UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL MARINE FISHERIES SERVICE

NORTHWEST FISHERIES CENTER

FUR SEAL INVESTIGATIONS, 1974

by

Marine Mammal Division

National Marine Fisheries Service

February 1975

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FUR SEAL INVESTIGATIONS, 1974

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 1974, research was carried out on several aspects of the fur seal resource including Monitoring and Management, Population Dynamics, Physiology and Medicine, Behavior, and Pelagic Life in the Bering Sea.

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 AND MANAGEMENT, PRIBILOF ISLANDS

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

Age Classification and Number of Seals Killed, by Sex

A maximum body length limit of 46 inches (116.8 cm) from tip of nose to tip of tail prescribed for harvesting male seals in 1973 was imposed again in 1974. Female seals were not intentionally taken in 1974.

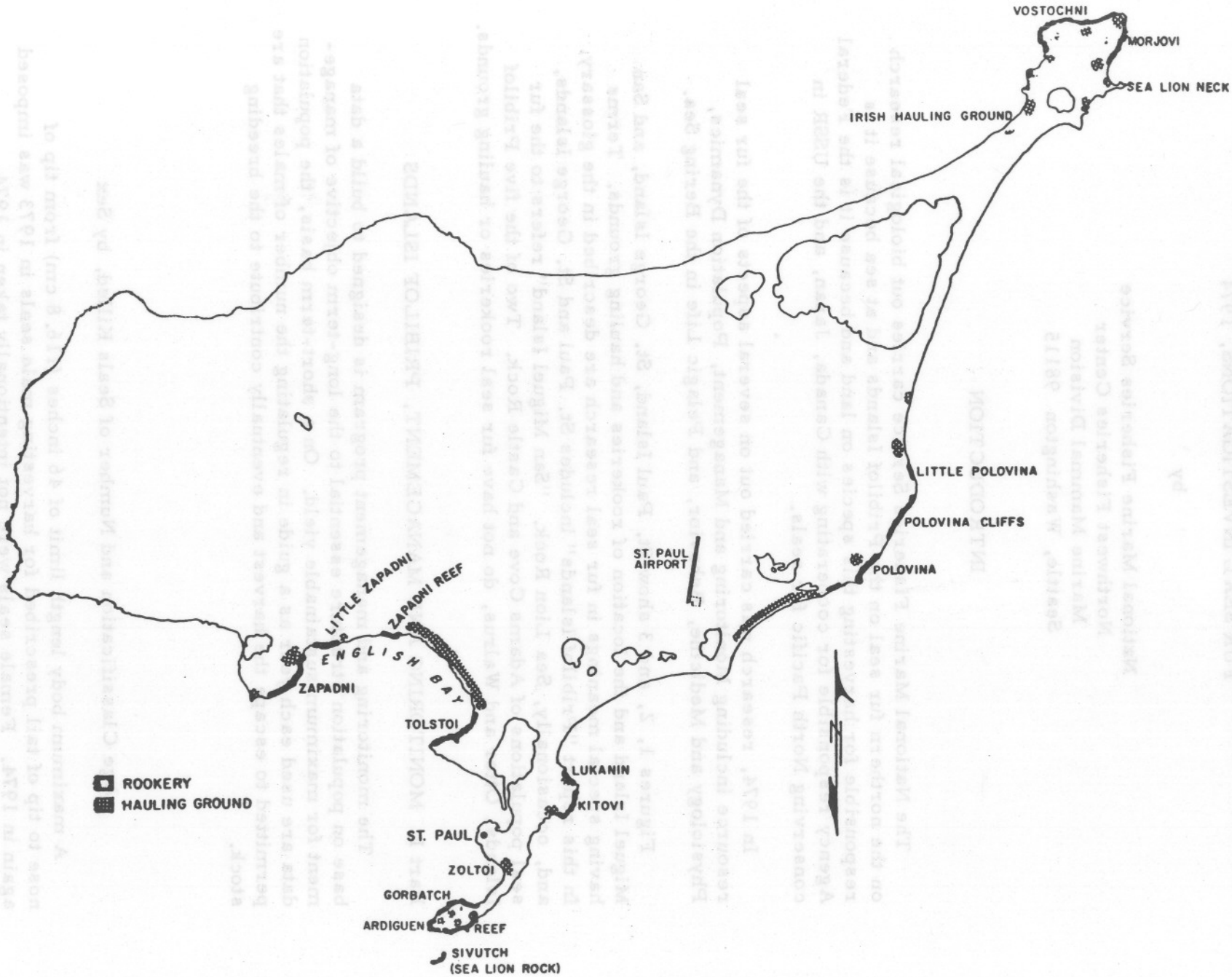

Figure 1.--Location of rookeries and hauling grounds, St. Paul Island.

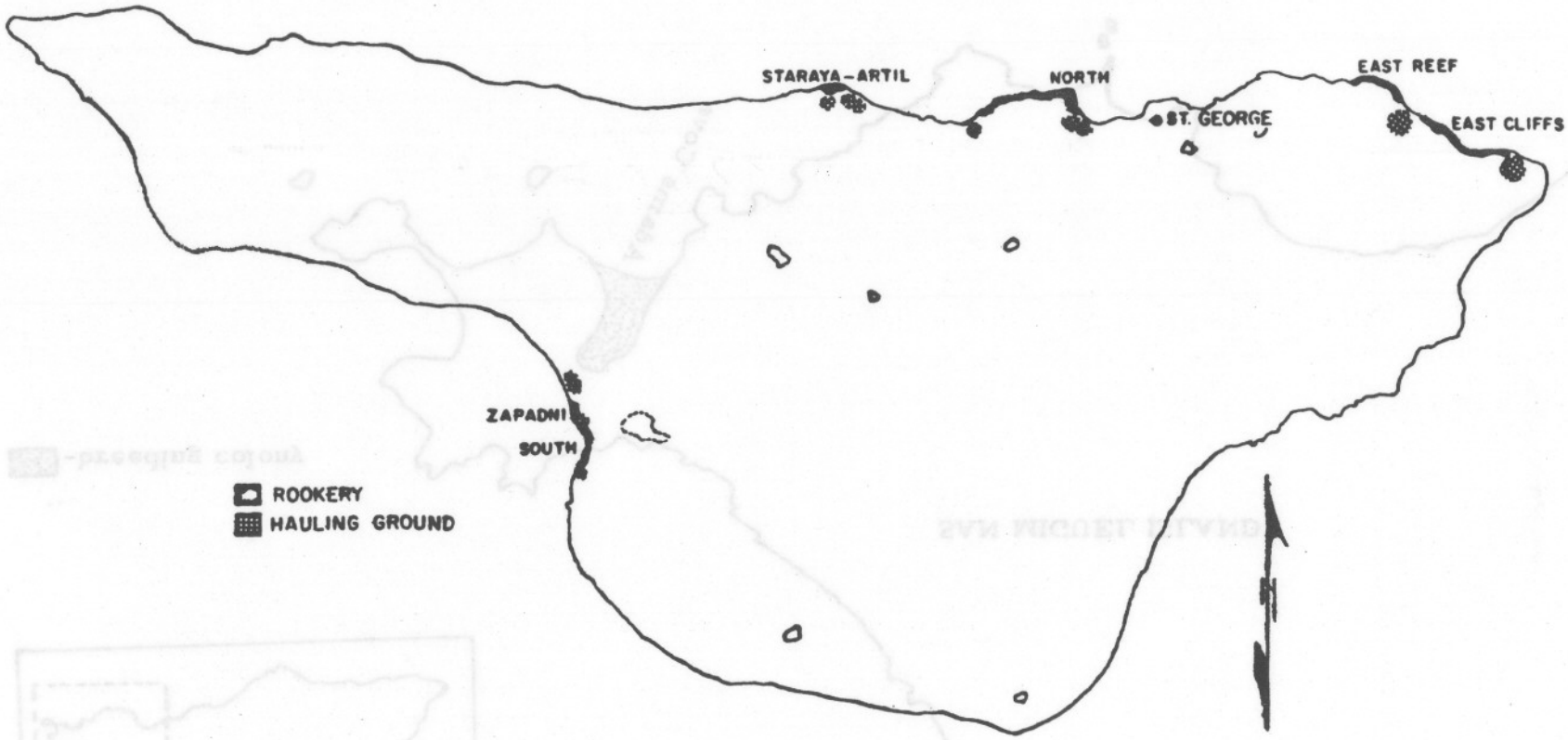

Figure 2.--Location of rookeries and hauling grounds, St. George Island.

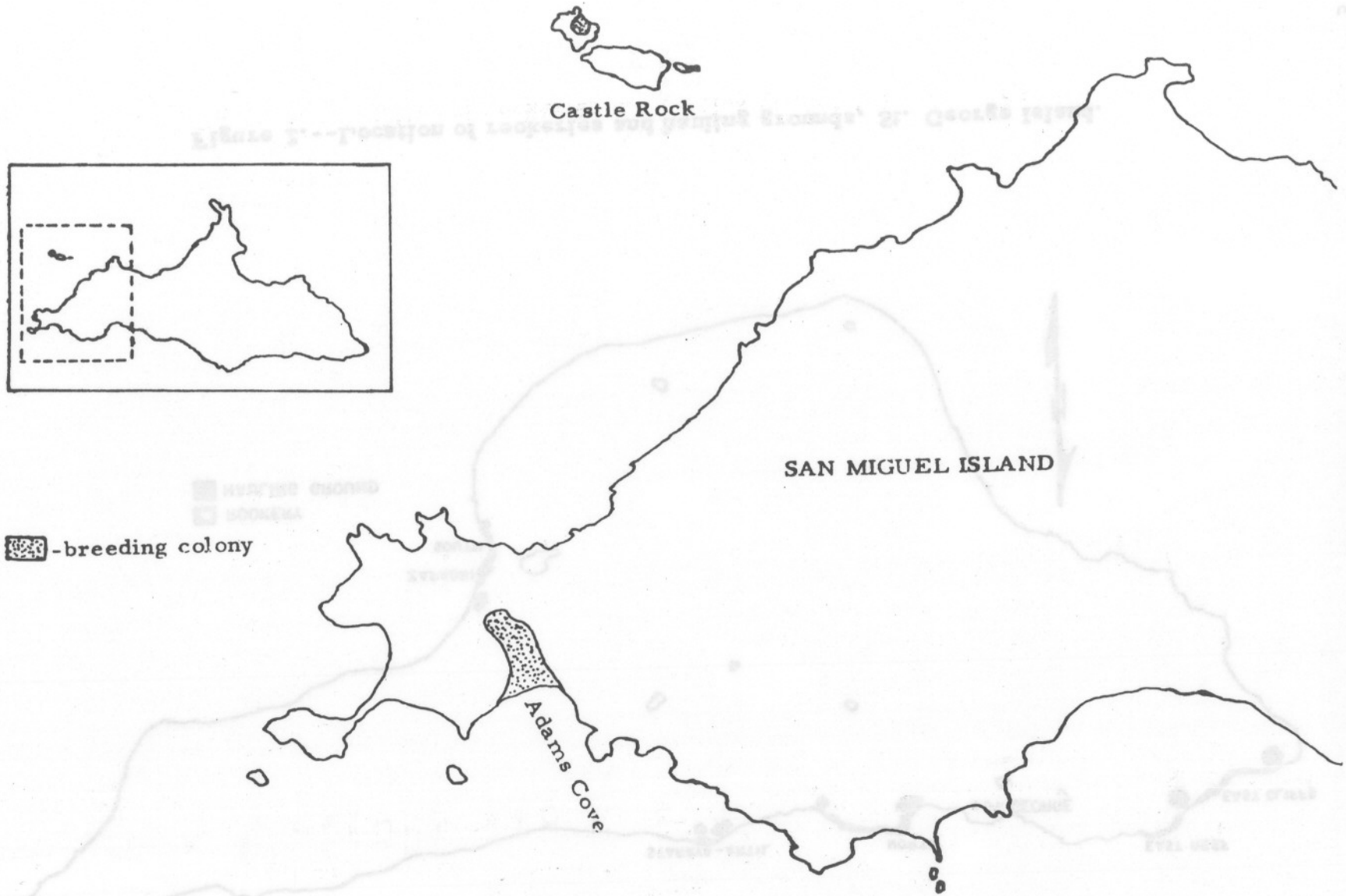

Figure 3. Location of northern fur seal breeding colonies, San Miguel Island, California

Seals were harvested on St. Paul Island from 24 June through 27 July in 1974 exclusive of Sundays and 4 July. Each rookery-hauling ground complex was visited five times at 7-day intervals during the season for the purpose of harvesting seals. Each daily harvest was begun about 6:00 a. m.

A total of 32, 976 male seals of ages 2 through 6 years was taken (Tables A-1 and A-2). Right maxillary canine teeth were collected from 20 percent of the harvested animals and used as a basis for calculating the number of seals taken by age. Fifty-one females harvested unintentionally were not classified by age.

The trend in the availability of 3- and 4-year-old males harvested on St. Paul Island in 1974 is shown in Figure 4, and the number of males killed there from year classes 1960 through 1972 is given in Figure 5 and Table 1.

Survey Data

The response of the fur seal herd to management practices was monitored in 1974 through counts of living adult males and of dead seals of both sexes and all ages, and estimates of the number of pups born.

Living Adult Male Seals Counted

The living adult males were counted on all rookeries of St. Paul and St. George Island in June, on selected rookeries of St. Paul Island in July, and on all rookeries of St. George Island in July (Tables A-3 to A-10).

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. The relative locations of the five classes of adult males on the rookery are shown in Figure 6.

Characteristics and locations of the five classes of adult males are:

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

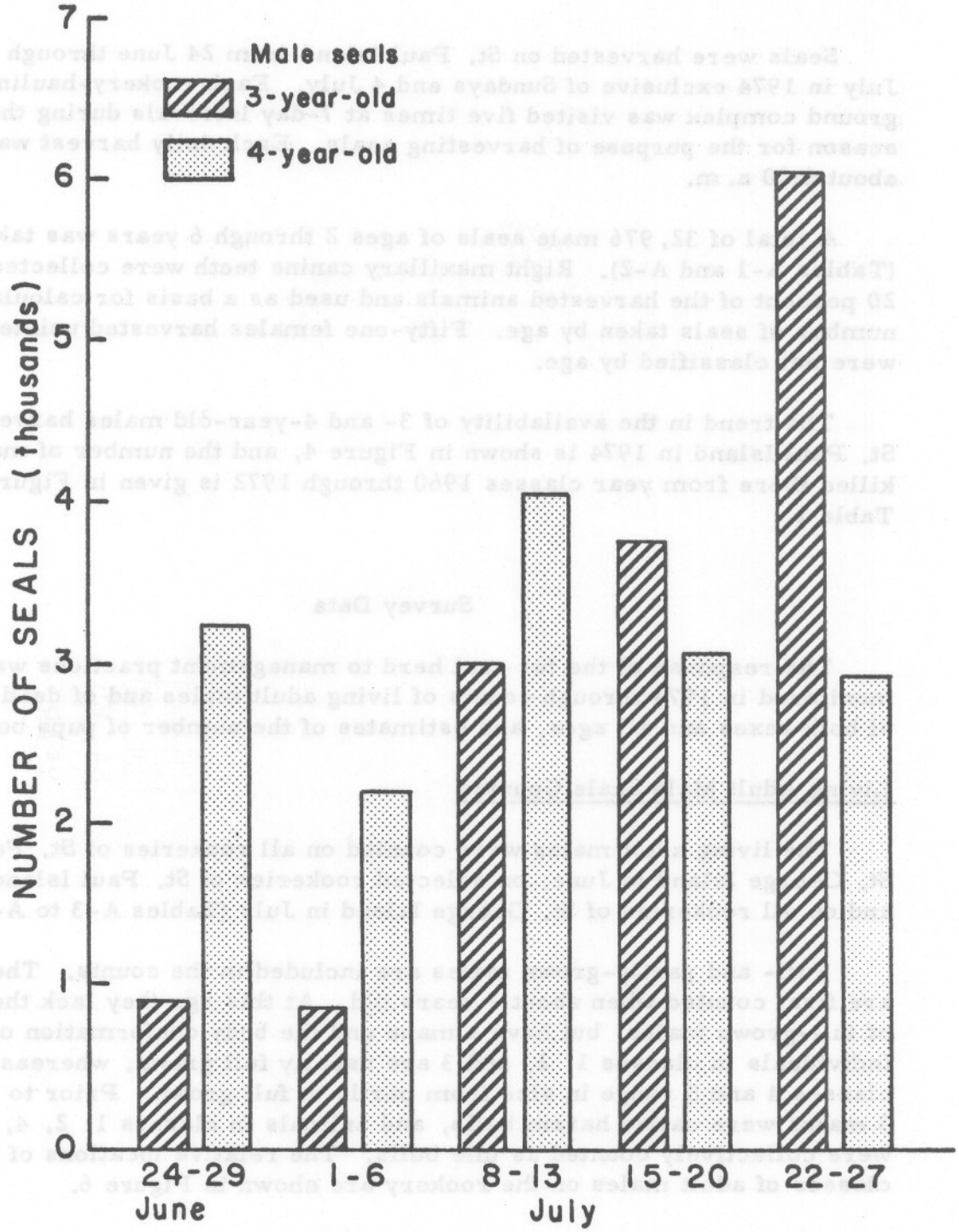

Figure 4.--Three- and four-year-old male seals killed, St. Paul Island, 24 June to 27 July 1974 (See Table A-1 for basic data).

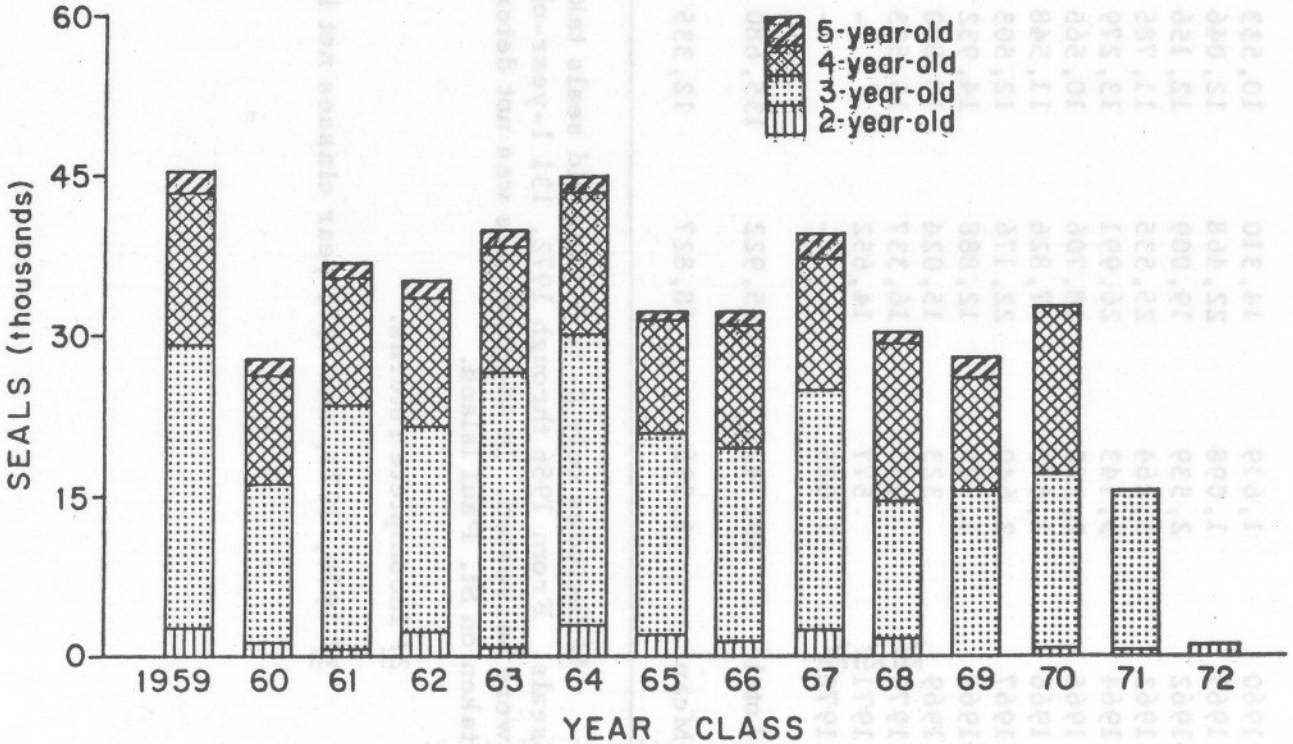

Figure 5.--Kill of male seals, by year class, Pribilof Islands, Alaska, 1959-72.

Table 1.--Kill of male seals,[1/] by year class, St. Paul Island, 1960-72

Year class	Age when killed 2	3	4	5	Total
1960	1,619	14,310	10,533	1,240	27,702
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[2/]	916	16,337	15,533	-	32,786
1971[2/]	577	14,652	-	-	15,229
1972[2/]	1,025	-	-	-	1,025
Total	20,742	225,922	135,680	13,414	395,758
Mean	1,596	18,827	12,335	1,341	[3/]34,672

1/ Includes only 2- to 5-year-old seals taken during the kill of male seals. From 1956 through 1972, 131 1-year-olds and 1,102 6-year-olds were harvested. In addition, age was not determined for 4,919 males taken on St. Paul Island.

2/ Incomplete returns.

3/ 1970, 1971, and 1972 year classes not included.

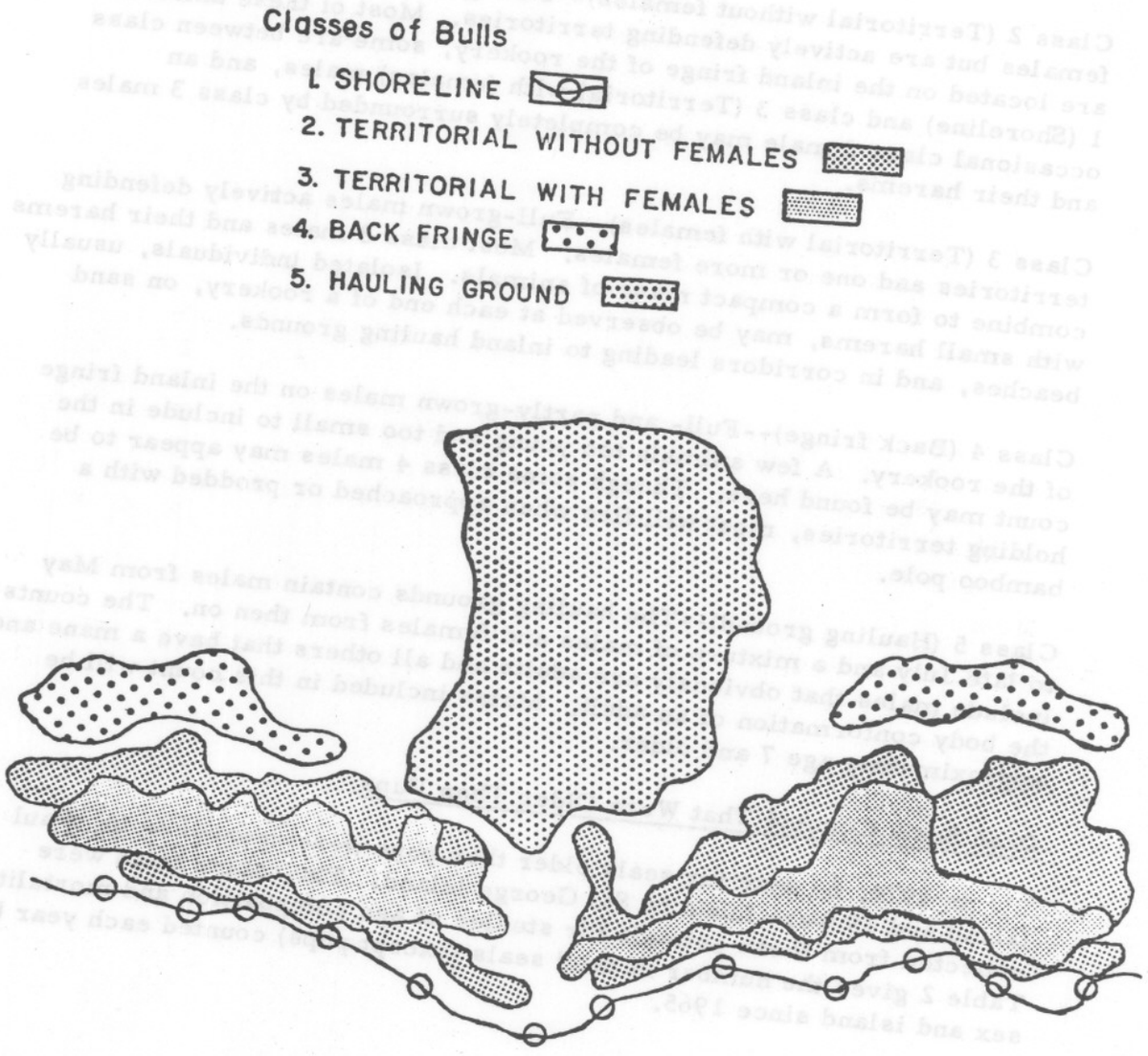

Figure 6.--General composition of a typical fur seal rookery.

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 bamboo 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.

Dead Seals Counted That Were Older Than Pups

In 1974, 63 dead fur seals older than pups were counted on St. Paul Island and 19 were found on St. George Island. The canine teeth were collected from these animals for studies of age composition and mortality. Table 2 gives the number of dead seals (except pups) counted each year by sex and island since 1965.

Dead Pups Counted

Dead pups were counted in August and September 1974 on the Pribilof Islands (Table A-11). A count of 2,879 on St. Paul Island was obtained 23 August on Reef, Gorbatch, and Ardiguen, a group of rookeries representing 25% of the total number of pups born on St. Paul Island. On St. George Island, a count of 1,353 dead pups was obtained for all rookeries (North, East Reef, East Cliffs, Zapadni, and South) 8-13 September except Staraya Artil. The dead pups on this rookery were not counted in 1974 in order to keep it relatively free of disturbance. Table A-12 lists the number of dead pups counted on the Pribilof Islands from 1965 through 1974.

Table 2.--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1965-74

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

Marking

Marked seals that are recovered provide a basis for studying growth, survival, and distribution at sea. Marked seals recovered in 1974 are listed in Tables A-13 to A-15.

Application of Marks

Since 1941 fur seals of both sexes have been marked at various ages. Figure 7 illustrates different marks used and their locations on the flippers.

Pups.--From 26 August to 4 September, 20,000 seal pups were randomly selected without regard for sex and marked on St. Paul Island by removing about 3/4 inch (1.9 cm) of the cartilagenous tip of the third digit on the right hind flipper. Marking quotas for each rookery were based on the average distribution of class 3 males counted in mid-July of 1969 and 1970. Seal pups were not marked by this method on St. George Island in 1974. Table A-16 lists the number of pups given tags or other marks since 1965.

