UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL MARINE FISHERIES SERVICE

NORTHWEST FISHERIES CENTER

FUR SEAL INVESTIGATIONS, 1975

by

Marine Mammal Division

National Marine Fisheries Service

February 1976

NOTICE

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by

National Marine Fisheries Service
Northwest Fisheries Center
Marine Mammal Division
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INTRODUCTION

The National Marine Fisheries Service carries out biological research on the northern fur seal on the Pribilof Islands and at sea because it is responsible for harvesting this species on land and because it is the Federal Agency responsible for cooperating with Canada, Japan, and the USSR in conserving North Pacific fur seals.

In 1975, research was carried out on several aspects of the fur seal resource including Monitoring for Management, Population Dynamics, Physiology and Medicine, Behavior, and Pelagic Life.

Figures 1, 2, and 3 show St. Paul Island, St. George Island, and San Miguel Island and the location of rookeries and hauling grounds. Terms having special meanings in fur seal research are described in the glossary. In this report "Pribilof Islands" includes St. Paul and St. George Islands, and, occasionally, Sea Lion Rock. "San Miguel Island" refers to the fur seal populations of Adams Cove and Castle Rock. Two of the five Pribilof Islands, Otter and Walrus, do not have fur seal rookeries or hauling grounds.

Part I. MONITORING FOR MANAGEMENT, PRIBILOF ISLANDS

The monitoring for management program is designed to build a data base on population structure essential to the long-term objective of management for maximum sustainable productivity. On a short-term basis, the population data are used each year as a guide in establishing size limits for harvested males to insure that a sufficient number are permitted to escape and eventually contribute to the breeding stock.

Age Classification and Number of Seals Killed, by Sex

From 30 June through 2 August, 29,093 male fur seals in ages 2 to 6 years and with a body length of 46 inches (116.8 cm) or less from tip of tail to tip of nose were harvested on St. Paul Island, Monday through Saturday beginning at 6 a.m.

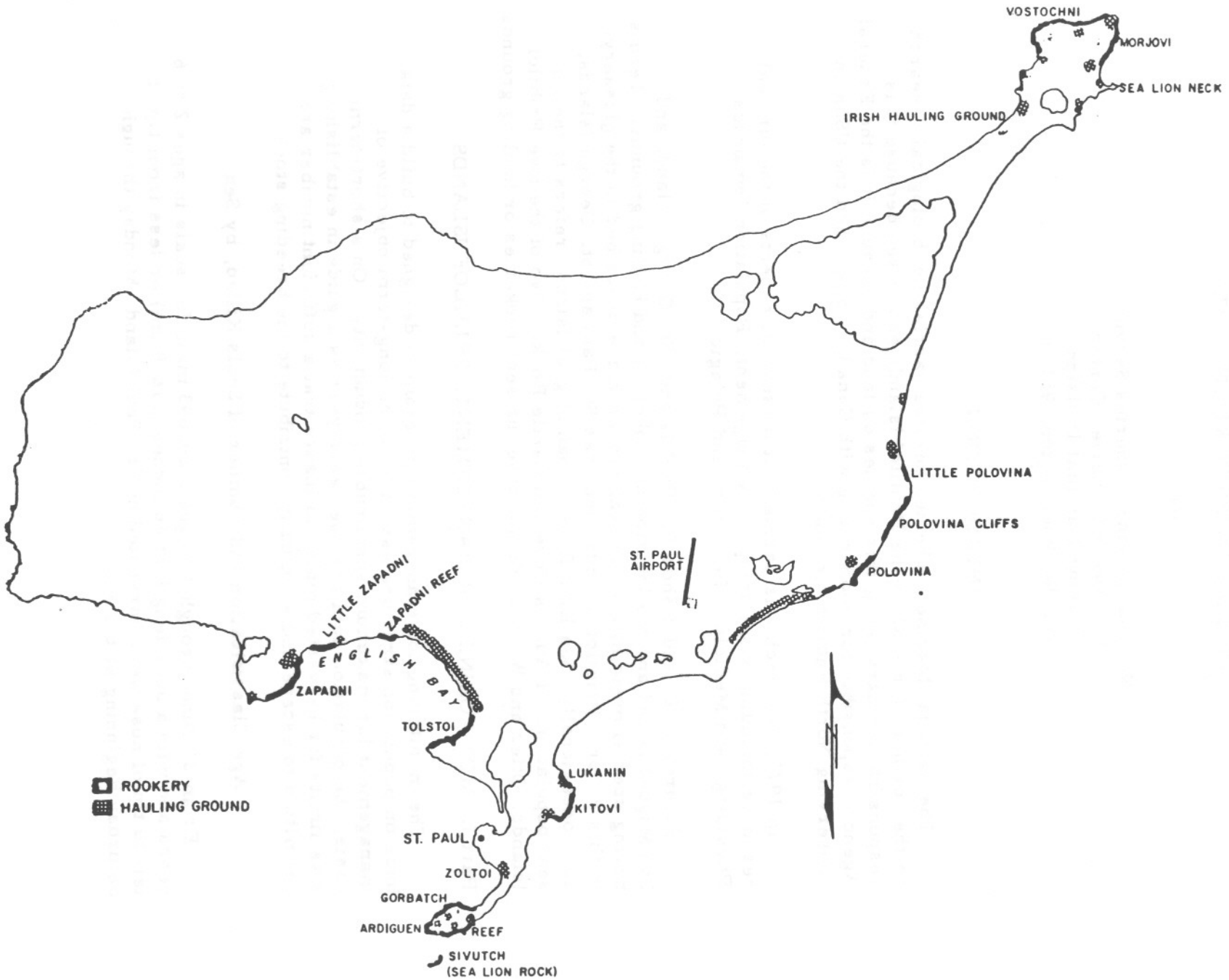

Figure 1.--Location of rookeries and hauling grounds, St. Paul Island.

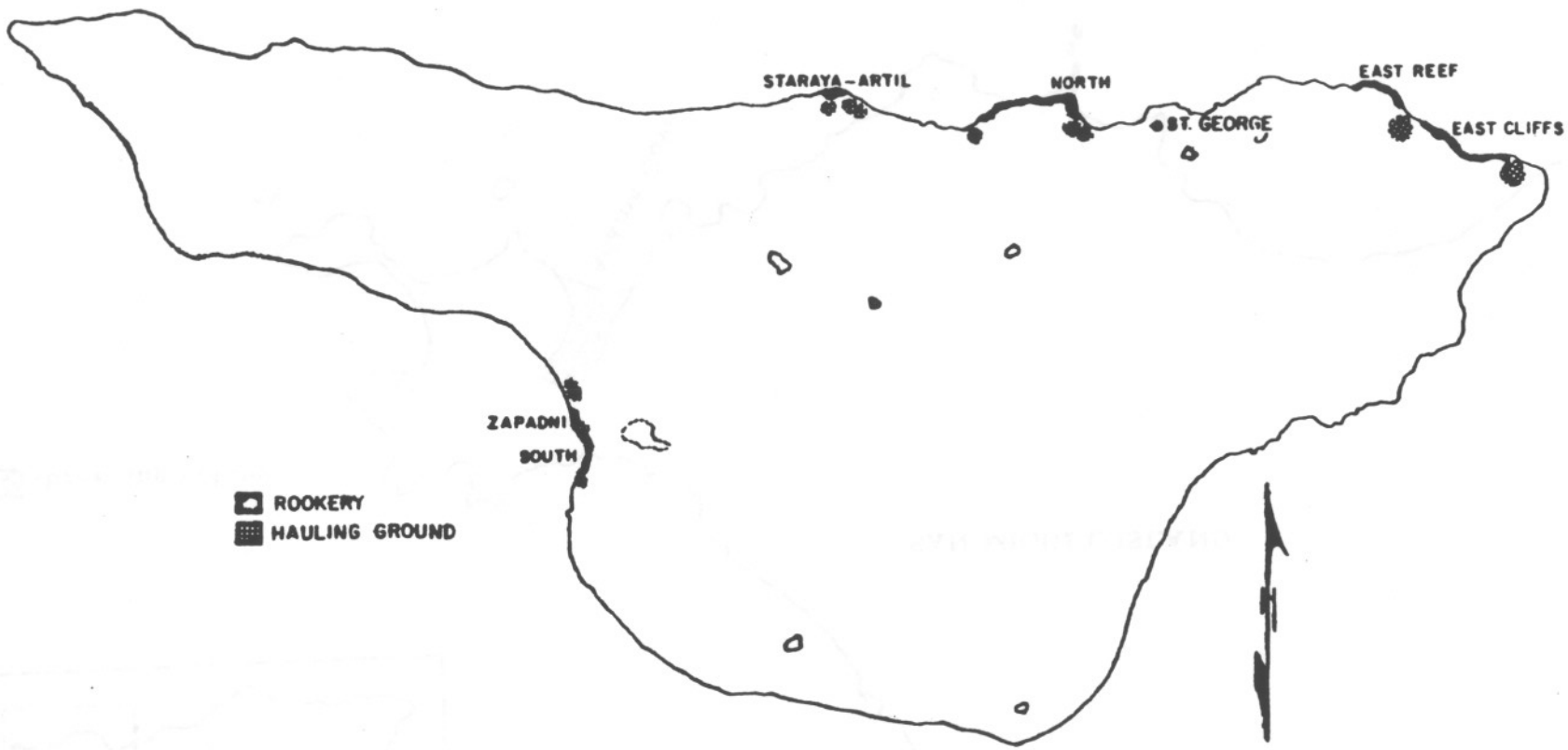

Figure 2.--Location of rookeries and hauling grounds, St. George Island.

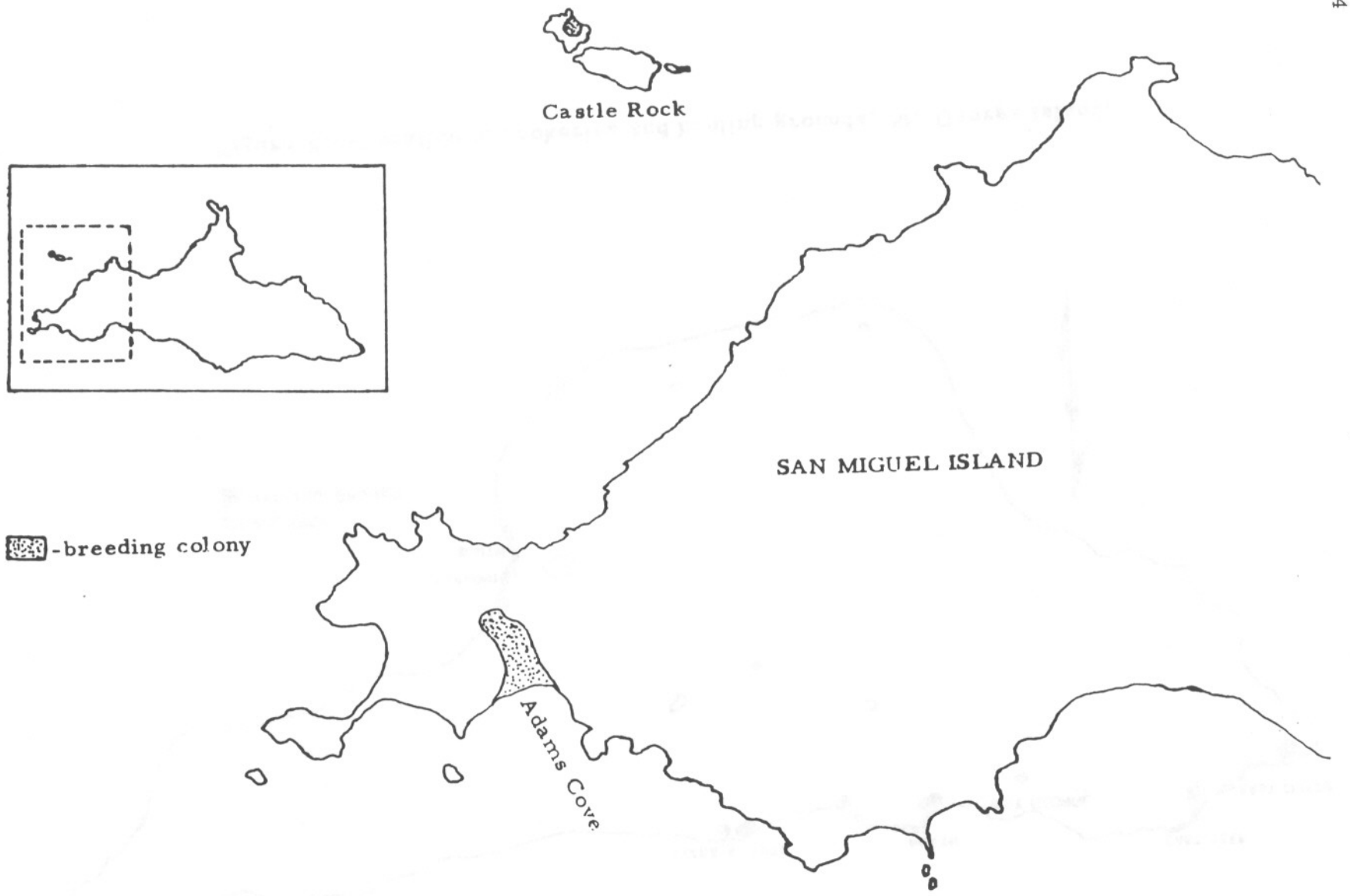

Figure 3. Location of northern fur seal breeding colonies, San Miguel Island, California

A 20% sample of maxillary canine teeth was collected daily to determine age composition (Table A-1). Fifty-five female seals killed unintentionally were not classified by age.

The seasonal trend in the availability of 3- and 4-year-old males killed on St. Paul Island in 1975 is shown in Figure 4. Table 1 and Figure 5 give the number of males killed, by year class.

Survey Data

In 1975, counts of living adult males and of dead seals of both sexes and all ages, and estimates of the number of living pups provided the basis for monitoring fur seal management techniques.

Living Adult Male Seals Counted

Living adult male seals were counted on all rookeries and hauling grounds on St. Paul and St. George Islands in June and July (Tables A-2 to A-9).

Full and partly grown males are included in the counts. The males are first counted when about 7 years old. At this age they lack the size of full-grown males, but have a mane and the body conformation of an adult. Individuals in classes 1, 2, and 3 are usually full grown, whereas those in classes 4 and 5 range in size from partly to full grown. Prior to 1966, class 3 males were called harem bulls, and animals in classes 1, 2, 4, and 5 were collectively counted as idle bulls (see glossary for a description of the classes of males). 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. Figure 6 shows the relative locations of the three classes (2, 3, and 5) of adult males on the rookery.

Dead Seals Counted That Were Older Than Pups

Canine teeth were collected from dead fur seals older than pups (99 females, 92 males) that had died on St. Paul Island in 1975 (Table 2). The teeth will be used for age and mortality studies.

Dead Pups Counted

Dead pups counted 27 August to 2 September on St. Paul Island and 20-21 August on St. George Island totaled 20,625 and 3,289, respectively (Tables A-10 and A-11). The counts were conducted on all rookeries of both islands. In 1975 the death rate on land was 0.074 on St. Paul Island

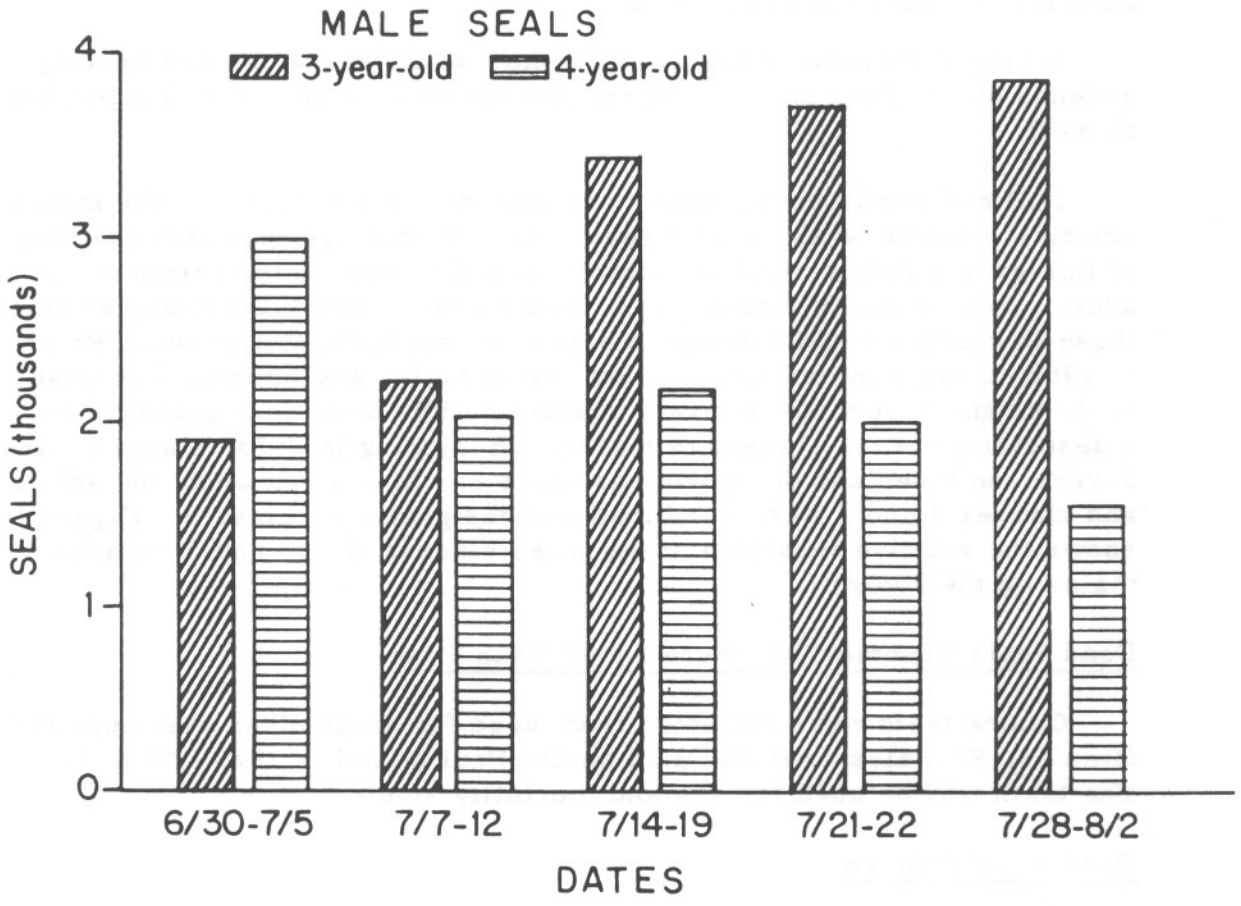

Figure 4. --Three- and four-year-old male seals killed, St. Paul Island, 30 June to 2 August 1975

Table 1 . --Kill of male seals, [1/] by year class, St. Paul Island, 1961-73

Year class	Age when killed				Total
	2	3	4	5	
1961	1,098	22,468	12,046	1,270	36,882
1962	2,539	19,009	12,156	1,287	34,991
1963	1,264	25,535	11,785	1,542	40,126
1964	3,143	26,991	13,279	1,469	44,882
1965	2,200	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 [2/]	577	14,652	10,768	-	25,997
1972 [2/]	1,025	15,186	--	-	16,211
1973 [2/]	1,642	-	-	-	1,642
Total	20,765	226,798	135,915	13,576	397,054
Mean	1,597	18,900	12,356	1,358	[3/] 35,320

1/ Includes only 2- to 5-year-old seals taken during the kill of male seals. From 1956 through 1973, 131 1-year-olds and 1,197 6-year-olds were harvested. In addition, age was not determined for 4,919 males taken on St. Paul Island.

2/ Incomplete returns.

3/ 1971, 1972, and 1973 year classes not included.

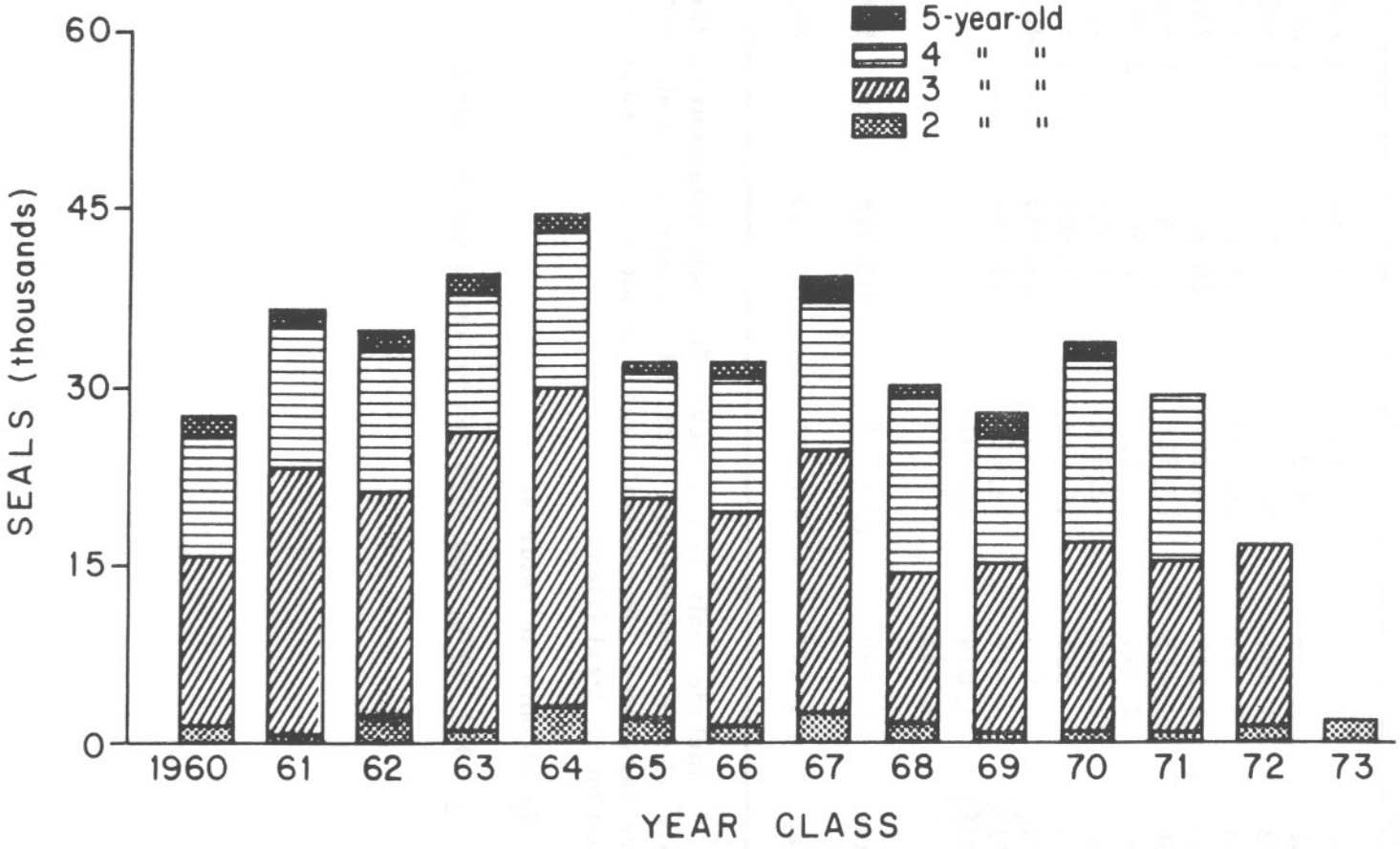

Figure 5. --Kill of male seals, by year class, St. Paul Island, 1960-73.

