Northwest Fisheries Center Processed Report*

FUR SEAL INVESTIGATIONS, 1976

by

Marine Mammal Division*

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest & Alaska Fisheries Center
Marine Mammal Division
Seattle, Washington 98115

* This report does not constitute a publication and is for information only. All data herein are to be considered provisional.

NOTICE

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February 1977

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INTRODUCTION

The National Marine Fisheries Service is responsible for the management of northern fur seals on the Pribilof Islands and is the federal agency which coordinates management and research activities with Canada, Japan, and the USSR under terms of the Interim Convention on Conservation of North Pacific Fur Seals. National Marine Fisheries Service research on the Pribilof Islands, San Miguel Island, and at sea yields the knowledge needed for management of the Pribilof Islands fur seal herd.

In 1976, research was carried out on several aspects of the fur seal resource including population dynamics, behavior, feeding habits, distribution at sea, and causes of death.

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

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

Part 1. POPULATION ASSESSMENT, PRIBILOF ISLANDS

The Population Assessment Project is designed to build a population structure data base essential to the long-term objective of management for maximum sustainable productivity. Current research includes (1 measurement of several population parameters, (2 development of yield models, (3 delineation of environmental factors that cause mortality at sea, and (4 analysis of alternative harvesting strategies.

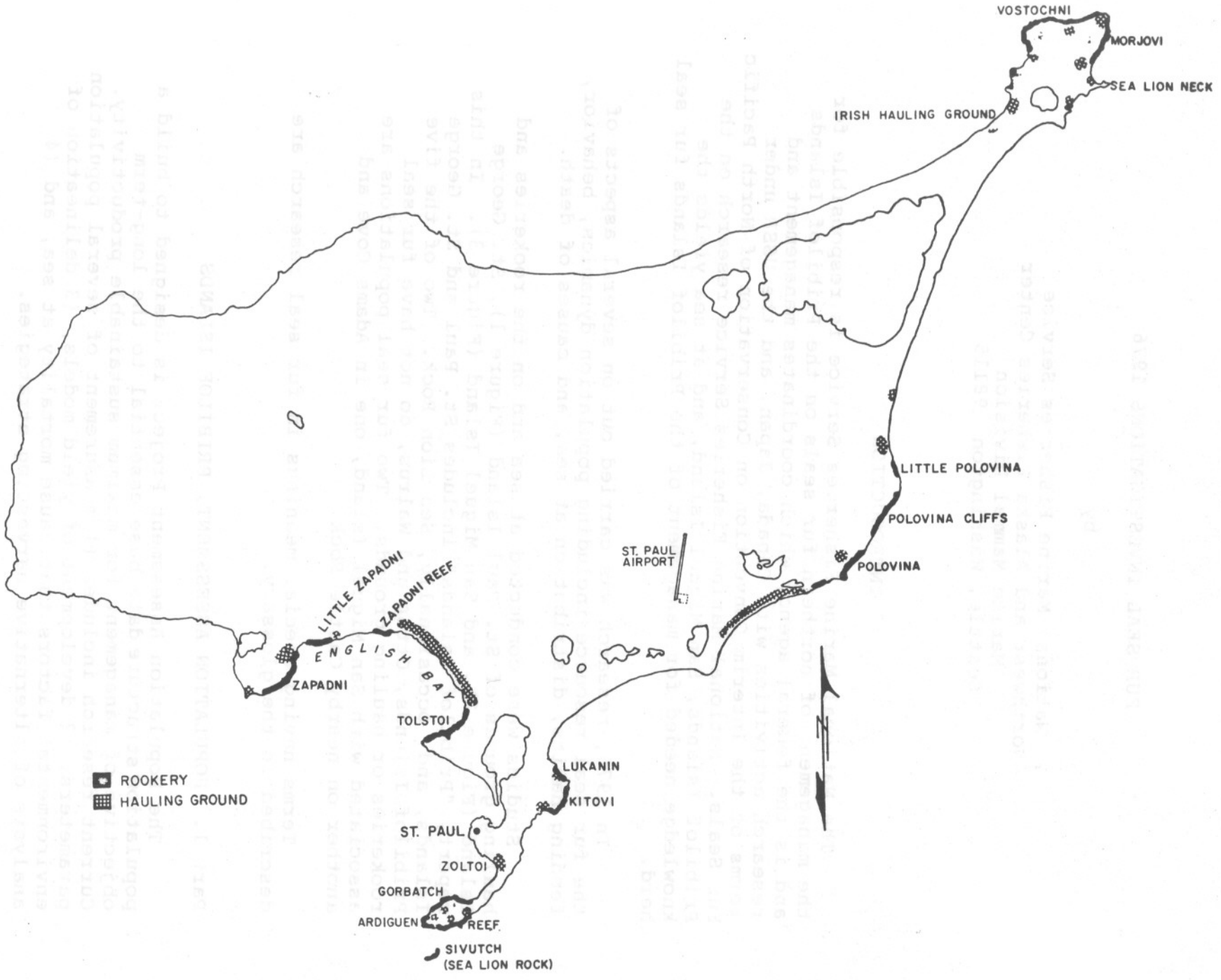

Figure 1. --Location of rookeries and hauling grounds, St. Paul Island.

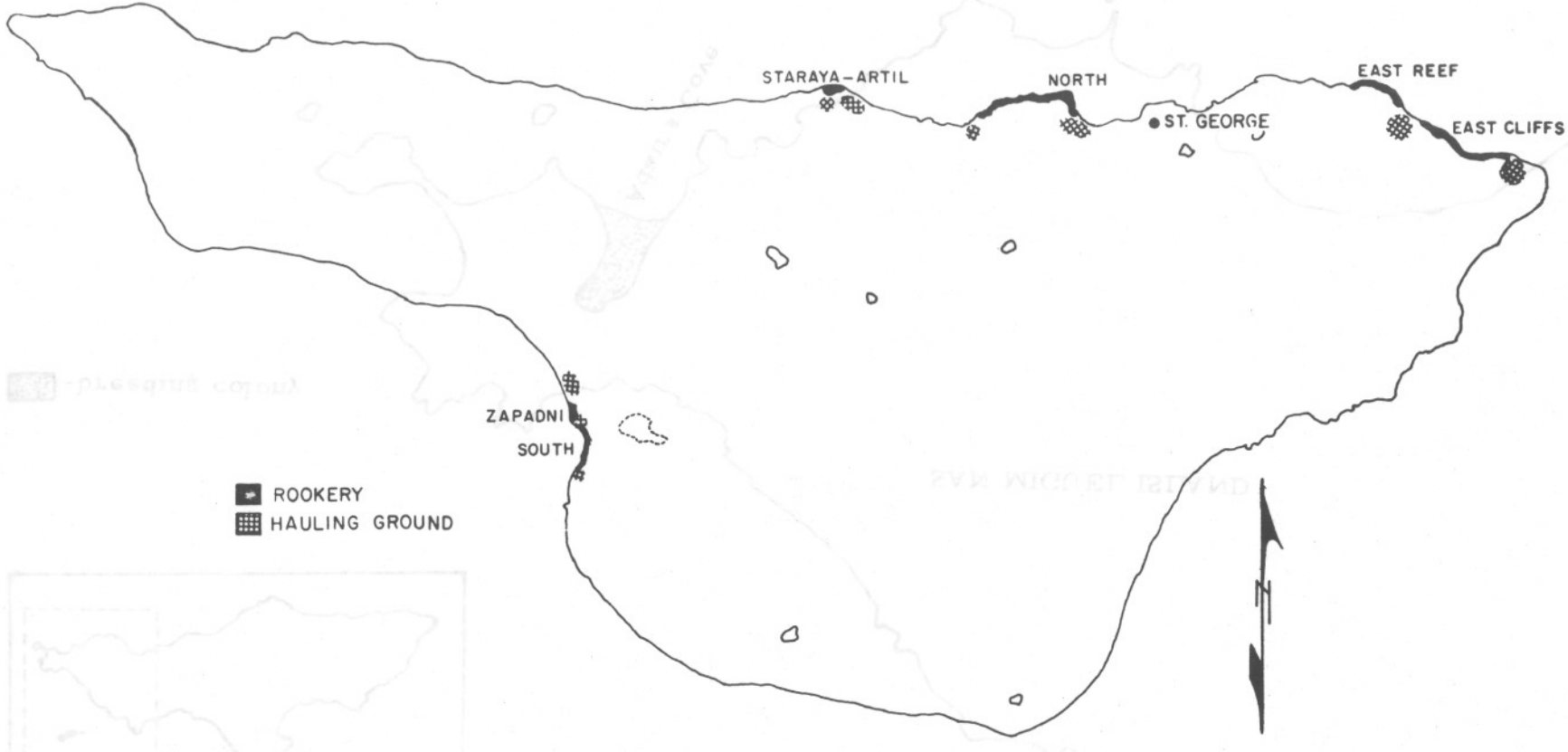

Figure 2. --Location of rookeries and hauling grounds, St. George Island.

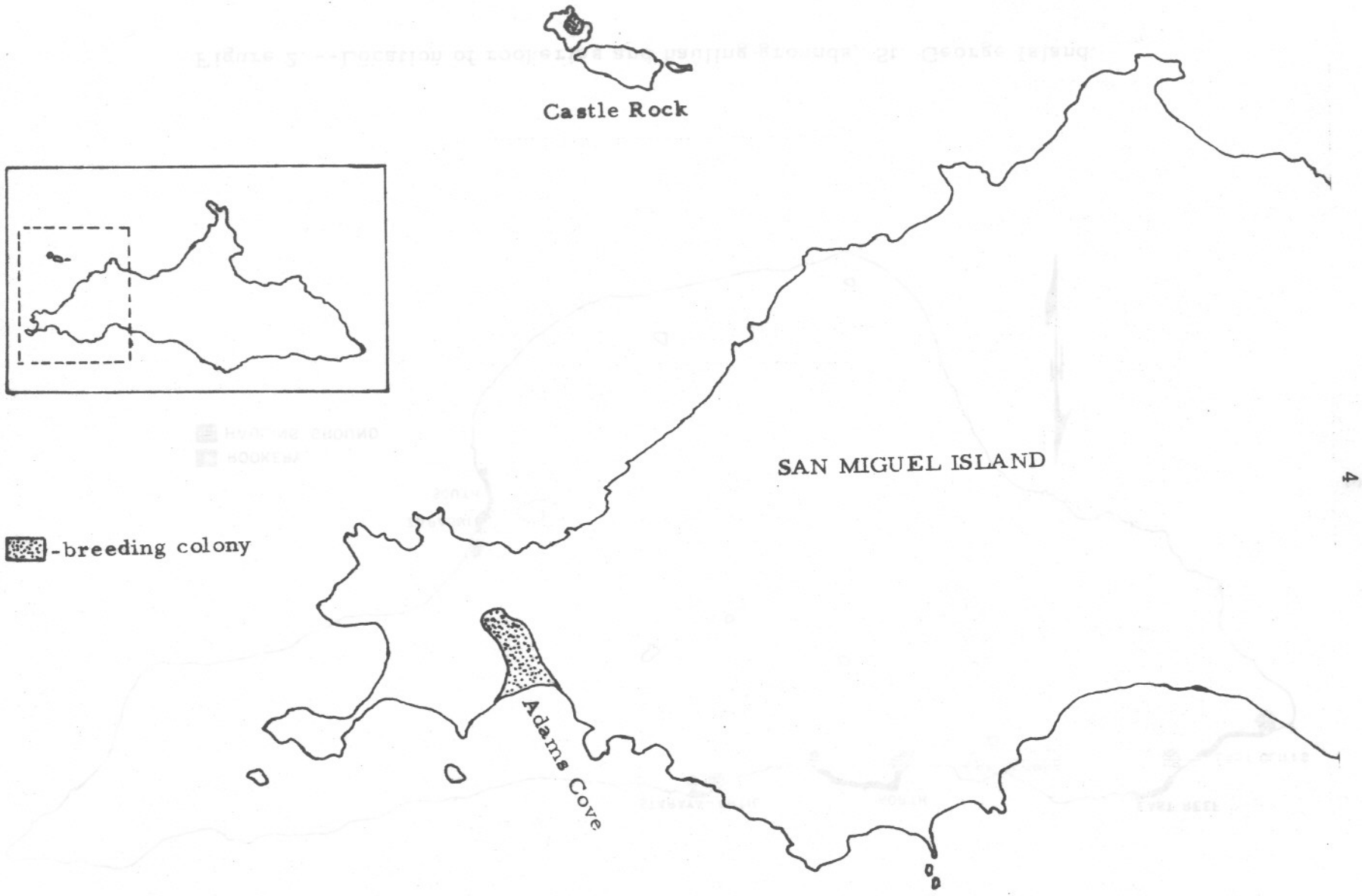

Figure 3. Location of northern fur seal breeding colonies, San Miguel Island, California

Population Parameters

Several population parameters are measured in order to estimate the level of maximum sustainable productivity, the current population level, and the response of the Pribilof Islands' fur seal herd to changes in the harvesting regime and the environment.

Age and Sex Composition of Seals Killed

In 1976 only male seals with a body length of 47 inches (119.4 cm) or less from tip of tail to tip of nose were selectively harvested on St. Paul Island from 28 June through 31 July beginning at 5 a.m. Monday through Saturday. The length limit was prescribed to allow most seals older than 4 years to escape. However, some 5- and 6-year-old seals with body lengths less than or close to the maximum allowable limit were taken. Maxillary canine teeth were collected each day from 20% of the harvested males to determine age composition (Table A-1). Figure 4 shows the number of 3- and 4-year-old males killed by round 1/ and date. The number of males killed on St. Paul Island, by year class, since 1962 is given in Figure 5 and Table 1. Table 2 gives the age composition by year of male seals killed on the Pribilof Islands since 1967.

A total of 619 of the 896 male seals harvested 21 July on Tolstoi-Zapadni Reef Rookeries was measured as a check on conformance to the upper body length limit of 47 inches (119.4 cm) set for taking the animals in 1976. The results, which indicated acceptable utilization of the available seals, were as follows:

Length in inches (tip of nose to tip of tail)	Number	Percentage
40	9	1.5
41	33	5.3
42	71	11.5
43	109	17.6
44	109	17.6
45	101	16.3
46	80	12.9
47	61	9.9
48	23	3.7
49	16	2.6
50	7	1.1

1/ See glossary for a description or round.

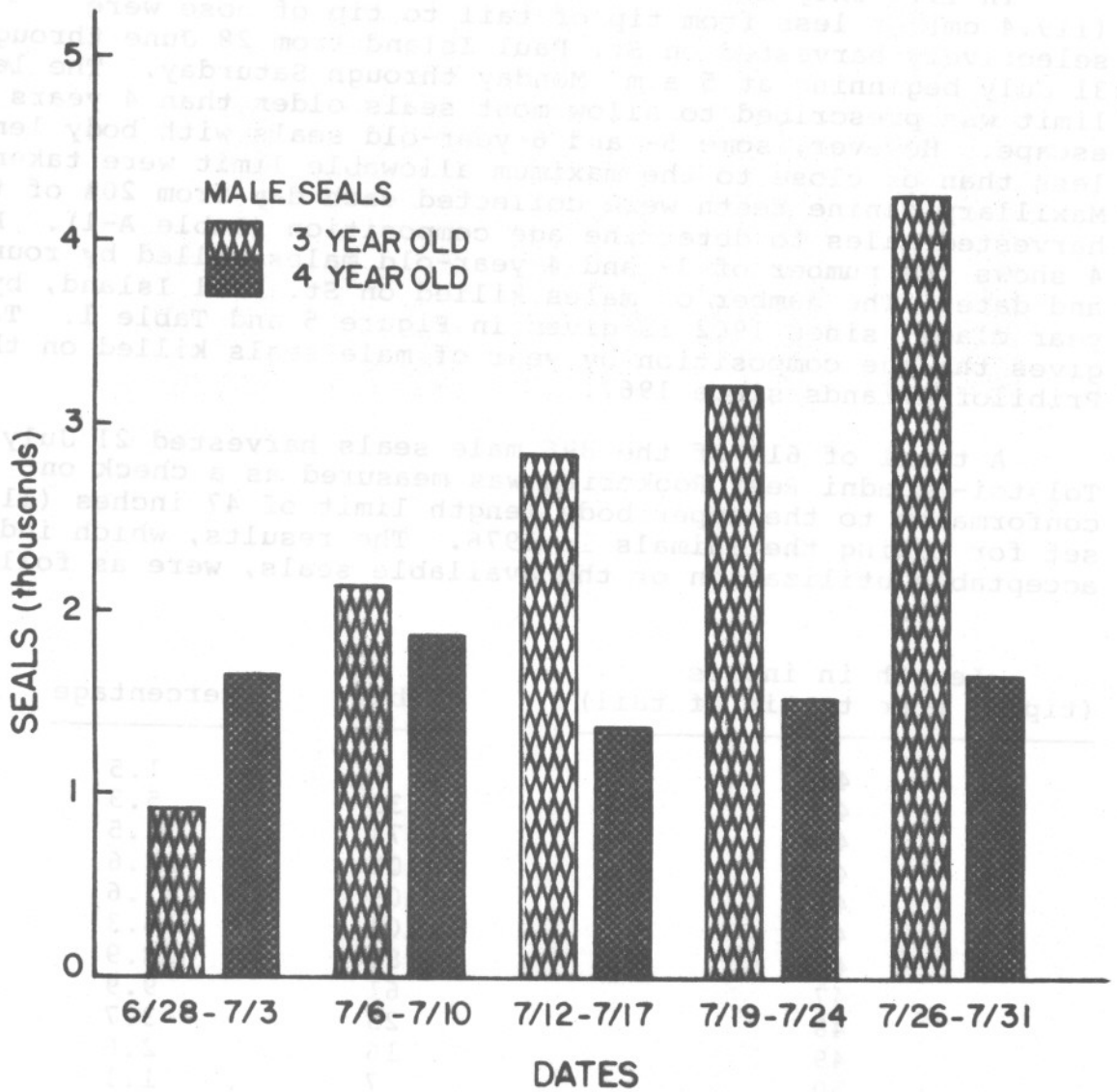

Figure 4.--Three- and four-year-old male seals, St. Paul Island, 28 June to 31 July 1976.

