334	536	391	200	456
Staraya Artil	770	1,055	640	1,243	1,662	616	552	[3/] -	709	454	410	590
Counted total	2,520	4,643	1,531	3,267	5,220	2,484	2,661	1,353	3,289	2,289	1,208	2,518
Estimated oversight 5%	126	232	76	163	261	124	133	68	165	114	60	126
Total	2,646	4,875	1,607	3,430	5,481	2,608	2,794	1,421	3,454	2,403	1,268	2,644
Pribilof Islands counted total	16,596	29,941	14,810	23,848	51,659	25,133	12,569	4,232	23,914	25,965	15,291	10,591
Estimated oversight 5%	830	1,497	740	1,192	2,583	1,256	628	212	1,196	1,298	764	530
Total	17,426	31,438	15,550	25,040	54,242	26,389	13,197	4,444	25,110	27,263	16,055	11,121

1/ The dead pups are counted after 15 August each year; most mortality has occurred by that date.

2/ The dead pups were counted only on selected rookeries on St. Paul Island.

3/ Dead pups were not counted.

TABLE A-10.--Seals marked as pups and recovered at ages 3 - 6 years, St. Paul Island, 26 June to 31 July 1978.

Hind flipper mark[1/]	Age (years)	Total (number)	Island of marking
RH1	3	253	St. Paul
LH1	3	19	St. George
RH3	4	380	St. Paul
RH2	5	66	St. Paul
RH1	6	1	St. Paul
LH1	6	2	St. George

1/ Seals marked by clipping cartilagenous tip of the 1st, 2nd, or 3rd digit from the left or right hind flipper:

[LH1, LH2, LH3] -- LH refers to the left hind flipper; 1, 2, 3, refer to the 1st, 2nd, or 3rd digit, respectively.

[RH1, RH2, RH3] -- RH refers to the right hand flipper; 1, 2, 3 refer to the 1st, 2nd,or 3rd digit, respectively.

TABLE A-11.--Soviet tags recovered in the United States harvest of male fur seals, St. Paul Island, 26 June to 31 July 1978.

Date	Tag number	Age (years)	Sex	Island of tagging	Rookery of recovery
28 July	OM-1550	3	M	Medny	Zapadni
26 July	OM-1580,OM-1580	3	M	Medny	Polovina
12 July	OM-1774	3	M	Medny	Lukanin-Kitovi
14 July	OM-2470	3	M	Medny	Zapadni
19 July	OM-3744,OM-3744	3	M	Medny	Lukanin-Kitovi
27 July	OM-4866,OM-4866	3	M	Medny	Tolstoi-Zapadini Reef
31 July	OM-7926,OM-7926	3	M	Medny	Reef
24 July	MB-2098,MB-2098	3	M	Bering	Reef

TABLE A-12.--Seal pups tagged and marked, Pribilof Islands, Alaska, 1966-75

Year	Series	St. Paul Island (Number)	St. George Island (Number)	Location of tag	Checkmarks or marks
1966	S 1-2500		2,499	Left front flipper	Tip of left front flipper sliced off
	S 2501-12500	10,000		Right front flipper	Tip of 2d digit on right hind flipper sliced off
	Marked	9,578		Not tagged	Tip of 3d digit on right hind flipper sliced off
	Marked		2,503	---do.---	Tip of 2d digit on left hind flipper sliced off
1967	T 9-2500		2,492	Right front flipper	Tip of right front flipper sliced off
	T 5001-15000	9,980		------do.-------	Do.
1968	U 1-2500		2,475	Left front flipper	"V" notch near tip left front flipper
	U 2501-12500	9,200		------do.------	Do.
1969	Marked	20,000		Not tagged	Tip of 1st digit (big toe) on left hind flipper sliced off
	Marked		5,000	---do.---	Tip of 1st digit (big toe) on right hind flipper sliced off
1970	Marked	20,030		Not tagged	Tip of 2d digit on left hind flipper sliced off
	Marked		5,000	---do.---	Tip of 2d digit on right hind flipper sliced off
1971	Marked	19,995		Not tagged	Tip of 3d digit on left hind flipper sliced off
	Marked		5,000	---do.---	Tip of 3d digit on right hind flipper sliced off
1972	Marked	20,019		Not tagged	Tip of 1st digit (big toe) on right hind flipper sliced off
	Marked		5,000	---do.---	Tip of 1st digit (big toe) on left hind flipper sliced off
1973	Marked	20,000		Not tagged	Tip of 2d digit on right hind flipper sliced off
	Marked		5,000	---do.---	Tip of 2d digit on left hind flipper sliced off
1974 1/	Marked	20,000		Not tagged	Tip of 3d digit on right hind flipper sliced off
1975	Marked	10,000		Not tagged	Tip of 1st digit (big toe) on right hind flipper sliced off
	Marked		5,000	Not tagged	Tip of 1st digit (big toe) on left hind flipper sliced off