Male Seals Ages 1 and 2 years.--Male seals of ages 1 and 2 years were last marked in 1971. A record of these seals is shown in Table A-17.

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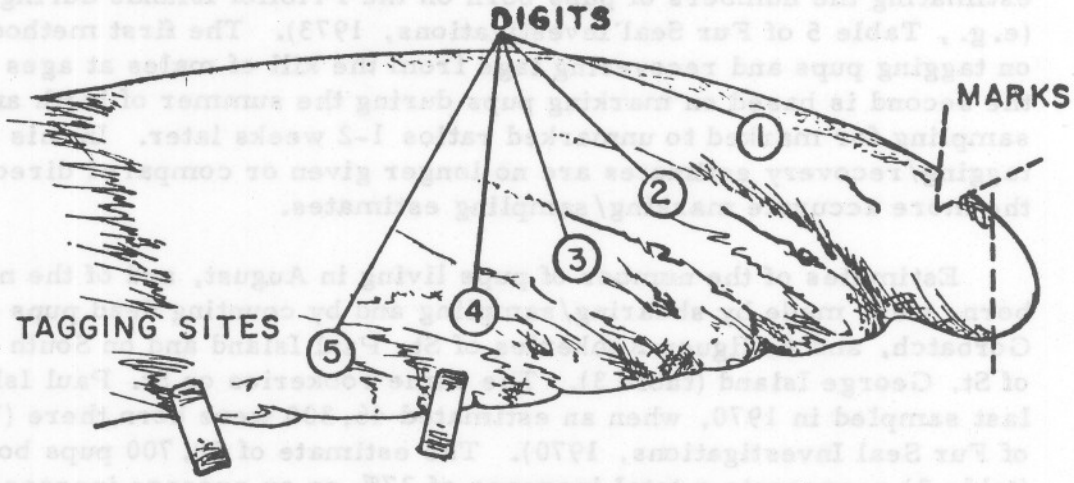
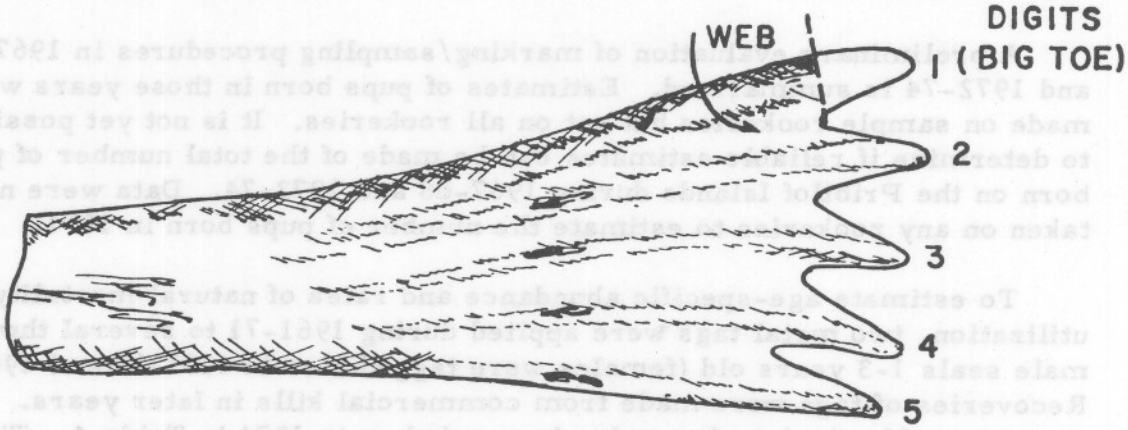


FRONT FLIPPER
TAGS CLINCHED AT THE HAIRLINE AND BETWEEN THE FOURTH AND THE FIFTH DIGIT.
MARKS MADE BY CUTTING A V-NOTCH AND REMOVING THE TIP.



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

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

Part II. POPULATION DYNAMICS

Recent annual reports compare the results between two methods of estimating the numbers of pups born on the Pribilof Islands during 1961-66 (e.g., Table 5 of Fur Seal Investigations, 1973). The first method is based on tagging pups and recovering tags from the kill of males at ages 2-5 years; the second is based on marking pups during the summer of birth and sampling for marked to unmarked ratios 1-2 weeks later. In this report, tagging/recovery estimates are no longer given or compared directly with the more accurate marking/sampling estimates.

Estimates of the number of pups living in August, and of the numbers born, were made by shearing/sampling and by counting dead pups on Reef, Gorbatch, and Ardiguen Rookeries of St. Paul Island and on South Rookery of St. George Island (table 3). The same rookeries on St. Paul Island were last sampled in 1970, when an estimated 46,300 were born there (Table 13 of Fur Seal Investigations, 1970). The estimate of 58,700 pups born in 1974 (table 3) represents a total increase of 27% or an average increase of about 6% a year. Sampling conditions are more difficult on South Rookery of St. George Island, which was last sampled in 1973. In that year, an estimated 11,200 pups were living at the time of the shearing (Table 6 of Fur Seal Investigations, 1973). The 1974 estimate of 8,900 (table 3) represents an apparent decrease of 26%.

A preliminary evaluation of marking/sampling procedures in 1967-68 and 1972-74 is summarized. Estimates of pups born in those years were made on sample rookeries but not on all rookeries. It is not yet possible to determine if reliable estimates can be made of the total number of pups born on the Pribilof Islands during 1967-68 and 1972-74. Data were not taken on any rookeries to estimate the number of pups born in 1971.

To estimate age-specific abundance and rates of natural mortality and utilization, two metal tags were applied during 1961-71 to several thousand male seals 1-3 years old (females were tagged also in 1961-63 and 1965). Recoveries of tags were made from commercial kills in later years. The summary of basic data for males is carried up to 1974 in Table 4. The analysis will be delayed until 1976, however, because the investigator who conducted the experiments will not have completed a manuscript on these topics until then.

A new method of estimating natural survival rates was developed in 1974. The method does not require recoveries of tags or marks from the kill. Basic data are the numbers of pups born and the composition of the kill by age and sex; therefore, it will be possible in the future to apply the

Table 3. Estimates of seal pups in 1974 year class at times of shearing and birth on sample rookeries, Pribilof Islands, Alaska; sampling periods 1 and 2 were on 14 and 19 August, respectively.

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	Estimated number alive[2/] 2	Estimated number alive[2/] Mean	Born[3/]
St. Paul Island												
Reef	4,803	237	165	819	615	5,925	4,125	1,580	34,747	32,215	33,481	35,061
Gorbatch	3,026	124	110	479	454	3,100	2,750	1,188	19,584	18,329	18,956	20,144
Ardiguen	770	25	26	153	141	625	650	111	3,145	3,550	3,348	3,459
Total	8,599	---	---	---	---	---	---	2,879	---	---	55,785[2/]	58,664
St. George Island												
South	2,200	84	79	554	470	2,100	1,975	112	8,339	9,245	8,792	8,904

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 estimate number born.

Table 4.--Summary of tag loss for male seals tagged at age 1 or older, Pribilof Islands, Alaska

Tag series	Time elapsed since tagging	Both tags recovered (n_2)	One tag lost (n_1)	Incidence of tag loss (p)[1/]
	Years	Number	Number	
1W	1	519	158	0.13
1W	2	630	254	0.17
1W	3	48	36	0.27
1W	4	3	2	0.25
Total		1,200	450	0.16
1Y	1	639	355	0.22
1Y	2	207	234	0.36
1Y	3	18	28	0.44
Total		864	617	0.26

1/ $p = \frac{n_1}{2n_2+n_1}$; where n_1 = number recovered with one tag loss; n_2 = number recovered with no tag loss.

method to data from the Commander Islands and Robben Island. This report summarizes the assumptions of the estimating procedure and the results of its application to males of the 1961-66 year classes from the Pribilof Islands.

Finally, the condition of the Pribilof Islands population is discussed in relation to estimates of maximum sustainable yield.

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Estimates of Pups on Sample Rookeries

The purpose of estimating the number of pups on sample instead of all rookeries is to reduce the disturbance of seals; disturbance may be a factor in mortality (Fur Seal Investigations, 1967). If yearly changes in the pup population on sample rookeries are truly representative of the changes on all rookeries, then estimates of pups on sample rookeries can be extrapolated to find the approximate total number of pups born on the Pribilof Islands. The effect of disturbance on the total survival rate of pups until they are first subjected to the harvest (age 2 years) cannot be measured directly, however, because (1) direct estimates of abundance and survival require disturbance of the pups by counting (on small rookeries) or by marking/sampling (on large rookeries), and (2) alternate methods of estimating the number of pups without disturbing them (e.g., aerial photography) are not yet available.

Several years of data have been collected to begin evaluating the experiments on sample rookeries only (1967-68 and 1972-74). Table 5 gives the proportion or contribution, by rookery, of the estimated total number of pups born on St. Paul and St. George Islands. Contributions are calculated by adding the marking/sampling estimates of living pups to the counts of dead pups (both in August) in years when these data were taken on all rookeries of either island. Original estimates of the number of pups born on St. Paul Island (1963-66 and 1969-70) are in Table 13 of Fur Seal Investigations, 1970; contributions for the different rookeries on St. George Island are calculated from estimates of living pups and counts of dead pups in reports of Fur Seal Investigations for 1966, 1970, and 1973.

Variability in the contributions between years ranges on St. Paul Island from a low of .083-.079 = .004 for Polovina Cliffs Rookery to a high of .161-.122 = .039 for Zapadni Rookery (Table 5). The mean or average

Table 5.--Proportion, by rookery, of total numbers of pups born on St. Paul Island and St. George Island as estimated from shearing/sampling (plus dead pup counts) during 1963-66, 1969-70, and 1973, when data were taken on all rookeries of either island. A dash (-) indicates no basic data for all rookeries on an island.

Island	Rookery	1963	1964	1965	1966	1969	1970	1973	Range	Mean 1/ $\bar{x}$	Standard deviation s
St. Paul	Morjovi	.075	.069	.071	.070	.070	.072	--	.069-.075	.071	.002
	Vostochni	.152	.160	.151	.173	.152	.161	--	.151-.173	.158	.008
	Little Polovina	.028	.032	.032	.031	.023	.018	--	.018-.032	.027	.006
	Polovina Cliffs	.083	.082	.079	.081	.082	.081	--	.079-.083	.081	.001
	Polovina	.021	.021	.024	.020	.017	.018	--	.017-.024	.020	.002
	Tolstoi	.102	.099	.116	.102	.127	.112	--	.099-.127	.109	.011
	Zapadni	.141	.132	.122	.137	.136	.161	--	.122-.161	.138	.013
	Little Zapadni	.062	.064	.069	.082	.085	.072	--	.062-.085	.072	.009
	Zapadni Reef	.026	.024	.022	.018	.021	.020	--	.018-.026	.022	.003
	Reef	.147	.147	.149	.129	.122	.118	--	.118-.149	.136	.014
	Gorbatch	2/	.089	.079	.075	.079	.069	--	.069-.089	.079	.007
	Ardiguen	2/	.010	.010	.010	.016	.014	--	.010-.016	.012	.003
	Kitovi	.045	.051	.053	.048	.049	.058	--	.045-.058	.051	.005
	Lukanin	.022	.019	.024	.025	.022	.026	--	.019-.026	.023	.003
St. George	East Cliffs	--	--	--	.041	--	.049	.050	.041-.050	.046	.005
	East Reef	--	--	--	.155	--	.159	.178	.155-.178	.168	.012
	North	--	--	--	.404	--	.345	.350	.345-.404	.369	.033
	Staraya Artil	--	--	--	.115	--	.131	.187	.115-.187	.143	.038
	Zapadni	--	--	--	.144	--	.180	.117	.117-.180	.146	.032
	South	--	--	--	.140	--	.136	.119	.119-.140	.132	.011

1/ Sum of previously reported estimates over all years divided by total of estimates over all years and rookeries for each island; usually this value is the same as, or close to, the unweighted mean of the yearly ratios to the left.

2/ Estimates were combined for these rookeries in Table 13 of Fur Seal Investigations, 1970; together both rookeries contributed 9.6% of the estimated total in 1963 for St. Paul Island.

contribution for all years of complete sampling is lowest for Ardiguen Rookery (.012) and highest for Vostochni Rookery (.158).

The variability is about twice as large on St. George Island even though marking/sampling on all rookeries was done only in 3 years (instead of 6 years as on St. Paul Island). Variability between years ranges from .050-.041 = .009 for East Cliffs Rookery to .187-.115 = .072 for Staraya Artil Rookery. The mean contribution is lowest for East Cliffs Rookery (.046) and highest for North Rookery (.369).

The standard deviation (s in table 6) may be used instead of the range (highest minus lowest value as given above) to measure the variability between years: s is highly correlated with the range (the linear coefficients of correlation are r = .977 for St. Paul Island and r = .997 for St. George Island). The coefficient of variation ($s/\bar{x}$) measures the variability between years relative to the mean contribution over all years; therefore, rookeries with relatively low values of $s/\bar{x}$ may be more desirable for marking/sampling if selected instead of all rookeries continue to be used as a basis for estimating the total number of pups born.

Values of $s/\bar{x}$ fall into three groupings of relative magnitude on each island as shown in table 6.

Tables 5 and 6 suggest several points in connection with the sampling problem. First, Polovina Cliffs, Morjovi, and Vostochni may be the most desirable rookeries to subsample on a continuing basis on St. Paul Island when we consider (1) the relatively low values of $s/\bar{x}$, (2) the fact that a consistent change between years (time trend) is not evident for their contributions in Table 5, and (3) these rookeries account for a relatively high mean contribution (.081 + .071 + .158 = .310) of the estimated total number of pups born on St. Paul Island. A second point is that Reef Rookery, although its value of $s/\bar{x}$ falls in the "medium" instead of the "high" category, may bias any total estimate for St. Paul Island: it is the largest rookery near the village of St. Paul (Fig. 1), and therefore may be subjected to harmful disturbance from humans as suggested by its steadily declining contribution from .149 in 1965 to .118 in 1970 (table 5). Another point is that continued use of sample rookeries only on St. George Island is questionable because values of $s/\bar{x}$ in each category (low, medium, and high) are higher here than on St. Paul Island.

Two conclusions are obvious: (1) Further analysis is needed to decide if marking/sampling should continue on sample rookeries (and if so, which rookeries); and (2) marking/sampling should be conducted again in 1975 on all rookeries in order to finish the analysis and to reach a decision.

Table 6.--Coefficient of variation ($s/\bar{x}$) for different rookeries on St. Paul Island and St. George Island.

Relative magnitude of $s/\bar{x}$	Island and Rookery	Value of $s/\bar{x}$
Low	St. Paul	---
	Polovina Cliffs	.01
	Morjovi	.03
	Vostochni	.05
	St. George	---
	East Reef	.07
	North	.09
	East Cliffs	.11
Medium	St. Paul	---
	Gorbatch, Zapadni	.09 each
	Kitovi, Tolstoi, Reef, Polovina	.10 each
	Lukanin, Little Zapadni	.13 each
	Zapadni Reef	.14
	St. George	---
	Zapadni	.22
	Staraya Artil	.27
High	St. Paul	---
	Little Polovina	.22
	Ardiguen	.25
	St. George	---
	South	.34

Results of the complete analysis and sampling in 1975 will be reported in that year along with any marking/sampling estimates then available for the total number of pups born annually on the Pribilof Islands during 1967-68 and 1972-74. Estimates for 1961-66 and 1969-70 are repeated in Table 7 from Fur Seal Investigations, 1973 (Table 5).

Natural Survival

The new method of estimating survival from natural mortality (natural survival) is for two time periods in the life of male seals of the 1961-66 year classes. First is the total rate of natural survival from the time of birth until the animals are first harvested, which is at age 2 years. Second is the average annual rate of natural survival from the time the kill ends at age 2 years until the kill starts at age 5 years. Basic assumptions are as follows:

1. Average monthly rates of instantaneous natural mortality are no greater (a) during ages 2-5 years than during ages 0-5 years, or, therefore, (b) during ages 0-5 years than during ages 0-2 years. That is, the natural mortality rate is assumed to be higher during ages 0-2 years than during ages 2-5 years.
2. Natural mortality is absent or nearly so during the time (about 1.0 months) of commercial kills on land at ages 2-5 years.
3. The observed kill at age 5 years is a lower limit for the unknown number of recruits living when the kill starts at age 5 years.
4. The sum of observed kills at ages 4 and 5 years is an upper limit for the unknown number of recruits living when the kill starts at age 5 years.

Details of the method are not yet published. It relies on (1) the derivation of lower and upper limits for the number of male seals living during ages 2-5 years, and (2) the fact that most of the kill of males at ages 2-5 years actually occurs at ages 3-4 years. Tagged or marked seals in the kill are not needed, as mentioned previously; the required data are a count or estimate of the number of seals born in a year class, and the kill by age and sex.

Basic data and results of application are in Table 8 for male seals of the 1961-66 year classes. Estimates of average natural survival during ages 2-5 years ($\hat{s}$) vary between year classes for 84-89%/year. Estimates of total natural survival during ages 0-2 years vary more, from 31-42%.

Table. 7.--Marking/sampling estimates of the numbers of pups born, including counts of dead pups, on the Pribilof Islands during 1961-66 and 1969-70.[1/]

Year Class	Estimated number of pups born
1961	438,000
1962	362,000
1963	343,000
1964	370,000
1965	347,000
1966	388,000
1969	304,000
1970	306,000

1/ Estimates were made only on sample rookeries during 1967-68 and 1972-74, and data are being analyzed to determine if reliable estimates can be made; no estimates were made on any rookeries in 1971.

Table 8.--Estimated number (thousands) of male pups born and killed,[1/] and estimated rates of natural survival[2/] for the 1961-66 year classes, Pribilof Islands, Alaska.

Year Class	Number of male pups born	Number of males killed by age				Estimated male survival[2/]	
		2	3	4	5	$\hat{s}$ *	$\hat{s}$
1961	219.0	2.019	29.416	14.638	1.772	0.329	0.840
1962	181.0	3.678	22.745	16.037	1.679	0.357	0.870
1963	171.5	1.431	31.121	15.523	1.948	0.406	0.884
1964	185.0	3.534	34.613	16.959	2.149	0.421	0.888
1965	173.5	2.940	23.149	12.769	1.278	0.342	0.851
1966	194.0	2.116	20.471	13,822	1.805	0.307	0.840

1/ From Tables 1 and 6 of Fur Seal Investigations, 1972.

2/ $\hat{s}$ * is estimated total natural survival during ages 0-2 years; $\hat{s}$ is estimated annual natural survival during ages 2-5 years.

Status of Population Relative to Estimates of Maximum Sustainable Yield

Reliable evidence shows that (1) the average kill of male seals from the 1962-66 year classes (43,000) was considerably less than that from the 1929-33 year classes (53,600) and (2) the number of pups born annually was nearly the same (300,000-400,000) during both periods (National Marine Fisheries Service, 1973). The basic method of harvesting has changed little; the average kills observed during the two periods represent the relative numbers actually available for killing. Therefore, it is believed that natural survival from birth to age 2 years was about 25% higher for the 1929-33 year classes than for the 1962-66 year classes. The value is calculated from the average kills: (53,600-43,000)(100)/ 43,000 = 25%.

The foregoing evidence rasies the question: Do published estimates of maximum sustainable yield, which rely partly on early data (e.g., pup counts in 1920-22 as used by Chapman, 1964 and 1973), apply to modern conditions? The question cannot be answered now. The population certainly is smaller now than when the herd reduction program of 1956-63 began. Reliable estimates of pup production in modern times are presently limited, however, to the period 1961-70 (table 7). Seven and ten years are required for female and male pups, respectively, to attain peak breeding ages; commercial killing on St. George Island ended only in 1973. To evaluate the effects of population density on survival under modern conditions, and therefore to answer the question concerning maximum sustainable yield, will require a long period of time.

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Part III. BEHAVIOR--ST. GEORGE ISLAND

The behavior research program underwent a major shift in direction and intensity in 1974. Based on the precept that all factors which affect maximum sustainable yield, such as competition, mortality and recruitment, have measurable behavioral correlates, an attempt was made to identify those correlates that could be measured for immediate use by management, and those that would be useful for long-term comparisons between harvested and unharvested populations.

In searching for measurable correlates the program examined both population-wide and individual behavioral patterns, all of which might be density dependent. Descriptive, comparative and experimental studies were performed simultaneously during this search, and all studies were quantitative. In addition to the data collected, a capability for immobilizing adult males without drugs was developed, as was one of holding females, males, and pups in captivity. As a result of the research in 1974, a few specific topics were selected for more intensive study in 1975.

Work Plan

In May, a new observation blind with a covered catwalk approximately 50 meters long was constructed on East Reef Rookery. A spur was added to the catwalk on Zapadni Rookery and a new blind was erected there for the use of Dr. T. Ichihara (Japan). Observation grids measuring 100 by 50 meters, and 100 by 30 meters, with intersections every 10 meters, were constructed on Zapadni and East Reef Rookeries, respectively. The holding facility in the unused skin processing plant was expanded to include four water pools connected with a large outdoor compound.

At East Reef Rookery, two observers occupied the blind during four 4-hour shifts each day from mid-June to late September. They collected quantitative data on a variety of subjects (see below), censused the herd, and maintained history cards on known animals. An observer occupied one of two blinds on Zapadni Rookery for half a day, censused the herd, kept history cards and made maps of distribution from mid-June to late August. At the other blind on Zapadni Rookery, observers followed radio-tagged females and subadult males full time during July and August.

In September and October, data were collected primarily on predation by sea lions on fur seal pups, the movements of marked pups between rookeries, and female suckling cycles. In all, over 800 man-days of effort comprised the 1974 field season.

Collection of Data

Quantitative data were collected on the following subjects:

1. Density of Female Aggregations

Maps of the distribution of females show changes in their intra-group density as a function of time and terrain.

2. Arrival Behavior of Individual Females

Maps show the path taken, and behavioral interactions along the way, of pregnant and lactating females as they arrived and found a rest site. These data are the behavioral basis of the density data above.

3. History Cards--Females

These cards show suckling cycles, timing of birth and copulation, suckling sites, and activity patterns for 40 females on East Reef Rookery and 250 females on Zapadni Rookery.

4. History Cards--Males

These cards give territory location and activity level for 51 males on East Reef Rookery and 15 males on Zapadni Rookery.

5. History Cards--Pups

These cards give location and activity information for 39 pups marked on Zapadni Rookery and 12 pups marked on East Reef Rookery.

6. Activity Levels

Measurements were taken eight times daily for 3-1/2 months on the level of activity within selected groups of seals. The results can be correlated with time of day or weather factors.

7. Censuses

A census was taken at least once a day on East Reef Rookery and Zapadni Rookery for 3-1/2 months.

8. Arrivals and Departures of Females

Tallies were made of the number of females arriving and departing every hour of the day for 6 weeks. Movements in the female population can be correlated with weather changes and time of day.

9. Copulations

Quantitative descriptions of 411 copulations serve as a baseline for copulatory behavior and give copulation frequency for males on East Reef Rookery. Maps show locations of all copulations for later correlations with male territorial data.

10. Births

Quantitative descriptions of 110 births serve as a baseline for studying mother-young behavior at parturition. Maps show the locations of all births for comparison as the population grows.

11. Aggressive Behavior of Males

Two thousand recorded encounters between males will provide a quantitative description of territorial maintenance at the current population level.

12. Captive Animals

Data on six adult females and their pups, and one adult male for one month, show that all reproductive events can be replicated in the laboratory.

13. Radio Tracking

Twenty-seven females on Zapadni Rookery were equipped with radio transmitters and followed by telemetry or visually for 2-1/2 months. Their presence on Zapadni Rookery and possible presence on other rookeries was checked daily.

14. Movements of Subadult Males

The daily presence on hauling grounds of 79 hair-branded and 5 radio-tagged subadult males was noted (in conjunction with Dr. T. Ichihara).

15. Predation by Foxes and Sea Lions on Fur Seal Pups

Notes were made for 3-1/2 months on every fox that visited East Reef Rookery; 145 man-hours were spent observing kills of fur seal pups by northern sea lions offshore.

16. Effects of Human Disturbance

Males were driven from two rookeries and the identity of and aggression among returnees was noted. Also, the departures and returns of 26 marked females were noted during two other disturbances.

Data on items 3, 4, 5, 6, 8, 9, and 11 were reduced to computer punch cards, and programs for their analysis are now being written. Items 2, 10, 12, 13, and 14 are to be analyzed manually, and items 1, 7, 15, and 16 have been analyzed and are discussed below.

Marking

Members of several components of the fur seal population were marked by one or more methods. Tags used are listed in Table A-18.

Adult Males

A squeeze-cage was devised for immobilizing territorial males without the use of drugs. The cage, which was constructed of plywood and measured 2.2 by 1.2 by 1.2 meters, had sliding doors in each end and a top which could be lowered to the floor. Territorial males were roped and pulled into the cage by eight men. The doors were closed, and the top was lowered onto the animal and tied down. A trapdoor in the cage top exposed a 0.5 by 0.3 meter patch of fur over the male's shoulders. Identification numbers were clipped and bleached in this fur, and a metal tag was attached to the flipper. Fifteen males were marked in two days on Zapadni Rookery.

Adult Females

Thirty-five females were marked by clipping and bleaching identification letters in their fur, and by attaching metal tags to their flippers. In addition, each of 27 females was hair-branded, tagged, and equipped with a radio transmitter.

Subadult Males

Seventy-nine subadult males were hair-branded on Zapadni Rookery.

Pups

A total of 127 pups were marked by clipping identification numbers into their fur and by tagging.

Analysis of Data

The results in this section should not be considered definitive since they are based on only one year of data.

Density of Females

Density dependent mortality has been assumed to operate in fur seals, yet no data showing density changes over time are available, and the mechanisms by which density relates to mortality are obscure.

The measurement of density used in 1974 (number of females/m^2 within groups of females) was simple and repeatable. The method provided a means of comparing the herd over time, and of comparing different geographic areas simultaneously. But this measure of density is only one of several; others remain to be tried, such as the number of female groups per unit area of rookery. Density data collected in 1974 did not provide evidence for the mechanisms by which density and mortality are related.

On maps of observation grids on East Reef and Zapadni Rookeries, observers drew lines that represented the outlines of female groups, and counted the number of females in each group. Small errors were made in counting females and in drawing map lines since all groups were viewed obliquely. These maps were made at East Reef Rookery from 20 June to 28 August and for the same time period at Zapadni Rookery except for three weeks in July. A planimeter was used to measure the area occupied by specific groups and the results converted to m^2. The ratio females/m^2 was then calculated for each group. The resulting ratios were grouped by week of the season, and weekly mean densities were calculated.