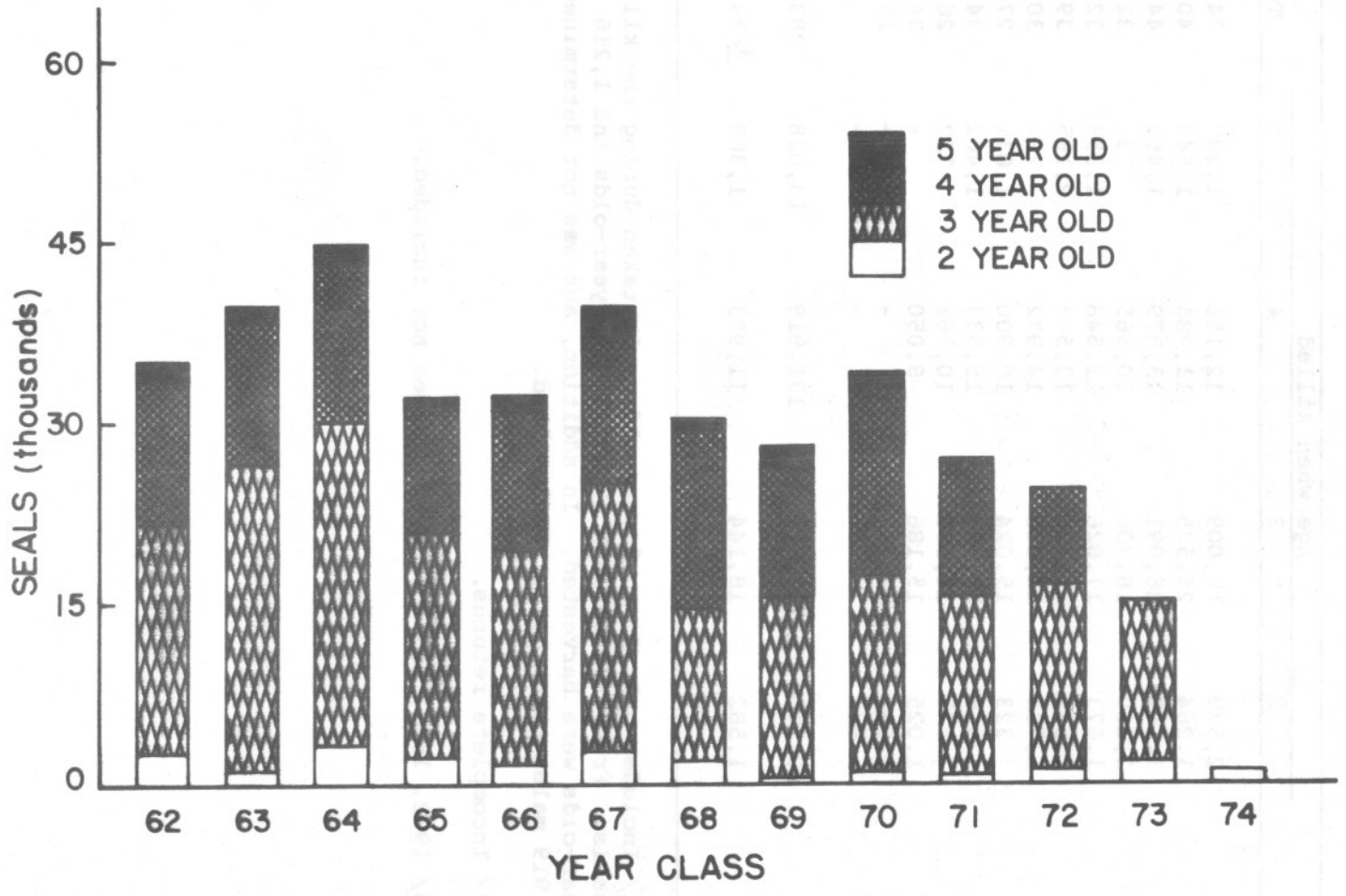

Figure 5.--Kill of male seals, by year class, St. Paul Island, 1962-74.

Table 1.--Kill of male seals,[1] by year class, St. Paul Island, 1962-74.

Year class	Age when killed				Total
	2	3	4	5	
1962	2,539	19,009	12,156	1,287	34,991
1963	1,264	25,535	11,785	1,542	40,126
1964	3,143	26,991	13,279	1,469	44,882
1965	2,220	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[2]	1,025	15,186	8,050	-	24,261
1973[2]	1,642	13,397	-	-	15,039
1974[2]	893	-	-	-	893
Total	20,560	217,727	131,919	13,028	383,234
Mean	1,582	18,144	11,993	1,303	[3]34,304

1/ Includes only 2- to 5-year-old seals taken during the kill of male seals. From 1956 through 1974, 131 one-year-olds and 1,216 six-year-olds were harvested. In addition, age was not determined for 4,919 males taken on St. Paul Island.

2/ Incomplete returns.

3/ 1972, 1973, and 1974 year classes not included.

Table 2.--Age classification of male seals killed, Pribilof Islands, Alaska, 1967-76

Year of harvest	St. Paul Island						St. George Island						Total both islands
	Estimated seals killed from each age group						Estimated seals killed from each age group						
	2	3	4	5	6	Total	2	3	4	5	6	Total	
	Number												
1967	2,200	26,991	11,785	1,287	96	42,359	740	7,622	3,738	392	40	12,532	54,891
1968	1,673	18,706	13,279	1,542	92	35,292	433	4,443	3,680	406	38	9,000	44,292
1969	2,640	17,826	10,565	1,469	121	32,621	411	2,645	2,204	680	117	6,057	38,678
1970	1,725	22,176	11,548	731	17	36,197	98	2,916	2,274	547	89	5,924	42,121
1971	323	12,888	12,503	1,338	190	27,242	32	1,456	2,517	467	81	4,553	31,795
1972	916	15,024	14,932	2,185	53	33,110	57	1,442	2,125	559	21	4,204	37,314
1973[1/]	577	16,337	10,800	721	22	28,457	-	-	-	-	-	-	28,457
1974[1/]	1,025	14,652	15,533	1,631	135	32,976	-	-	-	-	-	-	32,976
1975[1/]	1,642	15,186	10,768	1,402	95	29,093	-	-	-	-	-	-	29,093
1976[1/]	893	13,397	8,050	722	19	23,081	-	-	-	-	-	-	23,081

1/ No commercial fur seal harvest on St. George Island.

The ages of 15 females killed unintentionally during the male harvest were not determined.

Two hundred male seals of ages 2 through 5 years were taken on the west hauling ground of North Rookery, St. George Island for local subsistence purposes with no restrictions as to age or size. Forty seals were harvested each Tuesday from 29 June through 27 July, and maxillary canine teeth were collected from each for determination of age (Table A-2).

Living Adult Male Seals Counted

Counts of living adult males of all classes [2/] totaled 8,673 on St. Paul Island and 1,214 on St. George Island in June and 9,365 and 2,089, respectively, in July (Tables A-3 to A-8). An estimate of 375 living adult males on Sea Lion Rock was obtained from averaging counts of 361 and 389 taken there on 1 July (Table A-4). The count may be low because it was made from a skiff. The relative locations of the classes of adult males on a rookery are shown in Figure 6.

Dead Seals Counted That Were Older Than Pups

In 1976, 110 dead fur seals older than pups (46 males and 64 females) were counted on the rookeries and hauling grounds of St. Paul Island (Table 3). Canine teeth were collected from these animals for studies of age and mortality.

Dead Pups Counted

In 1976, 23,676 dead seal pups were counted on St. Paul Island and 2,289 on St. George Island (Tables A-9 and A-10). All of St. Paul Island's fourteen fur seal rookeries were censused 19 to 26 August, whereas on St. George Island five rookeries were censused 23 to 24 August and one on 21 September.

In 1976, estimates (Table 4) were made of the number of living pups on Vostochni, Polovina Cliffs, and Zapadni Reef rookeries of St. Paul Island. The death rates for pups on these three rookeries in that year were 0.074, 0.080, and 0.080, respectively, and in 1975 were 0.073, 0.058, and 0.066.

Mark Recoveries

In 1976, 1,433 seals given permanent marks as pups on St. Paul and St. George Islands by removing about 3/4 inch (1.9 cm) of the cartilagenous tip from a digit on the right or left hind

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2/ See Table A-3 or glossary for a description of the classes of adult males.

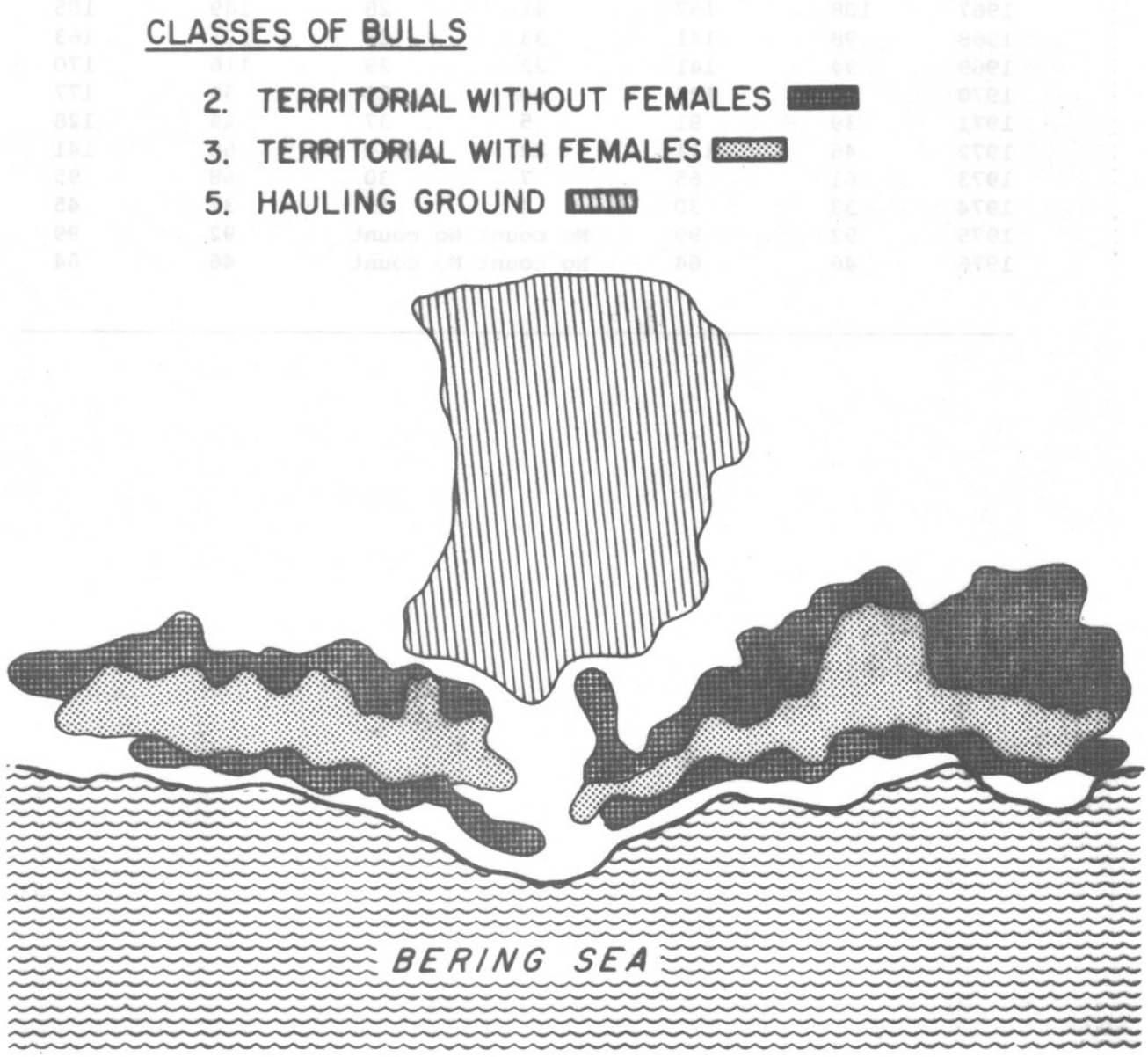

Figure 6. --General composition of a typical fur seal rookery.

Table 3.--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1965-76.

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	Number					
1965	158	No count	No count	No count	158	No count
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	No count	No count	92	99
1976	46	64	No count	No count	46	64

flipper were recovered at ages 2 through 6 years during the male seal harvest on St. Paul Island (Table A-11). Three seals marked with tags as pups on Bering Island, USSR were also recovered in the harvest (Table A-12).

Types of marks applied to fur seals in recent years, and their locations, are illustrated in Figure 7 and listed and described in Tables A-13 and A-14.

Alton Y. Roppel

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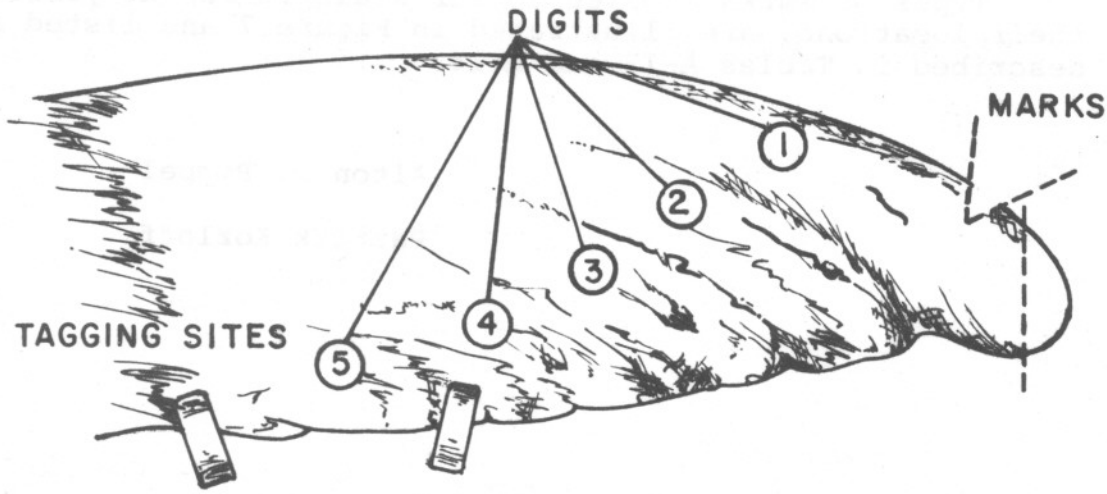
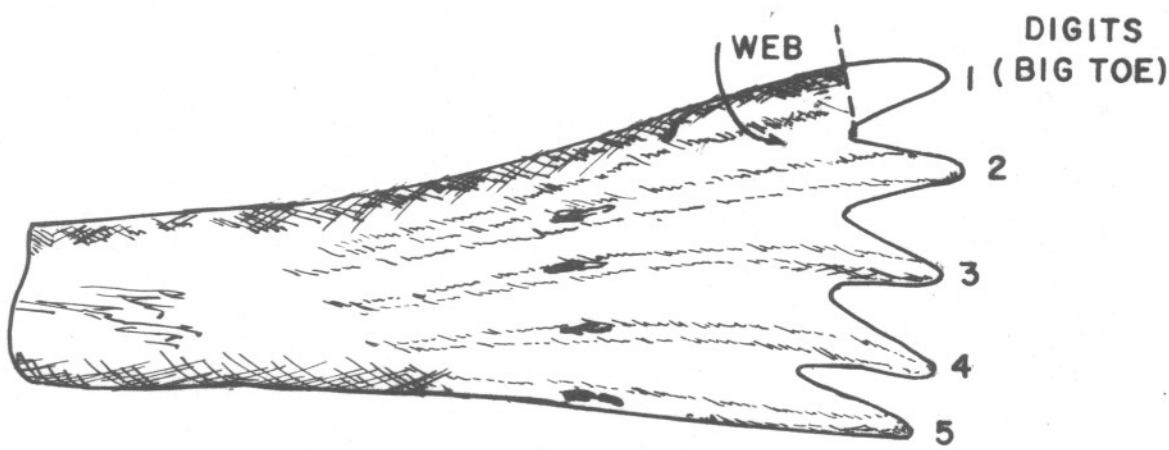


FRONT FLIPPER
TAGS CLINCHED AT THE HAIRLINE AND BETWEEN THE FOURTH AND THE FIFTH DIGIT.
MARKS MADE BY CUTTING A V-NOTCH AND REMOVING THE TIP.



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.