1/ Seal pups were not marked on St. George Island.

TABLE A-13.--Seal pups marked by freeze marking, St. Paul Island, 1966-76

Year	Rookery	Marks or symbols used	Seals effectively marked (Number)	Location of marks
1966	Zapadni Reef	S or ᔕ [1/]	40 (♂♂ and ♀♀)	Dorsal surface of front flipper (manus)
1966	Zapadni Reef	---do.---	40 (♂♂ and ♀♀)	Dorsal surface of forearm (antebrachium)
1967	Zapadni Reef	T, ⊣, ⊥, or ⊢ [2/]	115 (♂♂ and ♀♀)[3/]	Do.
1969	Reef	Bar (-) and angle (<) numbering system[4/]	192♂♂ and 183♀♀	Dorsal surface of left forearm (antebrachium) and head
1969	Gorbatch	-----do.-----	200♂♂ and 200♀♀	Do.
1970	Reef	-----do.-----	245♂♂ and 189♀♀	Dorsal surface of right forearm (antebrachium) and head
1970	Gorbatch	-----do.-----	246♂♂ and 218♀♀	Do.
1973	Reef	-----do.-----	9 (♂♂ and ♀♀)	Dorsal surface of left front flipper (manus)
1973	Reef	-----do.-----	9 (♂♂ and ♀♀)	Dorsal surface of right front flipper (manus)
1974	Zapadni Reef	-----do.-----	90 (♂♂ and ♀♀)	Dorsal surface of left front flipper (manus) and chest
1975	Zapadni Reef	Solid Circle (●)	40 (♂♂ and ♀♀)	Dorsal surface of left and right front flippers (manus) and chest
1976	Kitovi	Bar (-) and angle (<) numbering system[4/]	40 (♂♂ and ♀♀)	Dorsal surface of left and right shoulder

1/ For photographs of branded animals, see Fur Seal Investigations, 1966, Marine Mammal Biological Laboratory, Seattle, Wash.

2/ For photograph of a branded animal, see Fur Seal Investigations, 1967, Marine Mammal Biological Laboratory, Seattle, Wash.

3/ In addition, 16 adult females were freeze branded on Kitovi Rookery with letter "U" and "S" instruments on the forearm, shoulder, chest, and rump.

4/ For system of identification symbols used, see Fur Seal Investigations, 1969, Marine Mammal Biological Laboratory, Seattle, Wash.

TABLE A-14.--Fur seals entangled in fishing debris and other materials, United States commercial harvest of fur seals, St. Paul Island, Alaska, 1967-78

Year	Number of seals harvested[1/]	Number of entangled seals observed on killing field[1/]	Percent of harvest
1967	50,229	75	0.15
1968	46,893	75	0.16
1969	32,817	67	0.20
1970	36,307	101	0.28
1971	27,338	113	0.41
1972	33,173	139	0.42
1973	28,482	135	0.47
1974	33,027	197	0.60
1975	29,148	211	0.72
1976	23,096	102	0.44
1977	28,444	99	0.35
1978	24,885	114	0.46

1/ Includes both sexes.

TABLE A-15 --Northern fur seals tagged as pups on the Pribilof Islands (St. Paul and St. George), Commander Islands (Bering and Medny), and Robben Island, and dates first observed on San Miguel Island, California, 1969-78.