Figure 8 shows that density of females within groups was higher on Zapadni than on East Reef Rookery. This difference may be attributable to terrain differences (East Reef is rocky and Zapadni is flat and sloping). Figure 8 also shows that density peaked early in the season at East Reef Rookery and that a strong temporal decline occurred thereafter. This decline is not as clear in the curve for Zapadni Rookery because of the missing data in July, but the decline seemed evident in the field.

Figure 8 shows interesting trends in the timing of events. Note that for both study sites density peaked before the peak in female numbers occurred (bottom half of figure), indicating that female density and female numbers are partly independent within the season. One interpretation of this finding is that males can control the movements of the few females present early in the season, thereby increasing the number of females/m^2 within groups. As more females arrive, males lose this control and females spread out, thereby decreasing density.

Finally, Figure 8 shows that the peak in female density occurs about five weeks before the peak in pup mortality, which occurs from the last week in July to the first week in August. Therefore intra-group density of females is probably not the direct cause of pup mortality since it peaks from one to three weeks before most pups are born, and approximately five weeks before the peak of pup mortality. Other measures of density, such as inter-group density, may show more direct correlations with pup mortality. A real demonstration of the mechanisms by which density and mortality are related will rest on finding a directly measurable behavioral correlate linking the two. The search for this correlate will be aided by the above basic information about intra-group density.

Predation on Fur Seal Pups

Foxes and northern sea lions prey on fur seal pups.

Foxes.--All visits to East Reef Rookery by foxes were recorded throughout the 1974 season. Foxes usually ate or carried away placentas or parts of dead pups. On three occasions, however, foxes were observed to attack living pups and severely injure them. In all cases the pups had been

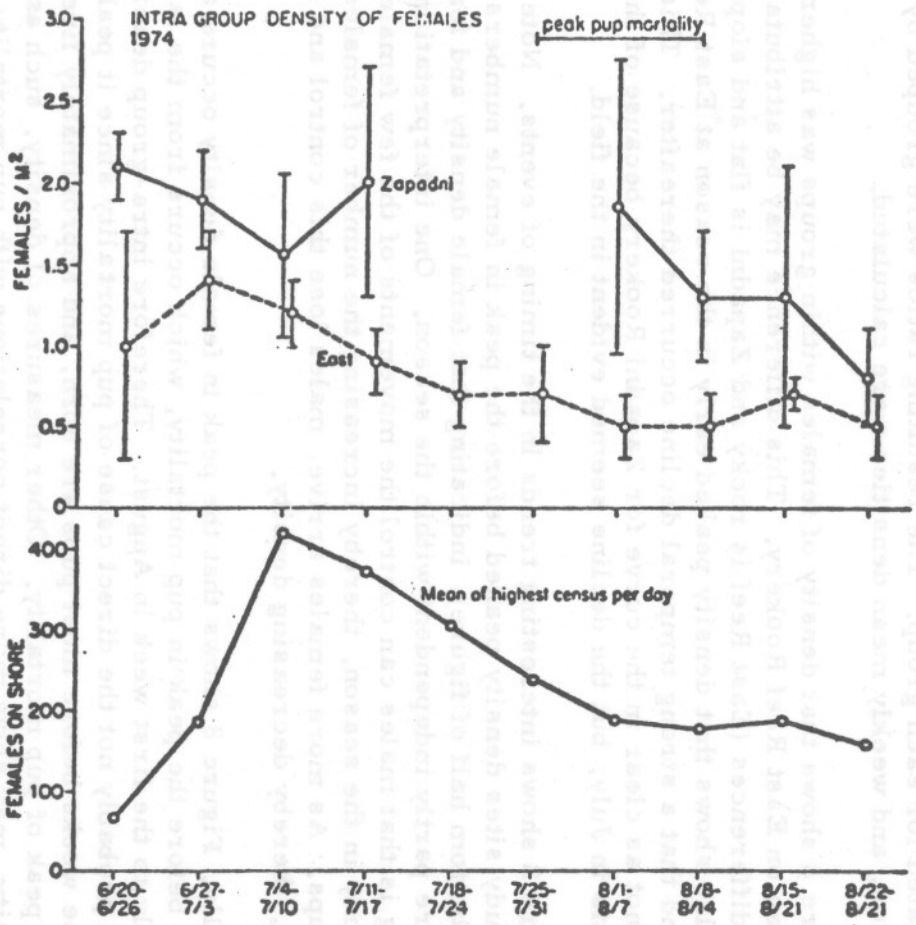

Figure 8. --Intragroup density of female fur seals, St. George Island, 1974.

separated from their mother within two days of birth. The pups were not killed outright but their injuries may have contributed to their deaths later. Predation on living fur seal pups by foxes, which is not a major source of mortality, amounts to a fraction of 1% of the pups born on St. George Island.

Sea Lions.--In 1974 as in 1973, sea lions were observed to kill and consume fur seal pups. In 1974, a video tape was made of one kill near the dock on St. George Island. The remains of this kill were taken away from the sea lion and positively identified as a fur seal.

From 20 August to 2 October, 145 man-hours of observation were spent watching for sea lion predation. The first kill was observed by R. L. DeLong on 20 August, and the last was reported on 2 November by G. McGlashan, St. George Island resident. Eighty-six kills were recorded in which a flipper, head, or pelage of a fur seal pup were "verified" (clearly seen). Another 19 "possible" kills were recorded where fur seal parts could not be clearly seen. Data on size of the sea lion, distance from shore, and duration of feeding, were collected on as many kills as possible. Some observations were made on St. Paul Island in September; predation was neither seen by us nor reported by St. Paul Island residents.

All kills occurred in the water, usually in kelp beds within 50 meters of shore. Sea lions usually hunted singly; cooperative hunting was not seen although occasionally more than one sea lion fed on the remains if pieces of the pup were broken off. The mean duration of 19 kills for which a clear start and end were seen was 21 minutes (SD 9.5).

Sea lions usually killed the fur seal pups by surfacing beneath them and biting their abdomens, then either throwing them into the air or shaking them vigorously. Birds attracted to kill sites picked up stomachs and intestines. After the first strike, the pups were usually carried under water beyond the kelp bed where they were eaten; definite chewing and swallowing motions were interspersed with shaking. The few remains that were recovered suggested that muscle and bones were consumed but skin, blubber, head, and flippers were not. Such kills were not clearly related to either rough or calm seas, and samples were inadequate for establishing daily periodicity of feeding.

The predation rate at East Reef and East Cliffs Rookeries, where 112.5 of the 145 observation hours were spent, suggested some seasonal fluctuations. Table 9 shows the observations at these rookeries divided into eight-day blocks (starting 20 August) and combines "verified" and "possible" kills in the rate estimates.

Table 9.--Seasonal fluctuations in sea lion predation rate

	Eight-day block	Number of observation hours	Number of kills/ observation hours
Start 20 August	1	16.50	0.61
	2	43.00	1.28
	3	28.25	0.18
	4	4.75	0.21
	5	17.00	0.76
End 6 October	6	3.00	1.33

A low number of sampling hours in some blocks (such as 4 and 6) undoubtedly contributed to fluctuations in the predation rate, but differences between blocks 2 and 3, where the largest number of observation hours occurred, are probably real. Predation rate undoubtedly fluctuates throughout the time period in which it occurs, but the magnitude of these changes cannot be assessed from these data.

Estimating the overall predation rate for the population is a difficult sampling problem. It is possible that the kill rate varies according to time of day, and according to geographic area. Daily and seasonal changes may occur differently at different geographic sites, and the extent to which predation is linked to weather is still unknown. Until good estimates for all of these variables are available, any estimate of an overall predation rate must be tentative.

With the above qualifications the present data can be analyzed to estimate maximum sea lion predation. The main value of such an estimate is to dictate whether the problem is of sufficient magnitude to warrent further research. If it is assumed that kills occurred 24 hours per day from 20 August to 2 November, then predation covered 1,800 hours. If the total number of observed kills (including "verified" and "possible") is divided by the number of observation hours, then for East Reef and East Cliff Rookeries the rate is 0.78 (88 kills in 112.5 hours). If it is assumed that this rate represents the entire sampling period (despite fluctuations noted above), then 0.78 x 1,800 = 1,404 pups would have been taken. Assuming that 13,200 living pups were on East Reef and East Cliffs Rookeries (the estimate for 1973--an estimate of the number of pups on these rookeries in 1974 was not made) then the 1,404 animals taken would be equivalent to 10.6% of the living pups on those two rookeries. The available data are insufficient to make a comparable estimate of the rate from other rookeries. But if the rates on all rookeries are similar, the problem of sea lion predation on fur seal pups near St. George Island does warrant further study.

Human Disturbance

The effects on reproductive efficiency or on pup survival of management and research-related disturbances at breeding sites have been discussed in previous reports, but not quantified. An attempt was made to quantify some kinds of disturbances in 1974.

Adult Males. --We measured the effect of total disruption of the territorial grounds, before the females arrived, on (1) the fidelity of reestablishing the territorial system and (2) the amount of male-male aggression required for reestablishment. On 3 June at East Reef Rookery, 17 males on the 100-meter study grid were identified by location or by marks peculiar to each individual. These males were then chased into the water and observations made of their returns; 2.5 hours later, 14 males had returned to land. Nine of the 14 were identified by marks as males present before the disturbance and all 9 used the same rest sites; the five unmarked males used the same rest sites as the previous tenants. It was assumed unlikely, however, that five new males would use the same rest sites used by their predecessors, and that therefore these animals were the former tenants. This assumption was supported by the fact that during reestablishment the males did not fight and only 12 boundary displays (mutual threats at territorial borders) were observed. More aggressive behavior would have occurred if new males had arrived and established territories. After 12 hours, 17 males had returned to land, and all occupied rest sites used before the disturbance.

We repeated the experiment on Zapadni Rookery, 10 June. The 20 males on the 100-meter grid were more difficult to drive from this rookery than were the males on East Reef Rookery. After seven hours, 19 males had returned. Eight of these animals were identified by marks as having been in the rookery previously. The 16 unmarked males used the same rest sites that were occupied before the disturbance. Three true fights occurred, and 44 boundary displays associated with reestablishment of territories were observed.

It appears that before the females arrive, human disruptions have little effect on territorial structure either in the arrangement of males or in the amount of aggression among them. It also appears that little replacement of established males accompanies such disturbances, at least in early June.

Adult Females. --The effect of human disturbance on females was measured on two different days. At East Reef Rookery on 12 September, five marked females were ashore when the rookery was disturbed for the dead pup count. All of the females went to sea during the disturbance. The mean duration away from the rookery was 1.9 hours (SD 0.22). Three of these five females were present through the next day and one remained for three days after the disturbance. For these five females the mean duration of the visit to the rookery during which the disturbance occurred (including days before and after the disturbance) was 2.8 days (SD 1.1). This value fits

well with Peterson's (1965) estimate of 2.0 days for the normal on-land part of the suckling cycle.

Further observations on the effects of disturbance were made on 14 August when approximately 100 females were herded inland and 27 were marked. Records are not available for the lengths of time these females were ashore before tagging, but their tenure after tagging was as follows:

1. Forty percent remained on the rookery at least 24 hours.

2. Forty percent departed but returned to the rookery from 5 to 8 days after tagging (absent for one normal at-sea period).

3. Ten percent departed but did not return to the rookery for more than 10 days (neither of the two females was suckling a pup).

4. Ten percent were not seen on the rookery again.

The data do not show that the normal suckling cycle of any female was permanently altered by the disturbance.

Preliminary observations show encouragingly few effects of disturbance on suckling cycles. These conclusions are based on very few observations, which will be repeated with larger samples in 1975.

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Part IV. 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 found in Adams Cove on the west end of San Miguel Island in 1968 (Peterson, LeBoeuf, and DeLong, 1968), and another breeding colony on Castle Rock, a small island located about 2 miles north of the west end of San Miguel Island in 1972 (Dept. of Comm. News Release, 12 Sept. 1972).

Adams Cove

The Adams Cove population has been monitored since 1969. Observations have been made from blinds and the colony has been allowed to grow in a relatively undisturbed environment. Some of the observations made of the Adams Cove population are given in Table 10.

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 in 1974. The largest number of females ashore was counted 8 September. This count does not reflect the actual number of females in the breeding population because many were newly arrived from the sea, as evidenced by growth of algae on the animals.

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 several 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 colony. These data are given in Tables A-19 and A-20.

The growth of the colony is supplemented in part by a continual influx of females from the old established 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.

Castle Rock

The Castle Rock population is counted from aerial photographs and by one survey from afoot each year. 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 present (20) was seen in photographs taken 2 July 1974, plus an additional 3 possible

Table 10. --Summary of some observations of the northern fur seal colony in Adams Cove on San Miguel Island, California, 1969-74

Observation	1969	1970	1971	1972	1973	1974
Season span						
Beginning Date 1/	16 May	23 May	15 May	16 May	9 May	20 May
Ending Date	1 Oct.	20 Sept.	6 Sept.	7 Sept.	15 Aug.	9 Sept.
First Male	16 May	29 May	24 May	16 May	26 May	20 May
First Female	27 May	28 May	25 May	22 May	17 May	20 May 5/
First Birth	6 June	28 May	31 May	22 May	7 June 2/	27 May
Mean Birth Date	24 June	21 June	26 June	22 June	24 June	23 June
Total Births	28	33	45	70	68	220
Total Pup Deaths	2	14	15	21	17	52
Total Females (maximum counted and date) 3/	175 23 Aug.	179 23 Aug.	274 2 Sept.	310 16 Aug.	394 4 Aug.	551 8 Sept.
Total large adult males	4	2	4	6	6	6
Total small adult males	4	4	6	7	5	6
Total Bachelors 4/	4	5	6	10+	6	8

1/ Beginning and ending dates of continuous observations.
2/ 1 still birth occured on 19 May.
3/ A few 2, 3, and 4-year old males may have been included because they are about the same size as adult females.
4/ Animals about 104-127 cm in body length, tip of nose to tip of tail.
5/ May have arrived earlier.

adult males. A complete count of females was not obtained. A total of 301 pups (280 living, 21 dead) was counted from afoot 2 August 1974. Most of the adult males and females were in the water and could not be counted at this time.

The number of pups born in the two colonies increased from 261 in 1973 to 521 in 1974.

A study of the nocturnal behavior and individual vocal characteristics of fur seals in the Adams Cove colony was begun in 1974.

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). To date, quantified data on the nocturnal behavior of pinnipeds is inadequate.

During the 1974 breeding season on San Miguel Island, nocturnal and diurnal observations of the northern fur seal were conducted.[1/] Preliminary analysis of the data has shown that fur seal social activity does continue throughout the evening hours. Presently, an examination of the relationship between activity cycles of groups and individual vs. meterological and celestial events is being conducted. The ultimate purpose is to predict the combination of environmental conditions which will produce peaks in fur seal activity.

In addition to the behavioral and environmental observations, a cassette recorder was used to document individual fur seal vocalizations and monitor the vocal activity of select groups of northern fur seals on a 24-hour basis. The analysis of these recordings will serve several purposes:

1. The 24-hour recordings can be used as a gross measure of fur seal activity, if a relationship between the frequency of vocalizations and activity can be demonstrated.
2. The vocal pattern analysis of individual females and their pups may help explain their ability to locate each other, especially during the night.
3. Fur seal voice prints will be kept on file and serve as a "natural tag" with which to examine the possible return of individuals to San Miguel Island.

Clifford H. Fiscus, Willman M. Marquette,
Robert L. DeLong, George A. Antonellis, Jr.

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

Part V. PELAGIC--BERING SEA

Pelagic fur seal research was conducted in the eastern Bering Sea from the chartered vessel M/V Pat San Marie[2/] from 17 July through 9 September 1974. In order to ensure intensive coverage by time and area, sampling was limited to an ocean area of from 5 to 35 miles in width around the Pribilof Islands, which was bounded by latitudes 57°30' N and 56°10' N and longitudes 171°00' W and 169°00' W (5,200 square miles). This ocean area was subdivided equally into four smaller subareas, each of which was subdivided into 24 areal units to facilitate the analysis of data. The four subareas were numbered clockwise 1 through 4 starting in the upper left corner. The data were divided into early (17 July to 13 August) and late (14 August to 9 September) groups for analysis.

The objectives of the research in 1974 were to: (1) Obtain age-specific pregnancy (postpartum) and ovulation rates by time and area; and (2) determine the relative importance of food species in the sampling area.

We acknowledge the assistance of Clifford H. Fiscus in determining the ages of fur seals and identifying squid remains in the stomach samples.

Distribution and Abundance

The distribution and abundance observed in 1974 is shown by month in Figures 9 through 11, and the basic data used to derive the figures are listed in Tables B1 through B-3. Generally, the western subareas (1 and 4) had a more uniform distribution of seals throughout the study period. Only three 10-minute square areal units did not contain seals (one areal unit in subarea 1 in July, and two in subarea 4 in September). In contrast, data from the eastern subareas (2 and 3) suggest a patchier distribution; 11 areal units were without seals in the period. In the northernmost part of subarea 2, density increased from July to August, suggesting a possible influx of seals. No discernible trend in movement among months is evident for the other three subareas.

Although attempts were made to sample the four subareas uniformly in time and intensity, demands on vessel time in support of shore-based research and management operations prevented optimum replication among the four subareas. Fairly even coverage was obtained in August, but total hours spent in each of the subareas during all three months showed that subarea 1 received as much coverage as subareas 2 and 3 combined in Figure 12 (Panel A).

2/ Registered length 90.3 feet, 765 horsepower, cruising spped 12 knots.

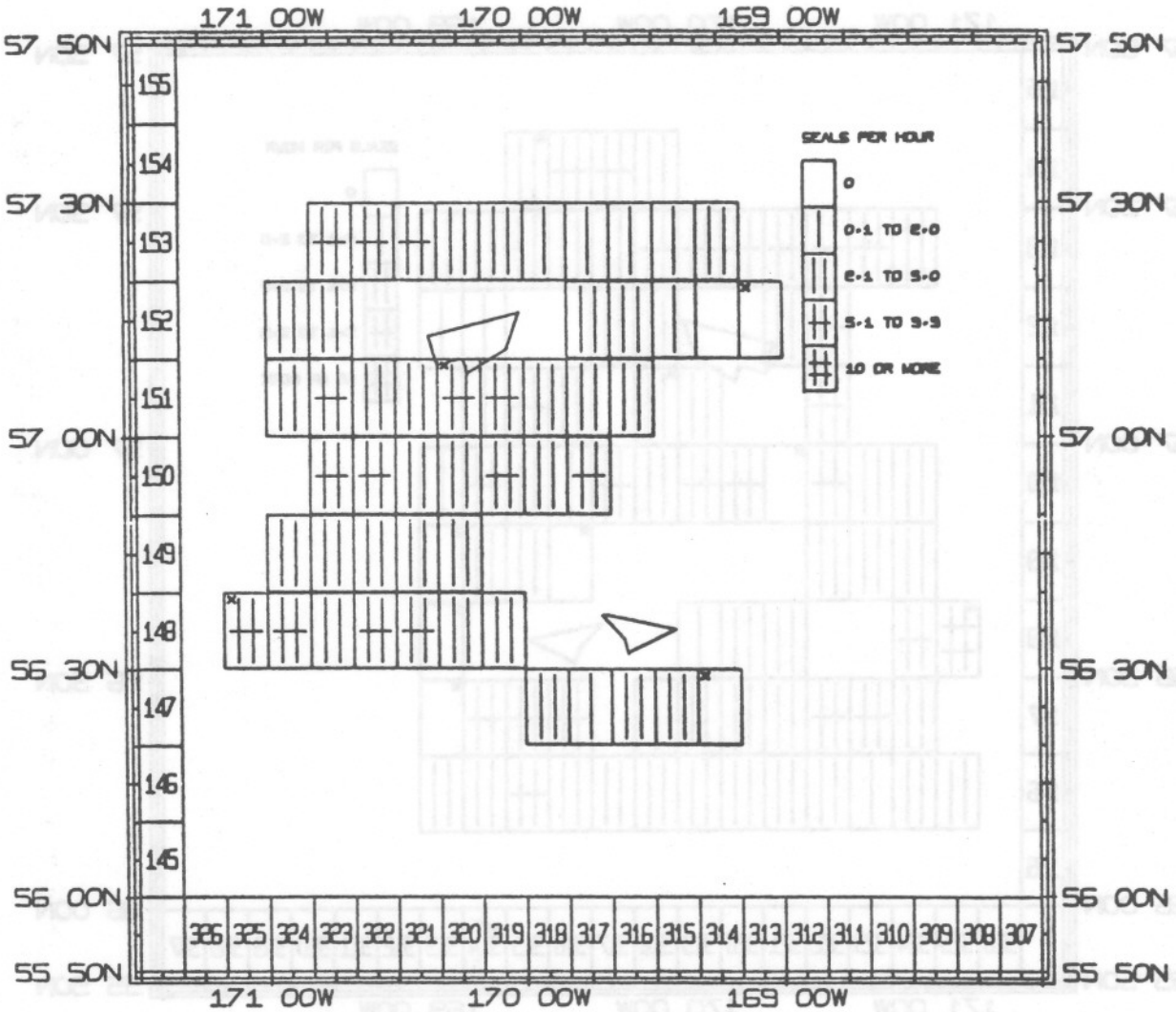

Figure 9.--Number of seals seen per hour of effort in each areal unit occupied by a research vessel in July 1974, in the eastern Bering Sea. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-1 for data.

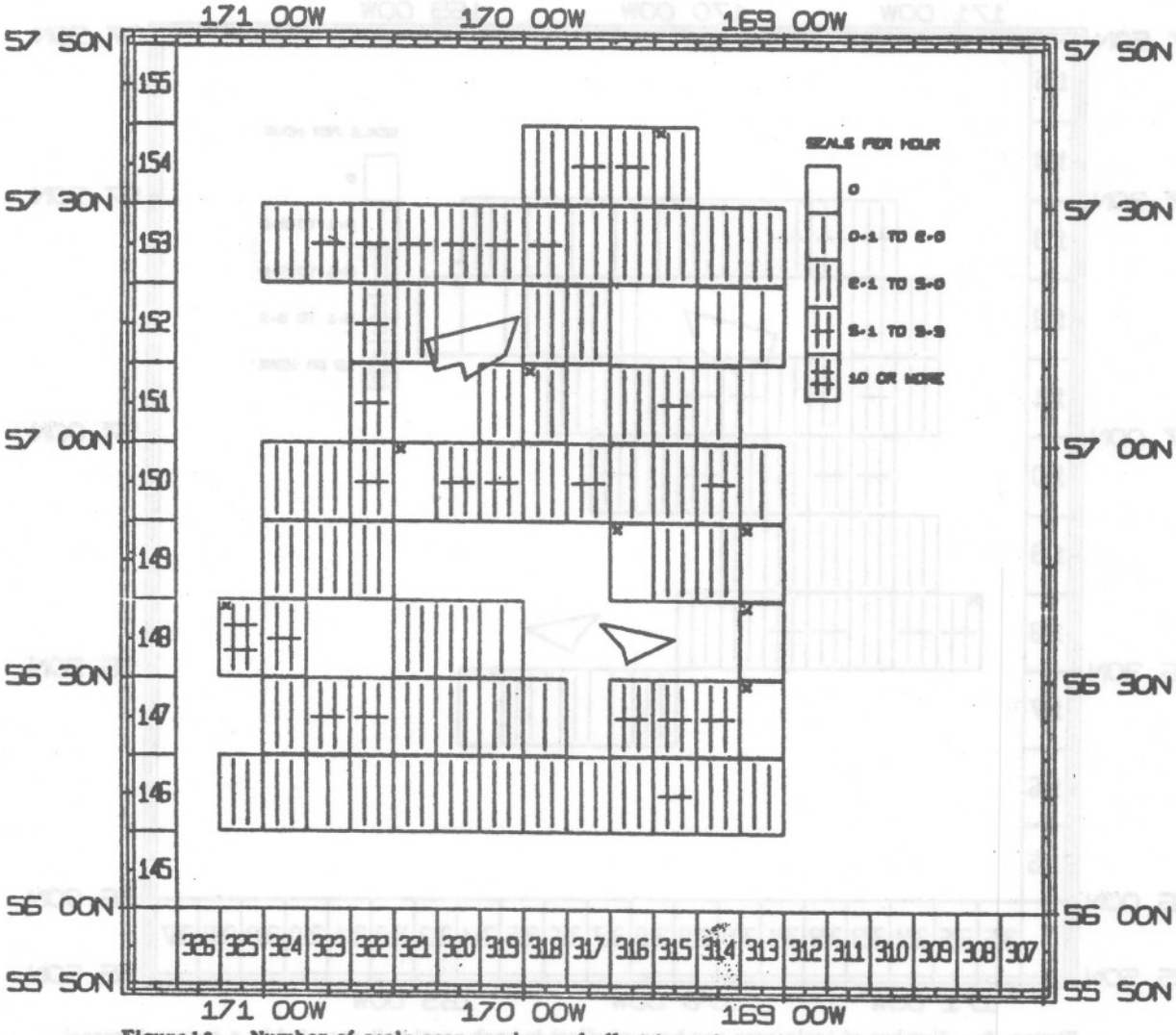

Figure 10.--Number of seals seen per hour of effort in each areal unit occupied by a research vessel in August 1974, in the eastern Bering Sea. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-2 for data.