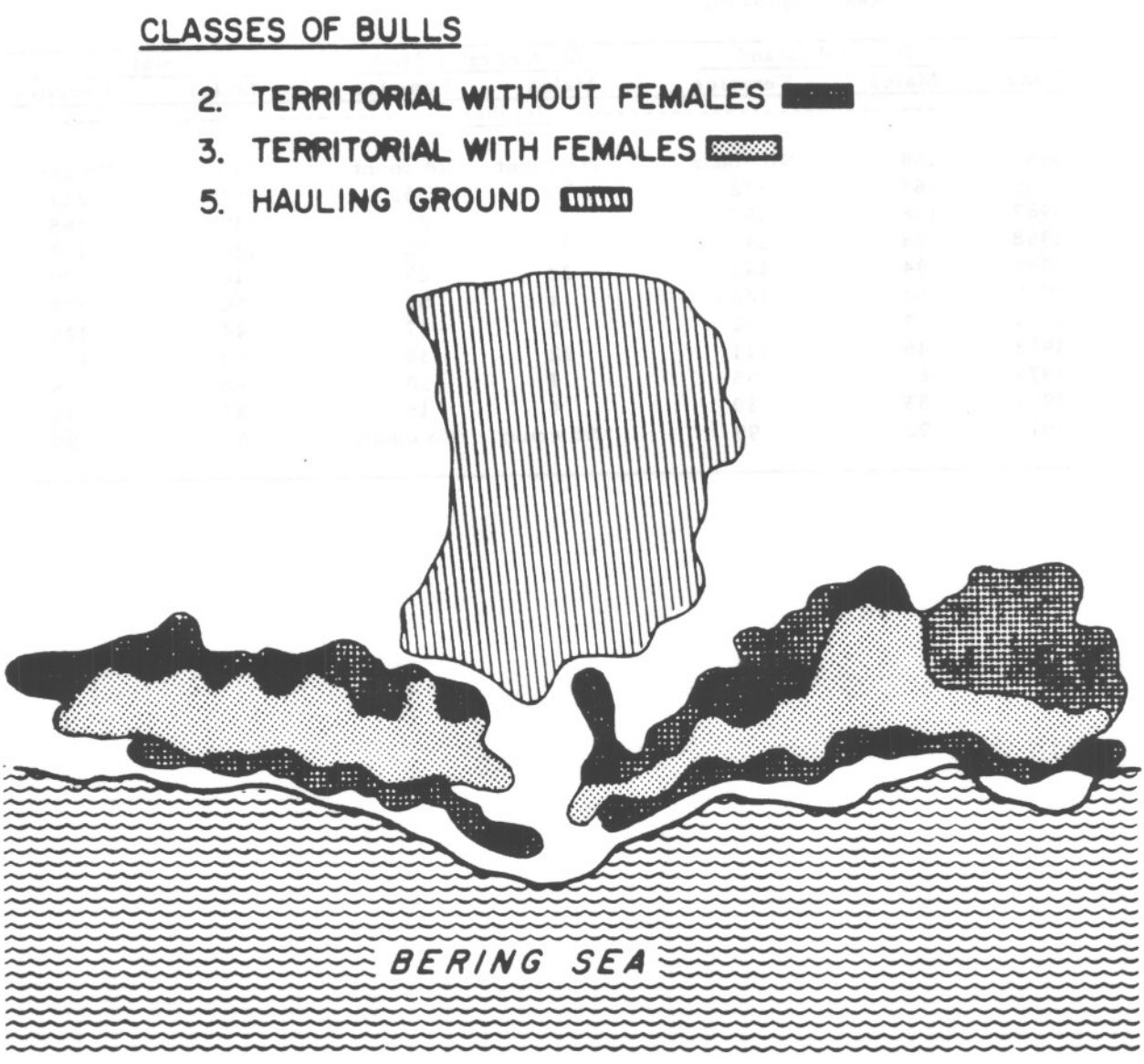

Figure 6. --General composition of a typical fur seal rookery.

Table 2 .--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1965-75.

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	Number					
1965	158	No count	No count	No count	158	No count
1966	181	172	41	55	222	227
1967	108	157	41	28	149	185
1968	98	141	33	22	131	163
1969	94	141	22	29	116	170
1970	52	124	4	53	56	177
1971	39	91	5	37	44	128
1972	46	111	22	30	68	141
1973	61	65	7	30	68	95
1974	33	30	4	15	37	45
1975	92	99	No count	No count	92	99

and 0.040 on St. George Island compared to 0.089 in 1970 for St. Paul and 0.044 in 1973 for St. George. The years 1970 and 1973 are the most recent years in which complete, comparative data were obtained for the respective islands.

Marking

Studies of survival and of the intermixture of seals from the various breeding grounds are based on recovery data from marked seals. Marked seals recovered in 1975 are listed in Tables A-12 and A-13.

Application of Marks

Since 1870 fur seals of both sexes have been marked at various ages. Marks applied in recent years, and their locations on the flipper, are shown in Figure 7.

Pups.--In August, 5,000 pups were permanently marked on St. George Island by removing about 3/4 inch (1.9 cm) of the cartilagenous tip of the first digit from the left hind flipper. An additional 10,000 pups were similarly marked in September on St. Paul Island by removing the cartilagenous tip of the first digit from the right hind flipper. The marking effort for each rookery was proportioned according to the counted distribution of adult male fur seals (class 3) with established territories and adult females in mid-July. Marks that have been applied to pups since 1966 are listed in Table A-14.

Male seals ages 1 and 2 years.--Male seals of these ages have not been marked on St. Paul Island since 1971. Table A-15 lists the number and type of tags applied from 1961 to 1971.

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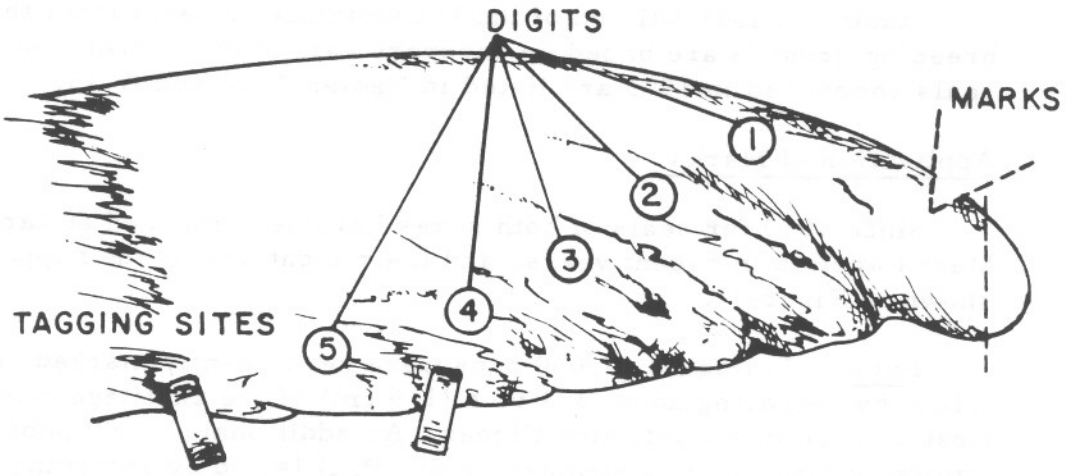
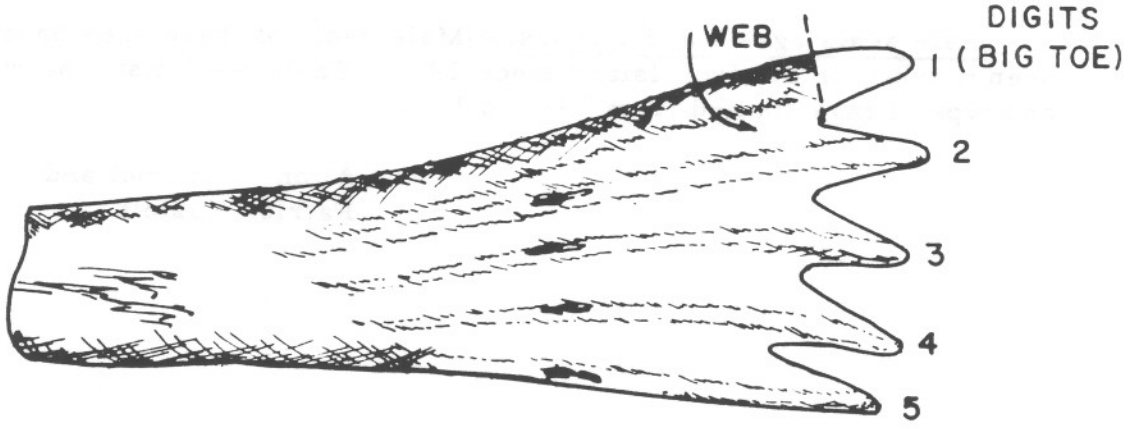


FRONT FLIPPER
TAGS CLINCHED AT THE HAIRLINE AND BETWEEN THE FOURTH AND THE FIFTH DIGIT.
MARKS MADE BY CUTTING A V-NOTCH AND REMOVING THE TIP.



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

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

Part II. POPULATION DYNAMICS

Estimates of the number of pups alive in August and of the number born were made by shearing/sampling and by counting dead pups on all rookeries in 1975, the first such estimate obtained for St. Paul Island since 1970, and for St. George Island since 1973. The 1975 estimates of pups born are 278,300 for St. Paul Island and 83,000 for St. George Island (Table 3). These values indicate an increase over the 5 years of 21% above the estimated 230,400 pups born on St. Paul Island in 1970 (Table 13 of Marine Mammal Biological Laboratory, 1971), and an increase over 2 years of 37% above the estimated 60,500 born on St. George Island in 1973 (Tables 6 and A-11 of the Marine Mammal Division, 1974). An increase of 37% in 2 years greatly exceeds an average annual increase of 8% based on direct counts of living and dead pups on the Pribilof Islands during 1912-24 when the population was small and growing rapidly. Because we have no explanation for this apparent anomaly, an estimate of the number of pups born will be obtained on all rookeries of St. George Island again in 1976 as a check on the accuracy of the 1975 estimate.

An analysis was made of data taken during seven years when shearing/sampling estimates of living pups and counts of dead pups are available for all rookeries on St. Paul Island. The purpose was to find if realistic estimates of the numbers of pups born could be developed for any or all five past years when data were taken in each on a different group of sample rookeries only. A similar analysis was carried out on data from individual rookeries to find if particular rookeries might be sampled in future years to give a reliable estimate of the number of pups born without shearing and sampling on all rookeries. Estimates for 1967-68 and 1972-74 are developed and conclusions are reached concerning specific rookeries to sample in future years.

Information on the homing of male seals 2-5 years old to St. Paul Island and St. George Island is brought up to date from recoveries of tags and marks through 1975 by age and year class. Seals were last killed commercially and tags or other marks recovered on St. George Island in 1972; in an effort to find if the absence of a kill is starting to influence the number of subadult males straying from St. George Island, recoveries during 1973-75 on St. Paul Island of seals tagged or otherwise marked as pups on St. George Island are

Table 3. Estimates of seal pups in 1975 year class at times of shearing and birth on Pribilof Islands, Alaska; sampling periods 1 and 2 were 18-21 and 22-26 August, respectively, on St. Paul Island and 17-19 and 24-25 August, respectively, on St. George Island. Pups were sheared 4-14 August on St. Paul Island and 11-15 August on St. George Island.

Island and Rookery	Number of pups Sheared	Number counted alive by category and period: 25-pup samples 1	25-pup samples 2	Sheared 1	Sheared 2	Total[1] 1	Total[1] 2	Count of dead pups	Estimated Number Alive[2] 1	Alive[2] 2	Alive[2] Mean	Born[3]
St. Paul Island												
Morjovi	1,648	73	115	125	256	1,825	2,875	1,765	24,061	18,508	21,284	23,049
Vostochni	3,501	193	261	393	575	4,825	6,525	3,259	42,983	39,729	41,356	44,615
Little Polovina	386	27	35	77	98	675	875	252	3,384	3,446	3,415	3,667
Polovina Cliffs	2,020	107	106	195	243	2,675	2,650	1,529	27,710	22,029	24,870	26,399
Polovina	386	47	42	88	114	1,175	1,050	419	5,154	3,555	4,354	4,773
Tolstoi	2,721	171	166	386	352	4,275	4,150	4,141	30,135	32,080	31,108	35,249
Zapadni	2,674	184	187	308	371	4,600	4,675	3,252	39,936	33,695	36,816	40,068
Little Zapadni	1,598	118	130	208	264	2,950	3,250	1,204	22,664	19,672	21,168	22,372
Zapadni Reef	615	40	68	91	136	1,000	1,700	508	6,758	7,688	7,223	7,731
Reef	2,729	125	173	318	417	3,125	4,325	1,837	26,818	28,304	27,561	29,398
Gorbatch	1,696	86	114	221	275	2,150	2,850	1,025	16,500	17,577	17,038	18,063
Ardiguen	373	11	16	40	50	275	400	142	2,564	2,984	2,774	2,916
Kitovi	1,171	71	73	141	191	1,775	1,825	787	14,741	11,189	12,965	13,752
Lukanin	491	35	34	68	82	875	850	505	6,318	5,090	5,704	6,209
Island Total	22,009	-	-	-	-	-	-	20,625	269,726	245,546	257,636	278,261
St. George Island												
Zapadni	623	37	42	57	61	925	1,050	470	10,286	11,188	10,737	11,207
South	1,163	57	49	136	109	1,425	1,225	344	13,557	13,532	13,544	13,888
North	2,277	157	149	286	257	3,925	3,725	1,230	32,414	33,140	32,777	34,007
East Cliffs	979	35	39	82	79	875	975	434	10,406	11,333	10,870	11,304
East Reef[4]	-	-	-	-	-	-	-	102	-	-	1,708	1,810
Staraya Artil	616	41	44	65	72	1,025	1,100	709	10,174	9,971	10,072	10,781
Island Total	5,658	-	-	-	-	-	-	3,289	78,545	80,872	79,708	82,997
Total both Islands	27,667	-	-	-	-	-	-	23,914	-	-	337,344	361,258

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

2/ Estimated from $\hat{N} = MC/R$ (M=number sheared, C=count of total pups in all samples, and R=count of sheared pups in all samples); means of estimates in each period are added to estimate the number alive on all rookeries at time of shearing.

3/ Dead pup counts added to estimated mean number alive at time of shearing to estimated number born.

4/ Live pups on East Reef Rookery were counted completely, not sheared and sampled.

compared with recoveries before the kill ended.

A marking experiment was started in July of 1975 to estimate the number of subadult males on the east hauling ground of North Rookery on St. George Island (Figure 2). This experiment failed.

Finally, the trend of pup production during 1961-75 is reviewed.

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Population Analysis of Pup Data from Sample Rookeries

Our report for 1974 (Marine Mammal Division, 1975) gives a preliminary analysis of pup data with respect to two objectives. The first objective is to determine if estimates can be made of the total numbers of pups born on the Pribilof Islands in 1967-68 and 1972-74, when data for shearing/sampling estimates of living pups were taken on sample rookeries only, in order to reduce disturbance (data were taken from all rookeries in 1969-70 but from none in 1971). The second objective is to find if any particular rookeries might be sampled in future years to provide additional estimates of reasonable reliability without disturbing all of the seals by shearing and sampling on all rookeries every year.

The present analysis is more complete and includes the 1975 estimates of living pups from shearing/sampling, dead pup counts, and the resulting estimates of pups born (Table 3). The analysis is limited to St. Paul Island: data from all rookeries are available from there for more years and, as noted last year in Tables 5-6 of Marine Mammal Division, 1975, the contributions of most rookeries to the total number of pups born fluctuate more widely between years on St. George Island.

Estimation of Pups Born in 1967-68 and 1972-74

The total number of pups alive (in August) and of pups born during each of the seven years (1963-66, 1969-70, and 1975) as based on shearing/sampling estimates and dead pup counts from all rookeries on St. Paul Island are considered to be "known" without error. Our analysis is based on data taken during those same years on each of the five rookery groups actually sampled in any one of the five years 1967-68 and 1972-74.

The first method directly relates the known total number of pups born annually to the estimated number born on a sample rookery group; i. e., total number born is estimated from each of the five resulting regression equations. Known and estimated values are then compared between sample rookery groups to see if any or all of them can be expected to provide reliable estimates for years with data available from sample rookeries only. Decisions are based on values of (1) residual sums of squares, i.e., the sum over all seven years of (estimate-known value)^2, a common statistical criterion, and on (2) the maximum relative error in the estimate for any one year.

In the second method we calculate regression estimates of known total living pups from the seven years with complete data, then add the yearly total dead pup counts on St. Paul Island in order to estimate the number born. Deviations of these new estimates from the known total pups born are again calculated to give another set of comparisons between the five sample rookery groups. The second method is not applicable to 1973 or 1974 even if it gives smaller deviations because dead pups were counted only on sample rookeries in years 1973 and 1974 (Table A-11).

Dead pup counts (D) and shearing/sampling estimates of living pups (L) from previous annual reports are added in Tables 4 and 5 to give the estimated number of pups born (B) on each rookery. Values are in thousands and are rounded to the nearest 100 pups; the maximum rounding error in annual totals for St. Paul Island is also 100 pups born (e.g., the 1965 total in Table 4 is 264.9, and Table 13 of Marine Mammal Biological Laboratory, 1971 gives 264.8). Table 5 summarizes the data for years when estimates were made on sample rookeries only.

Figure 8 shows for the years with complete data (Table 4) the relations between known total pups born and estimated pups born annually on each sample rookery group (values for living pups look much the same and are not graphed). Plotted values are summarized in Table 6 for convenience. The relationships in Figure 8 are clearly linear. Deviations between actual values and regression lines appear to be lowest when Morjovi and Vostochni Rookeries are sampled, and highest when Reef or Tolstoi Rookeries are sampled.

Table 7 gives correlation coefficients and regression constants for the lines shown in Figure 8. Also in Table 7 are comparable values calculated from the living pup data for the second method of analysis.

Table 4. --Thousands of dead pups (D), estimated living pups in August from shearing and sampling (L), and estimated pups born (B=D+L) on different rookeries of St. Paul Island, year classes 1963-66, 1969-70 and 1975. A dash indicates that original data for living pup estimate from Ardiguen and Gorbatch Rookeries were combined in 1963.

Rookery or group	1963			1964			1965			1966			1969			1970			1975		
	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B
Morjovi	2.3	17.3	19.6	1.8	17.8	19.6	2.6	16.3	18.9	1.7	19.2	20.9	0.7	15.5	16.2	1.6	14.9	16.5	1.7	21.3	23.0
Vostochni	5.1	34.7	39.8	3.4	42.0	45.4	4.2	35.7	39.9	2.8	48.8	51.6	1.7	33.7	35.4	3.3	33.8	37.1	3.3	41.4	44.7
Little Polovina	0.9	6.5	7.4	0.6	8.4	9.0	1.1	7.0	8.1	0.4	8.7	9.1	0.2	5.1	5.3	0.3	3.8	4.1	0.3	3.4	3.7
Polovina Cliffs	2.2	19.6	21.8	1.1	22.3	23.4	2.9	18.2	21.1	0.8	23.3	24.1	0.8	18.2	19.0	1.6	17.1	18.7	1.5	24.9	26.4
Polovina	1.2	4.2	5.4	0.8	5.1	5.9	1.2	5.1	6.3	0.3	5.7	6.0	0.3	3.6	3.9	0.5	3.7	4.2	0.4	4.4	4.8
Ardiguen	-	-	-	0.1	2.8	2.9	0.5	2.3	2.8	0.2	2.8	3.0	0.1	3.6	3.7	0.1	3.1	3.2	0.1	2.8	2.9
Gorbatch	-	-	-	1.5	23.6	25.1	3.1	17.7	20.8	1.6	20.8	22.4	0.8	17.7	18.5	1.0	15.0	16.0	1.0	17.0	18.0
Ardiguen-Gorbatch	2.5	22.6	25.1	1.6	26.4	28.0	3.6	20.0	23.6	1.8	23.6	25.4	0.9	21.3	22.2	1.1	18.1	19.2	1.1	19.8	20.9
Reef	5.7	33.0	38.7	3.0	38.7	41.7	7.7	31.8	39.5	3.6	34.9	38.5	1.4	27.1	28.5	2.2	24.9	27.1	1.8	27.6	29.4
Kitovi	0.9	10.8	11.7	0.5	14.1	14.6	2.2	11.9	14.1	0.4	14.0	14.4	0.7	10.9	11.6	0.7	12.7	13.4	0.8	13.0	13.8
Lukanin	0.5	5.2	5.7	0.4	5.1	5.5	1.1	5.2	6.3	0.4	7.2	7.6	0.5	4.7	5.2	0.4	5.5	5.9	0.5	5.7	6.2
Tolstoi	3.3	23.6	26.9	2.6	25.5	28.1	4.0	26.8	30.8	3.4	27.0	30.4	2.8	26.7	29.5	3.6	22.2	25.8	4.1	31.1	35.2
Little Zapadni	2.6	13.8	16.4	1.1	17.1	18.2	2.5	15.3	17.8	1.6	23.0	24.6	0.8	18.9	19.7	1.4	15.2	16.6	1.2	21.2	22.4
Zapadni Reef	0.7	6.2	6.9	0.4	6.5	6.9	0.7	5.4	6.1	0.5	4.9	5.4	0.2	4.6	4.8	0.3	4.2	4.5	0.5	7.2	7.7
Zapadni	4.6	32.4	37.0	4.2	33.4	37.6	5.4	27.0	32.4	3.7	37.2	40.9	2.3	29.4	31.7	3.6	33.7	37.3	3.3	36.8	40.1
All	32.5	229.9	262.4	21.5	262.4	283.9	39.2	225.7	264.9	21.4	277.5	298.9	13.3	219.7	233.0	20.6	209.8	230.4	20.5	257.8	278.3

Table 5. --Thousands of dead pups (D), living pups (L), and pups born (B), as estimated on sample rookeries of St. Paul Island, Alaska, in 1967-68 and 1972-74.

Rookery	1967			1968			1972			1973			1974		
	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B
Reef	2.0	31.4	33.4	3.1	24.8	27.9	-	-	-	-	-	-	1.6	33.5	35.1
Tolstoi	2.3	33.5	35.8	-	-	-	-	-	-	3.6	35.3	38.9	-	-	-
Morjovi	-	-	-	2.3	15.9	18.2	2.2	16.3	18.5	-	-	-	-	-	-
Vostochni	-	-	-	4.2	33.3	37.5	4.7	39.0	43.7	-	-	-	-	-	-
Zapadni Reef	-	-	-	0.7	4.6	5.3	-	-	-	0.7	7.7	8.4	-	-	-
Zapadni	-	-	-	-	-	-	-	-	-	3.9	33.6	37.5	-	-	-
Little Zapadni	-	-	-	-	-	-	-	-	-	1.8	22.8	24.6	-	-	-
Ardiguen	-	-	-	-	-	-	-	-	-	-	-	-	0.1	3.3	3.4
Gorbatch	-	-	-	-	-	-	-	-	-	-	-	-	1.2	19.0	20.2
Total	4.3	64.9	69.2	10.3	78.6	88.9	6.9	55.3	62.2	10.0	99.4	109.4	2.9	55.8	58.7

Table 6. --Data from Table 4 on thousands of dead pups (D), living pups (L) and pups born (B) on sample rookery groups of St. Paul Island and on all rookeries of the island, 1963-66, 1969-70 and 1975.

Rookery	1963			1964			1965			1966			1969			1970			1975		
	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B	D	L	B
Reef - Tolstoi	9.0	56.6	65.6	5.6	64.2	69.8	11.7	58.6	70.3	7.0	61.9	68.9	4.2	53.8	58.0	5.8	47.1	52.9	5.9	58.7	64.6
Reef - Morjovi - Vostochni - Zapadni Reef	13.8	91.2	105.0	8.6	105.0	113.6	15.2	89.2	104.4	8.6	107.8	116.4	4.0	80.9	84.9	7.4	77.8	85.2	7.3	97.5	104.8
Morjovi - Vostochni	7.4	52.0	59.4	5.2	59.8	65.0	6.8	52.0	58.8	4.5	68.0	72.5	2.4	49.2	51.6	4.9	48.7	53.6	5.0	62.7	67.7
Tolstoi - Zapadni Reef Zapadni - Little Zapadni	11.2	76.0	87.2	8.3	87.5	90.8	12.6	74.5	87.1	9.2	92.1	101.3	6.1	79.6	85.7	8.9	75.3	84.2	9.1	96.3	105.4
Reef - Ardiguen - Gorbatch	8.2	55.6	63.8	4.6	65.1	69.7	11.3	51.8	63.1	5.4	58.5	63.9	2.3	29.4	31.7	3.3	43.0	46.3	2.9	47.4	50.3
All on St. Paul Island	32.5	229.9	262.4	21.5	262.4	283.9	39.2	225.7	264.9	21.4	277.5	298.9	13.3	219.7	233.0	20.6	209.8	230.4	20.5	257.8	278.3

Table 7. --Linear correlation coefficient (r) and regression intercept (a) and slope (b) from data in Table 6 for living pups and pups born as calculated for each rookery group.