Number of Pups Born

A total of 291,000 pups were born on St. Paul Island in 1976 as estimated from shearing and sampling. The accuracy of the shearing and sampling method of estimation was determined by estimating the number of pups born on Zapadni Reef Rookery of St. Paul Island using this technique, and comparing the results with an actual count of the total. The 1976 estimate is 5% higher than the 1975 estimate of 278,300 and 26% above the 1970 estimate of 230,400 (Table 13 of Marine Mammal Division, 1976).

The estimate of 291,000 pups born on St. Paul Island is based on (1) dead pups counts and shearing/sampling data collected on two rookeries (Vostochni and Polovina Cliffs), and (2) regression equations developed in 1975 which show that errors in the estimated total number of pups born on the islands are lower when based on data from these two rookeries than on data from all other rookeries (Table 12 of Marine Mammal Division, 1976). In particular, the data and estimates for 1976 in Table 4 of Vostochni and Polovina Cliffs Rookeries are used with the regression equations for these rookeries in Table 11 of Marine Mammal Division, 1976. The mean of the estimates from both rookeries is the estimate for St. Paul Island as shown below (all values in thousands of pups born):

Vostochni Rookery: $\hat{Y} = 82.982 + (4.324)(51.796) = 306.95$

Polovina Cliffs Rookery: $\hat{Y} = 90.009 + (7.908)(23.378) = 274.88$

Mean, both rookeries = 290.9

On St. George Island the count of about 5,800 pups born on South Rookery (280 dead and 5,528 alive, the latter counted during the last week in July 1976) was much lower than the estimate of 13,900 born there in 1975 (Table 3, Marine Mammal Division, 1976). The count of 5,800 pups in 1976 agrees with the strong indication in last year's report (page 13 of Marine Mammal Division, 1976) that the 1975 estimate of pups born on all rookeries of St. George Island was too high. In 1977 and 1978, therefore, we plan to estimate or count the numbers of pups born on all rookeries of St. George Island in order to eliminate the uncertainty, which has existed since 1973, concerning annual pup production there.

As mentioned previously, living and dead pups were also counted on Zapadni Reef Rookery of St. Paul Island in 1976, and a shearing/sampling estimate made of the living pups. The

estimated and counted numbers of pups born differed by 7%, as shown by the data in Table 4. This difference is within the approximate limits of error, ± 10%, previously determined for estimates based on the shearing/sampling technique (Chapman and Johnson, 1968).

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Table 4.--Estimated numbers of seal pups in 1976 at times of shearing and birth on three rookeries of St. Paul Island, Alaska, and numbers counted on one of the same rookeries. Pups were sheared 1-3 August; sampling periods 1 and 2 were 10 August and 17-18 August, respectively. Live pups on Zapadni Reef Rookery were counted 11 August.

Item	Vostochni Rookery	Polovina Cliffs Rookery	Zapadni Reef Rookery
No. pups sheared	5,400	2,692	819
No. 25-pup samples			
Period 1	234	123	51
Period 2	225	133	50
No. sheared pups counted			
Period 1	687	371	137
Period 2	608	432	143
Total no. pups counted[1/]			
Period 1	5,850	3,075	1,275
Period 2	5,625	3,325	1,250
Estimated no. live pups[2/]			
Period 1 sampling	45,982	22,312	7,622
Period 2 sampling	49,959	20,720	7,159
Mean, both periods	47,970	21,516	7,390
Counted no. pups			
Dead	3,826	1,862	638
Live	-	-	6,874
No. pups born[3/]			
Estimated	51,796	23,378	8,028
Counted	-	-	7,512

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

Other Population Parameters

The analysis with Canada of data collected at sea (1958-74) is still at an early stage (see Section V of this report); therefore, new information about population parameters is not yet available from this source. Estimates of ocean mortality to 2 years of age are given in the section of this report on "Environmental Factors".

Tagging and recovery data (1958-68 year classes) from the Pribilof Islands, Commander Islands, and Robben Island were intensively analyzed in a further effort to provide reliable estimates of the intermixture of seals from these three origins (Lander and Worlund, 1976). The analysis provided further evidence in support of a conclusion submitted at the 1976 annual meeting of NPFSC that permanent identification of seals on the Pribilof Islands should be suspended because tagging or flipper marking, if conducted as in the past, would only repeat the present uncertainty concerning the true rates of intermixture (Lander, 1976).

YIELD MODEL

Further studies on the form of the stock-recruit relationship are presently being done (by D. G. Chapman, University of Washington). Results are expected during 1977.

ENVIRONMENTAL FACTORS

Estimates were made of the rate of natural mortality of young male seals of the 1950-70 year classes from St. Paul Island during their first 20 months at sea. Also estimated for these seals were rates of pup mortality on land and rates of average annual natural mortality (nearly all of which occurs at sea) which occur between the end of the kill at 2 years of age and the start of the kill at 5 years of age. The three sets of estimates are in Table 5.

Within the limitations of the data and estimating procedures, the study concluded that 82% of the annual variations in yield at 3 years of age could be explained by variations in (1) numbers of pups migrating to sea (after mortality on land) and (2) natural mortality during the first 20 months at sea. An attempt is being made, therefore, to develop a numerical index of the frequency, duration, and intensity of winter storms between the Pribilof Islands and the Washington-British Columbia coastline. This index would cover the first winter at sea in the life of the young seals, and possibly could assist to (1) predict the ocean mortality rate during the first 20 months of ocean life and (2) improve the accuracy of predictions of the kill of 3-year-old male seals.

Table 5. Estimated natural survival of male fur seals from St. Paul Island, Alaska in three stages from birth to the start of the commercial kill at age 5 years, 1950-70 year classes.

Year class	On land	First 20 months at sea until start of kill at age 2 years	Annual average from end of kill at age 2 years to start of kill at age 5 years
1950	0.88	0.41	0.85
1951	0.84	0.42	0.87
1952	0.91	0.46	0.92
1953	0.82	0.38	0.80
1954	0.79	0.30	0.74
1955	0.84	0.33	0.79
1956	0.78	0.18	0.63
1957	0.85	0.37	0.85
1958	0.92	0.49	0.88
1959	0.88	0.43	0.87
1960	0.81	0.34	0.84
1961	0.83	0.39	0.86
1962	0.84	0.43	0.88
1963	0.88	0.47	0.89
1964	0.92	0.47	0.89
1965	0.85	0.41	0.87
1966	0.92	0.36	0.84
1967	0.95	0.42	0.87
1968	0.89	0.42	0.91
1969	0.94	0.38	0.86
1970	0.91	0.46	0.92

ALTERNATE HARVESTING STRATEGIES

A computer model is being developed (by T. D. Smith, University of Hawaii) to simulate the numerical response of the Pribilof Islands' population to different age- and sex-specific rates of natural mortality, pregnancy, and exploitation. The model will be used to evaluate the effect of alternatives to the present method of harvesting in which only males are purposely killed at 2-5 years of age.

The effects of killing females will be evaluated initially. For example, the expected increase in the yield of males did not occur when females were killed commercially on land starting in 1956. A prediction of the effects of female kills is needed before future decisions with respect to harvesting females can be made. Results of this population modeling are expected during 1977.

R. L. Lander

Part II. PHYSIOLOGY AND MEDICINE

Even as man is beset with a host of infectious disease epidemics, so also are animals beset with epizootics of infectious disease that take a toll of lives and energy that can and do exceed losses from simple starvation, predation, injury, and weather.

This situation is true whether the animals are wild or domestic, aquatic or terrestrial; however, we recognize that epizootics are less apparent, usually, in wild populations because the population, as a whole, through repeated exposure to the infectious agents, has become largely resistant through the production of antibodies by individuals that survived particular attacks, and by the transfer of these specific antibodies from mother to young via the milk or placenta.

Then, on a cyclical basis, the immunity diminishes gradually so that part of the population becomes susceptible again. Or, the entire population becomes susceptible because the organism has changed its specific proteins so that the old antibodies are no longer effective. We have been watching both of these phenomena take place in the fur seal population with respect to the agents of leptospirosis and vesicular exanthema.

This helps us to realize that the great population of northern fur seals is no exception, and that there must be several highly fatal viruses, bacteria, and other microscopic parasites, as well as macroscopic parasites, operating within the herd via cycles that involve fish and other aquatic life, and probably marine birds, as well as other marine mammals.

Pathology--St. Paul Island

From 29 June through 15 August, M. C. Keyes, C. R. Forhan, ans S. W. Keyes collected 242 dead fur seal pups from under catwalks on study areas at Reef and Northeast Point Rookeries as described by the Marine Mammal Biological Laboratory, 1970. Of these 242 pups, 210 were necropsied and 32 were discarded as unsuitable for examination because of advanced postmortem degeneration.

Tabulation of the primary diagnoses for pups necropsied shows that the main causes of death were hookworm disease and emaciation syndrome, which together accounted for 66.1% of the deaths. Infectious disease was next at 7.5%, and trauma and miscellaneous causes were less important (7.0%). Undetermined causes and pups unsuitable for examination accounted for 19.4% of the sample. In most of these cases it was possible to rule out hookworm disease or emaciation syndrome as the cause of death (Tables 6 and A-15).

Table 6.--Primary diagnoses for causes of death among seal pups, three mortality study areas, St. Paul Island, 29 June to 15 August 1976

Primary diagnoses	Study areas: Reef Rookery, Area 1, Dead pups		Reef Rookery, Area 2, Dead pups		Northeast Point, Area 3, Dead pups		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Emaciation syndrome	27	40.9	9	33.3	30	20.1	66	27.3
Hookworm disease	9	13.6	8	29.6	77	51.7	94	38.8
Microbial infection	3	4.5	3	10.1	12	8.1	18	7.5
Peritonitis	-	-	(1)	(3.7)	(3)	(2.0)	(4)	(1.7)
Navel	(1)	(1.5)	-	-	(1)	(0.7)	(2)	(0.8)
Enteritis	-	-	(1)	(3.7)	(4)	(2.7)	(5)	(2.1)
Abscess	-	-	-	-	(1)	(0.7)	(1)	(0.4)
Leptospirosis (perinatal complex)	(2)	(3.0)	(1)	(3.7)	(3)	(2.0)	(6)	(2.5)
Trauma	2	2.0	-	-	1	0.7	3	1.2
Bite wounds	(1)	(1.5)	-	-	-	-	(1)	(0.4)
Organ rupture	(1)	(1.5)	-	-	(1)	(0.7)	(2)	(0.8)
Miscellaneous	6	9.0	-	-	8	5.3	14	5.8
Stillborn	(2)	(3.0)	-	-	(2)	(1.3)	(4)	(1.7)
Retained meconium	(2)	(3.0)	-	-	(2)	(1.3)	(4)	(1.7)
Nonhookworm anemia	(1)	(1.5)	-	-	(1)	(0.7)	(2)	(0.8)
Meningitis	-	-	-	-	(1)	(0.7)	(1)	(0.4)
Dystocia	(1)	(1.5)	-	-	-	-	(1)	(0.4)
Lung edema	-	-	-	-	(2)	(1.3)	(2)	(0.8)
Undetermined	9	13.6	1	3.7	5	3.4	15	6.2
Unsuitable for examination	10	15.2	6	22.2	16	10.7	32	13.2
Total	66	100.0	27	100.0	149	100.0	242	100.0

The number and distribution of causes of death among pups in 1975 and 1976 were very similar, with the exception of leptospirosis (perinatal complex). Leptospirosis, caused by a serotype of Leptospira pomona, an infectious spirochaete bacterium, has shown a decreasing trend in the last three years. At least the number of affected newborn carried to term and born on the study areas has diminished. The number found with leptospirosis declined from 28 (13.9%) in 1974 to 17 (7.0%) in 1975, then to 6 (2.5%) in 1976. The incidence of lesions typical of this disease was constant at about 2.5% for many years until 1967 when it rose to 17.2%. One probable explanation for the decline from 1974 to 1976 is an increase in population immunity to the leptospiral agent because of the recent high incidence and exposure of the population to the agent for the past several years. Another possible explanation is that more deaths in 1976 were in the form of premature pups aborted at sea prior to the mother's arrival on land.

A three year cyclic increase in total pup deaths (primarily owing to an increase in deaths from emaciation syndrome) observed in 1965, 1968, and 1971, failed to materialize in 1974 and has not been evident in 1975 or 1976.

Pathology--St. George Island

Pups were not necropsied on St. George Island in 1976, but the construction of catwalks over an adequate collection site was completed in October for use in collecting dead pups for necropsies in 1977.

Infectious Disease Research in Cooperation with Naval Bioscience Laboratory (formerly Naval Biomedical Research Laboratory)

A research team of eight scientists, made up of one veterinary epidemiologist, one veterinary virologist, one veterinary pathologist, and five research assistants spend a total of 175 man days on St. Paul Island between 13 July and 8 August. In addition, a veterinary virologist and assistant from the University of Wisconsin worked in cooperation with the Naval Bioscience Laboratory team to study avian-mammalian disease relationships. Of particular interest to these scientists was the possible influenza and San Miguel sea lion virus interspecies infections.

General Bacteriology

Samples of various tissues and body fluids (see below) were collected to isolate and identify known pathogenic bacteria as well as the normal flora. The latter aspect was to better understand the animals' nonspecific resistance to infection and anatomical factors related to resistance.

The vagina, fallopian tubes and ovaries of five adult, full term females were cultured using Kellogg's media for Neisseria and tryptocase soy agar with 5% defibrinated seal blood from other organisms.

Samples from 3-and 4-year-old males were collected from 61 livers, 60 kidneys, 15 spleens, and 27 blood specimens. These samples were cultured in castanetta bottles for anaerobes and trypticase soy agar for aerobes to determine the blood borne bacterial load.

Five one-week old pups and five three-week old pups were sampled and cultured for mycoplasma, bacteria inhabiting the throat and the whole blood.

Gallbladders from 46 young males were cultured on McConkey's and XLD media for isolating nonlactose fermenters such as Salmonella spp. and Shigella spp. The carrier state for these bacteria is known to be established in some mammalian species by localized infections in the gallbladder.

An extensive program of sampling and culturing for enteric organisms was initiated. Four intact gastrointestinal tracts were each sampled at seven different sites under specific and highly anaerobic conditions. Sections of gut corresponding to the sampling sites are being prepared for light, thin section and scanning electron microscopy in an effort to evaluate the host-parasite relationship at the cellular level.

Fur Seal Immunity

Blood samples were collected to establish hematologic baselines for red blood cell fragility, platelet counts, white cell counts, red cell counts, clotting time and packed cell volume. Red blood cell antigen is being prepared for producing specific fur seal RBC antiserum for marine mammal cross-matching and blood typing studies.

In addition to serum and blood, colostrum and tissues were collected from adult females and from pups up to 5 weeks of age. Gut mucus was collected from 3-and 4-year-old males for secretory immunoglobulins.

Virology

The entire 1976 fur seal harvest was sampled for incidence of vesicular lesions. Serums, throat swabs and rectal swabs were collected from 2% of the animals harvested. From necropsied animals, 337 swab samples were collected and frozen in tissue culture media. These samples have subsequently been passaged three times in Vero and pig kidney cell lines for a total of 2,022 cell culture procedures.

For the first time, experimental infectivity studies were initiated using homogenized tissues from fur seal vesicular lesions. Intradermal inoculations were made on the foreflippers, rear flippers, lip, and tongue of six young males in captivity. One seal was killed each day postinfection and samples were collected for subsequent virus assays.

Physiology

Thermoregulation

From 18 to 29 July the Physiology and Medicine Section gave assistance to Dr. Arnoldus Blix, a Norwegian physiologist associated with the University of Alaska on thermoregulation in arctic mammals. He conducted several noncritical experiments on newborn pups to determine their ability to withstand exposure to low temperatures. He identified brown fat in several locations within the body, noted the subcutaneous fat and the fur and drew the preliminary conclusion that healthy newborn fur seals are as well equipped to withstand the cold as the young of pagophilic (ice inhabiting) species. These findings support contentions of the medical staff that "storms" and "weather" do not kill healthy pups.

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3/ Dr. Smith, Veterinary Virologist, Dr. Brown, Certified Veterinary Pathologist, and Dr. Vedros, Microbiologist, are with the Naval Bioscience Laboratory, Oakland, California. Miss Forhan is a veterinary medical student at Washington State University.

Part III. BEHAVIOR AND BIOLOGY, PRIBILOF ISLANDS

Routine data were collected as in past seasons on behavioral factors that may change as the sex ratio or density of the unharvested St. George Island population changes. Data such as that on copulation frequencies of known males, activity levels of males, and density of females on the rookery, will not be summarized until expected changes occur. This report concentrates on selected special subjects completed during the 1976 field season. Included are the stages and duration of estrus, the responses of females and neonates to management-caused disturbances, measured female feeding cycles in comparison with like measurements made 12 years ago, and the effects of oil pollution on the metabolic rates of fur seals.

Work Plan

Observational studies were conducted on East Reef and Zapadni Rookeries of St. George Island from 10 May through 15 October. In addition, a new observation facility was erected at Kitovi Rookery on St. Paul Island on the same site where R. S. Peterson conducted a behavioral study from 1961 through 1963. At this site a grid was painted on the rocks as on St. George Island. Approximately 2020 man-hours of data were collected on each island using identical study methods, developed on St. George Island since 1973.

Experiments on the stages and duration of estrus were conducted in a holding facility on St. George Island in 1976. In addition, experiments were conducted on the effects of oil pollution on (a) metabolic rates of immersed fur seals using the biological laboratory on St. George Island, and on (b) the diving abilities of fur seals released from East Reef Rookery.