Tag number	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Sex	Island of origin	Date tagged
E-2818	21 July	---	11 Aug.	22 July	29 June	6 July	---	4 Aug.	17 July	---	---	F	Bering	1960
T-19022	---	---	---	29 Oct.	23 July	---	---	---	---	---	---	F	Medny	1965
N-41314	21 July	---	---	---	24 Aug.	---	---	---	22 July	---	19 Aug	F	St. Paul	1961
N-16387	---	25 July	14 July	23 June	27 July	---	---	9 Aug.	---	---	---	F	St. Paul	1961
N-19851	---	12 Sept.	12 Aug.[1]	24 July	29 June	21 July	---	---	---	---	---	F	St. Paul	1961
N-25437	---	25 July	2 Aug.	9 July	26 July	4 Aug.	---	---	---	---	---	F	St. Paul	1961
M-53901	---	31 July	23 July	14 June	---	---	---	---	---	---	---	F	St. Paul	1960
O-26056	---	25 July	18 July	29 July	3 Sept.[2]	22 July	---	28 July	29 July	---	17 July	F	St. Paul	1962
R-8179	---	1 Oct.	---	---	---	---	---	---	---	---	---	F	St. Paul	1965
J-4937	---	18 Aug.[3]	14 Aug.	14 June	24 Aug.	---	---	---	---	---	---	F	St. George	1957
N-29437	---	---	20 July	---	---	---	---	---	---	---	---	F	St. Paul	1961
N-48079	---	---	11 Aug.	---	---	---	---	---	---	30 July	---	F	St. Paul	1961
N-2114	---	---	---	14 June	31 July	4 Aug.	---	27 July	24 July	---	---	F	St. George	1961
N-31432	---	---	---	7 July	12 July	3 July	---	26 Aug.	---	---	---	F	St. Paul	1961
Q-20975	---	---	---	10 July	---	---	---	---	---	---	---	F	St. Paul	1964
R-8844	---	---	---	8 Aug.	27 Aug.	19 July	---	27 July	18 July	---	---	F	St. Paul	1965
T-24	---	---	---	7 Aug.	12 July	25 July	---	---	---	---	---	F	St. George	1967
T-9697	---	---	---	19 Aug.	2 Aug.	---	---	11 Aug.	7 Sept.	---	---	F	St. Paul	1967
T-12129	---	---	---	25 Aug.	26 July	21 July	---	---	---	---	---	F	St. Paul	1967
U-6971	---	---	---	21 Aug.	26 July	10 July	---	31 July	2 Aug.	---	17 July	F	St. Paul	1968
O-48131	---	---	---	---	3 Sept.	---	---	---	---	---	---	F	St. Paul	1962
T-6003	---	---	---	---	5 Sept.	10 July	12 Aug.	---	---	---	---	F	Robben	1965
T-8572	---	---	---	---	23 July	23 July	---	---	---	21 Aug	---	F	St. Paul	1967
Y-7104	---	---	---	---	30 Aug.	13 July	10 June	3 July	11 July	6 Aug	---	F	Robben	1966
BB-1364	---	---	---	---	7 Sept.	---	9 Aug.	---	---	8 Sept	8 July	F	Bering	1969
AM-8302	---	---	---	---	---	---	14 Aug.	28 July	18 July	---	---	F	Medny	1968
U-697[4]	---	---	---	---	---	---	5 July	---	---	7 Sept	---	F	St. George	1968
U-579	---	---	---	---	---	---	1 Sept.	---	---	---	---	F	St. George	1968
CM-3667	---	---	---	---	---	---	---	3 July	---	---	---	F	Medny	1970
ET-593	---	---	---	---	---	---	---	17 July	---	---	---	F	Robben	1971
H-2314	---	---	---	---	---	---	---	20 Aug.	---	---	---	F	Robben	1963
T-19022	---	---	---	---	---	---	---	20 Aug.	---	---	---	F	Medny	1965
DT-TINRO[5]	---	---	---	---	---	---	---	14 Aug.	21 July	---	---	F	---	---
I-3698?[6]	---	---	---	---	---	---	---	---	5 Sept.	---	---	F	St. Paul	1956

1/ Tag number N-19851 recorded as N-15851 in 1970.
2/ Tag number O-26056 also recorded on Castle Rock, 8 September 1972.
3/ Tag number J-4937 recorded as J-4939 in 1969.
4/ Female identified by tag #U6971 may be the same individual.
5/ A double-tagged female. TINRO was read but the numbers could not be seen with the scope.
6/ Last number on tag unreadable.