Sample rookery group	Living Pups			Pups Born		
	r	a	b	r	a	b
Reef - Tolstoi	0.843	22.559	3.804	0.851	51.914	3.307
Reef - Morjovi - Vostochni - Zapadni Reef	0.971	39.879	2.161	0.973	61.880	1.986
Morjovi - Vostochni	0.977	54.515	3.316	0.964	65.406	3.252
Tolstoi - Zapadni Reef - Zapadni - Little Zapadni	0.808	45.538	2.367	0.750	53.414	2.303
Reef - Ardiguen - Gorbatch	0.653	169.205	1.421	0.751	185.032	1.432

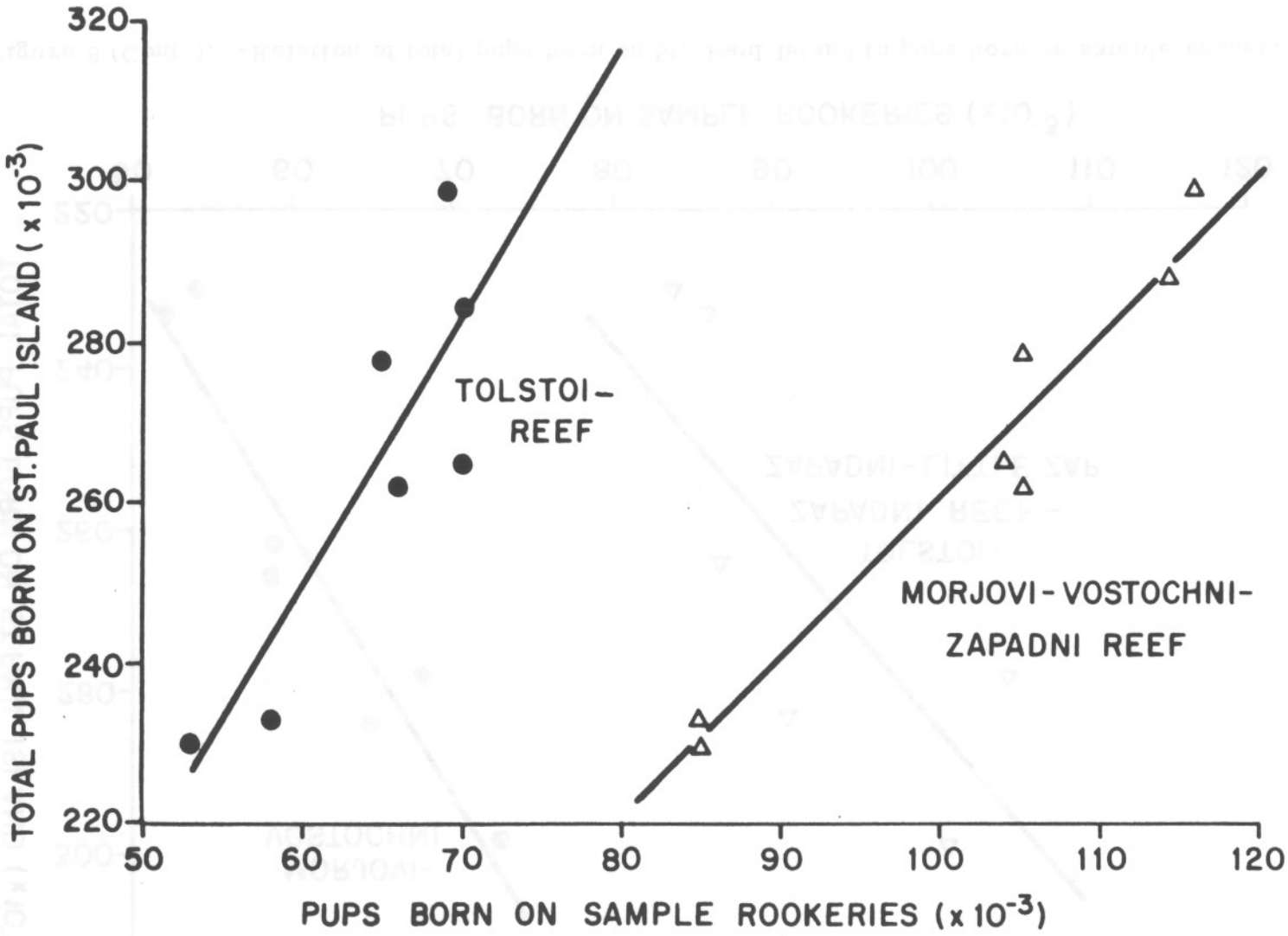

Figure 8.--Relation of total pups born on St. Paul Island to pups born on sample rookery groups.

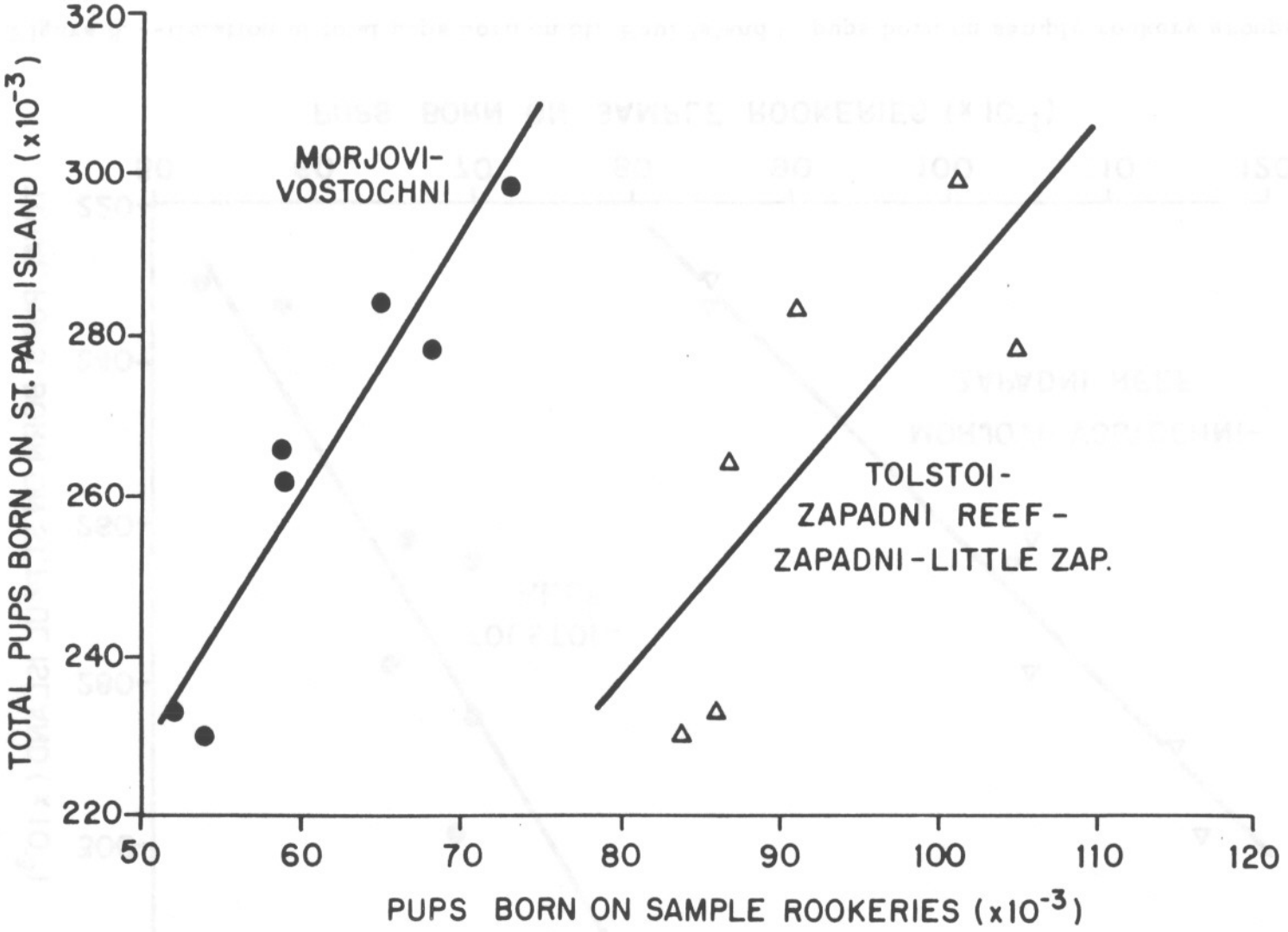

Figure 8 (Cont.).--Relation of total pups born on St. Paul Island to pups born on sample rookery groups.

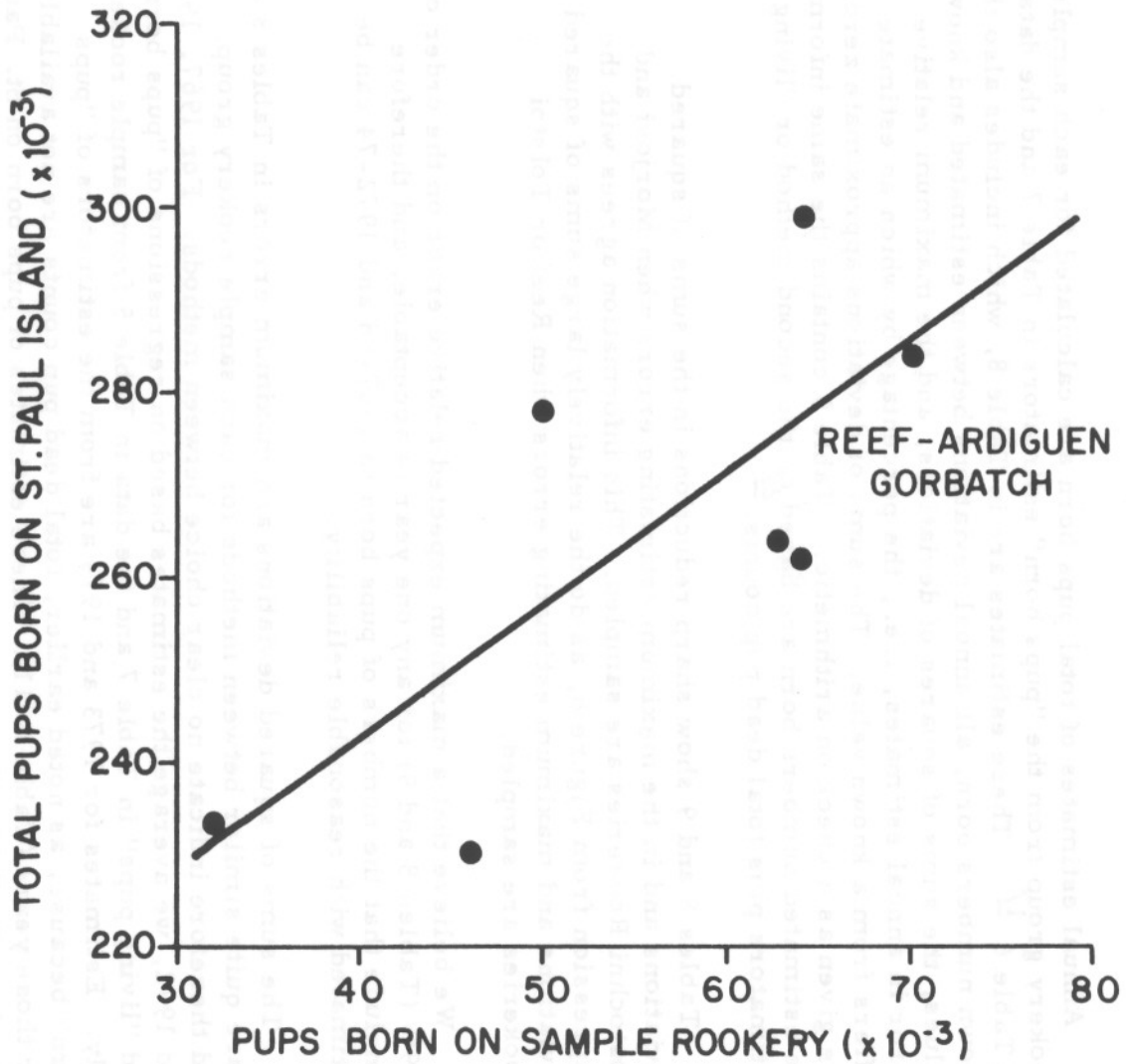

Figure 8 (Cont.).--Relation of total pups born on St. Paul Island to pups born on sample rookery groups.

Whether based on pups born or on living pups, the correlations are highest when Morjovi and Vostochni Rookeries are sampled (r ranges from 0.964 to 0.977, significant at the 99% level). The usual statistical interpretation is that at least 0.964^2 of 93% of the annual variation in total number of pups on St. Paul Island is associated with the number on those two rookeries.

Annual estimates of total pups born are calculated for each sample rookery group from the "pups born" estimators in Table 7 and the data in Table 6. [1/] These estimates are in Table 8, which includes also the known numbers born, all annual deviations between estimated and known values, the sums of squares of deviations, and the maximum relative error in annual estimates, i.e., the percentage by which an estimate differs from a known value. The sums of deviations approximate zero and are given as a check on arithmetic. Table 9 contains the same information; the estimated numbers born are based on the second method or "living pup" estimators plus total dead pup counts. [2/]

Tables 8 and 9 show sharp reductions in the sums of squared deviations and in the maximum estimating errors when Morjovi and Vostochni Rookeries are sampled. This information agrees with the impression from Figure 8, as do the relatively large sums of squared deviations and maximum estimating errors when Reef or Tolstoi Rookeries are sampled.

We believe that a maximum expected relative error on the order of 8-9% (Tables 8 and 9) for any one year is acceptable, and therefore conclude that the numbers of pups born in 1967-68 and 1972-74 can be estimated with reasonable reliability.

The sums of squared deviations and maximum errors in Tables 8 and 9 are quite similar between methods for each sample rookery group, and therefore indicate no clear choice between methods. For 1967, 1968, and 1972, we average the estimates based on regressions of "pups born" and "living pups" in Table 7 and the data in Table 5 from sample rookeries only. Estimates for 1973 and 1974 are from the estimators of "pups born" because, as noted earlier, total dead pup counts are not available for those years (Table A-11). These estimates of pups born on St. Paul Island are in Table 10.

1/ Calculated from $\hat{Y} = a+bB$, where $\hat{Y}$ = estimated pups born on St. Paul Island, a is the intercept and b the slope of the "pups born" regressions for a sample rookery group, and B is pups born on sample rookeries.

2/ Calculated from $\hat{Y} = a+bL+D$, where a and b are for "living pup" regressions, L is living pups on sample rookeries, and D is total dead pups on St. Paul Island.

Table 8. --Known and estimated numbers of pups born on St. Paul Island, Alaska, based on data in Table 4 and regression estimators of living pups for sample rookery groups in Table 7. Deviations of estimated from known values are below each estimate; additional information on estimating errors is summarized at the bottom.

Year Class	Thousands of pups born	Reef - Tolstoi	Reef -Morjovi - Vostochni- Zapadni Reef	Morjovi - Vostochni	Tolstoi - Zapadni Reef - Zapadni - Little Zapadni	Reef - Ardiguen - Gorbatch
1963	262.4	270.4 8.0	269.5 7.1	259.4 -3.0	257.9 -4.5	280.7 18.3
1964	283.9	288.3 4.4	288.3 4.4	274.3 -9.6	262.3 -21.6	283.2 -0.7
1965	264.9	284.7 19.8	271.8 6.9	266.1 1.2	261.1 -3.8	282.0 17.1
1966	298.9	279.4 -19.5	294.2 -4.7	301.4 2.5	284.9 -14.0	273.7 -25.2
1969	233.0	240.5 7.5	228.0 -5.0	231.0 -2.0	247.3 14.3	224.3 -8.7
1970	230.4	222.3 -8.1	228.6 -1.8	236.6 6.2	244.4 14.0	250.9 20.5
1975	278.3	266.4 -11.9	271.1 -7.2	282.9 4.6	294.0 15.7	257.1 -21.2
Sum of deviations		0.2	-0.3	-0.1	0.1	0.1
Sums of squares of deviations		1,119.1	219.6	172.5	1,344.2	2,208.2
Maximum error in estimate		7.5% (1965)	2.7% (1963)	-3.4% (1964)	-7.6% (1964)	-8.4% (1966)

Table 9.-- Known and estimated numbers of pups born on St. Paul Island, Alaska, based on data in Table 4 and regression estimators of pups born for sample rookery groups in Table 7 . Deviations of estimated from known values are below each estimate; additional information on estimating errors is summarized at the bottom.

Year Class	Thousands of pups born	Reef - Tolstoi	Reef-Morjovi-Vostochni-Zapadni Reef	Morjovi-Vostochni	Tolstoi-Zapadni Reef-Zapadni-Little Zapadni	Reef-Ardiguen-Gorbatch
1963	262.4	269.9	270.4	258.6	254.2	276.4
		6.5	8.0	-3.8	-8.2	14.0
1964	283.9	282.7	287.5	276.8	262.5	284.8
		-1.2	3.6	-7.1	-21.4	0.9
1965	264.9	284.4	269.2	256.6	254.0	275.4
		19.5	4.3	-8.3	-10.9	10.5
1966	298.9	279.8	293.1	301.2	286.7	276.5
		-19.1	-5.8	2.3	-12.2	-22.4
1969	233.0	243.7	230.5	233.2	250.8	230.4
		10.7	-2.5	0.2	17.8	-2.6
1970	230.4	226.9	231.1	239.7	247.3	251.3
		-3.5	0.7	9.3	16.9	20.9
1975	278.3	265.5	270.1	285.6	296.2	257.1
		-12.8	-8.2	7.3	17.9	-21.2
Sum of deviations		0.1	0.1	-0.1	-0.1	0.1
Sum of squares of deviations		1,079.3	203.1	278.9	1,715.7	1,701.8
Maximum error in estimate		7.4% (1965)	3.0% (1963)	-3.1% (1965)	-7.5% (1964)	9.1% (1970

Table 10. --Estimated numbers of pups born on St. Paul Island and the Pribilof Islands, Alaska, in 1967-68 and 1972-74, when shearing/sampling estimates of living pups were made on sample rookeries only.

	St. Paul Island			
	Regression Method			
Year	Living Pups	Pups born	Mean	Pribilof Islands
1967	280, 758	283, 539	282, 100	368, 000
1968	238, 435	235, 034	236, 700	312, 000
1972	267, 680	260, 490	264, 100	359, 000
1973	-	305, 362	305, 400	412, 000
1974	-	269, 090	269,100	365, 000

The total number of pups born on the Pribilof Islands remains to be estimated. Sivutch Rookery on Sea Lion Rock was last sampled in 1966 to yield an estimate of 20,200 pups born there and when St. Paul Island contributed an estimated 81% of the pups born on St. Paul and St. George Islands (U.S. Fish and Wildlife Service, 1969). The estimated contributions of St. Paul Island to pups born on both islands, which was again 81% in 1970 (Marine Mammal Biological Laboratory, 1971), dropped to 77% in 1975 (Table 3 or present report). We assume (1) a constant production of 20,200 pups on Sea Lion Rock during 1966-75 (alternate assumptions will have little effect on total estimates), a contribution by St. Paul Island of 81% in 1967-68 and of 78% in 1972-74 (excluding Sea Lion Rock). Assumptions are applied to estimates for St. Paul Island to approximate the number of pups born on the Pribilof Islands. The latter are also in Table 10.

Selection of Sample Rookeries

To determine more exactly the performance of the different rookeries in producing a useable basis for estimating the total number of pups born annually on St. Paul Island, the data may be analyzed by individual rookeries instead of by groups (Table 4 shows that six years of data instead of seven are available for Ardiguen and Gorbatch Rookeries). Regression estimators and correlation coefficients for living pups and pups born are in Table 11. Table 12 summarizes the estimates and deviations.

The sums of squared deviations and maximum estimating errors in Table 12 are smallest for Vostochni Rookery in particular, followed by those for Polovina Cliffs and Morjovi Rookeries; e.g., maximum errors in estimates from these rookeries range over both methods from -7% to 7% of total "known" numbers born in any one year. The largest estimating errors are associated with Kitovi, Zapadni Reef and Zapadni Rookeries (-15% to 16%); errors are of intermediate magnitude for Reef and Tolstoi Rookeries (-11% to 13%). For nine of the fourteen rookeries, the sums of squared deviations are larger when estimates are based on "pups born" regressions. The largest single ratio of sums of squared deviations is in the opposite direction ("living"/"born") however, and occurs for Ardiguen Rookery (3.315/1,939=1.7); this small rookery is peculiar also in having the only negative correlation with total pups alive or born (Table 11).

Table 11. --Linear correlation coefficients (r), regression intercepts (a), and slopes (b) for estimation of total living pups born on St. Paul Island, Alaska, from living pups and pups born on indicated rookeries, year class 1963-66, 1969-70 and 1975.

Rookery	Living Pups			Pups Born		
	r	a	b	r	a	b
Morjovi	0.818	77.500	9.324	0.834	92.419	8.945
Vostochni	0.964	74.648	4.296	0.948	82.982	4.324
Little Polovina	0.543	200.364	6.533	0.623	218.027	6.972
Polovina Cliffs	0.915	80.958	7.772	0.862	90.009	7.908
Polovina	0.783	125.610	25.268	0.774	154.199	21.162
Ardiguen	-0.332	303.428	-21.130	-0.702	447.482	-59.216
Gorbatch	0.730	120.984	6.503	0.731	140.325	6.188
Reef	0.659	133.765	3.424	0.681	166.189	2.829
Kitovi	0.747	65.028	14.046	0.652	84.949	13.431
Lukanin	0.667	124.896	20.946	0.648	136.278	21.176
Tolstoi	0.532	116.388	4.746	0.453	154.133	3.739
Little Zapadni	0.720	144.882	5.370	0.612	166.304	5.068
Zapadni Reef	0.491	177.189	11.346	0.587	188.723	12.547
Zapadni	0.673	88.639	4.621	0.639	93.978	4.646

Table 12. --Known and estimated numbers of pups born on St. Paul Island, Alaska, based on data in Table 5 and regression estimators in Table 11 for living pups (L) and pups born (B) on individual rookeries in 1963-66, 1969-70 and 1975. Deviations of estimates from known values are below each estimate; additional information on estimating errors is at the bottom. A dash (-) indicates that original data are not available for Ardiguen and Gorbatch Rookeries individually in 1963.