As in 1975, a radio telemetry study of subadult male activity cycles was made on the Zapadni hauling ground (St. George Island). Supplementary cattle ear tags applied to these animals are listed in Table 7.

Twenty-seven territorial males on East Reef and Zapadni Rookeries were captured, weighed, marked with cattle ear tags and bleach, and released. The weights of these adult males ranged from 155 to 280 kg with a mean of 212 kg standard deviation 31.9. Forty-one adult females were marked with tags and hair brands on Zapadni Rookery, 9 females were marked with bleach and tags on East Reef, and 16 females were given tags and bleach marks on Kitovi Rookery of St. Paul Island. Tags applied to these animals are listed in Table 7.

Table 7. --Tags applied to fur seals for studies of behavior, St. George Island, and St. Paul Island, Alaska, 1976.

Monel Tags	Tag number	Age-Sex Class	Rookery
Silver, X-series 1/	X1601 - X1610	Adult males	East Reef
	X1611 - X1635 (less 1627)	Adult males	Zapadni
	X1642 - X1650	Adult females	Zapadni
	X1651 - X1660	Adult females	East Reef
	X1676 - X1743	Adult females	Zapadni
	X1751 - X1754	Adult females	East Reef
Silver, IW-series 2/	IW2355 - IW2372 (less 2366)	Adult females	Kitovi
Silver, X-series 2/	X801 - X825	Subadult males	Zapadni
	X843 - X850	Subadult males	Zapadni
Silver, XA-series 2/	XA212 -XA225	Subadult males	Zapadni

1/ Double-tagged (consecutive numbers), left and right front flippers.

2/ Double-tagged (identical numbers), left and right front flippers.

Data Analysis

Stages and Duration of Estrus

Physiological estrus is known to last about one month (Craig, 1964), but behavioral receptivity is much shorter. Experiments in 1975 showed that females which do not copulate between 5 and 10 days postpartum do not enter estrus again within 30 days, and are therefore unlikely to copulate until the next season. Hence there is only one period of behavioral receptivity in each period of physiological estrus. The importance of this finding to fur seal management is that the number of breeding males on the rookeries must be adequate to ensure pregnancy during the single estrus cycle. The absolute length of the receptive period, if known, would determine further the number of males needed to produce optimum pregnancy rates; obviously fewer males would be required if the period of receptivity were quite long. The purposes of this study were to determine the length of time over which females will permit mounting by an adult male, and to identify the behavioral stages of estrus.

Given that receptivity immediately terminates at the first copulation for most females (Peterson, 1968), the first condition for these experiments was that females not be allowed to copulate, but that a convincing measure of receptivity be obtained. To satisfy the first condition a harness was devised to which was attached a special shield or "chastity belt" that prevented intromission in the event the female was mounted. This harness and shield did not hamper the female's normal movements and postures, and it did not preclude male investigatory behavior. Receptivity was measure by making careful observations of behavior of the pair, and comparing results with male-female pairs which were allowed to copulate.

Eighteen females and their pups were captured on the rookeries on the day of parturition and were moved to the village holding facility as pairs. They were housed in 4 x 5 m outdoor cages with other females, and were observed casually until day 5 postpartum. On that day each female was fitted with the special harness and released into a 5 x 5 m cage containing an adult male. The pair was allowed to interact for 15 minutes. For the first 10 females notes were made on the kinds and number of behavioral interactions occurring. From these notes evolved a time-ruled check sheet which was used in collecting systematic data on the remaining 8 females. The check sheet listed 28 different behavioral categories, and 6 postural categories, and was divided into 15 vertical columns, one for each minute of the session. One researcher observed the pair and called off behavioral categories as they occurred and a second observer scored these items on the check sheet. Females were tested three times each day from day 5 postpartum until all signs of behavioral receptivity ceased. Data were collected on 62 test sessions of 15 minutes duration each.

Stages of estrus.--The onset of estrus, or behavioral receptivity, was very rapid. For four females the first signs of receptivity occurred within a test session after several minutes of nonreceptive behavior. Such a rapid shift from nonreceptive to receptive behavior suggests that the presence of the male in some way induces the commencement of estrus. That is, the presence of the male may be the final trigger which initiates estrus after the female has entered the approximate postpartum period when estrus is likely. The termination of estrus also seemed abrupt, although not as precipitous as the onset. The females did not shift from receptive to nonreceptive status within a test session, but became nonreceptive between sessions. The mean duration between the last test session in which the female was judged "in" estrus, and the first session in which she was judged "out of" estrus, was 12.3 hours, indicating that females went out of estrus overnight.

There was only a brief period prior to estrus when the female underwent detectable behavioral changes. The responses that females gave spontaneously (such as panting and producing a special "estrus call"), and those that they gave in response to the male (such as permitting the male to touch her neck with his nose, or presenting "lordosis") occurred only a matter of minutes before the female permitted the male to mount the first time. However, at the end of estrus the female often allowed the male to perform some behavioral patterns that suggested she might be receptive (such as allowing the male to touch her neck with his nose), but did not permit mounting. Therefore, the termination of estrus was behaviorally less clear than was the onset of estrus.

Duration of estrus.--The following estimate for the duration of estrus was made under the assumptions that estrus (a) did not begin before the first test session in which the female acted receptive, and (b) was terminated halfway between the last session in which she was judged "in" estrus, and the first session in which she was judged "out of" estrus. The records of seven of the eight females showed the transition from nonreceptive to receptive, to nonreceptive again. The mean duration of estrus for these females was 33.7 hours (standard deviation 12.9, range 14 to 50 hours). Thus the duration of estrus by this behavioral measure was highly variable. Much of the variability was due to the experimental design (where test sessions were discrete and were held several hours apart). Clearly much more work is required to refine this estimate.

Management-Related Disturbances

The Coordinated Land-Pelagic Research Proposal postulates that reduced survival of harvestable animals may stem from management-induced disturbances of the population. It is suggested that the mother-young suckling cycle is disrupted,

thereby producing insufficient nourishment of the young and resulting in less viable offspring. Three years have been spent (a) observing the movements and duration of the suckling cycle for known mothers that were on the rookery the day of management-caused disturbances, and (b) conducting experiments on the flexibility of the on-land phase of the suckling cycle.

Interruptions of the cycle.--In 1974 a preliminary study on the effects of two management-caused disturbances concluded that brief disturbances appeared to have little effect on the duration of the suckling cycle within which the disturbance occurred (Marine Mammal Division, 1975). Since 1974, records have been kept on St. George Island on the effects of other disturbances on known females. Although the number of females observed is still small these data warrant reporting because, for one rookery, the trend remains the same from year to year, and because a new tendency now appears. In 1975 and 1976 the seals were disturbed a total of four times on East Reef Rookery and once on Zapadni Reef Rookery. These disturbances occurred in August and September during the count of dead pups and the marking of pups of the year. Special records were kept on the presence and behavior of all marked females just prior to and after each disturbance until the animals departed on their next feeding excursion. Basically, the females responded in one of two ways to disturbance. They either went to sea for a short period ($n = 20$ females; $\bar{x}$ absence = 3.7 hours) and then returned and resumed suckling their pups, or they immediately began their next feeding excursion at sea (Table 8). In the latter case ($n = 12$ females; $\bar{x} = 7.2$ days at sea), the feeding excursions appeared normal in length and there was no evidence that the cycles were lengthened by the disturbance. In no case did a female abandon the rookery following a disturbance.

Females on the two rookeries responded differently when chased into the sea as a result of research activities. For example, 8 of the 12 females that immediately began another feeding cycle instead of returning to nurse their pups were from Zapadni Rookery (Table 8). Access to this rookery follows a 200-300 m long and comparatively steep incline as opposed to a rather level access to East Reef Rookery of not more than 30 m in length. These differences in terrain may very well explain observed differences in the behavior of females on the two rookeries following disturbance.

In most cases, even those in which the female remained at sea, the total hours observed on land during the disturbed cycle appeared normal despite the disturbance. Table 8 shows that 14 of the 20 females that returned to suckle their pup spent more time ashore after than before the disturbance.

That is, they had not been on shore long before the disturbance occurred. It also shows that 9 of the 12 females that immediately began their next feeding excursion after the disturbance had already been on land a significant amount of time. Comparing the "Total" column of Table 8 with the "Control" column of Table 9 it is clear that 29 of the 32 disturbed females spent amounts of time on shore that were within the range (mean ± 1 standard deviation) of females undergoing normal (undisturbed) on-shore cycles. The other three females were never observed to suckle a pup, and may not have been mothers. Therefore, these observations do not show any effect (measured by hours spent on shore) of brief management-related disturbances on suckling cycles within which the disturbances occurred. This conclusion, however, does not preclude the possibility of a cumulative effect on many such brief disturbances.

This study suggests that mothers were less affected (did not shorten their stay on land) by disturbances than were non-mothers (did shorten their stay on land). It also suggested that rookery terrain may influence the female's response to a disturbance. The number of observations, however, were too few to be much more than suggestive.

Flexibility of the On-Land Phase.--Peterson (1968) observed that the on-land phase of the female feeding cycle (about 2.0 days) was relatively less variable than the at-sea phase. From observing that periods on land are relatively uniform in length, and from finding that their length is not significantly affected by brief management-caused disturbances, the question arises whether the observed uniformity is obligate or facultative. If it is obligate then it should be impossible to modify the length of the cycle in any way; if it is facultative then the cause of the observed regularity is not obvious. To determine the limits of flexibility in the on-land phase of the cycle we devised an experiment in which the reunion of the mother-pup pair would be delayed varying numbers of hours beyond the female's arrival at the rookery, and in which her responses to this delay could be measured.

In 1975 and 1976 females and their pups on East Rookery were marked with numbers on the day of parturition, and records were kept of the date and hour at which the females went to sea and returned. After at least four normal (control) visits to the rookery had been recorded, marked pups were removed from the rookery just before the mothers were expected to return. Pups were held in the St. George Island holding facility for varying numbers of hours (starting with 12 and increasing in approximate 12 hour increments) after their mothers had returned to the rookery. Observers recorded the date and time of arrival of the female, as well as her activities and movements during the absence of her pup. At the end

Table 8.--Responses of lactating females to management-caused disturbances by rookery, year, and female.

Rookery, Date	♀	Time Absent After Disturbance	Hours Spent on Land Before +	After =	Total
East Reef					
14-8-74	A6	0 (did not leave)	41	73	114
	B2	1.5 hr	18	48	66
East Reef					
12-9-74	A5	2.0 hr	23	25	48
	A7	1.75 hr	3	25	28
	C7	2.25 hr	23	1	24
	D2	1.75 hr	4	26	30
	E9	1.75	4	68	72
East Reef					
21-8-75	A3	1.5 hr	45	21	66
	D7	1.75 hr	6	20	26
	E9	< 18 hr	30	26	56
	C9	5 days	30	0	30
East Reef					
29-8-75	A3	<1.0 hr	6	20	26
	B3	<1.0 hr	6	91	97
	D7	<2.0 hr	6	20	26
	D8	15 days	31	0	31
	E1	<2.0 hr	3	0	3
	H2	<1.0 hr	6	30	36
	H7	<2.0 hr	74	52	126
	H8	1.0 hr	6	20	26
East Reef					
21-9-76	A2	8 days	43	0	43
Zapadni					
23-8-76	A6	8 days	94	0	94
	A7	<11 hrs	94	0	94
	B4	24 hrs	0	24	24
	B5	8 days	18	0	18
	B6	6 days	19	0	19
	B7	11 days	0	49	49
	B8	8 days	18	0	18
	B9	<11 hrs	23	20	43
	C3	2 days	20	17	37
	C8	<11 hrs	1/	0	
	D3	7 days	1/	0	
	D7	8 days	17	0	17

1/ Female seen only once after disturbance, no duration obtained.

of the pre-determined withholding period the pup was returned to the rookery in a location that ensured reunion with its mother, and observers continued to collect data until the mother departed for her next feeding excursion. This experiment was repeated whenever a marked pup was in an accessible location on the rookery just before its mother was expected to return.

Table 9 shows that two of the four females were exposed to and tolerated pup absences of 72 hours (note that 72 hours is much longer than the normal amount of time females spent on shore ("Control" column)). Only one pup was withheld from its mother for as long as 96 hours; this female departed before her pup was returned. From this small sample it is not clear whether 72 hours is the upper limit of female flexibility in waiting for the pup.

Table 9. --Comparison of normal (control) on-land cycles with experimental cycles in which the pup was prevented from joining the female for varying periods.

Female	Mean hours on Land (Controls)			Total Hours on Land (Experimentals)			Mean Stay after Reunion (Hrs)
Name	$\bar{x}$	SD	n	Exp. 1	Exp. 2	Exp. 3	
F4	33	25.5	9	63 (22)	74 (38)	140 (50)	56
A2	36	19.3	10	99 (45)	123 (72)		52
A7	35	9.3	8	53 (27)	98 (72)		26
I4	25	8.8	5	84 (34)	75 (47)	96 (96)[1/]	39

1/ Female left at 96 hours before pup was returned to her.
()=Number of hours pup was withheld from its mother.
n =Number of observations.
SD=Standard deviation

The experiment also showed that despite the length of time she waited for her pup, the female tended to spend a normal (or greater) amount of time with it before departing for the next feeding excursion. In Table 9 note that the mean stays after reunion were within $\pm$ 1 standard deviation of the control means for the same females, except for that of female I4 which was greater than the control mean + 1 standard deviation. The waiting period, combined with the stay after reunion, often resulted in total on-land stays which were three to four times longer than the mean stay when pups were not withheld (Table 9, experiment 3 on female F4, and experiment 2 on female A2).

From these experiments we can conclude that the regularity of the on-land phase of the feeding cycle is facultative; a female will spend an amount of time on shore necessary to ensure reunion with her pup, plus a normal amount of contact time with it after the reunion. Given that a female has the capability of spending three to four times longer on land than she normally does, it would be beneficial to know the mechanism by which a female terminates her visit to land, and the conditions which produce regularity within a flexible system.

Female Feeding Cycles: a 12 year comparison

It has been asked recently whether the increased pollock fishery in the Bering Sea is responsible for the failure of fur seals to increase in number following herd reduction from 1956 through 1963. Specifically, it has been questioned whether feeding cycles of fur seals have increased in length, thereby indicating that foraging may now be more difficult than before the fishery increased. To answer this question we investigated feeding cycles of females on St. George Island for three years and on St. Paul Island for one year. A comparison of these recent data to those of Peterson (1968) from 1962 (when the fishery was small compared to recent years) should reveal any temporal trends in length of feeding cycle.

Observations of feeding cycles were made on East Reef Rookery (St. George Island) in 1974, 1975 amd 1976, and on Zapadni Rookery (St. George Island) and Kitovi Rookery (St. Paul Island) in 1976. In all five of these studies adult females were marked by clipping and bleaching numerals in their pelage on the day of parturition. From June through mid-October (except East Reef in 1975 when observation lasted until mid-November) observers searched for these marked animals one or more times every day. Each sighting was recorded on computer code sheets along with date, time of day, location and behavior. To eliminate variables caused by differences in reproductive status only the records of actively suckling females were used. Peterson collected most of his data (on Kitovi Rookery - St. Paul Island) in 1962. His raw data were re-analyzed for comparison with the present effort.

The feeding cycle, or time spent at sea, was defined as the duration between successive sightings on land; the results are reported in whole days. We followed Peterson's example of excluding from the analysis a female that was absent more than 15 days, on the premise that we did not see her on land during one cycle.

Figure 8 compares all the data, including a re-calculation of Peterson's 1962 raw data, by means of a frequency distribution of feeding cycles. The results are pooled by duration of

cycle rather than by individual female in an attempt to establish a population profile from the combined records of individuals in the population. In these graphs the records of any one animal will therefore appear in several columns unless all her cycles were of exactly the same duration.

The figure shows a very distinct difference in female feeding cycles between the St. Paul site and East Reef Rookery on St. George Island. Note that for all three years at East Reef Rookery more than 70% of the observations were of absences from 4 to 8 days duration, whereas 70% of the observations at Kitovi were of absences from 8 to 12 (1962) or from 7 to 11 (1976) days duration. The best comparisons are between East Reef Rookery in 1975 and Kitovi Rookery in 1962 where identical time periods were covered. Therefore, although the ranges overlap, these two sites are very different in the duration of most (>70%) feeding cycles.

It is doubtful whether females from the two islands can be assumed to differ in feeding cycles because these two rookeries differ. Figure 8 shows that on Zapadni Rookery more than 70% of the observations were of 4 to 10 day absences, which overlaps East Reef and Kitovi Rookeries, even though Zapadni Rookery, like East Reef, is also on St. George Island. The difference between Zapadni and East Reef Rookeries may in some way be associated with the more difficult access to the former from the sea (see Management-Related Disturbances). Until more is known about the effects of terrain and other variables on duration of the feeding cycle, or until data from a larger number of rookeries is obtained we are not justified in concluding that females from the two islands differ in the duration of their feeding cycles.

The static view of female feeding cycles presented in Figure 8 does not show the important changes that occur within the season. For example, the 1975 Report of Fur Seal Investigations showed that on East Reef Rookery female feeding cycles increased in length as the number of days beyond parturition increased. Similar trends seem to occur in all the data (Figure 8), and it is possible that differences in these trends will be useful in comparing rookeries or islands. Various statistical tests are presently being applied to the data to explore this possibility.