TABLE A-16--Northern fur seals tagged on San Miguel Island in 1968 and the dates first resighted in each season from 1969 through 1978.[1/]

Tag number	Tag placement	Date observed 1969	Date observed 1970	Date observed 1971	Date observed 1972	Date observed 1973	Date observed 1974	Date observed 1975	Date observed 1976	Date observed 1977	Date observed 1978
UC-3789	R	---	---	24 July	23 July	31 July	---	---	---	---	---
-3793	R	---	21 July	13 July	11 July	---	---	---	---	12 Aug.	1 Sept.
-3926	L			9 July			---	---	---	---	---
-3927	R	31 July	23 July		26 July	21 July					
-3931[2/]	R	---	---	---	---	---	---	---	---	---	19 Aug.
-3932	R	16 Aug.	29 July	2 July		---	27 July	8 Aug.	10 July	18 Aug.	18 Aug.
-3933	L				13 July						
-3934[2/]	L	---	---	---	---	---	---	---	29 Aug.	---	---
-3936	L	---	---				28 July	---			
-3937	R		---	24 July	31 July	22 July			10 July	18 Aug.	21 July
-3938	L		10 Aug.	8 June		---	---	---	---	---	---
-3939	R	31 July			29 June						
-3940	L	31 July	29 July	---	---	---	---	---	---	---	---
-3941	R										
-3942	R	31 July	17 July	22 July	14 July	---	---	20 Aug.	29 July	18 Aug.	15 Aug.
-3943	L										
-3944	R		17 July			18 July					15 Aug.
-3945	L	14 Aug.		14 June	27 June		15 July	9 July	14 July	12 Aug.	
-3951	L	---	21 July	22 July	12 July	---	---	---	---	---	---
-3953[3/]	R										
-3955	R	25 July	31 July	2 July	15 July	---	---	---	---	---	---
-3956	L										
-3957[4/]	R	7 Aug.	---	---	---	---	---	---	---	---	---
-3959	R	25 July	---	---	---	---	---	---	---	---	---
-3961[2/]	R	12 Sept.	---	---	---	---	---	---	---	---	---
-3964	L		2 Aug.	21 July	12 July	1 Aug.	---	---	---	---	30 Aug.
-3965	R	12 Aug.							2 Aug.		
-3968	R	---	18 July	6 July	---	---	---	---	---	---	---
-3971	L	---									
-3972	L		16 Aug.	22 July		---	---	---	---	---	---
-3973	R	31 July			5 Aug.						
-3974	L	---	---	---	---		15 July	8 Aug.		22 Aug.	
-3975	R					5 Aug.			4 Aug.		8 July
-3976	R		---	---	---	---	---	11 Aug.	---	---	---
-3977	L	31 July									
-3978[2/]	L	---	22 July	---	---	---	---	---	---	---	---
-3980	R	---	31 July		30 Aug.	---	15 July	---		---	---
-3984	L			9 July					18 July		
-3981	R		9 July	5 July	11 July		---	---	---	---	---
-3982	L	31 July				4 Aug.					
-3985	L	31 July	---		---	---	---	---	---	---	---
-3986	R			17 July							
-3987	L	---		6 July	14 July	2 Aug.	---	---	---	---	---
-3988	R		10 Aug.								
-3989	L			5 July		11 June	10 Aug.	7 Aug.	---	---	---
-3990	R	10 Aug.	8 July		27 June						
-3991	L	7 Aug.	20 July								
-3992	L			27 July	12 July	4 Aug.		28 July		21 Aug.	25 July
-3993	R	16 Aug.		4 July	---	---			10 July	---	25 July
-3994	L		17 Aug.				27 July	17 July			
-3995	R	---		---	11 Aug.	---		17 July	---	---	---
-3996	L		21 July				28 July				
-3997	L	---		---	---		---		6 Sept.	---	---
-3998	R			21 July		4 July		10 July			
-3999	R	---	---		---	---	13 Aug.	---	---	---	---
-4000	L			3 Aug.							