Year Class	Thousands of Pups Born	Morjovi		Vostochni		Little Polovina		Polovina Cliffs		Polovina		Ardiguen		Gorbatch		Reef		Kitovi		Lukanin		Tolstoi		Little Zapadni		Zapadni Reef		Zapadni	
		L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B	L	B
1963	262.4	271.3	267.7	256.2	255.1	275.3	269.6	265.8	262.4	264.2	268.5	-	-	-	-	279.3	275.7	249.2	242.1	266.3	257.0	260.9	254.7	251.5	275.3	280.0	275.3	270.9	265.9
		8.9	5.3	-6.2	-7.3	12.9	7.2	3.4	0.0	1.8	6.1	-	-	-	-	16.9	13.3	-13.2	-20.3	3.9	-5.4	-1.5	-7.7	-10.9	12.9	17.6	12.9	8.5	3.5
1964	283.9	265.0	267.7	276.6	279.3	276.7	280.8	275.8	275.1	276.0	279.1	265.8	275.8	296.0	295.7	287.8	284.2	284.6	281.0	253.2	252.7	259.0	259.2	258.2	275.3	272.4	275.3	264.5	268.7
		-18.9	-16.2	-7.3	-4.6	-7.2	-3.1	-8.1	-8.8	-7.9	-4.8	-18.1	-8.1	12.1	11.8	3.9	0.3	0.7	-2.9	-30.7	-31.2	-24.9	-24.7	-25.7	-8.6	-11.5	-8.6	-19.4	-15.2
1965	264.9	268.7	261.4	267.2	255.5	285.3	274.5	261.6	256.9	293.7	287.5	294.0	281.7	275.3	269.0	281.8	277.9	271.4	274.3	273.0	269.7	282.7	269.3	266.2	265.3	277.7	265.3	252.6	244.5
		3.8	-3.5	2.3	-9.4	20.4	9.6	-3.3	-8.0	28.8	22.6	29.1	16.8	10.4	4.1	16.9	13.0	6.5	9.4	8.1	4.8	17.8	4.4	1.3	0.4	12.8	0.4	-12.3	-20.4
1966	298.9	277.9	279.4	305.7	306.1	278.6	281.5	283.4	280.6	291.0	281.2	265.6	269.8	277.6	278.9	274.7	275.1	283.1	278.4	297.1	297.2	266.0	267.8	289.8	256.3	254.2	256.3	281.9	264.0
		-21.0	-19.5	6.8	7.2	-20.3	-17.4	-15.5	-18.3	-7.9	-17.7	-33.3	-29.1	-21.3	-20.0	-24.2	-23.8	-15.8	-20.5	-1.8	-1.7	-32.9	-31.1	-9.1	-42.6	-44.7	-42.6	-17.0	-34.9
1969	233.0	235.3	237.3	232.7	236.1	247.0	255.0	235.7	240.3	229.9	236.7	240.7	228.4	249.4	254.8	239.9	246.8	231.4	240.7	236.6	246.4	256.4	264.4	259.7	248.9	242.7	248.9	237.8	241.3
		2.3	4.3	-0.3	3.1	14.0	22.0	2.7	7.3	-3.1	3.7	7.7	-4.6	16.4	21.8	6.9	13.8	-1.6	7.7	3.6	13.4	23.4	31.4	26.7	15.9	9.7	15.9	4.8	8.3
1970	230.4	237.0	240.0	240.5	243.4	245.8	246.6	234.4	237.9	239.8	243.1	258.5	258.0	239.1	239.3	239.6	242.9	264.0	264.9	260.7	261.2	242.3	250.6	247.1	245.2	245.4	245.2	265.9	267.3
		6.6	9.6	10.1	13.0	15.4	16.2	4.0	7.5	9.4	12.7	28.1	27.6	6.7	8.9	9.2	12.5	33.6	34.5	30.4	30.8	11.9	20.2	16.7	14.8	15.0	14.8	34.6	36.9
1975	278.3	296.6	298.2	273.0	276.3	243.1	243.8	295.0	298.8	257.3	255.8	264.8	275.8	252.0	251.7	248.8	249.4	268.1	270.3	264.8	267.6	284.5	285.7	279.2	285.3	279.4	285.3	279.2	280.3
		18.3	19.9	-5.3	-2.0	-35.2	-34.5	16.7	20.5	-21.0	-22.5	-13.5	-2.5	-26.3	-26.6	-29.5	-28.9	-10.2	-8.0	-13.5	-10.7	6.2	7.4	0.9	7.0	1.1	7.0	0.9	2.0
Sum of deviations		0.0	-0.1	0.1	0.0	0.0	0.0	-0.1	-0.2	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.2	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2	0.0	-0.2	0.1	0.2
Sum of squares of deviations		1,276	1,190	274	393	2,719	2,393	631	1,006	1,497	1,566	3,315	1,939	1,745	1,818	2,175	2,094	1,703	2,243	2,146	2,271	2,749	3,105	1,856	2,576	2,924	2,576	2,110	2,316
Maximum error in estimate		-7% (1966)	-7% (1966)	4% (1970)	6% (1970)	-13% (1975)	-12% (1975)	6% (1975)	7% (1975)	11% (1965)	-8% (1975)	-11% (1966)	12% (1970)	-9% (1975)	-10% (1975)	-11% (1975)	-10% (1975)	15% (1970)	15% (1970)	13% (1970)	13% (1970)	-11% (1966)	13% (1969)	11% (1969)	-14% (1966)	-15% (1966)	-14% (1966)	15% (1970)	10% (1970)

Morjovi, Kitovi, and Lukanin Rookeries are equal between methods with respect to absolute magnitude of maximum estimating errors; of the remaining 11 rookeries, errors are higher for 7 when estimates are based on "pups born" regressions. Differences are small, however, and for the two rookeries (Polovina and Little Zapadni) with the maximum difference of 3% (algebraic sign ignored) between methods, the error is greater for Polovina Rookery (11%) when the "living pups" regression method is used.

We again conclude that there is no clear choice between the two methods of estimating the total number of pups born. The possibility of a slight gain in average or expected accuracy by using "living pups" regressions is probably more than offset by the disturbance associated with counting dead pups on all rookeries every year.

The estimating performance of Vostochni Rookery is best, as noted above, along with those of Morjovi and Polovina Cliffs Rookeries. We now confine our attention to this group. Noting again from Table 12 that the maximum estimating error from any of these individual rookeries is 7% (sign ignored), it is useful to ask if better performance can be expected from sampling all three. Table 13 gives the same type of analysis as before and shows that sampling all three rookeries reduces the maximum expected error from 7% to 4%. The latter compares favorably with the average maximum error (between methods) of 5% for Vostochni Rookery alone (Table 12). The difference between methods in Table 13 (4.4% - 3.3% = 1.1%) is too small to justify counting dead pups on all rookeries. Furthermore, the average numbers of pups born on these three rookeries during 1963-70 was a substantial proportion of all pups born on St. Paul Island, 31% (Marine Mammal Division, 1975), and was 34% in 1975 (Table 3).

We conclude that shearing/sampling estimates of living pups and counts of dead pups on Vostochni, Morjovi, and Polovina Cliffs Rookeries in future years will provide data for reliable estimates of the total number of pups born on St. Paul Island. In the future it may be desirable to again take data from all rookeries in order to refine the regression estimator given in the second footnote to Table 13. The present analysis demonstrates, however, that (1) sampling the three rookeries should provide estimates at least 96% as accurate each year (i.e., the maximum expected error is 4%) as if data were taken additionally on the other 11 rookeries, and (2) disturbance will be reduced by about two-thirds.

Table 13. --Thousands of dead pups (D), living pups (L), and pups born (B) as estimated from shearing and sampling on three indicated sample rookeries (subscript S) and on all rookeries (subscript T) of St. Paul Island, Alaska, in 1963-66, 1969-70 and 1975, and summary of estimates and deviations.

Year Class	Morjovi-Vostochni-Polovina Cliffs			Total St. Paul Island			Estimated pups born and deviation of estimated from "known" B_T	
	D_S	L_S	B_S	D_T	L_T	B_T	$\hat{B}_L$ [1/]	$\hat{B}_B$ [2/]
1963	9.6	71.6	81.2	32.5	229.9	262.4	261.0	259.5
							-1.4	-2.9
1964	6.3	82.1	88.4	21.5	262.4	283.9	275.2	276.8
							-8.7	-7.1
1965	9.7	70.2	79.9	39.2	225.7	264.9	264.3	256.4
							-0.6	-8.5
1966	5.3	91.3	96.6	21.4	277.5	298.9	297.2	296.5
							-1.7	-2.4
1969	3.2	67.4	70.6	13.3	219.7	233.0	231.7	234.1
							-1.3	1.1
1970	6.5	65.8	72.3	20.6	209.8	230.4	235.1	238.2
							4.7	7.8
1975	6.5	87.6	94.1	20.5	257.8	278.3	287.4	290.5
							9.1	12.2
Sum of deviations							0.1	0.2
Sum of squares of deviations							188	248
Maximum error in estimate (1975)							3.3%	4.4%

1/ Based on data to the left and $\hat{B}_L = 56.352 + 2.404\ L_S + D_T$

2/ Based on data to the left and $\hat{B}_B = 64.491 + 2.402\ B_S$

Finally, it must be remembered that data taken from all rookeries in any year provides an estimate (assumed here to be known value) which is itself subject to sampling error.

R. H. Lander

Homing to Island of Origin

Tag recovery data showing the tendency of male fur seals 2-5 years old to return or "home" to the island of birth was summarized for the 1956-61 year classes in Table 11 of our 1966 report (U.S. Fish and Wildlife Service, 1969). This information is updated in Table 14 for year classes starting with 1962 (homing rates at ages 2-5 years are completely available only for the 1962-67 year classes because 1972 was the last year in which seals were killed commercially and permanent tags or other marks recovered on St. George Island). Table 14 confirms information given in the 1966 report, i.e., homing (1) typically is greater to St. Paul Island than to St. George Island and (2) tends to increase with age, especially for St. George Island (but apparently dropped off at age 5 years for the 1965-66 year classes).

The increasing abundance of subadult males on St. George Island since 1972 is obvious qualitatively, but it has not yet been possible to quantify their relative or absolute abundance (see next section entitled Abundance of Subadult Males on St. George Island). As the abundance of subadult males on St. George Island increases, a constant or increasing probability of straying from St. George Island would show up in 1973-75 as a higher probability (than before harvesting ended) of recovering, on St. Paul Island, the tags or other marks applied to pups on St. George Island. Data from Table 14 are summarized in Table 15 to compare these recovery probabilities at ages 2-4 years between 1970-72, the last three years of harvesting on St. George Island, and 1973-75. Pups were not tagged or otherwise marked on St. George Island in 1965; the comparison for age 5 years is therefore between the last two years of harvest (1971-72) and the first two years of no harvest (1973-74).

Table 15 shows no significant change in recovery probabilities for ages 4 or 5 years. The hypothesis of equal recovery probabilities between 1970-72 and 1973-75 is rejected for ages 2 and 3 years, but in opposite directions. At age 2 years, the probabilities suggest 0.002880/0.001443 = 2.0 times as much straying from St. George Island after harvesting ended than before; at age 3 years, however,

Table 14.--Number of fur seal pups tagged or marked in 1962-73 and number of males recovered in 1964-75 at ages 2-5 years on St. Paul Island (P), St. George Island (G) and both islands (B). Numbers of seals with lost tags (identified by check marks on flippers[1]) and which could not be identified by island of origin are in parentheses. A dash (-) means no data are available or applicable to homing rates.

Year Class	Island of origin	No. pups tagged or marked	2 years			3 years			4 years			5 years			Homing by age (%)			
			P	G	B	P	G	B	P	G	B	P	G	B	2	3	4	5
1962	St. Paul	39,928	131	29	160	1,302	78	1,380	783	60	843	77	4	81	82	94	93	95
	St. George	9,980	15	38	53	95	207	302	52	242	294	3	35	38	72	69	82	92
	Both	49,908	146	68	214	1,397	285	1,682	835	302	1,137	80	39	119	-	-	-	-
			(105)	(20)	(125)	(749)	(30)	(779)	(675)	(141)	(816)	(92)	(22)	(114)	-	-	-	-
1963	St. Paul	19,978	50	3	53	929	79	1,008	463	21	484	52	1	53	94	92	96	98
	St. George	4,993	9	7	16	109	165	274	29	146	175	1	26	27	44	60	83	96
	Both	24,971	59	10	69	1,038	244	1,282	492	167	659	53	27	80	-	-	-	-
			(61)	(4)	(65)	(491)	(72)	(563)	(314)	(48)	(362)	(24)	(8)	(32)	-	-	-	-
1964	St. Paul	19,998	101	6	107	1,141	94	1,235	548	22	570	63	1	64	94	92	96	98
	St. George	4,993	20	4	24	90	258	348	32	140	172	1	26	27	17	74	81	96
	Both	24,991	121	10	131	1,231	352	1,583	580	162	742	64	27	91	-	-	-	-
			(60)	(21)	(81)	(560)	(92)	(652)	(272)	(36)	(308)	(43)	(1)	(44)	-	-	-	-
1965	St. Paul	30,087	115	23	138	1,786	184	1,970	1,113	24	1,137	108	44	152	83	91	98	71
	St. George	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Both	30,087	115	23	138	1,786	184	1,970	1,113	24	1,137	108	44	152	-	-	-	-
1966	St. Paul	19,578	66	8	74	968	19	987	643	48	691	78	11	89	89	98	93	88
	St. George	5,002	7	5	12	85	86	171	63	123	186	24	23	47	42	50	66	49
	Both	24,580	73	13	86	1,053	105	1,158	706	171	877	102	34	136	-	-	-	-
			(22)[2]	(10)[2]	(32)[2]	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	-	-	-	-
1967	St. Paul	9,980	66	1	67	404	13	417	193	6	199	17	1	18	99	97	97	94
	St. George	2,492	10	8	18	48	52	100	20	54	74	3	15	18	44	52	73	83
	Both	12,472	76	9	85	452	65	517	213	60	273	20	16	36	-	-	-	-
			(19)	(4)	(23)	(216)	(10)	(217)	(150)	(4)	(154)	(28)	(3)	(31)	-	-	-	-
1968	St. Paul	9,200	32	0	32	146	6	152	179	4	183	2	-	-	100	96	98	-
	St. George	2,475	2	0	2	23	14	37	5	9	14	1	-	-	0	38	64	-
	Both	11,675	34	0	34	169	20	189	184	13	197	3	-	-	-	-	-	-
			(13)	(1)	(14)	(103)	(11)	(114)	(179)	(22)	(201)	(7)	-	-	-	-	-	-
1969	St. Paul	20,000	25	10	35	897	44	941	655	-	-	136	-	-	71	95	-	-
	St. George	5,000	11	10	21	96	71	167	60	-	-	28	-	-	48	43	-	-
	Both	25,000	36	20	56	993	115	1,108	715	-	-	164	-	-	-	-	-	-
1970	St. Paul	20,030	29	0	29	813	-	-	938	-	-	64	-	-	100	-	-	-
	St. George	5,000	5	1	6	40	-	-	53	-	-	13	-	-	17	-	-	-
	Both	25,030	34	1	35	853	-	-	991	-	-	77	-	-	-	-	-	-
1971	St. Paul	19,995	40	-	-	828	-	-	548	-	-	-	-	-	-	-	-	-
	St. George	5,000	9	-	-	68	-	-	44	-	-	-	-	-	-	-	-	-
	Both	24,995	49	-	-	896	-	-	592	-	-	-	-	-	-	-	-	-
1972	St. Paul	20,019	70	-	-	870	-	-	-	-	-	-	-	-	-	-	-	-
	St. George	5,000	13	-	-	77	-	-	-	-	-	-	-	-	-	-	-	-
	Both	25,019	83	-	-	947	-	-	-	-	-	-	-	-	-	-	-	-
1973	St. Paul	20,000	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	St. George	5,000	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Both	25,000	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ See Glossary and Figure 7 .

2/ Seals with lost tags were not identified by island of origin from checkmarks in 1968.

Table 15.--Data from Table 14 and tests of the hypothesis that the probability of recovery on St. Paul Island at ages 2-5 years of pups tagged or marked on St. George Island is the same before and after harvesting stopped on St. George Island.

Age at recovery	Harvesting on St. George Island	Year Classes	No. released on St. George Island	No. recovered on St. Paul Island	Probability of recovery	Chi-square test Value	Chi-square test Result
2	Yes	1968-70	12,475	18	0.001443	-	-
	No	1971-73	15,000	42	0.002880	-	-
	Both	1968-73	27,475	60	0.002184	7.29	Reject
3	Yes	1967-69	9,967	167	0.016755		
	No	1970-72	15,000	185	0.012333		
	Both	1967-72	24,967	352	0.014099	8.41	Reject
4	Yes	1966-68	9,969	88	0.008827		
	No	1969-71	15,000	157	0.010467		
	Both	1966-71	24,969	245	0.009812	1.66	Accept
5	Yes	1966-67	7,492	27	0.003604		
	No	1968-69	7,475	29	0.003880		
	Both	1966-69	14,957	56	0.003744	0.04	Accept

the values suggest only 0.012333/0.016755 = 0.7 times as much straying after harvesting ended. These results appear to be inconsistent biologically: it is difficult to accept the idea of a reversal in straying behavior between adjoining age groups of immature males whose size distributions overlap. The use of release-recapture data for evaluating the effect of abundance on straying is therefore doubtful at this stage of investigation.

R. H. Lander
Patrick Kozloff

Abundance of Subadult Male Seals on St. George Island

The number of subadult male seals is known from observation to have increased on St. George Island since they were last killed there commercially in 1972. An attempt was made to carry out an experiment designed by D. G. Chapman (Consultant, University of Washington) in order to estimate the abundance of subadult males on the east hauling ground of North Rookery (Figure 2), i.e., by applying distinct, temporary marks to each of three groups at three times about one month apart, then recording sightings of marked and unmarked animals.

The experiment failed. A diamond-shaped mark (about 5.1 cm on a side) was applied with hot branding irons to both upper shoulders of 171 animals in early July. Even with binoculars, these marks were difficult or impossible to see through the fur, as indicated by the low counts of brand-marked animals shown in Table 16. Highly visible collars of flexible, non-stretch plastic were then stapled around the necks of 161 animals in August, but most were shed within a few days (Table 16). Daily counts were continued as a possible basis for evaluating abundance in 1975 relative to that in 1976. The extreme variability indicates, however, that counts will not be very useful for approximating even moderate changes in relative abundance between successive years. High air temperatures and rainfall are known to drive the animals into the sea; disturbance of the animals by humans has the same effect and occurred occasionally during the counting period.

For repeating the experiment in 1976, it is planned to (1) examine alternate methods of marking on captive animals, or (2)brand animals with hot irons again, then obtain counts of marked and

Table 16.--Counts of total and marked subadult males on the east hauling ground of North Rookery, July - September, 1975. A dash indicates collars not yet applied or no count because of heavy fog.

Date		Total	Brand	Collar
July	11	508	5	-
	12	342	4	-
	13	316	2	-
	14	740	6	-
	15	252	3	-
	16	388	4	-
	17	527	6	-
	18	650	5	-
	19	434	3	-
	20	568	5	-
	21	408	2	-
	22	424	2	-
	23	251	3	-
	24	371	3	-
	25	445	5	-
	26	603	6	-
	27	270	2	-
	28	198	0	-
	29	704	5	-
	30	724	4	-
	31	832	3	-
August	1	747	7	-
	2	453	1	-
	3	218	2	-
	4	232	0	-
	5	430	2	-
	6	520	5	-
	7	-	-	-
	8	244	1	-
	9	197	2	-
	10	198	2	-
	11	322	4	-
	12	-	-	-

Table 16.-Counts of total and marked subadult males on the east hauling ground of North Rookery, July - September, 1975. A dash indicates collars not yet applied or no count because of heavy fog (cont'd).

Date	Total	Brand	Collar
August 13	692	7	-
(cont'd)14	662	5	-
15	691	5	-
16	544	5	-
17	642	4	-
18	635	6	-
19	288	2	22
20	230	1	12
21	305	1	5
22	402	1	5
23	406	2	6
24	475	3	6
25	533	4	1
26	343	5	1
27	-	-	-
28	497	7	0
29	555	4	0
30	506	2	0
31	553	5	0
September			
1	523	4	1
2	622	5	0
3	569	3	0
4	243	4	0
5	760	5	0
6	731	6	0
7	835	4	0
8	781	6	0
9	911	3	0
10	873	5	0
11	677	6	0
12	527	4	0
13	456	3	0
14	648	5	0
15	420	4	0
16	482	3	0
17	221	2	0

unmarked animals by driving them past observers instead of sighting them from a distance.

James H. Johnson
R. H. Lander

Number of Pups Born, 1961-75

Our 1965 report (page 17 of Roppel et al., 1966) pointed out that the number of pups born, as estimated from tag recoveries, decreased steadily during 1959-63. This trend in estimates undoubtedly reflects a real decline in number of pups born because the herd was purposely reduced during 1956-63 by killing females in order to decrease pup production to a level then believed necessary to give maximum sustained yield (North Pacific Fur Seal Commission, 1962).

Marking and sampling to estimate annual pup production in the year of birth was started experimentally on a small scale in 1960 and continued on a large scale in 1961 (Abegglen et al, 1961). Estimates from tag recoveries were found later to be too high, and our 1967 report (page 16 of U. S. Fish and Wildlife Service, 1970) concludes: "Shearing and sampling now produces the most accurate estimate. The error caused by additional mortality that results from the tagging of pups has not been completely eliminated". Chapman and Johnson (1968) briefly discuss problems associated with tag-recapture estimates and intensively review the development of the marking/sampling technique from a statistical viewpoint. They emphasize that the difference between direct counts and marking/sampling estimates (from comparisons in 1964-66) are within the range of sampling error of the estimates, and finally point out that the distribution of positive and negative differences between estimates and counts suggest that the estimates are unbiased.

It is now possible, therefore, to present a set of estimates of number of pups born annually for the 15-year period, 1961-75, based entirely on the marking and sampling technique (marking was by tagging in 1961-62 and by shearing since 1962). Estimates from Table 7 of our 1974 report (Marine Mammal Division, 1975) and from Tables 3 and 10 of the present report are combined in Table 17, which also gives the trend based on 3-year moving averages. The missing value for 1971 (no data) is assumed to be the mean of the 1970 and 1972 estimates, then treated as an "estimate" in calculating appropriate averages.

Table 17. --Estimated numbers of pups born on the Pribilof Islands, Alaska during 1961-75, based on marking and sampling, and 3-year moving averages of estimates.

Year	Estimated no. pups born (thousands)	3-year moving average
1961	438	--
1962	362	381
1963	343	358
1964	370	353
1965	347	368
1966	388	368
1967	368[1/]	356
1968	312[1/]	328
1969	304	307
1970	306	314[3/]
1971	--[2/]	333[3/]
1972	359[1/]	368[3/]
1973	412[1/]	379
1974	365[1/]	379
1975	361	--

1/ From data on sample rookeries only (see Table 10)
2/ No data were taken in 1971 from which to make an estimate.
3/ Includes a missing value calculated for 1971 as the mean of 1970 and 1972 estimates (306+359/2=333), then used in calculating moving average.

Annual estimates and trend values are in Figure 9. The graph indicates an abrupt decline during 1961-63, relative stability with some suggestion of an increasing trend during 1963-66, another sharp decline during 1966-69, and a definite increase since 1970. Present pup production (1974-75) is apparently at about the 1967 level of 360,000 - 370,000, i.e., close to the value last calculated by Chapman (1973) as correct for producing a maximum sustainable yield: his estimate of 283,000 pups born on St. Paul Island, divided by a 77% contribution of St. Paul Island to account for St. George Island (Table 3), gives 368,000.

The 1973-75 estimates in Figure 9 suggest the possibility of another decline (although it must be remembered that all estimates are subject to sampling error). The 1976 estimate will therefore be of special interest in evaluating the level of pup production. At this stage of investigation we conclude that the declines of 1961-63 and 1966-69, and the increase since 1970, are real.

R.H. Lander

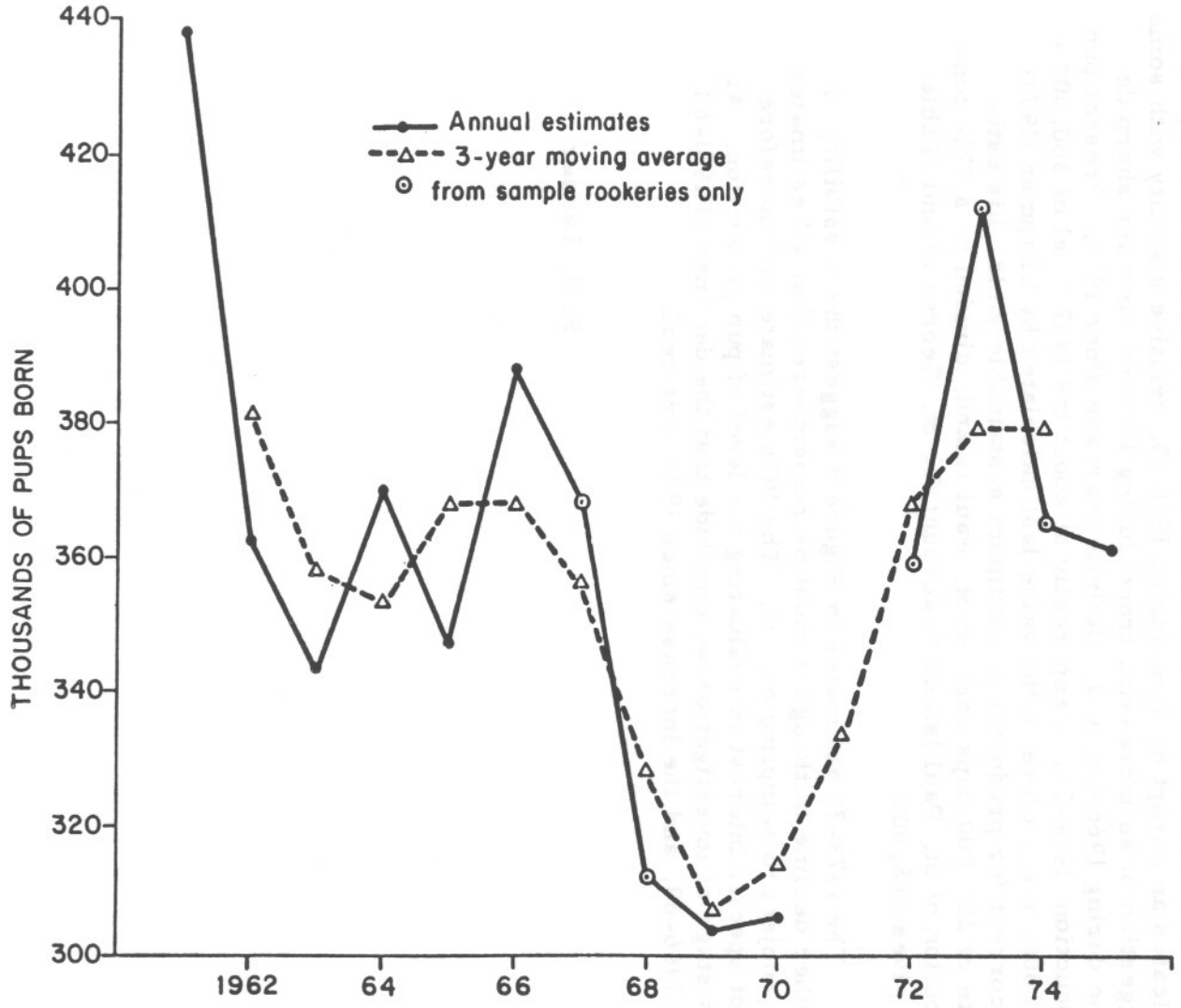

Figure 9. --Estimated number of pups born on the Pribilof Islands, Alaska, during 1961-75, based on marking and sampling in the year of birth.