This study has shown that there has been no measurable increase in the length of feeding cycles of female seals on Kitovi Rookery over the past 12 years. In fact, a slight decrease in duration is suggested (Figure 8). But since the sample is based on only 11 females we can have no confidence in this suggestion. Therefore fur seals either seem not to have changed, or possibly to have slightly decreased the length of

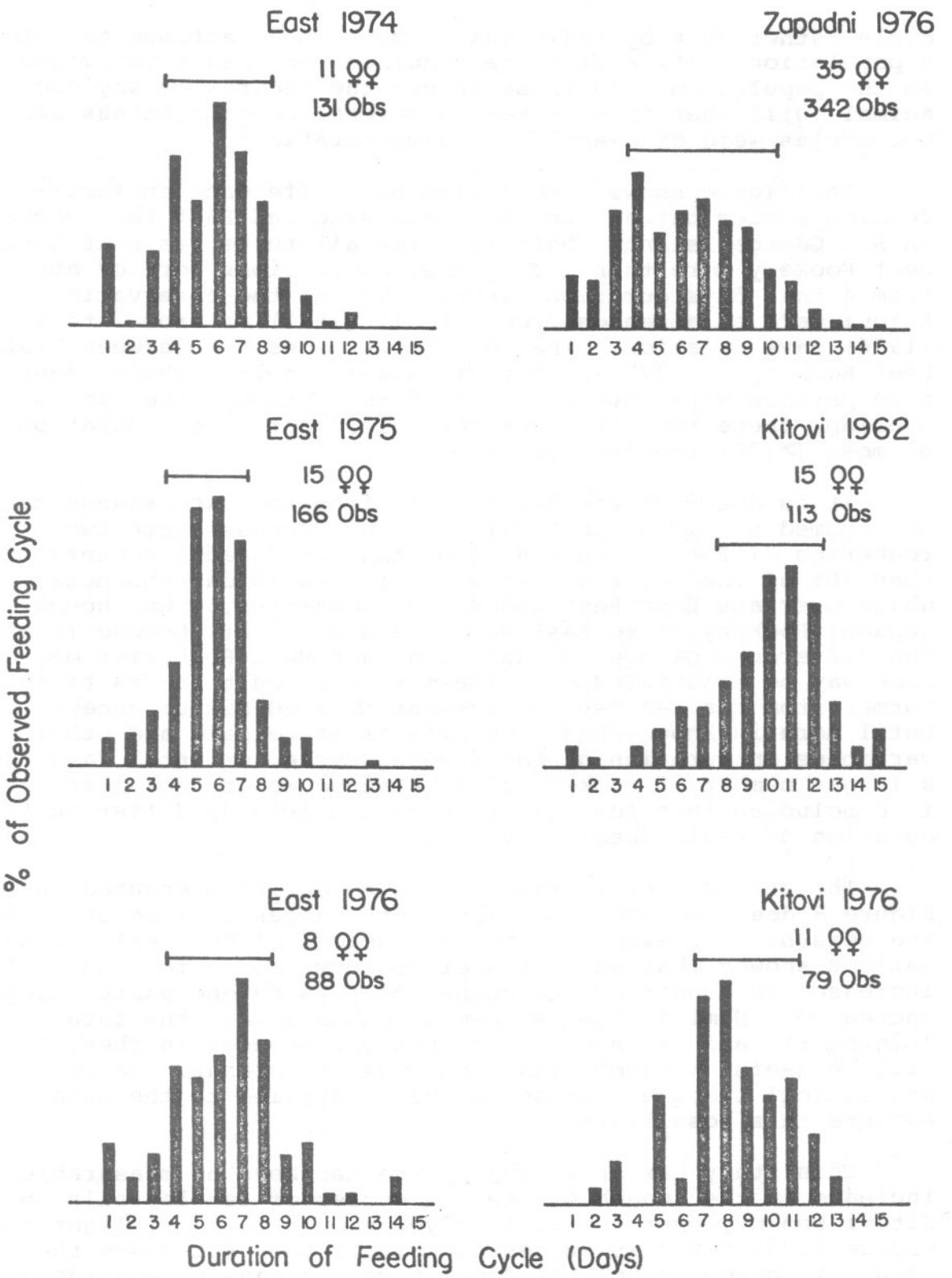

Figure 8.--Frequency distribution of female feeding cycles.

their feeding cycles within the period when the fisheries on one of their major prey species has greatly increased. It is unlikely that fur seals have not responded at all to these losses of resources, but the length of the feeding cycle may be too crude a measure to show the nature of their response. For instance, fur seals may have shifted to another prey species or size, changed the number, frequency or depth of their dives within feeding cycles, or changed feeding locations without changing the duration of absences from land. Studies of these latter topics is the obvious course to follow in future research.

Effects of Oil Pollution on Callorhinus

In cooperation with Dr. G. L. Kooyman, Scripps Institution of Oceanography, we investigated the possible effects of crude oil on (a) thermal conductance of the fur, (b) diving effort, and (c) metabolic rates while immersed. Baseline data for diving effort have been presented (Marine Mammal Division, 1976).

Thermal conductance.--Fresh, blubber-free pelts from several species (including Callorhinus) were collected and kept frozen until the time for heat flux measurements. These measurements were made with a Beckman-Whitley heat flow transducer, Model T200-3, consisting of a silver-constantan thermopile sandwiched between thin bakelite plates.

After measuring the heat flux for a period of about 12 hours (to achieve thermal stability) the pelts were squeezed dry, and 10 to 20 ml of Prudhoe Bay crude oil was painted into the fur with a brush. After rinsing briefly with water the heat flux measurements were repeated.

Heat flux in the experimental (oiled) pelts exceeded that of the controls by factors of 1.7 and 2.0 in the two fur seal pelts measured. That is, twice as much heat flowed through the insulative layer after oiling. The manner in which oil destroyed the insulative property of the pelt is not known. The sea otter pelt was the only one of nine species tested which showed a change in heat flux greater than that of the fur seal.

Diving effort.--A depth-time recorder used to measure diving in Callorhinus has been described (Marine Mammal Division, 1976). In 1976, a similar instrument was used with the modification that the scribe and pressure-sensitive paper were replaced with a light-emitting-diode and photographic film, respectively.

Nine recorders were sent to sea during 1976, six on lactating females and three on subadult males. Of the six lactating females, two had been coated with approximately 100 ml of crude

oil from the nape of the neck to the tail on the dorsal surface only. Unfortunately, neither of the two oiled animals returned to land. As a result, their depth-time recorders were not recovered, and we cannot assess what effects the oil might have on the depth and frequency of dives made by these animals.

Metabolic rates during immersion.--A special metabolic chamber was constructed for tests of metabolic rates during immersion. It measured 151 x 84 x 84 cm, was built of styrofoam sheets approximately 9.5 cm thick covered with layers of wood and fiberglass, and contained about 1400 liters of fresh water. In the lid of the box was a lucite dome measuring 60 cm in diameter which acted as an air reservoir when the box was filled to the top with water. The dome had two ports functioned as intake and exhaust for air drawn through this air space. Water in the box was circulated by means of pumps, and the temperature was kept constant (to within 0.50 C) with heating units which worked against a refrigerating unit. Deep body temperature of seals in the box was measured with an encapsulated radio transmitter (swallowed by the animal).

An AEI oxygen analyzer was used to measure 0_2 content with exhaust (expired) gas after water vapor, CO_2 and (in oiling trials) petroleum fumes were removed. The output of the AEI oxygen analyzer was continuously recorded on a 25 cm chart recorder. Seals were tested at a variety of water temperatures, each test lasting 12 hours.

After each of three seals had been tested at varying water temperatures each was given a light coating of Prudhoe Bay crude oil (70 - 100 ml) brushed on the fur from the nape of the neck to the tail on the dorsal surface only), and the metabolic trials were repeated. Two of the three oiled seals were cleaned with solvents, and were tested again as "washed" animals; the third animal was not cleaned but was tested over a two week period to determine how long the effects of oil coating lasted.

The results show that oiling affected the fur seals by increasing their metabolic rates approximately 1.5 times above controls. The actual values are probably greater since oiled animals were extremely reluctant to remain in the water, but instead held themselves in the lucite dome throughout the test period with only about 30% of their body surface area immersed. Had they been totally immersed these values would have been higher. Washing seals with Shelsol 70 (a solvent) or Basic H (a detergent) was not effective in reducing metabolic rates to the control levels.

The implications of this study are that any contact with petroleum would have a profound influence on the health of fur

seals through increases in pelt conductance with concommitant increases in metabolic rates. We cannot conclude that death would inevitably follow such contact, but from these studies it is clear that the health of oiled animals would be in serious jeopardy, and that washing with some detergents would be ineffective in salvaging them.

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

One small colony of northern fur seals was discovered in Adams Cove of San Miguel Island in 1968 (Peterson, LeBoeuf, and DeLong, 1968) and another in 1972 on nearby Castle Rock. We have annually carried out research on both of these colonies since their discovery in order to (1) measure the breeding success of this species in an atypical (warmer) environment and (2) identify behavior patterns conducive to this success.

Adams Cove

The population of fur seals breeding in Adams Cove on the west end of San Miguel Island has been monitored daily during each breeding season from 1969 through 1976. The salient results of this research are presented in Table 10 and described below.

Population Estimates and Counts

The adult males and females haul out in late May, and the mean pupping date occurs in late June. The number of births increased from 329 in 1975 to 417 in 1976, and the largest number of females ashore (495) in 1976 was counted on 14 July, (only 28 pups were born to this population in 1969). These counts do not reflect the actual number of females in the breeding population because (1) a large portion of parturient females were at sea and (2) new females continued to arrive on land as evidenced by the presence of algae on their pelage.

In addition to direct counts, an estimate was obtained of the number of females on the rookery from ratios of naturally marked females of high reliability to total daily counts.

Population studies conducted during the 1976 breeding season were divided into study periods one (21-23 August), two (26 - 29 August), and three (3-6 September). All daylight hours, which provided adequate visibility, were utilized during these three study periods, thus permitting the application of equal units of effort to each. The results of the study (Table 11) indicated a female population of fur seals in Adams Cove of approximately 1,200 individuals, an increase of 592 since 1971.

Natural growth of the Adams Cove colony is being partly and continuously supplemented by an influx of females from other colonies as indicated by the appearance on the island of individuals that had been tagged as pups on the Pribilof, Commander, and Robben Islands. Tagged males from these northern populations have not been observed here.

Table 10.--Summary of some observations of the northern fur seal colony in Adams Cove on San Miguel Island, California, 1969-76

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

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.

Table 11.--Female fur seal population estimates[1/] Adams Cove, 1976

Study Periods					
1		2		3	
Date	Number	Date	Number	Date	Number
21 August	1196	26 August	1431	3 September	1145
22 August	934	27 August	1209	4 September	1206
23 August	1466	28 August	1134	5 September	998
		29 August	1126	6 September	1386
	$\bar{x}$ = 1198		$\bar{x}$ = 1225		$\bar{x}$ = 1183

1/ Obtained from ratios of naturally marked females of high reliability to total daily counts.

Tagging Records

Records have been kept of each tagged seal observed ashore in Adams Cove since 1968, regardless of its origin (Tables A-16, A-17, and A-18). Some of these individuals had been given tags as pups on the Pribilof, Commander, and Robben Islands, and some were born to the Adams Cove population in 1968 and tagged there in that year. More recently, 99 fur seal pups were marked 10 September 1976 (Table A-19) using modified monel cattle ear tags described by the Marine Mammal Division (1976).

Mortality

In 1974 and 1975, pup mortality in the Adams Cove population was dispersed throughout the breeding season, but in 1976, over 50% of the pups that died here did so during two relatively short time periods. Possible causes of these deaths were abnormally hot weather and falling earth. For example, temperatures between 24 and 28 June reached 50°C for sand and 33°C for air. Adding to the problem were calm winds (no cooling effect) and excessive solar radiation which peaked at 1.25 cal/cm^2. The entire adult population moved to the splash zone during this period. The apparent inability of the pups at an early age to locate water or wet sand and cool themselves resulted in heat prostration and the untimely deaths of 41. A flood pond, normally present on the Adams Cove breeding ground during the first weeks after birth of the pups, may have prevented heat prostration of pups in the past by providing a means for losing heat. The absence of such a pond during the first few critical weeks following birth of the pups can combine with abnormally hot weather to become a mortality factor of some significance.

Falling earth is another cause of death among pups of the Adams Cove population. The pups frequently rest in areas at the base of ridges or cliffs, which provide shade from the sun and protection from strong northwest winds. These ridges and cliffs are composed of loose sand and top soil, and are therefore easily subjected to erosion and eventual sliding. The pups often cause earth slides in these areas when moving to and from them and when engaged in other activities such as playing among themselves or with vegetation dangling from above. Pup grooming behavior just prior to play or other movement is a third cause of soil erosion and eventual falling of earth from these ridges and cliffs, which range in height from 3 to 15 feet. Fewer pup deaths are caused by falling earth than by heat prostration, however, the former will continue to be lethal until the ridges are completely eroded. In 1976, 12 pups died under fallen earth 10-16 August.

Behavior

Several studies of the Adams Cove population were conducted

in order to assess activity levels around the clock and determine if fur seals are more active at night than during the day. General activity patterns of the males were monitored and the temporal frequency of copulations documented. Observations were made of territorial males during 261 nocturnal and 240 diurnal hours.[4/] Individuals were observed for from 24 to 198 hours each, and no more than four males were observed during any single period of research. Wide variability in time devoted to each male resulted from variations in visibility due to changes in the weather and from variations in distances of the animals from the blinds.

General Activity.--The general activity level of a male is defined as the number of times per hour he is upright as opposed to lying down. In practice, the rookery was surveyed and the number of upright males recorded every fifth minute, thus yielding a possible 12 postural scores per hour. These postures could be determined even under poor nighttime conditions, and since fur seals are normally active only when in an upright position, it was assumed that prone animals were socially inactive. The activity levels of all males were grouped and a percent upright group score for each hour within each 24-hour period was obtained (i.e., total number of males upright/total number of observations x 100) for each hourly period.

After 3:00 p.m., as ambient air and sand temperatures began to cool and solar radiation decreased, the activity of the males increased and reached a peak during the first hour of darkness (9:00 p.m.). During this hour, the males were upright 87% of the time. As temperatures began to stabilize, activity decreased, reaching a low between 1:00 and 2:00 a.m. The period between 1:00 and 2:00 a.m. was the only one during which activity fell below the 50% level. Activity increased after 2:00 a.m. and reached the second highest peak levels, first at 5:00 a.m. (61%) and again at 6:00 a.m. (67%). Ambient air temperatures during all nighttime hours were more stable than during daylight periods. Even during the hours of first light (5:00 - 6:00 a.m.) the air temperatures did not change more than 0.5°C from the evening low, which was usually reached by 9:00 p.m. After sunrise (approximately 6:00 a.m.) activity decreased markedly to an extreme low by 9:00 a.m., and remained below 50% as air temperatures and solar radiation increased until 6:00 p.m.

In addition to the data described above, the mean number of

4/ Diurnal observations -- binocular and variable power telescope
Nocturnal observations -- military-type starlight scope

times each male was observed in an upright posture was calculated for all nocturnal and diurnal hours. These data show that male activity was significantly greater at night than during the day (Table 12).

Vocalization.--Male vocalizations (wickers) recorded in 1974 and 1975 in order to determine their reliability as indicators of activity are presented here as part of the overall results of behavior research.

The vocalizations were automatically imprinted on tape using a cassette recorder housed in an observation blind. The microphone was adapted to a parabolic reflector to permit directional recording, and the directional receiver was mounted on a tripod so that it could be aimed at specific groups of fur seals.

The vocal activity of selected pods (n = 3) was recorded during 7 minutes of each hour during each 24-hour study 13-15 July in 1974 and from 30 June to 15 July in 1975[5/]. The mean hourly percentage of occurrence for each of the four types of vocalizations was calculated as follows:

(1) The number of times a specific type of vocalization occurred during an hourly 7-minute time sample was recorded, and is denoted by x_i, where i represents any one hourly time sample during a specific 24-hour period.

(2) The total number of each type of vocalization for each 24-hour period (5:00-4:00 a.m.) was used as a basis for calculating the relative frequency of occurrence for each hour of that 24-hour period as follows:

$$\frac{x_i}{\sum_{i=1} x_i} = f_{x_i}$$

(3) The mean percentage for each hour was calculated for all 24-hour periods by combining the total number of vocalizations of a specific type during all 24-hour study periods as follows:

$$\left(\frac{\sum_{j=1}^{n} f_{x_i}}{n} \right) 100 = \%_i$$

5/ Vocal activity in 1976 could not be recorded because the territorial males had shifted their location.

Table 12.--Overall male activity shown as the mean number of times males were observed upright per hour[1/], Adams Cove, 1976.

Male Identification Number	Mean Incidence of Upright Postures	
	Night	Day
Cl^2-75	8.8	6.6
Cl^3-75	5.2	1.7
Cl^4-75	6.6	5.9
Bro.-75	5.8	3.4
½moon-75	6.9	4.3
S.B.-75	5.8	3.6
Cl^1-75	5.2	7.0
R.F.-75	8.8	5.2
Cl^1-74	8.3	6.4
Cl^2-74	6.7	7.0
B.B.-74	5.3	4.6
Stud-74	5.3	5.6
Bro.-74	7.3	4.6
Ditto-74	6.0	5.1

1/ Wilcoxon test: $T=9$

$N=14$

$P \leq 0.01$

where j represents any 24-hour period and n is the total number of 24-hour periods.

