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NATIONAL MARINE FISHERIES SERVICE

FUR SEAL INVESTIGATIONS, 1970

by

Marine Mammal Biological Laboratory

National Marine Fisheries Service

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by
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ABSTRACT

Data was collected on the Pribilof Islands and at sea within the period March to October 1970.

In 1970, a kill of 53,700 male seals was forecasted; the actual kill included 42,121 males and 120 females.

Counts of living adult males were 9,035 in June and 9,354 in July.

Counts of dead fur seals included 25,040 pups and 233 animals older than pups. The main causes of death among 221 pups were hookworm disease, malnutrition, infection, trauma, and perinatal complex.

Male pup weights averaged 10.2 kg and females 9.0 kg.

We marked 25,919 pups of both sexes and 3,779 male seals of ages 1-4 years, and recovered 3,473 marked male seals.

Tag loss varies with tag series and for some appears to increase with age; apparently tagged animals suffer greater mortality than untagged seals.

The pup population in 1966 was estimated at 437,000 from one method and 388,000 from another; an estimated 306,000 pups were born in 1970.

Estimates of the survival of males from the 1966 year class to age 1 and 2 yielded 102,232 and 57,826, respectively.

Of 1,886 seals sighted off Washington, 403 were collected, 78 were wounded and lost, and 67 were killed and lost.

Single seals were sighted more frequently than were groups of 2 or more.

Twenty yearling seals from the 1969 year class were taken and 67 percent of 368 female seals killed were from 1 to 7 years old. Nineteen marked female seals were collected.

Thirty-three percent of the nonpregnant female seals in ages 4 to 21 years apparently had ovulated.

Squids were the leading food species consumed by fur seals in 299 stomachs containing food. Northern anchovy, rockfish, salmonids, and Pacific herring followed in importance. Salmon were the most valuable commercial fish eaten by fur seals off Washington.

Part I. FUR SEAL INVESTIGATIONS, PRIBILOF ISLANDS, ALASKA, 1970

The primary objective of conducting fur seal research on the Pribilof Islands is to determine the level at which the herd will produce a maximum sustained yield. The investigations satisfy obligations to the "Interim Convention for Protection of North Pacific Fur Seals" and produce the information needed to manage the resource. This report summarizes the data collected in 1970.

Figures 1 and 2 show the locations of breeding grounds on the Pribilof Islands, and 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. Two of the five Pribilof Islands, Otter and Walrus, do not have fur seal rookeries.

Alton Y. Roppel

AGE CLASSIFICATION AND NUMBER OF SEALS KILLED, BY SEX

All males without manes on the hauling grounds in 1970 were killed; a minimum body length limit was last used in 1968. Seals were taken from 24 June to 31 July beginning at 6 a.m. Monday through Saturday of each week on St. Paul Island, and on St. George Island beginning at 9 a.m. on Mondays, Wednesdays, and Fridays.

Females were not to be taken in 1970, however, 120 were mistaken for males and killed. The ages of these animals were not determined.

A kill of 42, 121 males in ages 2 to 6 included 36, 197 taken on St. Paul Island and 5, 924 from St. George Island (tables A-1 to A-4). The age composition of the kill on each island was determined daily by rookery from right upper canine teeth collected from 20 percent of the males killed.

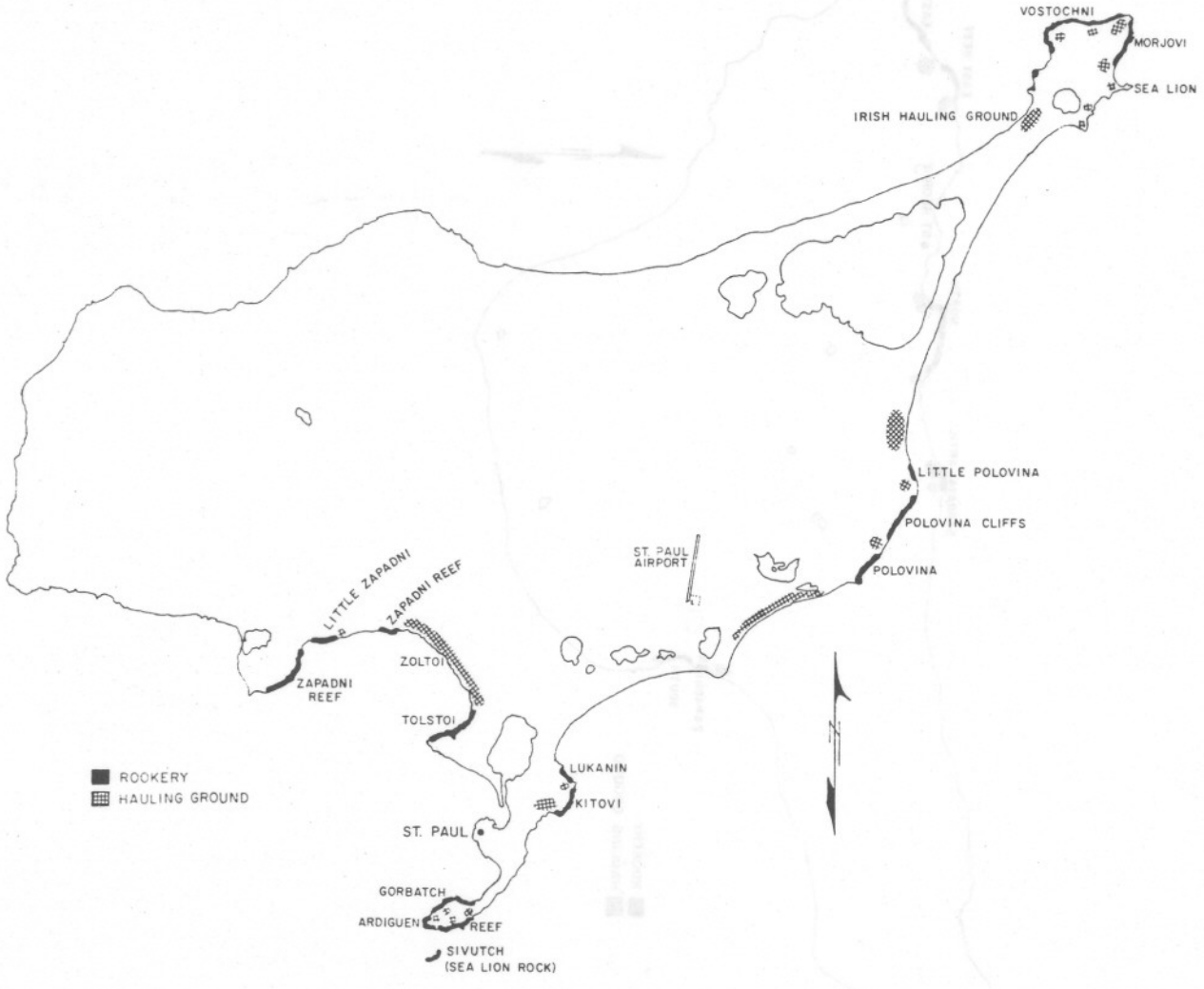


Figure 1. --Location of rookeries and hauling grounds, St. Paul Island.

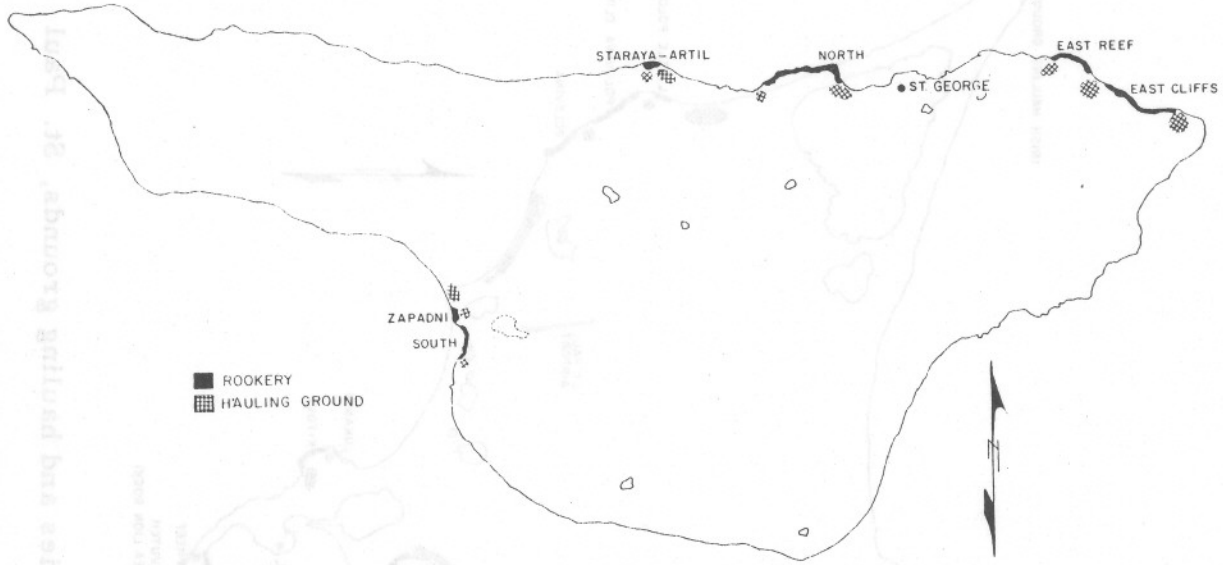


Figure 2. --Location of rookeries and hauling grounds, St. George Island.

We determined age and body length for 20 percent of the males killed 22-25 July to continue our study of the relation of abundance of a year class on land at age 2 to the number available for the harvest at age 3.

Trends in the availability of 3- and 4-year-old males killed during 1970 are given in figure 3 for St. Paul Island and in figure 4 for St. George Island, and the kill of males on the Pribilof Islands from year classes 1947 to 1968 are given in figure 5 and table 1.

Seals on a few minor but inaccessible hauling grounds were not disturbed in 1970, although they have been in the past. Animals have at times been frightened off these areas to give them a chance to haul out elsewhere and become "available" for the harvest.

Alton Y. Roppel

SURVEY DATA

We collected several kinds of data in 1970 to measure the response of the fur seal population to management programs. Living adult males and dead seals of all ages were counted, causes of death among sample pups were established, and living pups were weighed.

Living Adult Male Seals Counted

The living adult males on all rookeries except Sivutch were counted in June and July on St. Paul and St. George Islands; counts of males on Sivutch Rookery were made only in June (tables A-5 to A-8).

The current series of counts in mid-July were begun in 1911 with 329 "idle" (classes 1, 2, 4, and 5) and 1,356 "harem" (class 3) males on land. By 1941, the number of idle males had increased to over 5,000 and the harem males to about 12,000. With some variation, these levels were maintained through 1961, after which the population of adult males began to decline as a result of calculated efforts to harvest more of each year class of males and reduce the number of breeding females (table A-9 and fig. 6).

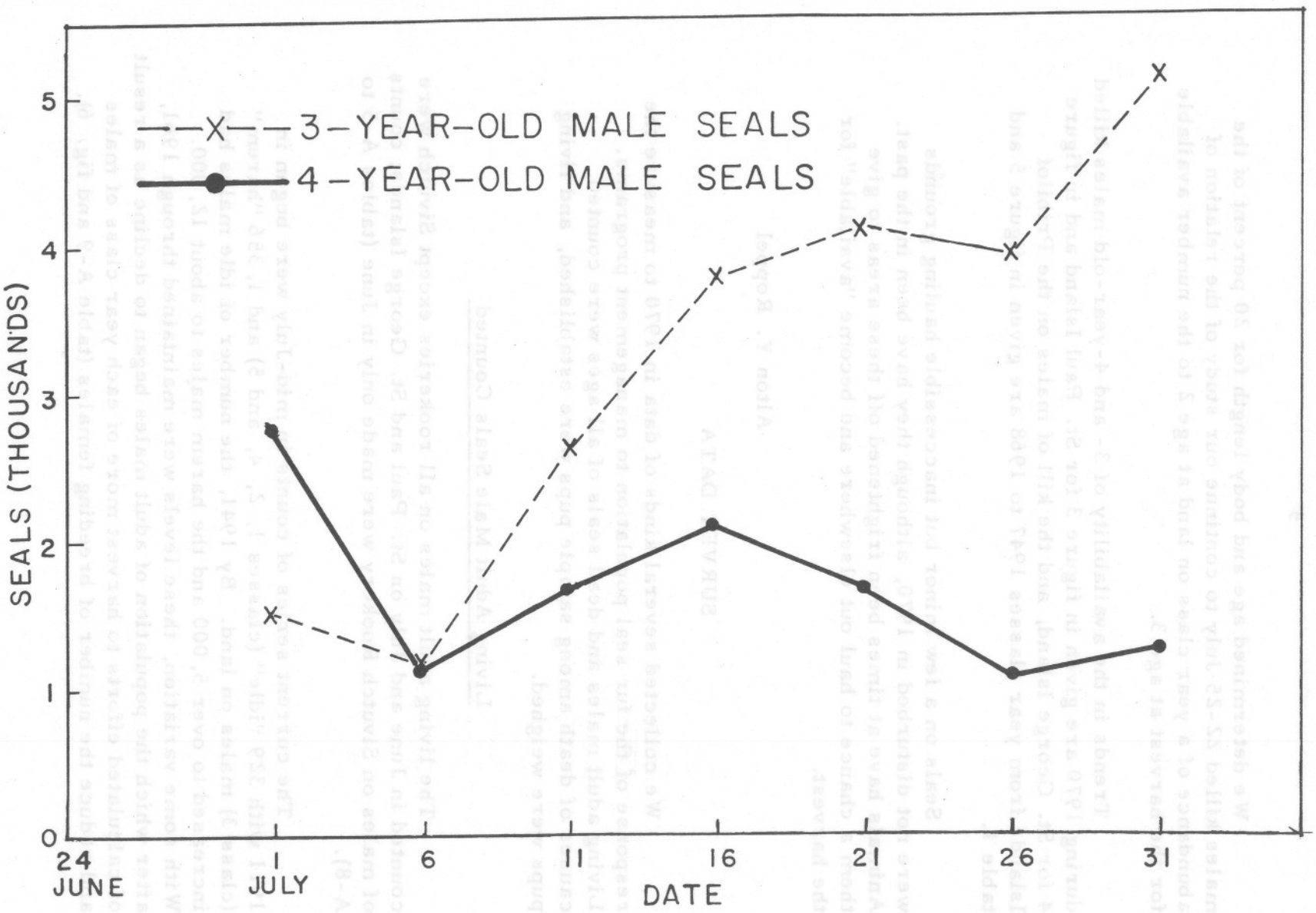


Figure 3.--Three- and four-year-old male seals killed, St. Paul Island, 24 June to 31 July 1970.

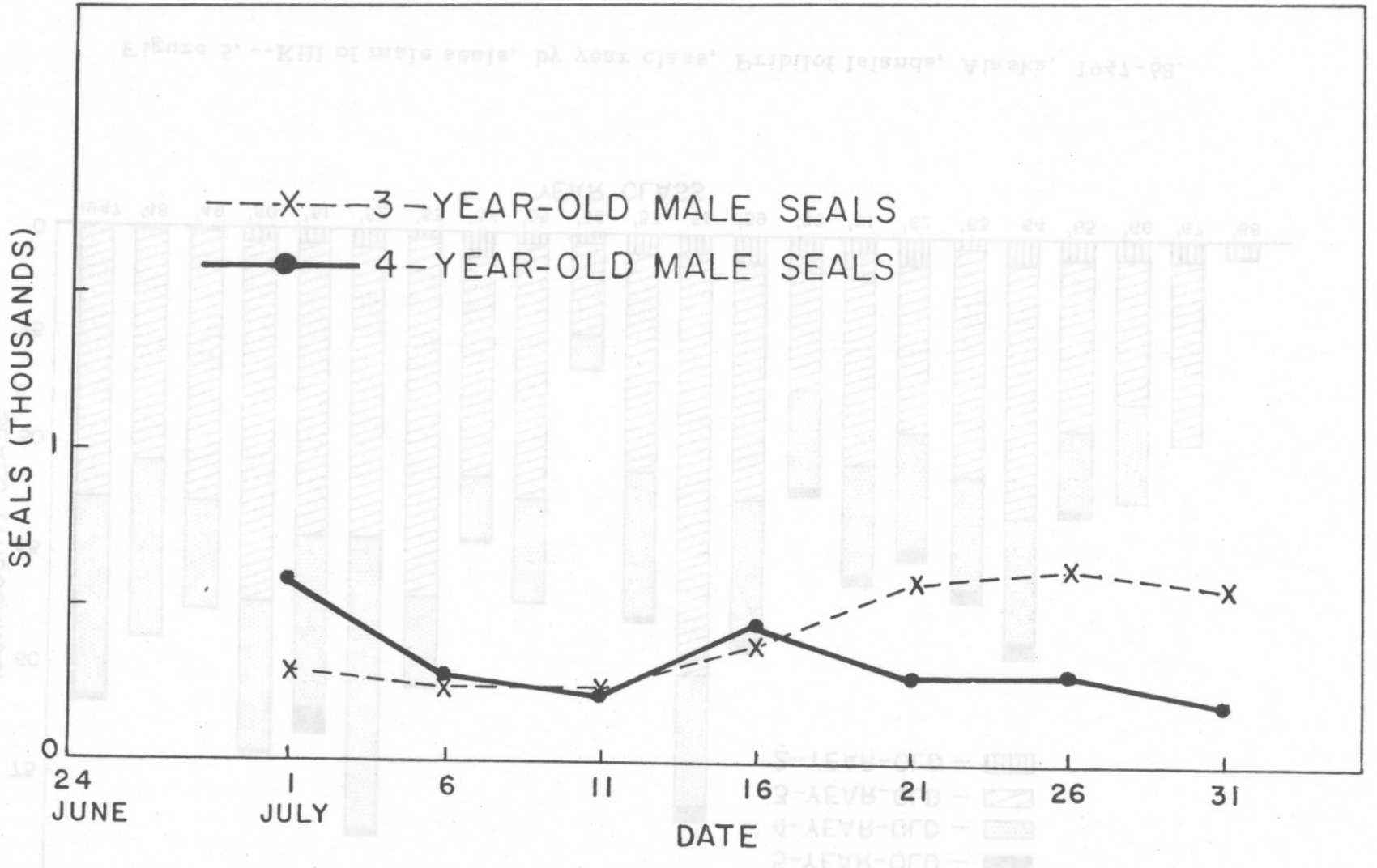


Figure 4. --Three- and four-year-old male seals killed, St. George Island, 24 June to 31 July 1970.

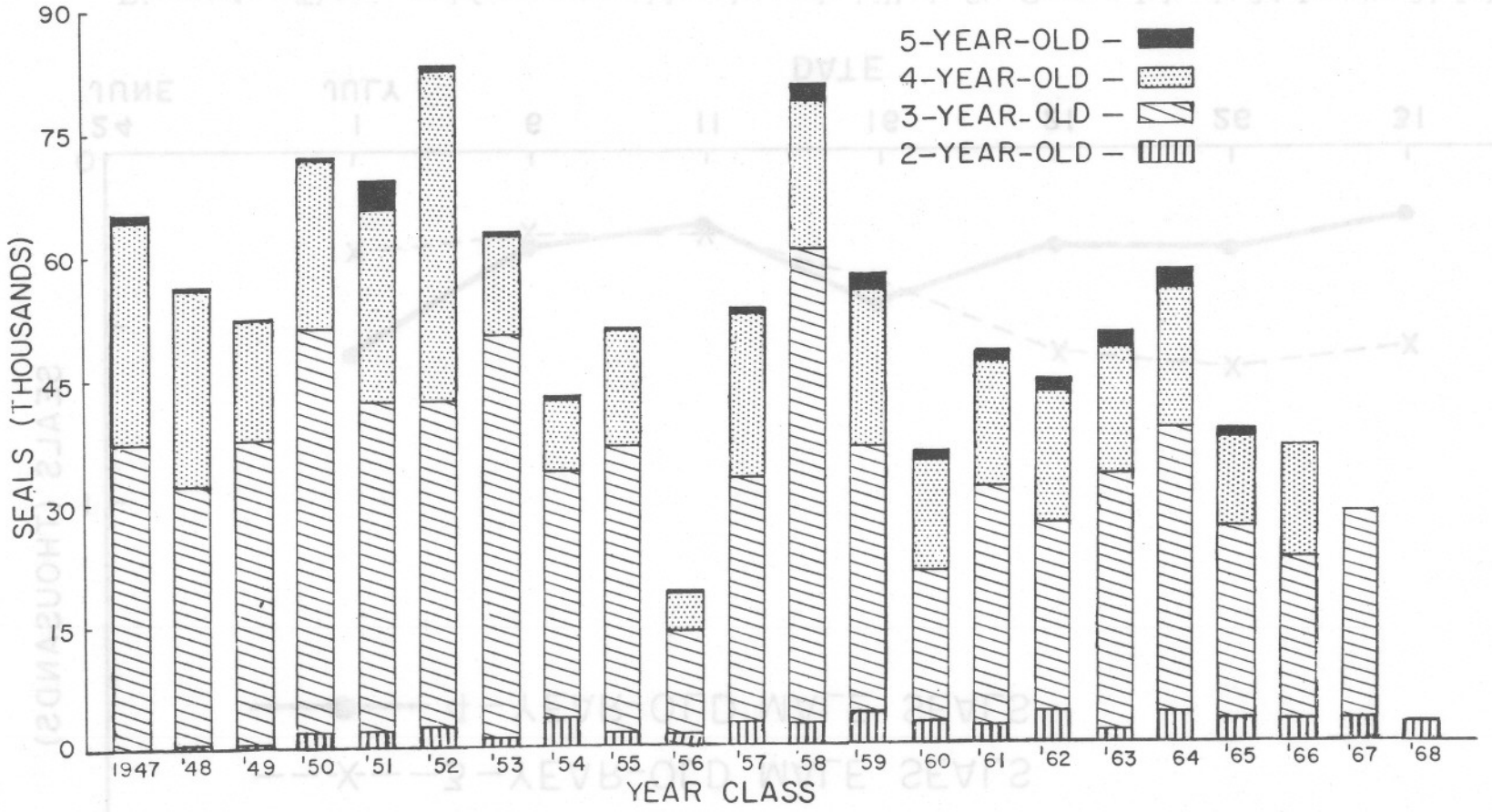


Figure 5.--Kill of male seals, by year class, Pribilof Islands, Alaska, 1947-68.