Part III. PHYSIOLOGY AND MEDICINE

From 1962 to 1971, we concentrated our veterinary medical research on mortality of the newborn and causes of death among fur seal pups during the first 3-5 weeks of life, and the methods of study were primarily gross pathology, histopathology, and some microbiology. Studies of anatomy and physiology as a basis for studying disease were carried out concurrently.

Since 1972 we have concentrated on virology, immunology, and other methods of investigating the infectious disease experience of a seal during its lifetime. This research has been made possible through cooperative efforts with the staff of the Naval Biomedical Research Laboratory (NBRL), which has been investigating the infectious diseases of pinnipeds on the Channel Islands, California, and on the Pribilof Islands, Alaska.

Pathology--St. Paul Island

From 3 July to 15 August, M. C. Keyes, M. K. Menth, and S. W. Keyes (with temporary assistance of R. C. Bartsch and G. G. Long) collected 244 dead pups from under catwalks on study areas at Reef and Northeast Point Rookeries as described by the U.S. Fish and Wildlife Service (1970). Of these pups collected, 214 were necropsied and 30 were discarded as unsuitable for examination because of advanced postmortem degeneration.

Tabulation of the primary diagnoses[3/] for pups necropsied shows that the main causes of death were hookworm disease and emaciation syndrome, which together accounted for 65.1% of the deaths. Infectious disease was next at 12.7%, and trauma and miscellaneous causes were less important (7.0%). Undetermined causes and pups unsuitable for examination accounted for 15.2% of the sample. In most of these cases it was possible to rule out hookworm disease or emaciation syndrome as the cause (Tables 18 and A-16).

3/ The cause of death for each necropsy is diagnosed as primary, secondary, tertiary, and so on. A specific cause is designated primary if it is the most serious or if it preceded other causes or brought about critical changes that eventually led to death. Secondary and tertiary diagnoses, where indicated, are not tabulated in this report but are recorded on individual necropsy reports. The distribution of secondary among primary causes was reported for necropsies performed in 1966 (U.S. Fish and Wildlife Service, 1969).

Table 18.--Primary diagnoses for causes of death among seal pups, three mortality study areas, St. Paul Island, 3 July to 15 August 1975

Primary diagnoses	Study areas: Reef Rookery Area 1 Dead pups Number	Reef Rookery Area 1 Dead pups Percent	Reef Rookery Area 2 Dead pups Number	Reef Rookery Area 2 Dead pups Percent	Northeast Point Area 3 Dead pups Number	Northeast Point Area 3 Dead pups Percent	Total Number	Total Percent
Emaciation syndrome	23	39.7	7	29.1	23	14.2	53	21.7
Hookworm disease	7	12.1	4	16.7	95	58.6	106	43.4
Microbial infection	11	19.0	3	12.5	17	10.5	31	12.7
Peritonitis	(1)	(1.7)	-	-	(6)	(3.7)	(7)	(2.9)
Pleuritis	-	-	(1)	(4.2)	(2)	(1.2)	(3)	(1.2)
Navel	(1)	(1.7)	-	-	(1)	(0.6)	(2)	(0.8)
Cellulitis	(1)	(1.7)	-	-	(1)	(0.6)	(2)	(0.8)
Multiple hemorrhage-perinatal complex (leptospirosis)	(8)	(13.8)	(2)	(8.3)	(7)	(4.3)	(17)	(7.0)
Trauma	2	3.5	-	-	5	3.1	7	2.9
Skull fracture	(1)	(1.7)	-	-	(2)	(1.2)	(3)	(1.2)
Bite wounds	(1)	(1.7)	-	-	(1)	(0.6)	(2)	(0.8)
Liver rupture	-	-	-	-	(2)	(1.2)	(2)	(0.8)
Miscellaneous	1	1.7	4	16.7	5	3.1	10	4.1
Stillborn	-	-	-	-	(1)	(0.6)	(1)	(0.4)
Congenital anomaly	-	-	(1)	(4.2)	(2)	(1.2)	(3)	(1.2)
Nonhookworm anemia	(1)	(1.7)	(2)	(8.3)	(2)	(1.2)	(5)	(2.1)
Umbilical hernia	-	-	(1)	(4.2)	-	-	(1)	(0.4)
Undetermined	3	5.2	1	4.2	3	1.9	7	2.9
Unsuitable for examination	11	19.0	5	20.8	14	8.6	30	12.3
Total	58	100.0	24	100.0	162	100.0	244	100.0

The total number of pup deaths from hookworm increased by 41 over the 1974 figure. This increase might be explained by a difference in the weather, which was somewhat milder in 1974. On 30 July we found 40 dead pups in one day, 29 of which died of hookworm. The usual daily pickup is 3-7 seals. There had been a chilling wind and rain the night before. Any combination of increased energy demands such as a need to withstand chilling temperatures, assimilation of a large meal (fur seal milk is 50% fat), or exertion might tax the greatly depleted (hemoglobin) oxygen-carrying capacity of the circulatory system. Death is from hypothermia.

In all other respects the number and distribution of causes of death were very similar to that which occurred in 1974 except for perinatal leptospirosis. There were 50% fewer cases of this disease in 1975 than in 1974. It must be kept in mind that with this disease, few fetuses are carried to term, which are the only ones we see. The vast majority of fetuses abort while still premature. In the northern fur seal, these abortions take place at sea, whereas in nonmigratory seals such as the California sea lion, abortions occur on land.

According to microscopic slide agglutination tests conducted by the NBRL the incidence of leptospiroses in fur seals that either recovered from the disease or successfully resisted it, ranged between 10.2 and 15.4% in adult females and 3- to 4-year-old males, but only about 2% in 3- to 4-month-old seals. The 2% figure held true for samples in 1974 and 1975 and suggests that juvenile fur seals are exposed to leptospira organisms later in life and probably at sea. Venereal spread no doubt occurs and might explain the incidence in adult females but does not explain the incidence in 3- and 4-year-old males who have not yet entered the breeding ranks.

Since leptospirosis is transmissible to humans, studies of Aleuts working in the harvest of fur seals were begun to determine if such contact constituted a health hazard for them. So far the results have been negative.

The NBRL has been conducting infectious disease research for the past four seasons, including two expeditions in November (1974 and 1975) to St. Paul Island to work on juvenile seals just prior to their departure. From 2 July 1974 to 1 September 1975, NBRL teams spent 190-man days on St. Paul Island. A total of 101 detailed necropsies were performed, and tissues from 89 females taken during pelagic collections were studied along with tissues from 119 subadult males from the harvest. Immune system tissues (thymus, tonsil, mesenteric lymph node, spleen, and

bone marrow) were collected from 20 subadult males for histology and serum proteins and 11 other chemical determinations were made by two procedures (SMA-12 and Digitek). Forty-nine seals were cultured for viruses. The results of this work are being published in several scientific journals.

Parasitology

Nasal Mites

The Marine Mammal Division has contracted with Dr. Ke Chung Kim of Pennsylvania State University to work out the life cycle of nasal mites in northern fur seals. His work in 1975 was concentrated on studying the developmental stages of mite larvae. Approximately 150 larvae of different sizes were reared in vitro using physiological saline as the medium, held at 70°F. About 40% of the larvae were reared successfully and completed their life cycle. The larvae all molted to nymphs and then passed through two more molts in one or two days to become adults.

Preliminary studies did not reveal a way to distinguish between the larvae of Orthohalarachne attenuata and O. diminuata, the two species known to infest fur seals, because of great morphological similarities, but it was learned that the nasal mites of fur seals go through two nymphal stages in a very short time, and considerable variation exists in the size of larvae regardless of their age.

Management Considerations

Freeze Marking

The latest in a series of experiments to determine an optimum technique for successful depigmentation of the skin or fur of fur seals was carried out on Zapadni Reef Rookery, St. Paul Island, 6 August 1975. Black pups were selected without regard to sex, but were animals judged to be older and in good condition to enhance chances that marked pups would be available for observation and evaluation of the marks in subsequent years. The technique of freeze marking using dry ice and alcohol has been described (U.S. Fish and Wildlife Service, 1969) and a record of seals marked is in Table A-17.

In 1975, however, we used a direct evaporative technique developed by R. Keith Farrell, D.V.M., U. S. Department of Agriculture and Washington State University. Freon 22 was applied directly to the skin or fur by means of a nozzle and flexible tubing attached to a cannister.

The liquid freon was confined to a circular area about 23 mm in diameter by means of a cut off 30-cc plastic syringe barrel held firmly against the surface.

This method is more convenient to use in the field and obviates the problem of storing dry ice. Another hoped for advantage is not having to clip or shave the skin before treating haired portions.

Forty pups were marked on the dorsal surfaces of their front flippers (manuses) by applying freon 22 to the left flipper for 1 second and to the right flipper for 2 seconds. The amount of freon 22 delivered in 1 second required 7-10 seconds to bubble away, and the amount delivered in 2 seconds required 19 seconds to do so; both applications left the skin frozen within the circle. These 40 pups were also marked on the chest with deliveries of freon 22 for 1, 2, and 3 seconds through the fur, and freezing the skin in each case.

Twenty pups were recaptured and photographed 1 week post-treatment. Most of the subjects had undergone blister formation and exfoliation at both the haired and unhaired sites.

At 2 weeks' post-treatment 20 pups were recaptured and photographed. At this stage, partial epithelialization of some of the marks of the unhaired manuses and an indication of developing depigmentation had occurred. Treated haired areas were still exfoliating.

At 3 weeks' post-treatment fairly good depigmentation of the unhaired skin was apparent but it was still too early to expect the growth of white fur or hair on the chest. Observations were not made after that date, and we will have to wait until survivors are harvested in 1978 and 1979 to complete the evaluation.

New Product Development

Flow Laboratories of Rockville, Maryland, arranged with NMFS to test the feasibility of marketing fur seal serum as a replacement for bovine fetal calf serum which is used extensively in virus culture and cancer research. They sent two men, Dean Oberholzer and George Susa, to handle the test sample. Their need was for 200 liters, or roughly 50 gallons of serum. Such a sample required help from four additional men to collect blood from about 500 seals to obtain approximately 800 liters of whole blood from which the 200 liters of serum was separated.

By January 1976 the serum had been processed and was ready for distribution to various research laboratories for testing. If the product is salable, we estimate a gross value of $100,000 for the raw material produced from an average harvest.

Mark C. Keyes, Alvin W. Smith,
Neylan A. Vedros, Thomas G. Akers,
and Ke Chung Kim[4/]

4/ Dr. Smith, Veterinary Virologist; Dr. Vedros, Microbiologist; and Dr. Akers, Virologist, are with the Naval Biomedical Research Laboratory, Naval Supply Center, Oakland, California. Dr. Kim is an Entomologist with Pennsylvania State University.

Part IV BEHAVIOR--ST GEORGE ISLAND

In addition to collecting more quantitative data on the behavioral traits of fur seals that are probably density dependent (see list in U. S. Department of Commerce [1975]) behavioral studies in 1975 were concentrated on these special topics; (a) determinants of the female feeding cycle, (b) lability of female estrus cycles, (c) predation on fur seal pups by northern sea lions, (d) behavior of fur seals at sea, (e) onshore-offshore movements of subadult male fur seals and (f) female-male interactions and the female/male ratio. This report summarizes topics (a) through (e) only.

Work Plan

After refurbishing the grids painted on rocks at East Reef and Zapadni Rookeries, and erecting a new blind at Zapadni Rookery, data were collected at these two sites 16 hours a day from mid June to late August, and collection was continued at East Reef Rookery until mid November. All hauling grounds were observed daily (except that at East Reef Rookery) from 1 July to 20 October. Daily observations for instrumented females were made at North and East Reef Rookeries from September to November, and daily observations and manipulations were made in the holding facility from June through August. In all, thirteen people spent approximately 1, 200 man-days collecting data for the behavioral program in 1975, using observational techniques described by the U. S. Department of Commerce (1975).

Marking

Adult Males

Sixteen adult males on East Reef and Zapadni Rookeries were each held in a squeeze cage and marked with metal tags and bleached numbers. All of these males were weighed after marking using a beam balance suspended from a chain hoist attached to a tripod straddling the cage. Weights ranged from 324 lbs. (147 kg.) to 744 lbs. (377 kg.) ($\bar{x}$ = 480 lbs., or 218 kg., SD 88. 99). Each of the animals regained his former station after marking and remained there throughout the reproductive season. See Table A-18 for tag numbers applied.

Adult Females

Fifteen females were marked with tags and bleach marks at

East Reef Rookery, and 31 females were similarly marked at Zapadni Rookery. Sixteen females were caught at North Rookery, tagged, and held captive at the holding facility for varying lengths of time before being released. Tag numbers appear in Table A-18. Eight females and 62 pups were given temporary (bleach) marks only.

Subadult Males

Sixty subadult males were equipped with radio transmitters at the Zapadni hauling ground and were simultaneously double tagged. Tag numbers appear in Table A-18.

Data Analysis

Female Feeding Cycles

The nature of the female feeding cycle is important to fur seal management because these cycles will eventually be used in a model for estimating female numbers, and because they may reflect inter- or intra- specific competition for food resources (including competition with fisheries). In 1974 the feeding cycles of 11 females at East Reef Rookery were examined for comparison with Peterson's (1965) study at St. Paul in 1961-63. There were four points of comparison in the resultant data: (a) The on-shore intervals were virtually identical (2.1 days St. George, 2.0 days St. Paul); (b) the at-sea intervals were vastly different (5.7 days St. George, 9.4 days St. Paul); (c) the regularity of cycles was similar (some females at both islands kept regular cycles, whereas others maintained irregular cycles); (d) the seasonal change in at-sea interval cannot presently be compared. Figure 10 shows that the number of days St. George females spent at sea increases with increasing number of days postpartum. Peterson's data, which were collated by month of the year rather than by days postpartum, are presently being reanalyzed for comparison.

To make the St. George data on feeding cycles more comparable to Peterson's earlier work, the number of females under observation in 1975 was increased to 37 and data were collected later into the year (mid November). Those data have not yet been analyzed.

To look for factors that determine the regularity of the female cycle, a four cell experiment was begun at East Reef Rookery involving the variables lactating/nonlactating, and pregnant/nonpregnant.

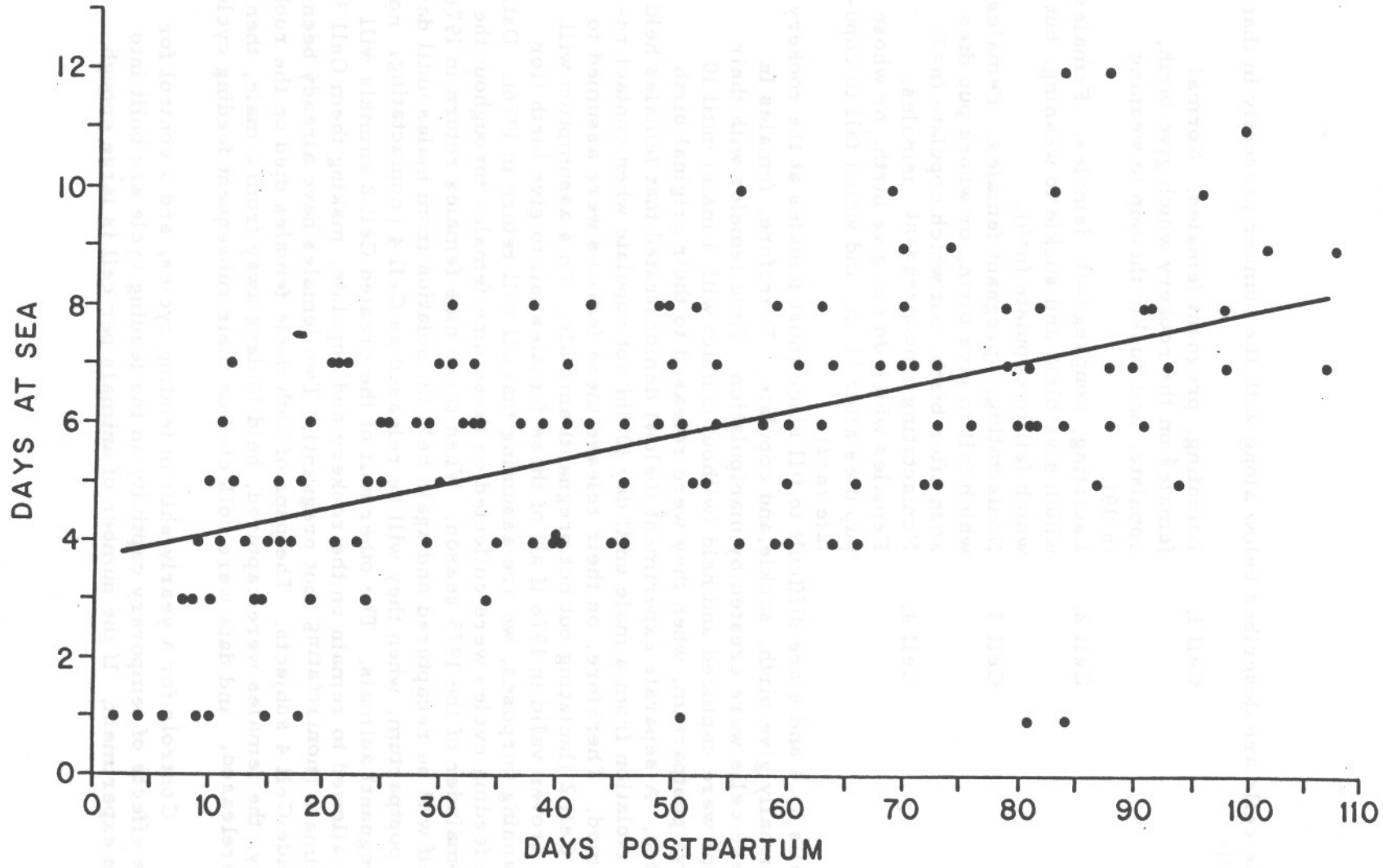

Figure 10. --Temporal change in length of female feeding cycle, 1974.

The cells are described below along with the number presently in that cell:

Cell 1. Lactating, pregnant females. Normal females on the rookery which give birth, copulate, and suckle the pup to weaning (n=19).

Cell 2. Lactating, nonpregnant females. Females which give birth and suckle to weaning, but which fail to copulate (n=9).

Cell 3. Nonlactating, pregnant females. Females which fail to give birth, or whose pup dies soon after birth, but which copulate (n=7)

Cell 4. Nonlactating, nonpregnant females. Females which do not give birth, or whose pup dies after birth, and which fail to copulate (n=2).

Cells 2, 3 and 4 are difficult to fill since most females at the rookery normally give birth, suckle,and copulate. Therefore, females in these cells were created by manipulation. Nine females with their pups were captured and held (without contact with a male) until 10 days postpartum, when they were released to their original birth sites. A separate experiment (below) demonstrated that females held in isolation from a male until day 10 did not copulate when contact resumed. Therefore, on their release these females were assumed to be Cell 2 (lactating but not pregnant) animals. This assumption will be proven valid in 1976 if all of these females fail to give birth (for planning purposes, we are assuming that all will return in 1976). Data on feeding cycles were collected on these nine females throughout the remainder of the 1975 season. When these nine females return in 1976, half will be recaptured and again held in isolation from males until day 10 postpartum, when they will be released as Cell 4 (nonlactating, nonpregnant) animals. The other half of the created Cell 2 animals will be allowed to remain on the rookery and copulate, making them Cell 3 animals (nonlactating but pregnant). Two females have already been made Cell 4 subjects. The pups of both these females died on the rookery, the females were captured, held 10 days away from a male, then rereleased, and data were collected on their subsequent feeding cycles.

Controls for a yearly shift in feeding cycles, and a control for the effects of temporary captivity on the feeding cycle are built into the experiment. If the number of animals per cell is large enough,

and either of the variables has some effect on the regularity of the cycle, this four cell experiment should reveal that effect.

Female Estrus Cycles

The efficiency of reproduction in the herd may depend not so much on the ratio of females to males as on the rate of change in that ratio. At St. George Island the female population grows differently at East Reef than it does at Zapadni Rookery. At East Reef Rookery (a narrow rookery adjacent to the shore) each male is exposed to an initial nucleus of females that slowly grows in size over time. Thus the female/male ratio (or more importantly the number of estrus females in each male's area) changes slowly over time. At Zapadni (a deep rookery, part of which is atop a cliff far from the shore) the females arrive from one end of the study site and quickly move in a solid phalynx along the cliff and up the hill. Since female arrival is precipitous the female/male ratio changes radically overnight. Under these conditions some females are likely to miss copulating, thereby decreasing the pregnancy rate.

In establishing in the herd a female/male ratio that optimizes reproductive efficiency it is important to know how many females miss copulating on rookeries where the female/male ratio changes quickly, and to know whether female estrus cycles are labile enough to compensate for missed copulations. That is, we need to know whether females can be diestrous if they fail to copulate immediately postpartum.

To answer the latter question, 27 female-pup pairs were captured on the day of parturition, taken to the holding facility, marked, and held captive in cages with other females and pups. On day 7 postpartum females were offered food (frozen herring). The readiness with which they accepted food determined the length of time they were kept for this experiment.

Females were held for varying lengths of time postpartum, then were placed in a compound with a captive adult male as a test of readiness to copulate. The male was fully adult and presumably experienced sexually since he was associated with more than 10 females when captured on his territory at East Reef Rookery. Females were released to the male at these intervals:

1 day postpartum	n = 4 (control group)
10 day postpartum	n = 7

15 day postpartum	n = 4
20 day postpartum	n = 4
25 day postpartum	n = 4
30 day postpartum	n = 4

When the assigned day postpartum arrived for each female she was placed in the compound with the adult male and observed for 60 minutes. Interactions between the male and female were divided into motor components, such as "touching noses", "lunging with an open mouth", and "recoiling from a lunge", etc. The advantage of this scoring system is that it can detect female receptivity without the copulation being seen. The motor components within each interaction, and the total number of interactions were recorded on a portable tape recorder. At the end of 60 minutes the female was left with the male for 24 hours, and was then observed for another 60 minute session as before. At the end of the second observation period the female and her pup were released to the original birth site on the rookery.

The data from this experiment have not yet been analyzed. However, it was clear as the data were collected that the male showed sexual interest (defined as encounters in which the components "anogenital investigation", "nosing the female's body", or "attempted mount" occurred) in all of the control females. Copulations for three of these four females was observed. Only one experimental female, a day 10 postpartum animal, elicited any sexual response from the male but no copulation occurred; the male either ignored or acted aggressively toward all other experimental females.

From this experiment we conclude that if females fail to copulate immediately postpartum, estrus will not be prolonged beyond day 10 postpartum, and that females will not enter estrus again within 30 days. No females are in physiological estrus beyond day 30 postpartum (Craig, 1964). Finally, brief exposure to males of females that have not copulated is not sufficient to trigger estrus. Thus, no compensatory mechanism for missed copulations appears to exist, and the pregnancy rate depends on the efficiency of male-female encounters between approximately day 5 and day 10 postpartum.

With present marking systems it is difficult or impossible to investigate the number of females that fail to copulate at rookeries where the female/male ratio undergoes rapid change.

Predation by Northern Sea Lions

Observations in 1974 suggested that sea lions may kill and consume up to 10.6% of the living pups at East Reef and East Cliff Rookeries of St. George Island. Inadequate sampling prevented similar estimates from being made at the other rookeries in that year. In 1975 a more comprehensive observation system was employed which permits these estimates to be made.

