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FUR SEAL INVESTIGATIONS 1979

FUR SEAL INVESTIGATIONS, 1979

Edited

by

Patrick Kozloff*

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

CONTENTS

CONTENTS -- continued

INTRODUCTION

Four countries, the United States, Canada, Japan, and the USSR, cooperate in an international program of conservation and research on the northern fur seal (Callorhinus ursinus), a species commercially harvested by the United States on St. Paul of the Pribilof Islands and by the USSR on the Commander and Robben Islands. In return for abstention from pelagic sealing, Japan and Canada share in the harvests on land under terms of the Interim Convention on the Conservation of North Pacific Fur Seals.

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

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

Part I. POPULATION ASSESSMENT, PRIBILOF ISLANDS

Various elements of the population of Pribilof Islands fur seals are counted or estimated annually as a way of monitoring changes that might occur and for managing the resource in terms of the annual harvest. In addition, each harvested animal is examined for marks that may have been applied by personnel of the United States or the USSR; appropriate records are maintained. Information is also collected on the number of harvested seals entangled in fishing gear debris and other materials by personnel of the Pribilof Islands Program[1/].

Population parameters

Features monitored on the Pribilof Islands in 1979 included: (1) age and sex composition of seals harvested commercially on

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1/ U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, 1700 Westlake Ave. N., Seattle, WA 98109.

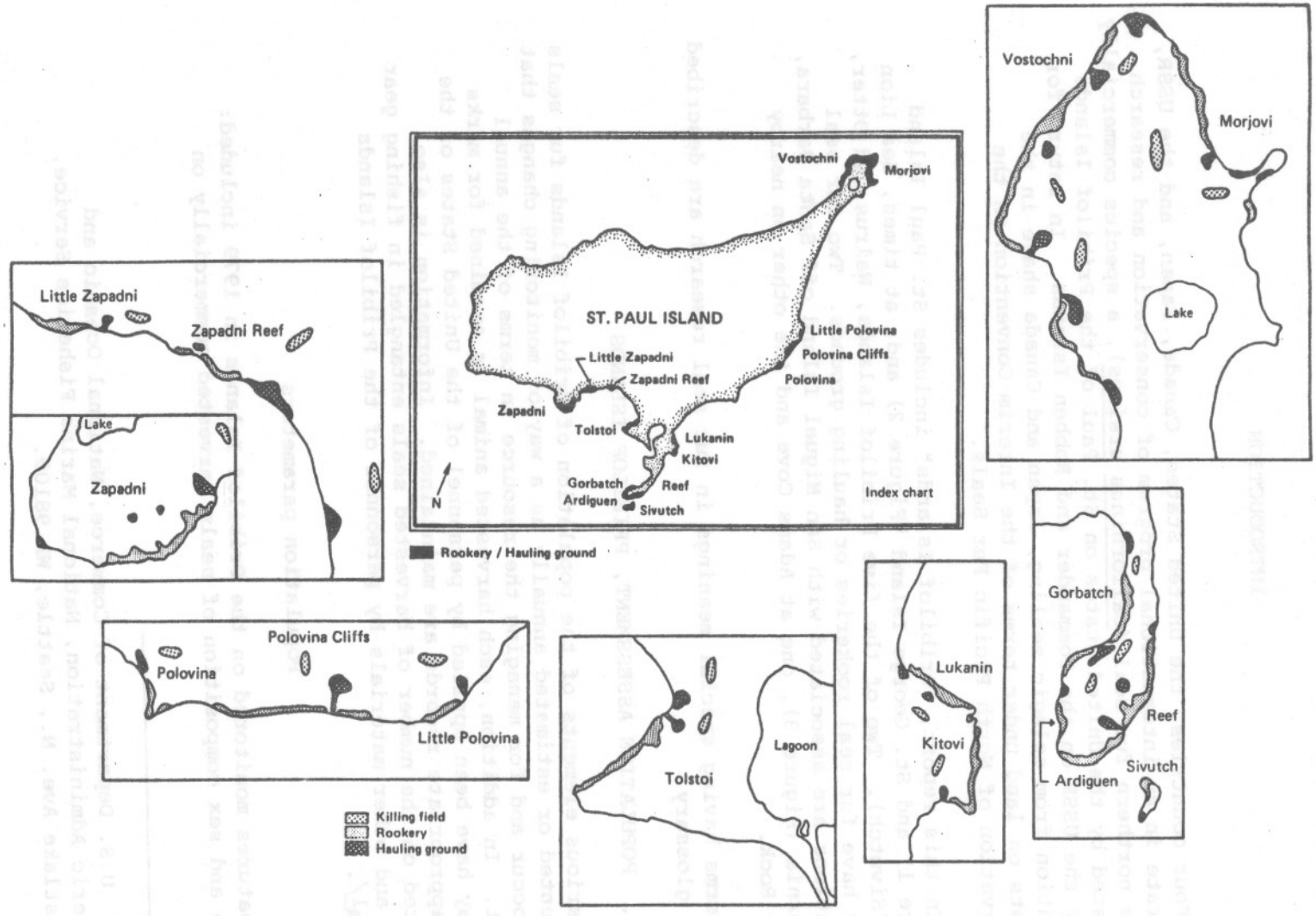

FIGURE 1.--Location of rookeries, hauling grounds and killing fields, St. Paul Island, Alaska.

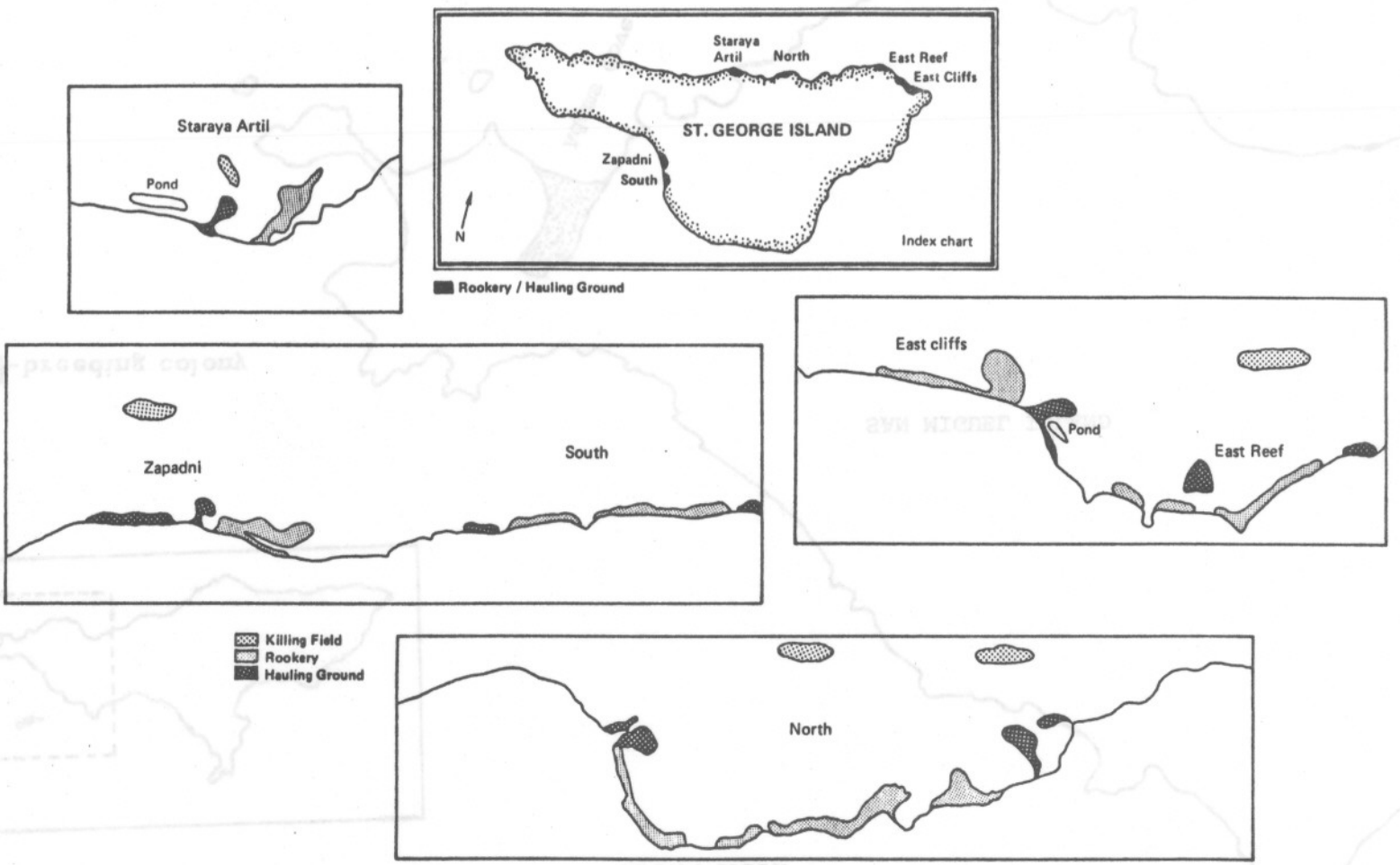

FIGURE 2.--Location of rookeries, hauling grounds and killing fields, St. George Island, Alaska.

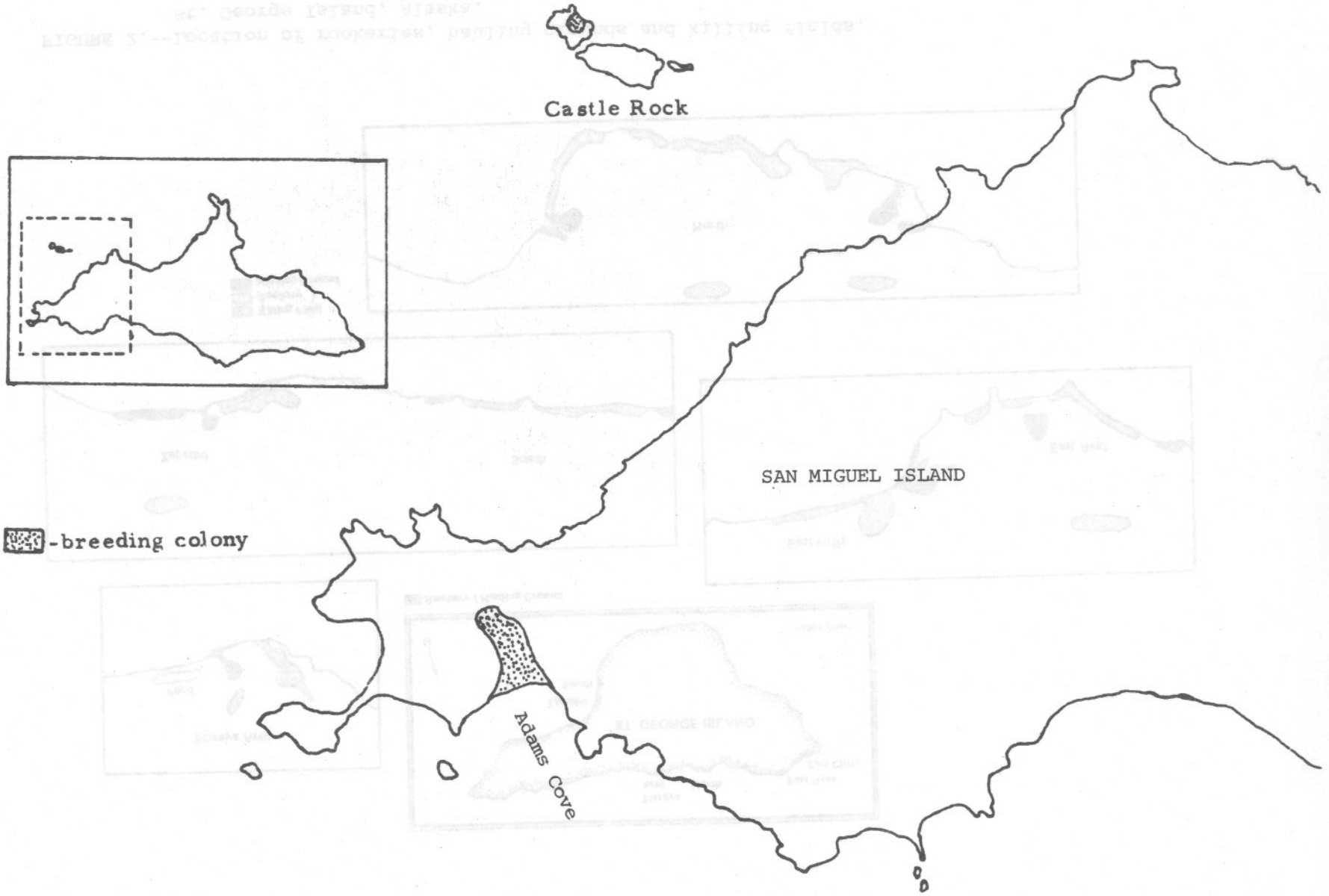

Figure 3. Location of northern fur seal breeding colonies, San Miguel Island, California

St. Paul Island and for food on St. George Island[2/]; (2) numbers of adult males in each of three classifications; and (3) number of pups and older seals found dead on the rookeries, hauling grounds, and adjacent beaches. In addition, the number of pups born on St. Paul Island was estimated.

Age and Sex Composition of Seals Harvested

Males.--In 1979, all male seals available on St. Paul Island beginning 26 June and ending 31 July that were 47 inches (119.4 cm) or less in body length from tip of nose to tip of tail were taken. There was no minimum limit and harvesting was carried out Monday through Friday during the period (except on the 4 July holiday). The sealing crew left the village at 5:00 a.m., drove the animals from the hauling grounds, and began the harvest between 6:00 and 6:30 a.m.

The age composition of harvested males was determined from a 20% sample of maxillary canine teeth collected from animals taken (Appendix A, Table A-1). The harvest of 3- and 4-year-old males in 1979 is shown in Figure 4; Figure 5 and Table 1 give the number of males harvested, by year class, since 1965. The age composition of males taken on the Pribilof Islands since 1970 is given in Table 2. Sixty females were mistaken for males and harvested on St. Paul Island in 1979.

Seals have not been commercially harvested on St. George Island since 1972 because of the need for an unexploited population there for intensified research. However, a small harvest for food was permitted on St. George Island again in 1979, and 351 males were taken as listed in Appendix A, Table A-2. The animals were taken on the hauling ground of Staraya Artil Rookery and on the east hauling ground of North Rookery.

Females.--The effects of the commercial female harvest (1956-68) and pelagic research collections (1958-74) on early survival rates and on the production of pups on St. Paul Island were analyzed by York and Hartley[3/]. Early survival rates for males (birth to age 2)

2/ The skins of seals harvested for food on St. George Island are processed and shared with Japan and Canada.

3/ A.E. York, and J.R. Hartley, 1979. The effect of a female fur seal harvest on pup production. Unpubl. manuscr., 19 p. Natl. Mar. Mamm. Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA., 98115.

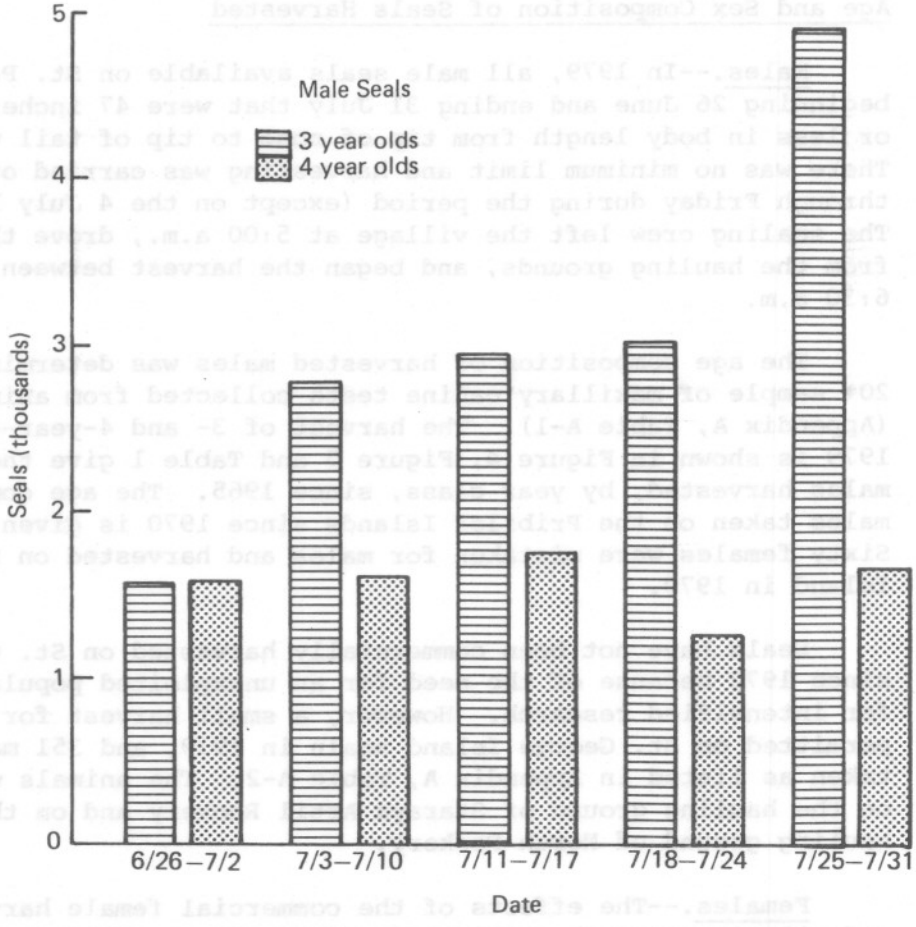

Figure 4.--Three- and four-year-old male seals harvested, St. Paul Island, Alaska, 26 June to 31 July 1979.

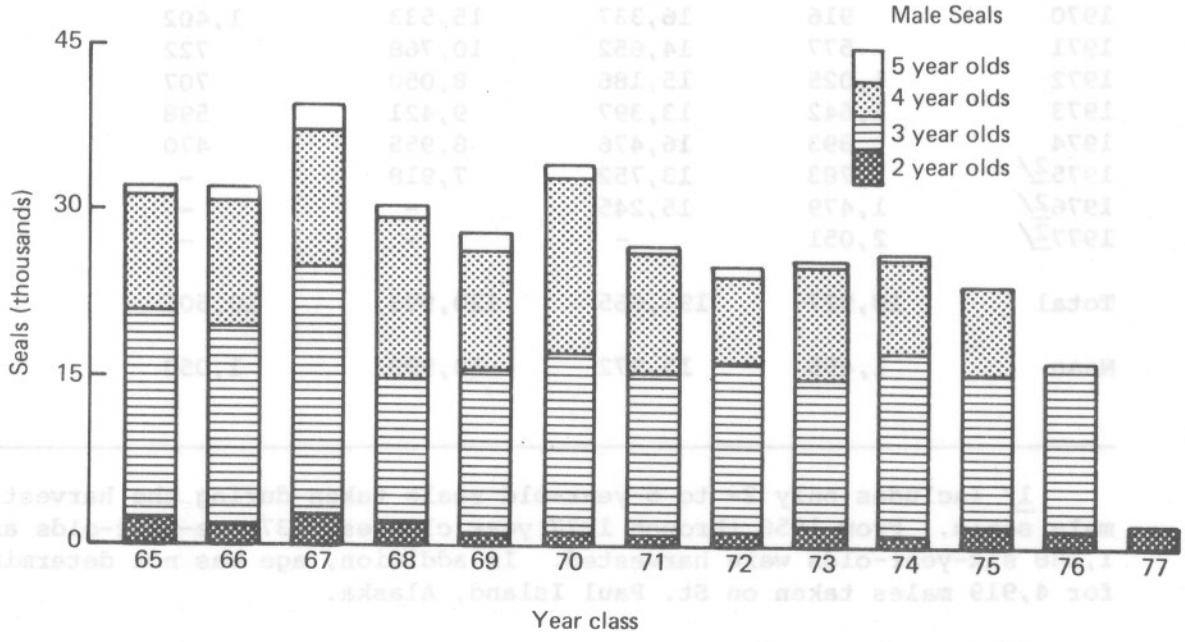

Figure 5.--Harvest of male seals, by year class, St. Paul Island, Alaska, 1965-77.

TABLE 1.--Harvest of male fur seals, by age group, St. Paul Island, Alaska, 1965-77 year classes[1/]

Year class	Age group				Total
	2	3	4	5	
1965	2,200	18,706	10,565	731	32,202
1966	1,673	17,826	11,548	1,338	32,385
1967	2,640	22,176	12,503	2,185	39,504
1968	1,725	12,888	14,932	721	30,266
1969	323	15,024	10,800	1,631	27,778
1970	916	16,337	15,533	1,402	34,188
1971	577	14,652	10,768	722	26,719
1972	1,025	15,186	8,050	707	24,968
1973	1,642	13,397	9,421	598	25,058
1974	893	16,476	8,955	470	26,794
1975[2/]	1,783	13,752	7,918	-	23,453
1976[2/]	1,479	15,245	-	-	16,724
1977[2/]	2,051	-	-	-	2,051
Total	18,927	191,665	120,993	10,505	342,090
Mean	1,456	15,972	10,999	1,050	29,986[3/]

1/ Includes only 2- to 5-year-old seals taken during the harvest of male seals. From 1956 through 1977 year classes, 137 one-year-olds and 1,288 six-year-olds were harvested. In addition, age was not determined for 4,919 males taken on St. Paul Island, Alaska.