Table 1.--Kill of male seals, [1/] by year class, Pribilof Islands, Alaska, 1954-68

Year class	St. Paul Island					St. George Island					Grand total
	Age when killed					Age when killed					
	2	3	4	5	Total	2	3	4	5	Total	
	Number					Number					Number
1954	2,918	23,473	5,599	554	32,544	535	6,651	2,779	162	10,127	42,671
1955	1,015	27,863	10,555	115	39,548	555	7,246	2,825	260	10,886	50,434
1956	885	10,671	2,762	532	14,850	171	2,251	1,387	218	4,027	18,877
1957	2,590	24,283	15,344	773	42,990	242	5,098	4,492	244	10,076	53,066
1958	1,977	48,458	14,149	1,587	66,171	431	9,413	3,707	540	14,091	80,262
1959	2,820	26,456	14,184	1,764	45,224	891	5,890	4,690	492	11,963	57,187
1960	1,619	14,310	10,533	1,240	27,702	636	4,332	2,579	178	7,725	35,427
1961	1,098	22,468	12,046	1,270	36,882	921	6,948	2,592	502	10,963	47,845
1962	2,539	19,009	12,156	1,287	34,991	1,139	3,736	3,881	392	9,148	44,139
1963	1,264	25,535	11,785	1,542	40,126	167	5,586	3,738	406	9,897	50,023
1964	3,143	26,991	13,279	1,469	44,882	391	7,622	3,680	680	12,373	57,255
1965	2,200	18,706	10,565	731	32,202	740	4,443	2,204	547	7,934	40,136
1966 [2/]	1,673	17,826	11,548	-	31,047	443	2,645	2,274	-	5,362	36,409
1967 [2/]	2,640	22,176	-	-	24,816	411	2,916	-	-	3,327	28,143
1968 [2/]	1,725	-	-	-	1,725	98	-	-	-	98	1,823
Total	30,106	328,225	144,505	12,864	515,700	7,771	74,777	40,828	4,621	127,997	643,697
Mean	2,007	23,445	11,116	1,072	[3/] 37,640	518	5,341	3,141	385	[3/] 9,385	[3/] 47,025

1/ Includes only age 2- to 5-year-old seals taken during the kill of male seals on the Pribilof Islands. From 1956 to 1968, 131 1-year-olds and 702 6-year-olds were taken on St. Paul Island and 20 1-year-olds and 408 6-year-olds were taken on St. George Island. In addition, age was not determined for 4,919 males taken on St. Paul Island, nor for 1,522 taken on St. George Island.

2/ Incomplete returns.

3/ 1966, 1967, and 1968 year classes not included.

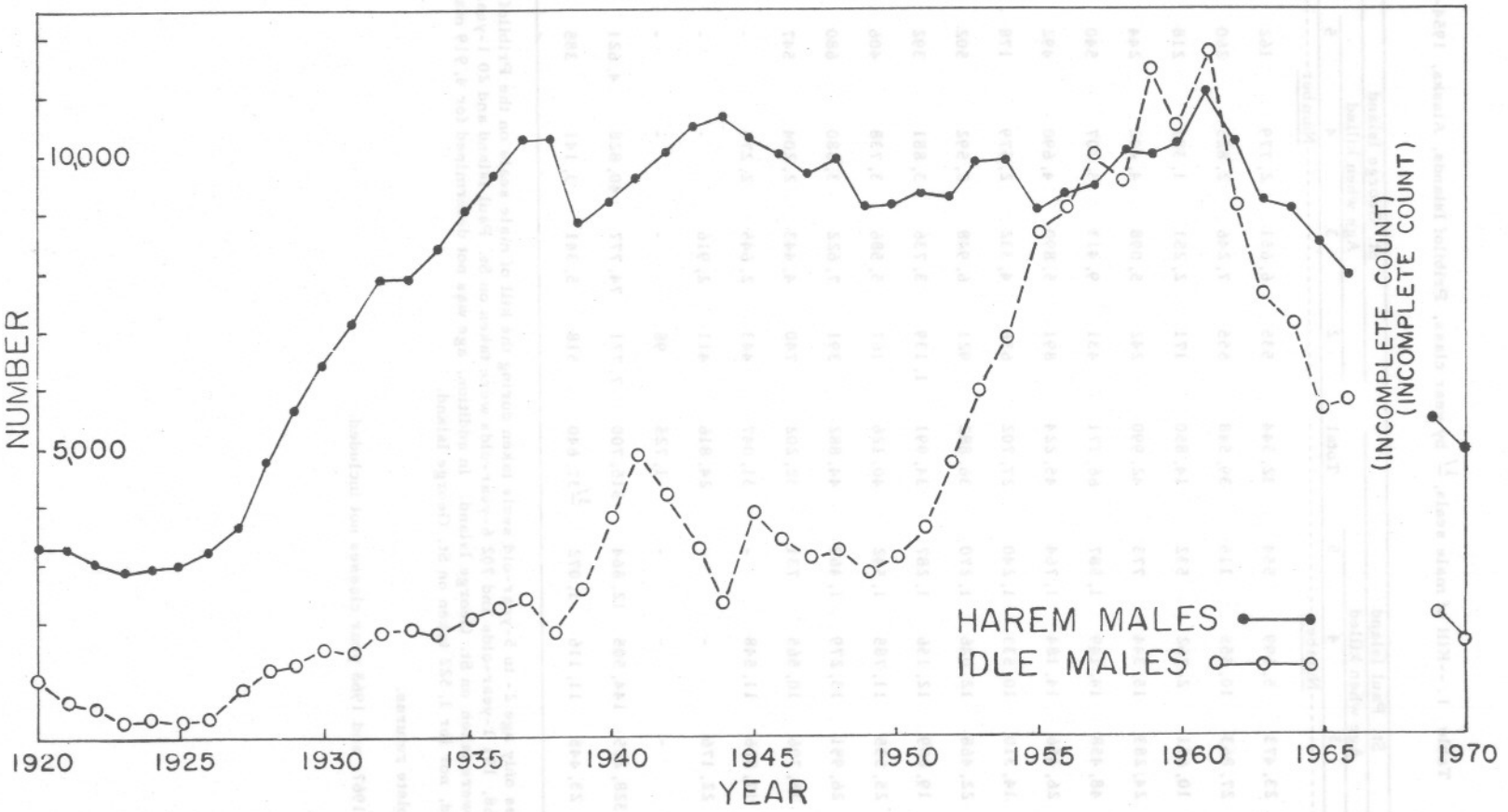


Figure 6. --Number of harem and idle male seals counted on all rookeries except Sivutch (Sea Lion Rock), St. Paul Island, 1920-70.

We counted 2,943 idle and 6,411 harem males on land in 1970. With at least one idle male available as a replacement for every two harem males, we conclude that the breeding stock will maintain itself at an adequate level under current management practices. From 1911 to 1930, for example, the ratio of idle to harem males averaged 1:4. Fewer available replacements for the breeding stock during this 20-year period did not prevent recovery from a population level approaching extinction.

Harem and idle males counted in mid-July 1966-70 are compared by rookery in table A-10, and the adult males counted in June of those years are given in table A-11 by class and rookery. We began counting adult males in June as well as in July because rookery disturbance is considerably reduced by making the counts before many harems have formed and when only a few pups have been born. Although the data may eventually have value as a predictor of the counts in July, they are presently inadequate for this purpose. Counts of animals on a few rookeries in July, however, can be used to predict total counts in that month. The data for adult males with and adult males without harems on St. Paul Island in mid-July 1944-66 and 1969-70 (total counts were not made in 1967 and 1968) indicate that Tolstoi, Zapadni, Little Zapadni, Zapadni Reef, Northeast Point, Lukanin, and Kitovi Rookeries provide the best estimates of the total count on St. Paul Island for males with and males without harems (table 2).

Alton Y. Roppel and
Raymond E. Anas

Dead Seals Counted That Were Older Than Pups

We found 56 males and 177 females older than pups dead on the beaches of the Pribilof Islands in 1970, and collected the canine teeth from most for studies of age distribution and death rate (some of the seals had lost their canines). The number of dead males found was the lowest since the counts were begun in 1965. Table 3 gives the number of dead animals of each sex counted since 1965.

Patrick Kozloff

Table 2. --Correlations of rookery counts to total counts for adult male fur seals, St. Paul Island, 1944-66 and 1969-70

Rookery	Adult male seals with harems				Adult male seals without harems			
	Rookery count to total count	Rookery count to log of total count	Log of rookery count to total count	Log of rookery count to log of total count	Rookery count to total count	Rookery count to log of total count	Log of rookery count to total count	Log of rookery count to log of total count
	r-value							
Zapadni	.9223	.9393	.9274	.9496	.8111	.8336	.8435	.8893
Little Zapadni	.8826	.8767	.9074	.9123	.9414	.9247	.9169	.9429
Zapadni Reef	.3857	.3929	.3902	.4087	.8709	.8348	.8652	.8644
Tolstoi	.8909	.8816	.9219	.9223	.9581	.9394	.9424	.9756
Pooled value	.9644	.9649	.9666	.9762	.9655	.9615	.9442	.9783
Kitovi	.9391	.9488	.9447	.9644	.7623	.7170	.7680	.7658
Lukanin	.8598	.8631	.8927	.9046	.9506	.9193	.9255	.9315
Pooled value	.9358	.9438	.9442	.9620	.9171	.8755	.9272	.9291
Reef	.8633	.8433	.9233	.9159	.6787	.6394	.6674	.6685
Ardiguen	.3456	.2814	.3314	.2679	.5671	.5225	.5996	.5679
Gorbatch	.9176	.9148	.9453	.9535	.7169	.7736	.6631	.7586
Pooled value	.8923	.8755	.9373	.9325	.7745	.7700	.7454	.7863
Vostochni	.9312	.9206	.9565	.9608	.9775	.9459	.9604	.9799
Morjovi	.5593	.5624	.6137	.6267	.9730	.9287	.9537	.9705
Pooled value	.9412	.9340	.9519	.9587	.9804	.9422	.9638	.9807
Little Polovina	.8078	.8120	.8659	.8854	.9293	.8839	.9072	.9094
Polovina Cliffs	.5108	.5163	.5483	.5629	.9798	.9448	.9595	.9741
Polovina	.8593	.8646	.9174	.9347	.9332	.9051	.9189	.9657
Pooled value	.7804	.7863	.8342	.8521	.9800	.9436	.9610	.9854

Table 3.--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1965-70

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	------Number----		------Number----		----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

Dead Pups Counted

Dead pups on the Pribilof Islands are counted about mid-August each year. In 1970, we counted 20,581 dead pups on St. Paul Island and 3,267 on St. George Island for a total of 23,848 (table A-12). The count for St. Paul Island in 1970 showed an increase of 55 percent over the number observed in 1969. On St. George Island, the number of dead pups counted in 1970 increased by 113 percent over the number observed in 1969. Table A-13 gives the number of dead pups counted from 1961 to 1970, plus a 5-percent addition for animals overlooked.

Patrick Kozloff

Living Pups Weighed

We weighed 800 pups on St. Paul Island 1-4 September. According to an analysis of variance test, significant differences existed between the weights of pups collected on different rookeries ($P<0.001$), and between the weights of males and females ($P<0.001$) (table 4). Differences between sexes were greater than differences between rookeries. Table 5 gives the variances and means of the weights of pups. Male pups averaged 10.2 kg and females 9.0 kg. These weights were 0.7 kg more for males and 0.6 kg more for females than the 1957-69 average.

Raymond E. Anas and
Patrick Kozloff

PATHOLOGY

From 2 July to 15 August, M. C. Keyes and D. Fly collected 257 dead pups from under catwalks on study areas at Reef and Northeast Point Rookeries (Marine Mammal Biological Laboratory, 1970b). Of these, 221 were necropsied, and 36 were discarded as unsuitable for examination because of advanced post mortem degeneration.

Table 4.--Analysis of variance in the weights of living seal pups, St. Paul Island, 1-4 September 1970

Source	Degrees of freedom	Sums of squares	Mean squares
Rookeries	3	150.77	1/ 50.26
Sexes	1	308.08	1/ 308.08
Interaction	3	7.45	2.46
Error	792	2275.28	2.87
Total	799	2741.58	

1/ $P<0.001$.

Table 5.--Variances in and means of the weights of living seal pups, St. Paul Island, 1-4 September 1970

Sex and rookery	Sample size	Variance	Mean
	Number		Kg.
Males			
Zapadni Reef	100	4.0013	9.5
Polovina	100	3.0884	10.1
Morjovi	100	3.2629	10.7
Reef	100	3.0924	10.6
All rookeries	400		10.2
Females			
Zapadni Reef	100	2.9368	8.3
Polovina	100	1.9938	9.2
Morjovi	100	2.5255	9.2
Reef	100	2.0814	9.4
All rookeries	400		9.0

Tabulation of the primary diagnoses[1/] for pups necropsied shows that the main causes of death were hookworm disease and malnutrition, which accounted for 62.3 percent of the deaths. Microbial infection, trauma, multiple hemorrhage-perinatal complex, miscellaneous, and undetermined causes were less important (table 6).

A comparison of the incidence of these causes over a 4-year period for study areas 1 and 3 (figs. 7 and 8) shows significant year-to-year variation, particularly for malnutrition and hookworm disease.

Figure 9 shows changes in pup mortality on Reef area 1 from 1964 to 1970.

A weekly summary of primary diagnoses (table A-14) shows, as usual, that deaths from malnutrition were relatively constant from 2 July to 15 August, and that most deaths from hookworms occurred between 18 July and 8 August. In 1970, however, 12 pups had died from hookworm disease before 17 July, the date when, in most years, the first cases have been noted. This situation was apparently a manifestation of the greatly increased incidence of hookworm disease on area 3 (10 of the 12 early cases were collected from area 3). Most of the deaths from microbial infection, trauma, perinatal complex, miscellaneous, and undetermined causes occurred by mid-July, indicating that, for the most part, these deaths were associated with recent birth.

1/ 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 and influenced 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 forms. The distribution of secondary causes among primary causes was reported for necropsies performed in 1966 (Marine Mammal Biological Laboratory, 1969).

Table 6.--Primary diagnoses[1/] for causes of death among seal pups, three mortality study areas, St. Paul Island, 2 July to 15 August 1970

Primary diagnoses	Study areas: Reef Rookery, Area 1, Old catwalk, Dead pups		Reef Rookery, Area 2, New catwalk, Dead pups		Northeast Point, Area 3, Hutchinson Hill, Dead pups		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Malnutrition	17	25.7	9	25.0	29	18.7	55	21.4
Hookworm disease	11	16.7	3	8.3	91	58.7	105	40.9
Infection (microbial)	6	9.1	1	2.7	4	2.6	11	4.3
Navel	(2)	(3.0)	(0)	(0.0)	(3)	(1.9)	(5)	(1.9)
Enteritis	(3)	(4.5)	(0)	(0.0)	(1)	(0.6)	(4)	(1.6)
Septicemia	(0)	(0.0)	(1)	(2.7)	(0)	(0.0)	(1)	(0.4)
Abscess	(1)	(1.5)	(0)	(0.0)	(0)	(0.0)	(1)	(0.4)
Trauma	3	4.5	3	8.3	3	1.9	9	3.5
Bite wounds	(3)	(4.5)	(2)	(5.6)	(1)	(0.6)	(6)	(2.3)
Skull fractures	(0)	(0.0)	(0)	(0.0)	(1)	(0.6)	(1)	(0.4)
Liver rupture	(0)	(0.0)	(1)	(2.7)	(1)	(0.6)	(2)	(0.8)
Multiple hemorrhage-perinatal complex	2	3.0	4	11.1	1	0.6	7	2.7
Miscellaneous	6	9.1	1	2.7	5	3.2	12	4.7
Stillborn	(1)	(1.5)	(0)	(0.0)	(2)	(1.3)	(3)	(1.2)
Anomaly	(2)	(3.0)	(0)	(0.0)	(2)	(1.3)	(4)	(1.6)
Dystocia	(1)	(1.5)	(0)	(0.0)	(0)	(0.0)	(1)	(0.4)
Anemia (nonhookworm)	(1)	(1.5)	(0)	(0.0)	(0)	(0.0)	(1)	(0.4)
Meconium impaction	(1)	(1.5)	(0)	(0.0)	(0)	(0.0)	(1)	(0.4)
Hemorrhage	(0)	(0.0)	(0)	(0.0)	(1)	(0.6)	(1)	(0.4)
Dwarfism	(0)	(0.0)	(1)	(2.7)	(0)	(0.0)	(1)	(0.4)
Undetermined	9	13.6	3	8.3	10	6.5	22	8.6
Unsuitable for examination	12	18.2	12	33.3	12	7.7	36	14.0
Total	66		36		155		257	

1/ See footnote in text.

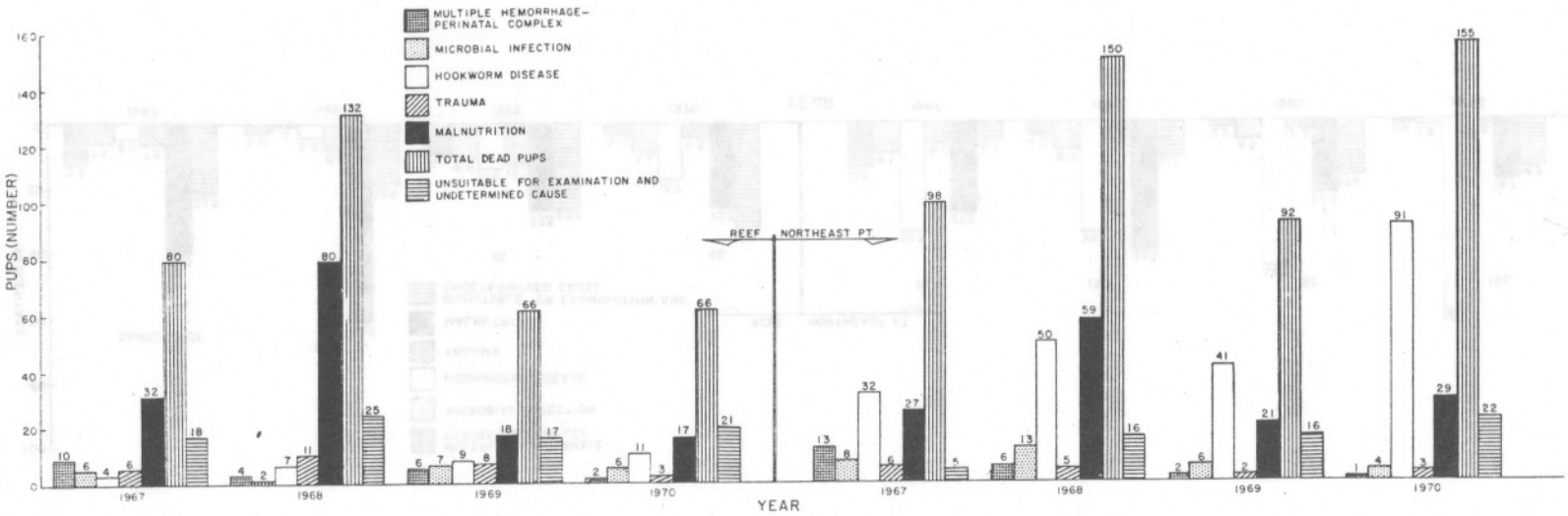


Figure 7. --Number of pups that died of various causes, Reef Rookery study area 1, and Northeast Point study area 3, 1967-70, St. Paul Island.

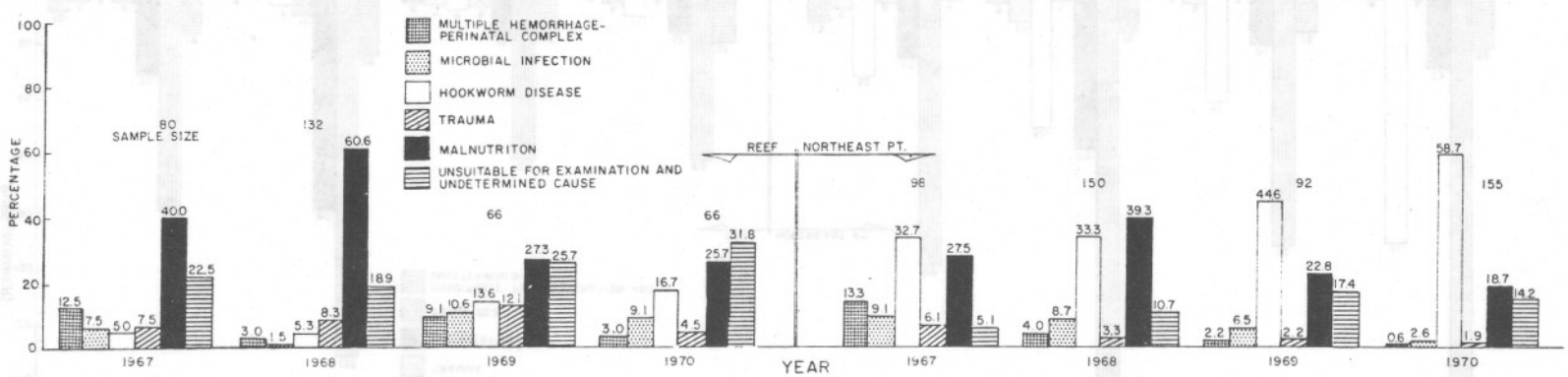


Figure 8. --Percentage of pups that died of various causes, Reef Rookery study area 1, and Northeast Point study area 3, 1967-70, St. Paul Island.