1/ A total of 36 pups (3751-3800 and 3958-3963 series and 3983) and 33 adult females (all other 3900-4000 series) were tagged on 20 July 1968.
2/ Female was double tagged, but the other tag number has never been resighted.
3/ Tag loss confirmed by observation of tag scar.
4/ Left flipper injured, not tagged.

TABLE A-17.--Adult female northern fur seals tagged at Adams Cove, San Miguel Island, on 9 October 1975 and the dates first resighted, 1976-78[1/].

Tag number	Date of first resighting		
	1976	1977	1978
SMI 201	23 Aug	-	13 July
202			
203		21 Sept	2 Sept
204			
205			
206	-	-	-
207			
208	-	-	-
209			
210	-	-	-
211	12 Aug	-	-
212			
213			
214	-	-	-
215	17 July	8 Sept	-
216			
217	12 July	4 Sept	19 Aug
218			
219	11 July	-	30 Aug
220			
221			
222	-	-	22 Aug
223	-	4 Sept	22 July
224			
225	Tag lost in sand of Arroyo west of Mallo Roses, Adams Cove		
226	11 July	18 Aug	-
227			
228	25 Aug	-	27 Aug
229			
230			
231	-	-	-
232	-	18 Aug	18 Aug
233			
234	-	-	-
235			
236	22 Aug	-	18 Aug
237			

TABLE A-17.--Adult female northern fur seals tagged at Adams Cove, San Miguel Island, on 9 October 1975 and the dates first resighted, 1976-78[17] (continued).

Tag number	Date of first resighting		
	1976	1977	1978
SMI 238	2 Aug	6 Aug	25 July
239			
240	-	-	-
241			
242	-	12 Aug	
243			
244	12 July	18 Aug	12 July
245			
246	-	20 Aug	9 Aug
247			
248	11 July	-	-
249			
250	-	20 Aug	-
251			
252	-	19 Aug	-
253			
254			
255	-	-	16 Aug
256			
257	-	-	-
258			
259	-	-	20 Aug
260			
261	-	-	-
262	-	10 July	10 July
263			
264	10 July	18 Aug	22 July
265			
266	26 July	12 Aug	9 Aug
267			
268	29 July	-	-
269			
270	29 July	12 Aug	-
271			
272	23 July	20 Aug	18 Aug
273			
274	5 Sept	-	10 July
275			

TABLE A-17.--Adult female northern fur seals tagged at Adams Cove, San Miguel Island, on 9 October 1975 and the dates first resighted, 1976-78[1/] (continued).

Tag number	Date of first resighting		
	1976	1977	1978
SMI 276	21 Aug	3 Sept	16 Aug
277 Tag destroyed			
278			
279	5 Aug	-	17 July
280			
281	23 July	4 Sept	22 July
282			
283	24 July	12 Aug	20 July
284			
285	25 Aug	-	20 July
286			
287	-	-	-
288			
289	-	30 July	-
290			
291	-	-	-
292			
293	10 Aug	-	-
294			
295	22 July	-	30 Aug
296			
297	29 Aug	-	1 Sept
298			
299	8 Aug	30 July	28 Aug
300			
301	21 Aug	-	20 Aug
302			

1/ Fifty adult females were tagged.

TABLE A-18-Northern fur seals tagged as pups at Adams Cove, San Miguel Island, California, and the date first observed in subsequent years at Adams Cove.