2/ Incomplete returns.

3/ 1975, 1976, and 1977 year classes not included.

TABLE 2.--Age classification of male fur seals harvested, Pribilof Islands, Alaska, 1970-79

Year of harvest	St. Paul Island						St. George Island[1/]					
	Age group					Total no. harvested	Age group					Total no. harvested
	2	3	4	5	6		2	3	4	5	6	
	Number											
1970	1,725	22,176	11,548	731	17	36,197	98	2,916	2,274	547	89	5,924
1971	323	12,888	12,503	1,338	190	27,242	32	1,456	2,517	467	81	4,553
1972	916	15,024	14,932	2,185	53	33,110	57	1,442	2,125	559	21	4,204
1973	577	16,337	10,800	721	22	28,457	-	-	-	-	-	-
1974	1,025	14,652	15,533	1,631	135	32,976	-	-	-	-	-	-
1975	1,642	15,186	10,768	1,402	95	29,093	-	-	-	-	-	-
1976	893	13,397	8,050	722	19	23,081	-	-	-	-	-	-
1977	1,783	16,476	9,421	707	9	28,396	-	-	-	-	-	-
1978	1,479	13,752	8,955	598	45	24,829	-	-	-	-	-	-
1979	2,051	15,245	7,918	470	18	25,702	-	-	-	-	-	-

1/ No commercial fur seal harvest on St. George Island, Alaska, 1973-79.

increased from an average of 0.32 for the pre-1956 year classes to about 0.40 for post-1956 year classes. Numbers of female pups not born due to the harvest, estimated for 1956-79, account for over two-thirds of the difference between pups actually born and the level of the pre-1956 pup births.

Living Adult Male Seals Counted

All males with territories are counted on the rookeries regardless of size or age, though there are few under age 10 years. Class 2 males are those with territories but without females and Class 3 males have both. Class 5 males are found mostly on the hauling grounds, with a few scattered along the inland fringe of the rookery; these animals are estimated to be age 7 years and older. The relative locations of the different classes of adult males (bulls) on a rookery-hauling ground complex are illustrated in Figure 6. In 1979, there were 8,139 adult males counted on St. Paul Island in June and 10,699 counted in July; St. George Island had 2,459 in June and 3,658 in July. These counts are given in more detail in Appendix A, Tables A-3 to A-8.

Dead Seals Counted That Were Older Than Pups

Counts of dead adult males and females on St. Paul Island during 27-30 August totaled 56 and 66, respectively. On St. George Island a total of 70 dead adult males and females were counted 4-11 August. Whenever possible, canine teeth were collected from these animals to determine their ages. Table 3 lists the number of dead adults, by year and sex, that have been counted on St. Paul and St. George Islands since 1966.

Dead Pups Counted

In 1979, the number of dead pups counted (6,444) 17-24 August on St. Paul Island was the lowest since 1924. On St. George Island 2,191 dead pups were counted 4-11 August on all rookery areas with the exception of the behavioral study site on Zapadni Rookery. Appendix A, Tables A-9 and A-10 give the number of dead pups counted on St. Paul and St. George Islands in 1979 and since 1967, respectively.

Number of Pups Born

Various methods used in the past to determine the numbers of fur seal pups were analyzed by York and Kozloff[4/]. The present

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4/ A.E. York, and P. Kozloff, 1979. Estimation of numbers of fur seal pups born on St. Paul Island. Unpubl. manuscr., 25 p. Natl. Mar. Mamm. Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA., 98115.

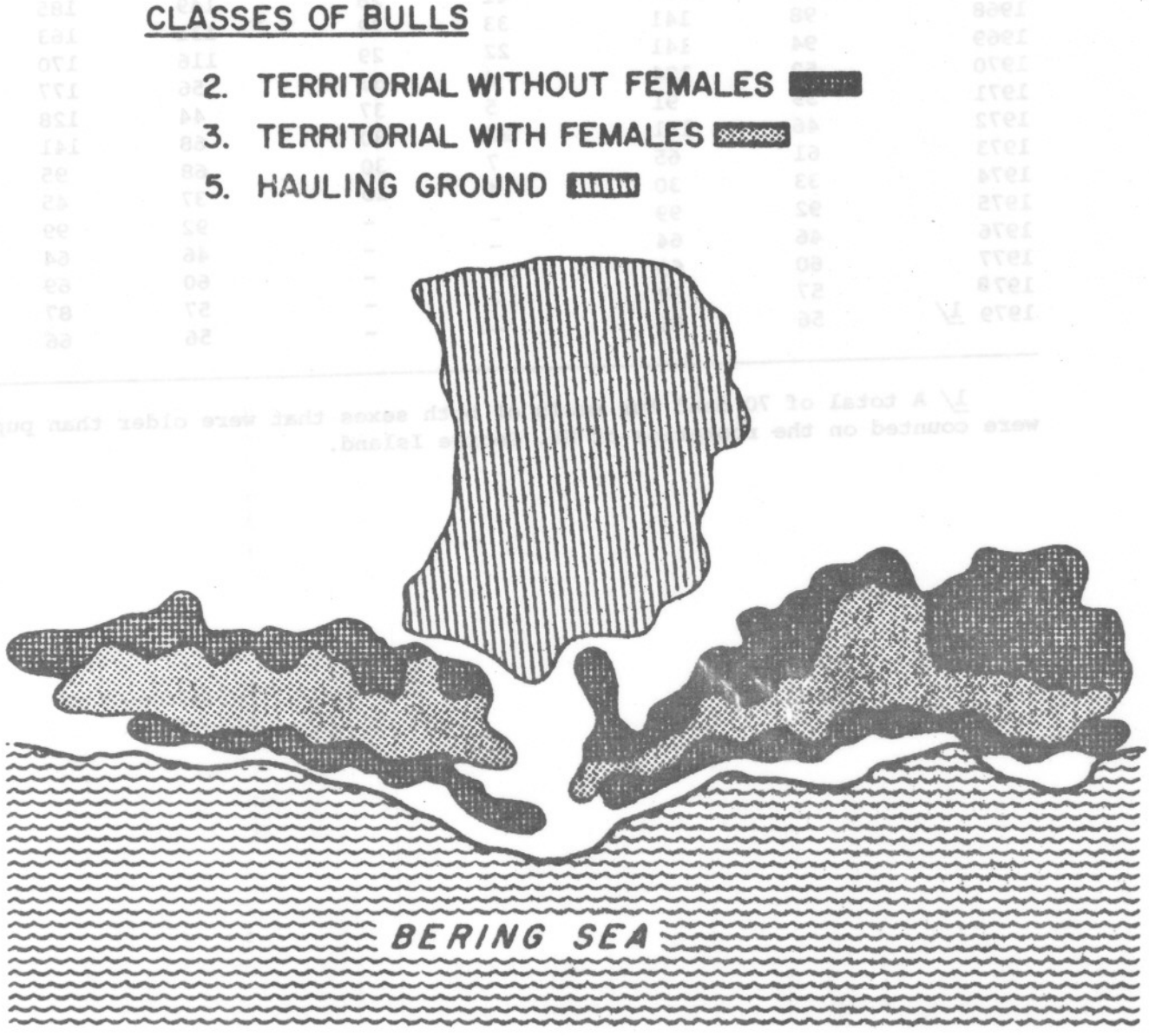


Figure 6. --General composition of a typical fur seal rookery.

TABLE 3.--Dead fur seals counted that were older than pups, Pribilof Islands, Alaska, 1966-79. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	Number					
1966	181	172	41	55	222	227
1967	108	157	41	28	149	185
1968	98	141	33	22	131	163
1969	94	141	22	29	116	170
1970	52	124	4	53	56	177
1971	39	91	5	37	44	128
1972	46	111	22	30	68	141
1973	61	65	7	30	68	95
1974	33	30	4	15	37	45
1975	92	99	-	-	92	99
1976	46	64	-	-	46	64
1977	60	69	-	-	60	69
1978	57	87	-	-	57	87
1979 1/	56	66	-	-	56	66

1/ A total of 70 dead fur seals of both sexes that were older than pups were counted on the rookeries of St. George Island.

shearing-sampling method was presented in detail. The report investigated the feasibility of estimating total pup population on the 14 rookeries of St. Paul Island by taking subsamples of the rookeries. Simple random sampling and stratified random sampling using both the standard estimation procedure and ratio estimates (obtained from a strong relationship between numbers of breeding males and live pups on the various rookeries) were considered. Evaluation of the sampling schemes and estimation methods was based on the performance of the estimators for the 3 years of data (1965, 1970, and 1975) for which mark-recapture estimates from all 14 rookeries were available. The analysis indicated, for both simple random sampling or stratified random sampling, ratio estimates are preferred to estimates obtained from the standard procedure. Furthermore, estimates from sampling plans based on three strata proved more satisfactory than those based on two strata.

In 1979, the number of fur seal pups born on St. Paul Island was estimated on all 14 rookeries (Table 4) using present shearing-sampling procedures. The number of pups born on the different rookeries of St. Paul Island, year classes 1963-70, 1972-76, and 1979, are presented in Table 5.

Life Table, Biomass and Mean Body Weight

Life tables for the Alaskan fur seal have not been published since Kenyon et al. (1954) reported an equilibrium population of approximately 1.8 million (including 530,000 newborn pups) at a time when the population had been at or very near a maximum level for about 15 years (1941-54). The present level of pup production is about the same as when the 1956-63 program of herd reduction ended. In addition, the effects of that program's removal of females have mainly passed through the population (York and Hartley, 1979)[3/], and the annual kill of males on St. Paul Island during the last part of the 1970's has been stable (Table 2).

A new life table for the Alaskan fur seal was developed in 1979. The postulated equilibrium and current level of abundance is some 1.25 million, including a 10-year average of 326,000 newborn pups (Table 6). It slightly exceeds the 1.2 million estimated by Johnson (1975) for 1970. Both estimates are slightly below the values of 1.3-1.4 million based upon less rigorous analyses often found in various popular accounts and administrative reports, and considerably below the 1.8 million given by Kenyon et al. (1954).

In connection with the new life table calculation, the report also documents a new population biomass estimate of 29,000 metric tons on approximately 1 June (i.e., excluding pups because none

TABLE 4.--Estimated number of fur seal pups in 1979 at times of shearing and birth on St. Paul Island, Alaska. Pups were sheared 2-13 August; sampling periods 1 and 2 were 17 and 20 August and 22 to 23 August, respectively. Values in parentheses are included in totals and refer to the second point south of Sea Lion Neck (for Morjovi Rookery) and to Kitovi Amphitheater (for Kitovi Rookery).

Rookery	Number of Pups Sheared	Number of pups counted alive by category and period: 25-pup samples 1	25-pup samples 2	Sheared 1	Sheared 2	Total[1] 1	Total[1] 2	Number of dead pups counted	Estimated number of pups Alive[2] 1	Alive[2] 2	Alive[2] Mean	Born[3]
Morjovi	1,600	66	80	179	233	1,650	2,000	233	14,749	13,734	14,242	14,475
	(158)	(12)	(7)	(33)	(27)	(300)	(175)	(36)	(1,436)	(1,024)	(1,230)	(1,266)
Vostochni	3,668	182	189	434	424	4,550	4,725	573	38,455	40,876	39,666	40,239
Little Polovina	345	18	32	48	77	450	800	28	3,234	3,584	3,409	3,437
Polovina Cliffs	1,916	120	155	294	353	3,000	3,875	433	19,551	21,033	20,292	20,725
Polovina	396	40	28	89	66	1,000	700	85	4,449	4,200	4,324	4,409
Tolstoi	2,921	191	207	444	430	4,775	5,175	1,645	31,414	35,154	33,284	34,929
Zapadni	2,715	146	151	340	324	3,650	3,775	1,368	29,146	31,633	30,390	31,758
Little Zapadni	1,525	98	135	208	268	2,450	3,375	637	17,963	19,205	18,584	19,221
Zapadni Reef	809	54	57	137	154	1,350	1,425	161	7,972	7,486	7,729	7,890
Reef	2,773	132	155	315	361	3,300	3,875	651	29,051	29,766	29,408	30,059
Gorbatch	1,538	75	72	201	179	1,875	1,800	260	14,347	15,466	14,906	15,166
Ardiguen	315	15	17	42	52	375	425	31	2,813	2,575	2,694	2,725
Kitovi	1,004	64	108	134	208	1,600	2,700	157	11,988	13,033	12,511	12,668
	(90)	(14)	(9)	(31)	(15)	(350)	(225)	(14)	(1,016)	(1,350)	(1,183)	(1,197)
Lukanin	448	46	29	98	54	1,150	725	132	5,257	6,015	5,636	5,768
Total	22,221	-	-	-	-	-	-	6,444	232,841	246,134	239,488	245,932

1/ Number of samples X 25 = total number of sheared and unsheared pups counted in each period.

2/ Estimated from $\hat{N} = MC/R$ (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

3/ Sum of dead pups counted and mean estimate of pups alive at time of sampling.

TABLE 5.--Estimated number of fur seal pups born on different rookeries of St. Paul Island, Alaska, year classes 1963-1970, 1972-1976, and 1979. [1] A dash indicates that data were not collected.

	Year													
Rookery	1963	1964	1965	1966	1967	1968	1969	1970	1972	1973	1974	1975	1976	1979
Morjovi	19,648	19,580	18,083	20,852	--	18,222	16,213	16,512	18,481	--	--	23,049	--	15,741
Vostochni	39,757	45,409	38,422	51,619	--	37,471	35,457	37,139	43,683	--	--	44,615	51,796	40,239
Little Polovina	7,423	9,016	7,250	9,147	--	--	5,291	4,185	--	--	--	3,667	--	3,437
Polovina Cliffs	21,760	23,362	21,404	24,075	--	--	19,000	18,728	--	--	--	26,399	23,378	20,725
Polovina	5,437	5,928	6,467	5,982	--	--	3,954	4,183	--	--	--	4,773	--	4,409
Tolstoi	26,874	28,064	29,077	30,433	35,735	--	29,507	25,774	--	38,875	--	35,249	--	34,929
Zapadni	37,014	37,537	30,450	40,932	--	--	31,727	37,227	--	37,479	--	40,068	--	31,758
Little Zapadni	16,380	18,226	16,767	24,632	--	--	19,671	16,626	--	24,609	--	22,372	--	19,221
Zapadni Reef	6,918	6,940	5,982	5,393	--	5,239	4,751	4,499	--	8,388	--	7,731	8,028	7,890
Reef	38,688	41,685	36,696	38,480	33,466	27,901	28,460	27,128	--	--	35,061	29,398	--	30,059
Gorbatch	25,172	25,174	20,052	22,401	--	--	18,504	16,002	--	--	20,144	18,063	--	15,166
Ardiguen	DC [2]	2,917	3,139	2,936	--	--	3,691	3,181	--	--	3,459	2,916	--	2,725
Kitovi	11,681	14,567	13,563	14,430	--	--	11,524	13,392	--	--	--	13,752	--	13,865
Lukanin	5,746	5,517	6,416	7,619	--	--	5,120	5,909	--	--	--	6,209	--	5,768
Total	262,498	283,922	253,768	298,931			232,870	230,485				278,261		245,932

[1] Estimates were not determined in 1971, 1977, and 1978.
[2] DC = Data for pups born combined with Gorbatch Rookery.

TABLE 6.--Life table for Alaskan fur seals (in thousands), Pribilof Islands, Alaska.

	Male				Female			
Age	St. Paul Island	St. George & Sea Lion Rock	Total	Non-pregnant	Pregnant	Total	Both sexes
0	126.00	37.00	163.00	163.00	0	163.00	326.0
1	63.00	14.80	77.80	81.50	0	81.50	159.3
2	47.88	11.10	58.98	65.20	0	65.20	124.2
3	37.30	8.88	46.18	54.77	0	54.77	101.0
4	17.77	7.10	24.87	48.36	2.01	50.37	75.2
5	6.05	5.33	11.38	29.78	17.49	47.27	58.7
6	4.16	3.74	7.90	13.35	31.15	44.50	52.4
7	3.28	2.44	5.72	8.41	33.64	42.05	47.8
8	2.65	1.48	4.13	5.99	33.95	39.94	44.1
9	2.14	0.81	2.95	4.94	33.04	37.98	40.9
10	1.64	0.41	2.05	4.28	31.42	35.70	37.8
11	1.13	0.19	1.32	3.95	28.98	32.93	34.3
12	0.76	0.07	0.83	3.58	26.25	29.83	30.7
13	0.50	0.04	0.54	3.43	22.98	26.41	27.0
14	0.25	0.02	0.27	3.63	19.03	22.66	22.9
15	0.13	0.01	0.14	3.78	16.11	19.89	20.0
16	<0.10	<0.01	<0.11	3.60	12.05	15.65	15.7
17	-	-	-	3.36	8.21	11.57	11.6
18	-	-	-	2.95	5.03	7.98	8.0
19	-	-	-	2.22	2.83	5.05	5.1
20	-	-	-	1.47	1.30	2.77	2.8
21	-	-	-	0.82	0.48	1.30	1.3
22	-	-	-	0.36	0.13	0.49	0.5
23	-	-	-	0.14	0.02	0.16	0.2
24+	-	-	-	<0.16	0	<0.16	0.1
Total	314.6	93.4	408.0	513.0	326.1	839.1	1,247.1

existed then, but including well developed fetuses to which energy from the ecosystem is also transferred). Also near 1 June, a mean body weight of 36 kg was estimated for the Alaskan fur seal.

Marking

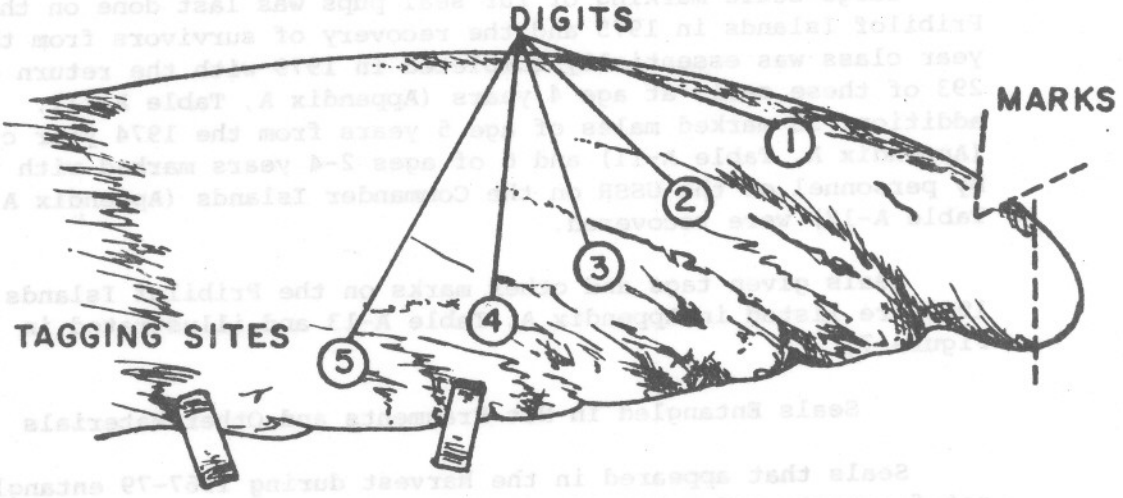
Large-scale marking of fur seal pups was last done on the Pribilof Islands in 1975 and the recovery of survivors from this year class was essentially completed in 1979 with the return of 293 of these seals at age 4 years (Appendix A, Table A-11). In addition, 53 marked males of age 5 years from the 1974 year class (Appendix A, Table A-11) and 6 of ages 2-4 years marked with tags by personnel of the USSR on the Commander Islands (Appendix A, Table A-12) were recovered.

Seals given tags and other marks on the Pribilof Islands since 1966 are listed in Appendix A, Table A-13 and illustrated in Figure 7.