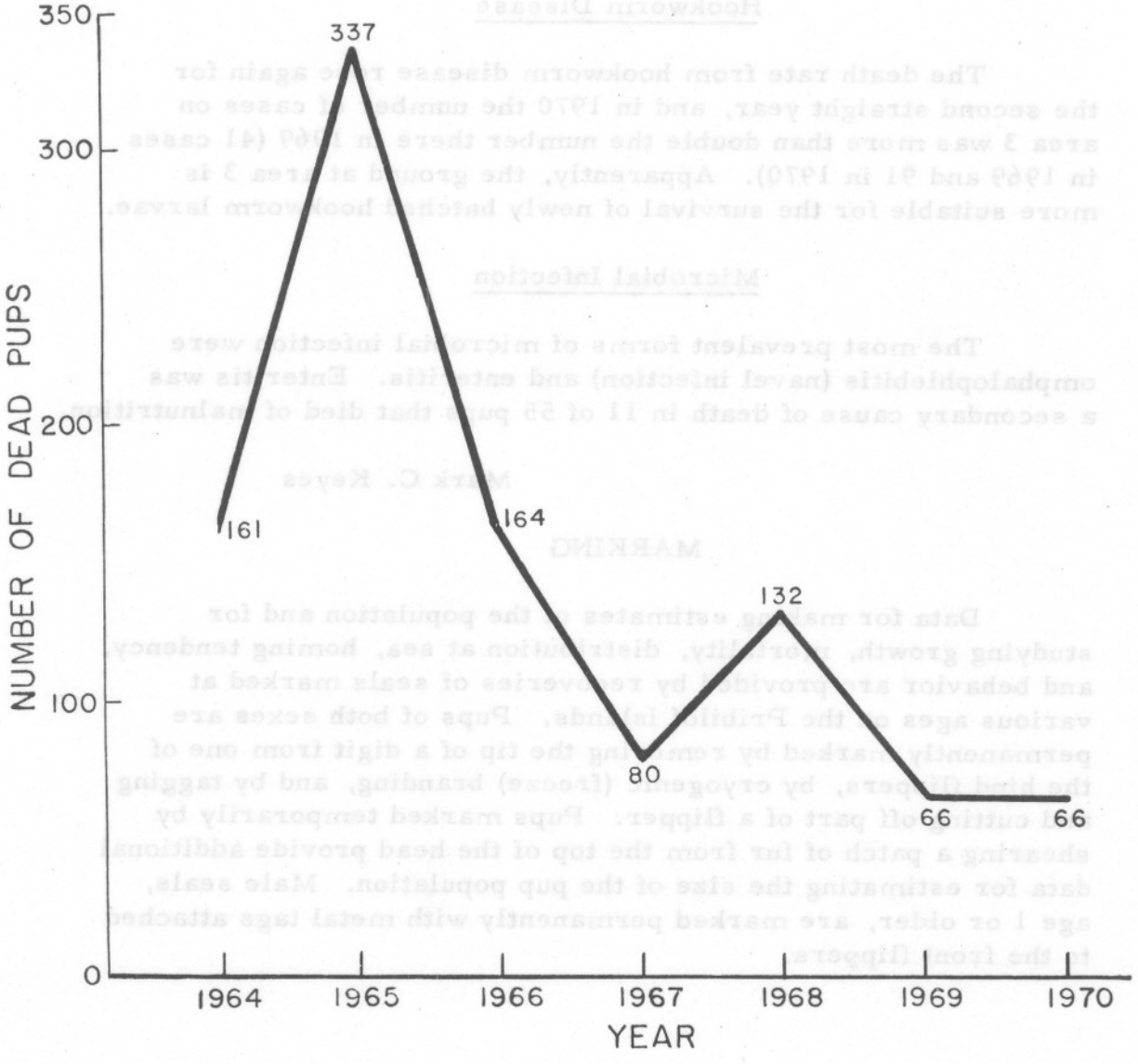


Figure 9. --Dead pups collected from Reef Rookery, study area 1, St. Paul Island, 1964-70.

Malnutrition

The incidence of malnutrition, although slightly lower on area 2 and slightly higher on area 3, was within 1 case of being the same as in 1969 for all areas combined.

Hookworm Disease

The death rate from hookworm disease rose again for the second straight year, and in 1970 the number of cases on area 3 was more than double the number there in 1969 (41 cases in 1969 and 91 in 1970). Apparently, the ground at area 3 is more suitable for the survival of newly hatched hookworm larvae.

Microbial Infection

The most prevalent forms of microbial infection were omphalophlebitis (navel infection) and enteritis. Enteritis was a secondary cause of death in 11 of 55 pups that died of malnutrition.

Mark C. Keyes

MARKING

Data for making estimates of the population and for studying growth, mortality, distribution at sea, homing tendency, and behavior are provided by recoveries of seals marked at various ages on the Pribilof Islands. Pups of both sexes are permanently marked by removing the tip of a digit from one of the hind flippers, by cryogenic (freeze) branding, and by tagging and cutting off part of a flipper. Pups marked temporarily by shearing a patch of fur from the top of the head provide additional data for estimating the size of the pup population. Male seals, age 1 or older, are marked permanently with metal tags attached to the front flippers.

Application of Marks

Monel cattle-ear tags have been used to mark seals on St. Paul Island since 1941 and on St. George Island from 1956 to 1968. A few of the tags used in recent years have been coated with blue or white epoxy. Table A-15 gives the pups marked by tagging or in other ways since 1961, and table A-16 shows seals age 1 or older marked by tagging since that year.

Pups

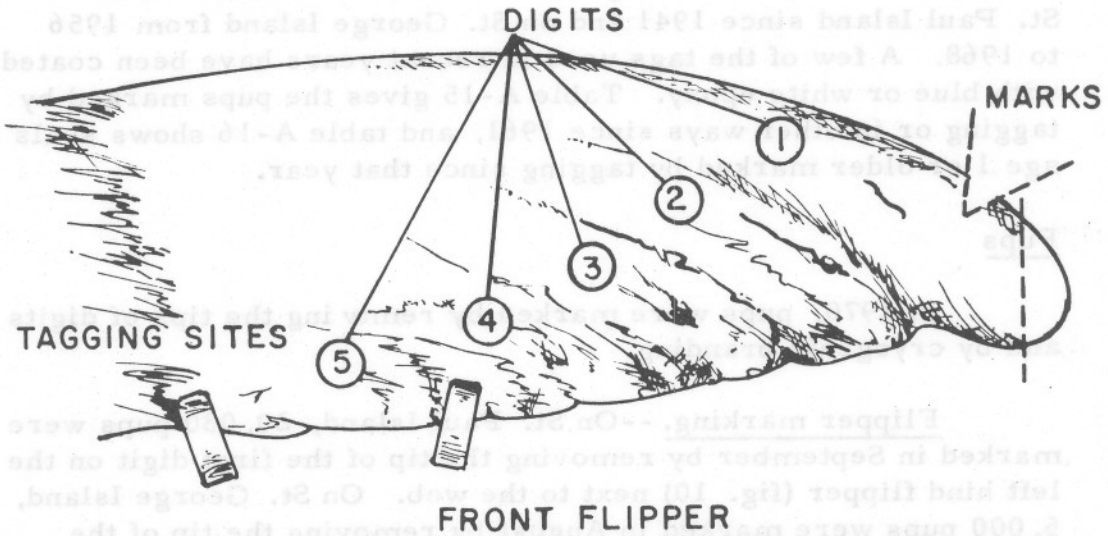
In 1970, pups were marked by removing the tips of digits and by cryogenic branding.

Flipper marking. --On St. Paul Island, 20,030 pups were marked in September by removing the tip of the first digit on the left hind flipper (fig. 10) next to the web. On St. George Island, 5,000 pups were marked in August by removing the tip of the first digit on the right hind flipper (fig. 10). Marking quotas of 20,000 and 5,000 pups were distributed among the rookeries of their respective islands according to the distribution of class 3 males counted in mid-July.

Patrick Kozloff

Freeze branding. --On Reef and Gorbatch Rookeries 889 pups were individually marked by freeze branding to provide a reservoir of marked animals for future observational studies. The technique used was similar to that used in 1969 (Marine Mammal Biological Laboratory, 1971). On Reef Rookery, 245 males and 189 females were marked on the right forearm and shoulder area; 246 males and 218 females were similarly marked on Gorbatch Rookery. For each sex and rookery, the animals were individually numbered beginning with 200 (fig. 11).

Ancel M. Johnson



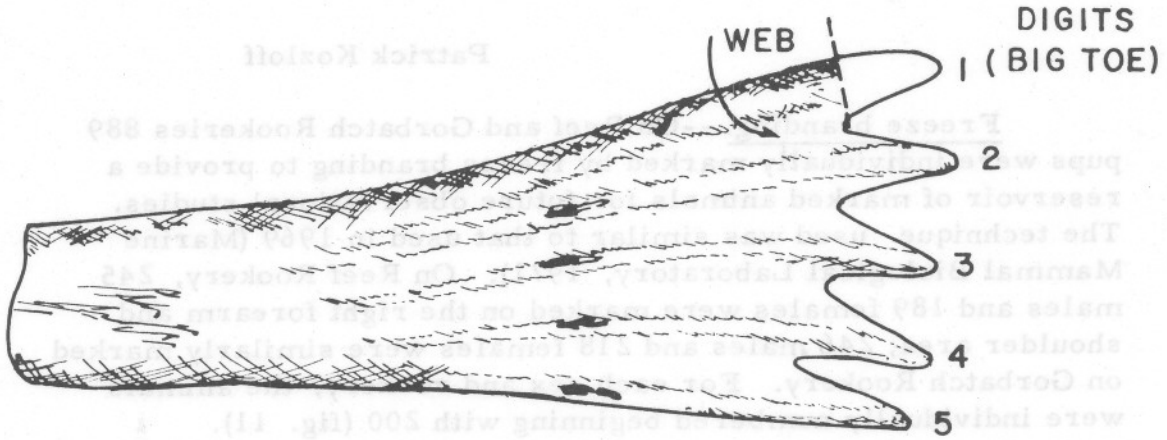


Figure 10. --Examples of mark locations that have been used on fur seals, Pribilof Islands, Alaska.

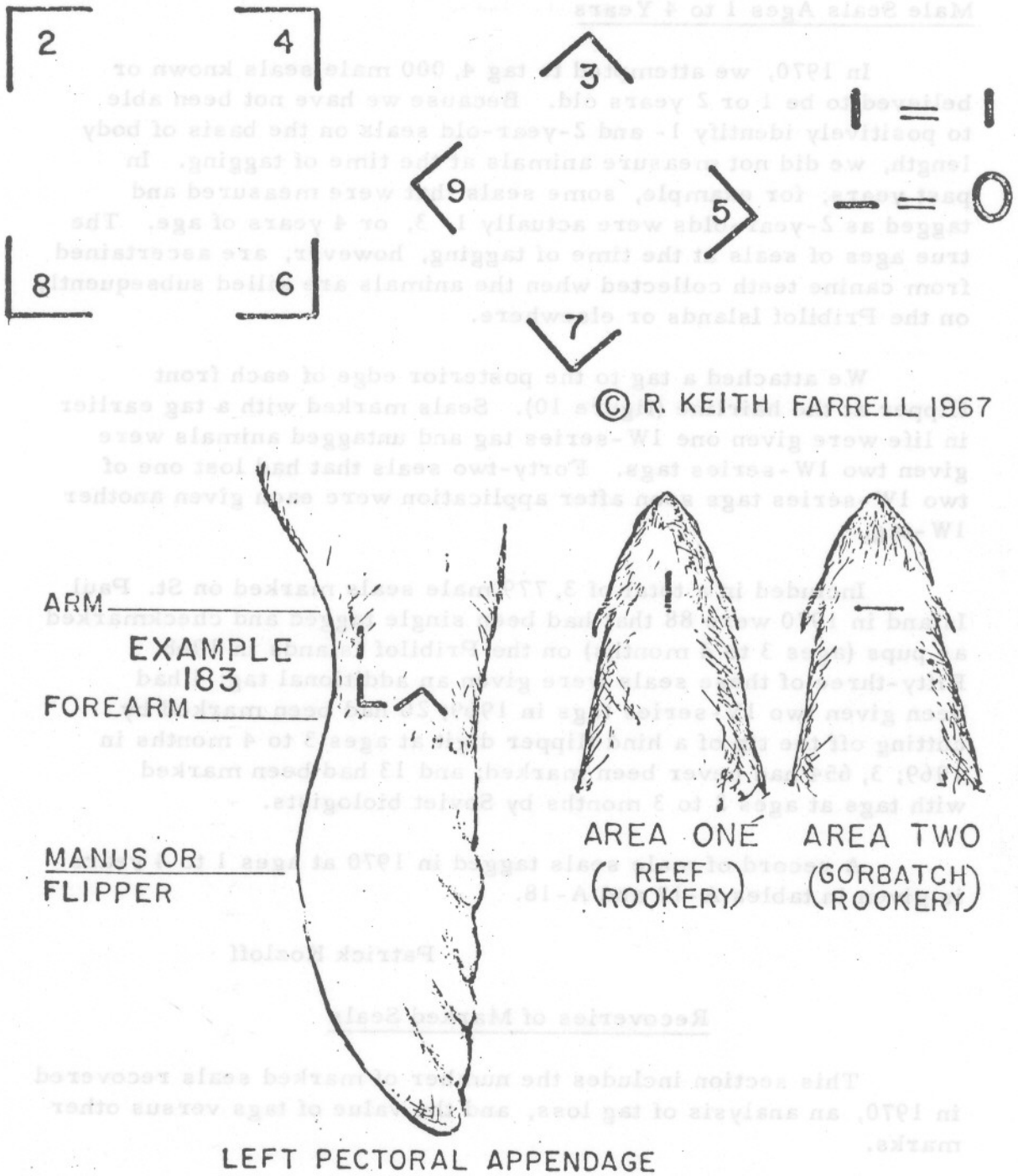


Figure 11. --System of identification symbols used as cryogenic brands applied to 889 pups, St. Paul Island, August 1970.

Male Seals Ages 1 to 4 Years

In 1970, we attempted to tag 4,000 male seals known or believed to be 1 or 2 years old. Because we have not been able to positively identify 1- and 2-year-old seals on the basis of body length, we did not measure animals at the time of tagging. In past years, for example, some seals that were measured and tagged as 2-year-olds were actually 1, 3, or 4 years of age. The true ages of seals at the time of tagging, however, are ascertained from canine teeth collected when the animals are killed subsequently on the Pribilof Islands or elsewhere.

We attached a tag to the posterior edge of each front flipper at the hairline (figure 10). Seals marked with a tag earlier in life were given one 1W-series tag and untagged animals were given two 1W-series tags. Forty-two seals that had lost one of two 1W-series tags soon after application were each given another 1W-tag.

Included in a total of 3,779 male seals marked on St. Paul Island in 1970 were 88 that had been single tagged and checkmarked as pups (ages 3 to 4 months) on the Pribilof Islands in 1968. Fifty-three of these seals were given an additional tag; 4 had been given two 1V-series tags in 1969; 20 had been marked by cutting off the tip of a hind flipper digit at ages 3 to 4 months in 1969; 3,654 had never been marked; and 13 had been marked with tags at ages 2 to 3 months by Soviet biologists.

A record of male seals tagged in 1970 at ages 1 to 4 years is given in tables A-17 and A-18.

Patrick Kozloff

Recoveries of Marked Seals

This section includes the number of marked seals recovered in 1970, an analysis of tag loss, and the value of tags versus other marks.

Marked Seals

A tabulation of male seals marked on the Pribilof Islands in previous years and recovered in 1970 is presented in tables A-19 to A-21. The ages of some animals could not be determined because the heads or flippers were separated from the carcasses during the skinning process.

Tag Loss

All seals tagged are given an additional mark or tag to decrease the loss of identity. Rates of tag loss can then be determined when the animals are taken in the kill and used, where appropriate, to modify population estimates based on recoveries. Tag loss varies with tag series and for some appears to increase with age (tables 7 and 8). The identity of animals tagged as pups is almost never lost because we give these animals a flipper mark (see glossary) at the time of tagging rather than an additional tag as we do for seals age 1 or older.

Tags vs. Flipper Marks (see glossary)

Large and variable tag loss and other evidence indicating increased mortality among tagged animals have shown that the cattle-ear tag should not be used for marking fur seal pups. Removal of part of a flipper (flipper mark) is a method of marking potentially superior to use of the cattle-ear tag. We have compared recovery rates for these two kinds of marks.

In 1965 and 1966 nearly equal numbers of pups were marked by tagging, by removing the tip of a hind flipper digit, and by cutting a "V-notch" into a front flipper (table A-15 and fig. 10). The recovery rate for seals marked in 1965 has been consistently higher for animals given flipper marks than for those given tags and marks (table 9). Based on total recoveries, the rate for animals with flipper marks was 1.13 times that of seals with tags. The data for the 1966 year class, however, have not been consistent in that the recovery rate for tagged animals was higher than that of seals with flipper marks for 2 years and lower for 1 year.

Table 7.--Summary of tag loss for male seals tagged as pups, tag series R through U, Pribilof Islands, Alaska

Year class and tag series	Age at recovery	St. Paul Island				St. George Island			
		Tagged seals (a)	Lost-tag seals (b)	Total (a)+(b)	Ratio (b)/[(a)+(b)]	Tagged seals (a)	Lost-tag seals (b)	Total (a)+(b)	Ratio (b)/[(a)+(b)]
	Years	Number				Number			
1965									
R[1/]	2	36	56	92	0.61	2	6	8	0.75
R	3	358	177	535	0.33	24	29	53	0.55
R	4	191	159	350	0.45	5	4	9	0.44
R	5	13	18	31	0.58	0	5	5	1.00
Total		598	410	1,008	0.41	31	44	75	0.59
1966									
S	2	35	22	57	0.39	6	10	16	0.62
S	3	285	283	568	0.50	58	13	71	0.18
S	4	138	223	361	0.62	45	21	66	0.32
Total		458	528	986	0.54	109	44	153	0.29
1967									
T	2	76	19	95	0.20	9	4	13	0.31
T	3	442	216	658	0.33	65	10	75	0.13
Total		518	235	753	0.31	74	14	88	0.16
1968									
U	2	31	13	44	0.30	0	1	1	1.00

1/ No R-series tags were applied to seals on St. George Island.

Table 8.--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	One tag lost	Incidence of tag loss (p) 1/
	Years	Number	Number	
2T	1	404	30	0.04
2T	2	261	51	0.09
2T	3	19	11	0.22
Total		684	92	0.07
2U	1	332	108	0.14
2U	2	240	146	0.23
Total		572	254	0.18
1S	1	77	51	0.25
1S	2	132	150	0.36
1S	3	39	54	0.41
1S	4	3	3	0.67
Total		251	258	0.34
1T	1	84	7	0.04
1T	2	177	42	0.11
1T	3	80	26	0.14
Total		341	75	0.10
1U	1	59	12	0.09
1U	2	121	60	0.20
Total		180	72	0.17
1V	1	648	384	0.23

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

Table 9.--Summary of recoveries of pups marked by two methods, year classes 1965-66, Pribilof Islands, Alaska

Year class	Method of marking		Marked seals recovered at age					Recovery rate
			2	3	4	5	Total	
			----- Number -------				Number	
1965								
	Tags:	10,000	100	588	359	36	1,083	0.108
	Marks:							
	RH1 1/	10,080	72	709	393	84	1,258	0.125
	RFV 2/	10,007	94	673	385	32	1,184	0.118
1966								
	Tags:	12,499	73	639	427	-	1,139	0.091
	Marks 3/							
	RH3 and LH2	12,081	45	519	457	-	1,021	0.085

1/ Tip of first digit of right hind flipper sliced off.

2/ V-notch cut into edge of right front flipper near tip.

3/ Tip of 3d digit right hind flipper and 2d digit left hind flipper sliced off.

Inconsistencies between year classes make it less obvious that there will be a higher rate of recovery from animals with flipper marks. Seals marked by tagging, however, must be given an additional mark because of high rate of tag loss, especially among pups. Other things being equal, it would seem safe to assume that there would be a higher rate of return for seal pups given flipper marks only, rather than marks and tags.

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POPULATION ESTIMATES

Estimates of year-class size and survival are based on mark-recapture data. Seals of several year classes have been marked on the Pribilof Islands at ages 0, 1, and 2 years and recovered from the kills there at ages 2 through 5 years to provide data for making these estimates. In addition to the usual methods, those described by Seber (1962) and Jolly (1965) have been used. For some year classes, the number of pups born was estimated from shearing and sampling in the year of birth (Chapman and Johnson, 1968) and from animals marked as pups (age 0) and recovered 2 to 4 years later in the kill. Estimates of survival from ages 0 to 1 and from 1 to 2 years have been based on the recovery in subsequent years of males that were older than pups when double tagged at estimated ages of less than 3 years in late September and early October. The age of each seal at the time of tagging was determined from a canine tooth collected when killed. Because of known sources of bias, confidence limits are not presented for any of the estimates.

Number of Seal Pups Born

The number of pups alive at the time of marking for year classes 1964 to 1968 on all rookeries of the Pribilof Islands was estimated from the recovery in 1970 of males of the above year classes marked as pups (table 10). An estimate was calculated for year classes 1961 to 1967 based on data pooled by combining the recoveries from each year class over several years (table 11). To determine the number of pups born, we have added the number of dead pups counted on land before marking to the estimates (table 11). An increase in the estimate for 1966 and 1967 reversed a decreasing trend apparent since 1961.

Table 10.--Estimates of the seal pup population, year classes 1964-68, at time of marking from recoveries in 1970 of marked male seals in ages 2 to 6, Pribilof Islands, Alaska

Year class	Age	Killed (C)	Marked (M)	Recovered (R)	Estimate of population at time of marking 1/ ($\hat{N}$) 2/
	Years		Number		
1964	6	106	3/ 24,991	17	148,564
1965	5	1,278	3/ 10,000	36	345,710
1965	5	1,278	4/ 10,080	84	151,689
1965	5	1,278	5/ 10,007	32	387,886
1965	5	1,278	6/ 30,087	152	251,520
1966	4	13,822	3/ 12,499	427	403,709
1966	4	13,822	7/ 12,078	475	350,773
1966	4	13,822	6/ 24,577	902	376,237
1967	3	25,092	3/ 12,472	733	426,410
1968	2	1,823	3/ 11,675	45	462,979

1/ Estimates do not include counts of dead pups.