During 12 different days from 23 September to 4 November, one observer was stationed at each of these sites; East Reef, St. George Village, North Rookery, Staraya Artil Rookery, and midway between South and Zapadni Rookeries. The observers were responsible for recording all kills or attacks within their "zone" (see Figure 11) during a four hour period each observation day, and were shifted among zones to randomize observer bias. During these 12 days virtually all water areas in which pups were exposed to predation were thus under observation simultaneously. Additional observations were made at the East Reef and St. George Village zones.

Simultaneous observations at all 5 sites occurred either from 0800 to 1200, or from 1300 to 1700 hrs. Observations were not made when winds exceeded 40 mph, during heavy fog, or under precipitation. The observers used binoculars or telescopes to identify food items being consumed by the sea lions. On special forms the observers noted the date, time, weather, duration of feeding, size of sea lion, and whether the food being consumed was "verified" as a fur seal (defined as positive identification of the head, fur, or flippers of a pup). When these parts were not seen the episode was logged as a "possible" kill.

Table 19, an analysis of all predation data collected in 1975, shows that the kill rate is not similar at all observation sites, but is highest at East Reef-East Cliffs and at South-Zapadni Rookeries. At these two areas sea lions occur on shore in largest numbers.

Table 20, an analysis of the 12 days of simultaneous observation at all sites, shows that the kill rate varied hourly when the site at which kills occurred is ignored (lumped). The rate appears to be higher in the early morning and late afternoon hours than in the middle of the day. Thus, the kill rate is highest during the hours when sea lions are returning from (morning) and departing for (evening) sea. It is possible that most fur seals are taken by sea lions in

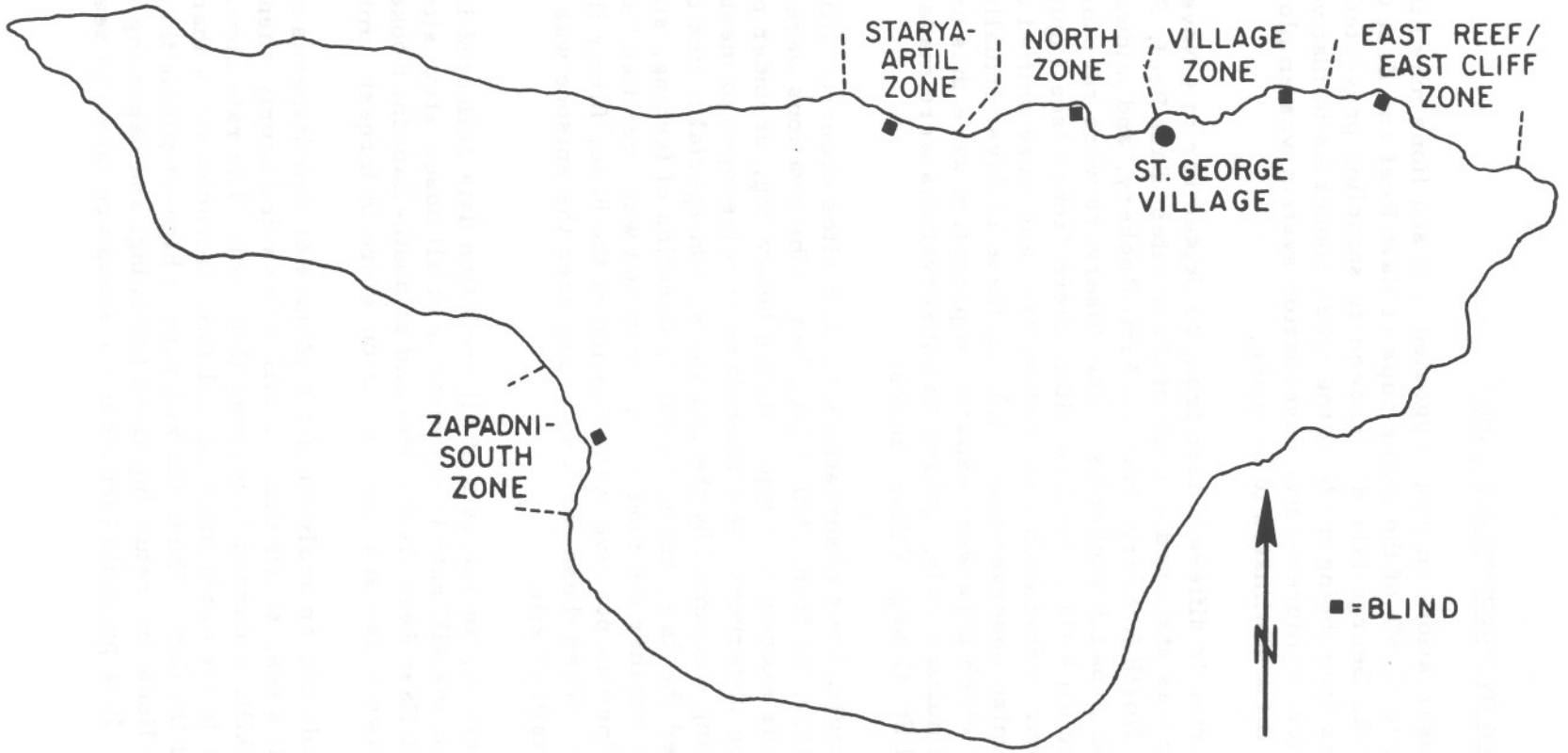

Figure 11. --Location of zones used to record predation on northern fur seals by northern sea lions.

Table 19.--Kill Rate by Geographic Zone

Site	Man-hours	# Kills 1/	Rate/Man-hr.
East	68.3	36	0.53
Village	52.2	18	0.34
North	43.8	13	0.30
Staraya Artil	42.3	13	0.31
Zapadni	37.8	26	0.69
TOTAL	244.4	106	

1/ Includes 89 "Verified" and 17 "Possible", summed to show greatest possible rate.

Table 20.--Kill Rate by Hour of Day

Hour	# Kills 1/	# Real Hours 2/	Rate/Real Hour
0801-0900	12	3.7	3.2
0901-1000	11	6.0	1.8
1001-1100	7	6.0	1.2
1101-1200	6	4.8	1.3
1301-1400	9	3.9	2.3
1401-1500	4	5.8	0.7
1501-1600	16	6.0	2.7
1601-1700	15	4.7	3.2
TOTALS	80	40.9	x2.05 (SD 0.95)

1/ Includes 66 "Verified" plus 14 "possible" to show greatest possible rate

2/ Real hours are man hours spend at that hour of day / 5 sites at which observations occurred. Only the 12 days of simultaneous observations are presented to give all sites equal weight.

transit to or from normal feeding grounds. Table 20 also shows that the whole fur seal population lost on the average of 2.05 pups per hour during those hours when the whole population was under observation. The number of hours on which the rates in Tables 19 and 20 are based is small because of observer scheduling and weather problems. Nevertheless, these rates are probably close to reality.

It is is assumed that kills occur over 104 days from 15 August to 20 November (the dates of the first and last kills seen in 1975) and the rate in Table 20 is reasonably accurate (80 kills in 41 hours) then the projected loss from the population by sea lion predation is a function of the number of hours per day that predation occurs. We do not have evidence on whether kills occur at night. If it is assumed that kills occur for only 12 hours per day then the 1,248 hours of killing between 15 August and 20 November would produce (by ratio and proportion) 2,435 pups killed. If it is assumed that the rate holds for a 24-hour day then 4,870 were taken. These estimates constitute 3.05% and 6.1% respectively of the 79,708 pups estimated to be alive on St. George Island during shearing-sampling in 1975.

Aside from examining stomach contents of sea lions for the presence of fur seal remains, the behavioral program does not plan to continue research on the problem of sea lion predation in 1976. The observational approach to this subject has produced hourly, seasonal, and geographic rates and, by itself, can yield little or no more information of importance on this subject. However, observations will be repeated in 1979 to look for long-term changes in predation rate.

Behavior at Sea

The behavioral project contracted with Dr. G. L. Kooyman, Scripps Institution of Oceanography, La Jolla, California, to investigate jointly, the effects of oil pollution on fur seals. The initial portion of this multiphasic project is to examine the effects of oil pollution on diving and feeding behavior of fur seals. In 1975 a baseline was established for the number, sequence, depth and duration of dives made by normal females during feeding excursions. Comparable data will be collected in 1976 on St. George Island from animals whose fur has been fouled by oil, and metabolic studies will be carried out.

Dr. Kooyman devised a depth-time recorder in which a battery operated motor moves by means of a gear train, a strip of pressure-sensitive paper past a stylus attached to a pressure transducer. Vertical deflection of the stylus, indicating pressure, was calibrated to 20 ATM pressure. The recorder was housed in a cylinder measuring approximately 3.5 by 20 cm, and weighing approximately 0.7 kg. The device could record continuously for eight days.

After testing the reliability of retrieving these recorders, five instruments were attached by means of nylon harnesses to five lactating females at North and East Reef Rookeries of St. George Island in September and October, 1975. Four recorders were subsequently recovered when these females returned to suckle their young. The recorders yielded 4, 8, 6 and 7 days of continuous diving records on these animals and measured 2,959 dives for depth and duration.

The deepest dive went to 630 ft. (194 m), and the greatest duration was less than six minutes. Table 21 gives the frequency distribution of dives, collated by 30 m intervals. Calculation shows that 96.2% of the dives extended to 80 m. (260 ft.) or less.

Dives to varying depths were not random along the time base, but appeared at times strikingly patterned. Some dives were markedly uniform in depth, duration and spacing, and occurred in clusters separated by many hours from other similar clusters. The deepest dives occurred singly, and often preceded one of the above clusters of dives. The record also showed periods in which no diving or other kind of bodily movement occurred. The sequence in dives to different depths, the day-night pattern of diving, and the temporal occurrence of quiet periods have not yet been analyzed. Such analysis will be performed when a larger sample of records is obtained in 1976.

Subadult Male Cyclic Activity

A study was made of on-land and at-sea cyclic activity of subadult males, 2-5 years old. Measuring the cycle, assuming one exists, will contribute to an assessment of the total subadult male population. An assessment is impossible if the proportion of animals ashore and at sea is unknown. Understanding movement patterns on and off the island should also help to determine the efficiency of present harvesting methods.

Table 21.— Frequency of Dives to Varying Depths

Fur Seal 1/ Number	# Hours Recorded	0-20m	21-50m	51-80m	81-110m	111-140m	141-170m	171-200m	Total Dives
2	92	1,148	1	10	9	49	7	2	1,226
3	200	54	478	89	1	4	0	0	626
4	149	201	200	14	7	6	3	0	431
1	167	301	314	37	9	13	2	0	676
Total		1,704	993	150	26	72	12	2	2,959

1/ Listed in order of retrieval.

Radio transmitters, built into nylon strap harnesses, were placed on each of 49 subadult males at Zapadni hauling ground. Twenty-four animals with body lengths ranging from 40-48 inches (101.6 - 121.9 cm) were tagged 10 July. Twenty-five animals with body lengths of 52-66 inches (132.1 to 167.6 cm) were tagged 19 August. Tagged animals were separately identifiable through differences in transmitter frequencies and pulse repetition rates. Presence of the tagged animals on or absence from the island was monitored with a portable receiver and antenna. Zapadni, South, Staraya Artil and North hauling grounds were checked one or more times daily, and East hauling ground every other day. Weather data, (temperature, wind speed and direction, sky condition) were recorded during each radio check. The monitoring program was ended 20 October.

Forty of the 49 tagged animals were monitored in sequences ranging from 1 to 9 departures and returns to land. A total of 148 such sequences was recorded. Length of intervals on land ranged from 1 to 15 days. Length of intervals at sea ranged from 1 to 39 days. Over half of the trips to sea were only of 1-2 days duration (Figure 12). Supplementary data suggest that some of these brief absences from land probably were related to high temperature, rainfall, and disturbance by humans, but in a large majority of cases a disturbance factor was not apparent. The 1-2 day absences accounted for 20% of the total number of days tagged animals spent at sea. Absences falling within the mode occuring at 10-20 days at sea account for 60% of the total time spent at sea. In the simpler pattern of stays on land, over half are of 1-4 days duration, and animals spent about 50% of the total time on land in stays of 1-5 days duration. Further analysis will test for significant variation between movements of large and small animals and whether on-offshore patterns vary over the course of the season.

Five tagged animals were monitored on hauling grounds at Staraya Artil and North, in each case for 1-2 days. Four of the five later returned to the Zapadni hauling ground. One radio-tagged animal was seen at St. Paul Island on Gorbatch hauling ground. Twenty three were monitored at South, suggesting that a majority of the population on this hauling ground is made up of subadult males from Zapadni.

The wide variation in movement seen here indicates the advisability of repeating the study in 1976. If repeated, tagging will begin

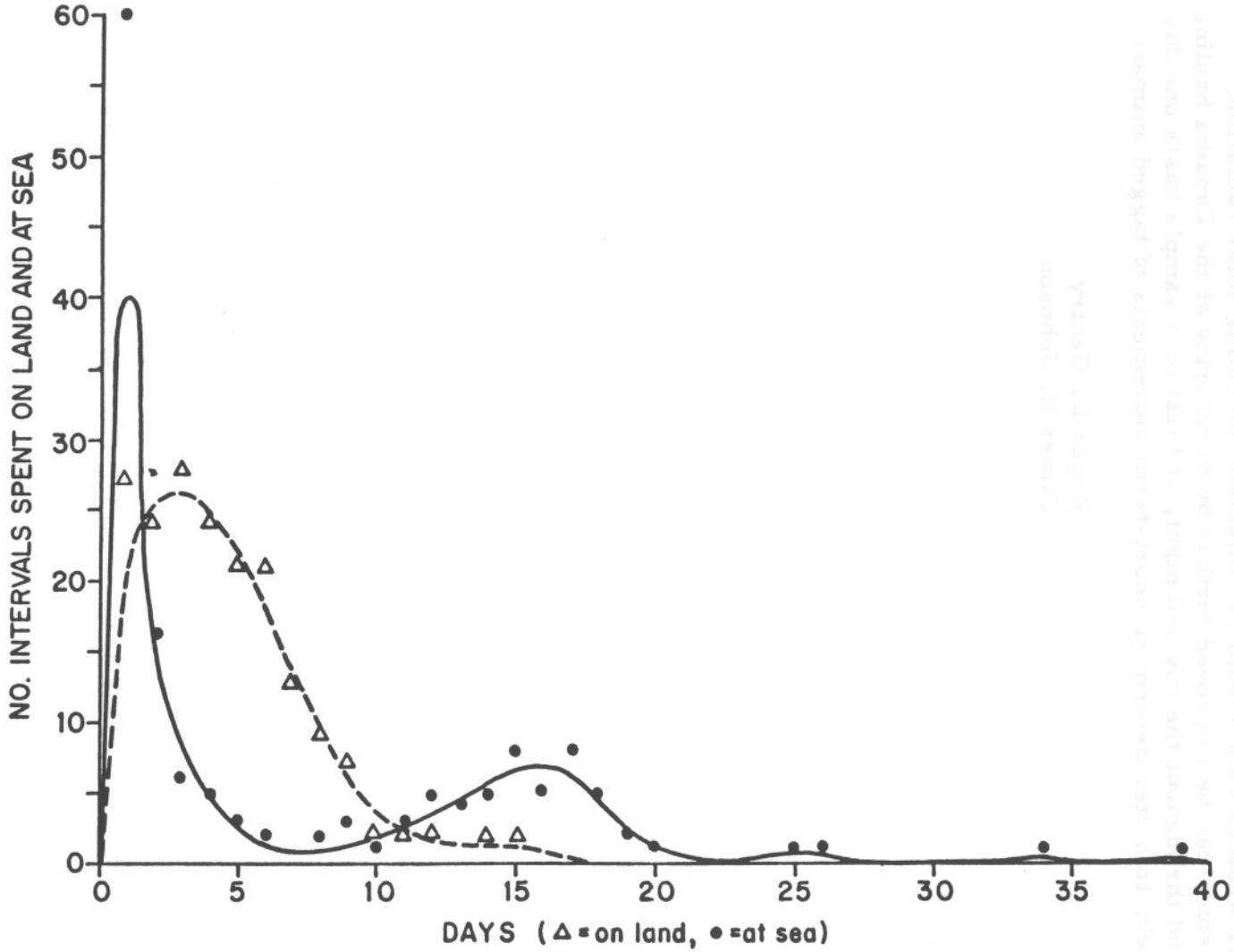

Figure 12. --Frequency of intervals spent on land and at sea by radio-tagged subadult males, St. George Island, 1975.

in June, approximately 3 weeks earlier than in 1975. In addition, better weather data should be collected, including solar radiation. The study can be improved further by monitoring at the Zapadni hauling ground throughout the day and night, at least on a sample basis one day a week, to better determine short-term movements of tagged animals.

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PART V. BEHAVIOR--SAN MIGUEL ISLAND

Northern fur seals formerly hauled out on San Miguel Island as did the Guadalupe fur seal (Repenning, Peterson, and Hubbs, 1971) but were extirpated before 1850 by sealers. A small breeding colony of about 100 individuals was discovered in Adams Cove on the west end of San Miguel Island in 1968 (Peterson, LeBoeuf, and DeLong, 1968), and a second breeding colony was found in 1972 on Castle Rock, a small island located about 2 miles north of the west end of San Miguel Island.

Adams Cove

The Adams Cove population has been monitored since 1969 by making daily observations from blinds during each breeding season. Some of the observations of this colony, which has been allowed to grow in a relatively undisturbed environment, are given in Table 22.

Adult males and females arrive in Adams Cove and haul out during the latter part of May and the mean pupping date occurs in late June. The number of births increased to 329 in 1975 from 220 in 1974. The largest number of females ashore (563) was counted on 24 August. This count does not reflect the actual number of females in the breeding population for two reasons: (1) A large proportion of parturient females are at sea feeding, and (2) on this date, after the breeding season, new females continue to arrive on land as evidenced by the presence of algal growth on their pelage.

Some members of the Adams Cove population were tagged by Peterson, LeBoeuf, and DeLong when the colony was discovered in 1968, and records were made of two animals tagged elsewhere. Since 1969, records have been kept and tag numbers recorded when these animals reappear in the colony and when animals tagged elsewhere arrive and join the group. These data are given in Tables A-19 and A-20. On 8 October 1975, single tags were placed on the fore flipper of 100 fur seal pups, and 50 adult females were double tagged (Tables A-21 and A-22). The tags were a modified version of the monel cattle ear tag, the post being rounded with a hollow core. It is hoped that the round post will decrease tag loss. The hollow posts were filled with antibiotic prior to placing them on the animals to reduce the chance of infection of the tag wound.

The rapid growth of the colony is supplemented in part by a continual influx of females from colonies of the Pribilof and Commander Islands and Robben Island, as indicated by the appearance of new arrivals with tags placed on them as pups on these islands. Tagged males from the northern colonies have not been observed.

Table 22.--Summary of some observations of the northern fur seal colony in Adams Cove on San Miguel Island, California, 1969-75

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

1/ Beginning and ending dates of continuous observations.
2/ May have arrived earlier.
3/ 1 still birth occurred on 19 May.
4/ A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
5/ Includes 2 males who arrived in late August and were not territorial (probably from Castle Rock).
6/ Animals about 104-127 cm in body length, tip of nose to tip of tail.

Castle Rock

The various elements of the Castle Rock population are counted from several aerial photographs taken during each season. In addition, one annual census of the pup population is made from afoot. Adult males and females are counted from photographs, and the pup count is made in late July or early August after most births have occurred. The largest number of males (20) was seen in photographs taken 1 July 1975; 15 were territorial and with females and 5 were apparently idle bulls. The largest count of females from aerial photos is less than the number of pups censused, therefore, the number of living and dead pups censused is used as a minimum estimate of the number of females.

A total of 396 pups (368 living and 28 dead) was counted during a ground census on 2 August 1975. Most of the adult males and females were in the water and could not be counted at this time.

The combined number of pups born in the two colonies increased from 261 in 1973 to 521 (a 100% increase) in 1974 and to 725 (a 39% increase) in 1975. These increases are spectacular and reflect recruitment of breeding females from northern populations.

Nocturnal Behavior

Researchers have suspected that, due to high ambient temperatures characteristic of the Channel Islands off California, the frequency of pinniped social interaction may increase at night because of cooler air temperature (Peterson and Bartholomew, 1967). During the 1974 and 1975 breeding seasons on San Miguel Island, nocturnal and diurnal observations of the northern fur seal were conducted in Adams Cove. 5/ Individual breeding males were observed during 60 different nocturnal periods (2030-0500 hours). Every 5 minutes during the day and night, a male was scored as either upright (active) or prostrate (inactive). Although variations were observed between individual males, some generalization about activity levels can be made. Activity appeared to peak during the first hour of darkness (2030-2130 hours), with males spending 78% of their time active. Subsequently, activity declined, reaching a low between 2400 and 0100 hours, when males were active 43% of the time. A gradual increase then occurred after 0100 hours until 58% of the males were active between 0430 and 0530 hours.

5/ Diurnal observations--binoculars, variable power telescope; nocturnal observations--starlight scope.

The fur seals were also reproductively active at night. The frequency of copulations increases following onset of darkness. During 13 different 24-hour studies, 146 copulations by 12 males were recorded. The frequency of copulations from this sample was 0.606 copulations per hour during the nocturnal hours and 0.384 copulations per hour during the diurnal hours (0530-2030). These two frequencies are significantly different ($p = 0.1$, Wilcoxon two-sample test).

Again in 1975 a cassette recorder was used to document individual fur seal vocalizations and monitor the vocal activity of selected groups of northern fur seals on a 24-hour basis. The analysis of these recordings is still preliminary but suggest:

1. The 24-hour recordings may be used as a gross measure of fur seal activity, if a relationship between the frequency of vocalizations and activity can be demonstrated.

2. Male fur seal voice prints may serve as a "natural tag" by which the annual return of individual males can be followed.

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and George A. Antonelis

Part VI. PELAGIC INVESTIGATIONS

The United States and Canada agreed, at the 18th meeting in 1975, to a joint analysis of pelagic fur seal data collected in the eastern North Pacific and Bering Sea (1958-74) and an initial planning meeting was held in April of that year to discuss the status of the United States and Canadian pelagic data as well as topics to be considered for analysis by both countries. It was agreed that the first priority was to put all sighting and effort data on computer data processing cards and further, to defer assignments and the scheduling of priorities until the next meeting, which will be scheduled after both countries have entered their data on the cards.

An 11-year period (1958-1968) was covered with this effort, which is also a period within which the bulk of United States data has been collected. For example, over 83 percent of the total seals sighted (over 75,000) during the entire collection period from 1958 through 1974 were recorded by 1968. Much time was devoted to the preparation of data for keypunching and checking the data after it was entered on the cards. This major task has now been completed.

Fur Seal Feeding on Walleye Pollock *T. chalcogramma* in the Eastern Bering Sea

A preliminary look was taken at fur seal feeding on walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea in 1962, 1963, and 1973 to determine if the feeding habits of fur seals have changed due to the intensive foreign fishery for pollock. This species is one of the major food fishes of fur seals in the eastern Bering Sea. The area of comparison for these years approximates the 1973 collecting area which coveres a 100 mile strip of water around the Pribilof Islands. The years 1962 and 1963 represent the years before the intensive pollock fishery and 1973, the period immediately following a peak pollock catch. The catch of pollock in each of these years was 0.05, 0.1 and 1.7 million metric tons in 1962, 1963 and 1973, respectively (the peak pollock catch of 1.8 million metric tons was in 1972).