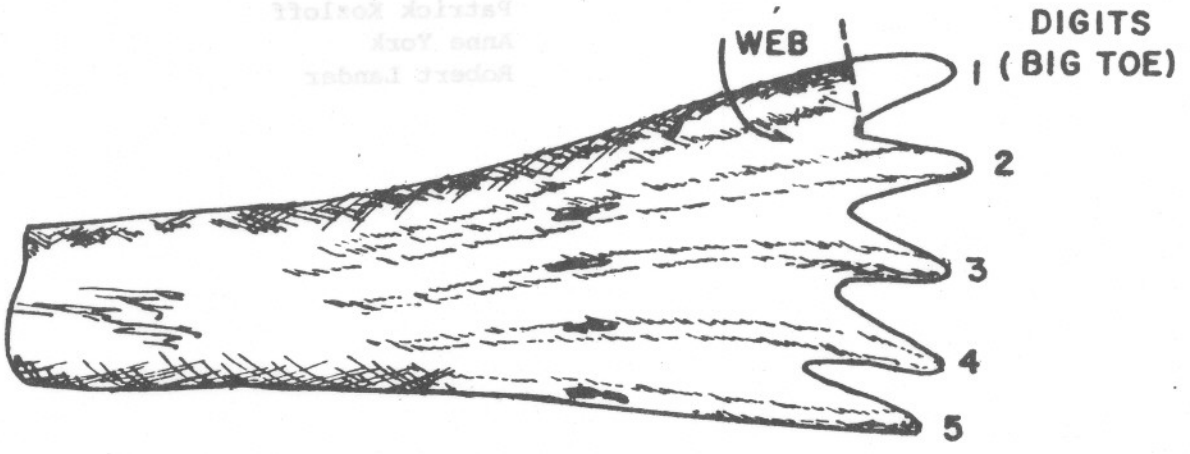
Seals Entangled in Net Fragments and Other Materials

Seals that appeared in the harvest during 1967-79 entangled in net fragments and other materials are listed in Appendix A, Table A-14.

Alton Roppel
Patrick Kozloff
Anne York
Robert Lander



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



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

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

Part II. BEHAVIOR AND BIOLOGY, PRIBILOF ISLANDS

In 1979, behavioral and biological research was carried out on St. George Island. The major thrust of field research was to repeat the study of onshore-offshore movements of juvenile males summarized in the 1978 Report of Fur Seal Investigations. The format and results of this year's study were essentially the same as those reported earlier. For that reason the results of the 1979 field effort will not be summarized here, but will be published later.

In each annual report of the Behavior and Biology section of Fur Seal Investigations, mention is made of "monitoring efforts" which are made routinely each year. These efforts include counting the number of animals on selected study sites each day, calculating the density of females, recording weights and territorial tenure of adult males, calculating the copulation frequencies of adult males, and other measures. Unlike the more specialized research topics which this task usually discusses in the annual report, these monitoring efforts do not address a specific question about the behavior of fur seals. Instead, they attempt to quantify the changes that occur as this formerly harvested herd approaches some non-harvest equilibrium. Since the herd changes have been gradual, there has been no obvious point at which to summarize these data in past annual reports. These changes are summarized in the present report because some obvious trends are now evident, and because at least 5 years of data are available for most of the parameters.

Table 7 represents herd parameters that have been measured at two study sites, East Reef and Zapadni Rookeries, from 1974 through 1979. Most of these parameters were measured each day in the field. But since the time course of herd changes remains virtually the same from year to year (see the similarity in the curves presented in the 1977 annual report), only 1 week of data is needed to represent the condition of the herd in a given year. The week ending 13 July was chosen since the peak in adult numbers always occurs during that week.

Data were collected at two sites simultaneously because of the possibility that herd-wide changes might be manifested differently depending on the terrain and size of a rookery. Therefore, characterizing changes in an entire island's population from a single study site might be misleading. East Reef and Zapadni Rookeries were selected because they represent the two distinct rookery types (shore line and inland) present on St. George Island. East Reef is a long, narrow rookery situated on a beach covered by large boulders. The study site occupies a portion in the center of the beach. Zapadni is a broad inland extension of a shore line

TABLE 7.--Population changes, behavioral study sites, St. George Island, Alaska, 1974-79.

	1974			1975			1976			1977			1978			1979			Total change[2]	Average change/year[3]
	$\bar{X}$	SD	%[1]	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%		
A Adult Females																				
East	399	53	100	390	34	98	405	27	102	334	40	84	286	14	72	235	6	59	-41%	-10.0%
Zapadni	1382	221	100	1110	211	80	808	140	58	747	84	54	488	41	35	470	71	34	-66%	-19.4%
B Female Density[4]																				
East	1.5	1.1	100	1.8	0.5	120	1.3	0.3	87	1.9	0.5	127	1.6	0.4	107	1.6	0.4	107	[5]	[5]
Zapadni	-	-	[6]	1.7	0.5	100	1.5	0.7	88	2.2	0.7	129	2.5	0.8	147	1.6	0.3	94		
C Pups																				
East	672	76	100	556	83	83	595	37	89	509	26	76	433	38	64	372	35	55	-45%	-11.3%
Zapadni	1744	[7]	100	1793	-	103	1328	-	76	1029	-	59	757	-	43	738	-	42	-58%	-15.9%
D Adult Males[8]																				
East	19	1	100	22	2	115	29	2	152	31	1	163	47	2	247	41	2	215	+115%	+16.5%
Zapadni	41	2	100	44	1	107	40	3	98	76	3	185	69	3	168	73	1	178	+ 78%	+12.2%
E "Harem/ Idle" Male Ratio																				
East	3.2	0.7	100	5.7	1.9	178	7.4	3.0	231	2.9	0.7	91	2.2	0.3	69	2.3	0.4	72	[5]	[5]
Zapadni	1.8	0.4	100	1.2	0.3	67	2.0	0.7	111	1.1	0.2	61	1.7	0.6	94	1.0	0.1	56		

TABLE 7.--Population changes, behavioral study sites, St. George Island, Alaska, 1974-79.--continued.

	1974			1975			1976			1977			1978			1979			Total change[2]	Average change/year[3]
	$\bar{X}$	SD	%[1]	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%	$\bar{X}$	SD	%		
F Female/Male Ratio																				
East																				
♀/"Harem ♂"	26	2.2	100	21	1.6	81	16	1.7	62	15	2.2	58	9	0.7	35	8	0.5	31	-69%	-20.9%
♀/Total ♂	20	2.1	100	18	1.6	90	14	1.4	70	11	1.5	55	6	0.4	30	6	0.3	30	-70%	-21.4%
Zapadni																				
♀/"Harem ♂"	52	4.2	100	49	12.8	94	32	8.3	62	19	3.2	37	12	1.6	23	13	1.5	25	-75%	-24.2%
♀/Total ♂	33	3.6	100	26	5.3	79	21	4.6	64	10	1.1	30	7	0.5	21	6	1.0	18	-82%	-29.0%
G Territory Size																				
East	79	7/	100	68	-	86	52	-	66	48	-	61	32	-	40	37	-	46	-54%	-14.4%
Zapadni	98	-	100	91	-	93	100	-	102	53	-	54	58	-	59	55	-	56	-44%	-10.9%

1/ % = percent of the 1974 value (or percent of first year of data collection).

2/ Total percent change from first to last year of data collection.

3/ Average change/year = $(\bar{X}$ last year/$\bar{X}$ first year$)^{1/n-1}$ -1 where n = number of years of observation.

4/ Density = number of females in a group/area occupied by group in meter^2.

5/ No directional trend is evident; value not calculated.

6/ No data.

7/ Data results from a single measure; no SD calculated.

8/ "Harem" plus "Idle" males.

rookery, situated on a flat but sloping plain at least 100 meters from the sea, having few large rocks. At East Reef Rookery a grid, with dimensions 20 x 60 meters and having intersections every 10 meters, has been painted on the rocks. At Zapadni Rookery, the study site is a 40 x 100 meter grid covering virtually all areas used by adult females.

The numbers presented in Table 7 are intended only to provide an index to changes that have occurred in the herd; they should not be interpreted as showing specific herd changes. For example, part A of Table 7 shows a decrease in adult females at Zapadni Rookery from 1974 to 1979. Since we do not know how many females are at sea or how many had not arrived by the census date, the numbers are useful only to show an approximately three-fold decrease in numbers in six seasons.

To emphasize the more general conclusions to be drawn, Table 7 expresses all trends as a percentage of the earliest year's data, and concludes with an estimate of the annual rate of change where strong directional trends are evident. The numerical entries, upon which the percentages are based, are the means of several measurements of that parameter made during the week ending 13 July. The specific methods of collecting the data, and the number of samples upon which each mean is based, are discussed in each section that follows. The table does not present all the data available because the analysis is not yet complete. However, from a preliminary analysis, it is doubtful that the trends reported here will be reversed by the as yet unanalyzed data.

Number of Adult Females

The adult females are counted once a day between 11:00 a.m. and 2:00 p.m. at each study site. On blank census and distribution maps, which show the grid lines to scale, observers daily draw lines that represent as closely as possible the outlines of female groups. Then the number of females and pups in each group is counted using binoculars, and the number is entered directly on the map. Where groups are extremely large and cover several 10 x 10 meter grid sectors, the number of females in the group is tallied by grid sector and is entered on the map separately. These maps provide a good pictorial history of population distribution within and between seasons.

To derive the size of the female population reported for a given year in part A of Table 7, seven such maps, one for each day from 7 through 13 July, were averaged together (except for Zapadni Rookery, 1974 for which only two censuses are available). Note

that this number does not indicate the total size of the female population, but instead shows the largest number seen on shore during the peak of the season.

Part A of Table 7 suggests a strong decline in females at both rookeries over the past six seasons. It appears that East Reef Rookery has shown relatively less of a decline than has Zapadni Rookery. If we characterize the whole island's population of females by averaging the results from East Reef and Zapadni Rookeries, it appears that the female population has been declining at a rate near 15%.

A similar decline in females occurred following the cessation of a harvest of male elephant seals at South Georgia Island in the South Atlantic Ocean. It is possible that the fur seal decline is caused by the same mechanism as in the elephant seal, that is, intra-specific food competition. In 1980 we will investigate this possibility by measuring diving and feeding effort in juvenile males by use of time-depth recorders. Further monitoring of female numbers is obviously required to determine whether the decline follows the same course as the short lived decline in elephant seals.

Density of Females

Density-dependent changes may be important determinants of population size. However, no agreement exists on the units to be used (e.g., the whole species, a single island population, a single rookery, etc.) in detecting density effects. We have measured the density of females within female groups under the rationale that if the decline in the female population results from land based density processes then these processes should be measurable within groups.

Data on densities were collected on daily census and distribution maps. On each map, the area occupied by each of three distinct female groups was determined using a planimeter. The same female groups were measured on each successive map unless the group disappeared. Neither very large nor very small groups were selected for measuring density. The calculation "number of females in the group per area occupied by the group" was made for each group. The numerical entries in part B of Table 7 represent the mean density calculation for 21 groups (3 groups each day for 7 days) during the week ending 13 July each year.

The results in part B of Table 7 show no clear correlation between intra-group density and absolute population size. Note that the densities at Zapadni Rookery in 1975 and 1979 are virtually the same despite a three-fold decrease in maximum numbers on shore there, and

that densities at East Reef and Zapadni Rookeries in 1975 were virtually the same despite the almost three-fold difference in population size.

Perhaps intra-group density is determined by the individual animal's tolerance to the nearness of neighbors, a tolerance that is not affected by the total numbers present. Other data show that intra-group density decreases significantly from the start of a given season to the end. Thus, female tolerance of neighbors might depend on the age of the pup (time postpartum) instead of on the size of the female population. Year to year fluctuations in density shown in part B of Table 7 may therefore result from yearly differences in the time-course of pupping among females.

Note that density within groups fluctuates with a relatively narrow range and never falls below 1.30 females/m^2 in any of the means. The density of females per rookery varies much more than the density within groups. For example, females at Zapadni Rookery always utilize the same 40 x 80 meter portion of the grid, regardless of their numbers. By division, the rookery density in the week of 13 July 1974 was 1,382 females/3,200 m^2 = 0.43 females/m^2. In 1979, it was 470 / 3,200 = 0.15 females/m^2, approximately a three-fold change. It is apparent that the population decrease in females has been accompanied by decreases in the size of female groups and by increases in the spacing between groups, but not by changes in the spacing between individuals within groups. This tendency is seen in Figures 8a and 8b. Note the small, scattered groups on 11 July 1979 (Figure 8a), compared to the large, close groups on 11 July 1974 (Figure 8b). Given the amount of space available at small population sizes, it is noteworthy that females form groups at all, rather than dispersing. Perhaps females group at small population sizes out of avoidance of direct contact with males.

Number of Pups

The pups at East Reef Rookery are counted once each day on female census and distribution maps. Because of the large boulders, many of the pups are not visible. However, the same amount of terrain is viewed each year, so the numbers in part C of Table 7, which are means of 7 days of census, are merely an index of the actual numbers. At Zapadni Rookery, the terrain is flat, but the bodies of the females obscure the pups present. Pups can only be counted there during heavy rains which drive the adult females to sea. On such days virtually all pups are visible so counts are of real numbers. One or two pup counts are made each year, usually in late July or early August after most of the pups have been born. One count per year is reported in part C of Table 7 for Zapadni Rookery.

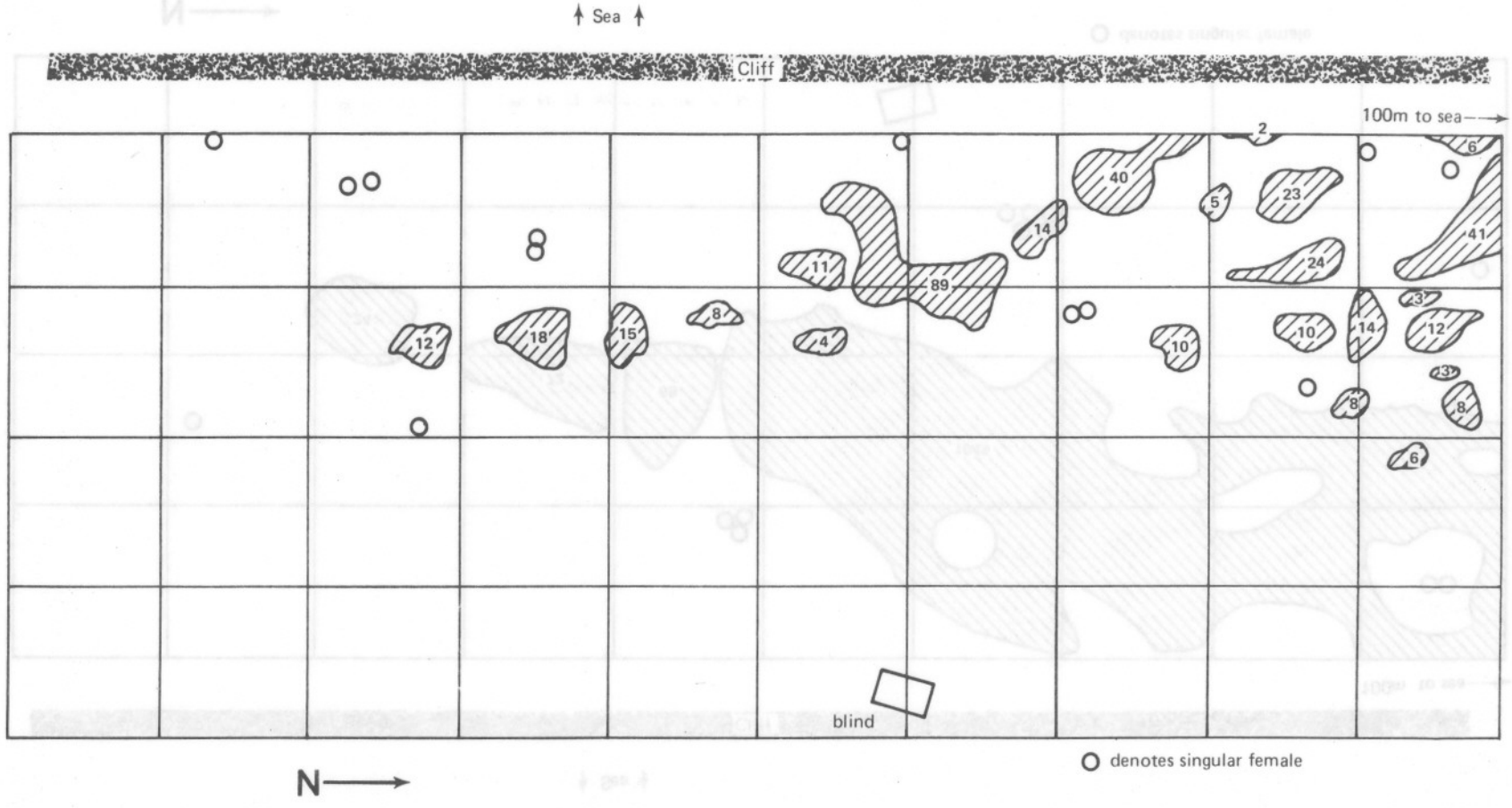


Figure 8a.--Distribution of 398 female seals, Zapadni Rookery, St. George Island, Alaska, 11 July 1979.

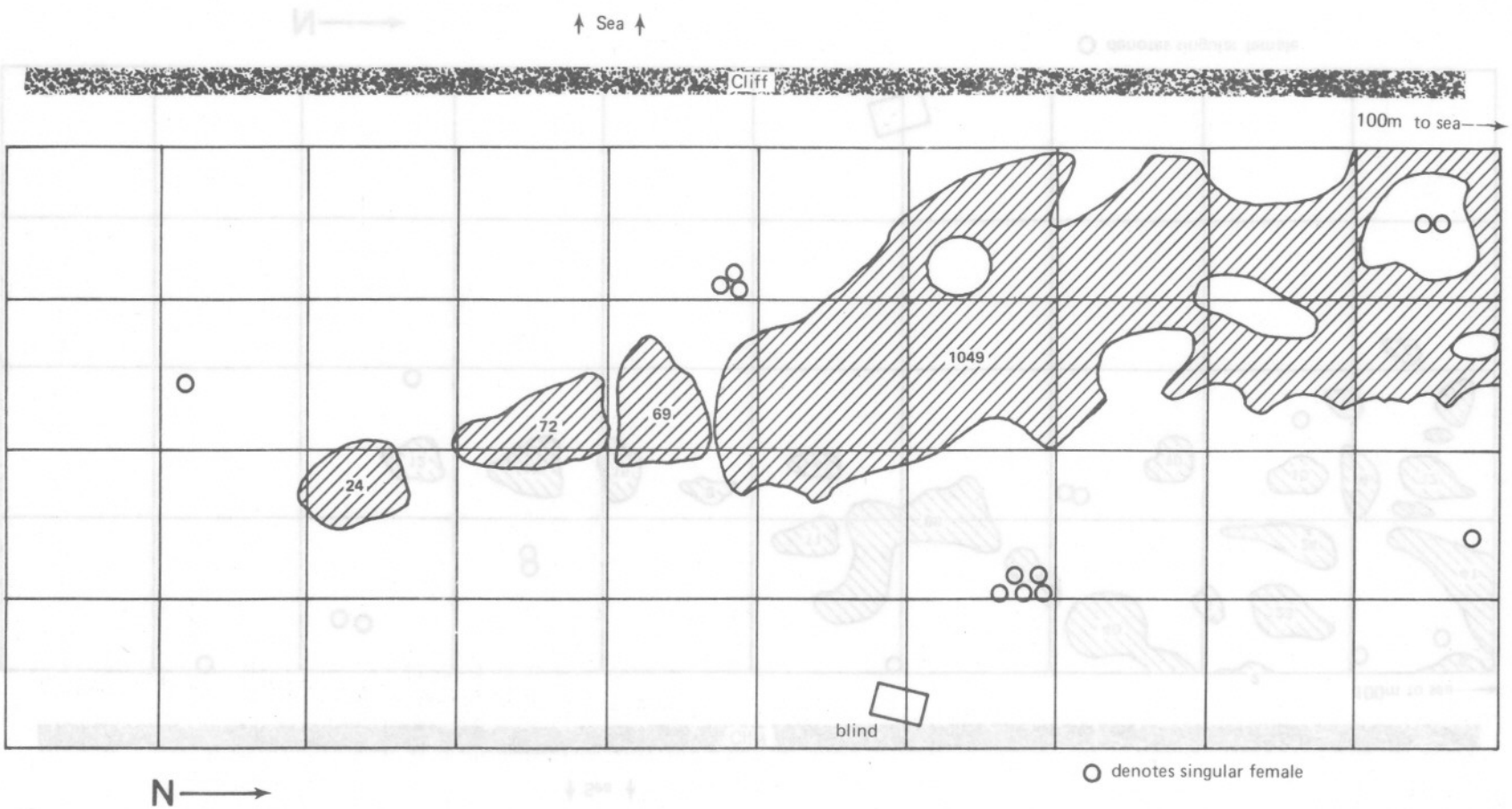


Figure 8b.--Distribution of 1,226 females, Zapadni Rookery, St. George Island, Alaska, 11 July 1974.

Note that the decline in females is mirrored by the decline in pups, shown in part C of Table 7. East Reef and Zapadni Rookeries appear to be declining at slightly different rates, as are the adult females. Note that in any given year the pup numbers always exceed the number of females because part of the female population is at sea on any given day. Table 5 of the 1978 Report of Fur Seal Investigations showed that pups declined at all rookeries between the 1973 and the 1977 and 1978 counts. This finding demonstrates that the decline in females and pups at our study sites did not result from researcher disturbance.