2/ $\hat{N} = \frac{(C+1)(M+1)}{(R+1)}$

3/ Marked by tagging.

4/ Marked by removing the tip of the first digit on the right hind flipper.

5/ Marked by cutting a V-notch into the leading edge of the right front flipper.

6/ Marked seals of the 1965 year class combined.

7/ Includes 9,578 seals marked by removing the tip of the third digit on the right hind flipper and 2,500 marked by removing the tip of the second digit on the left hind flipper.

Table 11.--Estimates of the seal pup population, year classes 1961-67, at time of tagging, from recoveries of marked male seals ages 2 through 5, and the count of dead pups, Pribilof Islands, Alaska

Year class	Estimated pups alive at time of tagging	Count of dead pups	Total pups born
	Number	Number	Number
1961	473,000	71,000	544,000
1962	423,000	54,000	477,000
1963	404,000	39,000	443,000
1964	396,000	25,000	421,000
1965	1/ 341,000	46,000	387,000
1966	1/ 410,000	27,000	437,000
1967	417,000	17,000	434,000

1/ Estimates based on combined recoveries of males marked by tagging and by removing parts of flippers.

In 1970, the pup population on each rookery except Sivutch (Sea Lion Rock) was estimated by shearing and sampling. Pups were marked by shearing a small patch of guard hair from the top of the head, then sampled twice for marked-to-unmarked ratios later in the season (table 12). Shearing was done before the dead pups were counted, but after most mortality had occurred. Thus, estimates from shearing and sampling plus the counts of dead pups equal the number of pups born. Estimates based on shearing and sampling made on St. Paul Island for most years since 1963 show that the pup population on every rookery decreased in 1969 and 1970 (table 13).

Only in 1966 were pups sheared and sampled on all rookeries of the Pribilof Islands. In that year, the total estimate was 1.3 times that for St. Paul Island. Therefore, estimates made only for St. Paul Island in other years have been multiplied by 1.3 to produce an estimate for the Pribilof Islands (table 14). Estimates for 1969 and 1970 indicate a decrease in the number of pups born since the period 1963-66.

The number of pups born, estimated from tagging and from shearing and sampling, are compared in table 15. The difference between estimates based on the two methods is less from 1964 through 1966 than in earlier years, probably because of improvements in techniques.

A final estimate of the number of pups born in 1970 cannot be made until 1973 or 1974 when recoveries of 3- and 4-year-old seals marked as pups become available in the kill. A preliminary estimate of between 300,000 and 350,000, however, indicates a decrease since 1966. We make this estimate on the assumption that those based on shearing and sampling in 1969 and 1970 are low.

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Table 12.--Estimates of the seal pup population, [1/] year class 1970, at time of shearing, Pribilof Islands, Alaska

Island and Rookery	Pups sheared	First sampling period [2/]				Second sampling period [2/]				Mean of estimates
		Counted			Estimated pup population at time of shearing	Counted			Estimated pup population at time of shearing	
		Samples	Sheared	Total		Samples	Sheared	Total		
	Number									
St. Paul Island										
Morjovi	1,405	83	167	2,075	17,457	66	188	1,650	12,331	14,894
Vostochni	3,265	177	475	4,425	30,416	206	452	5,150	37,201	33,809
Little Polovina	412	18	46	450	4,030	21	59	525	3,666	3,848
Polovina Cliffs	1,620	65	167	1,625	15,763	126	277	3,150	18,422	17,092
Polovina	355	16	40	400	3,550	27	62	675	3,865	3,708
Tolstoi	2,280	111	302	2,775	20,950	125	304	3,125	23,438	22,194
Zapadni	2,660	133	269	3,325	32,879	129	249	3,225	34,452	33,666
Little Zapadni	1,300	72	159	1,800	14,717	81	167	2,025	15,763	15,240
Zapadni Reef	424	29	81	725	3,795	29	67	725	4,588	4,191
Reef	2,871	50	165	1,250	21,750	113	289	2,825	28,064	24,907
Gorbatch	1,554	71	195	1,775	14,145	86	210	2,150	15,910	15,028
Ardiguen	432	13	46	325	3,052	12	41	300	3,161	3,106
Kitovi	969	35	61	875	13,900	59	124	1,475	11,526	12,713
Lukanin	432	16	26	400	6,646	34	84	850	4,371	5,508
Island total	19,979				203,050				216,758	209,904
St. George Island										
Zapadni	672	26	55	650	7,942	23	64	575	6,038	6,990
South	792	22	71	550	6,135	24	62	600	7,665	6,900
North	1,548	67	142	1,675	18,260	67	148	1,675	17,520	17,890
East Cliff	498	21	29	525	9,016	23	39	575	7,342	8,179
East Reef	306	10	34	250	2,250	8	21	200	2,914	2,582
Staraya Artil	582	29	44	725	9,590	30	58	750	7,526	8,558
Island total	4,398				53,193				49,005	51,099
Total both islands	24,377				256,243				265,763	261,003

1/ Estimates do not include counts of dead pups.

2/ First sampling period, 12-13 August on St. Paul Island and 8 August on St. George Island; second sampling period, 17-18 August on St. Paul Island and 12 August on St. George Island.

Table 13. --Estimates of the number of seal pups born, [1/] year classes 1963-70, from shearing and sampling, St. Paul Island

Rookery	Year class							
	1963	1964	1965	1966	1967[2/]	1968[2/]	1969	1970
	Number							
Morjovi	19,600	19,600	18,900	20,900	-	18,200	16,200	16,500
Vostochni	39,800	45,400	39,900	51,600	-	37,500	35,400	37,100
Little Polovina	7,400	9,000	8,100	9,200	-	-	5,300	4,200
Polovina Cliffs	21,800	23,400	21,000	24,100	-	-	19,000	18,700
Polovina	5,400	5,900	6,300	6,000	-	-	4,000	4,200
Tolstoi	26,900	28,100	30,800	30,400	35,700	-	29,500	25,800
Zapadni	37,000	37,500	32,400	40,900	-	-	31,700	37,200
Little Zapadni	16,400	18,200	17,700	24,600	-	-	19,700	16,600
Zapadni Reef	6,900	6,900	6,100	5,400	-	5,200	4,800	4,500
Reef	38,700	41,700	39,500	38,500	33,500	27,900	28,500	27,100
Gorbatch	[3/]25,200	25,200	20,900	22,400	-	-	18,500	16,000
Ardiguen		2,900	2,700	2,900	-	-	3,700	3,200
Kitovi	11,700	14,600	14,100	14,400	-	-	11,500	13,400
Lukanin	5,700	5,500	6,400	7,600	-	-	5,100	5,900
St. Paul Island total	262,500	283,900	264,800	298,900	-	-	232,900	230,400

1/ Estimates include the counts of dead pups.

2/ Pups were sheared and sampled only on selected rookeries.

3/ In 1963, estimates were combined for Gorbatch and Ardiguen Rookeries.

Table 14. --Estimates of the seal pup population, year classes 1961-66 and 1969-70, from shearing and sampling, [1/] Pribilof Islands, Alaska

	Year class							
	1961[2/]	1962[2/]	1963[2/]	1964[2/]	1965[2/]	1966	1969[2/]	1970
Estimate for St. Paul Island at time of marking	276,000	231,800	229,900	262,300	225,700	227,500	219,600	209,900
Dead pups counted on St. Paul Island	60,800	47,500	34,200	22,700	41,100	22,500	13,900	21,600
Number of pups born on St. Paul Island	336,800	278,300	264,100	285,000	266,800	300,000	233,500	231,500
Estimate for Pribilof Islands	437,800	361,800	343,300	370,500	346,800	[3/]387,700	303,500	[4/]306,000

1/ In 1961 and 1962 marking was done by tagging instead of shearing.

2/ Estimate for the Pribilof Islands is 1.3 times the estimate for St. Paul Island. The factor 1.3 is based on 1966 data when pup population estimates were made on all rookeries of St. Paul and St. George Islands and Sea Lion Rock.

3/ Estimates were made on all rookeries in 1966.

4/ Based on estimates made in 1970 for St. Paul and St. George Islands and an estimate of 20,000 for Sea Lion Rock.

Table 15. --Comparison of the estimated number of pups born, 1/ year classes 1961-66, based on tag recoveries with that from shearing and sampling, Pribilof Islands, Alaska

Year class	Estimate of pups born: From tag recoveries (N_t)	Estimate of pups born: From shearing and sampling (N_s)	Ratio of the estimate (N_s/N_t)
	Number	Number	
1961	544,000	438,000	0.81
1962	477,000	362,000	0.76
1963	443,000	343,000	0.77
1964	421,000	370,000	0.88
1965	387,000	347,000	0.90
1966	437,000	388,000	0.89

1/ Estimates include counts of dead pups.

Number, Survival, and Utilization of Males Older Than Pups

Males older than pups (most are ages 1 and 2 years) have been double-tagged in late September and early October nearly every year since 1961 on St. Paul Island. Recovery of these animals in the kill at ages 2 through 5 years provides a basis for making estimates of population size, survival, and the utilization of year classes. Methods used to make the estimates are an extension of the usual capture-recapture methods (Seber, 1962; Jolly, 1965).

Before applying the methods, three difficulties must be overcome. The first two present no particular problem, but the best way to overcome the third is less obvious. A complete discussion of the procedures used was presented by the Marine Mammal Biological Laboratory (1971) and will only be summarized here. First, the ages of small males are not known at the time of tagging, therefore the distribution of tags applied by age must be calculated from the age distribution determined for marked animals after they have been killed. Secondly, the ages of several tagged males recovered each year cannot be determined because the head or flippers are separated from the body during skinning. These males are assigned ages in proportion to the age composition of animals for which ages were determined. The third difficulty is tag loss. Considerable numbers of small males given two tags lose both before recovery but are recognizable from "tag scars." We can determine ages but not tag series for these animals. To compensate for double-tag loss, we have adjusted the estimated number tagged by the factor $(1-p^2)$, where p is the probability of losing one tag as estimated from recoveries of animals that had been double tagged (table 8). The factor p^2 is an estimate of double-tag loss, assuming that the probability of losing one or both tags is independent.

Estimates of population and survival for ages and year classes for which we have data are given in tables 16 and 17. Petersen's method was used to calculate the population estimates. Estimates of survival were made using a method described by Jolly (1965).

Table 16.--Estimates of the number of 1- and 2-year-old male seals, year classes 1964-67, Pribilof Islands, Alaska

Year class and tag series	Year when killed	Age when killed	Kill size (C)	Recovered[1] (R)	Tagged[2] (M)	$\hat{N} = \frac{MC}{R}$
		Years	Number			
		Tagged at Age 1 Year				
1964					734	
1R	1966	2	3,533	40		64,831
1R	1967	3	34,613	222		114,441
1R	1968	4	16,912	64		193,960
1R	1969	5	2,149	7		225,338
1R	Pooled		57,207	333		126,096
1965					1,146	
1S	1967	2	2,940	88		38,287
1S	1968	3	22,978	263		100,125
1S	1969	4	12,769	91		160,805
1S	1970	5	1,278	6		244,098
1S	Pooled		39,965	448		102,232
1966					724	
1T	1968	2	2,040	63		23,444
1T	1969	3	20,471	198		74,854
1T	1970	4	13,822	101		99,080
1T	Pooled		36,333	362		72,666
1967					461	
1U	1969	2	3,051	35		40,186
1U	1970	3	25,092	132		87,632
1U	Pooled		28,143	167		77,688
		Tagged at Age 2 Years				
1964					965	
2S	1965	3	34,613	573		58,292
2S	1966	4	16,912	101		161,585
2S	1967	5	2,149	6		345,631
2S	Pooled		53,674	680		76,170

See footnotes at end of table.

Table 16.--Estimates of the number of 1- and 2-year-old male seals, year classes 1964-67, Pribilof Islands, Alaska--Continued

Year class and tag series	Year when killed	Age when killed	Kill size (C)	Recovered[1/] (R)	Tagged[2/] (M)	$\hat{N}=\frac{MC}{R}$
		Years		Number		
			Tagged at Age 2 Years--continued			
1965					1,137	
2T	1968	3	22,978	409		63,878
2T	1969	4	12,769	293		49,551
2T	1970	5	1,278	26		55,888
2T	Pooled		37,025	728		57,826
1966					1,338	
2U	1969	3	20,471	405		67,630
2U	1970	4	13,822	358		51,659
2U	Pooled		34,293	763		60,136

1/ Number recovered includes those of unknown age.

2/ Number of marks applied adjusted to compensate for double tag loss and according to the error in determining age at time of tagging. See example in section "Number of male seals ages 1 to 2 years."

Table 17.--Estimated number of male seals ($X10^{-3}$) ages 0, 1, and 2, estimated survival rate between ages 0 to 1 and 1 to 2, and the number of male seals killed ($X10^{-3}$), year classes 1961-67, Pribilof Islands, Alaska

Statistic estimated		Year classes[1/] 1961	1962	1964	1965	1966	1967
Number of males Age 0 (N_0)[2/]	(1)	236	211	198	171	205	208
	(2)	183	154	173	150	181	-
Survival rate to age 1 (s_1)[3/]		0.34	0.37	0.63	0.60	0.35	0.37
Number of males Age 1 (N_1)[4/]	(1)	80	78	125	103	72	77
	(2)	62	57	109	90	63	-
Survival rate to age 2 (s_2)[5/]				0.62	0.57	0.81	
Number of males Age 2 (N_2)[6/]	(1)			78	59	58	
	(2)			68	51	51	
Total number of males killed from year class		47	43	57	40	38[7/]	

1/ Data missing for some year classes.

2/ Estimates based on tag recoveries from the kill (1) and on shearing and sampling (2) taken from tables 11 and 14. Does not include dead pups counted before marking.

3/ Survival rate from time of marking at age 0 to time of marking at age 1 based on recoveries of marked animals (see text).

4/ $N_1 = (s_1)(N_0)$.

5/ Survival rate from time of marking at age 1 to time of marking at age 2, excluding commercial kill (see text).

6/ $N_2 = (s_2)N_1$

7/ Estimated kill from year class at age 5 included.

For age 0 to 1 we have $s_1 = \frac{M_1 R_0^*}{M_0 R_1^*}$

and for age 1 to 2; $s_2 = \left(\frac{M_2 R_1^*}{R_2^*} + R_{12} \right) / M_1$

where

s_{i+1} = estimated survival from age i to i+1, excluding utilization

M_i = number of males marked at time i

R_i^* = sum of recoveries of M_i tags after time i+1

R_{i+1} = number of M_i marks recovered at time i+1

The underlying assumption for the above equations is that $(s_{i+1} M_i / M_{i+1}) = (R_i^* / R_{i+1,}^*)$ with the symbols already defined.

The estimates of survival vary considerably for ages 0 to 1 and 1 to 2 years (table 17). Also, two of three estimates for the latter period are lower than had been expected. Before data became available we believed that most year-class mortality between ages 0 and 3 occurred during the first year at sea and then would be relatively low and stable the following two years. Although this tendency may be the general pattern, mortality in some years may be as high in the second as in the first year. Additional data that will become available in the next few years will be useful for interpreting the meaning of these estimates.

Using estimates of population and survival together with the kill, calculations were made of the number of males in each of several year classes from the year of birth through age 5 (table 18). It is unlikely that the number of pups born are underestimated to the extent that this situation would account for the impossible estimates of utilization at age 4 and no escapement at age 5. Apparently the estimates of survival are too low. Underestimates of survival of only a few percent at ages 1 and 2 would make a considerable difference in calculations for ages 3, 4, and 5. Until more data are available we must assume that survival rates to age 1 or 2, or both, are underestimated. Increased mortality among tagged pups could explain an underestimate of survival to age 1.

Table 18. --Calculations of the male seal segment ($X10^{-3}$) of the fur seal population, year classes 1961-62 and 1964-67

Statistics of male seal population[1/]	Year class					
	1961	1962	1964	1965	1966	1967
N_0	210	182	186	160	193	208
N_1	71.4	67.3	117.2	96.0	67.6	77.0
N_2[2/]	47.8	45.1	72.7	54.7	54.8	51.6
C_2	2.0	2.7	3.5	2.9	2.0	3.1
U_2	0.04	0.06	0.05	0.05	0.04	0.06
N_3	36.6	33.9	55.4	41.4	42.2	48.5
C_3	28.8	22.7	34.6	23.0	20.5	25.1
U_3	0.79	0.67	0.62	0.56	0.49	0.52
N_4	6.2	9.0	16.6	18.4	17.4	18.7
C_4	14.6	16.0	16.9	12.8	13.8	-
U_4	>1.00	>1.00	>1.00	0.70	0.79	-
N_5	-	-	-	5.6	-	-
C_5	1.8	1.7	2.1	1.3	-	-
U_5	-	-	-	0.23	-	-
E	-	-	-	4.3	-	-

1/ Where N_0 = estimated number of males assuming a 1:1 sex ratio, based on the mean of the estimate from tag recoveries and marking and sampling in the year of birth. Does not include dead pups counted.

N_1 = estimated number of males surviving to age 1 based on the estimate of survival--s_1N_0.

N_2 = estimated number of males surviving to age 2 based on the estimate of survival--s_2N_1. Mean of the three estimates of s_2, 0.67, used for 1961, 1962, and 1967 year classes.

C_2, C_3, C_4, C_5 = kill of males at ages 2, 3, 4, and 5, respectively.

U_2, U_3, U_4, U_5 = utilization rate of males at age 2, 3, 4, and 5.

N_3, N_4, N_5 = number of males age 3, 4, and 5 assuming a survival rate of 0.8.

E = estimated escapement of males.

2/ Assume s_{1-2} = 0.67 for years when no estimate of s_{1-2} is available.

Data from animals tagged in 1969 with "1-V" series tags and recovered in 1970 were not used in the above calculations because the age distribution cannot be estimated with confidence until after additional animals from this group are killed in 1971.

Ancel M. Johnson

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GLOSSARY

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

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

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.

Flipper Mark — See mark.

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 has a certain combination of tag-scar and checkmark.

Lost-tag Refers to a seal known to have been tagged as a pup because it bears a checkmark.

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 grown 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 Examples of marks are the tip of a digit from a hind flipper removed, a V-notch cut into the leading edge of a front flipper near the tip, or the tip of a front flipper sliced off.

Rookery An area on which breeding seals congregate.

Round The sequence in which hauling grounds on St. Paul Island are visited to harvest seals. When used, a circuit or round of the hauling grounds is completed in 5 days and the procedure is repeated throughout the kill of males. The mean round of the kill is calculated by multiplying the round number by the number killed in that round and dividing the cumulative product by the cumulative kill.

Tagged Describes a seal having an inscribed metal tag or tags attached to one or more of its flippers.

Tag Recoveries Includes tags recovered, marked seals recovered, and seals identified from checkmarks as having lost their tags. See checkmark, marked, and lost tag.

PART II. PELAGIC FUR SEAL INVESTIGATIONS, 1970

Pelagic research is carried out as part of the United States treaty obligation as stated in the Interim Convention of 1957 and the Protocol of 1963. The pelagic research program provides information for the management of the Pribilof Islands fur seal herd and adds to our knowledge of the fur seal in relation to its ocean environment, where it spends on the average about 8 months of each year ranging the subarctic waters of the North Pacific Ocean from the Bering and Okhotsk Seas south to the coasts of Japan and southern California.

The United States and Canada began an intensive study of fur seals off the Washington and British Columbia coasts in 1969. This program has continued in 1970. Methods of collecting and recording information are standardized and data can be exchanged on punch cards.

RESEARCH IN 1970

Pelagic fur seal research was carried out off Washington from 3 March to 9 June (research cruise 33) from the chartered vessel M/V Tonquin. 2/ The results obtained during the cruise form the body of this report.

A biologist spent from 15 May through 20 June aboard the R/V George B. Kelez, 3/ a National Marine Fisheries Service vessel operated by the Biological Laboratory, Seattle, Wash. The Kelez was making a salmon research cruise south of the western Aleutian Islands. Fur seal distribution was studied in this area and on the return voyage to Seattle, Wash. Results of this cruise will be reported later.

2/ Registered length 29.4 m (96.6 feet), 200 tons net, 350 horsepower, cruising speed 16.7 km per hour (9 knots).

3/ Registered length 100.0 m (165 feet), 262 tons net, 1,000 horsepower, cruising speed 19.4 km per hour (10.5 knots).

Equipment and methods used to collect seals, preserve specimens, and record data at sea and in the laboratory have been described by Fiscus, Baines, and Wilke (1964) and by Fiscus and Kajimura (1967).

Distribution

Figure 12 shows the ocean area usually surveyed for fur seals by research vessels off Washington.

This is a region of shifting oceanic changes (Dodimead, Favorite, and Hirano, 1963). The Alaskan Gyre and the California Current are separating near this area and their boundaries shift "seasonally." The outfall of estuarine water is considerable, seasonably strong tides and high winds from several directions all play a part in the ecology of the region. There are seasonal and yearly variations in the abundance and distribution of food species preyed upon by fur seals in the area.

The edge of the continental shelf, 180 m depth, lies about 46 km offshore in this region. The slope drops rapidly and a depth of 1,800 m is reached within 110 km of shore in most places. The slope and shelf have numerous canyons; three of the more important ones are, from south to north, Astoria Canyon, Gray's Canyon, and Juan de Fuca Canyon. Offshore in this region are a series of seamounts rising from the ocean floor, which has an average depth of about 2,700 m. The most spectacular one is Cobb Seamount, located about 520 km off Grays Harbor, Wash., which rises from a depth of about 2,400 to 2,700 m to 33 m below the surface in a distance of less than 18 km.

The seasonal distribution of fur seals off Washington, as shown by the work of U.S. and Canadian research vessels, beginning with early winter is:

November-December--seals seen on the continental slope and shelf, gradually increasing in numbers in December (Marine Mammal Biological Laboratory, 1970b). No offshore surveys have been made in November and December.