Tag Number	Year Tagged	Sex	Date of first resighting	
			1977	1978
SMI-4	1975	F	-	31 Aug
-15	-do-	M	-	18 Aug
-20	-do-	M	-	22 Aug
-21	-do-	M	-	9 Aug
-22	-do-	M	-	9 Aug
-24	-do-	M	-	9 Aug
-41	-do-	F	18 Aug	-
-44	-do-	F	-	21 Aug
-46	-do-	M	-	29 Aug
-52	-do-	F	-	31 Aug
-55	-do-	F	-	13 Aug
-61	-do-	F	-	22 Aug
-70	-do-	F	-	19 Aug
-72	-do-	F	-	1 Sep
-73	-do-	M	-	29 July
-75	-do-	F	2 Sep	17 Aug
-85	-do-	F	-	6 Sep
-86	-do-	M	-	17 July
-96	-do-	F	-	9 Sep
-304	-do-	M	-	1 Sep
-313	1976	F	-	10 Sep

TABLE A-19--Northern fur seal pups tagged in Adams Cove, San Miguel Island on 14 September 1978.

Tag number	Flipper tagged	Sex	Weight (kg.)	Checkmark	Remarks
SMI 1182	R	M	12.5	LHD4	
1183	L	F	13.0	"	
1184	R	M	15.0	"	
1185	Tag destroyed				
1186	Tag destroyed				
1187	R	M	14.5	"	
1188	L	F	14.0	"	
1189	L	F	12.5	"	
1190	Tag destroyed				
1191	L	F	12.5	"	
1192	R	M	10.5	"	
1193	R	M	8.0	"	
1194	L	F	5.0	"	
1195	R	M	13.5	"	
1196	L	F	11.5	"	
1197	R	M	13.0	"	
1198	R	M	7.5	"	
1199	R	M	10.0	"	
1200	R	M	15.5	"	
1201	R	M	13.0	"	
1202	R	M	11.0	"	
1203	R	M	10.5	"	
1204	L	F	10.0	"	
1205	R	M	10.0	"	
1206	R	M	15.0	"	
1207	R	M	15.5	"	
1208	R	M	14.5	"	
1209	L	F	10.5	"	
1210	R	M	11.0	"	
1211	L	F	14.5	"	
1212	R	M	12.0	"	
1213	L	F	6.0	"	
1214	R	M	12.0	"	
1215	R	M	13.5	"	
1216	L	F	9.5	"	
1217	R	M	14.0	"	
1218	L	F	12.5	"	
1219	L	F	10.0	"	
1220	R	M	13.0	"	
1221	L	F	10.5	"	
1222	L	F	11.5	"	
1223	L	F	12.0	"	
1224	L	F	12.0	"	
1225	R	M	11.5	"	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island on 14 September 1978.--Continued

Tag number	Flipper tagged	Sex	Weight (kg.)	Checkmark	Remarks
SMI 1226	R	M	8.5	LHD4	
1227	L	F	10.5	"	
1228	L	F	9.5	"	
1229	L	F	10.0	"	
1230	L	F	8.5	"	
1231	L	F	8.5	"	
1232	L	F	12.5	"	
1233	L	F	8.0	"	
1234	R	M	15.0	"	
1235	R	M	13.0	"	
1236	L	F	10.5	"	
1237	L	F	12.5	"	
1238	L	F	12.0	"	
1239	L	F	16.0	"	
1240	R	M	11.0	"	
1241	R	M	14.0		
1242	Tag destroyed				
1243	L	F	8.5	"	
1244	R	M	9.5	"	
1245	R	M	12.0	"	
1246	R	M	17.5	"	
1247	L	F	12.0	"	
1248	L	F	9.5	"	
1249	L	F	8.0	"	
1250	Tag destroyed				
1251	R	M	11.5	"	
1252	L	F	11.0	"	
1253	R	M	14.5	"	
1254	L	F	9.5	"	
1255	R	M	14.0	"	
1256	R	M	12.0	"	
1257	L	F	7.0	"	
1258	R	M	10.0	"	
1259	L	F	12.0	"	
1260	R	M	12.5	"	
1261	R	M	12.0	"	
1262	L	F	11.0	"	
1263	R	M	14.0	"	
1264	L	F	11.5	"	
1265	R	M	15.0	"	
1266	R	M	10.5	"	
1267	R	M	9.0	"	
1268	L	F	7.5	"	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island on 14 September 1978.-- Continued