Number of Adult Males

At both study sites, the males are counted daily by indicating the location and identification (if known) of each one on a census and distribution map similar to that used for females. Peripheral males (including "back fringe" and "shoreline" males)5/ are included on this map if they actively defend a territory from day to day, and are approximately the size of adult males. In 1978 and 1979 many of these peripheral males were tagged at Zapadni Rookery so that their incorporation into the adult male social structure can be followed. All the numerical entries in part D of Table 7 are the means of seven daily census and distribution maps for the week ending 13 July.

Part D of Table 7 shows the trend that was predicted to result from the cessation of the commercial harvest, a marked increase in the number of males surviving to adulthood. By combining Table A-7 in Appendix A of the 1978 Report of Fur Seal Investigations with the 1979 July count of adult males on St. George Island, it appears that the male population on the entire island has increased at an annual average rate of 23%. This value is somewhat greater than our counts from East Reef and Zapadni Rookeries indicate. Since the whole island census includes the hauling grounds, it is possible that our rookery counts present a biased view of the growth of the male population. By either count, the annual growth of the male population far exceeds the annual decline in females and pups.

"Harem to Idle Male" Ratio

The adult males on the daily census and distribution maps were counted separately according to whether the males were seen in contact with females during the sampling period. Contact was determined by

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5/ See glossary for a description of the classes of adult male fur seals.

comparing the daily maps for males with those of the female distribution. Such contact with females is the same criterion used to assign males to the "Harem" and "Idle" categories during the annual count of adult males in July. Because the female distribution changes daily, the number of males assigned to these two categories may change even if the total number of males remains the same. Therefore, to obtain the means presented in part E of Table 7, daily counts were made of males in these categories, and "Harem/Idle" male ratios were calculated for each day. The seven daily ratios from the week ending 13 July were combined into one mean to represent the "Harem/Idle" ratio for each year.

Part E of Table 7 shows that the "Harem/Idle" male ratio has not shown a directional change during the past 6 years. That is, neither category of males has been affected consistently more than the other during the period when the male populations at East Reef and Zapadni Rookeries grew by 115% and 78%, respectively. The "Harem/Idle" ratio at East Reef Rookery has remained relatively constant. The apparent increases in 1975 and 1976 result from the fact that the population of idle males was so low that even slight increases in actual numbers had an apparently amplified effect in the ratio. At Zapadni Rookery, the ratio seems to have fluctuated unpredictably but shows no directional trend.

This finding in two sample rookeries is substantiated by the annual July counts of adult males for the island as a whole. Table A-7 in Appendix A of the 1978 Report of Fur Seal Investigations shows that the "Harem/Idle" male ratios for the island have fluctuated unpredictably from 1974 to 1978. Because of the rapidity with which some males change from "Harem" to "Idle" and back, depending on the distribution of females, and because males classified as "Idle" in mid-July may occupy a territory full time in late July, caution should be used in making management decisions based on the instantaneous "Harem/Idle" male ratio obtained from a single count in July.

Female/Male Ratio

The relationship between adult female and adult male numbers was calculated in two ways. Females/total males is intended to show changes in the overall sex ratio of adults present. Females/"Harem" males is intended to show changes in the effective sex ratio of adults, that is, the sex ratio among reproducing adults. The latter ratio is equivalent to the older concept of average "harem size." The harem concept is not used here because 1) the movements of individual females shows that such groups are not discrete, and 2) reproduction proceeds with or without spatial separations between apparent groups. Nevertheless, it is important to consider the ratio

of females to males, regardless of the social structure within which male-female contact occurs. The term "harem male" is retained for convenience in expression but is denoted with quotation marks.

The daily total number of females, "harem," and "idle" males was determined from census and distribution maps. Daily ratios of females/"harem" males and of females/total males were calculated each year for every day of the week ending 13 July. These daily ratios were grouped into two means representing the population for that season. Part F of Table 7 presents these means and their standard deviations. Note that Zapadni Rookery, 1974 is represented from only two female censuses.

Female/male ratios have undergone four to five-fold decreases during the past six seasons, as part F of Table 7 shows. These decreases are somewhat greater than the three-fold decreases in the female population (part A of Table 7) because of the effect on the ratio that increases in the male population (part D of Table 7) have had. The similarity between the decline for total males and for "harem" males at both sites further emphasizes the previous finding that the "harem/idle" male ratio has not changed progressively.

It is important to note that the ratios here are instantaneous. They show that at the peak of the season average males "see" 6 to 13 females each day. Because an unknown number of females is at sea, the actual sex ratio in the adult herd is unknown but larger. Part F of Table 7 therefore suggests that the actual sex ratio, whatever it is, has probably changed substantially in the past 6 years.

Male Territory Size

Male territory size is important because a) it directly determines the number of males that can contact a given female population, and b) it may affect reproductive efficiency and pup survival indirectly through the aggressive acts used to defend the territory (aggression should increase as territory size decreases). Therefore, the changes in territory size that accompany changes in the size of the male population are important aspects of the optimum sex ratio.

Territory size can be measured in several ways. The best method is to mark on a map the terrain actually defended by each male, and then calculate the area defended using a planimeter. This method yields the variability in the herd, and the minimum area of ground that males will defend. Such measurements can be correlated with individual copulation frequencies to find, in reproductive terms, the optimum territory size. Our data on defended area have not been analyzed.

A second method is to find the mean territory size for a rookery by dividing the number of square meters available by the number of males using the area. Such a calculation is simple and might be widely used as an index to optimum territory size after this relationship is established using the above method. Our data do permit a calculation of mean territory size.

Mean territory size at East Reef Rookery was calculated for each year by dividing 1500 meters^2 (i.e., fifteen 10 x 10 meter grid sectors) by the mean number of males present during the week of 13 July, reported in part D of Table 7. At Zapadni Rookery the division was 4,000 meters^2 / males present. This method is slightly inaccurate because it assumes, incorrectly, that territorial boundaries of all males lie completely within the boundaries of the grid. Nevertheless, the method is accurate enough to show broad trends.

Territories at East Reef Rookery appear to have been smaller at the outset (1974) than at Zapadni Rookery, and to have remained smaller through the progressive decline caused by the increasing male population. One possible explanation of the difference between sites is that East Reef Rookery is a narrow beach having little space available where peripheral males can establish residence whereas Zapadni offers substantial peripheral areas. Furthermore, males at East Reef Rookery may use the large boulders to separate themselves from neighbors. Such use of rocks would allow males to reside in smaller territories than males on flat terrain lacking rocks (such as Zapadni Rookery).

Monitoring population changes at St. George Island in detail has thus provided a more detailed picture than the conventional monitoring efforts of the stages in herd recovery from the harvested to an unharvested condition. The measures discussed in this report will be continued into the future until the parameters appear to stop changing. They will be reported in the annual report of Fur Seal Investigations only sporadically.

Tags applied during behavioral and biological research during 1979 are reported in Table 8.

Roger Gentry
John Francis
John Holt

TABLE 8.--Tags applied to fur seals for behavioral study, St. George Island, Alaska, 1979.

Type of tag	Tag number	Age-sex class	Number	Rookery
Monel, silver	x 1826-1828 x 1830-1850	Adult male	13	Zapadni
Plastic, white	531-536	Adult female	6	East Reef
Plastic, green	55, 56, 58-73, 75, 201-204	Non-territorial Adult male	19	Zapadni
	76-77, 81, 83-94	Non-territorial Adult male	14	East Reef
Plastic, yellow	700-802	Male pup	102	East Reef
	803-835 837-853 855-906	Male pup	101	Zapadni
Plastic, white	700-804	Female pup	105	East Reef
	805-909	Female pup	105	Zapadni

Part III. VETERINARY MEDICAL SERVICES AND RESEARCH (Formerly Physiology and Medicine)

Pathology -- St. Paul Island

From 26 June through 14 August, Mark Keyes and Edward Robb collected or counted 131 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). Study areas 2 and 3 were not constructed and in use until 1967. Study area 4 was constructed just prior to the 1977 season.

Parasitology

Respiratory Mite Research

This work was carried out by Ke Chung Kim and assistant Michael Quinn, Department of Entomology, Pennsylvania State University. They were assisted by Mark Keyes and Edward Robb.

The objectives of the study were to 1) obtain missing data on the density and structure of populations of Orthohalarachne attenuata and O. diminuata on northern fur seals; 2) determine the effects of temperature and diet on nasal mites in artificial culture; 3) study the mode and time of transmission from mother to pup; 4) investigate the ecological relationship between the two species of mites; and 5) determine the effects of the mites on the host (behavioral and pathological).

1. Population density and structure.--Heads and respiratory organs were collected from 16 subadult male fur seals from the commercial harvest of males, six black pups found dead on mortality study areas, and two Steller sea lions found dead at Lukanin and Polovina Rookeries. Skins were collected from the six pups and two sea lions in the above sample. Mucus and pharyngeal epithelium samples were taken from four subadult males in the harvest.

2. Artificial culture.--Eight different media were tried: MEM Eagle, Earle Base (commercial tissue culture medium); MEM Eagle, Earle Base plus methyl cellulose; Nutrient Dextrose Agar; Neopeptone Dextrose Agar; Water Dextrose Agar; PDA-Potato Dextrose Agar; Water Agar; and air with a cotton plug.

Agar base media were unsatisfactory. Mites molted and grew in MEM Eagle, Earle Base medium, and in air with a cotton plug for as long as three weeks. Adult mites could not be cultured.

3. Transmission studies.--Six pregnant female fur seals were captured from Zapadni Reef Rookery on 6 July and maintained in cages along the inland fringe of the rookery. Five of the females delivered a single pup each by 8 July, at which time each pup was artificially infected with 100 larval mites of each species collected from fresh snouts of subadult males taken in the harvest. Five days later the infected pups were killed and the snouts and respiratory organs taken for analysis of development and spread of the mites. The sixth female did not deliver until 10 July so she was released with her pup. The other five females were also released.

4. Ecological relationships.--The effect of light and temperature on mite activity was studied. Intranasal and deep body temperatures were taken on 10 subadult male fur seals during the commercial male harvest just after the seals had been stunned. Nasal passage temperatures varied from 33.50° to 40.00°C and deep body temperatures (taken rectally) varied from 37.00° to 39.75°C during ambient temperatures of 5.25° to 7.00°C.

5. Pathology.--Tissue samples were taken from the nasopharynx and ethmoidal labrynth for histopathology. Sneezing of subadult male and adult female fur seals was monitored.

Pathology -- St. George Island

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

From 3 July to 15 August, Richard Stroud and Thomas Roffe collected 213 dead fur seal pups from under catwalks on the study area at Staraya Artil Rookery as described earlier (Marine Mammal Division, 1978). Of these pups, 204 were necropsied and 9 were discarded as unsuitable for examination because of advanced post mortem degeneration.

Necropsy Results

Tabulation of the primary diagnoses for pups necropsied (Table 9) showed that the main cause of death was emaciation syndrome which accounted for 107 cases (50.2%) on study area 4, 10 more than in 1978. There were 5 more hookworm deaths in 1979 than in 1978, but 10 fewer deaths from microbial infection. The incidence of leptospirosis dropped from 26 cases in 1978 to 8 in 1979. Deaths from trauma continued higher than in 1977 at 13 cases (6.1%). Included in the miscellaneous category were one case of toxemia, three congenital

TABLE 9.--Primary diagnoses of causes of death among seal pups on Staraya Artil Rookery, Mortality Study Area 4, St. George Island, Alaska, by weekly intervals from 28 June to 15 August, 1979.

Primary Diagnoses	28 June-4 July		5-11 July		12-18 July		19-25 July		26 July-1 Aug		2-8 Aug		9-15 Aug		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Emaciation Syndrome	0	0.0	9	30.0	15	39.5	27	55.1	25	64.1	16	66.6	15	88.2	107	50.2
Hookworm Disease	1	6.3	5	16.7	11	28.9	8	16.3	9	23.0	4	16.7	1	5.9	39	18.3
Microbial Infection	1	6.3	6	20.0	3	7.9	2	4.1	4	10.3	3	12.5	1	5.9	20	9.4
Peritonitis	-	-	(1)	(3.3)	-	-	-	-	-	-	-	-	-	-	(1)	(0.5)
Absess/Cellulitis	-	-	(1)	(3.3)	(1)	(2.6)	(1)	(2.0)	-	-	-	-	(1)	(5.9)	(4)	(1.9)
Omphalophlebitis	(1)	(6.3)	-	-	-	-	(1)	(2.0)	-	-	-	-	-	-	(2)	(0.9)
Enteritis	-	-	-	-	-	-	-	-	(4)	(10.3)	(1)	(4.2)	-	-	(5)	(2.3)
Leptospirosis (Perinatal-complex)	-	-	(4)	(13.4)	(2)	(5.3)	-	-	-	-	(2)	(8.3)	-	-	(8)	(3.8)
Trauma	2	12.5	5	16.7	3	7.9	2	4.1	-	-	1	4.2	-	-	13	6.1
Bite Wound	(1)	(6.3)	(1)	(3.3)	(1)	(2.6)	(1)	(2.0)	-	-	-	-	-	-	(4)	(1.9)
Skull Fracture	-	-	(2)	(6.7)	(2)	(5.3)	(1)	(2.0)	-	-	(1)	(4.2)	-	-	(6)	(2.8)
Organ Rupture	-	-	(2)	(6.7)	-	-	-	-	-	-	-	-	-	-	(2)	(0.9)
Crushing/suffocation	(1)	(6.3)	-	-	-	-	-	-	-	-	-	-	-	-	(1)	(0.5)
Miscellaneous	0	0.0	2	6.6	5	13.2	4	8.2	-	-	-	-	-	-	11	5.2
Toxemia	-	-	-	-	(1)	(2.6)	-	-	-	-	-	-	-	-	(1)	(0.5)
Congenital/Anomalies	-	-	(1)	(3.3)	(1)	(2.6)	(1)	(2.0)	-	-	-	-	-	-	(3)	(1.4)
Dystocia/Stillbirth	-	-	-	-	(3)	(7.9)	(2)	(4.1)	-	-	-	-	-	-	(5)	(2.3)
Suffocation	-	-	-	-	-	-	(1)	(2.0)	-	-	-	-	-	-	(1)	(0.5)
Hemolytic Crisis	-	-	(1)	(3.3)	-	-	-	-	-	-	-	-	-	-	(1)	(0.5)
Undetermined	3	18.7	3	10.0	1	2.6	6	12.2	1	2.6	-	-	-	-	14	6.6
Unsuitable	9	56.2	-	-	-	-	-	-	-	-	-	-	-	-	9	4.2
Total	16	100.0	30	100.0	38	100.0	49	100.0	39	100.0	24	100.0	17	100.0	213	100.0

anomalies, five stillbirths, one suffocation, and one hemolytic crisis or nonhookworm anemia. The congenital anomalies included one case of multiple defects; severe scoliosis, cleft palate, abnormal thoracic development, and female pseudohermaphroditism; a case of pulmonary hypoplasia due to a large intrathoracic congenital pancreatic cyst, and a case of ventricular septal defeat with a common pulmonary artery-aorta septal defect, along with lung atrophy, and defects in the diaphragm in association with bilateral hyphema, a characteristic of leptospirosis.

Death Rate

Total live pup counts within the study area were made as follows: 6 July, 899; 13 July, 1,274; 20 July, 1,540; 27 July, 1,536; 3 August, 1,111; 9 August, 989; and 15 August, 799. The average number of pups in the study area over the 7-week period was 1,272. A total of 213 dead pups collected from the study area thus represents a death rate of 16.7% for Staraya Artil Rookery and a 9.7% sample of the total dead pups counted on St. George Island in 1979.

Epizootiology

Table 10 compares the incidence of the major categories of death causes for the past 3 years and shows a gradual increase in the incidence of emaciation syndrome. Since simple starvation is indistinguishable from emaciation syndrome, it is possible that some increment of this increase could be owing to increased disruption of nursing pairs by increased numbers of harem males. Another hint of such a trend is the noticeable increase in deaths from injury noted from 1977 to 1978 and 1979, the first years that large increases in territorial males on the rookeries might be expected because of the fact that the first year of the moratorium was 1973 and some of the survivors since that year are now 10-11 years old and competing for space on the rookeries. There were 71 adult males on the study area on 10 July 1978 and 81 on 13 July 1979.

Leptospirosis appeared to reach a peak in 1978 so a reduction in 1979 was not surprising. On four occasions, adult females identified as mothers of newborn dead pups with bilateral hyphema (whole blood in the anterior chamber of both eyes) were killed by gunshot and collected for pathology and serology.

The number of hookworm deaths in 1979, as in 1978, was considerably lower than in 1977. The weather during mid-July of 1978 and 1979 was much milder than during the same period in 1977. Mid-July to the end of the first week in August is the period when the greatest percentage of pups are dangerously anemic.

TABLE 10.--Comparison of primary diagnoses for causes of death among seal pups, Study Area 4, St. George Island, Alaska, 1977-1979.

Primary diagnoses	1977 Dead pups		1978 Dead pups		1979 Dead pups		Total Dead pups	
	No.	%	No.	%	No.	%	No.	%
Emaciation syndrome	78	38.2	97	44.5	107	50.2	282	44.4
Hookworm disease	64	31.4	34	15.6	39	18.3	137	21.6
Microbial infection	20	9.8	30	13.8	20	9.4	70	11.0
(Leptospirosis)	(10)	(4.9)	(26)	(11.9)	(8)	(3.8)	(44)	(6.9)
Trauma	5	2.5	18	8.3	13	6.1	36	5.7
Miscellaneous	2	1.0	14	6.4	11	5.2	27	4.2
Undetermined	6	2.9	16	7.3	14	6.6	36	5.7
Unsuitable for examination	29	14.2	9	4.1	9	4.2	47	7.4
Total	204	100.0	218	100.0	213	100.0	635	100.0

Baseline data for 1977 appears to be more representative of pup mortality prior to a buildup of adult males than data collected in 1978 and 1979, although all 3 years' data, singly or collectively, are similar to comparable data from St. Paul Island. In 1978 on the Staraya Artil Rookery study area, St. George Island, emaciation syndrome accounted for 44.5% of the pup deaths. On study area 1, Reef Rookery, St. Paul Island, emaciation syndrome accounted for 43.2% in 1966 and 40.9% in 1976. On St. George Island in 1977, hookworm disease accounted for 31.4% of the pup deaths on Staraya Artil Rookery. On study area 3, Vostochni Rookery, St. Paul Island, the death rate from hookworm disease was 32.7% in 1967 and 38.8% for all three St. Paul Island study areas combined in 1976. Leptospirosis had a rate of 3.3% on St. George Island in 1977. The 4-year average for all study areas on St. Paul Island from 1968 through 1971 was 3.9%.

Mark Keyes
Richard Stroud
Ke Chung Kim

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

Adams Cove

Northern fur seals breeding at Adams Cove on the western end of San Miguel Island (Appendix D, Figure D-2) have been monitored daily during each breeding season from 1969 to 1979. The resulting population information is presented in Table 11 and summarized below.

The breeding season begins in mid- to late May when the adult males establish territories on the rookery and the first females haul out. In 1979, the first pup was born 28 May and the mean pupping date was 29 June; 834 pups were born at the Adams Cove rookery, an increase of 31% over 1978. Although this increase was not as great as that from 1977 to 1978 (51%), the population's growth rate continues to be extremely high.

In addition to female recruitment from within the population, large increases in the number of breeding females at Adams Cove were caused partly by the immigration of animals from other rookeries as documented by frequent observations of individuals that had been tagged or otherwise marked as pups on the Pribilof, Commander, and Robben Islands. Females could also be immigrating from nearby Castle Rock into the Adams Cove colony, although at this time there is no evidence to confirm such movements.

The number of territorial and nonterritorial adult males (large and small) observed at Adams Cove from 1978 to 1979 changed very little. The number of subadult males, however, increased from 19 to 50. This increase was probably the result of recruitment of males born after 1973 when pup production began to increase markedly. Marked males from northern populations have never been observed at San Miguel Island.

Tagging Records

Records have been kept of each marked seal observed ashore in Adams Cove, starting in 1968 with the discovery of this colony on San Miguel Island. As stated earlier, some of these females had been tagged as pups on the Pribilof, Commander, and Robben Islands (Appendix A, Table A-15), and some had been tagged as adult females or pups at Adams Cove on 20 July 1968 (Appendix A, Table A-16). Records have also been kept of sightings of adult females tagged on San Miguel Island in 1975 (Appendix A, Table A-17). From 1976 to 1979, we resighted 43 of 50 females (86%) tagged in 1975; however, during each separate season we resighted only about 50% of these individuals (Appendix A, Table A-16).

TABLE 11.--Summary of some observations of the northern fur seal colony in Adams Cove on San Miguel Island, California, 1969-79.