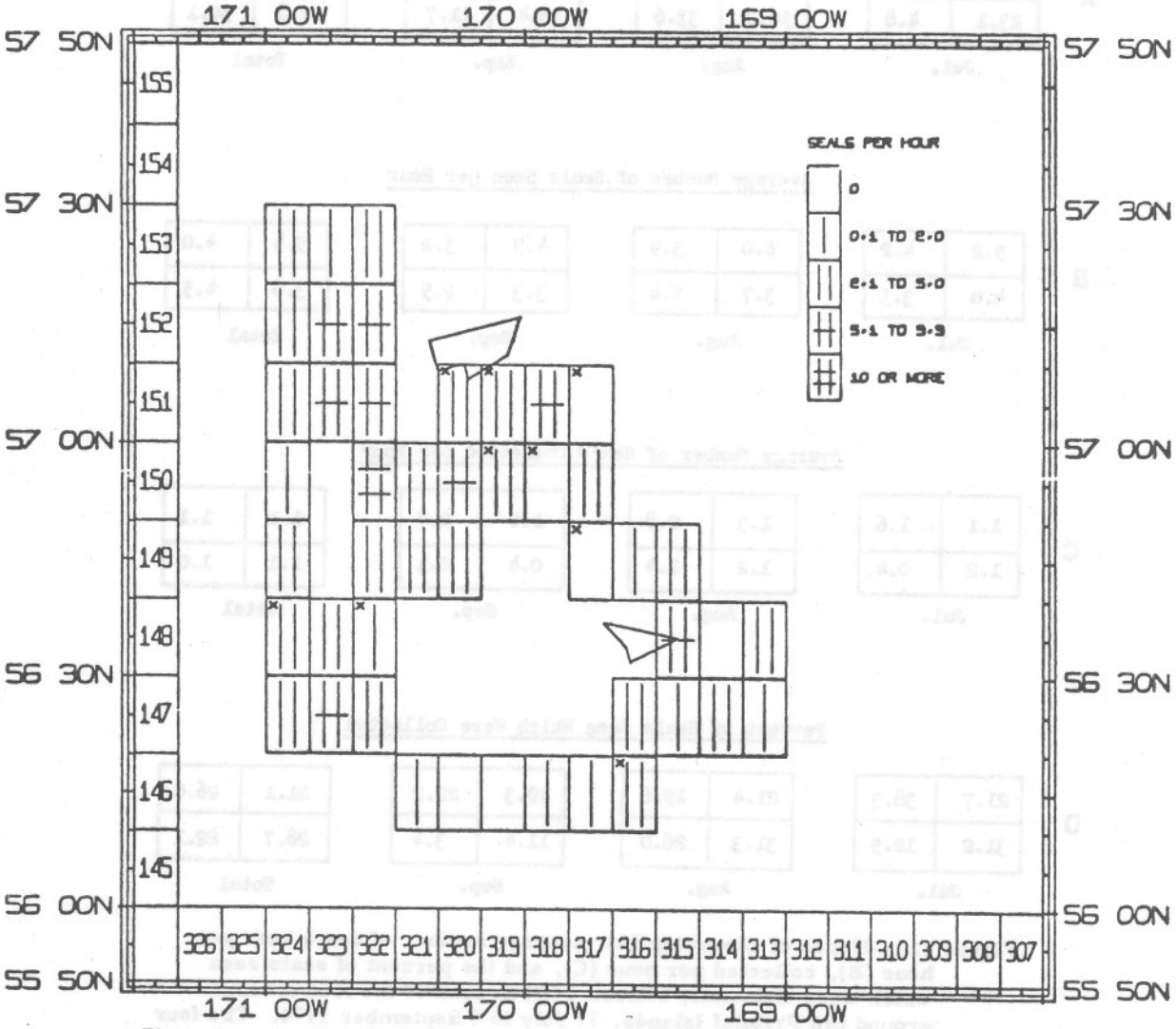

Figure 11.--Number of seals seen per hour of effort in each areal unit occupied by a research vessel in September 1974, in the eastern Bering Sea. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-3 for data.

Hours of Observing

A

Jul.		Aug.		Sep.		Total	
54.5	27.0	43.8	47.2	28.3	2.8	126.6	77.0
23.1	4.8	56.3	33.6	13.4	11.7	92.8	50.1

Average Number of Seals Seen per Hour

B

Jul.		Aug.		Sep.		Total	
5.2	4.2	6.0	3.9	4.9	3.2	5.4	4.0
4.0	3.3	3.7	5.4	3.3	2.5	3.8	4.5

Average Number of Seals Collected per Hour

C

Jul.		Aug.		Sep.		Total	
1.1	1.6	1.3	0.8	1.0	0.7	1.1	1.1
1.2	0.4	1.2	1.4	0.4	0.1	1.1	1.0

Percent of Seals Seen Which Were Collected

D

Jul.		Aug.		Sep.		Total	
21.7	38.3	21.4	19.6	19.3	22.2	21.1	26.6
31.2	12.5	31.3	26.0	11.4	3.4	28.7	22.1

Figure 12.--Hours of observing (A), average number of seals seen per hour (B), collected per hour (C), and the percent of seals seen which were ultimately collected (D) in each of the four subareas around the Pribilof Islands, 17 July to 9 September 1974. The four blocks in each square refer to relative locations of the four subareas.

Figure 12 (panels B, C, and D) summarizes various aspects of the comparative abundance of seals observed among the four subareas. Although subarea 1 received a disproportionate share of time, the four subareas were uniformly compared by calculating the average number of seals seen (panel B) and collected (panel C) per hour. Subarea 1 had the highest monthly and total concentrations of seals; their densities ranged from 4.9 to 6.0 seals seen per hour. Subareas 2 and 4 had the lowest average densities, 4.0 and 3.8 seals seen per hour, respectively. Subarea 3 had the most variable density, ranging from 5.4 seals per hour in August to 2.5 in September. Despite this intra-subarea variation, however, the overall density among the subareas was more even, ranging from a low of 3.8 in subarea 4 to a high of 5.4 seals per hour in subarea 1. Despite these differences in density, the number of seals collected per hour was remarkably constant among the four subareas (panel C).

Curiously, the percent of seals seen which were collected (panel D) was inversely proportional to their density (panel B) for the four subareas. The cause was probably because more effort was spent on collecting seals in areas where they were relatively scarce. Also, when seals were more abundant, others were often seen while one animal was being pursued. Further, when one or more seals were seen together, they often separated when one of them was chased.

As shown in Table B-4, 57.7% of the seals were seen alone, 33.6% were seen in pairs, and only 6.8% were in threes. One group of 12 was the largest seen.

Tables B-5 and B-6 list the wounded and lost and killed and lost rates for all years since pelagic studies were begun in 1958. A possible reason for the high (22.9%) killed and lost rate in 1974 may be in part explained by the behavior of seals in close proximity to the Pribilof Islands during the breeding season. Seals found here at this time are generally traveling, either returning to the islands to nurse their pups or leaving for the feeding grounds, and very few sleeping animals are encountered. Sleeping seals that are killed generally float because the head settles in the water and traps air in the lungs, whereas air is probably forced from the lungs of seals shot in the head (instantaneous death), causing the seal to sink immediately. Only 11 instances were recorded of animals killed and lost due to poor vessel maneuvering, and only two losses were attributed to poor weather.

Hunting effort in terms of seals seen and collected per boat-hunting day is summarized in Tables B-7 and B-8.

Age and Sex

The age and sex distribution of seals taken in 1974 is shown in Table 11. The ages of 53 males collected ranged from 2 to 7 years; 77% of the total males collected were of ages 2, 3, and 4 years (34%, 19%, and 24%, respectively). The ages of 323 females ranged from 2 to 23 years, with ages 4 through 10 comprising 72% of the total number taken. Females of ages 7 and 8 years were the largest groups, contributing 13% and 12%, respectively. Females of the same year class in the 1973 catch (ages 6 and 7 years) also represented the largest group.

Length and Weight

Mean lengths and weights are given for nonpregnant and postpartum females collected in 1974 in Tables B-9 through B-12, and for males in Tables B-13 and B-14. These data are also shown for the three pregnant females and their fetuses taken during July in Tables B-15 and B-16.

Recoveries of Marked Seals

Marked seals provide data for studying the distribution of seals at sea. Among 18 marked seals recovered in 1974 (Table 12), one female had been tagged by the USSR in 1972 on Bering Island (Commander Islands) and 17 were given marks on the Pribilof Islands. Of the 17 recoveries from the Pribilof Islands, 4 had been given tags (ages 5, 7, 10, and 17), 4 had checkmarks (seals that had lost their tags; ages 6, 8, 12, and 13), and 9 had hind flipper marks representing ages 2-, 3-, 4-, and 9-year-olds. The youngest of the marked seals were three 2-year-olds and the oldest a 17-year-old.

Reproduction

The age-specific reproductive condition and pregnancy rates of female seals collected pelagically are listed in Tables B-17 and B-18, respectively. Three gravid seals (one primiparous and two multiparous) were collected, all in July. Postpartum females (237) comprised 74% of 321[3/] females collected in 1974. In 1973, postpartum females represented 75% of the total females taken. The youngest postpartum females collected in 1974

3/ The genital tracts of an additional two females were not examined.

Table 11.--Age and sex, by month, of fur seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July				August				September				Total			
	Male		Female		Male		Female		Male		Female		Male		Female	
Years	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
2	1	5.6	-	-	15	48.4	5	2.9	2	50.0	1	3.2	18	34.0	6	1.9
3	5	27.8	-	-	4	12.9	9	5.2	1	25.0	5	16.2	10	18.9	14	4.3
4	8	44.4	9	7.7	4	12.9	17	9.8	1	25.0	7	22.7	13	24.5	33	10.2
5	3	16.7	6	5.1	4	12.9	18	10.3	-	-	4	13.0	7	13.2	28	8.7
6	1	5.6	8	6.8	1	3.2	16	9.2	-	-	2	6.4	2	3.8	26	8.0
7	-	-	12	10.2	3	9.7	29	16.7	-	-	1	3.2	3	5.7	42	13.0
8	-	-	19	16.1	-	-	19	10.9	-	-	2	6.4	-	-	40	12.4
9	-	-	16	13.6	-	-	16	9.2	-	-	1	3.2	-	-	33	10.2
10	-	-	13	11.1	-	-	17	9.8	-	-	1	3.2	-	-	31	9.6
11	-	-	8	6.8	-	-	10	5.7	-	-	-	-	-	-	18	5.6
12	-	-	5	4.2	-	-	4	2.3	-	-	1	3.2	-	-	10	3.1
13	-	-	6	5.1	-	-	3	1.7	-	-	-	-	-	-	9	2.8
14	-	-	3	2.5	-	-	5	2.9	-	-	3	9.7	-	-	11	3.4
15	-	-	3	2.5	-	-	2	1.1	-	-	-	-	-	-	5	1.6
16	-	-	5	4.2	-	-	1	0.6	-	-	2	6.4	-	-	8	2.5
17	-	-	2	1.7	-	-	2	1.1	-	-	-	-	-	-	4	1.2
18	-	-	1	0.8	-	-	-	-	-	-	-	-	-	-	1	0.3
19	-	-	1	0.8	-	-	1	0.6	-	-	-	-	-	-	2	0.6
23	-	-	1	0.8	-	-	-	-	-	-	1	3.2	-	-	2	0.6
Total	18		118		31		174		4		31		53		323	

Table 12.--Tag recoveries from fur seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	Year of tagging	Tag series	Seals tagged or marked	Tag recovery ♂	Tag recovery ♀	Seals collected in each age group 1/ ♂	Seals collected in each age group 1/ ♀
Years			Number	Number 2/		---Number---	
2	1972	Marked 3/	25,019	2	4/ 1	18	6
3	1971	Marked	24,995	1	-	10	13
4	1970	Marked	25,030	-	3	13	33
5	1971	1Y	24,995	5/ 1	-	7	28
6	1968	U	11,675	-	1(1)	2	26
7	1967	T	12,472	-	1	3	42
8	1966	S	24,580	-	1(1)	-	40
9	1965	Marked	30,087	-	3	-	33
10	1964	Q	24,991	-	1	-	31
12	1962	O	49,908	-	1(1)	-	10
13	1961	N	49,921	-	1(1)	-	9
17	1957	J	49,842	-	1	-	4

1/ Table does not include seals born in years when none were tagged or marked, nor year classes from which no tagged or marked seals were taken.

2/ Figures in parentheses indicate number of animals that had lost tags; they are included in the totals.

3/ See table A-16, Seal pups tagged and marked, Pribilof Islands, Alaska, 1965-74.

4/ Tagged on Bering Island, U.S.S.R. (HB-1287).

5/ Double tagged at age 1 year.

were seven primiparous 4-year-old seals and the oldest, one multiparous 19-year-old. Of the four subareas, 1 and 4 contributed a higher percentage of postpartum seals than did 2 or 3.

Chi-square tests give no evidence of differences in any age-specific pregnancy rate from 1973 to 1974 based on samples collected in the eastern Bering Sea. Although subarea differences in pregnancy rates for combined ages 4 and 5 years were noted for 1973, indications of subarea differences in the smaller 1974 samples were not seen. Chi-square tests comparing the data from early and late periods (areas combined) do not indicate a significant difference in the pregnancy rates of females of ages 6 years old and older in either 1973 or 1974, which were 0.90 and 0.89, respectively. For ages 4 and 5 years combined, however, the pregnancy rate value of .58 for the early period in 1973 and .47 for the early period in 1974 is nearly twice that of values for the late period in each of these years, 0.32 and 0.25, respectively. A possible explanation is that some of the 4- and 5-year-old females become sexually mature earlier than others and therefore must arrive on the Pribilof Islands in July for the breeding season. Earlier arriving 4- and 5-year-old females have higher pregnancy rates than later arriving females of these ages. Slightly lower trends in ovulation rates of mature females were noted for the smaller samples taken in 1974 for ages 5, 8, and 10 years (0.80, 0.78, and 0.74%, respectively) than in 1973 (0.96, 0.96, and 0.91%, respectively).

Table 13 gives the reproductive rates of all females of age 3 years and older collected pelagically in the eastern North Pacific Ocean by the United States since 1958.

Feeding Habits

Of 376 seals collected, 201 stomachs (53%) contained food, 173 (46%) were empty, and the stomach contents of 2 females were not examined. Seventy-four percent of the total stomach content volume of all seals was represented principally by walleye pollock (*Theragra chalcogramma*) and 12% unidentified Gadidae (Table 14). These foods were followed in order by 7% Atka mackerel (*Pleurogrammus monopterygius*), 3% deepsea smelt (Bathylagidae), 2% squids of three gonatid genera (*Gonatus*, *Berryteuthis*, and *Gonatopsis*), and 1% Greenland turbot (*Reinhardtius hippoglossoides*). These food species represented 99% of the total food volume for seals collected in 1974.

Age Years	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	197[illegible]	1958-74 combined
	Number																	
3	39 (2.6)	43 (0.0)	18 (0.0)	84 (0.0)	93 (1.1)	53 (0.0)	74 (0.0)	51 (0.0)	30 (0.0)	10 (0.0)	35 (0.0)	19 (0.0)	62 (0.0)	39 (0.0)	15 (0.0)	36 (0.0)	13 (0.0)	714 (0.3)
4	42 (2.4)	93 (6.4)	36 (2.8)	96 (1.0)	140 (2.9)	113 (7.1)	62 (1.6)	73 (0.0)	68 (1.5)	9 (0.0)	95 (5.3)	32 (3.1)	66 (0.0)	56 (0.0)	17 (0.0)	40 (15.0)	33 (39.1)	1,071 (4.1)
5	70 (45.7)	114 (56.1)	55 (49.1)	68 (20.6)	123 (26.0)	162 (43.8)	84 (35.7)	23 (26.1)	66 (27.3)	9 (11.4)	37 (37.8)	23 (34.8)	37 (35.1)	24 (25.0)	36 (13.9)	44 (59.1)	28 (53.6)	1,003 (38.4)
6	99 (80.8)	118 (77.1)	45 (80.0)	62 (75.8)	72 (54.2)	90 (74.4)	81 (75.3)	37 (56.8)	35 (71.4)	20 (60.0)	47 (76.6)	23 (56.5)	41 (63.4)	26 (69.2)	26 (50.0)	67 (80.6)	26 (80.8)	865 (76.3)
7	103 (89.3)	143 (76.2)	66 (78.8)	95 (75.8)	93 (84.9)	77 (88.3)	44 (77.3)	24 (79.2)	46 (78.3)	7 (71.4)	69 (72.5)	27 (63.0)	19 (84.2)	23 (87.0)	20 (55.0)	66 (87.8)	42 (88.1)	964 (80.4)
8	102 (89.2)	164 (86.6)	105 (85.7)	107 (79.4)	98 (89.8)	87 (97.7)	46 (84.8)	33 (84.8)	43 (79.1)	7 (85.7)	38 (78.9)	22 (72.7)	23 (82.6)	15 (80.0)	20 (80.0)	51 (96.1)	40 (95.0)	1,001 (86.6)
9	81 (96.3)	108 (88.9)	144 (92.4)	114 (93.9)	73 (83.6)	60 (85.0)	30 (83.3)	17 (70.6)	20 (100.0)	12 (100.0)	40 (82.5)	5 (100.0)	22 (77.3)	11 (54.5)	13 (61.5)	57 (89.5)	33 (93.9)	840 (88.9)
10	97 (87.6)	96 (85.4)	129 (91.5)	112 (93.8)	100 (89.0)	72 (93.1)	49 (87.8)	10 (90.0)	13 (84.6)	11 (90.9)	40 (77.5)	21 (81.0)	13 (61.5)	18 (77.8)	17 (82.4)	48 (89.6)	31 (87.1)	877 (88.1)
11	113 (92.0)	98 (89.8)	136 (91.2)	82 (89.0)	91 (89.0)	88 (94.3)	42 (85.7)	18 (83.3)	23 (78.3)	4 (100.0)	39 (76.9)	26 (73.1)	14 (78.6)	10 (80.0)	15 (93.3)	40 (97.5)	17 (100.0)	856 (89.2)
12	134 (82.0)	76 (88.2)	106 (90.6)	71 (93.0)	97 (89.7)	92 (92.4)	51 (84.3)	15 (73.3)	16 (100.0)	3 (66.7)	40 (90.0)	24 (83.3)	13 (69.2)	16 (81.2)	8 (87.5)	39 (92.3)	10 (100.0)	811 (88.0)
13	110 (82.7)	56 (89.3)	120 (87.5)	76 (82.9)	58 (94.8)	76 (90.8)	33 (84.8)	8 (100.0)	12 (100.0)	3 (100.0)	24 (83.3)	11 (36.4)	14 (64.3)	8 (100.0)	8 (100.0)	31 (93.6)	9 (88.9)	657 (86.8)
14	92 (81.5)	70 (84.3)	107 (80.4)	67 (92.5)	65 (87.7)	57 (80.7)	38 (76.3)	10 (80.0)	14 (85.7)	1 (100.0)	26 (80.8)	7 (71.4)	1 (100.0)	3 (66.7)	5 (80.0)	20 (100.0)	11 (100.0)	594 (84.0)
15	71 (78.9)	87 (88.5)	67 (83.6)	68 (79.4)	53 (81.1)	75 (85.3)	41 (65.9)	14 (78.6)	15 (93.3)	3 (66.7)	30 (86.7)	4 (100.0)	5 (100.0)	4 (50.0)	6 (66.7)	19 (100.0)	5 (100.0)	567 (82.7)
16	56 (78.6)	69 (75.4)	53 (71.7)	55 (85.5)	50 (82.0)	45 (82.2)	22 (72.7)	12 (83.3)	5 (80.0)	6 (100.0)	26 (96.2)	5 (60.0)	3 (100.0)	3 (66.7)	3 (66.7)	18 (94.4)	8 (75.0)	439 (80.4)
17	36 (56.6)	36 (80.6)	46 (67.4)	24 (62.5)	44 (72.7)	28 (71.4)	21 (61.9)	10 (80.0)	5 (40.0)	2 (0.0)	21 (81.0)	7 (57.1)	- -	2 (0.0)	2 (50.0)	4 (100.0)	4 (75.0)	292 (68.2)
18	22 (59.1)	27 (85.2)	23 (82.6)	25 (64.0)	25 (72.0)	12 (58.3)	20 (60.0)	8 (37.5)	- -	- -	11 (72.7)	4 (75.0)	6 (16.7)	3 (100.0)	1 (100.0)	6 (16.7)	1 (100.0)	194 (66.5)
19	14 (28.6)	16 (81.3)	19 (57.9)	10 (50.0)	15 (60.0)	5 (60.0)	7 (57.1)	2 (0.0)	3 (33.3)	- -	10 (60.0)	2 (50.0)	2 (0.0)	- -	1 (0.0)	2 (100.0)	2 (50.0)	110 (54.6)
20	3 (33.3)	5 (40.0)	6 (16.7)	7 (100.0)	11 (72.7)	11 (45.5)	10 (20.0)	2 (0.0)	1 (0.0)	1 (0.0)	7 (71.4)	- -	- -	1 (100.0)	- -	2 (100.0)	- -	67 (47.8)
21	1 (100.0)	7 (85.7)	6 (50.0)	2 (50.0)	3 (100.0)	4 (50.0)	- -	1 (0.0)	1 (0.0)	- -	3 (33.3)	- -	1 (0.0)	- -	- -	- -	- -	29 (58.6)
22	1 (0.0)	5 (40.0)	- -	- -	3 (66.7)	- -	- -	- -	- -	1 (0.0)	3 (0.0)	- -	- -	1 (100.0)	- -	- -	- -	14 (35.7)
23	- -	1 (0.0)	1 (0.0)	1 (0.0)	- -	2 (0.0)	1 (100.0)	1 (0.0)	- -	- -	1 (0.0)	- -	- -	- -	- -	- -	2 (0.0)	10 (10.0)
24	- -	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	4 (0.0)
26	- -	1 (0.0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (0.0)
Total	1,286 (76.1)	1,434 (73.8)	1,289 (79.7)	1,227 (68.5)	1,308 (63.4)	1,209 (69.3)	756 (58.7)	369 (45.8)	416 (52.3)	109 (61.5)	642 (61.4)	262 (53.4)	342 (40.4)	263 (44.1)	213 (50.7)	590 (77.0)	315 (76.2)	12,030 (67.0)
6-26 years	1,135 (83.3)	1,184 (83.4)	1,180 (84.4)	979 (84.3)	952 (83.2)	881 (86.0)	536 (77.0)	222 (73.4)	252 (81.3)	81 (77.8)	475 (78.9)	188 (69.7)	177 (70.6)	144 (76.4)	145 (71.0)	470 (89.8)	241 (89.6)	9,242 (82.6)

Table 14.--Stomach contents of fur seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974[1/]

Food	Summer July-August Volume Cc.	Summer July-August Volume Percent	Summer July-August Frequency Number	Fall September Volume Cc.	Fall September Volume Percent	Fall September Frequency Number	Summer-Fall July-September Volume Cc.	Summer-Fall July-September Volume Percent	Summer-Fall July-September Frequency Number
Fish									
Oncorhynchus nerka	265	0.7	1	-	-	-	265	0.5	1
Mallotus villosus	T	0.0	1	38	0.4	1	38	0.1	2
Bathylagidae	1,315	3.3	3	-	-	-	1,315	2.7	3
Gadidae	4,979	12.6	34	1,054	11.4	7	6,033	12.3	41
Theragra chalcogramma	28,876	72.8	46	7,014	76.2	8	35,890	73.5	54
Hexagrammidae	15	0.0	1	-	-	-	15	0.0	1
Pleurogrammus monopterygius	3,318	8.4	11	-	-	-	3,318	6.8	11
Ammodytes hexapterus	15	0.0	1	-	-	-	15	0.0	1
Anarhichas orientalis	-	-	-	504	5.5	2	504	1.0	2
Reinhardtius hippoglossoides	20	0.0	3	528	5.7	10	548	1.1	13
Unidentified	143	0.4	32	T	0.0	2	143	0.3	34
Squid									
Gonatidae	24	0.0	63	38	0.4	8	62	0.1	71
Gonatus sp.	41	0.1	33	39	0.4	4	80	0.2	37
Berryteuthis magister	329	0.8	4	-	-	-	329	0.7	4
Gonatopsis borealis	350	0.9	4	-	-	-	350	0.7	4
Unidentified	T	0.0	3	-	-	-	T	0.0	3
Pebbles	T	0.0	26	T	0.0	5	T	0.0	31
Organic material	T	0.0	2	-	-	-	T	0.0	2
Invertebrate	T	0.0	2	-	-	-	T	0.0	2
Amphipoda	T	0.0	2	-	-	-	T	0.0	2
Mollusca	T	0.0	13	T	0.0	2	T	0.0	15
Crustacea	T	0.0	2	-	-	-	T	0.0	2
Pelecypoda	T	0.0	1	-	-	-	T	0.0	1
Gastropoda	T	0.0	4	-	-	-	T	0.0	4
Total	39,690			9,215			48,905		
Stomachs with food	177			24			201		
Stomachs empty	163			10			173		

1/ T = trace (≤5 cc.). Trace counts are included in frequency counts.

A higher percentage of stomachs containing food were from seals collected in subareas 1 and 4 (66% and 61%) as compared to subareas 2 and 3 (51% and 56%). Walleye pollock and unidentified gadids were found in stomachs from all subareas, but were principally from those of seals taken in subareas 1 and 4 (Fig. 13). Pollock and gadids were also important in both of these subareas in 1973. The total area sampled in 1973 was much larger (20 to 100 miles) around the Pribilof Islands than in 1974 (5 to 35 miles). Although Atka mackerel occurred in all four subareas, the majority were from seals taken in subarea 4 (Fig. 14). This species was not important in 1973. The deepsea smelt was the fourth largest contributor in total food volume but was represented by only three stomachs, two from subarea 3 and one from subarea 4 in deep water. The 30 occurrences in 1973 were also found in the stomachs of seals taken in subareas 3 and 4. Squid remains of the Family Gonatidae (principally beaks) were found in all four subareas but the majority were from seals taken in subareas 3 and 4 (Figs. 15 and 16). In 1973, squid also occurred only in subareas 3 and 4. Eleven of the thirteen occurrences of Greenland turbot were from seals taken in subarea 1 (Fig. 14). The majority of occurrences of this species in 1973 was also from seals taken in subarea 1.

Relation of Food of Fur Seals to Commercial Fisheries

Sockeye salmon (*Oncorhynchus nerka*, 1 occurrence), walleye pollock (54 occurrences), and an unidentified gadid (probably walleye pollock, 41 occurrences) were the most important commercial fishes eaten by fur seals in the eastern Bering Sea. The sockeye salmon (age 2.1, length 30 cm) was identified from its scales. Walleye pollock were generally small, ranging in length from 10 to 35 cm with the majority of sub-commercial size, averaging about 19-21 cm.