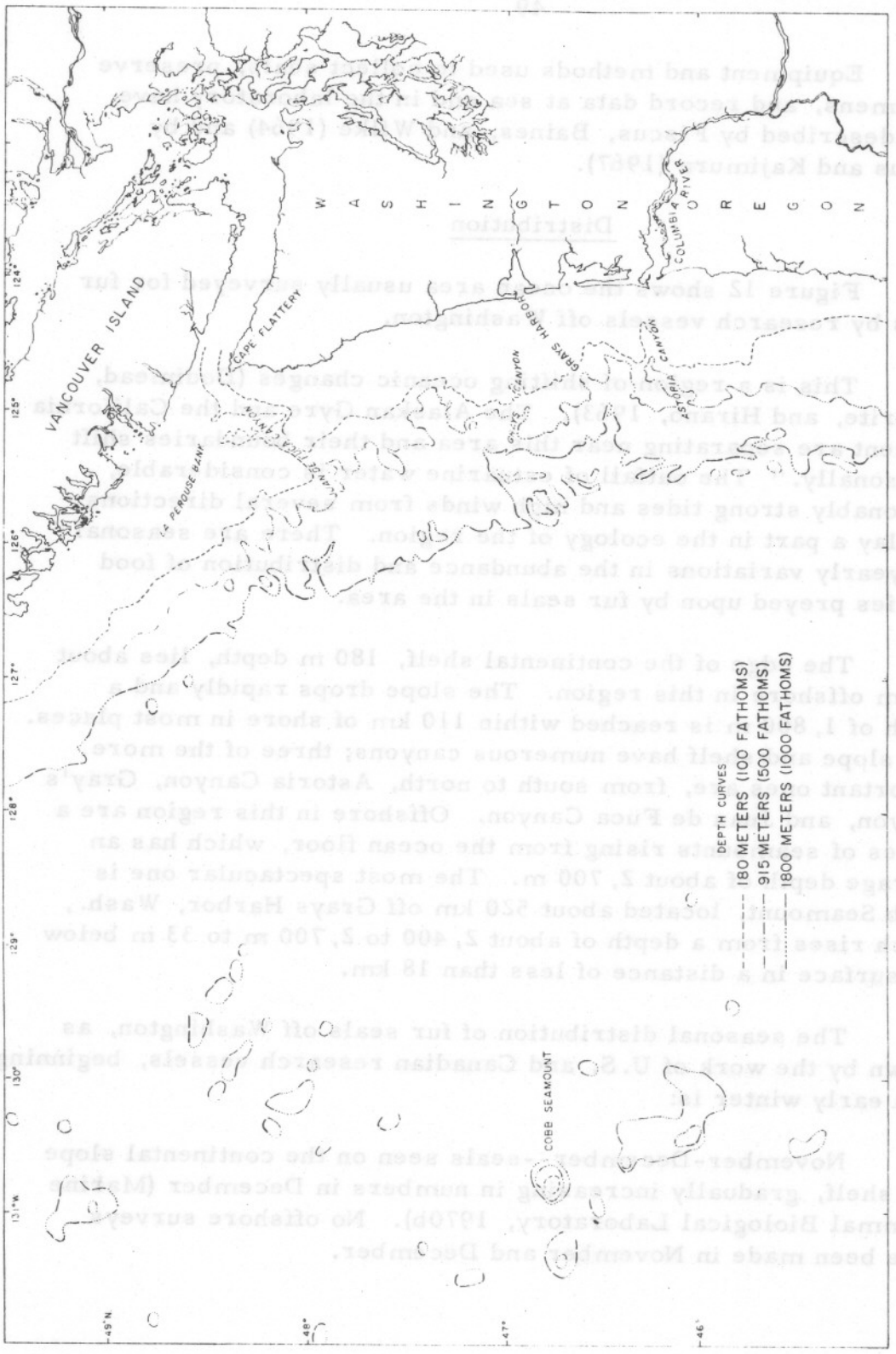

Figure 12. --The ocean off Washington, southern British Columbia, and northern Oregon, showing configuration of the 180, 915, and 1800 meter depth curves (from USCGS Chart 5052, 17th ed.).

January--most seals seen have been located on the continental slope and shelf. Offshore a few seals are found but they are usually scattered (Marine Mammal Biological Laboratory, 1970a, b).

February--most seals seen have been found on the continental slope and shelf. A few seals present offshore, usually scattered (Marine Mammal Biological Laboratory, 1970a, b; 1971).

March--seals locally abundant on continental slope and shelf. No offshore surveys have been made in March (Marine Mammal Biological Laboratory, 1971). 4/

April--most seals sighted on continental slope and shelf and only a few in the offshore waters. 5/

May--most seals were sighted on the continental slope and shelf. Offshore a few seals are present and on one occasion were locally abundant near Cobb Seamount. 6/

In 1970, the distribution pattern differed from that of previous years in April and May. Reasons for this change are not apparent, but may be related to a scarcity of food on the continental slope and shelf.

4/ Pike, G. C., and I. B. MacAskie. 1968. Report on Canadian pelagic fur seal research in 1968. Fish. Res. Bd. Can. Nanaimo, B. C. 4 + 12 pp. (Processed.)

5/ Reports on Canadian pelagic fur seal research in 1967, 1968, and 1969. Fish. Res. Bd. Can. Nanaimo, B. C. (Processed.)

6/ Reports on Canadian pelagic fur seal research in 1968 and 1969. Fish. Res. Bd. Can. Nanaimo, B. C. (Processed.)

In March, we located seals along the continental slope and on the shelf in considerable numbers (fig. 13, table B-1). One of the larger concentrations of seals found this month was located in depths of 90 to 110 m, immediately north of the Astoria Canyon.

In April, fewer seals were seen on the shelf and along the slope than in March (fig. 14, table B-2). The research vessel moved offshore, finding seals from 120 to 280 km west of Grays Harbor and the Columbia River.

No concentrations of seals were located on cruises over the continental shelf and slope in May. Offshore cruises were more productive, seals were abundant at times from the continental slope offshore to Cobb Seamount (fig. 15, table B-3).

In early June, seals were present in greater numbers offshore than on the continental shelf (fig. 16, table B-4). The only concentration of seals found on the shelf in June was located about 75 km west of Cape Flattery on La Perouse Bank. The research cruise ended 9 June.

Abundance

We have collected seals off Washington during parts of 9 years since 1958, and the 1970 figure of 31.4 seals sighted per boat-hunting day has been exceeded only one other year (1969, 42.9 seals). Of 1,886 seals sighted off Washington in 1970, 403 (21.4 percent) were collected, 78 (3.9 percent) were wounded and lost, and 67 (3.6 percent) were killed and lost. In addition, 97 seals were sighted south of the western Aleutians or between Amukta Pass and Cape Flattery during May and June 1970; 2 of 97 seals were collected and 2 were killed and lost. The number and relative abundance of seals seen and collected off Washington by 10-day periods is shown in tables B-5 and B-6.

Tables B-7 and B-8 give the numbers and percentages of seals collected, wounded and lost, and killed and lost among seals sighted and shot throughout their range between California and the Bering Sea from 1958 to 1970.

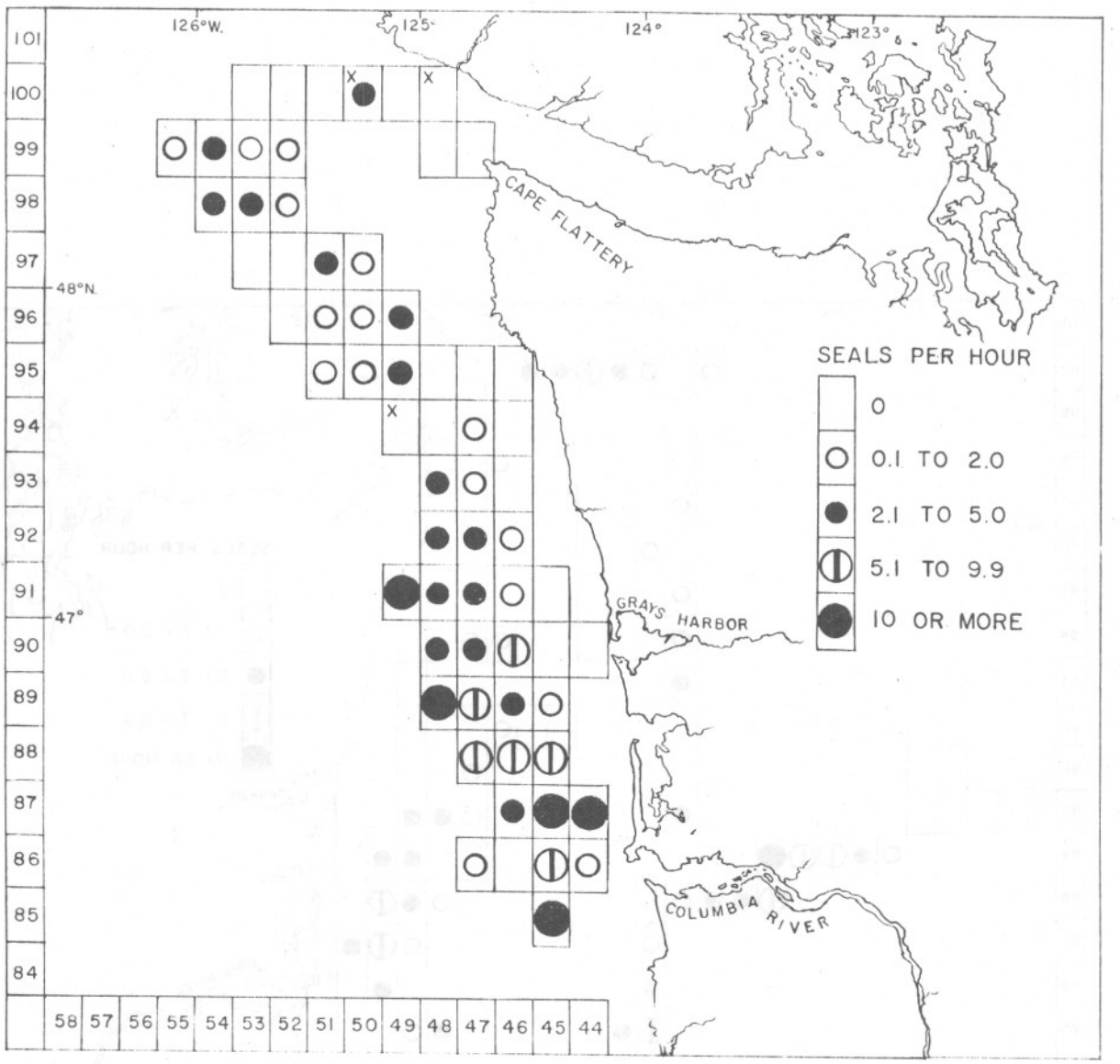

Figure 13. --Number of seals seen per hour of effort in each areal unit occupied by a research vessel in March 1970 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-1 for data.

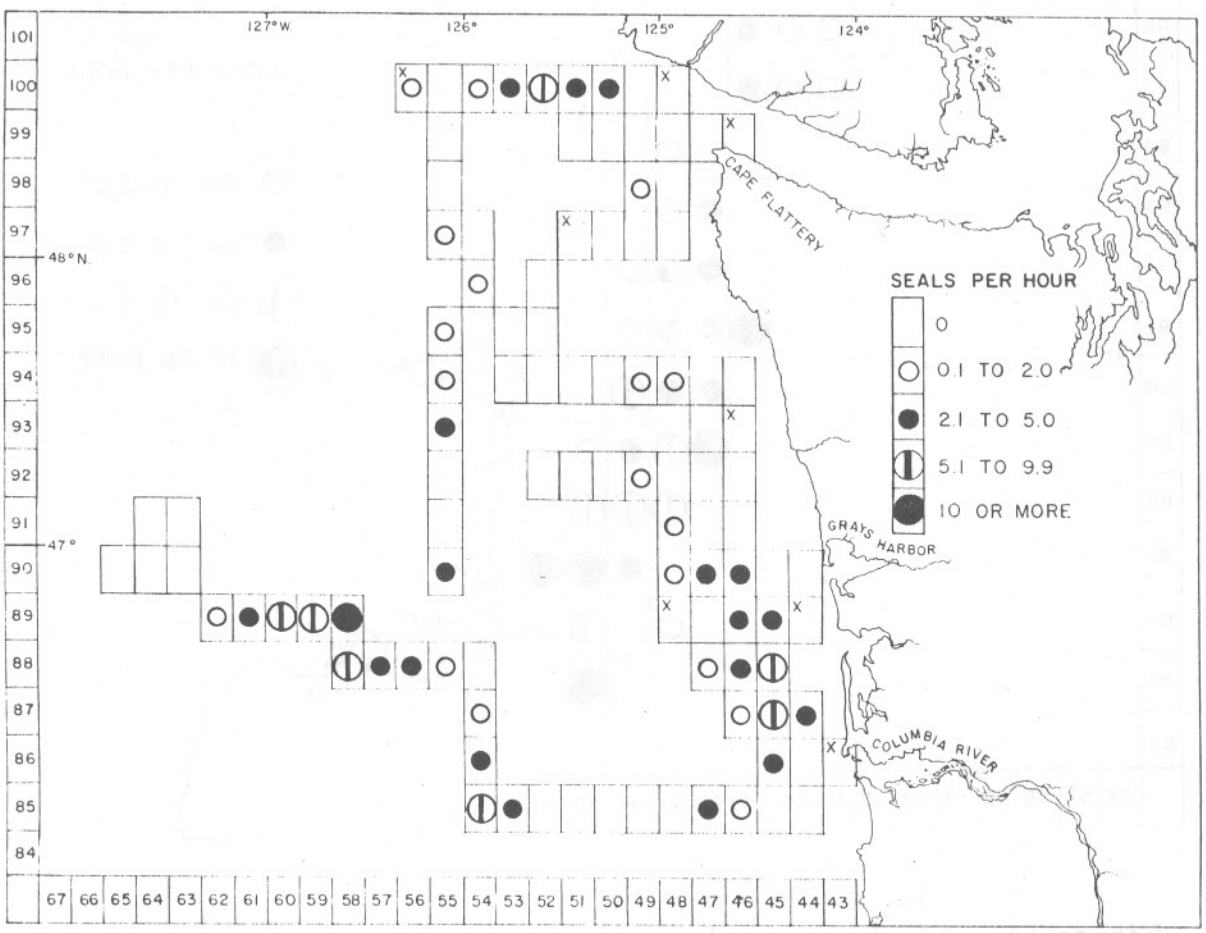

Figure 14.--Number of seals seen per hour of effort in each areal unit occupied by a research vessel in April 1970 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-2 for data.

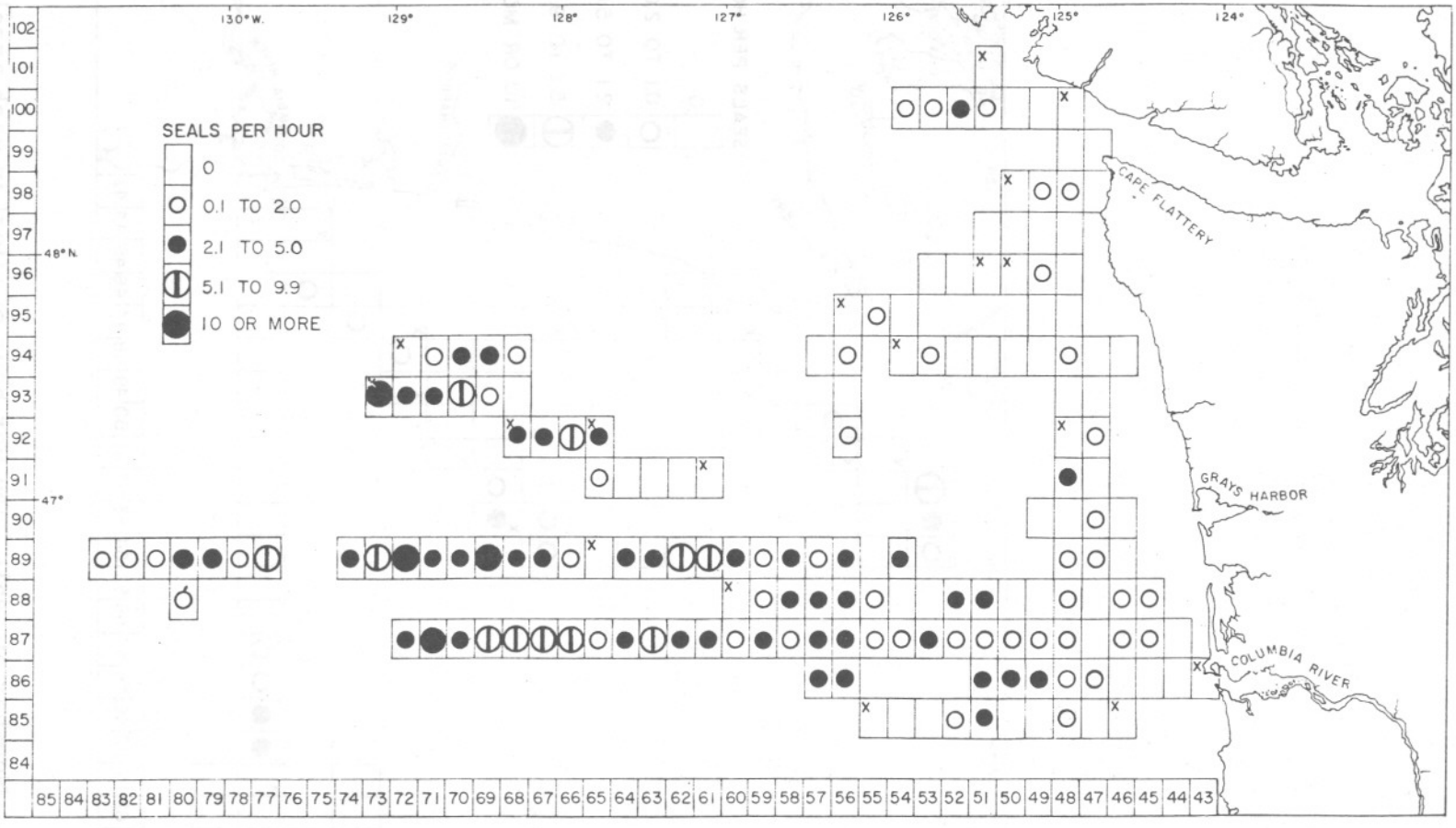

Figure 15. --Number of seals seen per hour of effort in each areal unit occupied by a research vessel in May 1970 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-3 for data.

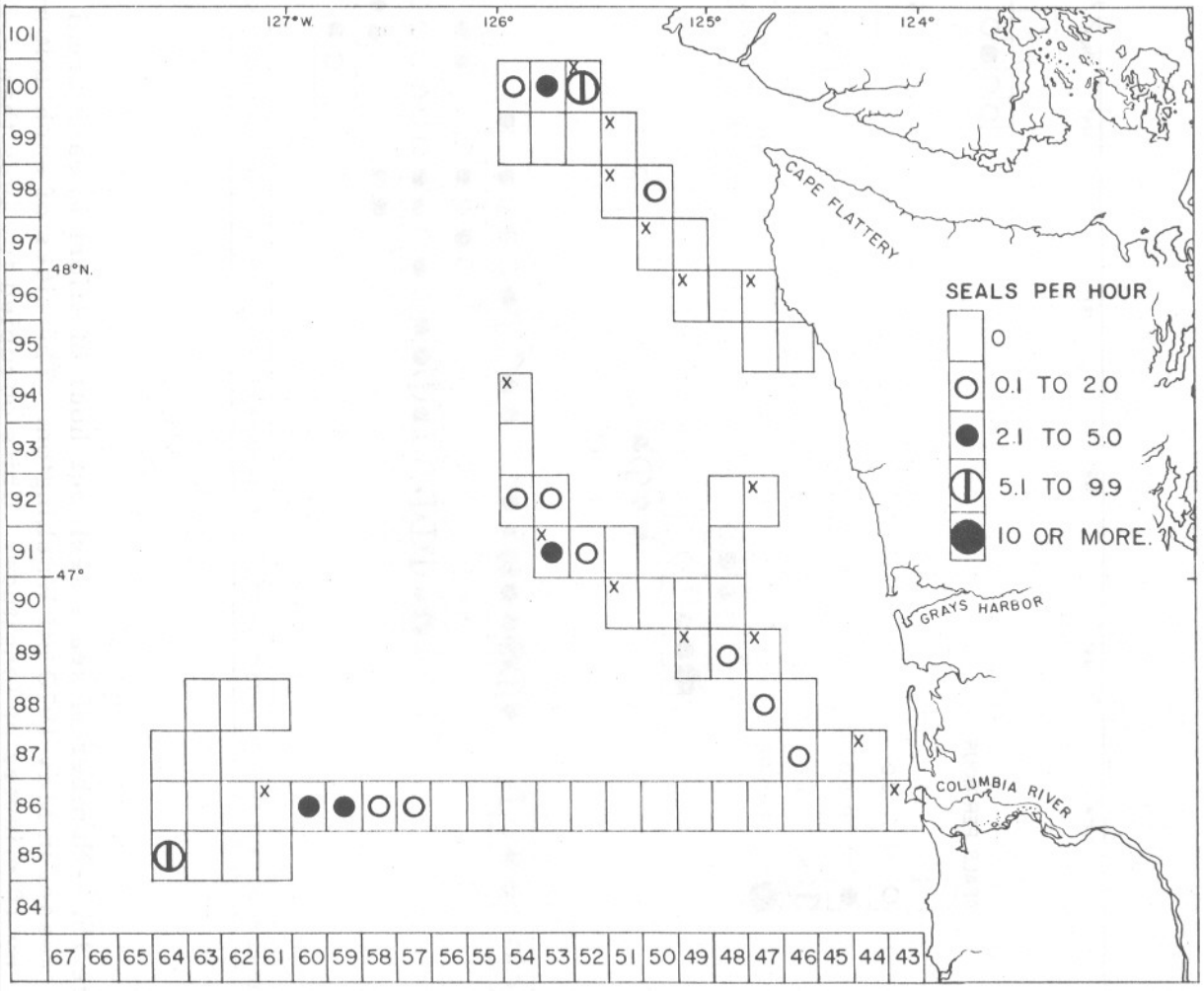

Figure 16. --Number of seals seen per hour of effort in each areal unit occupied by a research vessel in June 1970 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-4 for data.