Observation	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Season span											
Beginning date[1]	16 May	23 May	15 May	16 May	9 May	20 May	19 May	29 May	18 May	17 May	15 May
Ending date	1 Oct.	20 Sept.	6 Sept.	7 Sept.	15 Aug.	9 Sept.	6 Sept.	14 Sept.	22 Sept.	9 Sept.	15 Sept.
First male	16 May	29 May	24 May	16 May	26 May	20 May	12 May	29 May[2]	18 May[9]	17 May[3]	21 May
First female	27 May	28 May	25 May	22 May	17 May	20 May[3]	19 May	29 May[2]	18 May[9]	17 May[11]	16 May[13]
First birth	6 June	28 May	31 May	22 May	7 June[4]	27 May	27 May	29 May[5]	29 May	30 May	28 May
Mean birth date	24 June	21 June	26 June	22 June	24 June	23 June	27 June	29 June	25 June[10]	24 June	29 June
Total births	28	33	45	70	68	220	329	417	421	635	834
Total pup deaths	2	14	15	21	17	52	46	91	64	77	72
Total females (maximum counted and date)[6]	175	179	274	310	394	551	563	495	681	584	702
	23 Aug.	23 Aug.	2 Sept.	16 Aug.	4 Aug.	8 Sept.	24 Aug.	14 July	26 Aug.	18 Aug	25 Aug.
Total large adult males	4	2	4	6	6	6	10[7]	7	7	13[7]	11
Total small adult males	4	4	6	7	5	6	6	5	3	12[12]	13[12]
Total bachelors[8]	4	5	6	10+	6	8	7	11	7+	19	50

1/ Beginning and ending dates of continuous observations.
2/ Four males, nine females present 29 May--arrived prior to 29 May.
3/ May have arrived earlier.
4/ One still birth occurred on 19 May.
5/ One pup present 29 May--born prior to 29 May.
6/ A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
7/ Includes two males who arrived in late August and were not territorial (probably from Castle Rock).
8/ Animals about 104-127 cm in body length, tip of nose to tip of tail.
9/ Three males and 2 females present 17 May--arrived prior to 18 May.
10/ Estimated from previous breeding season information.
11/ Two females present 17 May -- arrived prior to 18 May
12/ Includes six small adult males who were not territorial.
13/ Four females present 16 May--arrived prior to 16 May.

The fur seal pup tagging program on San Miguel Island began in 1975. During subsequent years, the general trend has been for more resightings of tagged fur seals from each year class as they increase in age (Appendix A, Table A-18). In 1979 nine 3-year-olds (6 females and 3 males) and twenty-three 4-year-olds (10 females and 13 males) were resighted at Adams Cove. From 1976 through 1979 tagged yearlings were never resighted and resightings of tagged 2-year-olds averaged 1.0% for 1977 through 1979. The resightings of tagged 3-year-olds averaged 14.0% for 1978 and 1979, and of tagged 4-year-olds, 23.0%. This apparent age specific return rate for tagged fur seals at Adams Cove is similar to the Pribilof Islands population; however, it is impossible to statistically compare the two because of the harvest of young males on the latter.

In August 1979 two 4-year-old females tagged in 1975 at Adams Cove were observed nursing pups of the year. We are relatively certain that these females were the pups' natural mothers because of their obvious maternal behavior. Both females were probably primiparous since the year of first pregnancy rarely occurs before age 4 years on the Pribilof Islands (North Pacific Fur Seal Commission, 1969). These are the first known-age parturient females that have been recruited from within the Adams Cove population.

On 9 September 1979, 200 fur seal pups were single tagged with modified monel cattle ear tags and checkmarked by removal of the cartilaginous extension of the 2nd digit of the right hind flipper (Appendix A, Table A-19).

Mortality

In 1979 the fur seal pup mortality rate was 8.6% of the total pup production, the lowest for the Adams Cove population since 1970. Thirty-two percent of the 72 pup deaths recorded in 1979 resulted from heat prostration during 3 days of abnormally hot weather conditions[6/] (7, 8, and 9 June). Eleven percent of the total were crushed or suffocated by falling earth embankments. Approximately 12.0% of the pup deaths occurred during periods of large storm surf which flooded the rookery. These pups probably died from drowning or exposure. The cause of pup mortality for the remaining 45.0% was undetermined.

6/ High air temperatures, solar radiation, and calm air combine to raise body temperatures and cause heat prostration.

Castle Rock

In 1972, a northern fur seal rookery was discovered on Castle Rock (Appendix D, Figures D-3 and D-4), a small island approximately 2 miles north of the west end of San Miguel Island. A summary of the Castle Rock census information for 1972 to 1979 is shown in Table 12. These data have been obtained from afoot, from aerial photographs, and from offshore using a small skiff. A total of 617 pups were born on Castle Rock in 1977. In 1978, there was a decline of 84 to 533. At a new and higher level of 653 (626 living and 27 dead) on 1 August in 1979, there were 120 more than in 1978, but only 36 more than in 1977.

Twenty-seven breeding males were counted on Castle Rock from aerial photographs taken 3 July 1979 (Table 12), the largest number of territorial males recorded since discovery of this colony.

On 7 September 1979, 100 fur seal pups were single tagged with modified monel cattle ear tags (Appendix A, Table A-20) and checkmarked as described for animals of the Adams Cove population.

Post-Breeding Season Use of Rookeries

During the post-breeding season (which begins in late summer) the numbers of subadult males and females increase, although lactating females and nursing pups still form the largest segment of the fur seal population remaining on the rookery. In October, the numbers ashore begin to decrease as some seals begin their winter ocean period. A pup tagged on 7 September 1979 was recovered 12 October 1979 near San Francisco, approximately 445 km north of San Miguel Island. By midwinter most fur seals have abandoned the rookery sites and on land their numbers remain very low until early summer at the beginning of the breeding season.

On San Miguel Island relatively large numbers of subadults, females and nursing pups are on the rookeries in December and their numbers are not greatly reduced until January. During the 1978-79 winter, there were 54 females, 6 subadult males, and 5 pups counted at Adams Cove on 13 December 1978 (Jim Lecky, NMFS, Pers. commun.). By 31 January 1979, only 14 females remained and no more than 5 were observed here between February and April 1979 (Brent Steward, Hubbs-Sea World Inst., Pers. commun.). During the 1979-80 winter at Adams Cove there were 104 females, 1 male and 121 pups on 5 December 1979 and by 8 January 1980, only 7 females, 1 subadult male and 1 pup remained (Brent Steward, Hubbs-Sea World Inst., Pers. commun.).

TABLE 12.--Summary of northern fur seal censuses on Castle Rock (adjacent to San Miguel Island) California, 1972-79[1/].

Fur seals	Numbers observed, methods and date of observation							
	1972	1973	1974	1975	1976	1977	1978	1979
Females	223[a] 1 Aug.	345[a] 11 Jul.	301(+)[d]	396(+)[d]	526[c] 27 Jun.	617(+)[d]	533(+)[d]	653(+)[d]
Pups (total observed)[2/]	95[a] 1 Aug.	193[b] 28 Jul.	301(+)[b] 2 Aug.	396[b] 2 Aug.	521[b] 25 Jul.	617[b] 29 Jul.	533[b] 2 Aug.	653[b] 1 Aug.
Pups (dead observed)	- -	33[b] 28 Jul.	21[b] 2 Aug.	28[b] 2 Aug.	27[b] 25 Jul.	20[b] 29 Jul.	26[b] 2 Aug.	27[b] 1 Aug.
Reproductive large adult males[3/]	9[a] 1 Aug.	13[a] 11 Jul.	11[a] 2 Jul.	15[a] 1 Jul.	16[c] 27 Jun.	9(+)[a] 26 Jul.	20[a] 1 July	27[a] 3 July
Total large adult males	10[a] 1 Aug.	14[a] 11 Jul.	20[a] 2 Jul.	20[a] 1 Jul.	18[c] 27 Jun.	9(+)[a] 26 Jul.	25[a] 1 July	32[a] 3 July
Total small adult males	-	-	-	-	-	-	-	7[a] 3 July

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

2/ Includes dead pup count

3/ Territorial adult males with females in territories.

The pattern of haulout behavior on San Miguel Island is similar to that of the Pribilof Islands (Peterson, 1965). The two populations differ, however, in the timing of movements off the island and the use of rookeries throughout the post-breeding season. Most fur seals on the Pribilof Islands have abandoned the rookeries by late November (Peterson, 1965), almost 2 months before low population levels are observed on San Miguel Island.

George Antonelis, Jr.
Robert DeLong
Clifford Fiscus

Part V. PELAGIC ECOSYSTEM

A separate report will be submitted to the North Pacific Fur Seal Commission in April 1980 regarding the general migration and distribution of northern fur seals in the eastern North Pacific Ocean and Bering Sea. This report considers monthly fur seal sightings, numbers collected, age and sex composition, reproduction (pregnancy rates) and their feeding habits. A life table and biomass estimates for northern fur seals will also be included.

Hiroshi Kajimura

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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:

Bachelor Young male seals of ages 2-5 years.

Checkmark A notch, slit, hole, or other mark made on a seal flipper when a tag is applied to ensure recognition of an animal that has lost its tag.

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

Escapement Seals that were not harvested 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.

Prior to 1966, 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.

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 cartilaginous tip of a digit from a hind flipper, by attaching an inscribed metal tag to one or more of its flippers, by freeze marking or by hair-clipping and bleaching.

Rookery An area on which breeding seals congregate. See HAULING GROUND.

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

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APPENDIX A

Tabulations of northern fur seal data collected on the Pribilof Islands, Alaska and on San Miguel Island, California and nearby Castle Rock in 1979.

APPENDIX A -- continued

TABLE A-1.--Age classification of male seals harvested on St. Paul Island, Alaska, 26 June to 31 July 1979.

Date/Rookery[1]	Males harvested	Tooth sample	Daily: Percent in each age group of sample					Daily: Estimated number harvested by age group					Total harvest to date	Cumulative: Estimated number harvested by age group					Cumulative: Percent harvested by age group				
			2	3	4	5	6	2	3	4	5	6		2	3	4	5	6	2	3	4	5	6
June 26 NEP (east)	725	127	0.8	35.4	57.5	6.3	0.0	6	256	417	46	0	725	6	256	417	46	0	1	35	58	6	0
26 NEP (west)	320	62	0.0	42.0	53.2	4.8	0.0	0	135	170	15	0	1,045	6	391	587	61	0	1	37	56	6	0
27 POL	500	97	1.0	46.4	49.5	3.1	0.0	5	232	247	16	0	1,545	11	623	834	77	0	1	40	54	5	0
27 L-K	208	36	5.6	61.0	27.8	5.6	0.0	12	127	57	12	0	1,753	23	750	891	89	0	1	43	51	5	0
28 TZR	385	69	0.0	40.6	53.6	5.8	0.0	0	156	206	23	0	2,138	23	906	1,097	112	0	1	43	51	5	0
29 ZAP	350	81	1.2	51.9	44.5	2.4	0.0	4	182	156	8	0	2,488	27	1,088	1,253	120	0	1	44	50	5	0
July 2 Reef	823	136	0.7	57.4	39.7	2.2	0.0	6	472	327	18	0	3,311	33	1,560	1,580	138	0	1	47	48	4	0
3 NEP (east)	610	167	3.0	50.3	44.3	2.4	0.0	18	307	270	15	0	3,921	51	1,867	1,850	153	0	1	48	47	4	0
3 NEP (west)	672	156	2.6	69.2	25.6	2.6	0.0	17	465	173	17	0	4,593	68	2,332	2,023	170	0	1	51	44	4	0
5 POL	375	110	1.8	43.7	51.8	2.7	0.0	7	164	194	10	0	4,968	75	2,496	2,217	180	0	1	50	45	4	0
5 L-K	242	64	3.1	39.0	54.7	1.6	1.6	8	94	132	4	4	5,210	83	2,590	2,349	184	4	2	50	45	3	0
6 TZR	333	93	4.3	64.5	31.2	0.0	0.0	14	215	104	0	0	5,543	97	2,805	2,453	184	4	2	51	44	3	0
9 ZAP	1,409	390	6.2	65.1	27.4	1.3	0.0	88	917	386	18	0	6,952	185	3,722	2,839	202	4	3	53	41	3	0
10 Reef	1,011	226	4.0	60.2	34.9	0.9	0.0	40	609	353	9	0	7,963	225	4,331	3,192	211	4	3	54	40	3	0
11 NEP (east)	960	212	7.0	59.0	32.1	1.9	0.0	67	567	308	18	0	8,923	292	4,898	3,500	229	4	3	55	39	3	0
11 NEP (west)	432	115	2.6	58.2	38.3	0.9	0.0	11	251	166	4	0	9,355	303	5,149	3,666	233	4	3	55	39	3	0
12 POL	913	174	4.6	59.2	34.5	1.7	0.0	42	540	315	16	0	10,268	345	5,689	3,981	249	4	3	55	39	3	0
12 L-K	461	88	3.4	52.3	42.0	2.3	0.0	16	241	194	10	0	10,729	361	5,930	4,175	259	4	3	55	39	3	0
13 TZR	432	100	0.0	42.0	54.0	4.0	0.0	0	182	233	17	0	11,161	361	6,112	4,408	276	4	3	55	40	2	0
16 ZAP	1,129	241	11.6	67.7	20.3	0.4	0.0	131	764	229	5	0	12,290	492	6,876	4,637	281	4	4	56	38	2	0
17 Reef	760	133	2.2	53.4	42.9	1.5	0.0	17	406	326	11	0	13,050	509	7,282	4,963	292	4	4	56	38	2	0
18 NEP (east)	338	69	7.3	71.0	21.7	0.0	0.0	25	240	73	0	0	13,388	534	7,522	5,036	292	4	4	56	38	2	0
18 NEP (west)	305	47	2.1	72.4	23.4	2.1	0.0	6	221	72	6	0	13,693	540	7,743	5,108	298	4	4	57	37	2	0
19 POL	210	44	0.0	50.0	47.7	2.3	0.0	0	105	100	5	0	13,903	540	7,848	5,208	303	4	4	56	38	2	0
19 L-K	150	41	0.0	63.4	36.6	0.0	0.0	0	95	55	0	0	14,053	540	7,943	5,263	303	4	4	57	37	2	0
20 TZR	415	97	3.1	54.7	41.2	1.0	0.0	13	227	171	4	0	14,468	553	8,170	5,434	307	4	4	56	38	2	0
23 ZAP	1,478	224	5.8	63.0	29.0	1.8	0.4	86	931	429	26	6	15,946	639	9,101	5,863	333	10	4	57	37	2	0
24 Reef	1,816	427	11.5	67.2	21.1	0.2	0.0	209	1,220	383	4	0	17,762	848	10,321	6,246	337	10	5	58	35	2	0
25 NEP (east)	940	287	8.7	65.2	24.7	1.4	0.0	82	613	232	13	0	18,702	930	10,934	6,478	350	10	5	58	35	2	0
25 NEP (west)	962	189	15.3	67.8	15.3	1.6	0.0	147	653	147	15	0	19,664	1,077	11,587	6,625	365	10	5	59	34	2	0
26 POL	997	195	8.2	58.5	29.7	3.6	0.0	82	583	296	36	0	20,661	1,159	12,170	6,921	401	10	6	59	33	2	0
26 L-K	365	90	22.2	61.1	15.6	1.1	0.0	81	223	57	4	0	21,026	1,240	12,393	6,978	405	10	6	59	33	2	0
27 TZR	608	154	5.9	59.7	33.8	0.6	0.0	36	363	205	4	0	21,634	1,276	12,756	7,183	409	10	6	59	33	2	0
30 ZAP	1,980	562	12.6	62.3	23.3	1.8	0.0	249	1,234	461	36	0	23,614	1,525	13,990	7,644	445	10	7	59	32	2	0
31 Reef	2,088	488	25.2	60.1	13.1	1.2	0.4	526	1,255	274	25	8	25,702	2,051	15,245	7,918	470	18	8	59	31	2	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 Ardiquen; L-K = Lukanin and Kitovi.

TABLE A-2.--Age classification of male seals killed, subsistence harvest, St. George Island, Alaska, 29 June to 21 August 1979. A dash indicates that teeth samples were not collected for age determination.

Date/Rookery[1/]	Males killed	Tooth sample	Percent in each age group of sample				Estimated number killed from each age group			
			2	3	4	5	2	3	4	5
June 29 Staraya Artil	25	22	0.0	27.3	72.7	0.0	0	7	18	0
July 3 Staraya Artil	25	25	0.0	68.0	32.0	0.0	0	17	8	0
6 Staraya Artil	25	25	0.0	32.0	60.0	8.0	0	8	15	2
10 Staraya Artil	25	24	4.2	58.3	37.5	0.0	1	15	9	0
13 Staraya Artil	24	24	4.2	50.0	45.8	0.0	1	12	11	0
17 North (east)	26	25	12.0	84.0	4.0	0.0	3	22	1	0
20 North (east)	25	-	-	-	-	-	-	-	-	-
24 North (east)	26	-	-	-	-	-	-	-	-	-
27 North (east)	26	-	-	-	-	-	-	-	-	-
31 North (east)	26	-	-	-	-	-	-	-	-	-
August 3 Staraya Artil	25	21	33.3	66.7	0.0	0.0	8	17	0	0
10 North (east)	25	25	68.0	32.0	0.0	0.0	17	8	0	0
14 North (east)	25	25	84.0	16.0	0.0	0.0	21	4	0	0
21 North (east)	23	-	-	-	-	-	-	-	-	-
Total	351									

1/ North (east) = east hauling ground of North Rookery; Staraya Artil = sole hauling ground of Staraya Artil Rookery.

TABLE A-3.--Adult male fur seals counted, by class [1/] and rookery section, St. Paul Island, Alaska 18-23 June 1979. 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	39	43	-	-	-	-	-	-	-	-	-	-	-	-	82
3	15	17	-	-	-	-	-	-	-	-	-	-	-	-	32
5	66	7	-	-	-	-	-	-	-	-	-	-	-	-	73
Kitovi [2/]															
2	36(13)	11	44	59	46	-	-	-	-	-	-	-	-	-	209
3	19 (6)	4	20	19	14	-	-	-	-	-	-	-	-	-	82
5	0 (0)	0	2	0	70	-	-	-	-	-	-	-	-	-	72
Reef															
2	63	82	82	46	64	43	66	68	46	47	16	-	-	-	623
3	13	13	19	10	11	17	1	12	14	10	7	-	-	-	127
5	11	2	7	0	189	17	0	30	0	15	2	-	-	-	273
Gorbatch															
2	65	54	51	23	38	66	-	-	-	-	-	-	-	-	297
3	30	19	12	1	11	13	-	-	-	-	-	-	-	-	86
5	60	0	1	151	5	0	-	-	-	-	-	-	-	-	217
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Morjovi [3/]															
2	59(41)	50	46	79	61	66	-	-	-	-	-	-	-	-	402
3	16 (5)	21	10	18	25	14	-	-	-	-	-	-	-	-	109
5	1(12)	66	50	0	0	25	-	-	-	-	-	-	-	-	154
Vostochni															
2	52	27	44	39	31	97	60	74	57	30	38	49	109	55	762
3	14	5	9	10	3	27	12	22	18	8	13	17	37	8	203
5	128	6	1	30	50	1	6	3	30	0	0	38	35	30	358

See footnotes at end of table.

TABLE A-3.--Adult male fur seals counted, by class[1/] and rookery section, St. Paul Island, Alaska 18-23 June 1979 (A dash indicates no numbered sections) - continued.

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	41	-	-	-	-	-	-	-	-	-	-	-	-	77
3	7	5	-	-	-	-	-	-	-	-	-	-	-	-	12
5	10	155	-	-	-	-	-	-	-	-	-	-	-	-	165
Polovina															
2	57	27	-	-	-	-	-	-	-	-	-	-	-	-	84
3	13	6	-	-	-	-	-	-	-	-	-	-	-	-	19
5	159	2	-	-	-	-	-	-	-	-	-	-	-	-	161
Polovina Cliffs															
2	40	29	30	51	59	51	120	-	-	-	-	-	-	-	380
3	0	8	5	13	13	8	21	-	-	-	-	-	-	-	68
5	0	0	2	0	1	50	0	-	-	-	-	-	-	-	53
Tolstoi															
2	34	35	59	29	94	91	89	93	-	-	-	-	-	-	524
3	32	31	27	21	51	47	43	32	-	-	-	-	-	-	284
5	0	0	2	0	20	0	15	110	-	-	-	-	-	-	147
Zapadni Reef															
2	108	52	-	-	-	-	-	-	-	-	-	-	-	-	160
3	21	17	-	-	-	-	-	-	-	-	-	-	-	-	38
5	23	43	-	-	-	-	-	-	-	-	-	-	-	-	66
Little Zapadni															
2	23	49	61	62	60	62	-	-	-	-	-	-	-	-	317
3	7	19	20	25	23	23	-	-	-	-	-	-	-	-	117
5	6	3	5	5	10	63	-	-	-	-	-	-	-	-	92
Zapadni[4/]															
2	53 (0)	113	108	123	82	66	72	16	-	-	-	-	-	-	633
3	21 (0)	35	26	35	17	23	18	7	-	-	-	-	-	-	182
5	0(68)	5	14	10	48	10	2	155	-	-	-	-	-	-	312

See footnotes at end of table.