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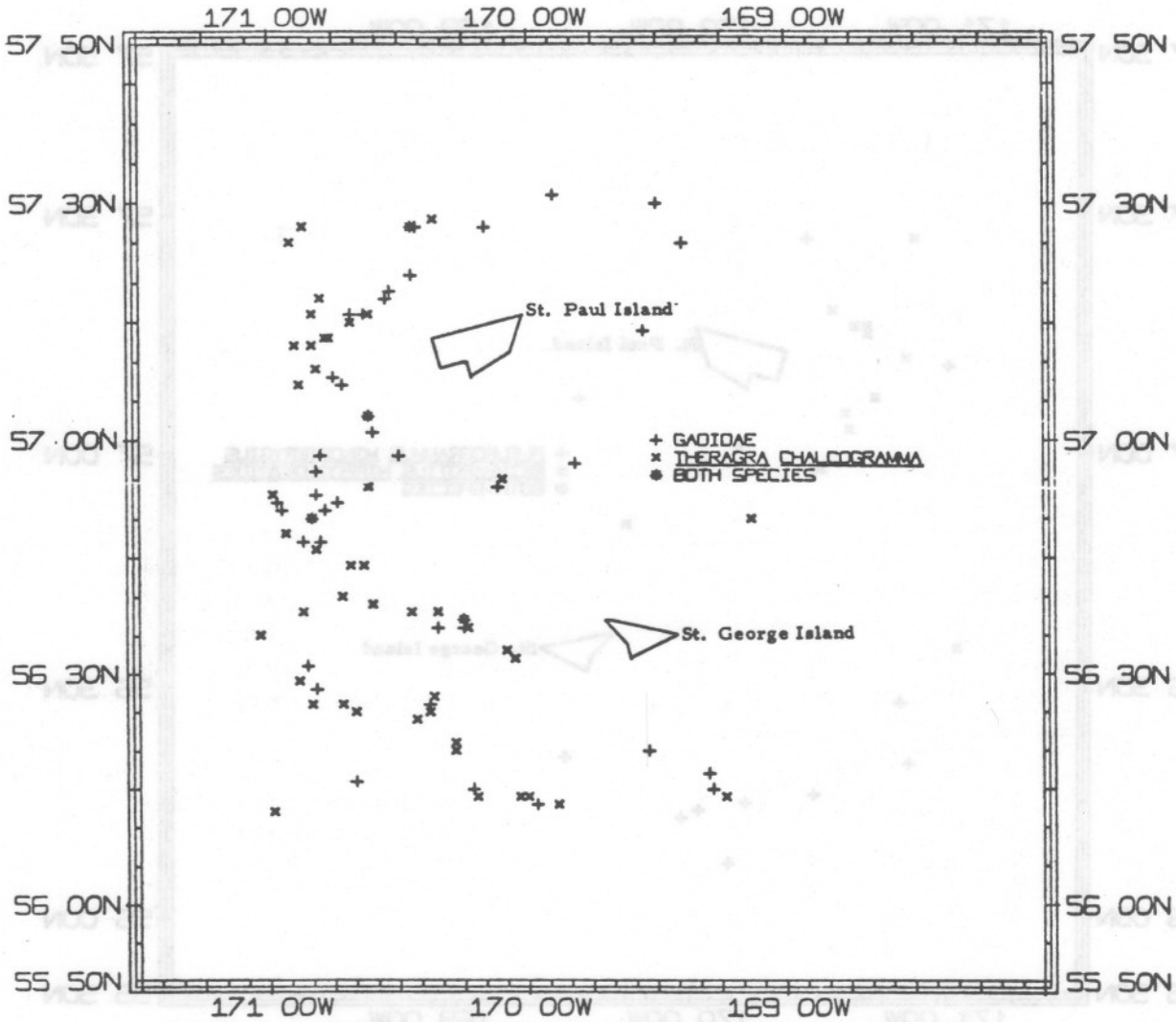

FIGURE 13.--LOCATIONS WHERE FUR SEAL STOMACHS COLLECTED IN THE BERING SEA IN 1974 CONTAINED GADIDAE (41 OCCURRENCES) AND THERAGRA CHALCOGRAMMA (54 OCCURRENCES).

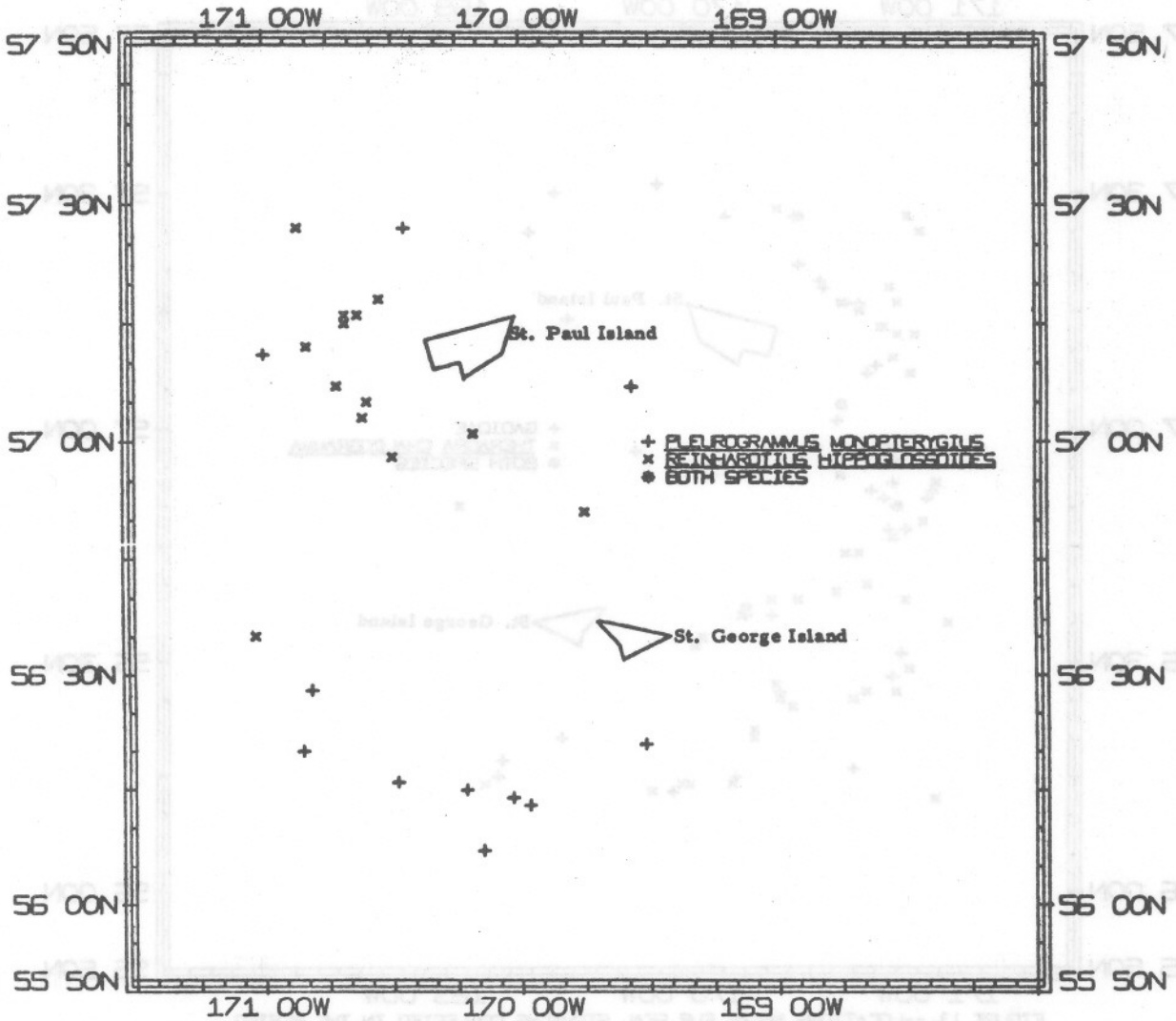

FIGURE 14.--LOCATIONS WHERE FUR SEAL STOMACHS COLLECTED IN THE BERING SEA IN 1974 CONTAINED *P. MONOPTERYGIUS* (11 OCCURRENCES) AND *R. HIPPOGLOSSOIDES* (13 OCCURRENCES).

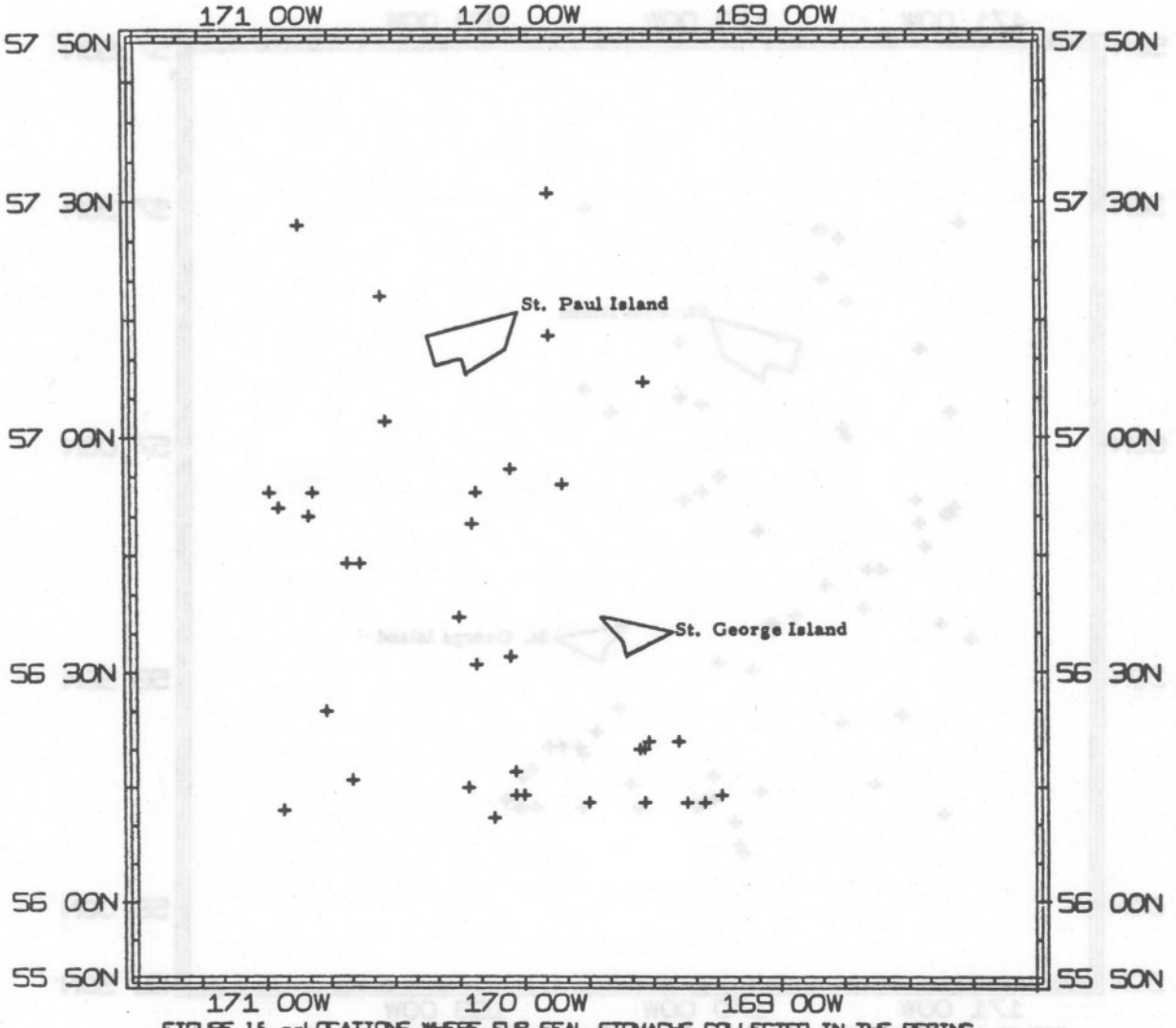

FIGURE 15.--LOCATIONS WHERE FUR SEAL STOMACHS COLLECTED IN THE BERING SEA IN 1974 CONTAINED *GONATUS* SP. (37 OCCURRENCES).

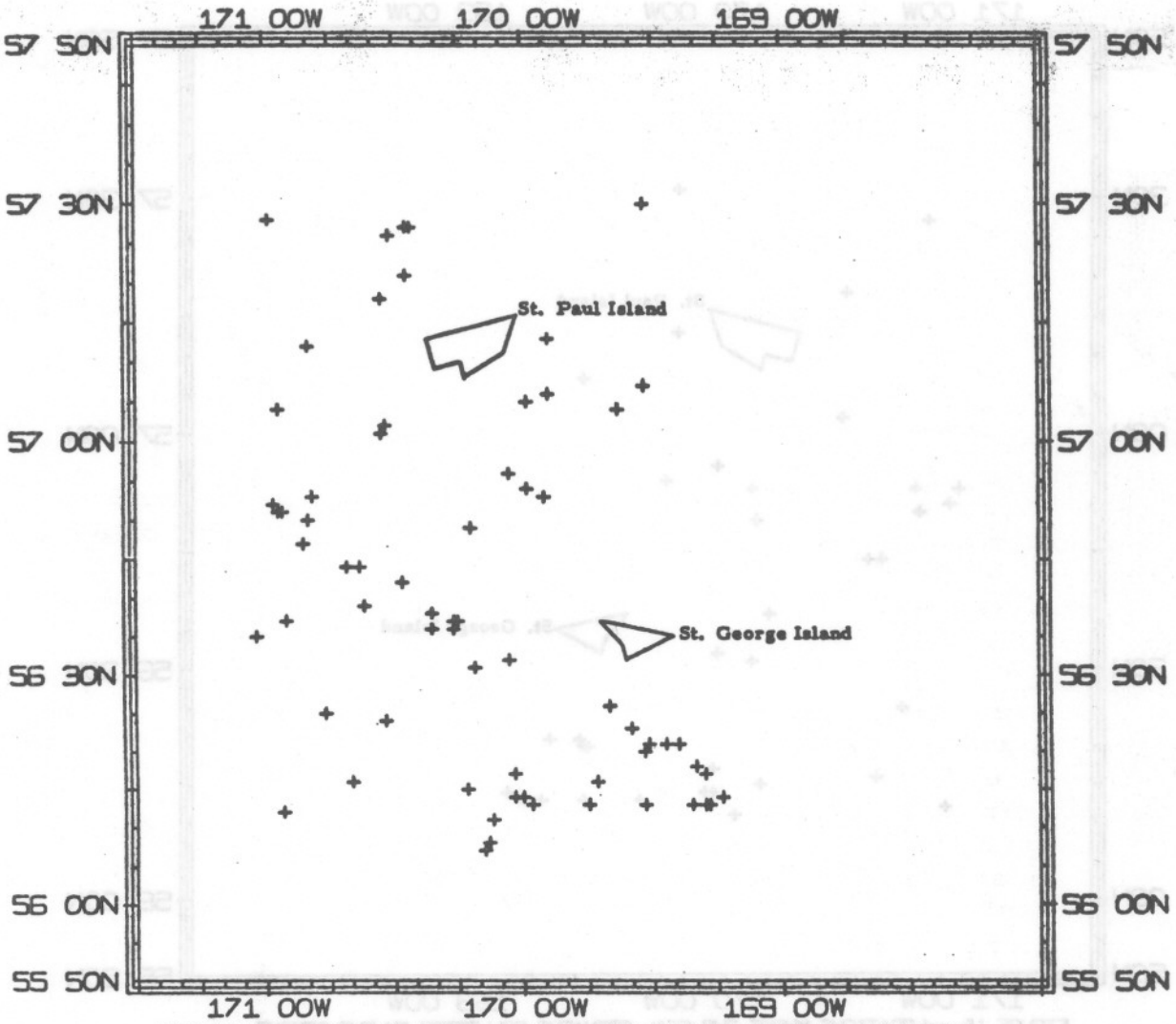

FIGURE 16.--LOCATIONS WHERE FUR SEAL STOMACHS COLLECTED IN THE BERING SEA IN 1974 CONTAINED GONATIDAE (71 OCCURRENCES).

Part VI. PHYSIOLOGY AND MEDICINE

From 1962 to 1971, veterinary medical research has concentrated on mortality of the newborn and causes of death 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. After 10 years of this approach, which has been essentially epizootiological, and after analyzing the relationship between this part of a year class' experience and survival to age 5 years, we recognize that there is very little evidence that survival at sea is, to any significant degree, dependent on what happens during the first 4 months of life spent on land and in the immediate offshore waters. This analysis consists of taking the results of over 2,000 necropsies and accompanying laboratory tests and, from a medical standpoint, concluding that none of the causes of death on land would logically have much residual effect on a pup's chances of surviving at sea. At the same time we have considerable evidence to indicate that there is no correlation between survival on land the first 4 months and survival to age 5 years. For example, the 1950 year class suffered a loss of 56,000 pups on land and returned 63,000 males to the harvest. The 1958 year class suffered only about half as much pup mortality (33,000) but produced about the same harvest (67,000). The number of pups born for these years have been estimated to be about the same. For another example, the 1954 and 1956 year classes both suffered 100,000 plus pup mortality, but one year class returned 33,000; the other only 16,000 (Chapman, In U.S. Fish and Wildlife Service, 1963).

One notable exception to this general theory is the pup's passive immunity imparted to it by the mother, either in-utero or through the colostrom of the milk. Consequently, since 1972 we have concentrated on virology, immunology, and other methods of investigating the infectious disease experience of a seal during its lifetime. This has been possible through cooperative efforts with the staff of the Naval Biomedical Research Laboratory (NBRL), which has been investigating the infectious diseases of pinnipeds in the Channel Islands, California, as well as in the Pribilof Islands, Alaska

Pathology--St. Paul Island

From 3 July to 15 August 1974, M. C. Keyes, T. R. Wilson, and E. J. Izquierdo collected 201 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, 178 were necropsied and 23 were discarded as unsuitable for examination because of advanced postmortem degeneration.

Tabulation of the primary diagnoses[4/] for pups necropsied shows that the main causes of death were hookworm disease, emaciation syndrome (formerly referred to as malnutrition), and multiple hemorrhage-perinatal complex, which together accounted for 70% of the deaths. Microbial infection, trauma, and miscellaneous were less important. Undetermined causes and pups unsuitable for examination amounted to 23.3% of the sample. In most of these cases, however, it was possible to rule out hookworm disease or emaciation syndrome as the cause (Table 15, Fig. 17, and Table A-22).

We reported in 1972 (Marine Mammal Biological Laboratory, 1972) that deaths from emaciation syndrome appeared to show cyclical increases every 3 years and correspond to increases in the total dead pup counts. We also said that deaths from hookworm disease accentuated these peaks in mortality for some years but did not seem to be cyclic. Figure 18 shows a positive correlation between the incidence of emaciation syndrome and the cyclic fluctuations in pup mortality. Since such peaks of mortality occurred in 1965, 1968, and 1971, we expected another peak in 1974. Instead of a peak, however, we detected a fall in death rate even lower than for average low years. On Study Area 1 this was owing primarily to a marked decrease in the number of pups dying from emaciation syndrome, whereas on Study Area 3 the drop was owing, in large part, to a combination of marked decreases in hookworm disease and emaciation syndrome (Fig. 19).

There are probably cyclical fluctuations of hookworm disease that act independently of the weather, but in 1974 the weather was an important factor. The entire summer was unusually mild but during the most critical time for the pups (mid-July to the first week in August) there was only one night of chilling rains. To be sure, deaths from hookworm the next day were four or five times greater than usual. Figure 18 shows that on Reef Rookery, emaciation syndrome and hookworm disease were out of phase (with each other) during the mortality peaks of 1965 and 1968, but in phase for the peak of 1971. At Northeast Point Rookery, where the

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4/ 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 (Marine Mammal Biological Laboratory, 1969).

Table 15.--Primary diagnoses for causes of death among seal pups, three mortality study areas, St. Paul Island, 3 July to 15 August 1974

Primary diagnoses	Study areas: Reef Rookery, Area 1, Dead pups		Reef Rookery, Area 2, Dead pups		Northeast Point, Area 3, Dead pups		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Emaciation syndrome	30	46.9	6	25.0	12	10.6	48	23.8
Hookworm disease	8	12.5	6	25.0	51	45.1	65	32.3
Infection (microbial)	2	3.1	3	12.5	1	0.9	6	3.0
Peritonitis	(1)	(1.5)	(2)	(8.3)	-	-	(3)	(1.5)
Pleuritis	-	-	(1)	(4.2)	(1)	(0.9)	(2)	(1.0)
Navel	(1)	(1.5)	-	-	-	-	(1)	(0.5)
Multiple hemorrhage-perinatal complex (leptospirosis)	8	12.5	2	8.3	18	15.9	28	13.9
Trauma	-	-	1	4.2	3	2.7	4	2.0
Skull fracture	-	-	(1)	(4.2)	(2)	(1.8)	(3)	(1.5)
Bite wounds	-	-	-	-	(1)	(0.9)	(1)	(0.5)
Miscellaneous	-	-	-	-	3	2.7	3	1.5
Suffocation	-	-	-	-	(1)	(0.9)	(1)	(0.5)
Acute congestive heart failure	-	-	-	-	(1)	(0.9)	(1)	(0.5)
Cleft palate	-	-	-	-	(1)	(0.9)	(1)	(0.5)
Undetermined	9	14.1	3	12.5	12	10.6	24	11.9
Unsuitable for examination	7	10.9	3	12.5	13	11.5	23	11.4
Total	64	100.0	24	100.0	113	100.0	201	100.0

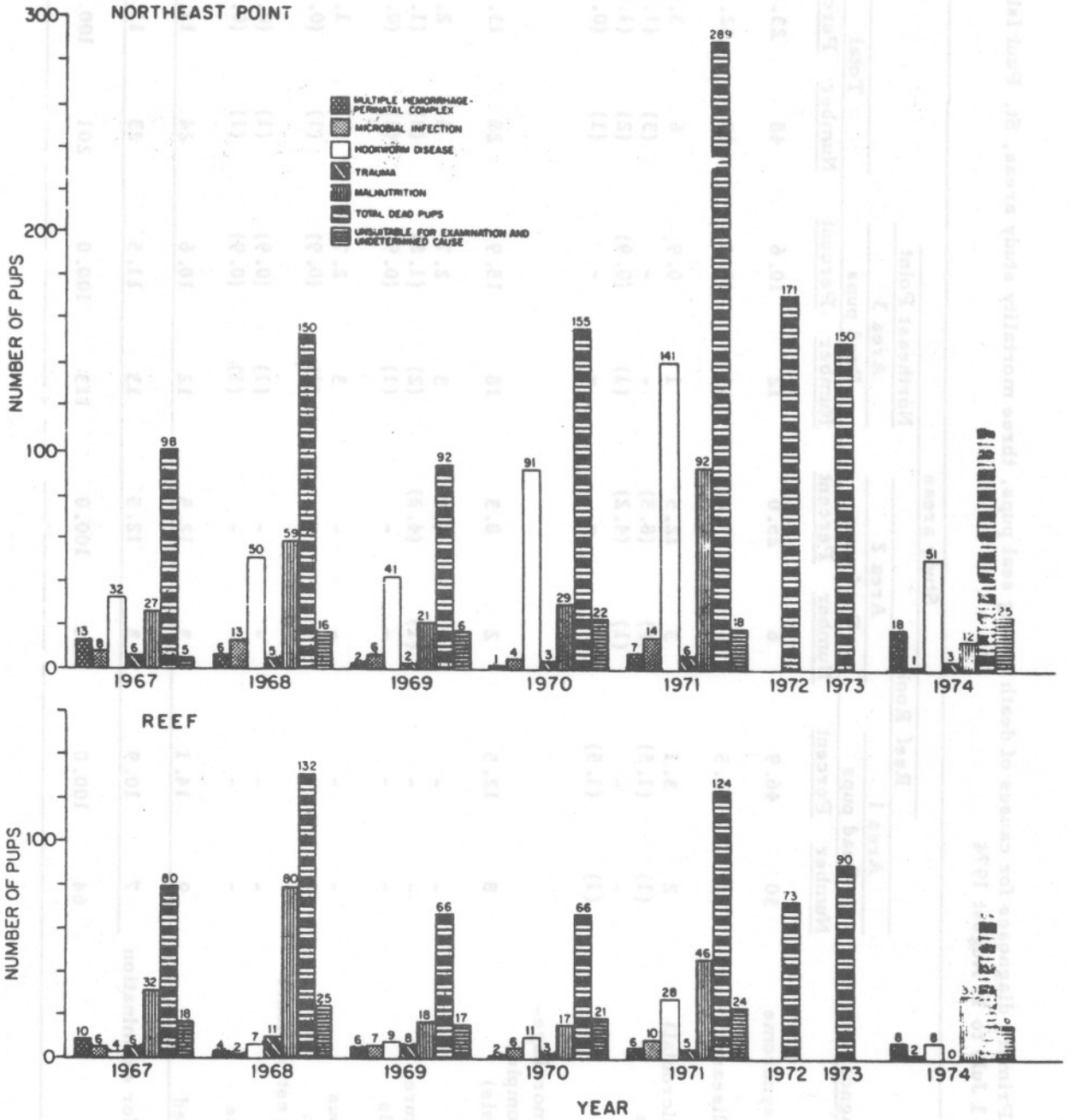

Figure 17.--Number of pups that died of various causes, Reef Rookery study area 1, and Northeast Point study area 3, 1967-74, St. Paul Island.

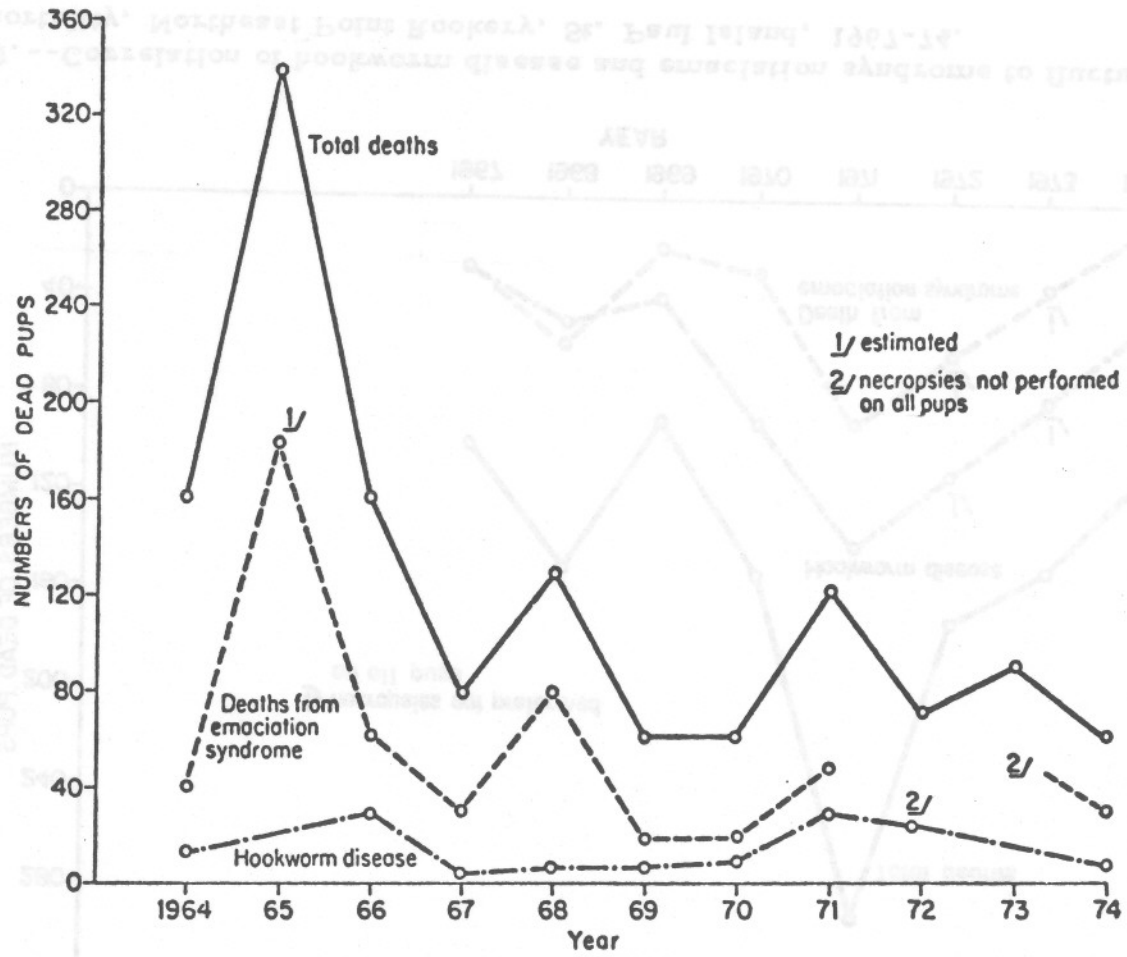

Figure 18.--Correlation of emaciation syndrome to fluctuations in mortality, Reef Rookery, St. Paul Island, 1964-74.