The largest group of seals sighted in 1970 contained 20 animals (table B-9). A group of seals is defined as one or more that are feeding, traveling, or resting in close association with each other. Seventy-five percent of the seals sighted were in groups of three or less. Solitary seals (29.5 percent) were sighted more frequently than any other group, followed closely by seals in pairs (27.0 percent), and groups of three (19.1 percent). The remaining 24.4 percent were represented by seals in groups of four or more.

Age and Sex

Twenty yearling seals (1969 year class) were taken off Washington in 1970; 11 (55 percent) were males and 9 (45 percent) were females. Thirty-three males, ages 1 to 4 years, were taken in 1970. Eleven yearlings and twelve 3-year-olds comprised nearly 70 percent of the male catch (table 19). Approximately two-thirds of the 368 females taken were from ages 1 to 7 years. One 21-year-old female seal was the oldest animal taken in 1970.

Recoveries of Marked Seals

Nineteen marked or tagged female seals were taken off Washington in 1970. The marked or tagged animals ranged in age from 2 to 9 years, except for two that were 13 years old. One seal was a 3-year-old female which had been tagged by Soviet biologists on Northern Rookery, Bering Island, in 1967. Sixteen seals had tags attached by U.S. biologists on the Pribilof Islands (table 20).

Lengths and Weights

Mean lengths and weights are given in tables B-10 to B-13 for pregnant and nonpregnant females collected in 1970, and in tables B-14 and B-15 for males. Mean lengths and weights of male and female fetuses taken in 1970 are shown by 10-day periods in table B-16.

Table 19. --Age and sex, by month, of fur seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March				April				May				June				Total			
	Male		Female		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	No.	Percent	No.	Percent
1	2	33.3	3	2.3	4	44.4	3	5.9	2	22.2	3	1.8	3	33.3	-	-	11	33.3	9	2.5
2	-	-	3	2.3	-	-	2	3.9	4	44.4	12	7.4	3	33.3	-	-	7	21.2	17	4.6
3	4	66.7	14	10.5	3	33.3	7	13.7	2	22.2	36	22.1	3	33.4	5	23.8	12	36.4	62	16.8
4	-	-	10	7.5	2	22.3	9	17.6	1	11.2	36	22.1	-	-	11	52.3	3	9.1	66	17.9
5	-	-	22	16.4	-	-	4	7.8	-	-	10	6.0	-	-	1	4.8	-	-	37	10.1
	-	-	19	14.2	-	-	8	15.7	-	-	12	7.4	-	-	2	9.5	-	-	41	11.1
7	-	-	12	9.0	-	-	1	2.0	-	-	6	3.7	-	-	-	-	-	-	19	5.2
8	-	-	5	3.8	-	-	6	11.8	-	-	11	6.7	-	-	-	-	-	-	22	6.0
9	-	-	10	7.5	-	-	3	5.9	-	-	9	5.5	-	-	1	4.8	-	-	23	6.3
10	-	-	6	4.5	-	-	2	3.9	-	-	5	3.1	-	-	-	-	-	-	13	3.5
11	-	-	8	6.0	-	-	1	2.0	-	-	5	3.1	-	-	-	-	-	-	14	3.8
12	-	-	6	4.5	-	-	3	5.9	-	-	4	2.5	-	-	-	-	-	-	13	3.5
13	-	-	7	5.3	-	-	2	3.9	-	-	5	3.1	-	-	-	-	-	-	14	3.8
14	-	-	-	-	-	-	-	-	-	-	1	0.6	-	-	-	-	-	-	1	0.3
15	-	-	1	0.8	-	-	-	-	-	-	4	2.5	-	-	-	-	-	-	5	1.4
16	-	-	2	1.5	-	-	-	-	-	-	1	0.6	-	-	-	-	-	-	3	0.8
18	-	-	3	2.3	-	-	-	-	-	-	2	1.2	-	-	1	4.8	-	-	6	1.6
19	-	-	1	0.8	-	-	-	-	-	-	1	0.6	-	-	-	-	-	-	2	0.5
21	-	-	1	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3
Total	6		133		9		51		9		163		9		21		33		368	

Table 20.--Tag recoveries from fur seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

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

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		--Number--	
2	1968	U	11,675	-	1	-	17
3	1967	T	12,472	-	[2/]1	-	62
4	1966	S	24,580	-	[3/]2	-	66
5	1965	R	30,087	-	[3/]4(1)	-	37
6	1964	Q	24,991	-	2(1)	-	41
7	1963	P	24,971	-	1(1)	-	19
8	1962	O	49,908	-	2	-	23
9	1961	N	49,921	-	4(1)	-	22
13	1957	J	49,842	-	2	-	14

1/ Table does not include seals born in years when seals were not tagged, nor year classes from which no tagged or marked seals were taken.

2/ Seal tagged by U.S.S.R. (X22266).

3/ Includes one marked only seal.

Reproduction

The youngest pregnant females collected were 11 primiparous and 2 multiparous 5-year-old seals. The latter two seals conceived at age 3 and gave birth to their first pup (during the summer of 1969) at age 4. The oldest pregnant female was 18 years old and the oldest nonpregnant female was 21 years old. Remnants of a resorbing fetus were found in the uterine horn of two females and abortion was indicated from the condition of uterine horns and the presence of resorbing corpora lutea in four females.

Missed pregnancies among fur seals occur when a female ovulates and the egg is not fertilized or if fertilized fails to implant. Resorbing corpora lutea indicated that 33 percent of the nonpregnant female seals ages 4 to 21 years had missed pregnancies in 1970. The 1970 missed pregnancy rate is lower than from females collected here in 1969. The lower rate may be influenced by a larger sample of nonpregnant 4-year-olds in 1970. Table B-17 shows the reproductive condition by month of female seals taken during 1970.

Table B-18 gives the pregnancy rates of females age 3 and older, and table 21 gives the pregnancy rates of all female seals collected in the eastern North Pacific Ocean by the United States since 1958.

Pregnancy rates of seals collected in 1970 were similar to those of 1969. In 1969, 34.8 percent of the 5-year-old females were pregnant; in 1970, 35.1 percent were pregnant. The percentage of pregnant females in the combined classes (6-26 years) was 69.7 percent in 1969 and 70.6 percent in 1970. The area of collection was the same during both years; however, the time of collection in 1969 was February and March and in 1970 it was March through early June.

Fetal Sex Ratio

The fetal sex ratio in fur seals is about equal. We have examined 5,257 fetuses since 1958, of which 49 percent were males and 51 percent were females. In 1970, 49 percent (69) of 140 fetuses were males and 51 percent (71) were females.

Table 21. --Number of female seals collected pelagically by the United States in the eastern Pacific Ocean and (in parentheses) percentage pregnant 1958-70

Age	Year													1958-70
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	combined
Years	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)	611 (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)	925 (3.1)
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 (44.4)	37 (37.8)	23 (34.8)	37 (35.1)	871 (38.2)
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)	770 (71.9)
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)	813 (79.8)
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)	875 (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)	726 (89.5)
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)	763 (88.5)
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)	774 (88.6)
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)	738 (87.8)
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)	601 (86.0)
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)	555 (83.2)
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)	533 (82.4)
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)	407 (80.1)
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)	- -	280 (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)	183 (67.2)
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)	105 (54.3)
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)	- -	- -	64 (48.4)
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)	- -	- -	13 (30.8)
23	- -	1 (0.0)	1 (0.0)	1 (0.0)	- -	2 (0.0)	1 (100.0)	1 (0.0)	- -	- -	1 (0.0)	- -	- -	8 (12.5)
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)	10,649 (67.1)
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)	8,242 (82.3)

Feeding Habits

The feeding habits of fur seals have not changed greatly since investigators first began examining fur seal stomach contents in 1891 (Lucas, 1899). Fur seals feed on a wide variety of fish and cephalopods throughout their range in the North Pacific Ocean, Bering Sea, Sea of Okhotsk, and the Sea of Japan (Scheffer, 1950; Taylor, Fujinaga, and Wilke, 1955; Wilke and Kenyon, 1957; Fiscus, Baines, and Wilke, 1964; North Pacific Fur Seal Commission, 1965; Fiscus, Baines, and Kajimura, 1965; Fiscus and Kajimura, 1965; 1967; North Pacific Fur Seal Commission, 1969; Marine Mammal Biological Laboratory, 1969; 1970a, b). Fur seals feed principally between dusk and dawn on the most readily available fishes and squids.

Of 403 fur seals collected in 1970, 299 stomachs (74 percent) contained food and 104 (26 percent) were empty (table 22). Squids were the leading food species consumed by fur seals and were found in 74 percent (222) of the stomachs containing food. Five food species contributed 85 percent of the total stomach content volume (fig. 17). Squids contributed 48 percent of the total food volume, followed in order by northern anchovy, Engraulis mordax (20 percent); rockfish, Sebastodes spp. (6 percent); Salmonidae (6 percent); and Pacific herring, Clupea harengus pallasi (5 percent). Although rockfish was the third leading species by volume, it was represented by only two occurrences.

The locations where principal food species were found in the stomachs of fur seals collected off Washington during March, April, May, and June 1970 are shown in figures B-1 to B-7.

Where applicable, the common and scientific names of fish are from a list published by the American Fisheries Society (1960), and names of cephalopods are those used by Berry (1912; 1914), Sasaki (1929), and Roper, Young, and Voss (1969). The following fishes and cephalopods were identified:

Table 22. --Stomach contents of fur seals collected pelagically by the United States off Washington, 3 March to 9 June 1970[1/]

Food	Spring March-May Volume Cc.	Spring March-May Volume Percent	Spring March-May Frequency Number	Summer June Volume Cc.	Summer June Volume Percent	Summer June Frequency Number	March-June Volume Cc.	March-June Volume Percent	March-June Frequency Number
Fish									
Lampetra tridentata	226	0.4	3	-	-	-	226	0.3	3
Clupeidae	T	0.0	3	T	0.0	1	T	0.0	4
Alosa sapidissima	T	0.0	2	-	-	-	T	0.0	2
Clupea harengus pallasi	615	1.0	5	2,731	59.9	10	3,346	5.0	15
Engraulis mordax	13,157	21.2	47	-	-	-	13,157	19.8	47
Salmonidae	3,898	6.3	12	25	0.5	1	3,923	5.9	13
Osmeridae	T	0.0	1	-	-	-	T	0.0	1
Mallotus villosus	3,299	5.3	14	-	-	-	3,299	4.9	14
Thaleichthys pacificus	22	0.0	2	-	-	-	22	0.0	2
Myctophidae	793	1.3	23	-	-	-	793	1.2	23
Cololabis saira	806	1.3	21	3	0.1	1	809	1.2	22
Gadidae	T	0.0	2	T	0.0	1	T	0.0	3
Merluccius productus	1,742	2.8	4	81	1.8	1	1,823	2.8	5
Gasterosteus aculeatus	468	0.7	1	-	-	-	468	0.7	1
Trachipteridae	T	0.0	2	-	-	-	T	0.0	2
Trachurus symmetricus	15	0.0	1	-	-	-	15	0.0	1
Sebastodes spp.	4,235	6.8	2	-	-	-	4,235	6.4	2
Anoplopoma fimbria	1,064	1.7	4	-	-	-	1,064	1.6	4
Zoarcidae	T	0.0	1	-	-	-	T	0.0	1
Unidentified	1,190	1.9	71	T	0.0	6	1,190	1.8	77
Octopoda	T	0.0	1	-	-	-	T	0.0	1
Squid									
Loligo opalescens	2,411	3.9	70	3	0.1	1	2,414	3.6	71
Onychoteuthis sp.	23,321	37.5	125	1,671	36.7	3	24,992	37.6	128
Moroteuthis robusta	T	0.0	1	-	-	-	T	0.0	1
Abraliopsis sp.	104	0.2	52	-	-	-	104	0.2	52
Gonatidae	221	0.4	132	T	0.0	1	221	0.3	133
Gonatus sp.	558	0.9	75	-	-	-	558	0.8	75
Berryteuthis magister	295	0.5	5	-	-	-	295	0.4	5
Gonotopsis borealis	3,641	5.9	39	41	0.9	2	3,682	5.5	41
Chiroteuthis veranyi	14	0.0	6	-	-	-	14	0.0	6
Unidentified	T	0.0	19	T	0.0	1	T	0.0	20
Bird	T	0.0	2	-	-	-	T	0.0	2
Pebbles	T	0.0	2	-	-	-	T	0.0	2
Organic material	T	0.0	2	T	0.0	1	T	0.0	3
Isopoda	T	0.0	1	-	-	-	T	0.0	1
Crustacea	T	0.0	1	-	-	-	T	0.0	1
Total	62,095			4,555			66,650		
Stomachs with food	299								
Stomachs empty	104								

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

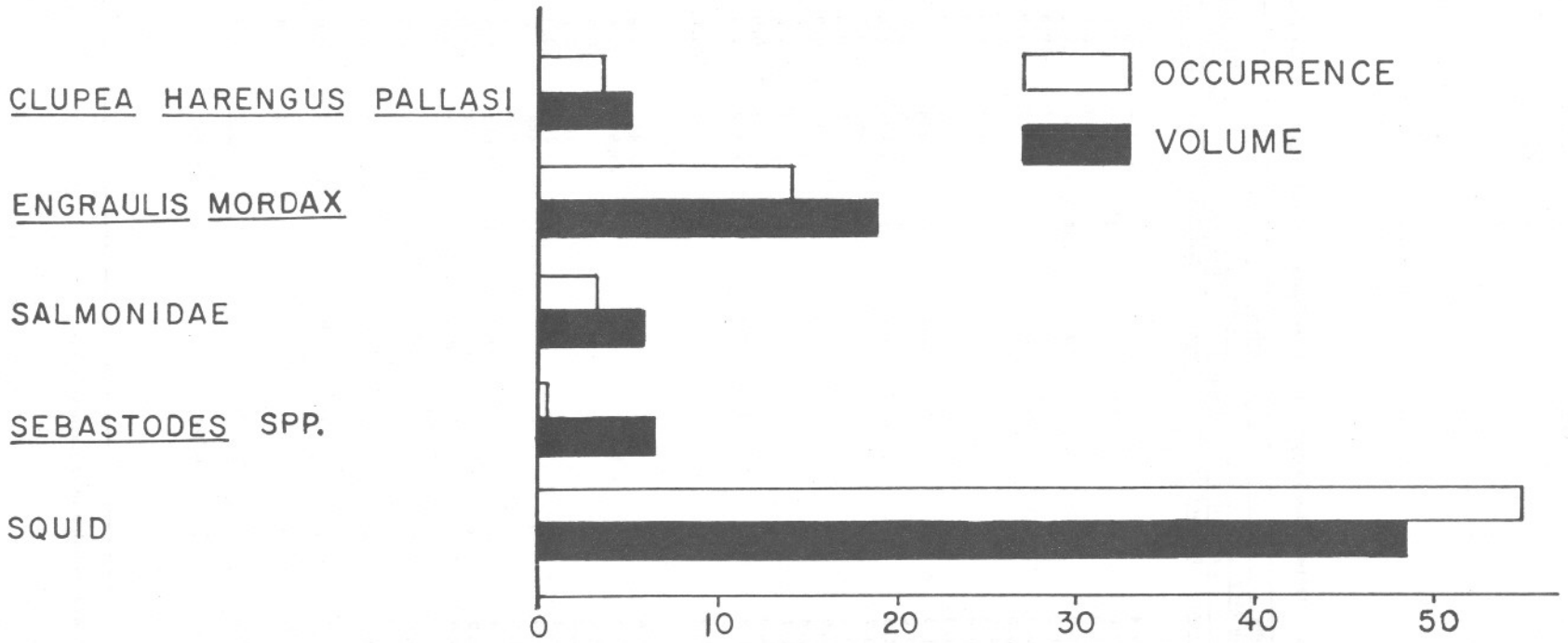

Figure 17. --Percentage of stomach content volume and percentage occurrence of principal food species in fur seal stomachs collected off Washington in 1970.

Lampetra tridentata. Pacific lamprey (3 occurrences) is a minor food of fur seals off Washington, although it has occurred in five previous collection years. Lamprey was found in stomachs of three fur seals taken off Grays Harbor and the Columbia River.

Alosa sapidissima. American shad has been a minor food of fur seals off Washington, although this species has occurred in 8 of the 9 years that samples were collected. During 1970, two occurrences were noted in seal stomachs, one seal taken off Cape Flattery and one off Willapa Bay (Long Beach Peninsula).

Clupea harengus pallasi. Pacific herring is one of the major food species consumed by fur seals off Washington. Eleven of fifteen occurrences were from seals taken on LaPerouse Bank. Fur seals taken from this area consistently contained herring in their stomachs. Herring has occurred in seal stomachs during every year collections were made off Washington.

Engraulis mordax. Northern anchovy (47 occurrences) is one of the major food species consumed by fur seals off Washington. The majority of the anchovies were in stomachs of seals taken between the Columbia River and Grays Harbor in 108-126 m. Nine occurrences were from seals taken beyond the continental shelf in 1,440-1,800 m of water. Anchovy has been found in stomachs of seals in 7 of the 9 years that seals have been collected off Washington.

Salmonidae. Salmonids were found in the stomachs of 13 seals taken off Washington in 1970. The majority were found in stomachs of seals taken in 72 to 90 m between Grays Harbor and LaPerouse Bank. Pacific salmon is one of the most important commercial fish eaten by fur seals. All five species of Pacific salmon (pink, Oncorhynchus gorbuscha; chum, O. keta; coho, O. kisutch; sockeye, O. nerka; and chinook, O. tshawytscha) were found in fur seal stomachs. 7/ Growth rings on scales of pink, coho, and sockeye salmon indicated these fish spent 1 year in the ocean, a chinook salmon 2 years, and a chum salmon 3 years.

7/ Salmon scales were identified and ages determined by Julaine Lyons, National Marine Fisheries Service, Biological Laboratory, Seattle, Wash.

Pink, coho, and chinook salmon remains were found in three seals taken 369 to 468 km offshore. Salmonidae has been found in seal stomachs every year seals have been collected off Washington.

Mallotus villosus. Capelin, a member of the smelt family, is one of the major food species consumed by seals off Washington. These small schooling fishes were found in 14 seal stomachs taken off Grays Harbor in 108 m. There was one occurrence of capelin in a seal collected off LaPerouse Bank and in one off the Columbia River. Previous occurrences were in 1961, 1967, 1968, and 1969.

Thaleichthys pacificus. Eulachon, another member of the smelt family, was identified in stomachs of two seals taken about 27 km off Willapa Bay (Long Beach Peninsula). Eulachon has been a major food of fur seals off Washington in past years. These fish have been found in seal stomachs since 1959.

Myctophidae. Lanternfishes are a minor food of fur seals off Washington. Lanternfishes are usually found in stomachs of fur seals taken in deep water. These fish are generally small. They were found in fur seal stomachs (four occurrences) in 1968. In 1970, when more offshore collecting was done, there were 23 occurrences of lanternfishes from seal stomachs taken beyond the continental shelf in deep water.

Cololabis saira. Pacific saury (3 occurrences) is a minor food of fur seals off the Washington coast. These fish have been found in stomachs of seals taken beyond the continental shelf in deep water. Previous occurrences were from seals collected during April of 1958, 1959, and 1965.

Merluccius productus. Pacific hake has been one of the main food species eaten by fur seals in past years, occurring in 8 of 9 years seals were collected off Washington. Of five occurrences in 1970, one was found in the stomach of a seal taken on LaPerouse Bank and four off the Columbia River.

Gasterosteus aculeatus. Threespine stickleback was identified in the stomach of one seal taken on LaPerouse Bank. This species is a minor food of fur seals and has appeared in fur seal stomachs during the spring months off Washington. This fish has occurred during 3 previous collection years off Washington.

Trachipteridae. The members of this family are an incidental food of fur seals. Trace amounts (vertebral fragments) were found in the stomachs of two fur seals taken in deep water west of the Columbia River this year. Ribbonfishes have been identified from the stomachs of fur seals taken in California waters. A king-of-the-salmon (Trachipterus altivelis) was retrieved on 15 April 1959, 63 km west of Cape Elizabeth, Wash., from a fur seal that had captured and brought it to the surface. This fish was 1.7 m long. Part of the head, the first five dorsal fin rays, pelvic fins, stomach, and parts of the abdominal wall were missing. When we first sighted the seal it was shaking and tearing the ribbonfish into smaller pieces to eat.

Trachurus symmetricus. Jack mackerel was found for the first time this season in the stomach of a fur seal taken off Washington. It is a major food in California waters.

Sebastodes spp. Rockfishes are a major food of fur seals taken from the waters of the continental slope and shelf. Sebastodes spp. have been one of the leading food species consumed by seals taken off the Washington coast, having occurred in every collection year since 1958. Although rockfish was found only twice in 1970, it ranked third in total volume. The two occurrences were from seals taken on the continental shelf north of Grays Harbor.

Anoplopoma fimbria. Sablefish (blackcod) has been one of the minor foods consumed by seals, although it ranked second in April 1959. This fish has been found in 6 of the 9 years that collections were made off Washington. The four occurrences in 1970 were scattered; one was found in a stomach of a seal taken on LaPerouse Bank, two off the Columbia River, and one about 270 km offshore northwest of the Columbia River.

Zoarcidae. This is the first occurrence of an eelpout from a fur seal stomach. These fish are bottom dwellers in muddy habitat and may be found in deepwater areas. This one occurrence of eelpout was found in the stomach of a seal taken over a depth of about 2,700 m, approximately 270 km west-northwest of the Columbia River.

Octopoda. A small lower beak of an octopus was found in a stomach of a seal taken just north of Grays Harbor. This is the first occurrence of Octopoda in stomachs of seals taken off Washington. They have been identified in the stomachs of seals taken off California.

Squids. Squids are one of the major foods of the fur seal throughout its range. Squid bodies are quickly digested, leaving only the beaks and pens, therefore squids usually rank high in frequency of occurrence and low in percentage volume. In 1970, however, squids were the leading food species in total volume and frequency of occurrence, contributing 48.4 percent of the total food volume. With the possible exception of one species (Loligo), squids generally are more abundant in deeper water beyond the continental shelf.