TABLE A-3.--Adult male fur seals counted, by class[1/] and rookery section, St. Paul Island, Alaska 18-23 June 1979. (A dash indicates no numbered sections.)--continued.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	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 fur seals counted, by rookery, Pribilof Islands, Alaska, June 1979.

Island and rookery	Date	Class of adult male 2	3	5	Total
		----------Number----------			
St. Paul Island	June				
Lukanin	19	82	32	73	187
Kitovi	19	209	82	72	363
Reef	19	623	127	273	1,023
Gorbatch	19	297	86	217	600
Ardiguen	19	45	27	15	87
Morjovi	21	402	109	154	665
Vostochni	21	762	203	358	1,323
Little Polovina	18	77	12	165	254
Polovina	18	84	19	161	264
Polovina Cliffs	18	380	68	53	501
Tolstoi	23	524	284	147	955
Zapadni Reef	20	160	38	66	264
Little Zapadni	20	317	117	92	526
Zapadni	20	633	182	312	1,127
Total		4,595	1,386	2,158	8,139
St. George Island	June				
Zapadni	19	117	67	72	256
South	19	191	79	21	291
North	19	590	150	76	816
East Reef	19	141	30	43	214
East Cliffs	19	243	74	227	544
Staraya Artil	19	264	26	48	338
Total		1,546	426	487	2,459
Total both islands		6,141	1,812	2,645	10,598

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

TABLE A-5.--Adult male fur seals counted, by class[1/] and rookery section, St. Paul Island, Alaska 11-16 July 1979. 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	2	-	-	-	-	-	-	-	-	-	-	-	-	4
3	65	62	-	-	-	-	-	-	-	-	-	-	-	-	127
5	53	2	-	-	-	-	-	-	-	-	-	-	-	-	55
Kitovi[2/]															
2	5(4)	2	5	10	7	-	-	-	-	-	-	-	-	-	33
3	46(25)	17	64	88	69	-	-	-	-	-	-	-	-	-	309
5	0(0)	6	1	4	65	-	-	-	-	-	-	-	-	-	76
Reef															
2	13	25	34	10	11	16	24	20	18	11	6	-	-	-	188
3	73	99	101	65	76	72	59	83	67	64	26	-	-	-	785
5	11	18	12	25	203	6	44	49	0	84	7	-	-	-	459
Gorbatch															
2	12	10	8	5	6	17	-	-	-	-	-	-	-	-	58
3	120	79	75	22	62	78	-	-	-	-	-	-	-	-	436
5	100	10	1	185	2	8	-	-	-	-	-	-	-	-	306
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
Morjovi[3/]															
2	7(21)	14	13	15	10	11	-	-	-	-	-	-	-	-	91
3	66(45)	74	55	109	68	81	-	-	-	-	-	-	-	-	498
5	75(13)	0	70	2	2	139	-	-	-	-	-	-	-	-	301
Vostochni															
2	5	7	3	7	6	31	24	19	14	7	8	17	25	12	185
3	76	34	58	52	42	101	70	81	75	40	63	89	183	76	1,040
5	0	7	0	58	111	10	10	6	20	6	0	52	35	71	386

See footnotes at end of table.

TABLE A-5.--Adult male fur seals counted, by class[1/] and rookery section, St. Paul Island, Alaska 11-16 July 1979. (A dash indicates no numbered sections) - continued.

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	11	16	-	-	-	-	-	-	-	-	-	-	-	-	27
3	47	51	-	-	-	-	-	-	-	-	-	-	-	-	98
5	14	146	-	-	-	-	-	-	-	-	-	-	-	-	160
Polovina															
2	14	11	-	-	-	-	-	-	-	-	-	-	-	-	25
3	71	41	-	-	-	-	-	-	-	-	-	-	-	-	112
5	263	15	-	-	-	-	-	-	-	-	-	-	-	-	278
Polovina Cliffs															
2	15	8	5	9	12	15	34	-	-	-	-	-	-	-	98
3	50	41	47	68	90	73	175	-	-	-	-	-	-	-	544
5	6	0	3	7	15	15	2	-	-	-	-	-	-	-	48
Tolstoi															
2	12	11	5	4	13	13	20	18	-	-	-	-	-	-	96
3	99	80	96	67	139	112	140	95	-	-	-	-	-	-	828
5	2	3	0	0	15	0	6	230	-	-	-	-	-	-	256
Zapadni Reef															
2	31	11	-	-	-	-	-	-	-	-	-	-	-	-	42
3	134	60	-	-	-	-	-	-	-	-	-	-	-	-	194
5	77	0	-	-	-	-	-	-	-	-	-	-	-	-	77
Little Zapadni															
2	10	18	25	30	16	10	-	-	-	-	-	-	-	-	109
3	31	72	92	87	65	86	-	-	-	-	-	-	-	-	433
5	10	1	0	16	10	158	-	-	-	-	-	-	-	-	195
Zapadni[4/]															
2	18(0)	24	31	27	27	32	35	5	-	-	-	-	-	-	199
3	72(0)	145	123	135	85	84	85	20	-	-	-	-	-	-	749
5	17(164)	22	17	22	50	6	8	370	-	-	-	-	-	-	676

See footnotes at end of table.

TABLE A-5.--Adult male fur seals counted, by class[1/] and rookery section, St. Paul Island, Alaska 11-16 July 1979 (A dash indicates no numbered sections) - continued

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	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 fur seals counted, by rookery, Pribilof Islands, Alaska July 1979.

Island and rookery	Date	Class of adult male 1/ 2	3	5	Total
		Number			
St. Paul Island	July				
Lukanin	16	4	127	55	186
Kitovi	16	33	309	76	418
Reef	12	188	785	459	1,432
Gorbatch	12	58	436	306	800
Ardiguen	12	9	89	20	118
Morjovi	13	91	498	301	890
Vostochni	13	185	1,040	386	1,611
Little Polovina	15	27	98	160	285
Polovina	15	25	112	278	415
Polovina Cliffs	15	98	544	48	690
Tolstoi	16	96	828	256	1,180
Zapadni Reef	11	42	194	77	313
Little Zapadni	11	109	433	195	737
Zapadni	11	199	749	676	1,624
Total		1,164	6,242	3,293	10,699
Sea Lion Rock	July				
Sivutch	15	32	470	150	652
St. George Island	July				
Zapadni	14	80	182	136	398
South	14	92	210	136	438
North	14	352	674	343	1,369
East Reef	14	67	132	97	296
East Cliffs	14	137	282	68	487
Staraya Artil	14	297	236	137	670
Total		1,025	1,716	917	3,658
Grand Total		2,221	8,428	4,360	15,009

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

TABLE A- 7.--Adult male seals counted, by class, 1/ rookery, and year, St. Paul Island, Alaska, June 1966-79.

Rookery and class of male	Year													
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	Number													
Lukapin														
1	13	12	8	4	10	6	2	0	1	-	-	-	-	-
2	83	93	62	51	24	22	36	36	66	65	69	54	61	82
3	67	53	45	34	59	58	39	26	29	52	45	58	51	32
4	0	4	1	2	0	0	1	0	0	-	-	-	-	-
5	84	51	15	28	45	54	44	21	40	80	50	48	70	73
Total	247	213	131	119	138	140	122	83	136	197	164	160	182	187
Kitovi														
1	22	17	31	10	5	8	7	6	3	-	-	-	-	-
2	229	211	179	156	69	96	95	86	143	151	174	173	182	209
3	193	144	122	76	137	136	96	63	45	120	87	121	86	82
4	4	4	0	2	0	0	0	1	5	-	-	-	-	-
5	102	91	49	52	45	51	66	69	44	45	68	32	72	72
Total	550	467	381	296	256	291	264	225	240	316	329	326	340	363
Reef														
1	119	72	57	77	26	33	16	22	7	-	-	-	-	-
2	852	752	616	508	401	522	431	375	376	410	454	534	593	623
3	333	272	255	222	206	110	142	103	137	230	251	210	175	127
4	0	18	42	11	29	4	4	3	11	-	-	-	-	-
5	425	241	400	175	313	229	239	236	163	336	488	395	378	273
Total	1,729	1,355	1,370	993	975	898	832	739	694	976	1,193	1,139	1,146	1,023
Gorbatch														
1	78	43	32	31	16	8	14	11	11	-	-	-	-	-
2	441	407	341	250	205	193	205	183	199	228	228	241	274	297
3	180	159	128	146	128	136	88	76	83	147	144	135	122	86
4	62	25	25	23	13	5	1	2	12	-	-	-	-	-
5	362	236	242	202	155	213	109	120	106	254	272	284	331	217
Total	1,123	870	768	652	517	555	417	392	411	629	644	660	727	600
Ardiguen														
1	8	6	2	3	1	0	6	3	2	-	-	-	-	-
2	40	49	62	59	107	46	44	46	62	45	30	37	52	45
3	53	39	42	27	43	24	38	24	31	34	39	40	34	27
4	9	0	0	0	0	0	0	0	0	-	-	-	-	-
5	50	58	50	64	62	40	47	23	0	27	29	32	15	15
Total	160	152	156	153	213	110	135	96	95	106	97	109	101	87

1/ See footnote at end of table.

TABLE A- 7.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, Alaska, June 1966- 79--Continued

Rookery and class of male	Year													
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	Number													
Morjovi														
1	108	41	35	30	22	13	11	0	11	-	-	-	-	-
2	452	394	309	236	167	133	129	179	220	225	268	338	355	402
3	230	189	228	160	139	124	97	92	89	182	205	135	149	109
4	3	73	21	3	5	2	0	2	6	-	-	-	-	-
5	464	249	146	191	190	160	91	180	216	292	224	366	215	154
Total	1,257	946	739	620	523	432	328	453	542	699	697	839	719	665
Vostochni														
1	92	109	67	39	23	17	15	7	17	-	-	-	-	-
2	1,019	940	804	605	420	330	373	463	478	508	476	607	707	762
3	522	333	462	360	289	254	187	171	181	348	479	291	245	203
4	18	147	11	11	1	4	5	3	8	-	-	-	-	-
5	542	557	389	306	164	194	187	375	153	125	622	263	490	358
Total	2,193	2,086	1,733	1,321	897	799	767	1,019	837	981	1,577	1,161	1,442	1,323
Little Polovina														
1	12	7	12	5	0	2	4	0	2	-	-	-	-	-
2	162	143	107	83	59	88	46	62	75	88	72	78	84	77
3	73	51	71	28	43	14	24	14	15	31	34	34	28	12
4	29	27	14	11	0	4	1	5	3	-	-	-	-	-
5	254	150	75	38	50	17	6	53	52	108	127	101	171	165
Total	530	378	279	165	152	125	81	134	147	227	233	213	283	254
Polovina														
1	75	27	8	15	3	4	3	3	1	-	-	-	-	-
2	168	150	89	69	44	51	35	40	50	54	55	67	90	84
3	65	43	68	25	31	4	13	8	19	42	40	26	26	19
4	0	25	1	1	2	0	0	7	1	-	-	-	-	-
5	253	185	177	43	61	80	41	80	64	170	189	184	197	161
Total	561	430	343	173	141	139	92	138	135	266	284	277	313	264
Polovina Cliffs														
1	48	38	52	33	15	7	19	2	8	-	-	-	-	-
2	494	408	315	295	192	245	186	200	249	262	291	441	350	380
3	202	192	256	105	150	49	70	85	75	193	159	140	200	68
4	5	68	16	3	7	4	3	3	6	-	-	-	-	-
5	81	47	74	65	58	101	67	107	71	97	100	114	71	53
Total	830	753	713	501	422	406	345	397	409	552	550	695	621	501

1/ See footnote at end of table.

TABLE A-7 .--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, Alaska, June 1966-79 --Continued.

Rookery and class of male	Year													
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	Number													
Tolstoi														
1	65	80	49	40	25	12	15	33	13	-	-	-	-	-
2	622	455	350	411	269	270	273	291	305	269	387	434	476	524
3	233	251	309	130	240	198	187	136	124	329	262	291	273	284
4	0	24	25	0	0	10	3	2	3	-	-	-	-	-
5	131	472	150	133	125	140	96	115	90	508	327	262	286	147
Total	1,051	1,282	883	714	659	630	574	577	535	1,106	976	987	1,035	955
Zapadni Reef														
1	13	13	3	3	1	7	0	0	1	-	-	-	-	-
2	142	125	72	67	43	63	59	57	79	78	117	107	136	160
3	65	52	75	46	43	41	33	27	26	64	43	55	44	38
4	0	13	3	1	0	0	3	0	2	-	-	-	-	-
5	146	64	59	4	28	38	24	56	34	113	84	63	62	66
Total	366	267	212	121	115	149	119	140	142	255	244	225	242	264
Little Zapadni														
1	70	42	27	37	15	17	10	6	8	-	-	-	-	-
2	339	328	218	219	148	166	154	169	184	176	223	198	291	317
3	150	184	234	127	175	119	108	73	83	181	171	151	224	117
4	0	28	9	18	2	12	2	0	22	-	-	-	-	-
5	133	120	84	61	44	36	45	83	43	136	81	122	137	92
Total	692	702	572	462	384	350	319	331	340	493	475	471	652	526
Zapadni														
1	149	74	55	51	42	19	18	13	13	-	-	-	-	-
2	716	611	508	465	315	296	315	324	329	334	486	443	604	633
3	275	277	357	219	251	225	167	164	173	269	212	238	277	182
4	0	82	34	10	5	12	7	2	19	-	-	-	-	-
5	521	353	300	504	202	414	338	210	245	625	512	330	329	312
Total	1,661	1,397	1,254	1,249	815	966	845	713	779	1,228	1,210	1,011	1,210	1,127
Grand total	12,950	11,298	9,534	7,539	6,207	5,990	5,240	5,437	5,442	8,031	8,673	8,273	9,013	8,139

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

TABLE A-8.--Harem and idle male fur seals counted in mid-July, Pribilof Islands, Alaska, 1970-79.

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	-----Number-----		-----Number------		-----Number----	
1970	4,945	1,666	1,466	803	6,411	2,469
1971	1/ 4,200	1/ 1,900	1,235	534	5,435	2,434
1972 2/	3,738	2,384	1,153	328	4,891	2,712
1973	3/ 4,906	3/ 2,550	875	375	5,781	2,925
1974	4/ 4,563	4/ 1,782	822	481	5,385	2,263
1975	5,018	3,535	877	1,427	5,895	4,962
1976	5,324	4,041	1,093	996	6,417	5,037
1977	6,457	3,845	1,610	899	8,067	4,744
1978	6,496	3,908	1,590	1,220	8,086	5,128
1979	6,242	4,457	1,716	1,942	7,958	6,399

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

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

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

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

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

(c) Solve July (H+I) - July(H) = July(I);

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

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

4/ Total numbers of harem and idle males in July were extrapolated from counts of harem and idle males on all rookeries in June and from counts of harem and idle males on sample rookeries (Reef, Gorbatch, and Ardiguen) in July using the same procedure applied in 1973(see footnote 3).

TABLE A-9.--Dead fur seal pups counted, by rookery section, Pribilof Islands, Alaska, 17-24 August 1979.

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/	153	23	19	39	27	8	-	-	-	-	-	-	-	-	269
Vostochni	18	8	25	32	26	162	102	20	52	15	16	37	46	14	573
Little Polovina	14	14	-	-	-	-	-	-	-	-	-	-	-	-	28
Polovina Cliffs	55	60	52	73	51	2/ 142	-	-	-	-	-	-	-	-	433
Polovina	54	31	-	-	-	-	-	-	-	-	-	-	-	-	85
Ardiguen 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
Gorbatch	46	57	54	9	45	49	-	-	-	-	-	-	-	-	260
Reef	28	47	83	68	67	133	77	63	28	50	7	-	-	-	651
Kitovi 4/	49	12	26	47	37	-	-	-	-	-	-	-	-	-	171
Lukanin	81	51	-	-	-	-	-	-	-	-	-	-	-	-	132
Tolstoi	100	80	100	51	178	298	439	399	-	-	-	-	-	-	1,645
Little Zapadni	12	69	82	99	239	136	-	-	-	-	-	-	-	-	637
Zapadni Reef	102	59	-	-	-	-	-	-	-	-	-	-	-	-	161
Zapadni	114	126	188	420	208	122	143	47	-	-	-	-	-	-	1,368
Total															6,444
St. George Island 5/															
North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	774
Zapadni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6/277
South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	186
East Reef	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104
East Cliffs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	285
Staraya Artil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	565
Total															2,191
Grand total															8,635

1/ Includes 36 dead pups counted on point south of Sea Lion Neck.
2/ Includes dead pups counted in section 7.
3/ No numbered sections.
4/ Includes 14 dead pups counted in Kitovi Amphitheater.
5/ Dead pups were not counted by rookery section.
6/ Partial count, does not include rookery study site above cliffs.

TABLE A-10.--Dead seal pups counted,[1] by rookery, Pribilof Islands, Alaska, 1967-79.

Island and rookery	1967	1968	1969	1970	1971	1972	1973[2]	1974[2]	1975	1976	1977	1978	1979
	Number												
St. Paul Island													
Morjovi	1,072	2,285	734	1,618	4,773	2,187	-	-	1,765	1,829	870	606	269
Vostochni	1,969	4,195	1,711	3,330	8,280	4,701	-	-	3,259	3,826	2,021	1,041	573
Little Polovina	233	509	200	337	1,207	372	-	-	252	316	103	90	28
Polovina Cliffs	825	1,616	836	1,636	5,445	1,566	-	-	1,529	1,862	733	761	433
Polovina	319	487	327	475	980	345	-	-	419	378	160	151	85
Ardiguen	90	118	112	75	373	161	-	111	142	212	112	15	31
Gorbatch	874	1,446	823	974	2,405	1,332	-	1,188	1,025	1,341	860	475	260
Reef	2,008	3,064	1,365	2,221	4,103	1,686	-	1,580	1,837	2,055	1,233	593	651
Kitovi	522	755	652	679	1,854	559	-	-	787	846	331	203	171
Lukanin	240	597	460	401	1,224	494	-	-	505	385	250	197	132
Tolstoi	2,251	3,315	2,778	3,580	5,147	3,540	3,613	-	4,141	4,241	3,291	1,488	1,645
Little Zapadni	1,098	1,781	798	1,386	3,223	1,686	1,783	-	1,204	1,977	1,133	674	637
Zapadni Reef	380	685	177	308	673	505	661	-	508	638	427	129	161
Zapadni	2,195	4,445	2,306	3,561	6,752	3,515	3,851	-	3,252	3,770	2,559	1,650	1,368
Counted total	14,076	25,298	13,279	20,581	46,439	22,649	9,908	2,879	20,625	23,676	14,083	8,073	6,444
Estimated oversight 5%	704	1,265	664	1,029	2,322	1,132	495	144	1,031	1,184	704	404	322
Total	14,780	26,563	13,943	21,610	48,761	23,781	10,403	3,023	21,656	24,860	14,787	8,477	6,766
St. George Island													
North	971	1,567	444	866	1,862	1,032	1,153	545	1,230	791	408	1,068	774
Zapadni	578	1,197	260	636	1,058	464	450	474	814	653	190	404	463
East	201	824	187	522	638	372	506	334	536	391	200	456	389
Staraya Artil	770	1,055	640	1,243	1,662	616	552	[3] -	709	454	410	590	565
Counted total	2,520	4,643	1,531	3,267	5,220	2,484	2,661	1,353	3,289	2,289	1,208	2,518	2,191
Estimated oversight 5%	126	232	76	163	261	124	133	68	165	114	60	126	110
Total	2,646	4,875	1,607	3,430	5,481	2,608	2,794	1,421	3,454	2,403	1,268	2,644	2,301
Pribilof Islands counted total	16,596	29,941	14,810	23,848	51,659	25,133	12,569	4,232	23,914	25,965	15,291	10,591	8,635
Estimated oversight 5%	830	1,497	740	1,192	2,583	1,256	628	212	1,196	1,298	764	530	432
Total	17,426	31,438	15,550	25,040	54,242	26,389	13,197	4,444	25,110	27,263	16,055	11,121	9,067

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.--Fur seals marked as pups and recovered at ages 4 and 5 years in the United States harvest of male fur seals, St. Paul Island, Alaska 26 June to 31 July 1979.

Hind flipper mark1/	Age (years)	Total (number)	Island of marking
RH1	4	195	St. Paul
LH1	4	98	St. George
RH3	5	53	St. Paul

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

[LH1] LH refers to the left hind flipper; 1 refers to the 1st digit.