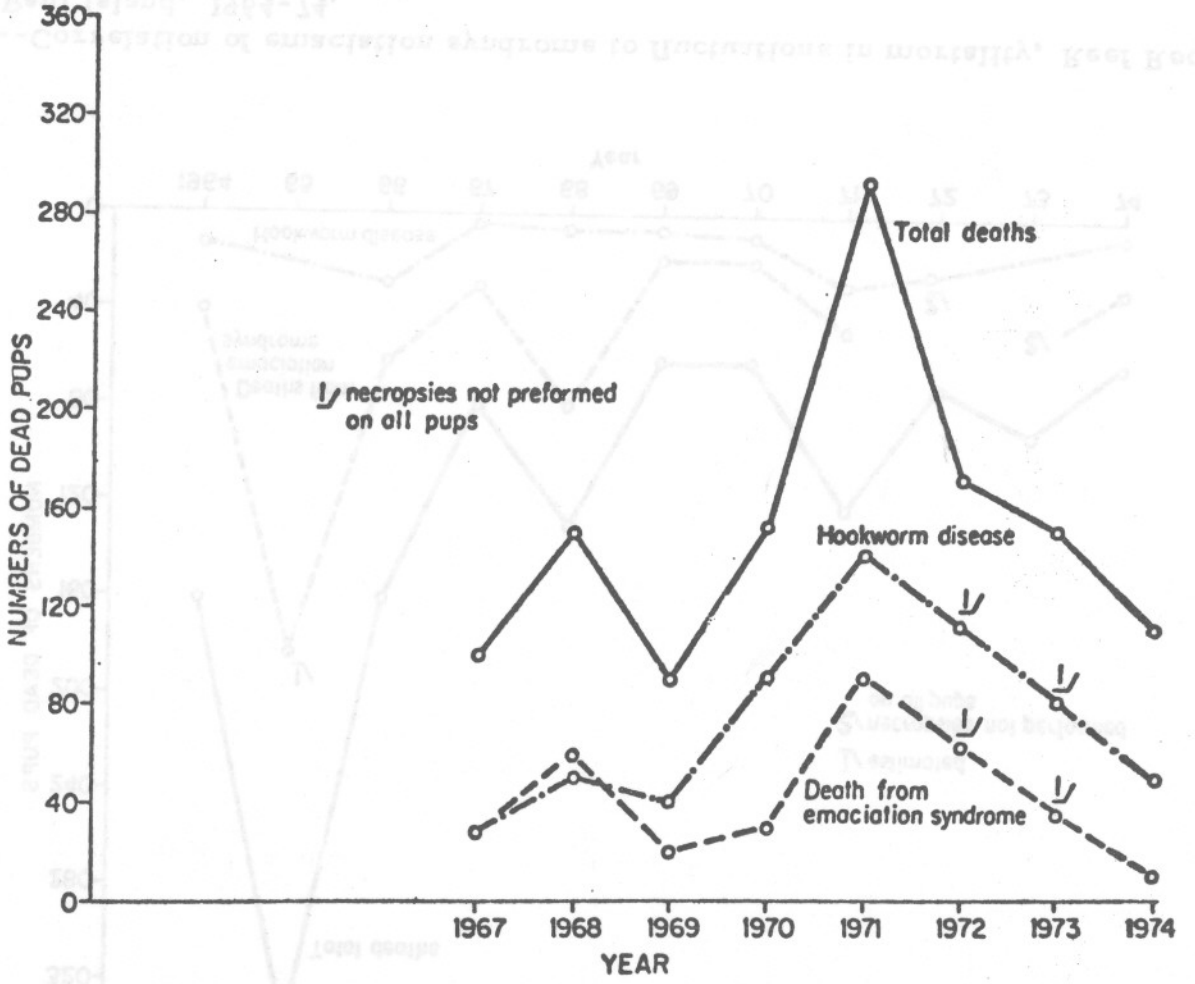

Figure 19.--Correlation of hookworm disease and emaciation syndrome to fluctuations in mortality, Northeast Point Rookery, St. Paul Island, 1967-74.

incidence of hookworm has been substantially greater, emaciation syndrome and hookworm disease are more noticeably in phase for 1971 when there was a sharp increase in mortality, and for 1974 when there was a sharp decline.

We think emaciation syndrome has been behaving like an infectious disease rather than like simple starvation (U.S. Fish and Wildlife Service, 1969), and we intend to put more emphasis on this syndrome during future infectious disease investigations.

Multiple hemorrhage-perinatal complex (MHPC) was first recognized as a syndrome in 1967 (U.S. Fish and Wildlife Service, 1970) when there was clearly an epizootic of this disease. Through cooperation of the NBRL the cause of this syndrome has been determined to be a serotype of Leptospira pomona, a spirochaete bacterium. In subsequent reports this disease will be referred to as hemorrhagic-perinatal complex of fur seals or perinatal leptospirosis of fur seals. This disease seems to be increasing in relative importance. For example, on the Northeast Point study area there were 18 cases of perinatal leptospirosis and only 12 cases of emaciation syndrome. This marks the first time the incidence of perinatal leptospirosis has exceeded the incidence of emaciation syndrome. In 1969, perinatal leptospirosis exceeded the incidence of hookworm disease on Study Area 1 at Reef.

Pathology--St. George Island

A catwalk was erected on a portion of North Rookery to establish a mortality study area from which recently dead pups could be retrieved and necropsied to determine causes of death, and eventually compare the incidence of causes on the two islands as a major yardstick of the effects of allowing the male population on St. George to increase naturally. We also arranged for the Armed Forces Institute of Pathology (AFIP) to participate in this study, and we acquired the services (at no salary) of Lt. Col. Michael A. Stedham, a board certified veterinary pathologist assigned to Walter Reed Hospital, to conduct gross and histopathology in this program. Dr. Stedham was assisted by Thomas R. Wilson. Unfortunately, subjects for study were not accessible enough from the catwalks provided; only six dead pups could be picked up during a 15-day period. Consequently, the effort was discontinued and Dr. Stedham returned to Washington, D. C.

Eleven additional pups were retrieved from Staraya Artil Rookery for a total of 17 necropsies. The causes of death were as follows: emaciation syndrome, 5; hemorrhagic-perinatal complex, 4; hookworm disease, 3; enteritis, 1; and undetermined, 4. Microscopic sections from these necropsies have been prepared at AFIP and are under study.

Histopathology--St. Paul Island

The NBRL infectious disease research team spent 85-man days on St. Paul Island 2-25 July and consisted of a board certified veterinary pathologist, a veterinary virologist, a Ph.D. microbioimmunologist, and two technicians. The team took and processed for histopathology tissues from 47 necropsies. Several hundred microscopic sections were prepared at NBRL and are now being read by the pathologist. Richard J. Brown et al (1974a; 1974b; 1975) have published some of the findings of histopathology for the last 2 years. These papers deal with three separate topics: One is the finding of atypical histiocytes morphologically similar to the mirror-image type of Reed-Sternberg cells seen in Hodgkin's lymphoma in man. Another paper deals with the identification of a renal fibrosarcoma (tumor) in a newborn fur seal, and the third paper describes sarcocystis, a protozoan parasite not previously reported in fur seals.

Microbiology--St. Paul Island

Leptospirosis

Fourteen fur seal pups that died of hemorrhagic-perinatal complex (HPC) were cultured for *Leptospira*. Samples of liver, kidney, and occasionally placenta were minced, macerated, and inoculated into enrichment media at various dilutions. This procedure resulted in 280 primary cultures which have been read four times using darkfield microscopy for a total of 1,120 darkfield procedures. *Leptospira* have been isolated from the kidney of one fur seal pup and the liver of another. These are the third and fourth *Leptospira* isolates ever made from northern fur seals. In perinatal leptospirosis, disease is caused by toxins emanating from a primary infection in the kidneys and liver of the mother and circulating in the blood of the fetus. Recovery of the organism from the fetus is unusual.

Virology

A total of 520 samples for virus isolation was collected from 28 fur seal pups and inoculated into monolayers of 5 different tissue culture cell lines to provide a wide host range and enhance the chances for virus growth and recovery. All tubes were examined microscopically each day for 1 to 8 days and frozen at -70° C at the time the cells showed cytopathogenic effects (CPE). All tubes were held for further passages in the respective cell lines. Bench work is continuing to characterize the virus isolates from the 1973 Pribilof studies. Most of the 1973 isolates were number 205, the San Miguel Sea Lion Virus which has been verified by the USDA's Plum Island Disease Station to be ~~the same as~~ indistinguishable from Vesicular Exanthema of Swine Virus (VESV).

General Bacteriology and Mycology

Pharyngeal swabs were taken on 20 normal animals from the kill field in an attempt to isolate Neisseria spp. (gonorrhea and meningitis in man) and to establish the carrier rates for this organism in normal fur seals. These samples were subcultured on selective and differential media for isolation and purification. These procedures were repeated on samples from the lower gut to isolate enteric pathogens. One complete digestive system was sampled throughout its length and tissues for histologic studies were taken at each sample site. This was to show the shift in gut flora in the different areas of the intestine and to find any microscopic lesions that might be associated with the carrier state of enteric pathogens in an otherwise normal appearing gut.

Blood cultures were made using heart blood from 12 pups that died of causes suspected to be infectious. Those positive for growth are still undergoing identification. Miscellaneous infections were cultured for bacteria and isolates are being screened for pathogenic species.

Four isolates identified as Neisseria caviae were isolated from young males from the harvest. This is the first time such bacteria have been isolated from pinnipeds, and plans are being made for the summer of 1975 to use these two species as bioindicators of the transmission potential between mother and pup.

Five Clostridia spp. have been isolated from the midgut and six atypical Escherichia coli species from the colon. The Clostridia are currently being identified for species and toxin elaboration. The E. coli have been sent to other scientists for comparison with other similar isolates from marine species. Two of the E. coli species have been found only in turtles.

Fungi are growing from the skin and hair of fur seal samples but have not yet been identified. The skin and fur of fur seals appear to be highly antimicrobial.

Serology

Serology has been completed on the 1972, 1973, and 1974 fur seal sera for SMSV serotypes 1MR, 2MR, 15FT, and 205. This activity involved running over 600 individual sera against 4 antigenic virus types employing microliter techniques. The results for number 205 are shown in Table 16. This table shows that nearly 80% carried detectable antibodies to the 205 strain. Three were positive at dilutions of one to two thousand five hundred and sixty, which is an extremely high titer. Sera from this past summer's pelagic sample and from juveniles sampled in November have not yet been tested for this serotype.

Equipment has been installed and standardized for isolation of the immunoglobulin classes in fur seals. High titer antisera to whole fur seal serum has been prepared in rabbits and preliminary immuno-electrophoreses data indicate high concentrations of IgG in 3- to 4-year-old males. Fractionation and purification of all three immunoglobulin classes is in progress.

Physiology

Hematology

Packed cell volumes (PCV's), red blood cells (RBC's), white blood cells (WBC's) and differential white counts were made on 20 fur seals.

Blood Chemistry

Sera from 20 animals were analyzed for 12 components. These were duplicate samples and are being compared to results obtained from another clinical laboratory.

Table 16.--Serologic results from San Miguel sea lion virus serotype 205, male seals ages 3-4 years, St. Paul Island, 1974

	Rookeries						
Titers	Northeast Point	Polovina	Zapadni	Reef	Lukanin	Northeast Point 1/	Total
Negative	7	9	11	4	19	5	46
1:20	2	2	-	-	1	-	5
1:40	-	2	-	1	3	1	7
1:80	2	1	3	2	4	4	16
1:160	6	4	4	5	4	3	26
1:320	10	6	10	8	6	3	43
1:640	12	12	9	10	9	2	54
1:1280	1	4	3	8	2	2	20
1:2560	-	-	-	2	1	-	3
Total	40	40	40	40	40	20	220

1972 - fur seal sera negative for 15FT and 205.

1973 - 3 sera from Little Zapadni Rookery were positive for 205 (1 at 1:60, 1 at 1:40, and 1 at 1:20).

1/ Northeast Point Rookery was sampled a second time in 1974.

Management Considerations

The latest in a series of experiments to determine the optimum technique for successful depigmentation of the skin or fur of fur seals was carried out on Zapadni Reef Rookery, St. Paul Island, 29 July 1974. 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 branding using dry ice and alcohol has been described (U.S. Fish and Wildlife Service, 1966). Ninety pups were branded on the chest and on the flipper skin of the left manus. The treatment was 5, 6, or 7 seconds for the manus, and 8, 9, or 10 seconds for the chest. All brands were fast thawed using warm water and a sponge. The brands were applied with branding instruments utilizing the angle system of numbers to indicate the duration of exposure so that the optimum technique could be readily identified (Fig. 20). Table A-22 lists pups marked by freeze branding since 1966 on St. Paul Island.

Mark C. Keyes, Alvin W. Smith,
Richard J. Brown, Neylan A. Vedros,
Eduardo J. Izquierdo, and Michael A.
Stedham[5/]

5/ Dr. Smith, Veterinary Virologist, Dr. Brown, Certified Veterinary Pathologist, and Dr. Vedros, Microbiologist, are with the Naval Biomedical Research Laboratory, Oakland, California. Dr. Izquierdo was a temporary employee of the Marine Mammal Division, NMFS, and a graduate student at the University of California. Dr. Stedham is with the Armed Forces Institute of Pathology.

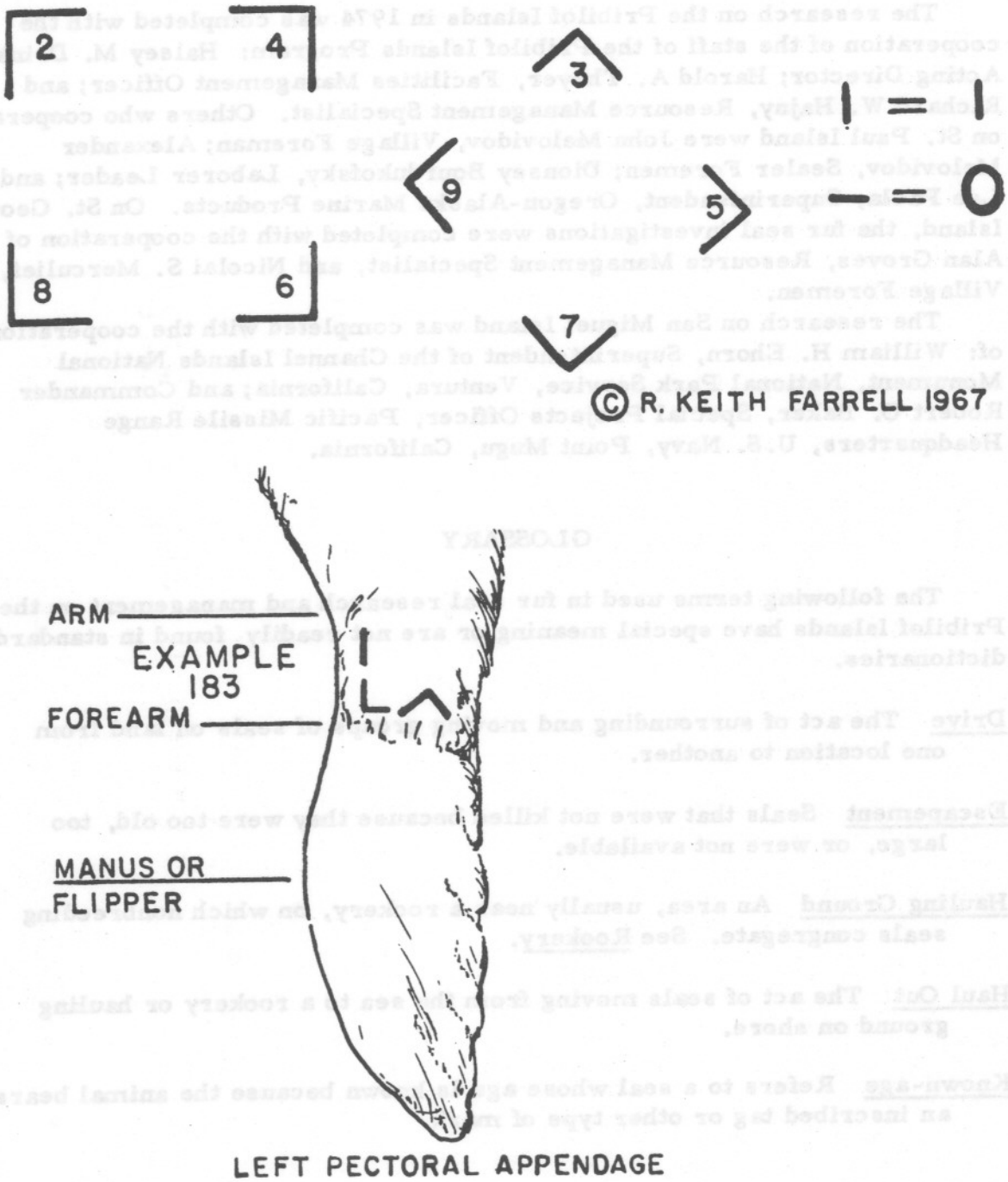

Figure 20.--System of identification symbols used as cryogenic brands applied to pups, St. Paul Island, Alaska.

ACKNOWLEDGEMENTS

The research on the Pribilof Islands in 1974 was completed with the cooperation of the staff of the Pribilof Islands Program: Halsey M. Drinkall, Acting Director; Harold A. Thayer, Facilities Management Officer; and Richard W. Hajny, Resource Management Specialist. Others who cooperated on St. Paul Island were John Melovidov, Village Foreman; Alexander Melovidov, Sealer Foremen; Dionsey Bourdukofsky, Laborer Leader; and Lee Paola, Superintendent, Oregon-Alaska Marine Products. On St. George Island, the fur seal investigations were completed with the cooperation of Alan Groves, Resource Management Specialist, and Nicolai S. Merculief, Village Foremen.

The research on San Miguel Island was completed with the cooperation of: William H. Ehorn, Superintendent of the Channel Islands National Monument, National Park Service, Ventura, California; and Commander Robert O. Baker, Special Projects Officer, Pacific Missile Range Headquarters, U.S. Navy, Point Mugu, California.

GLOSSARY

The following terms used in fur seal research and management on the Pribilof Islands have special meaning 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 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 gorwn males about age 7 and older without females and territories that are 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 on traditional hauling grounds.

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 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.

REFERENCES

Brown, Richard J., Alvin W. Smith, and Mark C. Keyes. 1974. Sarcocystis in the northern fur seal. J. Wildl. Dis. 10: 53.

Brown, Richard J., A. W. Smith, M. C. Keyes, W. P. Trevethan, and J. L. Kupper. 1974. Lesions associated with fatal hookworm infections in the northern fur seal. J. Amer. Vet. Med. Ass. 165: 804-805.

Brown, Richard J., A. W. Smith, and M. C. Keyes. 1975. Renal fibrosarcoma in the northern fur seal. J. Wildl. Dis. 11: 23-25.

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

1973. Spawner-recruit models and estimation of the level of maximum sustainable catch. Rapports et Procés-Verbaux, 164: 325-332.

Department of Commerce. 1972. News release, 12 September 1972. New seal colony discovered off southern California, NOAA 72-119.

Marine Mammal Biological Laboratory. 1971. Fur seal investigations, 1970. (Processed report.)

Marine Mammal Biological Laboratory. 1972. Fur seal investigations, 1971. (Processed report.)

Marine Mammal Division. 1974. Fur seal investigations, 1973. (Processed report.)

Peterson, Richard S., and George A. Bartholomew, Jr. 1967. The natural history and behavior of the California sea lion. Amer. Soc. Mammal., Spec. Publ. No. 1, 79 p.

Peterson, R. S., B. J. LeBoeuf, and R. L. DeLong. 1968. Fur seals from Bering Sea breeding in California. Nature, 219(5157): 899-901.

Repenning, C. A., R. S. Peterson, and C. L. Hubbs. 1971. Contributions to the systematics of the southern fur seals, with particular reference to the Juan Fernandez and Guadalupe species. In W. H. Burt (ed.), Antarctic Pinnipedia. Amer. Geophys. Union, Washington, D.C., p. 1-34.

U.S. Fish and Wildlife Service, 1963. Fur seal investigations, 1962. Spec. Sci. Rep. Fish. 454.

1969. Fur seal investigations, 1966. Spec. Sci. Rep. Fish. 584.

1970. Fur seal investigations, 1967. Spec. Sci. Rep. Fish. 597.

Table A-1.--Age classification of male seals killed on St. Paul Island, 24 June to 27 July 1974

Date	Rookery 1/	Males killed	Tooth sample	Seals in each age group of sample					Estimated seals killed from each age group				
				2	3	4	5	6	2	3	4	5	6
		Number	Number	Percent					Number				
June													
24	NEP(west)	307	63	-	19.1	68.2	11.1	1.6	-	59	209	34	5
24	NEP(east)	660	154	0.6	13.7	77.3	7.8	0.6	4	90	510	52	4
25	POL	503	131	-	9.9	69.5	19.8	0.8	-	50	349	100	4
26	TZR	586	117	1.7	15.4	65.8	16.2	0.9	10	90	386	95	5
27	ZAP	1,167	250	-	25.6	60.4	12.8	1.2	-	299	705	149	14
28	REEF	1,443	309	0.3	19.1	62.2	17.8	0.6	4	276	898	257	8
29	L-K	309	64	1.6	20.3	53.1	21.9	3.1	5	63	164	68	9
July													
1	NEP(west)	359	66	-	22.7	51.5	25.8	-	-	81	185	93	-
1	NEP(east)	799	162	-	17.9	70.4	10.5	1.2	-	143	562	84	10
2	POL	602	123	-	18.7	69.1	9.8	2.4	-	113	416	59	14
3	TZR	629	108	0.9	32.5	64.8	0.9	0.9	6	204	407	6	6
3	ZAP	461	106	0.9	29.3	67.0	2.8	-	4	135	309	13	-
5	REEF	282	55	3.6	40.0	54.6	1.8	-	10	113	154	5	-
6	L-K	277	60	1.7	28.3	66.6	1.7	1.7	5	78	184	5	5
8	NEP(west)	811	178	1.1	30.3	61.8	6.8	-	9	246	501	55	-
8	NEP(east)	1,079	195	2.6	36.9	58.0	2.0	0.5	28	398	626	22	5
9	POL	693	136	-	28.7	67.6	3.7	-	-	199	468	26	-
10	TZR	1,259	230	3.0	37.0	57.8	2.2	-	38	466	728	27	-
11	ZAP	1,760	331	1.2	45.6	51.4	1.2	0.6	21	803	905	21	10
12	REEF	1,200	224	1.8	50.9	44.6	2.7	-	22	611	535	32	-
13	L-K	616	117	-	47.0	49.6	3.4	-	-	289	306	21	-
15	NEP(west)	648	119	1.7	52.1	42.0	3.4	0.8	11	338	272	22	5
15	NEP(east)	1,435	281	1.8	48.0	47.7	2.1	0.4	26	689	684	30	6
16	POL	935	182	2.8	62.1	32.4	1.6	1.1	26	581	303	15	10
17	TZR	1,294	227	0.9	45.0	51.0	3.1	-	12	582	660	40	-
18	ZAP	596	113	7.1	52.2	38.0	2.7	-	42	311	227	16	-
19	REEF	1,793	323	3.7	54.8	38.1	3.4	-	66	983	683	61	-
20	L-K	605	116	2.6	50.0	41.4	6.0	-	16	303	250	36	-
22	NEP(west)	749	173	7.5	64.7	27.2	-	0.6	56	485	204	-	4
22	NEP(east)	1,642	251	6.0	60.1	32.7	1.2	-	98	987	537	20	-
23	POL	1,411	259	2.3	56.0	39.8	1.9	-	32	790	562	27	-
24	TZR	1,822	315	3.8	60.3	32.7	2.9	0.3	69	1,099	596	53	5
25	ZAP	2,012	389	9.0	65.5	24.2	1.0	0.3	181	1,318	487	20	6
26	REEF.	1,592	406	9.6	61.6	26.3	2.5	-	153	980	419	40	-
27	L-K	640	144	11.1	62.5	22.2	4.2	-	71	400	142	27	-

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. --Cumulative age classification of male seals killed on St. Paul Island, 24 June to 27 July 1974

Date	Rookery 1/	Estimated seals killed from each age group					Total kill	Seals killed from each age group				
		2	3	4	5	6		2	3	4	5	6
		Number						Percent				
June												
24	NEP(west)	-	59	209	34	5	307	-	19	68	11	2
24	NEP(east)	4	149	719	86	9	967	-	16	74	9	1
25	POL	4	199	1,068	186	13	1,470	-	13	73	13	1
26	TZR	14	289	1,454	281	18	2,056	-	14	71	14	1
27	ZAP	14	588	2,159	430	32	3,223	1	18	67	13	1
28	REEF	18	864	3,057	687	40	4,666	-	19	65	15	1
29	L-K	23	927	3,221	755	49	4,975	-	19	65	15	1
July												
1	NEP(west)	23	1,008	3,406	848	49	5,334	-	19	64	16	1
1	NEP(east)	23	1,151	3,968	932	59	6,133	-	19	65	15	1
2	POL	23	1,264	4,384	991	73	6,735	-	19	65	15	1
3	TZR	29	1,468	4,791	997	79	7,364	-	20	65	14	1
3	ZAP	33	1,603	5,100	1,010	79	7,825	-	21	65	13	1
5	REEF	43	1,716	5,254	1,015	79	8,107	1	21	65	12	1
6	L-K	48	1,794	5,438	1,020	84	8,384	1	21	65	12	1
8	NEP(west)	57	2,040	5,939	1,075	84	9,195	1	22	64	12	1
8	NEP(east)	85	2,438	6,565	1,097	89	10,274	1	24	64	10	1
9	POL	85	2,637	7,033	1,123	89	10,967	1	24	64	10	1
10	TZR	123	3,103	7,761	1,150	89	12,226	1	25	64	9	1
11	ZAP	144	3,906	8,666	1,171	99	13,986	1	28	62	8	1
12	REEF	166	4,517	9,201	1,203	99	15,186	1	30	60	8	1
13	L-K	166	4,806	9,507	1,224	99	15,802	1	30	60	8	1
15	NEP(west)	177	5,144	9,779	1,246	104	16,450	1	31	59	8	1
15	NEP(east)	203	5,833	10,463	1,276	110	17,885	1	33	58	7	1
16	POL	229	6,414	10,766	1,291	120	18,820	1	34	57	7	1
17	TZR	241	6,996	11,426	1,331	120	20,114	1	35	57	7	-
18	ZAP	283	7,307	11,653	1,347	120	20,710	1	35	56	7	1
19	REEF	349	8,290	12,336	1,408	120	22,503	2	37	55	6	-
20	L-K	365	8,593	12,586	1,444	120	23,108	2	37	54	6	1
22	NEP(west)	421	9,078	12,790	1,444	124	23,857	2	38	54	6	-
22	NEP(east)	519	10,065	13,327	1,464	124	25,509	2	39	52	6	1
23	POL	551	10,855	13,889	1,491	124	26,910	2	40	52	6	-
24	TZR	620	11,954	14,485	1,544	129	28,732	2	42	50	5	1
25	ZAP	801	13,272	14,972	1,564	135	30,744	3	43	49	5	-
26	REEF	954	14,252	15,391	1,604	135	32,336	3	44	48	5	-
27	L-K	1,025	14,652	15,533	1,631	135	32,976	3	45	47	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-3.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 19-23 June 1974