Loligo opalescens. This species of squid is usually found closer to shore than other species. In the past, L. opalescens has been the leading squid found in stomachs of fur seals off Washington. In 1970, the 71 occurrences represented 7.5 percent of the total squid volume and ranked third among the squids. Eleven occurrences were from seals taken offshore in deep water and 60 occurrences were from seals taken on the continental shelf.

Onychoteuthis sp. This squid was the leading food consumed by fur seals off Washington during 1970, representing 37.6 percent of the total food volume and occurring in 128 stomachs. Three occurrences were from seals taken in water less than 180 m, but the majority were from seals taken in depths greater than 1,800 m. One occurrence was from a seal taken about 486 km offshore.

Moroteuthis robusta. This is the first occurrence of M. robusta from a stomach of a fur seal taken off the Washington coast (one pair of large beaks). Four other occurrences have been noted previously in stomachs of seals taken off California. This squid is probably not commonly eaten because of its large size compared to other species of squids.

Abraliopsis sp. This is the second year in succession that this species of squid has been identified in stomachs of seals taken off the Washington coast. Fifty-two occurrences were noted in this year's collection compared to one occurrence in 1969. These squids were from seals taken beyond the continental shelf in deep water in an area between the Columbia River and Grays Harbor.

Gonatidae. Squids from the stomachs of 133 seals were identified only to the family Gonatidae, species undetermined. With the exception of four seals taken in water less than 180 m deep, they were all from seals beyond the continental shelf.

Gonatus sp. These squids have been called Gonatus fabricii in our reports through 1968. Recent evidence indicates that there are several undescribed species in the genus and until these species are described we will not make specific identifications. On the basis of beak differences, we found two types this year. Squids from this genus were found in the stomachs of 75 seals taken from an area between the Columbia River and Grays Harbor beyond the 1,260-m depth. One occurrence was noted from a stomach of a seal taken west of Cape Flattery on the 180-m curve. Two occurrences were from an area of 108-m depth.

Berryteuthis magister. This squid has recently been given full generic rank; previous reports list it as Gonatus magister. The four occurrences of this species were from seals taken in deep water beyond the continental shelf.

Gonatopsis borealis. This squid is generally found in stomachs of seals taken beyond the continental shelf in deep water. It had previously occurred once (1964) off Washington. In 1970, 41 stomachs of seals contained this species. It was taken over depths of 1,260 m (one exception, one occurrence from a seal taken in water over 360 m deep) in an area between the Columbia River and Grays Harbor in 1970. This squid ranked second in total volume among squids this year.

Chiroteuthis veranyi. This is the second occurrence of this species in fur seal stomachs taken off Washington. The six occurrences of C. veranyi in 1970 were from seals taken beyond the continental shelf in deep water. The first occurrence was from a seal taken in relatively shallow water on the continental shelf in 1968.

Miscellaneous contents. Unidentified bird feathers were found in two seal stomachs; pebbles in two stomachs; organic material in two stomachs; an unidentified isopod in one stomach; and a shrimp spine in one stomach.

Relation of Food of Fur Seals to Commercial Fisheries

Stomach content examinations show that some commercially valuable fish species are consumed by fur seals. Salmon (Oncorhynchus spp.) was the most valuable fish eaten by fur seals off Washington.

Since the relationship between fur seals and food species and the interrelationship between food species are not very well known, the effect of fur seals on commercially important fisheries cannot be accurately assessed with our limited knowledge of the ocean environment and its ecology.

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Table A-1 .--Age classification of male seals killed on St. Paul Island, 24 June to 31 July 1970

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(east)	308	67	-	19.4	68.7	11.9	-	-	58	213	37	-
24	NEP(west)	433	74	-	22.9	67.6	9.5	-	-	100	294	39	-
25	ZAP	608	121	2.5	34.7	54.6	7.4	0.8	12	213	335	42	6
26	REEF	541	107	-	37.4	57.0	4.7	0.9	-	200	309	27	5
27	POL	415	84	-	17.9	70.2	11.9	-	-	75	290	50	-
27	TZR	379	72	-	27.8	65.3	6.9	-	-	106	246	27	-
27	L-K	174	35	-	17.1	80.0	2.9	-	-	30	139	5	-
29	NEP(east)	412	80	-	33.8	57.5	8.7	-	-	140	239	33	-
29	NEP(west)	141	26	-	19.2	73.1	7.7	-	-	27	103	11	-
30	ZAP	634	122	0.8	45.9	47.6	4.9	0.8	6	292	298	32	6
July													
1	REEF	573	109	0.9	45.9	48.6	4.6	-	5	264	281	23	-
2	POL	317	60	-	41.7	51.7	6.6	-	-	130	165	22	-
2	TZR	163	30	-	36.7	56.7	6.6	-	-	60	93	10	-
2	L-K	177	33	-	48.5	51.5	-	-	-	85	92	-	-
3	NEP(east)	351	61	-	41.0	57.4	1.6	-	-	144	200	7	-
3	NEP(west)	257	50	-	42.0	54.0	4.0	-	-	108	139	10	-
6	ZAP	1,084	197	-	58.4	40.6	1.0	-	-	629	444	11	-
7	REEF	643	127	0.8	48.8	48.0	2.4	-	6	315	309	13	-
7	TZR	176	36	-	47.2	50.0	2.8	-	-	83	88	5	-
8	POL	504	95	1.0	48.4	47.4	3.2	-	5	242	237	20	-
8	NEP(west)	361	73	-	71.2	27.4	1.4	-	-	256	101	4	-
9	NEP(east)	944	188	2.7	58.5	37.2	1.6	-	28	557	349	10	-
10	ZAP	923	185	2.2	70.8	27.0	-	-	19	655	249	-	-
10	L-K	212	41	2.4	48.8	46.4	2.4	-	4	104	100	4	-
11	REEF	486	89	1.1	65.2	33.7	-	-	5	316	165	-	-
11	TZR	158	30	3.3	56.7	36.7	3.3	-	5	90	58	5	-
13	POL	442	86	1.2	45.3	52.3	1.2	-	4	204	230	4	-
13	TZR	246	44	-	56.8	38.6	4.6	-	-	140	96	10	-
14	NEP(east)	816	158	5.7	56.9	36.1	1.3	-	49	465	294	8	-
14	NEP(west)	685	136	5.1	68.4	25.0	1.5	-	34	466	171	14	-
15	ZAP	2,706	497	5.2	60.6	33.0	1.2	-	135	1,651	893	27	-
16	REEF	1,303	236	4.2	63.6	30.1	2.1	-	52	834	391	26	-
17	NEP(east)	689	159	4.4	69.2	24.5	1.9	-	28	475	172	14	-
17	NEP(west)	388	31	-	71.0	29.0	--	-	-	275	113	-	-
18	POL	934	148	3.4	68.2	26.4	2.0	-	28	635	252	19	-
18	TZR	253	73	2.7	58.9	37.0	1.4	-	8	149	94	2	-
18	L-K	458	97	1.0	68.1	30.9	-	-	5	311	142	-	-
20	ZAP	1,577	296	5.4	66.6	28.0	-	-	95	1,041	441	-	-
20	TZR	134	30	-	56.7	43.3	-	-	-	76	58	-	-
21	REEF	1,310	234	6.8	70.9	21.4	0.9	-	92	930	275	13	-
21	L-K	325	71	2.8	66.2	29.6	1.4	-	10	214	98	3	-
22	NEP(east)	1,115	221	5.9	69.2	24.0	0.9	-	67	769	268	11	-
22	NEP(west)	562	113	10.6	67.3	16.8	5.3	-	62	376	96	28	-
23	POL	634	126	4.0	71.4	24.6	-	-	25	450	159	-	-
23	TZR	484	95	3.2	77.9	17.9	1.0	-	14	378	87	5	-
24	ZAP	1,301	238	8.4	73.9	16.4	1.3	-	117	963	208	13	-
24	TZR	352	70	4.3	81.4	12.9	1.4	-	14	289	46	3	-
25	REEF	555	110	10.0	70.0	18.2	1.8	-	55	389	100	11	-
25	L-K	449	73	11.0	67.1	21.9	-	-	49	301	99	-	-
27	NEP(east)	196	36	5.6	80.6	13.8	-	-	10	159	27	-	-
27	NEP(west)	1,248	242	10.7	76.9	11.6	0.8	-	137	948	150	13	-
28	POL	263	55	-	74.6	23.6	1.8	-	-	195	63	5	-
28	TZR	859	162	8.6	74.1	16.7	0.6	-	69	636	146	8	-
29	ZAP	1,351	272	7.4	66.5	25.0	1.1	-	94	905	338	14	-
30	REEF	1,070	198	9.1	73.2	17.2	0.5	-	96	781	182	11	-
30	L-K	538	87	10.3	72.4	16.1	1.2	-	54	393	86	5	-
31	NEP(east)	939	210	11.9	70.0	18.1	-	-	113	657	169	-	-
31	NEP(west)	414	28	21.4	67.9	7.1	3.6	-	87	281	29	17	-
31	POL	227	42	11.9	71.4	16.7	-	-	27	161	39	-	-
Season total		36,197	6,866						1,725	22,176	11,548	731	17

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 31 July 1970

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(east)	-	58	213	37	-	308	-	19	69	12	-
24	NEP(west)	-	158	507	76	-	741	-	21	68	11	-
25	ZAP	12	371	842	118	6	1,349	1	28	62	9	-
26	REEF	12	571	1,151	145	11	1,890	1	30	61	8	-
27	POL	12	646	1,441	195	11	2,305	-	28	63	9	-
27	TZR	12	752	1,687	222	11	2,684	-	28	63	9	-
27	L-K	12	782	1,826	227	11	2,858	-	28	64	8	-
29	NEP(east)	12	922	2,065	260	11	3,270	-	28	64	8	-
29	NEP(west)	12	949	2,168	271	11	3,411	-	28	64	8	-
30	ZAP	18	1,241	2,466	303	17	4,045	-	31	61	8	-
July												
1	REEF	23	1,505	2,747	326	17	4,618	-	33	60	7	-
2	POL	23	1,635	2,912	348	17	4,935	-	34	59	7	-
2	TZR	23	1,695	3,005	358	17	5,098	-	34	59	7	-
2	L-K	23	1,780	3,097	358	17	5,275	-	34	59	7	-
3	NEP(east)	23	1,924	3,297	365	17	5,626	-	34	59	7	-
3	NEP(west)	23	2,032	3,436	375	17	5,883	-	35	59	6	-
6	ZAP	23	2,661	3,880	386	17	6,967	-	38	56	6	-
7	REEF	29	2,976	4,189	399	17	7,610	-	39	55	6	-
7	TZR	29	3,059	4,277	404	17	7,786	-	40	55	5	-
8	POL	34	3,301	4,514	424	17	8,290	-	40	55	5	-
8	NEP(west)	34	3,557	4,615	428	17	8,651	-	41	54	5	-
9	NEP(east)	62	4,114	4,964	438	17	9,595	-	43	52	5	-
10	ZAP	81	4,769	5,213	438	17	10,518	1	45	50	4	-
10	L-K	85	4,873	5,313	442	17	10,730	1	45	50	4	-
11	REEF	90	5,189	5,478	442	17	11,216	1	46	49	4	-
11	TZR	95	5,279	5,536	447	17	11,374	1	46	49	4	-
13	POL	99	5,483	5,766	451	17	11,816	1	46	49	4	-
13	TZR	99	5,623	5,862	461	17	12,062	1	47	48	4	-
14	NEP(east)	148	6,088	6,156	469	17	12,878	1	47	48	4	-
14	NEP(west)	182	6,554	6,327	483	17	13,563	1	48	47	4	-
15	ZAP	317	8,205	7,220	510	17	16,269	2	51	44	3	-
16	REEF	369	9,039	7,611	536	17	17,572	2	52	43	3	-
17	NEP(east)	397	9,514	7,783	550	17	18,261	2	52	43	3	-
17	NEP(west)	397	9,789	7,896	550	17	18,649	2	53	42	3	-
18	POL	425	10,424	8,148	569	17	19,583	2	53	42	3	-
18	TZR	433	10,573	8,242	571	17	19,836	2	53	42	3	-
18	L-K	438	10,884	8,384	571	17	20,294	2	54	41	3	-
20	ZAP	533	11,925	8,825	571	17	21,871	2	55	40	3	-
20	TZR	533	12,001	8,883	571	17	22,005	2	55	40	3	-
21	REEF	625	12,931	9,158	584	17	23,315	3	55	39	3	-
21	L-K	635	13,145	9,256	587	17	23,640	3	56	39	2	-
22	NEP(east)	702	13,914	9,524	598	17	24,755	3	56	39	2	-
22	NEP(west)	764	14,290	9,620	626	17	25,317	3	57	38	2	-
23	POL	789	14,740	9,779	626	17	25,951	3	57	38	2	-
23	TZR	803	15,118	9,866	631	17	26,435	3	57	38	2	-
24	ZAP	920	16,081	10,074	644	17	27,736	3	58	37	2	-
24	TZR	934	16,370	10,120	647	17	28,088	3	59	36	2	-
25	REEF	989	16,759	10,220	658	17	28,643	3	59	36	2	-
25	L-K	1,038	17,060	10,319	658	17	29,092	4	59	35	2	-
27	NEP(east)	1,048	17,219	10,346	658	17	29,288	4	59	35	2	-
27	NEP(west)	1,185	18,167	10,496	671	17	30,536	4	60	34	2	-
28	POL	1,185	18,362	10,559	676	17	30,799	4	60	34	2	-
28	TZR	1,254	18,998	10,705	684	17	31,658	4	60	34	2	-
29	ZAP	1,348	19,903	11,043	698	17	33,009	4	60	34	2	-
30	REEF	1,444	20,684	11,225	709	17	34,079	4	61	33	2	-
30	L-K	1,498	21,077	11,311	714	17	34,617	4	61	33	2	-
31	NEP(east)	1,611	21,734	11,480	714	17	35,556	5	61	32	2	-
31	NEP(west)	1,698	22,015	11,509	731	17	35,970	5	61	32	2	-
31	POL	1,725	22,176	11,548	731	17	36,197	5	61	32	2	-

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 . --Age classification of male seals killed on St. George Island, 24 June to 31 July 1970

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	NOR	290	51	-	25.5	49.0	13.7	11.8	-	74	142	40	34
26	EAST	177	33	-	27.3	48.5	24.2	-	-	48	86	43	-
26	STAR	68	10	-	30.0	60.0	10.0	-	-	20	41	7	-
29	NOR	140	29	-	13.8	65.5	20.7	-	-	19	92	29	-
29	ZAP	162	31	-	38.7	48.4	12.9	-	-	63	78	21	-
July													
1	NOR	132	25	-	28.0	60.0	8.0	4.0	-	37	79	11	5
1	EAST	122	26	-	27.0	53.8	19.2	-	-	33	66	23	-
3	ZAP	154	28	-	35.7	32.1	28.6	3.6	-	55	49	44	6
3	STAR	72	13	-	23.1	61.5	15.4	-	-	17	44	11	-
6	NOR	257	52	1.9	44.2	48.1	5.8	-	5	113	124	15	-
6	EAST	144	29	-	34.5	44.8	17.3	3.4	-	50	64	25	5
8	NOR	104	20	-	65.0	30.0	5.0	-	-	68	31	5	-
8	STAR	66	13	-	46.2	53.8	-	-	-	30	36	-	-
8	ZAP	118	21	-	42.9	57.1	-	-	-	51	67	-	-
10	EAST	100	20	-	55.0	40.0	5.0	-	-	55	40	5	-
10	ZAP	76	16	-	50.0	44.0	6.0	-	-	38	33	5	-
13	EAST	144	27	-	40.7	48.2	7.4	3.7	-	59	69	11	5
13	NOR	400	68	-	39.7	51.5	8.8	-	-	159	206	35	-
15	ZAP	79	15	-	53.3	46.7	-	-	-	42	37	-	-
15	STAR	132	24	-	33.3	50.0	16.7	-	-	44	66	22	-
15	NOR	184	34	-	44.1	38.2	14.7	3.0	-	81	70	27	6
17	EAST	145	27	3.7	66.7	25.9	3.7	-	5	97	38	5	-
17	NOR	273	54	3.7	42.6	40.7	13.0	-	10	116	111	36	-
17	STAR	99	20	-	85.0	15.0	-	-	-	84	15	-	-
20	ZAP	176	35	-	60.0	31.4	8.6	-	-	106	55	15	-
20	STAR	64	13	7.7	61.5	23.1	7.7	-	5	39	15	5	-
20	EAST	185	34	3.0	73.5	23.5	--	-	6	136	43	-	-
22	NOR	447	87	5.8	63.2	25.3	4.6	1.1	26	282	113	21	5
22	STAR	117	23	-	65.3	26.1	4.3	4.3	-	76	31	5	5
22	ZAP	58	12	16.7	33.3	41.7	8.3	-	10	19	24	5	-
24	EAST	161	36	-	61.1	33.3	5.6	-	-	98	54	9	-
24	NOR	122	26	3.9	61.5	23.1	11.5	-	5	75	28	14	-
24	ZAP	104	21	-	66.7	33.3	-	-	-	69	35	-	-
27	NOR	234	42	4.7	54.8	31.0	9.5	-	11	128	73	22	-
27	STAR	138	30	3.3	80.0	16.7	--	-	5	110	23	-	-
27	ZAP	66	12	-	50.0	33.4	8.3	8.3	-	33	23	5	5
29	EAST	90	17	5.9	64.7	23.5	5.9	-	5	59	21	5	-
29	NOR	91	20	-	65.0	30.0	5.0	-	-	59	27	5	-
31	NOR	78	14	-	71.5	14.3	7.1	7.1	-	55	11	6	6
31	STAR	100	20	-	90.0	5.0	5.0	-	-	90	5	5	-
31	EAST	32	7	14.3	57.1	14.3	14.3	-	5	17	5	5	-
31	ZAP	23	6	-	50.0	16.7	-	33.3	-	12	4	-	7
Season total		5,924	1,141						98	2,916	2,274	547	89

1/ ZAP=Zapadni and South; EAST=East Reef and East Cliffs; NOR=North; STAR=Staraya Artil.

Table A-4 . --Cumulative age classification of male seals killed on St. George Island, 24 June to 31 July 1970

Date	Rookery	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	NOR	-	74	142	40	34	290	-	25	49	14	12
26	EAST	-	122	228	83	34	467	-	26	49	18	7
26	STAR	-	142	269	90	34	535	-	27	50	17	6
29	NOR	-	161	361	119	34	675	-	24	53	18	5
29	ZAP	-	224	439	140	34	837	-	27	52	17	4
July												
1	NOR	-	261	518	151	39	969	-	27	53	16	4
1	EAST	-	294	584	174	39	1,091	-	27	53	16	4
3	ZAP	-	349	633	218	45	1,245	-	28	51	17	4
3	STAR	-	366	677	229	45	1,317	-	28	52	17	3
6	NOR	5	479	801	244	45	1,574	-	30	51	16	3
6	EAST	5	529	865	269	50	1,718	-	31	50	16	3
8	NOR	5	597	896	274	50	1,822	-	33	49	15	3
8	STAR	5	627	932	274	50	1,888	-	33	49	15	3
8	ZAP	5	678	999	274	50	2,006	-	34	50	14	2
10	EAST	5	733	1,039	279	50	2,106	-	35	49	13	3
10	ZAP	5	771	1,072	284	50	2,182	-	35	49	13	3
13	EAST	5	830	1,141	295	55	2,326	-	36	49	13	2
13	NOR	5	989	1,347	330	55	2,726	-	36	50	12	2
15	ZAP	5	1,031	1,384	330	55	2,805	-	37	49	12	2
15	STAR	5	1,075	1,450	352	55	2,937	-	37	49	12	2
15	NOR	5	1,156	1,520	379	61	3,121	-	37	49	12	2
17	EAST	10	1,253	1,558	384	61	3,266	-	38	48	12	2
17	NOR	20	1,369	1,669	420	61	3,539	-	39	47	12	2
17	STAR	20	1,453	1,684	420	61	3,638	-	40	46	12	2
20	ZAP	20	1,559	1,739	435	61	3,814	-	41	46	11	2
20	STAR	25	1,598	1,754	440	61	3,878	1	41	45	11	2
20	EAST	31	1,734	1,797	440	61	4,063	1	43	44	11	1
22	NOR	57	2,016	1,910	461	66	4,510	1	45	42	10	2
22	STAR	57	2,092	1,941	466	71	4,627	1	45	42	10	2
22	ZAP	67	2,111	1,965	471	71	4,685	1	45	42	10	2
24	EAST	67	2,209	2,019	480	71	4,846	1	46	42	10	1
24	NOR	72	2,284	2,047	494	71	4,968	2	46	41	10	1
24	ZAP	72	2,353	2,082	494	71	5,072	2	46	41	10	1
27	NOR	83	2,481	2,155	516	71	5,306	1	47	41	10	1
27	STAR	88	2,591	2,178	516	71	5,444	2	48	40	9	1
27	ZAP	88	2,624	2,201	521	76	5,510	2	48	40	9	1
29	EAST	93	2,683	2,222	526	76	5,600	2	48	40	9	1
29	NOR	93	2,742	2,249	531	76	5,691	2	48	40	9	1
31	NOR	93	2,797	2,260	537	82	5,769	2	49	39	9	1
31	STAR	93	2,887	2,265	542	82	5,869	2	49	39	9	1
31	EAST	98	2,904	2,270	547	82	5,901	2	49	39	9	1
31	ZAP	98	2,916	2,274	547	89	5,924	2	49	38	9	2

1/ ZAP=Zapadni and South; EAST=East Reef and East Cliffs; NOR=North; STAR=Staraya Artil.