[RH1, RH3] RH refers to the right hind flipper; 1 or 3 refer to the 1st or 3rd digit, respectively.

TABLE A-12.--Soviet tags recovered in the United States harvest of male fur seals, St. Paul Island, Alaska 26 June to 31 July 1979.

Date	Tag number	Age (years)	Sex	Island of tagging	Rookery of recovery
26 July	TB-4602,TB-4602	2	M	Bering	Polovina
26 July	TM-7595	2	M	Medny	Lukanin-Kitovi
31 July	OM-6232	3	M	Medny	Reef
12 July	OM-8411,0M-8411	3	M	Medny	Polovina
13 July	OM-1004, 0M-1004	4	M	Medny	Tolstoi-Zapadni Reef
12 July	OB-1378,0B-1378	4	M	Bering	Polovina

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

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

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

TABLE A-14.--Fur seals entangled in fishing debris and other materials, United States commercial harvest of fur seals, St. Paul Island, Alaska, 1967-79.

Year	Number of seals harvested[1/]	Number of entangled seals observed on killing field[1/]	Percentage of harvest
1967	50,229	75	0.15
1968	46,893	75	0.16
1969	32,817	67	0.20
1970	36,307	101	0.28
1971	27,338	113	0.41
1972	33,173	139	0.42
1973	28,482	135	0.47
1974	33,027	197	0.60
1975	29,148	211	0.72
1976	23,096	102	0.44
1977	28,444	99	0.35
1978	24,885	114	0.46
1979	25,762	110	0.43

1/ Includes both sexes.

TABLE A-15.--Northern fur seals tagged as pups on the Pribilof Islands (St. Paul and St. George), Commander Islands (Bering and Medny), and Robben Island, and dates first observed on San Miguel Island, California. 1969-79.

Tag number	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	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	--	--	--	--	--	--	1 Sept.	F	Medny	1965
N-41314	21 July	--	--	--	24 Aug.	--	--	--	22 July	--	19 Aug.	2 Sept.	F	St. Paul	1961
N-16387	--	25 July	14 July[1/]	23 June	27 July	--	--	9 Aug.	--	--	--	--	F	St. Paul	1961
N-19851	--	12 Sept.	12 Aug.[1/]	24 July	29 June	21 July	--	--	--	--	--	--	F	St. Paul	1961
N-25437	--	25 July	2 Aug.	9 July	26 July	4 Aug.	--	--	--	--	--	--	F	St. Paul	1961
M-53901	--	31 July	23 July	14 June	--	--	--	--	--	--	--	--	F	St. Paul	1960
O-26056	--	25 July	18 July	29 July	3 Sept.[2/]	22 July	--	28 July	29 July	--	17 July	24 May	F	St. Paul	1962
R-8179	--	1 Oct.[3/]	--	--	--	--	--	--	--	--	--	--	F	St. Paul	1965
J-4937	--	18 Aug.[3/]	14 Aug.	14 June	24 Aug.	--	--	--	--	--	--	--	F	St. George	1957
N-29437	--	--	20 July	--	--	--	--	--	--	--	--	--	F	St. Paul	1961
N-48079	--	--	11 Aug.	--	--	--	--	--	--	30 July	--	8 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	--	--	10 Aug.	F	St. Paul	1965
T-24	--	--	--	7 Aug.	12 July	25 July	--	--	--	--	--	--	F	St. George	1967
T-9697	--	--	--	19 Aug.	2 Aug.	--	--	11 Aug.	7 Sept.	--	--	--	F	St. Paul	1967
T-12129	--	--	--	25 Aug.	26 July	21 July	--	--	--	--	--	--	F	St. Paul	1967
U-6971	--	--	--	21 Aug.	26 July	10 July	--	31 July	2 Aug.	--	17 July	8 Aug.	F	St. Paul	1968
O-48131	--	--	--	--	3 Sept.	--	--	--	--	--	--	--	F	St. Paul	1962
T-6003	--	--	--	--	5 Sept.	10 July	12 Aug.	--	--	--	--	24 Aug.	F	Robben	1965
T-8572	--	--	--	--	23 July	23 July	--	--	--	21 Aug.	--	--	F	St. Paul	1967
Y-7104	--	--	--	--	30 Aug.	13 July	10 June	3 July	11 July	6 Aug.	--	--	F	Robben	1966
BB-1364	--	--	--	--	7 Sept.	--	9 Aug.	--	--	8 Sept.	8 July	11 Aug.	F	Bering	1969
AM-8302	--	--	--	--	--	--	14 Aug.	28 July	18 July	--	--	11 Aug.	F	Medny	1968
U-6974/	--	--	--	--	--	--	5 July	--	--	7 Sept.	--	--	F	St. George	1968
U-579	--	--	--	--	--	--	1 Sept.	--	--	--	--	--	F	St. George	1968
CM-3667	--	--	--	--	--	--	--	3 July	--	--	--	--	F	Medny	1970
ET-593	--	--	--	--	--	--	--	17 July	--	--	--	--	F	Robben	1971
H-2314	--	--	--	--	--	--	--	20 Aug.	--	--	--	--	F	Robben	1963

TABLE A-15.--Northern fur seals tagged as pups on the Pribilof Islands (St. Paul and St. George), Commander Islands (Bering and Medny), and Robben Island, and dates first observed on San Miguel Island, California, 1969-79.--continued.

Tag number	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Sex	Island of origin	Date tagged
T-19022	--	--	--	--	--	--	--	20 Aug.	--	--	--	--	F	Medny	1965
DT-TINRO 5/	--	--	--	--	--	--	--	14 Aug.	21 July	--	--	--	F	--	--
I-36987 6/	--	--	--	--	--	--	--	--	5 Sept.	--	--	--	F	St. Paul	1956
ET-9564	--	--	--	--	--	--	--	--	--	--	--	6 Aug.	F	Medny	1971

1/ Tag number N-19851 recorded as N-15851 in 1970.

2/ Tag number O-26056 also recorded on Castle Rock, 8 September 1972.

3/ Tag number J-4937 recorded as J-4939 in 1969.

4/ Female identified by #U6971 may be the same individual.

5/ A double-tagged female. TINRO was read but the numbers could not be seen with the scope.

6/ Last number on tag unreadable.

TABLE A-16.--Northern fur seals tagged on San Miguel Island, California in 1968 and the dates first resighted in each season from 1969 through 1979[1/].

Tag number	Tag placement	Date observed 1969	Date observed 1970	Date observed 1971	Date observed 1972	Date observed 1973	Date observed 1974	Date observed 1975	Date observed 1976	Date observed 1977	Date observed 1978	Date observed 1979
UC-3789	R	--	--	24 July	23 July	31 July	--	--	--	--	--	--
-3793	R	--	21 July	13 July	11 July	--	--	--	--	12 Aug.	1 Sept.	--
-3926	L			9 July			--	--	--	--	--	--
-3927	R	31 July	23 July		26 July	21 July						
-3931[2/]	R	--	--	--	--	--	--	--	--	--	19 Aug.	--
-3932	R	16 Aug.	29 July	2 July		--	27 July	8 Aug.	10 July	18 Aug.	18 Aug.	1 Sept.
-3933	L				13 July							
-3934[2/]	L	--	--	--	--	--	--	--	29 Aug.	--	--	--
-3936	L	--	--				28 July	--				--
-3937	R			24 July	31 July	22 July			10 July	18 Aug.	21 July	
-3938	L	31 July	10 Aug.	8 June		--	--	--	--	--	--	--
-3939	R	31 July			29 June							
-3940	L	31 July	29 July	--	--	--	--	--	--	--	--	--
-3941	R											
-3942	R	31 July	17 July	22 July	14 July	--	--	20 Aug.	29 July	18 Aug.	15 Aug.	11 Aug.
-3943	L											
-3944	R		17 July			18 July					15 Aug.	9 Aug.
-3945	L	14 Aug.		14 June	27 June		15 July	9 July	14 July	12 Aug.		
-3951	L	--	21 July	22 July	12 July	--	--	--	--	--	--	--
-3953[3/]	R											
-3955	R	25 July	31 July	2 July	15 July	--	--	--	--	--	--	--
-3956	L											
-3957[4/]	R	7 Aug.	--	--	--	--	--	--	--	--	--	--
-3959	R	25 July	--	--	--	--	--	--	--	--	--	--
-3961[2/]	R	12 Sept.	--	--	--	--	--	--	--	--	--	--
-3964	L		2 Aug.	21 July	12 July	1 Aug.	--	--		--	30 Aug.	--
-3965	R	12 Aug.							2 Aug.			

TABLE A-16.--Northern fur seals tagged on San Miguel Island, California in 1968 and the dates first resighted in each season from 1969 through 1979[1/].--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	Date observed 1977	Date observed 1978	Date observed 1979
UC-3968	R	--	18 July	6 July	--	--	--	--	--	--	--	--
-3971	L											
-3972	L		16 Aug.	22 July		--	--	--	--	--	--	--
-3973	R	31 July			5 Aug.							
-3974	L	--	--	--	--		15 July	8 Aug.		22 Aug.		
-3975	R					5 Aug.			4 Aug.		8 July	15 Aug.
-3976	R		--	--	--	--	--	11 Aug.	--	--	--	--
-3977	L	31 July										
-3978[2/]	L	--	22 July	--	--	--	--	--	--	--	--	--
-3980	R	--	31 July		30 Aug.	--	15 July	--		--	--	--
-3984	L			9 July					18 July			
-3981	R		9 July	5 July	11 July		--	--	--	--	--	--
-3982	L	31 July				4 Aug.						
-3985	L	31 July	--		--	--	--	--	--	--	--	--
-3986	R			17 July								
-3987	L	--		6 July	14 July	2 Aug.	--	--	--	--	--	--
-3988	R		10 Aug.									
-3989	L			5 July		11 June	10 Aug.	7 Aug.	--	--	--	--
-3990	R	10 Aug.	8 July		27 June							
-3991	R	7 Aug.	20 July				--		--			--
-3992	L			27 July	12 July	4 Aug.		28 July		21 Aug.	25 July	
-3993	R	16 Aug.		4 July	--	--			10 July	--	25 July	16 Aug.
-3994	L		17 Aug.				27 July	17 July				
-3995	R	--		--	11 Aug.	--		17 July	--	--	--	--
-3996	L		21 July				28 July					
-3997	L	--	--		--		--		6 Sept.	--	--	16 Aug.
-3998	R			21 July		4 July		10 July				

TABLE A-16.--Northern fur seals tagged on San Miguel Island, California in 1968 and the dates first resighted in each season from 1969 through 1979[1/].--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	Date observed 1977	Date observed 1978	Date observed 1979
UC-3999	R	--	--		--	--	13 Aug.	--	--	--	--	--
-4000	L			3 Aug.								

1/ A total of 36 pups (3751-3800 and 3958-3963 series and 3983) and 33 adult females (all other 3900-4000 series) were tagged on 20 July 1968.

2/ Female was double tagged, but the other tag number has never been resighted.

3/ Tag loss confirmed by observation of tag scar.

4/ Left flipper injured, not tagged.

TABLE A-17.--Adult female northern fur seals double tagged at Adams Cove, San Miguel Island, California on 9 October 1975 and the dates first resighted, 1976-79[1/]

Tag number	Date of first resighting			
	1976	1977	1978	1979
SMI 201	23 Aug		13 July	12 July
202		-		
203		21 Sept	2 Sept	-
204	-			
205				
206	-	-	-	-
207				
208	-	-	-	-
209				
210	-	-	-	-
211	12 Aug	-	-	16 Aug
212				
213				
214	-	-	-	7 Aug
215	17 July	8 Sept	-	-
216				
217	12 July	4 Sept	19 Aug	3 Aug
218				
219	11 July	-	30 Aug	9 Aug
220				
221				
222	-	-	22 Aug	-
223	-	4 Sept	22 July	-
224				
225	Tag lost in sand of Arroyo west of Mallo Roses, Adams Cove			
226	11 July	18 Aug	-	14 July
227				
228	25 Aug	-	27 Aug	16 Aug
229				
230				
231	-	-	-	-
232	-	18 Aug	18 Aug	-
233				
234	-	-	-	-
235				
236	22 Aug	-	18 Aug	-
237				
238	2 Aug	6 Aug	25 July	6 Aug
239				
240	-	-	-	6 July
241				
242	-	12 Aug	-	-
243				
244	12 July	18 Aug	12 July	8 July
245				

TABLE A-17.--Adult female northern fur seals double tagged at Adams Cove, San Miguel Island, California on 9 October 1975 and the dates first resighted, 1976-79[1/]. (Continued)

Tag number	Date of first resighting			
	1976	1977	1978	1979
SMI 246	-	20 Aug	9 Aug	-
247				
248	11 July	-	-	6 Aug
249				
250	-	20 Aug	-	5 Aug
251				
252	-	19 Aug	-	-
253				
254				
255	-	-	16 Aug	1 Sept
256				
257	-	-	-	-
258				
259	-	-	20 Aug	-
260				
261	-	-	-	23 Aug
262	-	10 July	10 July	-
263				
264	10 July	18 Aug	22 July	11 June
265				
266	26 July	12 Aug	9 Aug	-
267				
268	29 July	-	-	-
269				
270	29 July	12 Aug	-	-
271				
272	23 July	20 Aug	18 Aug	-
273				
274	5 Sept	-	10 July	1 Sept
275				
276	21 Aug	3 Sept	16 Aug	-
277	T a g	d e s t r o y e d		
278				
279	5 Aug	-	17 July	30 July
280				
281	23 July	4 Sept	22 July	-
282				
283	24 July	12 Aug	20 July	-
284				
285	25 Aug	-	20 July	16 Aug
286				
287	-	-	-	-
288				
289	-	30 July	-	15 Aug
290				

TABLE A-17.--Adult female northern fur seals double tagged at Adams Cove, San Miguel Island, California on 9 October 1975 and the dates first resighted, 1976-79[1/] - (continued)

Tag number	Date of first resighting			
	1976	1977	1978	1979
SMI 291	-	-	-	23 Aug
292				
293	10 Aug	-	-	-
294				
295	22 July	-	30 Aug	-
296				
297	29 Aug	-	1 Sept	18 Aug
298				
299	8 Aug	30 July	28 Aug	9 Aug
300				
301	21 Aug	-	20 Aug	24 Aug
302				

1/ Fifty adult females were tagged.

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

Tag Number	Year Tagged	Sex	Date of first resighting		
			1977	1978	1979
SMI-4	1975	F	-	31 Aug	6 Aug
-5	-do-	F	-	-	11 Aug 2/
-11	-do-	M	-	-	7 July
-15	-do-	M	-	18 Aug	28 May
-16	-do-	F	-	-	1 Aug 2/
-17	-do-	M	-	-	16 June
-20	-do-	M	-	22 Aug	12 June
-21	-do-	M	-	9 Aug	-
-22	-do-	M	-	9 Aug	23 June
-24	-do-	M	-	9 Aug	24 May
-32	-do-	M	-	-	9 June
-40	-do-	M	-	-	9 July
-41	-do-	F	18 Aug	-	-
-42	-do-	M	-	-	5 May
-44	-do-	F	-	21 Aug	-
-46	-do-	M	-	29 Aug	-
-52	-do-	F	-	31 Aug	-
-55	-do-	F	-	13 Aug	16 Aug
-58	-do-	F	-	-	24 Aug
-61	-do-	F	-	22 Aug	15 Aug
-63	-do-	M	-	-	2 June
-70	-do-	F	-	19 Aug	-
-72	-do-	F	-	1 Sept	-
-73	-do-	M	-	29 July	2 Aug
-75	-do-	F	2 Sept	17 Aug	27 May
-83	-do-	F	-	-	5 Aug
-85	-do-	F	-	6 Sept	-
-86	-do-	M	-	17 July	18 June
-89	-do-	M	-	-	9 Aug
-90	-do-	F	-	9 Sept	4 Sept
-99	-do-	F	-	-	8 Aug
-304	-do-	M	-	1 Sept	-
-312	1976	F	-	-	8 Aug
-313	-do-	M 1/	-	16 Sept	5 June
-330	-do-	M	-	-	23 July
-334	-do-	F	-	-	3 Sept
-615	-do-	F	-	-	28 Aug
-904	-do-	F	-	-	3 Sept
-956	-do-	M	-	-	5 June
-961	-do-	F	-	-	15 Aug
-997	-do-	F	-	-	3 Aug

1/ This fur seal was mistakenly identified as a female in 1978.

2/ Observed nursing a pup of the year.

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island, California, on 9 September 1979.

Tag number	Flipper tagged	Sex	Weight (kg)	Length (cm)	Checkmark	Remarks
1498	L	F	13.0	810	RHD2	
1499	L	F	11.4	825	RHD2	
1500	R	M	11.5	775	RHD2	
1501	L	F	7.8	735	RHD2	
1502	R	M	12.2	815	RHD2	
1503	L	F	10.5	765	RHD2	
1504	R	F	8.5	780	RHD2	
1505	L	F	11.9	785	RHD2	
1506	R	M	8.2	745	RHD2	
1507	R	M	14.0	825	RHD2	
1508	L	F	12.5	800	RHD2	
1509	L	F	8.9	745	RHD2	
1510	L	F	9.4	815	RHD2	
1511	R	F	10.5	775	RHD2	
1512	L	F	10.3	770	RHD2	
1513	R	M	13.5	835	RHD2	
1514	R	M	14.5	805	RHD2	
1515	L	F	10.9	780	RHD2	
1516	R	M	8.5	745	RHD2	
1517	R	F	10.0	755	RHD2	
1518	TAG DESTROYED					
1519	R	M	11.7	795	RHD2	
1520	L	F	6.5	675	RHD2	
1521	R	M	10.2	775	RHD2	
1522	L	F	12.4	795	RHD2	
1523	L	F	9.6	795	RHD2	
1524	L	F	12.0	805	RHD2	
1525	R	M	12.4	830	RHD2	
1526	R	M	12.5	840	RHD2	
1527	R	M	12.5	830	RHD2	
1528	L	F	11.0	790	RHD2	
1529	R	M	13.5	815	RHD2	
1530	R	M	7.7	695	RHD2	
1531	TAG DESTROYED					
1532	L	F	10.5	755	RHD2	
1533	L	F	9.0	745	RHD2	
1534	R	M	12.0	810	RHD2	
1535	L	F	12.7	815	RHD2	
1536	L	F	12.0	745	RHD2	
1537	R	M	11.5	815	RHD2	
1538	R	M	10.5	795	RHD2	
1539	R	M	9.5	765	RHD2	
1540	R	M	14.5	825	RHD2	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island, California, on 9 September 1979. - Continued

Tag number	Flipper tagged	Sex	Weight (kg)	Length (cm)	Checkmark	Remarks
1541	L	M	9.5	745	RHD2	
1542	R	M	10.0	775	RHD2	
1543	R	M	12.5	815	RHD2	
1544	R	M	11.0	795	RHD2	
1545	L	F	7.7	690	RHD2	
1546	R	M	15.0	855	RHD2	
1547	R	M	15.0	845	RHD2	
1548	L	F	12.5	800	RHD2	
1549	L	F	11.0	745	RHD2	
1550	R	M	12.0	790	RHD2	
1551	R	M	13.4	800	RHD2	
1552	L	F	9.0	730	RHD2	
1553	R	M	11.5	770	RHD2	
1554	R	M	9.0	720	RHD2	
1555	R	M	14.0	780	RHD2	
1556	R	M	10.5	770	RHD2	
1557	R	M	10.5	780	RHD2	
1558	R	M	11.5	770	RHD2	
1559	L	F	10.5	780	RHD2	
1560	R	M	15.5	840	RHD2	
1561	R	M	13.5	780	RHD2	
1562	L	F	9.1	750	RHD2	
1563	R	M	12.5	770	RHD2	
1564	R	M	12.0	760	RHD2	
1565	R	M	9.5	760	RHD2	
1566	L	F	12.5	770	RHD2	
1567	L	F	9.5	750	RHD2	
1568	R	M	12.0	810	RHD2	
1569	L	F	9.5	770	RHD2	
1570	R	M	16.0	870	RHD2	
1571	L	F	13.0	750	RHD2	
1572	R	M	12.0	770	RHD2	
1573	R	M	15.5	800	RHD2	
1574	L	F	12.0	760	RHD2	
1575	L	F	12.0	780	RHD2	
1576	R	M	11.0	800	RHD2	
1577	R	M	12.5	810	RHD2	
1578	R	M	13.0	780	RHD2	
1579	R	M	13.5	790	RHD2	
1580	R	M	16.5	850	RHD2	
1581	R	M	11.5	750	RHD2	
1582	R	M	11.5	800	RHD2	
1583	R	M	14.0	820	RHD2	
1584	R	M	16.5	840	RHD2	
1585	R	M	13.0	810	RHD2	
1586	R	M	14.0	820	RHD2	
1587	L	F	8.5	700	RHD2	
1588	R	M	13.5	790	RHD2	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island, California, on 9 September 1979. -Continued