Although the 1963 commercial catch was double that of the catch in 1962, the frequency of occurrence of pollock in fur seal stomachs was lower in 1963 than in 1962 (Figure 1). As shown in Figure 1, pollock was much more common in seal stomachs in 1973. Because the significance of this finding is not yet clear, the data will be examined in more detail by time and area. Fur seals may have fed heavily on pollock in 1973 because the fisheries had by then (1) reduced the populations of other

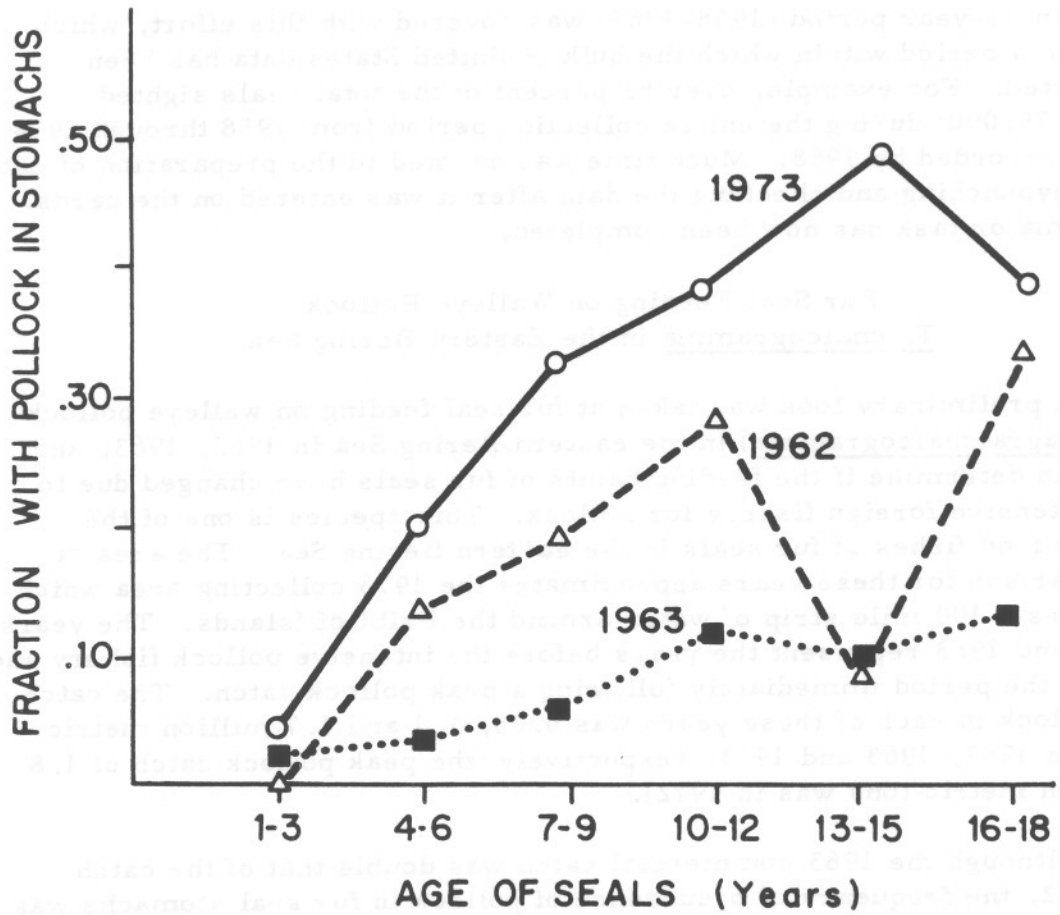

Figure 13.--Frequency of occurrence of pollock in fur seal stomachs, by age of seals.

species on which seals fed in 1962 and 1963, or (2) increased the survival of juvenile pollock by reducing the abundance of other species feeding on them. An examination of the stomachs of pollock taken in the eastern Bering Sea during 1974 show that 26% of the contents, by weight, consist of fish; of this total, approximately 75% of the fish eaten by pollock were immature pollock (Kenneth Waldron, Northwest Fisheries Center, National Marine Fisheries Service, pers. comm.). The pollock was also the predominant fish in the stomachs of turbot and cod.

Preliminary tests do not indicate differences between 1962, 1963, and 1973 in the frequency of pollock in stomachs of seals 1-3 years old. Differences did occur between these years for older animals (combined ages 4-16 years). Further tests will be made by time and area.

For the entire eastern Bering Sea, Figure 1 shows that the frequency of pollock in seal stomachs increased with increases in the ages of seals (except at ages 13-15 years in the 1962 data). Although the principal foods mentioned below are for the eastern Bering Sea in general, sampling in 1962 and 1963 was primarily near Unimak Pass and in Aleutian Islands areas, whereas sampling in 1973 was approximately 20 to 100 miles around the Pribilof Islands. The principal foods in 1962 of seals of ages 1-3 years old were capelin, (Mallotus villosus), Atka mackerel, (Pleurogrammus monopterygius) and squids. Pollock and gadids were not found in the stomachs of 1-to 3-year-old seals in 1962. In 1963, squids, capelin, and deepsea smelt (Bathylagidae), were the principal foods of 1- to 3-year-old animals. Two occurrences each of pollock and gadids were found in this group. In 1973, however, squids and gadids were the principal foods of seals of ages 1-3 years (squid 49 occurrences, gadids 32 occurrences, and pollock 5 occurrences). The overall food composition of fur seals taken in 1962 and 1963 in about the same sampling area as in 1973 will be determined soon for comparative purposes.

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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.

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

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

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

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

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

GLOSSARY, (Cont.)

Male Seals, Adult

Class 1 (Shoreline) -- Full-grown males apparently with established territories spaced along the water's edge at intervals of 10-15 years. 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.

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

Marked Describes a seal that has been marked by removing the cartilagenous tip of a digit from a hind flipper, by attaching an inscribed metal tag to one or more of its flippers, by freeze

GLOSSARY, (Cont.)

branding, or by hair-clipping and bleaching.

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

Round The sequence in which hauling grounds on St. Paul Island are visited to harvest seals. A circuit or round of the hauling grounds is completed in 6 days and the procedure is repeated throughout the kill of males.

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Table A-1. --Age classification of male seals killed on St. Paul Island, 30 June to 2 August 1975.

Date	Rookery 1/	Males killed	Tooth sample	DAILY: Percent in each age class of sample 2	3	4	5	6	DAILY: Estimated number killed from each age class 2	3	4	5	6	Total kill to date	CUMULATIVE: Estimated number killed from each age class 2	3	4	5	6	CUMULATIVE: Percent killed from each age class 2	3	4	5	6
June																								
30	NEP(east)	828	153	-	24.2	62.7	13.1	-	-	200	519	109	-	828	-	200	519	109	-	-	24	63	13	-
30	NEP(west)	701	130	-	30.0	60.8	8.5	0.7	-	210	426	60	5	1,529	-	410	945	169	5	-	27	62	11	-
July																								
1	POL	318	57	-	22.8	54.4	22.8	-	-	73	172	73	-	1,847	-	483	1,117	242	5	-	26	61	13	-
2	TZR	1,479	266	-	41.0	51.1	7.5	0.4	-	606	756	111	6	3,326	-	1,089	1,873	353	11	-	33	56	11	-
3	ZAP	577	121	-	24.8	61.2	13.2	0.8	-	143	353	76	5	3,903	-	1,232	2,226	429	16	-	32	57	11	-
5	REEF	1,186	276	0.7	46.0	48.2	5.1	-	8	546	572	60	-	5,089	8	1,778	2,798	489	16	-	35	55	10	-
5	L-K	351	70	-	37.2	55.7	5.7	1.4	-	131	196	20	4	5,440	8	1,909	2,994	509	20	-	35	55	9	1
7	NEP(east)	523	85	-	25.9	63.5	10.6	-	-	135	332	56	-	5,963	8	2,044	3,326	565	20	-	34	56	10	-
7	NEP(west)	733	131	0.8	42.7	51.1	4.6	0.8	6	313	374	34	6	6,696	14	2,357	3,700	599	26	-	35	55	9	1
8	POL	251	45	-	37.8	44.4	17.8	-	-	95	111	45	-	6,947	14	2,452	3,811	644	26	-	35	55	9	1
9	TZR	1,367	260	1.9	56.6	36.5	5.0	-	26	774	499	68	-	8,314	40	3,226	4,310	712	26	-	39	52	9	-
10	ZAP	414	70	-	40.0	54.3	5.7	-	-	166	224	24	-	8,728	40	3,392	4,534	736	26	1	39	52	8	-
11	REEF	1,194	193	3.1	57.5	34.7	4.7	-	37	687	414	56	-	9,922	77	4,079	4,948	792	26	1	41	50	8	-
12	L-K	154	31	9.7	41.9	45.2	3.2	-	15	64	70	5	-	10,076	92	4,143	5,018	797	26	1	41	50	8	-
14	NEP(east)	727	134	7.5	45.5	38.8	5.2	3.0	54	331	282	38	22	10,803	146	4,474	5,300	835	48	1	41	49	8	1
14	NEP(west)	1,303	220	10.9	61.8	25.5	1.8	-	142	805	332	24	-	12,106	288	5,279	5,632	859	48	2	44	47	7	-
15	POL	261	59	-	20.4	59.3	16.9	3.4	-	53	155	44	9	12,367	288	5,332	5,787	903	57	2	43	47	7	1
16	TZR	1,938	354	5.7	57.7	31.9	4.5	0.2	111	1,118	618	87	4	14,305	399	6,450	6,405	990	61	3	45	45	7	-
17	ZAP	934	146	3.5	45.2	41.8	8.2	1.3	33	422	390	77	12	15,239	432	6,872	6,795	1,067	73	3	45	45	7	-
18	REEF	879	153	7.8	56.9	33.3	2.0	-	68	500	293	18	-	16,118	500	7,372	7,088	1,085	73	3	46	44	7	-
19	L-K	388	77	5.2	57.1	29.9	6.5	1.3	20	222	116	25	5	16,506	520	7,594	7,204	1,110	78	3	46	44	7	-
21	NEP(east)	793	122	8.2	60.7	27.9	2.4	0.8	65	482	221	19	6	17,299	585	8,076	7,425	1,129	84	3	47	43	7	-
21	NEP(west)	389	79	13.9	60.8	24.0	1.3	-	54	237	93	5	-	17,688	639	8,313	7,518	1,134	84	4	47	43	6	-
22	POL	558	103	3.9	59.2	34.0	2.9	-	22	330	190	16	-	18,246	661	8,643	7,708	1,150	84	4	47	42	6	1
23	TZR	1,576	280	5.7	66.1	25.0	2.5	0.7	90	1,042	394	39	11	19,822	751	9,685	8,102	1,189	95	4	49	41	6	-
24	ZAP	1,094	136	9.6	52.9	36.8	0.7	-	105	579	402	8	-	20,916	856	10,264	8,504	1,197	95	4	49	41	6	-
25	REEF	1,433	256	5.9	54.7	36.7	2.7	-	84	784	526	39	-	22,349	940	11,048	9,030	1,236	95	4	50	40	6	-
26	L-K	487	94	4.3	55.3	36.1	4.3	-	21	269	176	21	-	22,836	961	11,317	9,206	1,257	95	4	50	40	6	-
28	NEP(east)	889	134	11.2	63.4	24.6	0.8	-	99	564	219	7	-	23,725	1,060	11,881	9,425	1,264	95	5	50	40	5	-
28	NEP(west)	546	96	15.6	51.1	30.2	3.1	-	85	279	165	17	-	24,271	1,145	12,160	9,590	1,281	95	5	50	40	5	-
29	POL	719	114	12.3	50.0	33.3	4.4	-	88	360	239	32	-	24,990	1,233	12,520	9,829	1,313	95	5	50	39	5	1
30	TZR	1,909	341	12.3	69.8	17.0	0.9	-	234	1,333	325	17	-	26,899	1,467	13,853	10,154	1,330	95	5	52	38	5	-
31	ZAP	1,078	185	7.0	60.0	30.3	2.7	-	75	647	327	29	-	27,977	1,542	14,500	10,481	1,359	95	6	52	37	5	-
August																								
1	REEF	791	132	6.8	62.9	26.5	3.8	-	54	498	209	30	-	28,768	1,596	14,998	10,690	1,389	95	6	52	37	5	-
2	L-K	325	50	14.0	58.0	24.0	4.0	-	46	188	78	13	-	29,093	1,642	15,186	10,768	1,402	95	6	52	37	5	-

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 and Little Polovina; ZAP = Zapadni; REEF = Reef, Gorbatch, and Ardiguen; L-K = Lukanin and Kitovi.

Table A-2 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 25-27 June 1975

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
2	28	37	-	-	-	-	-	-	-	-	-	-	-	-	65
3	21	31	-	-	-	-	-	-	-	-	-	-	-	-	52
5	80	0	-	-	-	-	-	-	-	-	-	-	-	-	80
Kitovi[2/]															
2	19(12)	9	35	39	37	-	-	-	-	-	-	-	-	-	151
3	23(11)	12	24	29	21	-	-	-	-	-	-	-	-	-	120
5	0(0)	0	0	0	45	-	-	-	-	-	-	-	-	-	45
Reef															
2	43	49	45	32	38	30	65	39	43	17	9	-	-	-	410
3	24	32	19	14	24	28	10	29	18	21	11	-	-	-	230
5	0	2	2	0	250	15	2	25	0	8	32	-	-	-	336
Gorbatch															
2	67	47	38	6	24	46	-	-	-	-	-	-	-	-	228
3	40	37	21	8	19	22	-	-	-	-	-	-	-	-	147
5	51	0	0	200	0	3	-	-	-	-	-	-	-	-	254
Ardiguen[3/]															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27
Morjovi[4/]															
2	35(13)	26	22	48	35	46	-	-	-	-	-	-	-	-	225
3	25(12)	27	25	31	31	31	-	-	-	-	-	-	-	-	182
5	136(16)	0	15	0	0	125	-	-	-	-	-	-	-	-	292

See footnotes at end of table.

Table A-2 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 25-27 June 1975--Continued

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Vostochni															
2	32	34	26	22	11	63	47	44	40	27	34	37	55	36	508
3	21	14	21	17	14	37	16	34	21	13	25	36	59	20	348
5	0	0	0	20	25	0	10	0	0	0	0	35	20	15	125
Little Polovina															
2	44	44	-	-	-	-	-	-	-	-	-	-	-	-	88
3	16	15	-	-	-	-	-	-	-	-	-	-	-	-	31
5	0	108	-	-	-	-	-	-	-	-	-	-	-	-	108
Polovina															
2	29	25	-	-	-	-	-	-	-	-	-	-	-	-	54
3	28	14	-	-	-	-	-	-	-	-	-	-	-	-	42
5	145	25	-	-	-	-	-	-	-	-	-	-	-	-	170
Polovina Cliffs															
2	23	20	29	23	43	50	74	-	-	-	-	-	-	-	262
3	22	22	24	23	33	26	43	-	-	-	-	-	-	-	193
5	6	4	4	4	4	75	0	-	-	-	-	-	-	-	97
Tolstoi															
2	23	24	19	12	54	54	42	41	-	-	-	-	-	-	269
3	30	34	34	27	68	53	53	30	-	-	-	-	-	-	329
5	1	0	0	0	4	3	0	500	-	-	-	-	-	-	508

See footnotes at end of table

Table A-2.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 25-27 June 1975--Continued

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Zapadni Reef															
2	55	23	-	-	-	-	-	-	-	-	-	-	-	-	78
3	42	22	-	-	-	-	-	-	-	-	-	-	-	-	64
5	28	85	-	-	-	-	-	-	-	-	-	-	-	-	113
Little Zapadni															
2	15	24	33	43	32	29	-	-	-	-	-	-	-	-	176
3	12	26	41	44	26	32	-	-	-	-	-	-	-	-	181
5	1	0	0	10	0	125	-	-	-	-	-	-	-	-	136
Zapadni[5/]															
2	32(0)	42	51	67	60	39	29	14	-	-	-	-	-	-	334
3	27(0)	36	42	47	31	41	36	9	-	-	-	-	-	-	269
5	0(250)	5	20	0	0	0	0	350	-	-	-	-	-	-	625

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.

Table A-2 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 25-27 June 1975--Continued

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

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

3/ No numbered sections.

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

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

Table A-3 . --Adult male seals counted, by class[1/] and rookery section, St. George Island, 1-2 July 1975

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Zapadni[2/]							
2	-	26	3	-	-	-	29
3	-	62	20	-	-	-	82
5	-	268	0	-	-	-	268
South							
2	12	9	14	-	-	-	35
3	41	45	49	-	-	-	135
5	90	0	4	-	-	-	94
North							
2	5	9	10	21	10	9	64
3	36	52	57	67	20	48	280
5	358	13	3	14	2	219	609
East Reef[3/]							
2	-	-	-	-	-	-	24
3	-	-	-	-	-	-	51
5	-	-	-	-	-	-	115
East Cliffs							
2	11	20	-	-	-	-	31
3	49	74	-	-	-	-	123
5	300	235	-	-	-	-	535
Staraya Artil							
2	20	11	-	-	-	-	31
3	49	21	-	-	-	-	70
5	304	6	-	-	-	-	310

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

2/ Count of adult male seals in section 2 includes count from section 1.

3/ No numbered sections.

Table A-4 . --Adult male seals counted, by rookery, Pribilof Islands, Alaska, June and July 1975

Island and rookery	Date	Class of adult male 1/ 2	3	5	Total
		----------Number----------			
St. Paul Island	June				
Lukanin	25	65	52	80	197
Kitovi	25	151	120	45	316
Reef	25	410	230	336	976
Gorbatch	25	228	147	254	629
Ardiguen	25	45	34	27	106
Morjovi	26	225	182	292	699
Vostochni	26	508	348	125	981
Little Polovina	25	88	31	108	227
Polovina	26	54	42	170	266
Polovina Cliffs	26	262	193	97	552
Tolstoi	27	269	329	508	1, 106
Zapadni Reef	27	78	64	113	255
Little Zapadni	27	176	181	136	493
Zapadni	27	334	269	625	1, 228
Total		2, 893	2, 222	2, 916	8, 031
St. George Island	July				
Zapadni	1	29	82	268	379
South	1	35	135	94	264
North	2	64	280	609	953
East Reef	1	24	51	115	190
East Cliffs	1	31	123	535	689
Staraya Artil	2	31	70	310	411
Total		214	741	1, 931	2, 886
Total both islands		3, 107	2, 963	4, 847	10, 917

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

Table A- 5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-14 July 1975.

Rookery and Class of Male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Lukanin															
2	4	7	-	-	-	-	-	-	-	-	-	-	-	-	11
3	51	61	-	-	-	-	-	-	-	-	-	-	-	-	112
5	68	2	-	-	-	-	-	-	-	-	-	-	-	-	70
Kitovi[2/]															
2	5(6)	3	5	5	5	-	-	-	-	-	-	-	-	-	29
3	49(24)	18	51	72	53	-	-	-	-	-	-	-	-	-	267
5	0(1)	5	2	0	40	-	-	-	-	-	-	-	-	-	48
Reef															
2	11	14	13	15	10	7	19	8	15	4	1	-	-	-	117
3	56	80	77	36	66	48	74	68	49	45	23	-	-	-	622
5	0	0	0	15	150	0	0	50	10	10	15	-	-	-	250
Gorbatch															
2	16	9	10	9	7	18	-	-	-	-	-	-	-	-	69
3	105	84	59	17	54	68	-	-	-	-	-	-	-	-	387
5	67	0	0	150	0	0	-	-	-	-	-	-	-	-	217
Ardiguen[3/]															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35

Table A-5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-14 July 1975, continued.

Rookery and Class of Male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Morjovi[4/]															
2	17(9)	14	10	24	21	16	-	-	-	-	-	-	-	-	111
3	57(25)	48	56	65	56	69	-	-	-	-	-	-	-	-	376
5	150(7)	5	0	0	0	110	-	-	-	-	-	-	-	-	272
Vostochni															
2	12	9	11	7	8	28	22	21	9	4	6	13	17	18	185
3	45	38	49	35	31	89	44	79	66	39	59	68	110	47	799
5	0	0	0	0	90	0	6	0	0	0	0	52	52	60	260
Little Polovina															
2	23	15	-	-	-	-	-	-	-	-	-	-	-	-	38
3	47	41	-	-	-	-	-	-	-	-	-	-	-	-	88
5	10	157	-	-	-	-	-	-	-	-	-	-	-	-	167
Polovina															
2	16	12	-	-	-	-	-	-	-	-	-	-	-	-	28
3	57	31	-	-	-	-	-	-	-	-	-	-	-	-	88
5	132	40	-	-	-	-	-	-	-	-	-	-	-	-	172
Polovina Cliffs															
2	8	7	7	7	11	13	37	-	-	-	-	-	-	-	90
3	48	41	53	50	78	71	120	-	-	-	-	-	-	-	461
5	5	0	0	10	5	84	0	-	-	-	-	-	-	-	104

Table A-5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-14 July 1975, continued.

Rookery and Class of Male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Tolstoi															
2	7	8	6	8	11	16	18	15	-	-	-	-	-	-	89
3	60	64	68	43	120	99	99	68	-	-	-	-	-	-	621
5	4	0	0	0	10	10	0	400	-	-	-	-	-	-	424
Zapadni Reef															
2	11	15	-	-	-	-	-	-	-	-	-	-	-	-	26
3	45	94	-	-	-	-	-	-	-	-	-	-	-	-	139
5	75	10	-	-	-	-	-	-	-	-	-	-	-	-	85
Little Zapadni															
2	11	14	12	27	15	8	-	-	-	-	-	-	-	-	87
3	23	49	79	81	69	62	-	-	-	-	-	-	-	-	363
5	10	1	4	8	0	75	-	-	-	-	-	-	-	-	98
Zapadni[5/]															
2	9(0)	12	10	23	25	12	11	2	-	-	-	-	-	-	104
3	54(0)	94	100	116	86	72	63	25	-	-	-	-	-	-	610
5	8(110)	0	0	25	0	0	0	200	-	-	-	-	-	-	343

1/ See Table A-2 or glossary for a description of the classes of adult male seals.
2/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.
3/ No numbered sections.
4/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.
5/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-6.--Adult male seals counted, by class[1/] and rookery section, St. George Island, 14-15 July 1975

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Zapadni[2/]							
2	-	9	3	-	-	-	12
3	-	66	25	-	-	-	91
5	-	228	6	-	-	-	234
South							
2	3	3	4	-	-	-	10
3	55	67	48	-	-	-	170
5	70	3	4	-	-	-	77
North							
2	9	6	10	5	1	8	39
3	43	62	62	72	24	64	327
5	300	9	4	5	6	150	474
East Reef[3/]							
2	-	-	-	-	-	-	10
3	-	-	-	-	-	-	56
5	-	-	-	-	-	-	125
East Cliffs							
2	6	16	-	-	-	-	22
3	55	88	-	-	-	-	143
5	258	102	-	-	-	-	360
Staraya Artil							
2	5	1	-	-	-	-	6
3	57	33	-	-	-	-	90
5	58	0	-	-	-	-	58

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

2/ Count of adult male seals in section 2 includes count from section 1.

3/ No numbered sections.

Table A-7.--Adult male seals counted, by rookery, Pribilof Islands, Alaska, July 1975

Island and rookery	Date	Class of adult males 1/ 2	3	5	Total
		Number			
St. Paul Island	July				
Lukanin	14	11	112	70	193
Kitovi	14	29	267	48	344
Reef	14	117	622	250	989
Gorbatch	14	69	387	217	673
Ardiguen	14	6	85	35	126
Morjovi	10	111	376	272	759
Vostochni	10	185	799	260	1,244
Little Polovina	10	38	88	167	293
Polovina	10	28	88	172	288
Polovina Cliffs	10	90	461	104	655
Tolstoi	11	89	621	424	1,134
Zapadni Reef	11	26	139	85	250
Little Zapadni	11	87	363	98	548
Zapadni	11	104	610	343	1,057
Total		990	5,018	2,545	8,553
St. George Island					
Zapadni	15	12	91	234	337
South	15	10	170	77	257
North	14	39	327	474	840
East Reef	14	10	56	125	191
East Cliffs	14	22	143	360	525
Staraya Artil	15	6	90	58	154
Total		99	877	1,328	2,304
Total both islands		1,089	5,895	3,873	10,857

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

Table A-8.--Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1966-75

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	-----Number----		-----Number----		-----Number-----	
1966	7,974	5,839	1,974	1,017	9,948	6,856
1967	1/ 7,230	1/ 4,439	1,646	1,268	8,876	5,707
1968	1/ 6,176	1/ 3,100	1,748	1,283	7,924	4,383
1969	2/ 5,928	2/ 2,535	1,457	677	7,385	3,212
1970	4,945	1,666	1,466	803	6,411	2,469
1971	3/ 4,200	3/ 1,900	1,235	534	5,435	2,434
1972 4/	3,738	2,384	1,153	328	4,891	2,712
1973	5/ 4,906	5/ 2,550	875	375	5,781	2,925
1974	6/ 4,563	6/ 1,782	822	481	5,385	2,263
1975	5,018	3,535	877	1,427	5,895	4,962

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

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

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

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

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

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

Table A-9 --Adult male seals counted, by class, [1/] rookery, and year, St. Paul Island, June 1966-75

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

1/ See footnote at end of table.

Table A-9 . --Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-75 --Continued

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

1/ See footnote at end of table.

Table A-9 .--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-75--Continued

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

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

Table A- 10 .--Dead seal pups counted, by rookery section, Pribilof Islands, Alaska, 20 August to 2 September 1975.