These mean hourly percentages were then presented over a 24-hour period (Figure 9).

A strong correlation was shown (Kendall's Correlation Test, ts = 4.42, N = 24, $\bar{p} \leq 0.01$) between the 24-hour patterns of recorded male vocalizations and observed male activity.

Reproduction.--The copulation frequency of 13 different males was scored during 13 different 24-hour study periods. The temporal distribution of all copulations observed during the study periods is shown in Figure 10. The frequency pattern of copulations observed during the 24-hour period is similar to the results mentioned above (Figure 9).

Furthermore, significantly greater rates of copulations occurred at night than during the day (Wilcoxon Test, T = 1, N = 13, $\bar{p} \leq 0.01$) (Table 13).

Table 13.--Overall copulation frequency shown as the mean number of copulations observed per hour 1/, Adams Cove, 1976

Male Identification Number	Mean Number of Copulations	
	Night	Day
Cl^1-74	0.259	0.155
Cl^2-74	0.296	0.177
Cl^3-74	0.166	0.100
Bro.-74	0.074	0.040
Stud-74	0.166	0.100
Ditto-74	0.111	0.066
Cl (B.C.)-74	0.111	0.066
Cl^2-75	0.481	0.155
Bro.-75	0.259	0.133
Cl^4-75	0.222	0.244
½ moon-75	0.222	0.066
R.F.-75	0.666	0.200
Cl^1-75	0.111	0.000

1/ Wilcoxon Signed Rank Test T = 1; N = 13; $\bar{p} \leq 0.01$

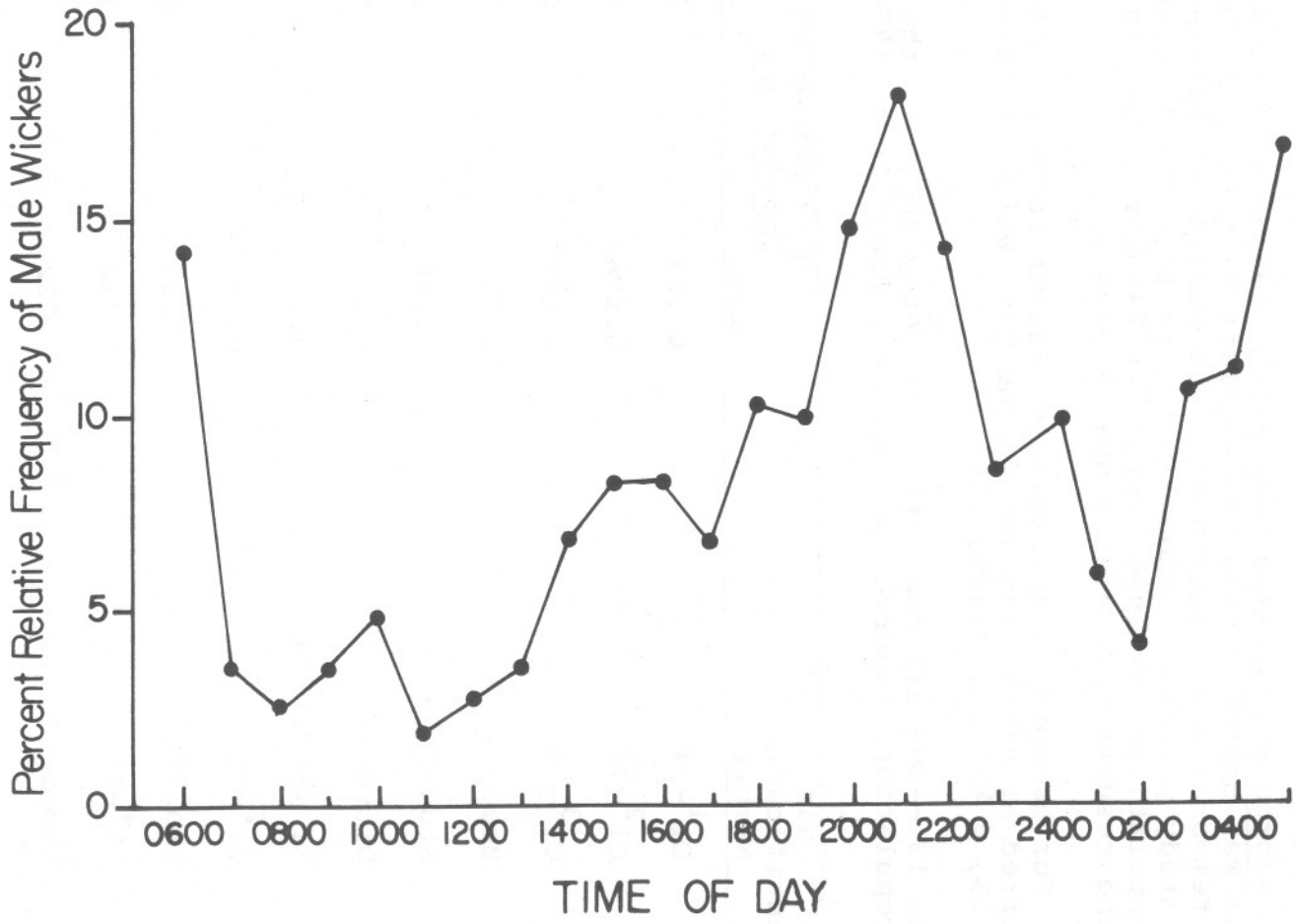

Figure 9.--The 24-hour distribution of auto-recorded male wickers.

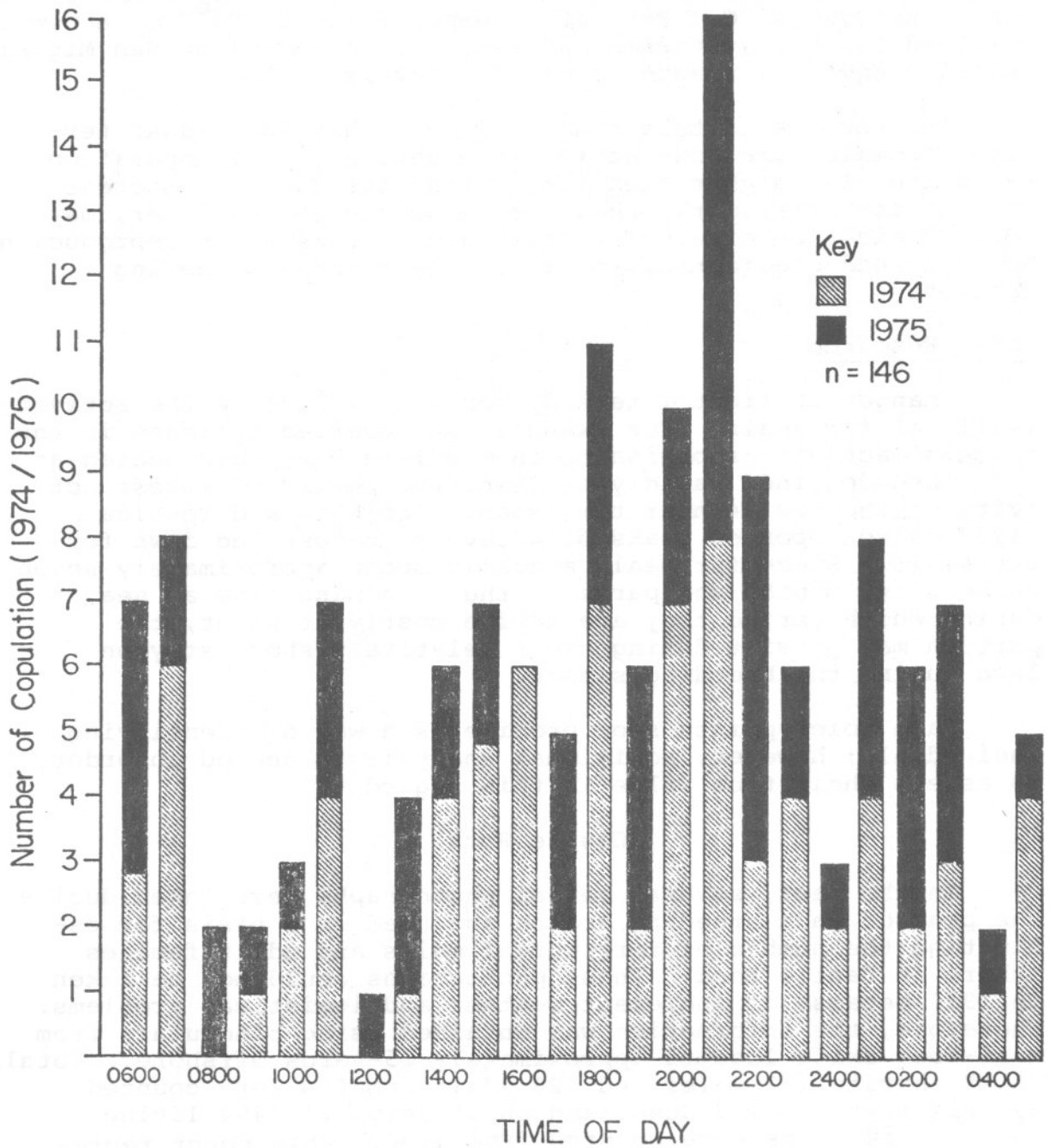

Figure 10.--The 24-hour distribution of all copulations observed during 24-hour study periods.

Since air temperatures on San Miguel Island are generally higher than those on the Pribilof Islands, one might expect that reproductive behavior of male fur seals on the former would be more stressful than on the latter. This hypothesis is supported by Bartholomew and Wilke (1956) who observed significant decreases in fur seal reproductive activity on the Pribilof Islands when skies cleared and ambient air temperatures exceeded 12°C. Prolonged temperatures of 12°C or above resulted in obvious thermal stress. Temperatures on San Miguel Island frequently reached stressful levels.

The results of this study indicate that individual territorial males are most active at night, and that copulation rates are also higher then than during the day. An increase in activity after dark, when air temperatures are lower, may be an indication of why fur seals are successful in reproducing on an island considerably south of their normal breeding grounds.

Other Research

Changes in light intensity may also influence the activity levels of fur seals. For example, an observed increase in the animals' activities beginning in the late afternoon peaked at dusk then declined rapidly at dawn, the period of lowest activity during the 24-hour time span. Ichihara and Yoshida (1972) also reported peaks of activity at dusk and dawn for fur seals. Since fur seals annually spend approximately seven consecutive months and parts of the remaining five at sea, during which period they are active mostly at night, the pattern may persist during their relatively short stay on land during the breeding season.

Male voice prints show promise as a way of identifying individuals; however, additional analysis is needed in order to assess their true value in this regard.

Castle Rock

In the past, several aerial photographs were taken during the peak of each breeding season and used as a basis for estimating the number of territorial males and adult females ashore on Castle Rock. These photographs could not be taken in 1976 because of inclement weather and logistical problems. Therefore, the information was obtained using binoculars from a 14-foot skiff located approximately 25-yards offshore. Totals of 18 territorial males and 526 adult females were counted by this method on 27 June, and on 25 July 521 (494 living and 27 dead) pups were counted from afoot. This count represents an increase of more than 400 pups born here since

discovery of the colony in 1972. An estimate of 95 pups was obtained that year.

On 9 September, a tag of the type used for pups in Adams Cove in 1976 was attached to the front flipper of each of 100 fur seal pups on Castle Rock and the cartilaginous tip of the fourth right hindflipper digit removed as a checkmark for identifying the animal should it lose its tag.

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Part V. PELAGIC ECOSYSTEMS

At the 18th meeting of the North Pacific Fur Seal Commission, the United States and Canada agreed to a joint analysis of all fur seal data collected from 1958 to 1974 on distribution, age composition, feeding habits, reproduction, migrations, abundance, and growth and mortality. These data have now been prepared for use in computer systems, and scientists from the two countries have agreed on specific analyses and reporting assignments, which they tentatively expect to complete by March of 1978.

To facilitate that part of the analyses dealing with distribution, the U.S. and Canadian sighting and collection effort data were combined by month into areal blocks of 1° of latitude by 1° of longitude and by 10' of latitude by 10' of longitude. The data on feeding habits are also being analyzed by these areal blocks, which will incorporate consumption rates of prey species by age and sex of fur seals. The analysis of migrations and distribution data with regard to segregation of females at sea by age and reproductive condition by time and area is in progress. The results of these analyses are expected to improve our understanding of fur seal-fish interactions throughout the collection area.

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ACKNOWLEDGEMENTS

Research on the Pribilof Islands in 1976 was completed with the cooperation of the staff of the Pribilof Islands Program: Walter Kirkness, Director; Alan Groves and Richard W. Hajny, Resource Management Specialists. Others who cooperated on St. Paul Island were John Melovidov, Village Foreman; Michael Zacharof, Sealer Foreman; and Lee Paola, Superintendent, Oregon-Alaska Marine Products. On St. George Island, fur seal investigations were completed with the cooperation of Harold A. Thayer, Facilities Management Officer, and Nicolai S. Merculief, Village Foreman. We also wish to thank students Stewart W. Keyes and Douglas Wooliver for assistance in collecting physiological and medical data.

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 Pribilof 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, on 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.

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 cartilagenous tip of a digit from a hind flipper, by attaching an inscribed metal tag to one or more of it flippers, by freeze branding, 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 6 days and the procedure is repeated throughout the kill of males.

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Table A-1.--Age classification of male seals killed on St. Paul Island, 28 June to 31 July 1976. A dash indicates missing data

Date	Rookery[1]	Males killed	Tooth sample	DAILY: Percent in each age class of sample 2	3	4	5	6	DAILY: Estimated number killed from each age class 2	3	4	5	6	Total kill to date	CUMULATIVE: Estimated number killed from each age class 2	3	4	5	6	CUMULATIVE: Percent killed from each age class 2	3	4	5	6
June																								
28	NEP(west)	191	40	0	35.0	60.0	5.0	0	0	67	115	9	0	191	0	67	115	9	0	0	35	60	5	0
28	NEP(east)	418	69	0	29.0	59.4	11.6	0	0	121	248	49	0	609	0	188	363	58	0	0	31	60	9	0
29	POL	324	61	3.3	18.0	65.6	13.1	0	11	58	213	42	0	933	11	246	576	100	0	1	26	62	11	0
30	TZR	537	111	1.8	27.0	58.6	11.7	0.9	10	145	314	63	5	1,470	21	391	890	163	5	1	27	61	11	0
July																								
1	ZAP	659	124	0.8	28.2	63.7	7.3	0	5	186	420	48	0	2,129	26	577	1,310	211	5	1	27	62	10	0
2	REEF	485	70	0	49.0	50.0	1.0	0	0	238	243	4	0	2,614	26	815	1,553	215	5	1	31	60	8	0
3	L-K	203	34	0	50.0	44.1	5.9	0	0	102	90	11	0	2,817	26	917	1,643	226	5	1	33	58	8	0
6	NEP(west)	410	82	0	63.4	34.2	2.4	0	0	260	140	10	0	3,227	26	1,177	1,783	236	5	1	37	55	7	0
6	NEP(east)	439	66	4.5	47.0	47.0	1.5	0	20	206	206	7	0	3,666	46	1,383	1,989	243	5	1	38	54	7	0
6	POL	487	104	0	40.4	55.8	3.8	0	0	197	271	19	0	4,153	46	1,580	2,260	262	5	1	38	55	6	0
7	TZR	1,165	171	0.6	54.4	42.7	2.3	0	7	634	497	27	0	5,318	53	2,214	2,757	289	5	1	42	52	5	0
8	ZAP	529	84	2.4	60.7	36.9	0	0	13	321	195	0	0	5,847	66	2,535	2,952	289	5	1	43	51	5	0
9	REEF	804	160	1.3	41.2	55.0	2.5	0	11	331	442	20	0	6,651	77	2,866	3,394	309	5	1	43	51	5	0
10	L-K	302	54	1.9	61.1	33.3	3.7	0	6	184	101	11	0	6,953	83	3,050	3,495	320	5	1	44	50	5	0
12	NEP(west)	610	73	5.5	58.9	31.5	4.1	0	34	359	192	25	0	7,563	117	3,409	3,687	345	5	1	45	49	5	0
12	NEP(east)	339	57	5.3	66.7	26.3	1.7	0	18	226	89	6	0	7,902	135	3,635	3,776	351	5	2	46	48	4	0
13	POL	442	83	2.4	55.4	38.6	3.6	0	11	245	170	16	0	8,344	146	3,880	3,946	367	5	2	47	47	4	0
14	TZR	1,192	193	2.6	67.4	26.9	3.1	0	31	803	321	37	0	9,536	177	4,683	4,267	404	5	2	49	45	4	0
15	ZAP	684	87	2.3	66.7	28.7	2.3	0	16	456	196	16	0	10,220	193	5,139	4,463	420	5	2	50	44	4	0
16	REEF	918	152	4.6	59.9	33.5	2.0	0	42	550	308	18	0	11,138	235	5,689	4,771	438	5	2	51	43	4	0
17	L-K	331	57	0	64.9	28.1	7.0	0	0	215	93	23	0	11,469	235	5,904	4,864	461	5	2	52	42	4	0
19	NEP(west)	818	65	7.7	67.7	24.6	0	0	63	554	201	0	0	12,287	298	6,458	5,065	461	5	2	53	41	4	0
19	NEP(east)	282	89	7.9	73.0	18.0	1.1	0	22	206	51	3	0	12,569	320	6,664	5,116	464	5	2	53	41	4	0
20	POL	462	93	3.2	63.5	30.1	3.2	0	15	293	139	15	0	13,031	335	6,957	5,255	479	5	3	53	40	4	0
21	TZR	896	144	1.4	75.0	23.6	0	0	13	672	211	0	0	13,927	348	7,629	5,466	479	5	3	55	39	3	0
22	ZAP	1,171	107	2.8	52.4	38.3	5.6	0.9	33	614	448	66	10	15,098	381	8,243	5,914	545	15	2	55	39	4	0
23	REEF	1,289	223	2.7	61.4	32.3	3.6	0	35	792	416	46	0	16,387	416	9,035	6,330	591	15	2	55	39	4	0
24	L-K	185	30	10.0	53.3	36.7	0	0	19	98	68	0	0	16,572	435	9,133	6,398	591	15	3	55	39	3	0
26	NEP(west)	769	128	6.2	71.9	21.9	0	0	48	553	168	0	0	17,341	483	9,686	6,566	591	15	3	56	38	3	0
26	NEP(east)	880	148	4.7	71.0	23.0	1.3	0	41	625	202	12	0	18,221	524	10,311	6,768	603	15	3	57	37	3	0
27	POL	511	58	3.4	46.6	44.8	5.2	0	17	238	229	27	0	18,732	541	10,549	6,997	630	15	3	56	37	4	0
28	TZR[2]	1,864	-	7.3	66.6	24.1	1.9	0.1	136	1,242	449	35	2	20,596	677	11,791	7,446	665	17	4	57	36	3	0
29	ZAP[2]	690	-	8.0	66.3	23.8	1.8	0.1	55	458	164	12	1	21,286	732	12,249	7,610	677	18	3	58	36	3	0
30	REEF[2]	1,229	-	8.2	65.2	24.1	2.4	0.1	101	801	296	30	1	22,515	833	13,050	7,906	707	19	4	58	35	3	0
31	L-K[2]	566	-	10.5	61.3	25.5	2.7	0	60	347	144	15	0	23,081	893	13,397	8,050	722	19	4	58	35	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.