Tag number	Flipper tagged	Sex	Weight (kg)	Length (cm)	Checkmark	Remarks
1589	R	M	15.0	820	RHD2	
1590	L	F	10.5	770	RHD2	
1591	R	M	7.5	700	RHD2	
1592	L	F	9.0	750	RHD2	
1593	R	M	9.0	740	RHD2	
1594	L	F	10.0	780	RHD2	
1595	R	M	14.5	825	RHD2	
1596	R	M	10.0	775	RHD2	
1597	R	M	11.0	780	RHD2	
1598	R	M	10.5	800	RHD2	
1599	L	F	10.5	765	RHD2	
1600	R	M	13.0	840	RHD2	
1601	L	F	9.0	725	RHD2	
1602	R	M	12.0	760	RHD2	
1603	L	F	8.0	675	RHD2	
1604	R	M	12.5	790	RHD2	
1605	L	F	8.0	700	RHD2	
1606	R	M	11.5	755	RHD2	
1607	R	M	13.5	850	RHD2	
1608	L	F	10.0	725	RHD2	
1609	R	M	12.0	795	RHD2	
1610	R	M	14.5	840	RHD2	
1611	L	F	11.5	770	RHD2	
1612	R	M	10.5	760	RHD2	
1613	L	F	12.5	805	RHD2	
1614	R	M	11.0	785	RHD2	
1615	L	F	8.5	695	RHD2	
1616	R	M	13.5	800	RHD2	
1617	L	F	9.5	760	RHD2	
1618	L	F	9.5	745	RHD2	
1619	L	F	9.5	695	RHD2	
1620	L	F	9.0	740	RHD2	
1621	L	F	9.0	695	RHD2	
1622	R	M	10.0	745	RHD2	
1623	R	F	8.2	760	RHD2	
1624	L	F	9.5	740	RHD2	
1625	L	F	14.0	815	RHD2	
1626	L	F	9.5	760	RHD2	
1627	R	M	10.5	745	RHD2	
1628	L	F	10.0	740	RHD2	
1629	R	M	10.5	790	RHD2	
1630	L	F	10.5	790	RHD2	
1631	R	M	13.0	840	RHD2	
1632	L	F	12.5	775	RHD2	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island, California, on 9 September 1979. - Continued

Tag number	Flipper tagged	Sex	Weight (kg)	Length (cm)	Checkmark	Remarks
1633	R	M	10.0	795	RHD2	
1634	R	M	12.0	770	RHD2	
1635	L	F	13.0	795	RHD2	
1636	L	F	10.0	745	RHD2	
1637	L	F	13.0	820	RHD2	
1638	R	M	11.0	770	RHD2	
1639	L	F	9.5	725	RHD2	
1640	L	F	10.5	740	RHD2	
1641	R	M	14.5	840	RHD2	
1642	L	F	11.5	820	RHD2	
1643	L	F	13.0	840	RHD2	
1644	R	M	10.0	715	RHD2	
1645	L	F	10.5	755	RHD2	
1646	L	F	12.0	800	RHD2	
1647	R	M	10.0	710	RHD2	
1648	R	M	12.0	775	RHD2	
1649	L	F	9.5	785	RHD2	
1650	R	M	12.5	790	RHD2	
1651	L	F	9.5	790	RHD2	
1652	R	M	10.0	760	RHD2	
1653	L	F	9.5	770	RHD2	
1654	L	F	11.0	775	RHD2	
1655	L	F	9.5	740	RHD2	
1656	L	F	14.0	830	RHD2	
1657	R	M	13.5	830	RHD2	
1658	R	M	11.0	760	RHD2	
1659	R	M	10.0	730	RHD2	
1660	L	F	10.0	760	RHD2	
1661	R	M	11.0	790	RHD2	
1662	L	F	11.0	770	RHD2	
1663	R	M	11.0	790	RHD2	
1664	R	M	10.5	730	RHD2	
1665	L	F	9.5	730	RHD2	
1666	R	M	10.5	720	RHD2	
1667	R	M	13.0	800	RHD2	
1668	L	F	9.5	-	RHD2	
1669	R	M	12.5	740	RHD2	
1670	L	F	11.5	740	RHD2	
1671	R	M	16.5	820	RHD2	
1672	L	F	12.0	770	RHD2	
1673	R	M	13.0	790	RHD2	
1674	L	F	11.0	750	RHD2	
1675	L	F	10.0	720	RHD2	
1676	L	F	11.0	780	RHD2	
1677	R	M	12.5	790	RHD2	
1678	R	M	11.0	770	RHD2	
1679	R	M	13.5	810	RHD2	
1680	R	M	10.5	760	RHD2	

TABLE A-19.--Northern fur seal pups tagged in Adams Cove, San Miguel Island, California, on 9 September 1979. - Continued

Tag number	Flipper tagged	Sex	Weight (kg)	Length (cm)	Checkmark	Remarks
1681	L	F	10.0	730	RHD2	
1682	R	M	12.0	790	RHD2	
1683	L	F	11.0	780	RHD2	
1684	L	F	10.0	770	RHD2	
1685	L	F	8.5	700	RHD2	
1686	R	M	13.5	840	RHD2	
1687	R	M	12.5	790	RHD2	
1688	L	F	11.5	780	RHD2	
1689	L	F	9.5	685	RHD2	
1690	R	M	10.5	765	RHD2	
1691	R	M	10.5	775	RHD2	
1692	L	F	10.0	750	RHD2	
1693	TAG DESTROYED					
1694	L	F	8.5	735	RHD2	
1695	R	F	15.5	800	RHD2	
1696	R	F	12.0	775	RHD2	
1697	L	F	9.5	755	RHD2	
1698	L	F	10.5	780	RHD2	
1699	R	F	11.5	735	RHD2	
1700	R	F	13.0	815	RHD2	

TABLE A-20.--Northern fur seal pups tagged on Castle Rock adjacent to San Miguel California, on 7 September 1979.

Tag number	Flipper tagged	Sex	Weight (kg.)	Length (cm.)	Checkmark	Remarks
SMI 1289	L	F	10.5	735	RHD2	
1290	R	M	12.0	815	RHD2	
1291	R	M	10.5	775	RHD2	
1292	L	F	9.3	780	RHD2	
1293	L	F	9.5	795	RHD2	
1294	R	M	12.0	800	RHD2	
1295	R	M	12.3	790	RHD2	
1296	L	F	8.5	720	RHD2	
1297	R	M	10.7	775	RHD2	
1298	L	F	7.5	700	RHD2	
1299	L	F	10.0	750	RHD2	
1300	L	F	8.5	710	RHD2	
1301	R	M	10.5	750	RHD2	
1302	L	F	8.5	755	RHD2	
1303	R	M	7.3	695	RHD2	
1304	R	M	12.4	810	RHD2	
1305	L	F	6.3	695	RHD2	
1306	L	F	12.0	745	RHD2	
1307	L	F	10.0	805	RHD2	
1308	L	F	6.5	705	RHD2	
1309	R	M	13.5	805	RHD2	
1310	L	F	10.5	775	RHD2	
1311	L	F	7.0	745	RHD2	
1312	L	F	9.0	730	RHD2	
1313	L	F	7.0	695	RHD2	
1314	R	M	9.5	745	RHD2	
1315	R	M	8.0	750	RHD2	
1316	R	M	12.5	805	RHD2	
1317	R	M	9.5	770	RHD2	
1318	R	M	10.3	785	RHD2	
1319	R	M	9.5	755	RHD2	
1320	R	M	12.0	805	RHD2	
1321	R	M	11.5	805	RHD2	
1322	L	F	10.0	735	RHD2	
1323	L	F	10.0	765	RHD2	
1324	L	F	9.5	750	RHD2	
1325	R	M	13.3	800	RHD2	
1326	L	F	11.0	795	RHD2	
1327	L	F	13.5	820	RHD2	
1328	R	M	9.5	760	RHD2	
1329	L	F	9.7	745	RHD2	
1330	L	F	11.3	800	RHD2	
1331	R	M	15.5	860	RHD2	
1332	R	M	9.3	785	RHD2	
1333	L	F	10.6	750	RHD2	
1334	L	F	7.0	725	RHD2	
1335	L	F	10.5	735	RHD2	
1336	L	F	11.0	785	RHD2	
1337	L	F	9.9	745	RHD2	
1338	R	M	11.0	805	RHD2	
1339	L	F	7.5	695	RHD2	

TABLE A-20.--Northern fur seal pups tagged on Castle Rock adjacent to San Miguel California, on 7 September 1979. - Continued

Tag number	Flipper tagged	Sex	Weight (kg.)	Length (cm.)	Checkmark	Remarks
SMI 1340	L	F	10.0	765	RHD2	
1341	R	M	9.5	745	RHD2	
1342	L	F	9.0	765	RHD2	
1343	R	M	12.2	825	RHD2	
1344	R	M	11.5	795	RHD2	
1345	R	M	12.5	800	RHD2	
1346	R	M	12.0	785	RHD2	
1347	R	M	10.5	750	RHD2	
1348	R	M	11.5	805	RHD2	
1349	R	M	11.0	785	RHD2	
1350	R	M	10.0	770	RHD2	
1351	R	M	11.5	795	RHD2	
1352	R	M	13.5	840	RHD2	
1353	L	F	10.0	795	RHD2	
1354	R	M	7.5	720	RHD2	
1355	L	F	11.5	790	RHD2	
1356	L	F	9.5	755	RHD2	
1357	L	F	8.7	775	RHD2	
1359	L	F	10.0	795	RHD2	
1358	TAG DESTROYED					
1360	L	F	10.5	810	RHD2	
1361	L	F	7.5	720	RHD2	
1362	R	M	12.5	810	RHD2	
1363	R	M	10.0	725	RHD2	
1364	L	F	9.5	715	RHD2	
1365	R	M	10.5	805	RHD2	
1366	R	M	10.5	775	RHD2	
1367	L	F	8.5	705	RHD2	
1368	L	F	13.0	800	RHD2	
1369	R	M	11.0	800	RHD2	
1370	L	F	8.0	755	RHD2	
1371	L	F	10.5	795	RHD2	
1372	R	M	12.0	800	RHD2	
1373	L	F	11.0	825	RHD2	
1374	L	F	10.5	790	RHD2	
1375	L	F	11.5	780	RHD2	
1376	R	M	13.0	850	RHD2	
1377	L	F	10.0	765	RHD2	
1378	R	M	12.0	800	RHD2	
1379	L	F	7.5	685	RHD2	
1380	R	M	12.5	805	RHD2	
1381	R	M	10.0	770	RHD2	
1382	L	F	10.0	755	RHD2	
1383	L	F	9.0	735	RHD2	
1384	L	F	11.0	785	RHD2	
1385	R	M	10.5	785	RHD2	
1386	R	M	9.0	755	RHD2	
1387	L	F	6.0	625	RHD2	
1388	R	M	9.7	735	RHD2	
1389	R	M	12.5	810	RHD2	

APPENDIX B

Persons engaged in fur seal research in 1979
National Marine Mammal Laboratory (NMML)
Michael F. Tillman, Director
W. Bruce McAlister, Acting Deputy Director
Clifford H. Fiscus, Coordinator, Fur Seal Research

Name	Affiliation	Assignment
Scientific Staff		
Permanent		
Alton Y. Roppel	NMML	Population Assessment
Patrick Kozloff	NMML	Population Assessment
Robert H. Lander	NMML	Population Assessment
Charles W. Fowler	NMML	Population Dynamics
Roger L. Gentry	NMML	Behavior and Biology
Robert L. DeLong	NMML	Behavior and Biology
Mark C. Keyes	NMML	Veterinary Medical Services
Hiroshi Kajimura	NMML	Pelagic Ecosystem
Michael A. Perez	NMML	Pelagic Ecosystem
Temporary		
John M. Francis	NMML	Behavior and Biology
Sue Carter	NMML	Behavior and Biology
John Holt	NMML	Behavior and Biology
John Calambokidis	NMML	Behavior and Biology
George A. Antonelis, Jr.	NMML	Behavior and Biology
Edward C. Jameyson	NMML	Behavior and Biology
Anne E. York	NMML	Population Dynamics
M. Richard Zacharof	NMML	Population Assessment
M. Robert Kochergin	NMML	Population Assessment
Edward Robb	NMML	Veterinary Medical Services
Lavrenty Stepetin	Pribilof Isl. Prog.	Population Assessment
Cooperators[1]		
Richard K. Stroud	San Diego Zoo, CA	Veterinary Medical Services
Tom Roffe	San Diego Zoo, CA	Veterinary Medical Services
Dana J. Seagars	Natl. Park Service[2]	Tagging Project
Mike Hill	Natl. Park Service	Tagging Project
Bill Ehorn	Natl. Park Service	Tagging Project
Carolynn Heath	Natl. Park Service	Tagging Project
Mark Connally	Natl. Park Service	Tagging Project
Bruce Krogman	NMML	Tagging Project

APPENDIX B.--continued.

Name	Affiliation	Assignment
Cooperators, continued		
Vickie Kirby	NOS Center[3/]	Tagging Project
Eugene Nitta	NMFS, SW Region	Tagging Project
Ke Chung Kim	Penn. State Univ.	Respiratory Mite Biology
Michael Quinn	Penn. State Univ.	Respiratory Mite Biology
Visiting Scientists		
Wally Hansen	Univ. of Wisconsin	--
Jane Homan	Univ. of Wisconsin	--
Bob Olsen	Univ. of Wisconsin	--
James Larison	Oregon State Univ.	--
James Hicks	Oregon State Univ.	--
North Pacific Fur Seal Commission		
Michael Bigg[4/]	Fish & Marine Serv. Environment Canada	--

1/ Financed wholly or in part by the National Marine Mammal Laboratory or other Federal agency.

2/ The National Park Service manages San Miguel Island for the Department of Navy and frequently assists in wildlife management activities when needed.

3/ Naval Ocean Systems Center.

4/ Canadian member of the Standing Scientific Committee.

APPENDIX C

Grounding of M/S Ryuyo Maru No. 2 on St. Paul Island, Alaska, 9 November 1979.

On 9 November 1979, the Japanese vessel M/S Ryuyo Maru No. 2 (Appendix D, Figure D-1) went aground (bow on the beach) on the village side of Tolstoi Point during an attempt to put a NMFS observer ashore. Shortly thereafter, some "several thousand" gallons of diesel oil escaped into the sea through one or more ruptures in the hull. Ocean currents at the time carried oil westerly around Tolstoi Point and into English Bay, into the Salt Lagoon, and southerly along the Zoltoi sand beach and onto the rocks of Gorbatch Rookery. Other beaches were touched little, if any.

There was a heavy kill of amphipods and other small marine organisms in the Salt Lagoon but so far as could be determined at the time, not so severe as to prevent eventual recovery. Monitoring of the situation into the future will be needed in order to determine the overall affect of the spill in this regard.

By 15 November, 3-4 fur seal pups and a few birds that had recently died were picked up. All will be necropsied to determine causes of death. Alton Roppel and Lavrenty Stepetin surveyed the 14 St. Paul Island rookeries and additional beaches as well 16-18 November. As a result of storm-churned seas, the rocks of Gorbatch Rookery had been cleansed of their coating of oil by that time and very little of the pollutant remained in English Bay. Two dead sea birds (murre and auklet) were collected from Zoltoi and one recently dead fur seal pup was picked up from the English Bay sand beach. All rookeries and other beaches were free of animals and birds that had recently died so far as could be determined. The hauling grounds were bare of fur seals and an estimated 10-30% of the summer population of animals remained on the rookeries.

On 19 November, representatives from the U.S. Coast Guard, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Alaska Department of Environmental Conservation, and the Aleut Corporation met in Anchorage, Alaska to discuss how best to dispose of an unknown quantity of oil still aboard the vessel. Five options were considered;

Option #1. Consider the ship inaccessible and do nothing. The result may be either a long-term leaking of oil extending into the 1980 bird and fur seal breeding season, or a sudden uncontrollable release of all or most of the pollutant. A considerable amount of fish aboard will release methane and hydrogen sulphide during the process of decomposition.

APPENDIX C.--continued.

Option #2. Attempt to remove the oil and fish from ship to barge at an estimated daily cost of $40,000 over a period of 3-4 months (according to past weather records for November, January, and February, pumping from ship to barge is possible only during 3-4 days of every 14 -- the equipment would then have to be moved to the lee side of the island for 10 of every 14 days to await calm weather).

Option #3. Pump the oil to the top of the bluff, an elevation of 175 feet. Such a feat has never been successfully accomplished to date because of the height and general weather conditions. Even if a pumping operation was to be successful, there existed a potentially serious problem of disposal. The estimates of pollutant remaining aboard ranged from 100,000 gallons to a mixture of oil and water five times that quantity, or 500,000 gallons. In addition, the vessel was classified as hazardous for personnel working aboard.

Option #4. Attempt to remove the vessel and tow it to sea for disposal. Since the bottom of the ship was already ruptured, the hull would have to be "foamed" first in order to float it, not quite an exact art as yet. Foaming requires air temperatures of between 50 and 70° F., which almost never occur in the Bering Sea, certainly never in the winter. If foaming was in fact possible, the job would take 1 to 1 1/2 years at an estimated total cost of $3-4 million.

Option #5. Blow holes in the fuel and fish compartments during optimum weather conditions (high winds and favorable water currents) and let heavy seas wash through the vessel, clean it out, and dispose of the pollutants.

Because of the need to quickly eliminate the problem and prevent continued pollution of the area, perhaps into the 1980 bird and fur seal breeding season and based on the fact that the first release of oil was quickly eliminated by a storm, the group opted for Option #5. This option was carried out to the satisfaction of all investigators of the problem.

APPENDIX D

Location of the M/S Ryuyo Maru No. 2 aground on St. Paul Island, Alaska in 1979 and of northern fur seals and California sea lions on San Miguel Island, California and nearby Castle Rock in 1978.

Figure D-1.--M/S Ryuyo Maru No.2 aground at Tolstoi Point, St. Paul Island, Alaska, 9 November 1979 (Photo by Alton Y. Roppel).

Figure D-2.--Breeding groups of northern fur seals, Callorhinus ursinus, (C) and scattered groups of California sea lions, Zalophus californianus, (Z) located on the dark sand and along the shore line, Adams Cove, San Miguel Island, California, 7 July 1978 (Photo by George Antonelis).

Figure D-3.--Northern fur seal (C) and California sea lion (Z) breeding areas on Castle Rock, 1 July 1978. San Miguel Island is in the background (Photo by Wilvert-Pencek and Associates).

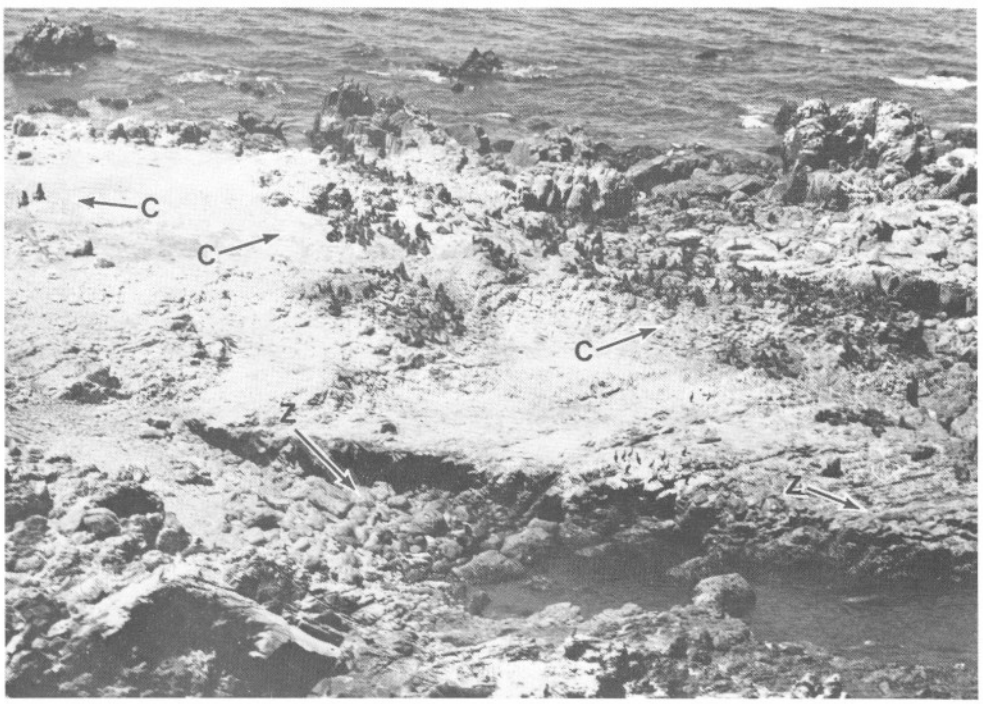

Figure D-4.--Northern fur seals (C) and California sea lions (Z) on Castle Rock, 1 July 1978 (Photo by Wilvert-Pencek and Associates).