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Lukanin															
1	0	1	-	-	-	-	-	-	-	-	-	-	-	-	1
2	32	34	-	-	-	-	-	-	-	-	-	-	-	-	66
3	14	15	-	-	-	-	-	-	-	-	-	-	-	-	29
4	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0
5	40	0	-	-	-	-	-	-	-	-	-	-	-	-	40
Kitovi[2/]															
1	1(0)	0	2	0	0	-	-	-	-	-	-	-	-	-	3
2	13(12)	16	24	46	32	-	-	-	-	-	-	-	-	-	143
3	9(3)	4	11	10	8	-	-	-	-	-	-	-	-	-	45
4	0(0)	0	0	0	5	-	-	-	-	-	-	-	-	-	5
5	0(0)	9	0	0	35	-	-	-	-	-	-	-	-	-	44
Reef															
1	1	0	4	0	2	0	0	0	0	0	0	-	-	-	7
2	40	40	36	26	35	28	56	40	32	32	11	-	-	-	376
3	13	18	10	9	15	17	0	18	21	8	8	-	-	-	137
4	0	1	0	4	0	0	0	4	2	0	0	-	-	-	11
5	0	0	0	0	147	0	0	0	0	0	16	-	-	-	163
Gorbatch															
1	7	2	0	0	2	0	-	-	-	-	-	-	-	-	11
2	50	30	36	17	22	44	-	-	-	-	-	-	-	-	199
3	18	18	12	2	17	16	-	-	-	-	-	-	-	-	83
4	2	5	5	0	0	0	-	-	-	-	-	-	-	-	12
5	10	0	0	95	0	1	-	-	-	-	-	-	-	-	106

Table A-3.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 19-23 June 1974--Continued

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Ardiguen[3/]															
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Morjovi[4/]															
1	1(0)	2	3	1	0	4	-	-	-	-	-	-	-	-	11
2	30(19)	22	31	40	33	45	-	-	-	-	-	-	-	-	220
3	11(7)	9	11	22	14	15	-	-	-	-	-	-	-	-	89
4	0(0)	0	0	2	4	0	-	-	-	-	-	-	-	-	6
5	85(11)	0	49	0	0	71	-	-	-	-	-	-	-	-	216
Vostochni															
1	0	0	2	1	3	3	1	1	1	0	0	3	1	1	17
2	32	24	23	24	19	85	28	45	34	25	28	31	51	29	478
3	8	7	15	8	9	15	13	16	14	7	14	21	29	5	181
4	0	1	0	0	0	0	0	2	2	0	3	0	0	0	8
5	0	0	0	29	3	0	37	0	0	0	0	42	40	2	153
Little Polovina															
1	0	2	-	-	-	-	-	-	-	-	-	-	-	-	2
2	27	48	-	-	-	-	-	-	-	-	-	-	-	-	75
3	8	7	-	-	-	-	-	-	-	-	-	-	-	-	15
4	0	3	-	-	-	-	-	-	-	-	-	-	-	-	3
5	5	47	-	-	-	-	-	-	-	-	-	-	-	-	52

Table A-3.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 19-23 June 1974--Continued

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Polovina															
1	1	0	-	-	-	-	-	-	-	-	-	-	-	-	1
2	29	21	-	-	-	-	-	-	-	-	-	-	-	-	50
3	12	7	-	-	-	-	-	-	-	-	-	-	-	-	19
4	1	0	-	-	-	-	-	-	-	-	-	-	-	-	1
5	48	16	-	-	-	-	-	-	-	-	-	-	-	-	64
Polovina Cliffs															
1	0	0	0	1	0	2	5	-	-	-	-	-	-	-	8
2	23	20	26	26	32	51	71	-	-	-	-	-	-	-	249
3	7	6	7	11	14	13	17	-	-	-	-	-	-	-	75
4	0	1	0	3	0	2	0	-	-	-	-	-	-	-	6
5	1	0	0	2	0	68	0	-	-	-	-	-	-	-	71
Tolstoi															
1	1	0	1	0	4	4	3	0	-	-	-	-	-	-	13
2	31	30	32	21	46	55	43	47	-	-	-	-	-	-	305
3	15	15	15	14	20	20	12	13	-	-	-	-	-	-	124
4	0	0	0	0	0	3	0	0	-	-	-	-	-	-	3
5	0	0	0	0	0	0	0	90	-	-	-	-	-	-	90
Zapadni Reef															
1	1	0	-	-	-	-	-	-	-	-	-	-	-	-	1
2	54	25	-	-	-	-	-	-	-	-	-	-	-	-	79
3	19	7	-	-	-	-	-	-	-	-	-	-	-	-	26
4	2	0	-	-	-	-	-	-	-	-	-	-	-	-	2
5	12	22	-	-	-	-	-	-	-	-	-	-	-	-	34

Table A-3.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 19-23 June 1974--Continued

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Little Zapadni															
1	0	0	3	1	4	0	-	-	-	-	-	-	-	-	8
2	17	19	39	33	41	35	-	-	-	-	-	-	-	-	184
3	6	13	15	15	19	15	-	-	-	-	-	-	-	-	83
4	1	3	0	9	0	9	-	-	-	-	-	-	-	-	22
5	4	0	0	0	0	34	-	-	-	-	-	-	-	-	43
Zapadni[5/]															
1	0(0)	2	0	4	1	1	5	0	-	-	-	-	-	-	13
2	27(0)	47	55	62	61	25	42	10	-	-	-	-	-	-	329
3	15(0)	31	28	37	18	21	17	6	-	-	-	-	-	-	173
4	1(0)	0	3	3	11	1	0	0	-	-	-	-	-	-	19
5	0(132)	0	0	0	0	0	3	110	-	-	-	-	-	-	245

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.

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-4.--Adult male seals counted, by class[1/] and rookery section, St. George Island, 25-26 June 1974

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Zapadni[2/]							
1	-	-	-	-	-	-	0
2	-	-	-	-	-	-	20
3	-	-	-	-	-	-	8
4	-	-	-	-	-	-	0
5	-	-	-	-	-	-	0
South[3/]							
1	-	10	3	-	-	-	13
2	-	37	24	-	-	-	61
3	-	79	44	-	-	-	123
4	-	0	0	-	-	-	0
5	-	103	0	-	-	-	103
North[4/]							
1	-	1	0	0	2	-	3
2	-	16	7	22	18	-	63
3	-	54	29	49	52	-	184
4	-	3	0	0	4	-	7
5	-	107	0	0	40	-	147
East Reef[5/]							
1	-	-	-	-	-	-	1
2	-	-	-	-	-	-	26
3	-	-	-	-	-	-	28
4	-	-	-	-	-	-	0
5	-	-	-	-	-	-	12
East Cliffs							
1	0	0	-	-	-	-	0
2	16	13	-	-	-	-	29
3	41	46	-	-	-	-	87
4	0	0	-	-	-	-	0
5	0	15	-	-	-	-	15

See footnotes at end of table.

Table A-4. --Adult male seals counted, by class[1/] and rookery section, St. George Island, 25-26 June 1974--Continued

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Staraya Artil							
1	3	0	-	-	-	-	3
2	32	12	-	-	-	-	44
3	50	2	-	-	-	-	52
4	0	4	-	-	-	-	4
5	70	0	-	-	-	-	70

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

2/ The adult male seals were counted on a behavior research area only, not by numbered section.

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

4/ Count of adult male seals in section 2 includes count from section 1; count of adult male seals in section 5 includes count from section 6.

5/ No numbered sections.

Table A-5. --Adult male seals counted, by rookery, Pribilof Islands, Alaska, June 1974

Island and rookery	Date	Class of adult male 1/ 1	2	3	4	5	Total
		Number					
St. Paul Island	June						
Lukanin	19	1	66	29	0	40	136
Kitovi	19	3	143	45	5	44	240
Reef	20	7	376	137	11	163	694
Gorbatch	20	11	199	83	12	106	411
Ardiguen	20	2	62	31	0	0	95
Morjovi	21	11	220	89	6	216	542
Vostochni	21	17	478	181	8	153	837
Little Polovina	19	2	75	15	3	52	147
Polovina	19	1	50	19	1	64	135
Polovina Cliffs	19	8	249	75	6	71	409
Tolstoi	20	13	305	124	3	90	535
Zapadni Reef	20	1	79	26	2	34	142
Little Zapadni	20	8	184	83	22	43	340
Zapadni	23	13	329	173	19	245	779
Total		98	2,815	1,110	98	1,321	5,442
St. George Island							
Zapadni 2/	26	-	20	8	-	-	28
South	26	13	61	123	0	103	300
North	26	3	63	184	7	147	404
East Reef	25	1	26	28	0	12	67
East Cliffs	25	0	29	87	0	15	131
Staraya Artil	26	3	44	52	4	70	173
Total		20	243	482	11	347	1,103

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

2/ The adult males were counted on a behavior research area only.

Table A-6.--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 13 July 1974

Rookery[2/] and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	Total
	Number											
Reef												
1	4	2	1	3	2	2	0	1	1	0	0	16
2	7	13	2	7	4	2	11	4	6	6	4	66
3	51	76	66	36	53	48	51	54	56	48	23	562
4	2	4	7	5	2	0	5	15	1	0	0	41
5	0	0	0	0	81	0	20	0	0	0	9	110
Gorbatch												
1	8	6	2	0	1	0	-	-	-	-	-	17
2	1	5	1	1	0	6	-	-	-	-	-	14
3	82	72	53	25	46	76	-	-	-	-	-	354
4	3	0	0	0	3	3	-	-	-	-	-	9
5	27	0	0	65	0	0	-	-	-	-	-	92
Ardiguen[3/]												
1	-	-	-	-	-	-	-	-	-	-	-	3
2	-	-	-	-	-	-	-	-	-	-	-	0
3	-	-	-	-	-	-	-	-	-	-	-	90
4	-	-	-	-	-	-	-	-	-	-	-	0
5	-	-	-	-	-	-	-	-	-	-	-	25

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

2/ Adult males were counted on selected rookeries only.

3/ No numbered sections.

Table A-7.--Adult male seals counted, by class[1] and rookery section, St. George Island, 13-15 July 1974

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Zapadni[2]							
1	-	-	-	-	-	-	2
2	-	-	-	-	-	-	10
3	-	-	-	-	-	-	110
4	-	-	-	-	-	-	0
5	-	-	-	-	-	-	5
South[3]							
1	-	12	5	-	-	-	17
2	-	2	4	-	-	-	6
3	-	128	62	-	-	-	190
4	-	0	0	-	-	-	0
5	-	86	8	-	-	-	94
North							
1	1	0	1	5	0	8	15
2	0	1	0	0	0	0	1
3	40	27	49	62	25	53	256
4	0	1	0	8	1	2	12
5	86	1	0	0	0	42	129
East Reef[4]							
1	-	-	-	-	-	-	14
2	-	-	-	-	-	-	0
3	-	-	-	-	-	-	50
4	-	-	-	-	-	-	1
5	-	-	-	-	-	-	3
East Cliffs							
1	2	4	-	-	-	-	6
2	1	1	-	-	-	-	2
3	49	62	-	-	-	-	111
4	0	0	-	-	-	-	0
5	68	36	-	-	-	-	104

See footnotes at end of table.

Table A-7. --Adult male seals counted, by class[1/] and rookery section, St. George Island, 13-15 July 1974--Continued

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Staraya Artil							
1	8	0	-	-	-	-	8
2	3	0	-	-	-	-	3
3	46	59	-	-	-	-	105
4	0	5	-	-	-	-	5
5	44	0	-	-	-	-	44

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

2/ Adult male seals were not counted by numbered sections.

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

4/ No numbered sections.

Table A-8. --Adult male seals counted, by rookery, Pribilof Islands, Alaska, July 1974

Island and rookery	Date	Class of adult male 1/ 1	2	3	4	5	Total
		Number					
St. Paul Island 2/	July						
Reef	13	16	66	562	41	110	795
Gorbatch	13	17	14	354	9	92	486
Ardiguen	13	3	0	90	0	25	118
Total		36	80	1,006	50	227	1,399
St. George Island							
Zapadni	15	2	10	110	0	5	127
South	13	17	6	190	0	94	307
North	14	15	1	256	12	129	413
East Reef	15	14	0	50	1	3	68
East Cliffs	14	6	2	111	0	104	223
Staraya Artil	14	8	3	105	5	44	165
Total		62	22	822	18	379	1,303

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

2/ The adult male seals were counted on selected rookeries only.

Table A-9.--Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1965-74

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	-----Number----		-----Number----		-----Number-----	
1965	8,553	5,616	1,917	1,113	10,470	6,729
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

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-10.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-74

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

1/ See footnote at end of table.

Table A-10.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-74--Continued

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

1/ See footnote at end of table.

Table A-10.--Adult male seals counted, by class,[1/] rookery, and year, St. Paul Island, June 1966-74--Continued

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

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

Table A-11--Dead seal pups counted, by rookery sections, Pribilof Islands, Alaska, 23 August to 13 September 1974

Island and rookery	Section 1	2	3	4	5	6	7	8	9	10	11	Total
	Number											
St. Paul Island 1/												
Reef	126	201	195	169	208	105	203	129	114	92	38	1,580
Gorbatch	378	311	228	39	109	123	-	-	-	-	-	1,188
Ardiguen 2/	-	-	-	-	-	-	-	-	-	-	-	111
Total												2,879
St. George Island 3/												
North	-	-	-	-	-	-	-	-	-	-	-	545
Zapadni	-	-	-	-	-	-	-	-	-	-	-	278
South	-	-	-	-	-	-	-	-	-	-	-	196
East Reef	-	-	-	-	-	-	-	-	-	-	-	59
East Cliffs	-	-	-	-	-	-	-	-	-	-	-	275
Staraya Artil	-	-	-	-	-	-	-	-	-	-	-	4/ -
Total												1,353

1/ Dead pups counted on selected rookeries only.

2/ No numbered sections.

3/ Dead pups not counted by numbered sections.

4/ Dead pups not counted.

Table A-12.--Dead seal pups counted,[1/] by rookery, Pribilof Islands, Alaska, 1965-74

Island and rookery	1965	1966	1967	1968	1969	1970	1971	1972	1973[2/]	1974[2/]
	Number									
St. Paul Island										
Morjovi	2,649	1,686	1,072	2,285	734	1,618	4,773	2,187	-	-
Vostochni	4,214	2,785	1,969	4,195	1,711	3,330	8,280	4,701	-	-
Little Polovina	1,132	449	233	509	200	337	1,207	372	-	-
Polovina Cliffs	2,856	809	825	1,616	836	1,636	5,445	1,566	-	-
Polovina	1,176	312	319	487	327	475	980	345	-	-
Ardiguen	459	160	90	118	112	75	373	161	-	111
Gorbatch	3,123	1,593	874	1,446	823	974	2,405	1,332	-	1,188
Reef	7,664	3,562	2,008	3,064	1,365	2,221	4,103	1,686	-	1,580
Kitovi	2,202	406	522	755	652	679	1,854	559	-	-
Lukanin	1,126	432	240	597	460	401	1,224	494	-	-
Tolstoi	3,955	3,425	2,251	3,315	2,778	3,580	5,147	3,540	3,613	-
Little Zapadni	2,461	1,634	1,098	1,781	798	1,386	3,223	1,686	1,783	-
Zapadni Reef	723	451	380	685	177	308	673	505	661	-
Zapadni	5,384	3,710	2,195	4,445	2,306	3,561	6,752	3,515	3,851	-
Counted total	39,124	21,414	14,076	25,298	13,279	20,581	46,439	22,649	9,908	2,879
Estimated oversight 5%	1,956	1,071	704	1,265	664	1,029	2,322	1,132	495	144
Total	41,080	22,485	14,780	26,563	13,943	21,610	48,761	23,781	10,403	3,023
St. George Island										
North	1,854	1,561	971	1,567	444	866	1,862	1,032	1,153	545
Zapadni	1,263	1,196	578	1,197	260	636	1,058	464	450	474
East	676	764	201	824	187	522	638	372	506	334
Staraya Artil	1,186	1,152	770	1,055	640	1,243	1,662	616	552	3/-
Counted total	4,979	4,673	2,520	4,643	1,531	3,267	5,220	2,484	2,661	1,353
Estimated oversight 5%	249	234	126	232	76	163	261	124	133	68
Total	5,228	4,907	2,646	4,875	1,607	3,430	5,481	2,608	2,794	1,421
Pribilof Islands counted total	44,103	4/26,087	16,596	29,941	14,810	23,848	51,659	25,133	12,569	4,232
Estimated oversight 5%	2,205	1,305	830	1,497	740	1,192	2,583	1,256	628	212
Total	46,308	27,392	17,426	31,438	15,550	25,040	54,242	26,389	13,197	4,444

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-13.--Seals marked as pups and recovered at ages 2-5 years, St. Paul Island, 24 June to 27 July 1974

Mark[1/]	Age Years	Total Number
Hind flipper (LH1)	2	13
Hind flipper (RH1)	2	70
Hind flipper (LH3)	3	828
Hind flipper (RH3)	3	68
Hind flipper (LH2)	4	938
Hind flipper (RH2)	4	53
Hind flipper (LH1)	5	136
Hind flipper (RH1)	5	28

1/ Seals marked by removing the tip of the 1st, 2d, or 3d digit from the left or right hind flipper, e.g., (LH1) = tip of the first digit removed from the left hind flipper.

Table A-14. --Tag recoveries[1/] from male seals that had been selected and tagged as yearlings in previous years, St. Paul Island, 1974

Year tagged and tag series	Age when: Tagged Years	Recovered Years	Total Number
1970			
1W	1	5	1
1W	2	6	4
1971			
1Y	1	4	13
1Y	2	5	31
1Y	3	6	2
1Y		[2/] Unknown	8

1/ In addition to the seals listed, 18 males that had lost both tags were taken.

2/ The tags were recovered but age could not be determined because the flippers or the heads were separated from the carcasses during the skin-stripping process.

Table A-15.--Soviet tags recovered in the United States harvest of fur seals, St. Paul Island, 24 June to 27 July 1974

Date	Tag number	Age Years	Sex	Island of tagging	Rookery of recovery
22 July	HB-8410, HB-8487	2	M	Bering	Northeast Point
27 July	EB-655	3	M	Bering	Lukanin-Kitovi
22 July	EB-1190	3	M	Bering	Northeast Point
8 July	EB-8355, EB-8369	3	M	Bering	Northeast Point
24 July	EM-5055	3	M	Medny	Tolstoi-Zapadni Reef
22 July	EM-6257	3	M	Medny	Northeast Point
3 July	EM-8236	3	M	Medny	Zapadni
15 July	EM-9471	3	M	Medny	Northeast Point
22 July	CB-9088	4	M	Bering	Northeast
11 July	CM-1413, CM-1414	4	M	Medny	Zapadni
27 June	CM-3045, CM-3046	4	M	Medny	Zapadni
22 July	CM-3771, CM-3772	4	M	Medny	Northeast Point
10 July	CM-5693, CM-5694	4	M	Medny	Tolstoi-Zapadni Reef
10 July	CM-5835, CM-5836	4	M	Medny	Tolstoi-Zapadni Reef
24 July	CM-6262	4	M	Medny	Tolstoi-Zapadni Reef
15 July	CM-6408	4	M	Medny	Northeast Point
10 July	CM-8037	4	M	Medny	Tolstoi-Zapadni Reef
2 July	CM-8283	4	M	Medny	Polovina
27 July	CM-8941	4	M	Medny	Lukanin-Kitovi
22 July	CM-9458	4	M	Medny	Northeast Point
8 July	CM-9496	4	M	Medny	Northeast Point
15 July	CM-9559	4	M	Medny	Northeast Point
24 July	BB-8704, BB-8786	5	M	Bering	Tolstoi-Zapadni Reef
28 June	BM-9610	5	M	Medny	Reef

Table A-16.--Seal pups tagged and marked, Pribilof Islands, Alaska, 1965-74

Year	Series	St. Paul Island	St. George Island	Location of tag	Checkmarks or marks
		------Number---------			
1965	R 1-10000	10,000		Left front flipper	"V" notch near tip left front flipper
	Marked	10,007		Not tagged	"V" notch near tip right front flipper
	Marked	10,080		---do.---	Tip of 1st digit (big toe) on right hind flipper sliced off
966	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

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

Table A-17. --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-18.--Tags applied to fur seals for studies of behavior. St. George Island, 1974

	Tag number	Age/sex class	Rookery
Monel tags, white, X-series			
	30-37	Adult males	Zapadni
	38-41	Adult females	East Reef
	132-134	- do -	- do -
	164-187	- do -	- do -
	71-125 1/	Subadult males	Zapadni
	135-163 2/	- do -	- do -
Monel tags, not colored, no letter series			
	106-130	Adult females	Zapadni
Plastic "Roto" tags, yellow			
	26-100	Male pups	East Reef
Plastic "Roto" tags, white			
	26-63	Female pups	East Reef

1/ Except number 98 which was attached to a female on the hauling grounds, Zapadni.

2/ Except number 150 which was attached to a female on the hauling grounds, Zapadni.

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, 1968-74.

Tag Number	1968	1969	1970	1971	1972	1973	1974	Sex	Island of Origin	Date Tagged
E-2818	21 July	---	11 Aug.	22 July	29 June	6 July	---	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	---	---	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	---	F	St. Paul	1962
R-8179	---	1 Oct.	---	---	---	---	---	F	St. Paul	1965
J-4937	---	18 Aug.2/	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.	---	F	St. George	1961
N-31432	---	---	---	7 July	12 July	3 July	---	F	St. Paul	1961
Q-20975	---	---	---	10 July	---	---	---	F	St. Paul	1964
R-8844	---	---	---	8 Aug.	27 Aug.	19 July	---	F	St. Paul	1965
T-24	---	---	---	7 Aug.	12 July	25 July	---	F	St. George	1967
T-9697	---	---	---	19 Aug.	2 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	---	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	F	Robben	1966
BB-1364	---	---	---	---	7 Sept.	---	9 Aug.	F	Bering	1969
AM-8302	---	---	---	---	---	---	14 Aug.	F	Medny	1968
U-697	---	---	---	---	---	---	5 July	F	St. George	1968
U-579	---	---	---	---	---	---	1 Sept.	F	St. George	1968

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.

Table A-20.--Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-74.

Tag Number	Tag placement	Date observed 1969	Date observed 1970	Date observed 1971	Date observed 1972	Date observed 1973	Date observed 1974
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
-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.	---	---
-3943	L	31 July	20 July	22 July	14 July	---	---
UC-3944	R	15 Aug.	17 July	2 July	---	18 July	---
-3945	L	14 Aug.	20 July	14 June	27 June	---	15 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
-3975	R	---	---	---	---	5 Aug.	---

See footnote at end of table.

Table A-20.--Northern fur seals tagged on San Miguel Island in 1968 and the dates first observed, 1969-74.-- continued.

Tag Number	Tag placement	Date observed 1969	Date observed 1970	Date observed 1971	Date observed 1972	Date observed 1973	Date observed 1974
UC-3976	R	2 Sept.	---	---	---	---	---
-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.
-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.	---
UC-3993	R	16 Aug.	11 Sept.	4 July	---	---	---
-3994	L	---	17 Aug.	4 July	---	---	27 July
UC-3995	L	---	16 Aug.	---	11 Aug.	---	11 Aug.
-3996	R	---	21 July	---	13 Aug.	---	28 July
UC-3997	L	---	---	24 July	---	---	---
-3998	R	---	---	21 July	---	4 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.--Primary diagnoses for causes of death among 201 seal pups, by 7-day periods, St. Paul Island, 3 July to 15 August 1974

Cause of death	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-Malnutrition complex	0	2	7	13	13	9	4	48
Hookworm disease	0	1	20	10	17	15	2	65
Microbial infection	0	2	1	1	1	0	1	6
Trauma	0	3	0	0	1	0	0	4
Perinatal complex	1	5	21	1	0	0	0	28
Miscellaneous	0	0	2	1	0	0	0	3
Undetermined	1	6	6	3	5	0	3	24
Total	2	19	57	29	37	24	10	178
Unsuitable for examination	3	10	2	3	4	1	0	23
Total	5	29	59	32	41	25	10	201
Advanced post mortem degeneration	3	13	3	7	4	1	0	31

Table A-22.--Seal pups marked by freeze branding, St. Paul Island, 1966-74

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

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 B-1.--List of chart units occupied by a research vessel in eastern Bering Sea, 17-31 July 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected 1/

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H147-V314	0.3	0.0	0	0
H147-V315	1.8	5.0	9	1
H147-V316	0.7	4.2	3	1
H147-V317	0.9	1.1	1	0
H147-V318	1.1	2.7	3	0
H148-V319	3.1	2.9	9	3
H148-V320	3.9	3.5	14	9
H148-V321	2.8	5.3	15	2
H148-V322	1.3	5.3	7	3
H148-V323	3.3	3.3	11	1
H148-V324	1.5	5.3	8	2
H148-V325	0.3	6.6	2	1
H149-V320	0.8	3.7	3	1
H149-V321	0.8	3.7	3	1
H149-V322	1.4	4.2	6	1
H149-V323	1.1	3.6	4	1
H149-V324	2.8	3.9	11	4
H150-V317	1.8	6.6	12	3
H150-V318	1.3	3.8	5	2
H150-V319	3.9	6.9	27	7
H150-V320	6.5	4.9	32	7
H150-V321	4.3	3.7	16	5
H150-V322	2.4	6.6	16	3
H150-V323	1.8	5.5	10	4
H151-V316	7.7	5.0	39	17
H151-V317	0.7	4.3	3	2
H151-V318	2.5	4.4	11	2
H151-V319	3.5	7.4	26	6
H151-V320	0.5	8.0	4	0
H151-V321	1.3	3.0	4	1
H151-V322	4.6	4.7	22	4
H151-V323	2.0	7.5	15	3

1/ See footnote at end of table.