2/ $P = (\frac{X}{Y})\ 100$; where P = percent in each age class of sample;
X = sum of males killed from each age class on this rookery on the same or nearest adjoining date during 1966-75;
Y = sum of males killed from all age classes on this rookery on the same or nearest adjoining date during 1966-75.

Table A-2.--Age classification of male seals killed, subsistence harvest, North Rookery, St. George Island, 29 June to 27 July 1976

Date	Males killed	Tooth sample	Percent in each age class of sample				Estimated number killed from each age class			
			2	3	4	5	2	3	4	5
June										
29	40	40	0	17.5	65.0	17.5	0	7	26	7
July										
6	40	40	0	45.0	50.0	5.0	0	18	20	2
13	40	39	2.6	53.8	41.0	2.6	1	22	16	1
20	40	40	7.5	62.5	30.0	0	3	25	12	0
27	40	40	4.9	65.8	29.3	0	2	26	12	0
Season total	200						6	98	86	10

Table A-3.--Adult male seals counted, by class[1] and rookery section, St. Paul Island, 23-28 June 1976. 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	32	37	-	-	-	-	-	-	-	-	-	-	-	-	69
3	23	22	-	-	-	-	-	-	-	-	-	-	-	-	45
5	50	0	-	-	-	-	-	-	-	-	-	-	-	-	50
Kitovi[2]															
2	29(9)	9	41	57	29	-	-	-	-	-	-	-	-	-	174
3	14(11)	7	19	19	17	-	-	-	-	-	-	-	-	-	87
5	1(4)	2	0	6	55	-	-	-	-	-	-	-	-	-	68
Reef															
2	52	59	51	30	40	37	68	27	50	28	12	-	-	-	454
3	17	34	29	16	27	32	9	34	21	20	12	-	-	-	251
5	5	0	16	0	407	0	1	32	0	8	19	-	-	-	488
Gorbatch															
2	63	46	36	13	21	49	-	-	-	-	-	-	-	-	228
3	39	38	26	6	17	18	-	-	-	-	-	-	-	-	144
5	61	0	5	200	3	3	-	-	-	-	-	-	-	-	272
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28
Morjovi[3]															
2	40(25)	27	35	50	47	44	-	-	-	-	-	-	-	-	268
3	32(12)	30	30	34	38	29	-	-	-	-	-	-	-	-	205
5	143(37)	8	36	0	0	0	-	-	-	-	-	-	-	-	224
Vostochni															
2	31	23	25	19	12	69	45	48	39	27	24	31	58	25	476
3	27	26	26	22	20	39	30	54	41	20	23	38	73	40	479
5	195	0	0	42	126	0	10	3	0	0	3	80	60	103	622

See footnotes at end of table.

Table A-3.--Adult male seals counted, by class[1] and rookery section, St. Paul Island, 23-28 June 1976--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	36	36	-	-	-	-	-	-	-	-	-	-	-	-	72
3	17	17	-	-	-	-	-	-	-	-	-	-	-	-	34
5	17	110	-	-	-	-	-	-	-	-	-	-	-	-	127
Polovina															
2	35	20	-	-	-	-	-	-	-	-	-	-	-	-	55
3	27	13	-	-	-	-	-	-	-	-	-	-	-	-	40
5	166	23	-	-	-	-	-	-	-	-	-	-	-	-	189
Polovina Cliffs															
2	22	35	30	24	44	48	88	-	-	-	-	-	-	-	291
3	15	13	13	25	27	22	44	-	-	-	-	-	-	-	159
5	2	0	2	0	8	73	15	-	-	-	-	-	-	-	100
Tolstoi															
2	37	27	42	25	75	63	51	67	-	-	-	-	-	-	387
3	30	19	30	21	44	55	40	23	-	-	-	-	-	-	262
5	1	0	0	0	0	0	0	326	-	-	-	-	-	-	327
Zapadni Reef															
2	85	32	-	-	-	-	-	-	-	-	-	-	-	-	117
3	29	14	-	-	-	-	-	-	-	-	-	-	-	-	43
5	20	64	-	-	-	-	-	-	-	-	-	-	-	-	84
Little Zapadni															
2	15	31	42	49	49	37	-	-	-	-	-	-	-	-	223
3	14	26	37	38	38	18	-	-	-	-	-	-	-	-	171
5	4	0	4	0	1	72	-	-	-	-	-	-	-	-	81
Zapadni[4]															
2	40(0)	78	79	90	76	54	51	18	-	-	-	-	-	-	486
3	16(0)	41	44	34	22	29	21	5	-	-	-	-	-	-	212
5	0(91)	0	3	5	13	0	0	400	-	-	-	-	-	-	512

See footnotes at end of table.

Table A-3.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 23-28 June 1976--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-4.--Adult male seals counted, by rookery, Pribilof Islands, Alaska, June and July 1976. A dash indicates missing data.

Island and rookery	Date	Class of adult male[1/] 2	3	5	Total
		Number			
St. Paul Island	June				
Lukanin	23	69	45	50	164
Kitovi	23	174	87	68	329
Reef	24	454	251	488	1,193
Gorbatch	24	228	144	272	644
Ardiguen	24	30	39	28	97
Morjovi	28	268	205	224	697
Vostochni	25	476	479	622	1,577
Little Polovina	24	72	34	127	233
Polovina	24	55	40	189	284
Polovina Cliffs	25	291	159	100	550
Tolstoi	24	387	262	327	976
Zapadni Reef	23	117	43	84	244
Little Zapadni	23	223	171	81	475
Zapadni	23	486	212	512	1,210
Total		3,330	2,171	3,172	8,673
Sea Lion Rock[2/]	July				
Sivutch	1	-	-	-	375
St. George Island	June				
Zapadni	26	51	50	36	137
South	26	78	82	60	220
North	27	137	189	68	394
East Reef	27	27	39	29	95
East Cliffs	27	48	100	99	247
Staraya Artil	26	39	52	30	121
Total		380	512	322	1,214

1/ See Table A-3 or glossary for a description of the classes of adult male seals.

2/ Adult males were not separated by class.

Table A- 5.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 9-14 July 1976. 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	2	5	-	-	-	-	-	-	-	-	-	-	-	-	7
3	57	67	-	-	-	-	-	-	-	-	-	-	-	-	124
5	17	2	-	-	-	-	-	-	-	-	-	-	-	-	19
Kitovi[2/]															
2	4(6)	3	7	8	12	-	-	-	-	-	-	-	-	-	40
3	55(25)	21	60	75	55	-	-	-	-	-	-	-	-	-	291
5	2(0)	0	0	2	22	-	-	-	-	-	-	-	-	-	26
Reef															
2	9	14	21	11	12	21	12	13	16	6	5	-	-	-	140
3	67	74	88	40	68	50	64	55	53	48	28	-	-	-	635
5	3	10	15	0	171	0	18	52	8	10	31	-	-	-	318
Gorbatch															
2	12	18	11	2	9	20	-	-	-	-	-	-	-	-	72
3	110	75	48	21	41	65	-	-	-	-	-	-	-	-	360
5	77	1	0	122	0	4	-	-	-	-	-	-	-	-	204
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
Morjovi[3/]															
2	15(12)	18	17	19	11	8	-	-	-	-	-	-	-	-	100
3	55(39)	59	53	80	77	71	-	-	-	-	-	-	-	-	434
5	139(26)	7	40	0	0	0	-	-	-	-	-	-	-	-	212
Vostochni															
2	8	3	5	2	1	27	13	12	9	9	8	3	19	6	125
3	60	42	50	38	39	95	71	86	75	45	54	68	128	54	905
5	200	1	0	79	114	0	19	2	0	0	0	88	38	56	597

See footnotes at end of table.

Table A-5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 9-14 July 1976--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	12	8	-	-	-	-	-	-	-	-	-	-	-	-	20
3	43	58	-	-	-	-	-	-	-	-	-	-	-	-	101
5	6	148	-	-	-	-	-	-	-	-	-	-	-	-	154
Polovina															
2	12	7	-	-	-	-	-	-	-	-	-	-	-	-	19
3	70	38	-	-	-	-	-	-	-	-	-	-	-	-	108
5	237	4	-	-	-	-	-	-	-	-	-	-	-	-	241
Polovina Cliffs															
2	11	10	14	7	14	9	22	-	-	-	-	-	-	-	87
3	51	48	68	65	86	75	54	-	-	-	-	-	-	-	447
5	1	5	0	0	0	91	17	-	-	-	-	-	-	-	114
Tolstoi															
2	10	9	8	9	18	23	19	31	-	-	-	-	-	-	127
3	70	59	88	53	132	108	93	81	-	-	-	-	-	-	684
5	0	0	5	0	6	0	0	117	-	-	-	-	-	-	128
Zapadni Reef															
2	34	13	-	-	-	-	-	-	-	-	-	-	-	-	47
3	94	42	-	-	-	-	-	-	-	-	-	-	-	-	136
5	32	69	-	-	-	-	-	-	-	-	-	-	-	-	101
Little Zapadni															
2	9	10	26	24	11	16	-	-	-	-	-	-	-	-	96
3	24	66	82	73	79	61	-	-	-	-	-	-	-	-	385
5	3	1	12	14	20	125	-	-	-	-	-	-	-	-	175
Zapadni[4/]															
2	7(0)	28	20	58	55	35	24	8	-	-	-	-	-	-	235
3	57(0)	98	128	115	84	79	70	21	-	-	-	-	-	-	652
5	15(235)	12	7	8	7	1	10	309	-	-	-	-	-	-	604

See footnotes at end of table.

Table A-5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 9-14 July 1976--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-3 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-6.--Adult male seals counted, by rookery, Pribilof Islands, Alaska, July 1976

Island and rookery	Date	Class of adult male 1/ 2	3	5	Total
		Number			
St. Paul Island	July				
Lukanin	12	7	124	19	150
Kitovi	12	40	291	26	357
Reef	10	140	635	318	1,093
Gorbatch	10	72	360	204	636
Ardiguen	10	14	62	19	95
Morjovi	13	100	434	212	746
Vostochni	13	125	905	597	1,627
Little Polovina	14	20	101	154	275
Polovina	14	19	108	241	368
Polovina Cliffs	14	87	447	114	648
Tolstoi	12	127	684	128	939
Zapadni Reef	9	47	136	101	284
Little Zapadni	9	96	385	175	656
Zapadni	9	235	652	604	1,491
Total		1,129	5,324	2,912	9,365
St. George Island					
Zapadni	11	29	144	202	375
South	11	25	173	105	303
North	11	84	416	174	674
East Reef	14	23	66	27	116
East Cliffs	14	49	172	156	377
Staraya Artil	11	47	122	75	244
Total		257	1,093	739	2,089
Total both islands		1,386	6,417	3,651	11,454

1/ See Table A-3 or glossary for a description of the classes of adult male seals.

Table A-7.--Adult male seals counted, by class, [1/] rookery, and year, St. Paul Island, June 1966-76

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

1/ See footnote at end of table.

Table A-7 . --Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-76 --Continued

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

1/ See footnote at end of table.

Table A-7.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-76--Continued

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

1/ See Table A-3 or glossary for a description of the classes of adult male seals.

Table A-8.--Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1967-76

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	----Number------		-----Number----		----Number-----	
1967	1/ 7,230	1/ 4,439	1,646	1,268	8,876	5,707
1968	1/ 6,176	1/ 3,100	1,748	1,283	7,924	4,383
1969	2/ 5,928	2/ 2,535	1,457	677	7,385	3,212
1970	4,945	1,666	1,466	803	6,411	2,469
1971	3/ 4,200	3/ 1,900	1,235	534	5,435	2,434
1972 4/	3,738	2,384	1,153	328	4,891	2,712
1973	5/ 4,906	5/ 2,550	875	375	5,781	2,925
1974	6/ 4,563	6/ 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

1/ Harem and idle males on St. Paul Island were counted on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries in 1967, and on Reef, Zapadni Reef, Vostochni, and Morjovi Rookeries in 1968, then extrapolated to produce counts representing all the rookeries.

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

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

4/ 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 count on St. George Island in 1971.

5/ Estimates of the total number of harem and idle males on St. Paul Island were extrapolated from counts on Zapadni, Little Zapadni, Zapadni Reef, and Tolstoi Rookeries in June and July of 1973 and on all rookeries of St. Paul Island in June 1973.

6/ The total number of harem and idle males on St. Paul Island were estimated from counts on Reef, Gorbatch, and Ardiguen Rookeries in June and July of 1974 and on all rookeries of St. Paul Island in June 1974.

Table A-9.--Dead seal pups counted, by rookery section, Pribilof Islands, Alaska, 19-26 August 1976.

Island and rookery	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
St. Paul Island															
Morjovi	1/518	220	232	343	281	235	-	-	-	-	-	-	-	-	1,829
Vostochni	158	90	160	145	132	1,017	395	280	240	53	142	194	574	246	3,826
Little Polovina	209	107	-	-	-	-	-	-	-	-	-	-	-	-	316
Polovina Cliffs	176	171	216	221	287	232	559	-	-	-	-	-	-	-	1,862
Polovina	253	125	-	-	-	-	-	-	-	-	-	-	-	-	378
Ardiguen 2/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	212
Gorbatch	453	364	245	29	141	109	-	-	-	-	-	-	-	-	1,341
Reef	157	284	270	169	249	157	320	127	142	121	59	-	-	-	2,055
Kitovi	3/190	52	215	219	170	-	-	-	-	-	-	-	-	-	846
Lukanin	179	206	-	-	-	-	-	-	-	-	-	-	-	-	385
Tolstoi	228	223	383	225	598	770	897	917	-	-	-	-	-	-	4,241
Little Zapadni	75	271	413	553	383	282	-	-	-	-	-	-	-	-	1,977
Zapadni Reef	189	449	-	-	-	-	-	-	-	-	-	-	-	-	638
Zapadni	274	517	675	1,024	504	309	344	123	-	-	-	-	-	-	3,770
Total															23,676
St. George Island 4/															
North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	791
Zapadni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	373
South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280
East Reef 5/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
East Cliffs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	354
Staraya Artil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	454
Total															2,289
Grand total															25,965

1/ Includes 145 dead pups counted on point south of Sea Lion Neck.
2/ No numbered sections.
3/ Includes 32 dead pups counted in Kitovi Amphitheater.
4/ Dead pups were not counted by rookery section.
5/ Dead pups were counted 21 September.

Table A-10.--Dead seal pups counted,[1] by rookery, Pribilof Islands, Alaska, 1967-76

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

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-11.--Seals marked as pups and recovered at ages 2-6 years, St. Paul Island, 28 June to 31 July 1976.

Hind flipper mark[1/]	Age Years	Total Number	Island of marking
RH3	2	37	St. Paul
RH2	3	671	St. Paul
LH2	3	55	St. George
RH1	4	581	St. Paul
LH1	4	44	St. George
RH3	5	18	St. George
LH3	5	17	St. Paul
RH2	6	10	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 hind flipper; 1, 2, 3 refer to the 1st, 2nd, or 3rd digit, respectively.

Table A-12.--Soviet tags recovered in the United States harvest of male fur seals, St. Paul Island, 28 June to 31 July 1976.