Tag number	Flipper tagged	Sex	Weight (kg.)	Checkmark	Remarks
SMI 1269	R	M	13.0	LHD4	
1270	R	M	10.5	"	
1271	L	F	8.0	"	
1272	L	F	10.5	"	
1273	R	M	14.5	"	
1274	R	M	12.0	"	
1275	L	F	10.5	"	
1276	L	F	12.5	"	
1277	L	F	10.0	"	
1278	L	F	8.0	"	
1279	R	M	11.5	"	
1280	L	F	12.0	"	
1281	L	F	11.5	"	
1282	L	F	8.0	"	
1283	R	M	15.5	"	
1284	R	M	10.5	"	
1285	R	M	9.5	"	
1286	R	M	11.0	"	

TABLE A-20.--Northern fur seal pups tagged on Castle Rock adjacent to San Miguel Island on 13 September 1978.

Tag number	Flipper tagged	Sex	Weight (kg)	Checkmark	Remarks
SMI 1074	L	F	7.5	LHD4	
1075	L	F	13.0	"	
1076	L	F	8.5	"	
1077	L	F	10.0	"	
1078	L	F	12.5	"	
1079	R	M	11.5	"	
1080	L	F	9.5	"	
1081	R	M	10.5	"	
1082	L	F	11.0	"	
1083	L	F	7.5	"	
1084	L	F	11.0	"	
1085	L	F	12.0	"	
1086	R	M	12.5	"	
1087	L	F	10.0	"	
1088	L	F	7.0	"	
1089	L	M	8.0	"	
1090	R	M	11.5	"	
1091	R	F	11.5	"	
1092	R	F	10.5	"	
1093	L	M	11.0	"	
1094	L	M	11.0	"	
1095	R	F	9.0	"	
1096	L	M	9.5	"	
1097	L	M	11.5	"	
1098	L	M	12.0	"	
1099	R	F	8.0	"	
1100	L	F	10.5	"	
1101	R	M	15.0	"	
1102	L	F	10.0	"	
1103	R	M	10.5	"	
1104	L	F	12.0	"	
1105	R	M	10.5	"	
1106	R	M	10.0	"	
1107	R	M	13.0	"	
1108	L	F	9.0	"	
1109	R	M	12.0	"	
1110	Tag lost in cobblestones on the southwest shore of Castle Rock.				
1111	L	F	9.0	"	
1112	R	M	11.5	"	
1113	L	F	7.5	"	
1114	R	M	12.0	"	
1115	Tag destroyed				
1116	R	M	12.0	"	

TABLE A-20.--Northern fur seal pups tagged on Castle Rock adjacent to San Miguel Island on 13 September 1978 - Continued.

Tag number	Flipper tagged	Sex	Weight (kg.)	Checkmark	Remarks
SMI 1117	L	F	8.0	LHD4	
1118	L	F	7.0	"	
1119	R	M	8.0	"	
1120	R	M	14.0	"	
1121	R	M	11.5	"	
1122	L	F	10.0	"	
1123	L	F	13.0	"	
1124	L	F	8.5	"	
1125	R	M	14.0	"	
1126	R	M	10.0	"	
1127	R	M	11.0	"	
1128	R	M	13.0	"	
1129	L	F	13.0	"	
1130	L	F	11.0	"	
1131	Tag destroyed				
1132	L	F	10.0	"	
1133	L	F	12.5	"	
1134	L	F	10.0	"	
1135	R	M	15.5	"	
1136	R	M	9.0	"	
1137	R	M	13.5	"	
1138	L	F	10.5	"	
1139	R	M	11.0	"	
1140	R	M	10.5	"	
1141	L	F	11.0	"	
1142	R	M	13.0	"	
1143	L	F	6.0	"	
1144	R	M	10.5	"	
1145	R	M	10.0	"	
1146	L	F	7.0	"	
1147	R	M	11.5	"	
1148	Tag destroyed				
1149	R	M	10.0	"	
1150	R	M	9.5	"	
1151	R	M	8.5	"	
1152	Tag destroyed				
1153	R	M	8.0	"	
1154	R	M	10.5	"	
1155	Tag destroyed				
1156	R	M	7.0	"	
1157	Tag destroyed				
1158	R	M	12.5	"	
1159	L	F	11.0	"	
1160	R	M	9.5	"	