Table B-1.--List of chart units occupied by a research vessel in eastern Bering Sea, 17-31 July 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]--Continued

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H151-V324	1.5	4.0	6	2
H152-V313	0.4	0.0	0	0
H152-V314	0.6	0.0	0	0
H152-V315	0.7	1.4	1	0
H152-V316	5.5	5.0	28	10
H152-V317	1.0	4.0	4	2
H152-V323	3.8	4.4	17	4
H152-V324	5.4	3.1	17	3
H153-V314	1.2	5.0	6	3
H153-V315	1.6	1.8	3	1
H153-V316	0.7	1.4	1	1
H153-V317	0.6	1.6	1	0
H153-V318	0.7	1.4	1	1
H153-V319	1.0	4.0	4	2
H153-V320	3.3	3.9	13	2
H153-V321	2.9	5.8	17	4
H153-V322	4.1	5.6	23	2
H153-V323	1.7	7.0	12	2

1/ The base chart is National Ocean Survey Chart No. 8802. The sides of each unit are 10 minutes of latitude by 10 minutes of longitude. The units are located by a system of vertical column and horizontal row numbers. Vertical column numbering begins at the lower right corner of chart (fig. 9) and horizontal row numbering begins at the lower left corner.

Table B-2.--List of chart units occupied by a research vessel in eastern Bering Sea, 1-31 August 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H146-V313	0.7	2.8	2	0
H146-V314	4.4	4.3	19	8
H146-V315	4.6	5.4	25	6
H146-V316	3.3	3.9	13	1
H146-V317	3.1	2.2	7	3
H146-V318	3.1	3.5	11	3
H146-V319	3.9	4.8	19	8
H146-V320	2.8	2.8	8	2
H146-V321	0.9	4.4	4	2
H146-V322	3.6	3.3	12	1
H146-V323	4.1	1.7	7	1
H146-V324	3.1	4.8	15	3
H146-V325	2.0	3.0	6	0
H147-V313	0.3	0.0	0	0
H147-V314	1.6	6.2	10	1
H147-V315	2.8	6.0	17	5
H147-V316	6.3	9.0	57	14
H147-V318	0.8	1.2	1	0
H147-V319	0.8	3.7	3	0
H147-V320	2.2	4.5	10	3
H147-V321	5.8	3.4	20	6
H147-V322	2.8	5.7	16	7
H147-V323	3.3	6.3	21	6
H147-V324	2.1	3.8	8	4
H148-V313	0.5	0.0	0	0
H148-V319	2.6	1.9	5	1
H148-V320	2.5	2.4	6	3
H148-V321	2.0	4.0	8	5
H148-V324	1.7	5.2	9	4
H148-V325	0.4	17.5	7	2
H149-V313	0.4	0.0	0	0
H149-V314	2.7	4.0	11	4

1/ See footnote at end of table.

Table B-2.--List of chart units occupied by a research vessel in eastern Bering Sea, 1-31 August 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]--Continued

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H149-V315	1.9	4.2	8	2
H149-V316	0.2	0.0	0	0
H149-V322	2.0	4.5	9	3
H149-V323	2.4	5.0	12	4
H149-V324	2.2	2.7	6	1
H150-V313	1.9	0.5	1	1
H150-V314	1.8	6.1	11	1
H150-V315	1.7	2.3	4	0
H150-V316	0.9	1.1	1	0
H150-V317	5.7	5.2	30	8
H150-V318	7.1	5.0	36	10
H150-V319	5.2	7.6	40	12
H150-V320	2.8	9.6	27	5
H150-V321	0.2	0.0	0	0
H150-V322	2.0	7.5	15	6
H150-V323	4.0	3.7	15	4
H150-V324	5.4	4.4	24	6
H151-V314	1.1	1.8	2	0
H151-V315	1.4	6.4	9	1
H151-V316	2.9	3.7	11	4
H151-V318	0.3	3.3	1	0
H151-V319	1.4	5.0	7	0
H151-V322	0.8	7.5	6	3
H152-V313	2.2	0.9	2	0
H152-V314	0.8	1.2	1	0
H152-V317	2.4	2.9	7	1
H152-V318	2.4	4.1	10	2
H152-V321	0.8	2.5	2	0
H152-V322	2.4	7.9	19	2
H153-V313	1.4	2.1	3	0
H153-V314	2.1	3.8	8	0
H153-V315	2.1	2.8	6	1

1/ See footnote at end of table.

Table B-2.--List of chart units occupied by a research vessel in eastern Bering Sea, 1-31 August 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]--Continued

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H153-V316	2.3	4.3	10	0
H153-V317	1.3	2.3	3	1
H153-V318	1.8	5.5	10	2
H153-V319	2.3	6.0	14	1
H153-V320	2.5	6.0	15	0
H153-V321	5.5	5.8	32	9
H153-V322	1.0	6.0	6	1
H153-V323	4.9	5.3	26	6
H153-V324	2.6	5.0	13	1
H154-V315	0.4	2.5	1	0
H154-V316	1.2	5.8	7	2
H154-V317	0.7	7.1	5	1
H154-V318	1.3	3.8	5	1

1/ The base chart is National Ocean Survey Chart No. 8802. The sides of each unit are 10 minutes of latitude by 10 minutes of longitude. The units are located by a system of vertical column and horizontal row numbers. Vertical column numbering begins at the lower right corner of chart (fig. 10) and horizontal row numbering begins at the lower left corner.

Table B-3.--List of chart units occupied by a research vessel in eastern Bering Sea, 1-9 September 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H146-V316	0.4	2.5	1	0
H146-V317	0.8	1.2	1	0
H146-V318	0.7	1.4	1	0
H146-V319	0.8	0.0	0	0
H146-V320	0.7	0.0	0	0
H146-V321	0.7	1.4	1	0
H147-V313	0.8	1.2	1	0
H147-V314	0.9	3.3	3	1
H147-V315	1.0	1.0	1	0
H147-V316	0.6	3.3	2	0
H147-V322	1.1	3.6	4	0
H147-V323	1.9	5.7	11	1
H147-V324	1.4	3.5	5	0
H148-V313	1.7	4.1	7	0
H148-V314	1.6	0.0	0	0
H148-V315	1.1	7.2	8	0
H148-V322	0.5	2.0	1	1
H148-V323	1.1	2.7	3	0
H148-V324	0.4	5.0	2	1
H149-V315	0.8	2.5	2	0
H149-V316	1.1	1.8	2	0
H149-V317	0.2	0.0	0	0
H149-V320	1.8	3.3	6	1
H149-V321	1.2	5.0	6	1
H149-V322	0.7	2.8	2	0
H149-V324	1.1	2.7	3	0
H150-V317	0.9	2.2	2	1
H150-V318	0.4	0.0	0	0
H150-V319	0.2	5.0	1	0
H150-V320	1.8	6.1	11	1
H150-V321	3.2	4.6	15	1
H150-V322	0.6	10.0	6	2

1/ See footnote at end of table.

Table B-3.--List of chart units occupied by a research vessel in eastern Bering Sea, 1-9 September 1974, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/]--Continued

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
H150-V324	1.9	1.0	2	0
H151-V317	0.3	0.0	0	0
H151-V318	1.2	5.8	7	1
H151-V319	0.2	5.0	1	0
H151-V320	0.2	5.0	1	1
H151-V322	1.1	6.3	7	1
H151-V323	2.7	7.7	21	2
H151-V324	1.8	4.4	8	1
H152-V322	1.7	5.2	9	5
H152-V323	3.6	8.6	31	10
H152-V324	2.1	2.3	5	1
H153-V322	1.3	3.8	5	0
H153-V323	2.9	1.7	5	0
H153-V324	3.0	4.0	12	2

1/ The base chart is National Ocean Survey Chart No. 8802. The sides of each unit are 10 minutes of latitude by 10 minutes of longitude. The units are located by a system of vertical column and horizontal row numbers. Vertical column numbering begins at the lower right corner of chart (fig. 11) and horizontal row numbering begins at the lower left corner.

Table B-4 .--Number of seals per group among 1,752 seals sighted in the eastern Bering Sea, 17 July to 9 September 1974

Number of seals in group	Group Number	Seals Number	Seals Percent
1	1,011	1,011	57.7
2	294	588	33.6
3	40	120	6.8
4	4	16	0.9
5	1	5	0.3
12	1	12	0.7
Total	1,351	1,752	100.0

Table B-5.--Total seals shot, percentage collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-74

Year	Total seals shot	Seals shot					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958	2,060	1,503	73.0	302	14.6	255	12.4
1959	2,150	1,548	72.0	316	14.7	286	13.3
1960	2,007	1,495	74.5	271	13.5	241	12.0
1961	1,652	1,352	81.8	176	10.7	124	7.5
1962	1,794	1,483	82.7	178	9.9	133	7.4
1963	1,700	1,355	79.7	202	11.9	143	8.4
1964	1,048	883	84.3	97	9.3	68	6.4
1965	514	419	81.5	50	9.7	45	8.8
1966	589	444	75.4	78	13.2	67	11.4
1967 1/	181	132	72.9	27	14.9	22	12.2
1968 2/	1,000	830	83.0	66	6.6	104	10.4
1969	417	334	80.1	41	9.8	42	10.1
1970	552	405	73.4	78	14.1	69	12.5
1971	460	353	76.7	44	9.6	63	13.7
1972	320	257	80.3	19	5.9	44	13.8
1973	850	675	79.4	56	6.6	119	14.0
1974	550	376	68.4	48	8.7	126	22.9
Total	17,844	13,844	77.6	2,049	11.5	1,951	10.9

1/ Includes 16 days during November and December 1966.

2/ Includes 25 days during November and December 1967.

Table B-6.--Total seals sighted, collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-74

Year	Total seals sighted 1/	Sighted seals					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958	7,024	1,503	21.4	302	4.3	255	3.6
1959	5,919	1,548	26.2	316	5.3	286	4.8
1960	6,287	1,495	23.8	271	4.3	241	3.8
1961	3,415	1,352	40.0	176	5.2	124	3.6
1962	6,111	1,483	24.3	178	2.9	133	2.2
1963	5,790	1,355	23.4	202	3.5	143	2.5
1964	2,864	883	30.8	97	3.4	68	2.4
1965	1,627	419	27.8	50	3.1	45	2.8
1966	2,704	444	16.4	78	2.9	67	2.5
1967 2/	897	132	14.7	27	3.0	22	2.5
1968 3/	2,587	830	32.1	66	2.6	104	4.0
1969	1,136	334	29.4	41	3.6	42	3.7
1970	1,983	405	20.4	78	3.9	69	3.5
1971	1,323	353	26.7	44	3.3	63	4.8
1972	849	257	30.3	19	2.2	44	5.2
1973	2,386	675	28.3	56	2.3	119	5.4
1974	1,752	376	21.5	48	2.7	126	7.2
Total	54,654	13,844	25.3	2,049	3.8	1,951	3.6

1/ Not all seals sighted are hunted.

2/ Includes 16 days during November and December 1966.

3/ Includes 25 days during November and December 1967.

Table B- 7.--Number of seals collected, and number collected per boat-hunting day, by 10-day periods,[1] eastern Bering Sea, 17 July to 9 September 1974

Period	Boat hunting days[2]	Seals collected			Seals collected per boat-hunting day	
		Males	Females	Total		
	Number				Number	Percent
17-20 July	4.00	1	36	37	9.2	9.8
21-31 July	7.75	17	82	99	12.8	26.3
1-10 Aug.	8.75	20	113	133	15.2	35.4
11-20 Aug.	5.25	5	31	36	6.8	9.6
21-31 Aug.	5.00	6	30	36	7.2	9.6
1-9 Sept.	6.00	4	31	35	5.8	9.3
Total	36.75	53	323	376	10.2	100.0

1/ The first and last periods were less than 10 days.

2/ A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table B-8.--Number of seals seen, and number seen per boat-hunting day, by 10-day periods,[1] eastern Bering Sea, 17 July to 9 September 1974

Period	Boat-hunting days[2]	Total seals seen	Seals seen per boat-hunting day	Seals seen per 10-day interval
	Number			Percent
17-20 July	4.00	172	43.0	11.0
21-31 July	7.75	333	43.0	21.3
1-10 Aug.	8.75	434	49.6	27.7
11-20 Aug.	5.25	225	42.8	14.4
21-31 Aug.	5.00	178	35.6	11.4
1-9 Sept.	6.00	222	37.0	14.2
Total	36.75	1,564	42.6	100.0

1/ The first and last periods were less than 10 days.

2/ A boat-hunting day is one in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table B-9.--Monthly mean lengths of nonpregnant female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	No.	Cm.	No.	Cm.	No.	Cm.	No.	Cm.	Cm.
2	-	-	5	102.0	1	92.0	6	100.3	4.80
3	-	-	9	107.4	4	107.5	13	107.5	3.36
4	5	113.2	13	116.4	6	113.8	24	115.1	4.32
5	1	109.0	10	115.5	2	117.5	13	115.3	5.75
6	-	-	5	120.8	-	-	5	120.8	-
7	1	128.0	4	123.0	-	-	5	124.0	-
8	1	127.0	1	128.0	-	-	2	127.5	-
9	1	131.0	1	124.0	-	-	2	127.5	-
10	2	129.5	2	127.5	-	-	4	128.5	-
13	1	134.0	-	-	-	-	1	134.0	-
16	2	125.5	-	-	-	-	2	125.5	-
17	-	-	1	126.0	-	-	1	126.0	-
19	1	133.0	-	-	-	-	1	133.0	-
23	1	134.0	-	-	1	130.0	2	132.0	-
Total	1/16		51		1/14		81		

1/ One 11-year-old seal collected in July and one 3-year-old seal collected in September not included.

Table B-10.--Monthly mean weights of nonpregnant female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

	July		August 1/		September		Combined weight		
Age Years	Seals No.	Mean weight Kg.	Seals No.	Mean weight Kg.	Seals No.	Mean weight Kg.	Seals No.	Mean Kg.	Standard deviation Kg.
2	-	-	5	19.4	1	15.0	6	18.7	2.25
3	-	-	9	23.3	4	21.5	13	22.8	2.59
4	5	27.2	13	28.2	6	24.3	24	27.0	5.16
5	1	28.0	9	28.3	2	24.5	12	27.7	4.46
6	-	-	5	31.4	-	-	5	31.4	-
7	1	33.0	4	33.8	-	-	5	33.6	-
8	1	40.0	1	35.0	-	-	2	37.5	-
9	1	38.0	1	36.5	-	-	2	37.3	-
10	2	38.0	2	38.0	-	-	4	38.0	-
13	1	43.0	-	-	-	-	1	43.0	-
16	2	38.0	-	-	-	-	2	38.0	-
17	-	-	1	36.0	-	-	1	36.0	-
19	1	47.0	-	-	-	-	1	47.0	-
23	1	54.0	-	-	1	58.0	2	56.0	-
Total	2/ 16		50		2/ 14		80		

1/ Weight of one 5-year-old seal missing.

2/ One 11-year-old seal collected in July and one 3-year-old seal collected in September not included.

Table B-11.--Monthly mean lengths of post partum female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	No.	Cm.	No.	Cm.	No.	Cm.	No.	Cm.	Cm.
4	4	114.3	4	117.8	1	119.0	9	116.3	4.50
5	4	110.5	8	115.9	2	114.5	14	114.1	4.69
6	8	120.8	11	119.3	2	111.5	21	119.1	6.28
7	11	121.5	25	121.2	1	124.0	37	121.3	4.68
8	18	122.4	18	122.8	2	120.0	38	122.5	4.27
9	15	125.9	15	121.1	1	125.0	31	123.5	5.93
10	11	122.3	15	123.9	1	132.0	27	123.6	5.40
11	6	125.8	10	125.9	-	-	16	125.9	4.69
12	5	123.4	4	126.3	1	126.0	10	124.8	5.73
13	5	125.8	3	127.0	-	-	8	126.3	6.45
14	3	127.7	5	121.6	3	131.3	11	125.9	8.09
15	2	130.0	2	125.5	-	-	4	127.8	-
16	3	129.7	1	127.0	2	118.5	6	125.5	6.60
17	2	125.0	1	131.0	-	-	3	127.0	-
18	1	140.0	-	-	-	-	1	140.0	-
19	-	-	1	131.0	-	-	1	131.0	-
Total	98		123		16		237		

Table B-12.--Monthly mean weights of post partum female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

	July		August 1/		September		Combined weight		
Age	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	Kg.
4	4	26.3	4	25.5	1	30.0	9	26.3	2.96
5	4	25.5	8	29.1	2	31.5	14	28.4	3.74
6	8	32.8	11	30.3	2	30.0	21	31.2	4.47
7	11	32.4	25	33.3	1	31.0	37	33.0	4.12
8	18	34.3	18	34.2	2	35.0	38	34.3	3.31
9	15	34.6	15	32.8	1	36.0	31	33.8	5.13
10	11	34.4	15	35.0	1	43.0	27	35.0	4.88
11	6	35.3	10	37.8	-	-	16	36.9	4.11
12	5	32.6	4	38.6	1	44.0	10	36.2	6.06
13	5	40.0	3	45.7	-	-	8	42.1	8.48
14	3	44.3	5	37.4	3	46.7	11	41.8	7.19
15	2	48.0	2	38.0	-	-	4	43.0	-
16	3	40.7	-	-	2	38.0	5	39.6	-
17	2	36.0	1	44.0	-	-	3	38.7	-
18	1	52.0	-	-	-	-	1	52.0	-
19	-	-	1	46.0	-	-	1	46.0	-
Total	98		122		16		236		

1/ Weight of one 16-year-old seal missing.

Table B-13.--Monthly mean lengths of male seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	No.	Cm.	No.	Cm.	No.	Cm.	No.	Cm.	Cm.
2	1	104.0	15	105.1	2	111.5	18	105.8	4.93
3	5	116.8	4	114.8	1	115.0	10	115.8	6.80
4	8	125.3	4	124.5	1	126.0	13	125.1	4.19
5	3	132.0	4	133.0	-	-	7	132.6	5.77
6	1	122.0	1	129.0	-	-	2	125.5	-
7	-	-	3	154.7	-	-	3	154.7	-
Total	18		31		4		53		

Table B-14.--Monthly mean weights of male seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July		August		September		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	Kg.
2	1	22.0	15	23.6	2	22.5	18	23.4	4.07
3	5	32.7	4	26.5	1	31.0	10	30.1	8.45
4	8	37.5	4	34.3	1	44.0	13	37.0	6.17
5	3	46.8	4	45.0	-	-	7	45.8	5.74
6	1	42.0	1	45.0	-	-	2	43.5	-
7	-	-	3	70.7	-	-	3	70.7	-
Total	18		31		4		53		

Table B-15.--Monthly mean lengths and weights of pregnant female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	July		
	Seals	Mean length	Mean weight
Years	Number	Cm.	Kg.
5	1	125.0	42.0
11	1	135.0	56.0
15	1	151.0	52.0
Total	3		

Table B-16.--Monthly mean lengths and weights of fur seal fetuses collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Period	Male			Female		
	Fetuses	Mean length	Mean weight	Fetuses	Mean length	Mean weight
	Number	Cm.	Kg.	Number	Cm.	Kg.
11-20 July	1	65.0	5.5	-	-	-
21-31 July	-	-	-	2	64.0	5.8

Table B-17. --Reproductive condition of female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

Age	Sample size	Immature	Mature: Post partum 1/	Mature: Ovulated
		July		
4	9	5	4	4
5	6	1	5(1)	2
6	8	-	8	7
7	12	1	11	10
8	19	-	18	13
9	16	-	15	15
10	13	-	11	9
11	7	-	7(1)	5
12	5	-	5	4
13	6	-	5	5
14	3	-	3	2
15	3	-	3(1)	2
16	5	-	3	5
17	2	-	2	2
18	1	-	1	1
19	1	-	-	1
23	1	-	-	-
Total	117	7	101(3)	87
		August		
2	5	5	-	-
3	9	9	-	-
4	17	13	4	2
5	18	10	8	8
6	16	5	11	10
7	29	3	25	25
8	19	-	18	16
9	16	-	15	14
10	17	-	15	13
11	10	-	10	10
12	4	-	4	4
13	3	-	3	3
14	5	-	5	5
15	2	-	2	1
16	1	-	1	1
17	2	-	1	2
19	1	-	1	1
Total	174	45	123	115

1/ See footnote at end of table.

Table B-17.--Reproductive condition of female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974--Continued

Age	Sample size	Immature	Mature: Post partum 1/	Mature: Ovulated
		September		
2	1	1	-	-
3	4	4	-	-
4	7	6	1	1
5	4	2	2	2
6	2	-	2	2
7	1	-	1	-
8	2	-	2	2
9	1	-	1	1
10	1	-	1	1
12	1	-	1	1
14	3	-	3	3
16	2	-	2	1
23	1	-	-	1
Total	30	13	16	15
		July-September		
2	6	6	-	-
3	13	13	-	-
4	33	24	9	7
5	28	13	15 (1)	12
6	26	5	21	19
7	42	4	37	35
8	40	-	38	31
9	33	-	31	30
10	31	--	27	23
11	17	-	17 (1)	15
12	10	-	10	9
13	9	-	8	8
14	11	-	11	10
15	5	-	5(1)	3
16	8	-	6	7
17	4	-	3	4
18	1	-	1	1
19	2	-	1	2
23	2	-	-	1
Total	321	65	240 (3)	217

1/ Figures in parentheses indicate pregnant seal and are included in total.

le B-18.--Pregnancy rates of female seals collected pelagically by the United States in the eastern Bering Sea, 17 July to 9 September 1974

	July			August			September			Combined data	
	Seals	Pregnant		Seals	Pregnant		Seals	Pregnant		July-Sept. Pregnant	1958-74 pelagic collections Pregnant
es	Number	Number	Percent	Number	Number	Percent	Number	Number	Percent	Percent	Percent
	-	-	-	5	-	0.0	1	-	0.0	0.0	-
	-	-	-	9	-	0.0	4	-	0.0	0.0	0.3
	9	4	44.4	17	4	23.5	7	1	14.3	27.3	4.1
	6	5	83.3	18	8	44.4	4	2	50.0	53.6	38.4
	8	8	100.0	16	11	68.8	2	2	100.0	80.8	76.3
	12	11	91.7	29	25	86.2	1	1	100.0	88.1	80.4
	19	18	94.7	19	18	94.7	2	2	100.0	95.0	86.6
	16	15	93.8	16	15	93.8	1	1	100.0	93.9	88.9
	13	11	84.6	17	15	88.2	1	1	100.0	87.1	88.1
	7	7	100.0	10	10	100.0	-	-	-	100.0	89.2
	5	5	100.0	4	4	100.0	1	1	100.0	100.0	88.0
	6	5	83.3	3	3	100.0	-	-	-	88.9	86.8
	3	3	100.0	5	5	100.0	3	3	100.0	100.0	84.0
	3	3	100.0	2	2	100.0	-	-	-	100.0	82.7
	5	3	60.0	1	1	100.0	2	2	100.0	75.0	80.4
	2	2	100.0	2	1	50.0	-	-	-	75.0	68.2
	1	1	100.0	-	-	-	-	-	-	100.0	66.5
	1	-	0.0	1	1	100.0	-	-	-	50.0	54.6
	1	-	0.0	-	-	-	1	-	0.0	0.0	10.0

Appendix C

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1974

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. & Monitoring
Patrick Kozloff	--do.--	Do.
Richard L. Foust	--do.--	Do.
Roger L. Gentry	--do.--	Seal research, behavior
James H. Johnson	--do.--	Do.
Clifford H. Fiscus	--do.--	Do.
Willman M. Marquette	--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.
Mark C. Keyes	--do.--	Seal research, physiology and medicine
Lavrenty Stepetin	St. Paul Island resident	Seal research, Mgmt. & Monitoring
Temporary employees		
Robert E. Atkinson	MMD	Seal reseach, pelagic
George H. Burkhardt	--do.--	Do.
Gilbert Hamilton	--do.--	Do.
Robert D. Everitt	--do.--	Do.
George A. Antonelis, Jr.	--do.--	Seal research, behavior
Rebecca J. McGee	--do.--	Do.
Mark Ryan	--do.--	Do.
Eleanora H. D'Arms	--do.--	Do.
Maxim Malavansky	St. George Is. resident	Seal research, behavior
Philbert D. Merculief	--do.--	Do.
Alvin Merculief	--do.--	Do.
George McGlashan	--do.--	Do.

1/ See footnote at end of table.

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1974--Continued

Name	Affiliation 1/	Work
Temporary employees		
Thomas R. Wilson	--do.--	Seal research, physiology & medicine
Eduardo J. Izquierdo	--do.--	Do.
Perfenia Pletnikoff, Jr.	Student, Alaska Methodist U.	Seal research, Mgmt. & Monitoring
Jacob N. Merculief	Student, Oregon State U.	Do.
M. Richard Zacharof	St. Paul Island resident	Do.
Agafon Krukoff, Jr.	--do.--	Do.
Cooperators		
Thomas G. Akers	NBRL	Seal research, physiology & medicine
Alvin W. Smith	--do.--	Do.
Richard J. Brown	--do.--	Do.
Neylan Vedros	--do.--	Do.
Henry Bray	--do.--	Do.
Douglas Skilling	--do.--	Do.
Michael Stedham	Armed Forces Inst. of Pathology	Do.
Ke Chung Kim	Penn. State U.	Seal research, entomology
David Shetlar	--do.--	Do.
Visiting Scientists and Observers		
Carmen J. Blondin	Commissioner, NPFSC	
Victor B. Scheffer	Chairman, MMC	
Douglas G. Chapman	Member, Sci. Comm. MMC	
Michael F. Tillman	MMD	
Jacqueline Jennings	Asst. MMRC, Wash. D.C.	
Michael A. Bigg	FRBC	
Ian B. MacAskie	--do.--	
G. Fredrik Chelnokov	TINRO, USSR	
N. Valeriy Mineer	CRF, USSR	
Vyacheslav Vasiliev	OMF, USSR	
Tadayoshi Ichihara	FSRL, Japan	Seal research, behavior

1/ See footnote at end of table.

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1974--Continued

1/ MMD = Marine Mammal Division
NBRL = Naval Biomedical Research Laboratory
FSRL = Far Seas Research Laboratory
NPFSC = North Pacific Fur Seal Commission
MMC = Marine Mammal Commission
MMRC = Marine Mammal Research Coordinator
FRBC = Fisheries Research Board of Canada
TINRO = Pacific Research Institute of Fisheries and Oceanography
CRF = Conservation and Regulations of Fisheries
OMF = Office of Minister of Fisheries