Island and Rookery	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
St. Paul Island															
Morjovi [1/]	585	213	212	327	224	204	-	-	-	-	-	-	-	-	1,765
Vostochni [2/]	145	99	153	117	114	973	386	311	-	135	123	156	380	167	3,259
Little Polovina	111	141	-	-	-	-	-	-	-	-	-	-	-	-	252
Polovina Cliffs	189	171	176	184	260	191	358	-	-	-	-	-	-	-	1,529
Polovina	267	152	-	-	-	-	-	-	-	-	-	-	-	-	419
Ardiguen [3/]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142
Gorbatch	256	297	195	62	97	118	-	-	-	-	-	-	-	-	1,025
Reef	129	226	198	151	208	214	202	174	161	115	59	-	-	-	1,837
Kitovi [4/]	212	43	215	176	141	-	-	-	-	-	-	-	-	-	787
Lukanin	229	276	-	-	-	-	-	-	-	-	-	-	-	-	505
Tolstoi	143	200	274	182	434	822	974	1112	-	-	-	-	-	-	4,141
Little Zapadni	67	180	286	276	203	192	-	-	-	-	-	-	-	-	1,204
Zapadni Reef	142	366	-	-	-	-	-	-	-	-	-	-	-	-	508
Zapadni	140	411	581	1148	415	201	248	108	-	-	-	-	-	-	3,252
TOTAL															20,625
St. George Island															
North	165	280	261	225	65	234	-	-	-	-	-	-	-	-	1,230
Zapadni [5/]	-	354	116	-	-	-	-	-	-	-	-	-	-	-	470
South	126	149	69	-	-	-	-	-	-	-	-	-	-	-	344
East Reef [3/]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102
East Cliffs	235	199	-	-	-	-	-	-	-	-	-	-	-	-	434
Staraya Artil	649	60	-	-	-	-	-	-	-	-	-	-	-	-	709
TOTAL															3,289
GRAND TOTAL															23,914

1/ Includes 103 dead pups counted on point south of Sea Lion Neck.
2/ Count of dead pups in section 10 includes dead pups counted in section 9.
3/ No numbered sections.
4/ Includes 49 dead pups counted in Kitovi Amphitheater.
5/ Count of dead pups in section 2 includes dead pups counted in section 1.

Table A-11.--Dead seal pups counted, [1/] by rookery, Pribilof Islands, Alaska, 1966-75

Island and rookery	1966	1967	1968	1969	1970	1971	1972	1973 [2/]	1974 [2/]	1975
	Number									
St. Paul Island										
Morjovi	1,686	1,072	2,285	734	1,618	4,773	2,187	-	-	1,765
Vostochni	2,785	1,969	4,195	1,711	3,330	8,280	4,701	-	-	3,259
Little Polovina	449	233	509	200	337	1,207	372	-	-	252
Polovina Cliffs	809	825	1,616	836	1,636	5,445	1,566	-	-	1,529
Polovina	312	319	487	327	475	980	345	-	-	419
Ardiguen	160	90	118	112	75	373	161	-	111	142
Gorbatch	1,593	874	1,446	823	974	2,405	1,332	-	1,188	1,025
Reef	3,562	2,008	3,064	1,365	2,221	4,103	1,686	-	1,580	1,837
Kitovi	406	522	755	652	679	1,854	559	-	-	787
Lukanin	432	240	597	460	401	1,224	494	-	-	505
Tolstoi	3,425	2,251	3,315	2,778	3,580	5,147	3,540	3,613	-	4,141
Little Zapadni	1,634	1,098	1,781	798	1,386	3,223	1,686	1,783	-	1,204
Zapadni Reef	451	380	685	177	308	673	505	661	-	508
Zapadni	3,710	2,195	4,445	2,306	3,561	6,752	3,515	3,851	-	3,252
Counted total	21,414	14,076	25,298	13,279	20,581	46,439	22,649	9,908	2,879	20,625
Estimated oversight 5%	1,071	704	1,265	664	1,029	2,322	1,132	495	144	1,031
Total	22,485	14,780	26,563	13,943	21,610	48,761	23,781	10,403	3,023	21,656
St. George Island										
North	1,561	971	1,567	444	866	1,862	1,032	1,153	545	1,230
Zapadni	1,196	578	1,197	260	636	1,058	464	450	474	814
East	764	201	824	187	522	638	372	506	334	536
Staraya Artil	1,152	770	1,055	640	1,243	1,662	616	552	3/	709
Counted total	4,673	2,520	4,643	1,531	3,267	5,220	2,484	2,661	1,353	3,289
Estimated oversight 5%	234	126	232	76	163	261	124	133	68	165
Total	4,907	2,646	4,875	1,607	3,430	5,481	2,608	2,794	1,421	3,454
Pribilof Islands counted total	[4/] 26,087	16,596	29,941	14,810	23,848	51,659	25,133	12,569	4,232	23,914
Estimated oversight 5%	1,305	830	1,497	740	1,192	2,583	1,256	628	212	1,196
Total	27,392	17,426	31,438	15,550	25,040	54,242	26,389	13,197	4,444	25,110

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.

4/ Not included in the total are 2,228 dead pups counted on Sea Lion Rock (Sivutch).

Table A-12 .--Seals marked as pups and recovered at ages 2-5 years, St. Paul Island, 30 June to 2 August 1975.

Hind Flipper Mark[1/]	Age Years	Total Number	Island of Marking
LH2	2	20	St. George
RH2	2	66	St. Paul
LH1	3	77	St. George
RH1	3	870	St. Paul
LH3	4	548	St. Paul
RH3	4	44	St. George
LH2	5	64	St. Paul
RH2	5	13	St. George

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

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

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

Table A-13. --Soviet tags recovered in the United States harvest of male fur seals, St. Paul Island, 30 June to 2 August 1975

Date	Tag number	Age	Sex	Island of tagging	Rookery of recovery
		Years			
21 July	HB-2117	3	M	Bering	Northeast Point
25 July	HM-38, HM-39	3	M	Medny	Reef
11 July	HM-112, HM-115	3	M	Medny	Reef
26 July	EB-4854	4	M	Bering	Lukanin-Kitovi
30 June	EM-2419, EM-2420	4	M	Medny	Northeast Point
1 Aug.	EM-4229, EM-4230	4	M	Medny	Reef
10 July	EM-4671, EM-4672	4	M	Medny	Zapadni
19 July	EM-6167	4	M	Medny	Lukanin-Kitovi
14 July	EM-7335	4	M	Medny	Northeast Point
26 July	EM-7952	4	M	Medny	Lukanin-Kitovi
28 July	EM-9281	4	M	Medny	Northeast Point
2 July	CB-3543	5	M	Bering	Tolstoi-Zapadni Reef
16 July	CB-4994	5	M	Bering	Tolstoi-Zapadni Reef
14 July	CM-2549, CM-2550	5	M	Medny	Northeast Point
28 July	CM-6862	5	M	Medny	Northeast Point
30 June	CM-6980	5	M	Medny	Northeast Point
1 July	CM-7119	5	M	Medny	Polovina
28 July	CM-9534	5	M	Medny	Northeast Point

Table A-14. --Seal pups tagged and marked, Pribilof Islands, Alaska, 1966-75

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

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

Table A-15. --Record of tags applied[1/] to male seals selected as yearlings and as 2-year-olds on the basis of body length or size, St. Paul Island, 1961-63 and 1965-71

Age category and year	Tag series	Tag number	Effective tags[2/]
			Number
Yearlings[3/]			
1961	M	1-2000	754
1962	N	50001-51000	929
1963	O	50001-51000	799
1965	1R	1-1000	991
1966	1S	20001-21500	1,495
1967	1T	1-1500	835
1968	1U	20001-21500	714
Age 2			
1966	2S	30001-31500	1,483
1967	2T	1-1500	1,220
1968	2U	30001-31500	1,495
Ages 1-2			
1969	1V	1-3431	3,419
1970	1W	1-4000	3,779
1971	1Y	1-4000	3,992

1/ Each seal was double tagged; one tag was attached at the hairline of each front flipper. Before 1971, seals with tags that had been attached at ages 3-4 months or at ages 1-2 years were given an additional tag.

2/ Total number of seals tagged within the series.

3/ Male and female seals were intentionally tagged in 1961, 1962, 1963, and 1965. From 1966 to 1971, only male seals were selected for tagging.

Table A-16. --Primary diagnoses for causes of death among 244 seal pups, by 7-day periods, St. Paul Island, 3 July to 15 August 1975

Cause of death	3 July	4 July	5-11 July	12-18 July	19-25 July	26 July to 1 Aug.	2-8 Aug.	9-15 Aug.	Total
	Number								
Emaciation syndrome	0	0	4	3	11	11	14	10	53
Hookworm disease	0	0	2	9	25	48	13	9	106
Infection (microbial)	0	0	0	0	5	1	3	5	14
Multiple hemorrhage-perinatal complex (leptospirosis)	1	1	6	5	3	1	0	0	17
Trauma	0	1	3	1	2	0	0	0	7
Miscellaneous	0	0	3	0	2	2	2	1	10
Undetermined	0	0	1	3	0	3	0	0	7
Total	1	2	19	21	48	66	31	26	214
Unsuitable for examination	12	0	0	5	2	9	1	1	30
Total	13	2	19	26	50	75	32	27	244

Table A-17.--Seal pups marked by freeze marking, St. Paul Island, 1966-75

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

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

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

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

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

Table A-18. --Tags applied to fur seals for studies of behavior, St. George Island, Alaska, 1975.

Monel Tags	Tag Number	Age/Sex Class	Rookery
White, X-series	76-78	Adult males	East
	79-95	Adult males	Zapadni
	401-464[1/]	Subadult males	Zapadni
	618-650	Adult females	East
Blue, X-series	623-650	Adult females	North
Silver, XA-series	626-654	Adult females	Zapadni

1/ Double-tagged; all others single tagged, usually on right front flipper.

Table A-19. --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, 1968-75.

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

1/ Tag number N-19851 recorded as N-15851 in 1970.
2/ Tag number J-4937 recorded as J-4939 in 1969.
3/ Tag number O-26056 also recorded on Castle Rock, 8 September 1972.
4/ A double tagged Female. TINRO was read but the numbers could not be seen with the scope.

Table A-20. --Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-75.

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
UC-3926	L	15 Aug.	31 July	9 July	18 Aug.	3 Aug.	---	---
-3927	R	31 July	23 July	9 July	26 July	21 July	---	---
UC-3932	R	16 Aug.	29 July	2 July	---	---	27 July	8 Aug.
-3933	L	17 Aug.	12 Aug.	2 July	13 July	---	---	---
UC-3936	L	---	---	10 Aug.	---	---	28 July	---
-3937	R	---	---	24 July	31 July	22 July	19 Aug.	---
UC-3938	L	16 Aug.	10 Aug.	8 June	26 Aug.	---	---	---
-3939	R	31 July	17 Aug.	2 July	29 June	---	---	---
UC-3940	L	31 July	29 July	---	---	---	---	---
-3941	R	31 July	14 Aug.	---	---	---	---	---
UC-3942	R	31 July	17 July	22 July	1 Sept.	---	---	20 Aug.
-3943	L	31 July	20 July	22 July	14 July	---	---	---
UC-3944	R	15 Aug.	17 July	2 July	---	18 July	---	31 Aug.
-3945	L	14 Aug.	20 July	14 June	27 June	---	15 July	9 July
UC-3951	L	---	21 July	22 July	12 July	---	---	---
Missing	R							
UC-3955	R	25 July	31 July	2 July	15 July	---	---	---
-3956	L	---	4 Aug.	2 July	---	---	---	---
UC-3957[1/]	R	7 Aug.	---	---	---	---	---	---
UC-3959	R	25 July	---	---	---	---	---	---
UC-3961	R	12 Sept.	---	---	---	---	---	---
UC-3964	L	15 Aug.	2 Aug.	21 July	12 July	1 Aug.	---	---
-3965	R	12 Aug.	24 Aug.	26 July	10 Aug.	---	---	---
UC-3968	R	---	18 July	6 July	---	---	---	---
-3971	L	---	21 July	7 July	---	---	---	---
UC-3972	L	1 Oct.	16 Aug.	22 July	---	---	---	---
-3973	R	31 July	1 Sept.	30 July	5 Aug.	---	---	---
UC-3974	L	---	---	---	---	---	15 July	8 Aug.
-3975	R	---	---	---	---	5 Aug.	---	---

Table A-20.--Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-75 -- 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
UC-3976	R	2 Sept.	---	---	---	---	---	11 Aug.
-3977	L	31 July	---	---	---	---	---	---
UC-3978	L	---	22 July	---	---	---	---	---
UC-3981	R	1 Aug.	9 July	5 July	11 July	---	---	---
-3982	L	31 July	31 July	7 July	27 July	4 Aug.	---	---
UC-3980	R	---	31 July	10 July	30 Aug.	---	15 July	---
-3984	L	---	20 Aug.	9 July	---	---	---	---
UC-3985	L	31 July	---	23 July	---	---	---	---
-3986	R	17 Aug.	---	17 July	---	---	---	---
UC-3987	L	---	---	6 July	14 July	2 Aug.	---	---
-3988	R	---	10 Aug.	10 July	---	---	---	---
UC-3989	L	16 Aug.	9 July	5 July	27 July	11 June	10 Aug.	7 Aug.
-3990	R	10 Aug.	8 July	9 July	27 June	11 July	7 Sept.	---
UC-3991	R	7 Aug.	20 July	28 July	---	---	---	---
-3992	L	---	20 July	27 July	12 July	4 Aug.	---	28 July
UC-3993	R	16 Aug.	11 Sept.	4 July	---	---	---	21 Aug.
-3994	L	---	17 Aug.	4 July	---	---	27 July	17 July
UC-3995	L	---	16 Aug.	---	11 Aug.	---	11 Aug.	17 July
-3996	R	---	21 July	---	13 Aug.	---	28 July	---
UC-3997	L	---	---	24 July	---	---	---	26 July
-3998	R	---	---	21 July	---	4 July	---	10 July
UC-3999	R	---	---	15 Aug.	---	---	13 Aug.	---
-4000	L	---	---	3 Aug.	---	---	17 Aug.	---
UC-3793	R	---	21 July	24 July	23 July	31 July	---	---
UC-3789	R	---	---	13 July	11 July	---	---	---

1/ Left flipper injured, not tagged.

Table A-21.—Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, 7&8 October 1975.

Tag number	Flipper tagged	Sex	Weight	Checkmark	Remarks
SMI 01	left	♀	13.0	(RH-D5)	
02	left	♀	12.0	"	
03	left	♀	13.5	"	
04	left	♀	9.5	"	
05	left	♀	10.0	"	
06	right	♂	14.5	"	
07	left	♀	10.0	"	
08	right	♂	13.0	"	
09	right	♂	13.0	"	
10	right	♂	16.0	"	
11	right	♂	14.0	"	
12	left	♀	10.0	"	in complete molt
13	right	♂	13.0	"	
14	right	♂	14.0	"	
15	right	♂	11.5	"	
16	left	♀	10.0	"	
17	right	♂	11.0	"	
18	left	♀	10.5	"	
19	right	♂	14.5	"	
20	right	♂	11.5	"	
21	right	♂	12.0	"	
22	right	♂	15.0	"	
23	left	♀	13.5	"	
24	right	♂	13.0	"	
25	right	♂	12.0	"	Tip D-5 on both flippers removed
26	right	♂	16.0	"	
27	left	♀	15.0	"	
28	right	♂	10.5	"	
29	left	♀	13.5	"	
30	left	♀	13.5	"	
31	right	♂	14.0	"	
32	right	♂	13.0	"	
33	right	♂	14.0	"	

Table A-21.-Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, 7&8 October 1975, continued.

Tag number	Flipper tagged	Sex	Weight	Checkmark	Remarks
SMI 34	left	♀	12.5	(RH-D5)	
35	left	♀	11.5	"	
36	right	♂	12.5	"	Molt incomplete
37	left	♀	7.0	"	Rub area on dorsal muzzle
38	left	♀	9.5	"	Molt incomplete
39	TAG DESTROYED				
40	right	♂	14.5	(RH-D5)	
41	left	♀	10.0	"	
42	right	♂	17.0	"	
43	left	♀	9.0	"	
44	left	♀	10.0	"	
45	right	♂	13.5	"	
46	right	♂	16.0	"	
47	right	♂	14.5	"	
48	left	♀	11.5	"	
49	left	♀	9.0	"	
50	left	♀	10.0	"	
51	unknown	?	15.5	"	
52	left	♀	12.5	"	
53	TAG DESTROYED				
54	left	♀	13.0	(RH-D5)	
55	left	♀	10.0	"	
56	TAG DESTROYED				
57	right	♂	12.0	(RH-D5)	
58	left	♀	8.5	"	
59	left	♀	11.5	"	
60	left	♀	11.5	"	
61	left	♀	10.0	"	
62	left	♀	11.0	"	
63	right	♂	16.0	"	
64	right	♂	13.5	"	
65	right	♂	17.0	"	
66	right	♂	16.0	"	
67	left	♀	9.5	"	
68	left	♀	13.5	"	
69	right	♂	13.0	"	

Table A-21.-Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, 7&8 October 1975, continued.

Tag number	Flipper tagged	Sex	Weight	Checkmark	Remarks
SMI 70	left	♀	14.5	(RH-D5)	
71	left	♀	13.0	"	
72	left	♀	12.5	"	
73	right	♂	11.5	"	
74	right	♂	15.5	"	
75	left	♀	11.0	"	
76	left	♀	13.5	"	
77	left	♀	11.5	"	
78	left	♀	13.5	"	
79	right	♂	18.0	"	
80	left	♀	13.5	"	
81	right	♂	15.0	"	
82	left	♀	10.5	"	
83	left	♀	9.5	"	
84	right	♂	15.0	"	
85	right	♂	10.0	"	
86	right	♂	10.5	"	
87	left	♀	10.5	"	
88	left	♀	12.5	"	
89	right	♂	12.0	"	
90	right	♂	15.5	"	
91	left	♀	15.5	"	
92	right	♂	15.5	"	
93	left	♀	15.5	"	
94	left	♀	17.0	"	
95	right	♂	10.5	"	
96	left	♀	11.5	"	
97	right	♂	15.0	"	
98	right	♂	10.0	"	
99	left	♀	12.0	"	
100	left	♀	13.0	"	
303	left	♀	13.5	"	
304	right	♂	14.0	"	
305	right	♂	17.0	"	

Table A-22.--Northern fur seal adult females tagged in Adams Cove, San Miguel Island, 9 October 1975.

Tag number	Flipper tagged	Color	Remarks
SMI 201	Right	White	Mangy, serum collected
202	Left		
203	Right	White	
204	Left		
205	Right	White	
206	Left		
207	Right	White	
208	Left		
209	Right	White	
210	Left		
211	Right	White	
212	Left		
213	Right	White	Small animal
214	Left		
215	Right	White	
216	Left		
217	Right	White	
218	Left		
219	Right	White	
220	Left		
221	Right	Mixed	
222	Left		

Table A-22.-Northern fur seal adult females tagged in Adams Cove, San Miguel Island, 9 October 1975, continued.

Tag number	Flipper tagged	Color	Remarks
SMI 223	Right	White	
224	Left		
225	Tag lost in sand of Arroyo west of Mallo Roses, Adams Cove.		
226	Right	Mixed	
227	Left		
228	Left	White	
229	Right		
230	Right	Black	
231	Left		
232	Right	White	
233	Left		
234	Left	White	
235	Right		
236	Right	Mixed	
237	Left		
238	Left	White	
239	Right		
240	Right	Black	
241	Left		
242	Right	Mixed	
243	Left		
244	Right	White	
245	Left		
246	Right	White	LFS, check mark from Pribilofs
247	Left		

Table A-22.-Northern fur seal adult females tagged in Adams Cove, San Miguel Island, 9 October 1975, continued.

Tag number	Flipper tagged	Color	Remarks
SMI 248	Left	White	Mange patches
249	Right		
250	Right	Mixed	
251	Left		
252	Right	Black	
253	Left		
254	No record of these tags being lost - probably placed on animal		
255			
256	Right	White	
257	Left		
258	Left	White	
259	Right		
260	Right	White	
261	Left		
262	Left	Mixed	
263	Right		
264	Left	White	
265	Right		
266	Left	Mixed	
267	Right		
268	Left	Mixed	
269	Right		
270	Right	Mixed	
271	Left		
272	Left	Mixed	
273	Right		

Table A-22.-Northern fur seal adult females tagged in Adams Cove, San Miguel Island, 9 October 1975, continued.

Tag number	Flipper tagged	Color	Remarks
SMI 274	Left	Unknown	
275	Right		
276	Right	Unknown	
278	Left		
277	Tag destroyed		
279	Right	White	
280	Left		
281	Left	White	Mange sampled, blood and flipper scrapings
282	Right		
283	Right	White	
284	Left		
285	Right	White	
286	Left		
287	Left	White	
288	Right		
289	Right	White	Small animal
290	Left		
291	Left	White	
292	Right		
293	Left	Black	
294	Right		
295	Left	Black	Gape broken-looks like 1973 pup w/congenital buccal defect
296	Right		
297	Right	White	
298	Left		

Table A-22. - Northern fur seal adult females tagged in Adams Cove, San Miguel Island, 9 October 1975, continued.

Tag number	Flipper tagged	Color	Remarks
SMI 299	Right	Mixed	
300	Left		
301	Right	White	Mange scrapings taken
302	Left		

Appendix B

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1975

Name	Affiliation[1/]	Work
Permanent employees		
George Y. Harry, Jr.	MMD	Division Director
W. Bruce McAlister	--do.--	Deputy Division Director
Alton Y. Roppel	--do.--	Seal research, mgmt. and monitoring
Patrick Kozloff	--do.--	--do.--
Roger L. Gentry	--do.--	Seal research, behavior
James H. Johnson	--do.--	--do.--
Clifford H. Fiscus	--do.--	--do.--
Robert L. DeLong	--do.--	--do.--
Robert H. Lander	--do.--	Seal research, population dynamics
Hiroshi Kajimura	--do.--	Seal research, pelagic
Gerald A. Sanger	--do.--	--do.--
Richart L. Fousi	--do.--	--do.--
Mark C. Keyes	--do.--	Seal research, physiology and medicine
Temporary employees		
Marcus K. Lester	MMD	Seal research, mgmt. and monitoring; behavior
John M. Francis	--do.--	Seal research, behavior
Suzanne K. Macy	--do.--	--do.--
Mark E. Towner	--do.--	--do.--
Edward C. Jameyson	--do.--	--do.--
George A. Antonelis, Jr.	--do.--	--do.--
Nancy C. Severinghaus	--do.--	--do.--
David W. Christel	--do.--	Seal research, behavior and pelagic
Marsha L. Caunt	--do.--	Seal research, pelagic
Andrew F. Anschell	--do.--	--do.--
Robert D. Everitt	--do.--	--do.--
Bruce M. Puckett	--do.--	--do.--
Gary S. Werner	--do.--	--do.--

1/ See footnote at end of table.

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1975 -- continued

Name	Affiliation[1/]	Work
Temporary employees		
Renee M. Engel	MMD	Seal research, population dynamics
Toby G. Larson	--do.--	--do.--
Michael K. Menth	--do.--	Seal research, physiology and medicine
George McGlashan	St. George Island resident	Seal research, behavior
Victor F. Malavansky	--do.--	--do.--
Dimitri A. Lestenkof	--do.--	--do.--
Alvin Merculief	--do.--	--do.--
Lida M. Merculief	--do.--	--do.--
Perfenia Pletnikoff, Jr.	St. Paul Island resident	Seal research, mgmt. and monitoring
M. Richard Zacharof	--do.--	--do.--
M. Robert Kochergin	--do.--	--do.--
Lavrenty Stepetin	--do.--	--do.--
Cooperators		
Robert Bartsch	Washington State University	Seal research, physiology and medicine
Gerald Long	--do.--	--do.--
Thomas G. Akers	NBRL	--do.--
Alvin W. Smith	--do.--	--do.--
Richard J. Brown	--do.--	--do.--
Neylan Vedros	--do.--	--do.--
Henry Bray	--do.--	--do.--
Douglas Skilling	--do.--	--do.--
Ke Chung Kim	Penn. State University	Seal research, entomology
Robert Anthony	--do.--	--do.--
Gerald L. Kooyman	Scripps Institution of Oceanography	Seal research, behavior
David Urquhart	--do--	--do.--

1/ See footnote at end of table.

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1975 -- continued

Name	Affiliation[1/]	Work
Visiting Scientist		
Robert V. Miller	MMRC, Washington D.C.	

1/ MMD = Marine Mammal Division
NBRL = Naval Biomedical Research Laboratory
MMRC = Marine Mammal Research Coordinator