Date	Tag number	Age Years	Sex	Island of tagging	Rookery of recovery
3 July	KB4579	3	M	Bering	Lukanin-Kitovi
17 July	HB1182	4	M	Bering	Lukanin-Kitovi
28 June	HB3115	4	M	Bering	Northeast Point

Table A-13. --Seal pups tagged and marked, Pribilof Islands, Alaska, 1966-75

Year	Series	St. Paul Island	St. George Island	Location of tag	Checkmarks or marks
		-----Number---------			
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-14.--Seal pups marked by freeze marking, St. Paul Island, 1966-76

Year	Rookery	Marks or symbols used	Seals effectively marked	Location of marks
			----Number----	
1966	Zapadni Reef	S or ∽ [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-15.--Primary diagnoses for causes of death among 242 seal pups, by 7-day periods, St. Paul Island, 29 June to 15 August 1976

Cause of death	June 29-July 4	July 5-11	July 12-18	July 19-25	July 26-Aug. 1	Aug. 2-8	Aug. 9-15	Total
Emaciation syndrome	1	2	11	22	9	12	9	66
Hookworm	0	0	18	28	27	9	12	94
Infection (microbial)	0	2	4	3	1	1	1	12
Leptospirosis (perinatal complex)	0	0	2	1	2	1	0	6
Trauma	0	2	0	0	1	0	0	3
Miscellaneous	2	2	7	2	1	0	0	14
Undetermined	2	0	5	4	3	0	1	15
Total	5	8	47	60	44	23	23	210
Unsuitable for examination	1	7	8	5	4	7	0	32
Total	6	15	55	65	48	30	23	242

Table A-16.--Northern fur seals tagged as pups on the Pribilof Islands (St. Paul and St. George), Commander Islands (Bering and Medney), and Robben Island, and dates first observed on San Miguel Island, California, 1968-76

Tag number	1968	1969	1970	1971	1972	1973	1974	1975	1976	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	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	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.	---	---	---	---	---	---	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.	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	---	---	---	F	St. Paul	1967
Y-7104	---	---	---	---	30 Aug.	13 July	10 June	3 July	11 July	F	Robben	1966
BB-1364	---	---	---	---	7 Sept.	---	9 Aug.	---	---	F	Bering	1969
AM-8302	---	---	---	---	---	---	14 Aug.	28 July	18 July	F	Medny	1968
U-697	---	---	---	---	---	---	5 July	---	---	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[4]	---	---	---	---	---	---	---	14 Aug.	21 July	F	---	---
I-3698?[5]	---	---	---	---	---	---	---	---	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/ A double-tagged female. TINRO was read but the numbers could not be seen with the scope.
5/ Last number on tag unreadable.

Table A-17.--Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-76

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
UC-3924	L	15 Aug.	31 July	9 July	18 Aug.	3 Aug.	---	---	---
-3927	R	31 July	23 July	9 July	26 July	21 July	---	---	30 July
-3932	R	16 Aug.	29 July	2 July	---	---	27 July	8 Aug.	10 July
-3933	L	17 Aug.	12 Aug.	2 July	13 July	---	---	---	20 July
-3936	L	---	---	10 Aug.	---	---	28 July	---	---
-3937	R	---	---	24 July	31 July	22 July	19 Aug.	---	10 July
-3938	L	16 Aug.	10 Aug.	8 June	26 Aug.	---	---	---	---
-3939	R	31 July	17 Aug.	2 July	29 June	---	---	---	---
-3940	L	31 July	29 July	---	---	---	---	---	---
-3941	R	31 July	14 Aug.	---	---	---	---	---	---
-3942	R	31 July	17 July	22 July	1 Sept.	---	---	20 Aug.	25 Aug.
-3943	L	31 July	20 July	22 July	14 July	---	---	---	29 July
-3944	R	15 Aug.	17 July	2 July	---	18 July	---	31 Aug.	5 Aug.
-3945	L	14 Aug.	20 July	14 June	27 June	---	15 July	9 July	14 July
-3951	L	---	21 July	22 July	12 July	---	---	---	---
Missing	R								
UC-3955	R	25 July	31 July	2 July	15 July	---	---	---	---
-3956	L	---	4 Aug.	2 July	---	---	---	---	---
-3957[1/]	R	7 Aug.	---	---	---	---	---	---	---
-3959	R	25 July	---	---	---	---	---	---	---
-3961	R	12 Sept.	---	---	---	---	---	---	---
-3964	L	15 Aug.	2 Aug.	21 July	12 July	1 Aug.	---	---	---
-3965	R	12 Aug.	24 Aug.	26 July	10 Aug.	---	---	---	---
-3968	R	---	18 July	6 July	---	---	---	---	---
-3971	L	---	21 July	7 July	---	---	---	---	---
-3972	L	1 Oct.	16 Aug.	22 July	---	---	---	---	---
-3973	R	31 July	1 Sept.	30 July	5 Aug.	---	---	---	---
-3974	L	---	---	---	---	---	15 July	8 Aug.	---
-3975	R	---	---	---	---	5 Aug.	---	---	4 Aug.
-3976	R	2 Sept.	---	---	---	---	---	11 Aug.	---
-3977	L	31 July	---	---	---	---	---	---	---
-3978	L	---	22 July	---	---	---	---	---	---
-3981	R	1 Aug.	9 July	5 July	11 July	---	---	---	---
-3982	L	31 July	31 July	7 July	27 July	4 Aug.	---	---	---

1/ See footnote at end of table.

Table A-17.--Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-76--Continued.

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
UC-3980	R	---	31 July	10 July	30 Aug.	---	15 July	---	24 July
-3984	L	---	20 Aug.	9 July	---	---	---	---	18 July
-3985	L	31 July	---	23 July	---	---	---	---	---
-3986	R	17 Aug.	---	17 July	---	---	---	---	---
-3987	L	---	---	6 July	14 July	2 Aug.	---	---	---
-3988	R	---	10 Aug.	10 July	---	---	---	---	---
-3989	L	16 Aug.	9 July	5 July	27 July	11 June	10 Aug.	7 Aug.	
-3990	R	10 Aug.	8 July	9 July	27 June	11 July	7 Sept.	---	---
-3991	R	7 Aug.	20 July	28 July	---	---	---	---	---
-3992	L	---	20 July	27 July	12 July	4 Aug.	---	28 July	---
-3993	R	16 Aug.	11 Sept.	4 July	---	---	---	21 Aug.	10 July
-3994	L	---	17 Aug.	4 July	---	---	27 July	17 July	6 Sept.
-3995	L	---	16 Aug.	---	11 Aug.	---	11 Aug.	17 July	---
-3996	R	---	21 July	---	13 Aug.	---	28 July	---	---
-3997	L	---	---	24 July	---	---	---	26 July	6 Sept.
-3998	R	---	---	21 July	---	4 July	---	10 July	---
-3999	R	---	---	15 Aug.	---	---	13 Aug.	---	---
-4000	L	---	---	3 Aug.	---	---	17 Aug.	---	---
-3793	R	---	21 July	24 July	23 July	31 July	---	---	---
-3789	R	---	---	13 July	11 July	---	---	---	---
-3963	R	---	---	---	---	---	---	---	2 Aug.
-3934	L	---	---	---	---	---	---	---	29 Aug.

1/ Left flipper injured, not tagged.

Table A-18.--Adult female northern fur seals tagged at Adams Cove, San Miguel Island, on 9 October 1975 and the dates first observed in 1976

Tag number	Date observed 1976
SMI 201	23 Aug.
202	
211	12 Aug.
212	
215	17 July
216	
217	12 July
218	
219	11 July
220	
226	11 July
227	
228	25 Aug.
229	
236	22 Aug.
237	
238	2 Aug.
239	
244	12 July
245	
248	11 July
249	
252	19 July
253	
262	10 July
263	
264	10 July
265	
266	26 July
267	

Table A-18.--Adult female northern fur seals tagged at Adams Cove, San Miguel Island, on 9 October 1975 and the dates first observed in 1976--Continued.

Tag number	Date observed 1976
SMI 268	29 July
269	
270	29 July
271	
272	23 July
273	
274	5 Sept.
275	
276	21 Aug.
278	
279	5 Aug.
280	
281	23 July
282	
283	24 July
284	
285	25 Aug.
286	
294	10 Aug.
295	22 July
296	
297	29 Aug.
298	
299	8 Aug.
300	
301	21 Aug.
302	

Table A-19. Northern fur seal pups tagged at Adams Cove, San Miguel Island, 10 September, 1976.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 306	TAG DESTROYED				
307	TAG DESTROYED				
308		F	9.0	RH-D-4	
309		F	10.5	"	
310	TAG DESTROYED				
311		M	9.0	RH-D-4	
312		F	8.5	"	
313		F	11.5	"	
314		F	8.0	"	
315		F	7.0	"	
316		M	8.0	"	
317		M	6.0	"	
318		M	6.0	"	
319		M	9.5	"	
320		M	9.0	"	
321		M	7.0	"	
322		F	6.5	"	
323	TAG DESTROYED				
324		F	8.0	RH-D-4	
325		Unknown	9.0	"	
326		F	10.5	"	
327		M	7.5	"	
328		F	9.0	"	
329	TAG DESTROYED				
330		M	7.0	RH-D-4	
331		M	7.0	"	
332		F	7.0	"	
333		F	9.5	"	
334		F	Unknown	"	

Table A-19. Northern fur seal pups tagged at Adams Cove, San Miguel Island, 10 September, 1976, continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 335		F	6.0	RH-D-4	
336		F	8.5	"	
337		M	7.5	"	
338		M	7.5	"	
339		M	9.5	"	
340		M	7.5	"	
341	TAG DESTROYED				
342		F	9.0	"	
343		M	8.5	"	
344		F	9.5	"	
345		M	9.0	"	
346		F	11.5	"	
347	TAG DESTROYED				
348		F	8.0	RH-D-4	
349		F	4.5	"	
350		F	7.5	"	
351		M	9.5	"	
352		M	9.5	"	
353		F	8.5	"	
354		F	6.5	"	
355		F	7.0	"	
356		F	6.5	"	
357		F	6.5	"	
358		F	9.5	"	
359		M	8.0	"	
360		M	9.5	"	
361		F	11.0	"	
362		F	10.5	"	
363		F	8.0	"	
364		F	7.0	"	

Table A-19. Northern fur seal pups tagged at Adams Cove, San Miguel Island, 10 September, 1976, continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 365		F	6.0	RH-D-4	
366		M	9.0	"	
367		M	9.0	"	
368		F	5.5	"	
369		F	7.5	"	
370		F	6.5	"	
371		F	6.0	"	
372		F	7.0	"	
373		F	8.5	"	
374		F	9.0	"	
375		F	7.5	"	
376		F	7.5	"	
377		M	7.5	"	
378		F	8.5	"	
379		F	5.0	"	
380		F	9.0	"	
381	TAG DESTROYED				
382		F	8.5	RH-D-4	
383		M	7.0	"	
384		M	9.0	"	
385		M	7.0	"	
386		M	9.5	"	
387		M	10.5	"	
388		M	8.5	"	
389		M	6.5	"	
390		F	7.5	"	
391		F	7.0	"	
392		F	8.0	"	
393	TAG DESTROYED				
394		M	10.0	RH-D-4	

Table A-19. Northern fur seal pups tagged at Adams Cove, San Miguel Island, 10 September, 1976, continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 395		M	7.5	RD-H-4	
396		M	9.0	"	
397		M	6.5	"	
398		F	9.5	"	
399		F	5.5	"	
400		F	7.5	"	
607		M	6.0	"	
608		M	9.0	"	
609		F	7.5	"	
610		F	7.0	"	
611		F	6.0	"	
612		F	7.0	"	
613		M	6.5	"	
614		M	10.0	"	
615		F	9.0	"	
616		F	10.5	"	
617		M	7.0	"	
618		F	8.5	"	
619		F	8.0	"	

Table A-20. Northern fur seal pups tagged on Castle Rock, San Miguel Island, 9 September, 1976.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 101	Left	F	8.0	RH-D4	
102	Right	M	11.5	"	
103	Right	M	7.5	"	
104	Right	M	7.0	"	
105	Right	M	7.5	"	
106	Right	M	7.5	"	
107	Right	M	8.0	"	
108	Right	M	7.0	"	
109	Right	M	9.5	"	
110	Right	M	9.0	"	
111	Right	M	10.5	"	
112	Right	M	9.0	"	
113	Right	M	8.0	"	
114	Left	F	9.5	"	
115	Right	M	7.0	"	
116	Right	M	9.0	"	
117	Right	M	9.0	"	
118	Right	M	13.5	"	
119	Right	M	7.0	"	
120	Right	M	8.0	"	
121	Right	M	8.5	"	
122	Right	M	7.0	"	
123	Left	F	10.0	"	
124	Left	F	8.5	"	
125	Right	M	7.5	"	
126	Left	F	6.5	"	
127	Right	M	8.5	"	
128	Right	M	7.5	"	
129	Left	F	8.0	"	

Table A-20. Northern fur seal pups tagged on Castle Rock, San Miguel Island, 9 September, 1976, continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 130	Left	F	6.0	RH-D-4	
131	Right	M	7.0	"	
132	Left	F	8.0	"	
133	Left	F	5.5	"	
134	Right	M	7.0	"	
135	Left	F	5.0		
136	Right	M	9.5	RH-D-4	
137	Right	M	6.5	"	
138	Right	M	7.5	"	
139	Left	F	6.0	"	
140	Right	M	7.5	"	
141	Right	M	6.5	"	
142	Right	M	8.0	"	
143	Left	F	8.5	"	
144	Left	F	8.5	"	
145	Left	F	7.5	"	
146	Right	M	8.0	"	
147	Right	M	7.5	"	
148	Left	F	8.5	"	
149	Right	M	8.0	"	
150	Right	M	9.5	"	
151	Left	F	6.0	"	
152	Right	M	9.5	"	
153		F	7.0	"	
154		M	7.5	"	
155		F	6.5	"	
156		F	7.0	"	
157		F	6.0	"	
158	TAG DESTROYED				
159		M	6.0	"	

Table A-20. Northern fur seal pups tagged on Castle Rock, San Miguel Island, 9 September, 1976, continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 160		F	6.0	RH-D-4	
161		M	7.5	"	
162		F	7.5	"	
163	TAG DESTROYED				
164	TAG DESTROYED				
165		F	9.5	"	
166		M	6.0	"	
167	TAG DESTROYED				
168		M	7.0	"	
169	TAG DESTROYED				
170		M	9.0	"	
171		M	10.5	"	
172		M	8.0	"	
173		F	7.0	"	
174		F	7.5	"	
175		F	6.0	"	
176		M	6.5	"	
177		F	6.5	"	
178		M	8.5	"	
179		M	7.5	"	
180		M	9.5	"	
181		F	8.5	"	
182		M	7.0	"	
183		F	7.0	"	
184		F	7.5	"	
185		F	7.0	"	
186		M	10.0	"	
187	TAG DESTROYED				
188		F	10.0	"	
189		F	6.5	"	

Table A-20. Northern fur seal pups tagged on Castle Rock, San Miguel Island, 9 September, 1976 continued.

Tag Number	Flipper Tagged	Sex	Weight (Kg.)	Checkmark	Remarks
SMI 190		F	8.0	RH-D-4	
191		F	5.0	"	
192		M	9.0	"	
193		F	9.0	"	
194		M	10.5	"	
195		M	8.5	"	
196		M	7.0	"	
197		M	10.5	"	
198		M	8.5	"	
199		M	7.5	"	
200		M	6.5	"	
601		F	6.5	"	
602		F	9.0	"	
603		F	7.0	"	
604		F	7.0	"	
605		F	5.0	"	
606		M	7.5	"	

Appendix B

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1976

Name	Affiliation[1/]	Work
Permanent employees		
George Y. Harry, Jr.	MMD	Division Director
W. Bruce McAlister	-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
James H. Johnson	-do.-	Do.
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	MMD	Behavior and biology
Suzanne K. Macy	-do.-	Do.
John Holt	-do.-	Do.
David W. Christel	-do.-	Do.
Tom Meyer	-do.-	Do.
George A. Antonelis, Jr.	-do.-	Do.
Robert D. Everitt	-do.-	Do.
Renee M. Engel	-do.-	Population assessment
Carol Forhan	-do.-	Physiology and medicine
Marsha L. Caunt	-do.-	Fur seal ecosystem--pelagic
Andrew F. Anschell	-do.-	Do.
M. Richard Zacharof	St. Paul Island resident	Population assessment
M. Robert Kochergin	---do.---	Do.
Darlene Stepetin	---do.---	Do.
Lavrenty Stepetin	---do.---	Do.
Gregory McGlashan	St. George Island resident	Behavior and biology
Edward C. Jameyson	MMD	Do.
Cooperators		
Alvin W. Smith	NBL	Physiology and medicine
Richard J. Brown	-do.-	Do.
Henry Bray	-do.-	Do.
Robert Crawford	-do.-	Do.
Carolyn Hoke	-do.-	Do.
Douglas Skilling	-do.-	Do.

1/ See footnote at end of table.

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1976--Continued

Name	Affiliation[1/]	Work
Gerald L. Kooyman	Scripps Institution of Oceanography	Behavior and biology
Randy Davis	---do.----	Do.
Jack Sarno	---do.----	Do.
Visiting Scientists		
Michael Bigg	FRBC	--
Graham Ellis	-do.-	--
John Sawyer	University of Calif.,Davis	Virology
Leigh Sawyer	---do.---	Do.

1/ MMD = Marine Mammal Division
NBL = Naval Bioscience Laboratory
FRBC = Fisheries Research Board of Canada