TABLE A-20.--Northern fur seal pups tagged on Castle Rock adjacent to San Miguel Island on 13 September 1978 - Continued.

Tag number	Flipper tagged	Sex	Weight (kg.)	Checkmark	Remarks
SMI 1161	R	M	12.0	LHD4	
1162	L	F	13.5	"	
1163	R	M	12.0	"	
1164	L	F	10.0	"	
1165	L	F	10.0	"	
1166	L	F	8.5	"	
1167	R	M	11.0	"	
1168	R	M	10.0	"	
1169	R	M	11.0	"	
1170	R	M	12.0	"	
1171	L	F	11.0	"	
1172	L	F	9.0	"	
1173	R	M	13.0	"	
1174	R	M	10.0	"	
1175	L	F	10.0	"	
1176	L	F	9.0	"	
1177	L	F	11.0	"	
1178	R	M	11.5	"	
1179	Tag destroyed				
1180	L	F	8.5	"	
1181	R	M	11.5	"	

Appendix B

Persons engaged in fur seal research in 1978

Name	Affiliation	Work
Permanent employees		
George Y. Harry, Jr.	Marine Mammal Division	Division Director
Michael F. Tillman	-do-	Deputy Division Director
Alton Y. Roppel	-do-	Population Assessment
Patrick Kozloff	-do-	-do-
Robert H. Lander	-do-	-do-
Roger L. Gentry	-do-	Behavior and biology
Clifford H. Fiscus	-do-	-do-
Robert L. DeLong	-do-	-do-
Mark C. Keyes	-do-	Physiology and medicine
Hiroshi Kajimura	-do-	Fur seal ecosystem-pelagic
Michael A. Perez	-do-	-do-
Temporary employees		
John M. Francis	Marine Mammal Division	Behavior and biology
Sue Carter	-do-	-do-
John Holt	-do-	-do-
John Calambokidis	-do-	-do-
George A. Antonelis, Jr.	-do-	-do-
Richard K. Stroud	-do-	Physiology and medicine
Kathy S. Okawa	-do-	-do-
Michael Booth	-do-	-do-
M. Richard Zacharof	-do-	Population assessment
M. Robert Kochergin	-do-	-do-
Darlene Stepetin	-do-	-do-
Lavrenty Stepetin	-do-	-do-
Cooperators		
Henry Bray	Naval Bioscience Laboratory	Physiology and medicine
Robin Brown	National Park Service	Behavioral and Population Assessment
Robert Cohen	-do-	-do-
Robert Morrow	-do-	-do-
Lana Antonelis	-do-	-do-
Marc Webber	-do-	-do-
Dana J. Seagars	-do-	-do-
Mike Hill	-do-	Tagging project
Jim Lecky	NMFS, Southwest Region	-do-
John Storer	Santa Barbara Museum of Natural History	-do-
Mary Rieger	Naval Ocean Systems Center	Physiology and medicine
Gery Purdy	-do-	-do-

Appendix B

Persons engaged in fur seal research in 1978.--continued

Name	Affiliation	Work
Eugene T. Lyons	University of Kentucky	Hookworm biology
Arnoldus S. Blix	University of Oslo and University of Alaska	Thermoregulation in newborn fur seals
K. C. Kim	Pennsylvania State University	Respiratory mite biology
Steve Istvan	-do-	-do-
Visiting scientists		
Michael Bigg	Fisheries Research Board of Canada	--
Gerald J. Conlogue	Washington State University	--
Raymond Pawlisch	University of Wisconsin	--
Wally Hansen	-do-	--
Howard Gielberg	Cornell University	--