Table A-5 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 20-24 June 1970

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
1	2	8	-	-	-	-	-	-	-	-	-	-	-	-	10
2	11	13	-	-	-	-	-	-	-	-	-	-	-	-	24
3	23	36	-	-	-	-	-	-	-	-	-	-	-	-	59
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	45	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Kitovi[2/]															
1	2(1)	-	1	1	-	-	-	-	-	-	-	-	-	-	5
2	15(8)	5	9	17	15	-	-	-	-	-	-	-	-	-	69
3	26(11)	9	28	40	23	-	-	-	-	-	-	-	-	-	137
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	4	-	-	41	-	-	-	-	-	-	-	-	-	45
Reef															
1	4	2	4	4	-	5	-	4	3	-	-	-	-	-	26
2	44	57	5	30	37	35	53	52	36	32	20	-	-	-	401
3	24	24	13	12	15	19	14	28	21	20	16	-	-	-	206
4	-	8	2	17	-	-	-	2	-	-	-	-	-	-	29
5	-	-	-	-	275	-	-	-	-	-	38	-	-	-	313
Gorbatch															
1	3	2	5	-	3	3	-	-	-	-	-	-	-	-	16
2	39	35	34	22	37	38	-	-	-	-	-	-	-	-	205
3	25	28	25	10	15	25	-	-	-	-	-	-	-	-	128
4	9	3	1	-	-	-	-	-	-	-	-	-	-	-	13
5	85	-	-	68	-	2	-	-	-	-	-	-	-	-	155
Ardiguen[3/]															
1															1
2															107
3															43
4															-
5															62
Sivutch[3/]															
1															62
2															180
3															269
4															-
5															100
Morjovi[4/]															
1	1(0)	4	1	6	7	3	-	-	-	-	-	-	-	-	22
2	22(18)	16	17	33	27	34	-	-	-	-	-	-	-	-	167
3	21(7)	21	13	32	23	22	-	-	-	-	-	-	-	-	139
4	-(0)	-	5	-	-	-	-	-	-	-	-	-	-	-	5
5	138(5)	-	-	-	-	47	-	-	-	-	-	-	-	-	190
Vostochni															
1	2	1	2	2	2	-	1	3	6	2	-	1	1	-	23
2	31	8	16	19	19	56	25	36	46	31	27	49	38	19	420
3	21	17	15	16	17	23	15	30	26	14	24	19	41	11	289
4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
5	-	-	-	45	-	-	42	-	-	-	-	47	14	16	164

See footnotes at end of table

Table A-5 .--Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 20-24 June 1970--Continued

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Little Polovina															
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	21	38	-	-	-	-	-	-	-	-	-	-	-	-	59
3	20	23	-	-	-	-	-	-	-	-	-	-	-	-	43
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	50	-	-	-	-	-	-	-	-	-	-	-	-	50
Polovina															
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
2	25	19	-	-	-	-	-	-	-	-	-	-	-	-	44
3	17	14	-	-	-	-	-	-	-	-	-	-	-	-	31
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
5	45	16	-	-	-	-	-	-	-	-	-	-	-	-	61
Polovina Cliffs															
1	1	4	1	2	1	4	2	-	-	-	-	-	-	-	15
2	17	20	28	20	18	32	57	-	-	-	-	-	-	-	192
3	18	15	14	14	31	27	31	-	-	-	-	-	-	-	150
4	1	1	-	5	-	-	-	-	-	-	-	-	-	-	7
5	-	-	-	-	-	58	-	-	-	-	-	-	-	-	58
Tolstoi															
1	8	2	3	3	3	2	3	1	-	-	-	-	-	-	25
2	20	18	26	17	54	44	45	45	-	-	-	-	-	-	269
3	28	31	24	24	41	44	29	19	-	-	-	-	-	-	240
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	125	-	-	-	-	-	-	125
Zapadni Reef															
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
2	26	17	-	-	-	-	-	-	-	-	-	-	-	-	43
3	31	12	-	-	-	-	-	-	-	-	-	-	-	-	43
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	8	20	-	-	-	-	-	-	-	-	-	-	-	-	28
Little Zapadni															
1	-	2	1	8	3	1	-	-	-	-	-	-	-	-	15
2	15	15	22	27	47	22	-	-	-	-	-	-	-	-	148
3	16	39	34	30	40	16	-	-	-	-	-	-	-	-	175
4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
5	6	-	-	-	-	38	-	-	-	-	-	-	-	-	44
Zapadni[5/]															
1	1(0)	8	8	4	9	7	5	-	-	-	-	-	-	-	42
2	28(0)	48	44	53	53	37	39	13	-	-	-	-	-	-	315
3	25(0)	53	37	37	20	42	32	5	-	-	-	-	-	-	251
4	5(0)	-	-	-	-	-	-	-	-	-	-	-	-	-	5
5	-(71)	-	-	-	-	-	-	131	-	-	-	-	-	-	202

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-6 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-14 July 1970

Rookery[2/] and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
3	45	62	-	-	-	-	-	-	-	-	-	-	-	-	107
4	4	3	-	-	-	-	-	-	-	-	-	-	-	-	7
5	25	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Kitovi[3/]															
1	2(0)	1	2	7	1	-	-	-	-	-	-	-	-	-	13
2	1(1)	3	2	-	1	-	-	-	-	-	-	-	-	-	8
3	44(25)	14	50	66	42	-	-	-	-	-	-	-	-	-	241
4	-(0)	-	1	-	-	-	-	-	-	-	-	-	-	-	1
5	-(0)	4	-	-	23	-	-	-	-	-	-	-	-	-	27
Reef															
1	3	4	1	1	2	7	-	4	3	1	2	-	-	-	28
2	6	6	4	4	2	3	6	-	1	2	2	-	-	-	36
3	76	92	74	34	70	62	72	81	59	59	37	-	-	-	716
4	-	7	5	6	-	1	-	6	-	-	-	-	-	-	25
5	-	-	-	15	253	-	-	-	-	-	57	-	-	-	325
Gorbatch															
1	2	4	3	5	-	1	-	-	-	-	-	-	-	-	15
2	7	1	-	5	1	5	-	-	-	-	-	-	-	-	19
3	91	67	62	35	46	84	-	-	-	-	-	-	-	-	385
4	8	2	4	1	-	-	-	-	-	-	-	-	-	-	15
5	54	-	-	75	-	-	-	-	-	-	-	-	-	-	129
Ardiguen[4/]															
1															2
2															5
3															108
4															-
5															70
Morjovi[5/]															
1	-(1)	2	1	2	1	4	-	-	-	-	-	-	-	-	11
2	1(3)	6	4	5	-	1	-	-	-	-	-	-	-	-	20
3	43(17)	46	39	81	57	69	-	-	-	-	-	-	-	-	352
4	-(0)	-	5	-	-	-	-	-	-	-	-	-	-	-	5
5	12(2)	-	-	-	-	30	-	-	-	-	-	-	-	-	44
Vostochni															
1	2	-	2	4	2	5	1	2	2	1	1	2	3	1	28
2	6	1	1	1	3	-	1	11	8	-	3	3	3	-	41
3	49	33	40	33	38	96	45	79	65	46	60	82	82	43	791
4	-	-	-	-	-	-	-	-	-	5	-	-	-	-	5
5	36	-	-	7	-	23	-	-	-	-	-	38	5	20	129
Little Polovina															
1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	4
2	3	8	-	-	-	-	-	-	-	-	-	-	-	-	11
3	43	60	-	-	-	-	-	-	-	-	-	-	-	-	103
4	1	5	-	-	-	-	-	-	-	-	-	-	-	-	6
5	1	29	-	-	-	-	-	-	-	-	-	-	-	-	30

See footnote at end of table.

Table A-6 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-14 July 1970--Continued

Rookery[2/] and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Polovina															
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	4
3	53	34	-	-	-	-	-	-	-	-	-	-	-	-	87
4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
5	31	1	-	-	-	-	-	-	-	-	-	-	-	-	32
Polovina Cliffs															
1	2	1	3	3	1	1	3	-	-	-	-	-	-	-	14
2	4	2	2	2	6	9	4	-	-	-	-	-	-	-	29
3	38	38	49	42	56	61	106	-	-	-	-	-	-	-	390
4	2	-	-	-	2	-	2	-	-	-	-	-	-	-	6
5	-	-	-	-	-	-	25	-	-	-	-	-	-	-	25
Tolstoi															
1	6	3	1	1	-	3	2	2	-	-	-	-	-	-	18
2	1	3	-	1	5	2	5	4	-	-	-	-	-	-	21
3	60	68	70	43	98	92	78	61	-	-	-	-	-	-	570
4	-	-	-	-	-	-	1	4	-	-	-	-	-	-	5
5	-	-	-	-	-	-	-	71	-	-	-	-	-	-	71
Zapadni Reef															
1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	4
2	3	5	-	-	-	-	-	-	-	-	-	-	-	-	8
3	72	34	-	-	-	-	-	-	-	-	-	-	-	-	106
4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
5	7	9	-	-	-	-	-	-	-	-	-	-	-	-	16
Little Zapadni															
1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
2	1	4	2	4	1	2	-	-	-	-	-	-	-	-	14
3	40	44	62	82	57	40	-	-	-	-	-	-	-	-	325
4	2	-	3	1	-	2	-	-	-	-	-	-	-	-	8
5	3	-	-	-	-	39	-	-	-	-	-	-	-	-	42
Zapadni[6/]															
1	2(0)	2	2	3	2	6	4	-	-	-	-	-	-	-	21
2	8(0)	6	-	2	9	7	5	-	-	-	-	-	-	-	37
3	79(1)	113	94	103	87	82	75	30	-	-	-	-	-	-	664
4	1(0)	3	1	7	1	1	2	-	-	-	-	-	-	-	16
5	-(81)	-	-	-	-	-	-	100	-	-	-	-	-	-	181

1/ For description of classes, see table A-5 or glossary.
2/ Adult males were not counted on Sivutch Rookery in July.
3/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.
4/ No numbered sections.
5/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.
6/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-7 . --Adult male seals counted, by class[1/] and rookery section, St. George Island, 22-23 June 1970

Rookery and class of male	Section						Total
	1	2	3	4	5	6	
	Number						
Zapadni							
1	3	6	2	-	-	-	11
2	63	74	25	-	-	-	162
3	32	39	12	-	-	-	83
4	-	-	-	-	-	-	-
5	211	-	-	-	-	-	211
South							
1	8	11	13	-	-	-	32
2	37	41	48	-	-	-	126
3	54	64	54	-	-	-	172
4	-	-	-	-	-	-	-
5	84	-	41	-	-	-	125
North							
1	5	5	5	6	1	8	30
2	16	56	46	61	22	67	268
3	33	41	41	49	19	36	219
4	-	5	2	1	1	-	9
5	40	-	-	-	-	89	129
East Reef[2/]							
1	-	-	-	-	-	-	1
2	-	-	-	-	-	-	48
3	-	-	-	-	-	-	51
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	62
East Cliffs							
1	3	5	-	-	-	-	8
2	30	27	-	-	-	-	57
3	53	31	-	-	-	-	84
4	-	-	-	-	-	-	-
5	56	-	-	-	-	-	56
Staraya Artil							
1	2	-	-	-	-	-	2
2	85	63	-	-	-	-	148
3	46	3	-	-	-	-	49
4	-	-	-	-	-	-	-
5	74	-	-	-	-	-	74

1/ See table A-5 or glossary for a description of the classes of adult male seals.

2/ No numbered sections.

Table A-8 .--Adult male seals counted, by class[1/] and rookery section, St. George Island, 13-15 July 1970

Rookery and class of male	Section 1	2	3	4	5	6	Total
	Number						
Zapadni							
1	1	2	-	-	-	-	3
2	13	12	6	-	-	-	31
3	74	132	18	-	-	-	224
4	36	-	11	-	-	-	47
5	267	-	11	-	-	-	278
South							
1	7	3	7	-	-	-	17
2	8	4	12	-	-	-	24
3	89	98	77	-	-	-	264
4	284	83	60	-	-	-	427
5	49	-	7	-	-	-	56
North							
1	1	2	4	1	1	1	10
2	2	5	4	2	12	10	35
3	55	95	95	121	50	100	516
4	2	1	-	1	1	-	5
5	44	-	-	-	-	81	125
East Reef[2/]							
1	-	-	-	-	-	-	2
2	-	-	-	-	-	-	3
3	-	-	-	-	-	-	102
4	-	-	-	-	-	-	2
5	-	-	-	-	-	-	48
East Cliffs							
1	6	5	-	-	-	-	11
2	-	1	-	-	-	-	1
3	87	79	-	-	-	-	166
4	-	-	-	-	-	-	-
5	50	3	-	-	-	-	53
Staraya Artil							
1	3	-	-	-	-	-	3
2	1	5	-	-	-	-	6
3	129	65	-	-	-	-	194
4	-	3	-	-	-	-	3
5	85	2	-	-	-	-	87

1/ See table A-5 or the glossary for a description of the classes of adult male seals.

2/ No numbered sections.

Table A-9 .--Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1960-70

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	----Number----		----Number----		----Number----	
1960	10,247	10,407	2,552	2,630	12,799	13,037
1961	11,163	11,791	2,843	2,489	14,006	14,280
1962	10,332	9,109	2,342	2,650	12,674	11,759
1963	9,212	7,650	2,071	1,890	11,283	9,540
1964	9,085	7,095	1,989	1,489	11,074	8,584
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	1,277	6,411	2,943

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).

Table A-10. --Harem and idle male seals counted, St. Paul Island, 9-14 July 1966-70

Rookery	Year and class of adult male seal[1/]									
	1966		1967		1968		1969		1970	
	Harem	Idle	Harem	Idle	Harem	Idle	Harem	Idle	Harem	Idle
	Number									
Lukanin	152	108	137	77	-	-	96	46	107	35
Kitovi	413	194	374	118	-	-	285	91	241	49
Reef	1,070	678	927	616	843	514	723	457	716	414
Gorbatch	607	521	-	-	-	-	426	209	385	178
Ardiguen	92	97	-	-	-	-	118	90	108	77
Morjovi	645	534	-	-	505	191	423	121	352	80
Vostochni	1,449	970	-	-	1,116	497	913	366	791	203
Little Polovina	218	312	-	-	-	-	129	66	103	51
Polovina	188	405	-	-	-	-	94	103	87	40
Polovina Cliffs	619	295	-	-	-	-	463	126	390	74
Tolstoi	819	441	791	283	-	-	638	199	570	115
Zapadni Reef	203	210	180	146	144	68	115	42	106	29
Little Zapadni	542	227	-	-	-	-	361	82	325	66
Zapadni	957	847	-	-	-	-	683	210	664	255
Total	7,974	5,839	2,409	1,240	2,608	1,270	5,467	2,208	4,945	1,666

1/ Harem = class 3; idle = classes 1, 2, 4, and 5 (see table A-5 or the glossary for a description of the classes of adult males).

Table A-11. --Adult male seals counted, by class, St. Paul Island, 20-27 June 1966-70

Year and rookery	Class of adult male 1/					Total
	1	2	3	4	5	
	Number					
1966						
Lukanin	13	83	67	-	84	247
Kitovi	22	229	193	4	102	550
Reef	119	852	333	-	425	1,729
Gorbatch	78	441	180	62	362	1,123
Ardiguen	8	40	53	9	50	160
Morjovi	108	452	230	3	464	1,257
Vostochni	92	1,019	522	18	542	2,193
Little Polovina	12	162	73	29	254	530
Polovina	75	168	65	-	253	561
Polovina Cliffs	48	494	202	5	81	830
Tolstoi	65	622	233	-	131	1,051
Zapadni Reef	13	142	65	-	146	366
Little Zapadni	70	339	150	-	133	692
Zapadni	149	716	275	-	521	1,661
Total	872	5,759	2,641	130	3,548	12,950
1967						
Lukanin	12	93	53	4	51	213
Kitovi	17	211	144	4	91	467
Reef	72	752	272	18	241	1,355
Gorbatch	43	407	159	25	236	870
Ardiguen	6	49	39	-	58	152
Morjovi	41	394	189	73	249	946
Vostochni	109	940	333	147	557	2,086
Little Polovina	7	143	51	27	150	378
Polovina	27	150	43	25	185	430
Polovina Cliffs	38	408	192	68	47	753
Tolstoi	80	455	251	24	472	1,282
Zapadni Reef	13	125	52	13	64	267
Little Zapadni	42	328	184	28	120	702
Zapadni	74	611	277	82	353	1,397
Total	581	5,066	2,239	538	2,874	11,298

See footnote at end of table.

Table A-11. --Adult male seals counted, by class, St. Paul Island, 20-27 June 1966-70--Continued

Year and rookery	Class of adult male 1/					Total
	1	2	3	4	5	
	Number					
1968						
Lukanin	8	62	45	1	15	131
Kitovi	31	179	122	-	49	381
Reef	57	616	255	42	400	1,370
Gorbatch	32	341	128	25	242	768
Ardiguen	2	62	42	-	50	156
Morjovi	35	309	228	21	146	739
Vostochni	67	804	462	11	389	1,733
Little Polovina	12	107	71	14	75	279
Polovina	8	89	68	1	177	343
Polovina Cliffs	52	315	256	16	74	713
Tolstoi	49	350	309	25	150	883
Zapadni Reef	3	72	75	3	59	212
Little Zapadni	27	218	234	9	84	572
Zapadni	55	508	357	34	300	1,254
Total	438	4,032	2,652	202	2,210	9,534
1969						
Lukanin	4	51	34	2	28	119
Kitovi	10	156	76	2	52	296
Reef	77	508	222	11	175	993
Gorbatch	31	250	146	23	202	652
Ardiguen	3	59	27	-	64	153
Morjovi	30	236	160	3	191	620
Vostochni	39	605	360	11	306	1,321
Little Polovina	5	83	28	11	38	165
Polovina	15	89	25	1	43	173
Polovina Cliffs	33	295	105	3	65	501
Tolstoi	40	411	130	-	133	714
Zapadni Reef	3	67	46	1	4	121
Little Zapadni	37	219	127	18	61	462
Zapadni	51	465	219	10	504	1,249
Total	378	3,494	1,705	96	1,866	7,539

See footnote at end of table.

Table A-11.--Adult male seals counted, by class, St. Paul Island, 20-27 June 1966-70--Continued

Year and rookery	Class of adult male 1/					Total
	1	2	3	4	5	
	Number					
1970						
Lukanin	10	24	59	-	45	138
Kitovi	5	69	137	-	45	256
Reef	26	401	206	29	313	975
Gorbatch	16	205	128	13	155	517
Ardiguen	1	107	43	-	62	213
Morjovi	22	167	139	5	190	523
Vostochni	23	420	289	1	164	897
Little Polovina	-	59	43	-	50	152
Polovina	3	44	31	2	61	141
Polovina Cliffs	15	192	150	7	58	422
Tolstoi	25	269	240	-	125	659
Zapadni Reef	1	43	43	-	28	115
Little Zapadni	15	148	175	2	44	384
Zapadni	42	315	251	5	202	815
Total	204	2,463	1,934	64	1,542	6,207

1/ See table A-5 or the glossary for a description of the classes of adult male seals.

Table A-12. --Dead seal pups counted, by rookery sections, Pribilof Islands, Alaska, 21-30 August 1970

Island and rookery	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
St. Paul Island															
Morjovi	1/668	163	105	262	165	255	-	-	-	-	-	-	-	-	1,618
Vostochni	98	59	123	155	151	89	326	373	226	65	77	86	2/310	-	3,330
Little Polovina	199	138	-	-	-	-	-	-	-	-	-	-	-	-	337
Polovina Cliffs	238	142	169	170	235	231	451	-	-	-	-	-	-	-	1,636
Polovina	354	121	-	-	-	-	-	-	-	-	-	-	-	-	475
Ardiguen 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75
Gorbatch	303	281	174	44	91	81	-	-	-	-	-	-	-	-	974
Reef	158	247	220	188	334	172	251	186	140	140	84	-	-	-	2,221
Kitovi	4/178	23	195	211	72	-	-	-	-	-	-	-	-	-	679
Lukanin	132	269	-	-	-	-	-	-	-	-	-	-	-	-	401
Tolstoi	152	157	235	144	378	734	779	1,001	-	-	-	-	-	-	3,580
Little Zapadni	99	216	296	355	253	167	-	-	-	-	-	-	-	-	1,386
Zapadni Reef	205	103	-	-	-	-	-	-	-	-	-	-	-	-	308
Zapadni	168	580	758	852	440	242	392	129	-	-	-	-	-	-	3,561
Total															20,581
St. George Island															
North	101	111	132	219	54	249	-	-	-	-	-	-	-	-	866
Zapadni	149	183	76	-	-	-	-	-	-	-	-	-	-	-	408
South	78	100	50	-	-	-	-	-	-	-	-	-	-	-	228
East Reef 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66
East Cliffs	230	226	-	-	-	-	-	-	-	-	-	-	-	-	456
Staraya Artil	895	348	-	-	-	-	-	-	-	-	-	-	-	-	1,243
Total															3,267
Grand total															23,848

1/ Includes 103 dead pups counted on point south of Sea Lion Neck.

2/ Count of dead pups on sections 13 and 14 combined.

3/ No numbered sections.

4/ Includes 50 dead pups counted in amphitheater.

Table A-13.--Dead seal pups counted, [1/] by rookery, Pribilof Islands, Alaska, 1961-70

Island and rookery	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	Number									
St. Paul Island										
Morjovi	5,259	4,881	2,348	1,830	2,649	1,686	1,072	2,285	734	1,618
Vostochni	10,173	8,565	5,057	3,404	4,214	2,785	1,969	4,195	1,711	3,330
Little Polovina	2,415	2,121	923	631	1,132	449	233	509	200	337
Polovina Cliffs	4,576	2,957	2,160	1,097	2,856	809	825	1,616	836	1,636
Polovina	2,499	1,880	1,237	783	1,176	312	319	487	327	475
Ardiguen	411	225	141	102	459	160	90	118	112	75
Gorbatch	3,550	1,373	2,431	1,549	3,123	1,593	874	1,446	823	974
Reef	10,047	7,897	5,688	3,000	7,664	3,562	2,008	3,064	1,365	2,221
Kitovi	2,215	2,081	881	462	2,202	406	522	755	652	679
Lukanin	1,294	660	546	402	1,126	432	240	597	460	401
Tolstoi	4,761	3,004	3,274	2,614	3,955	3,425	2,251	3,315	2,778	3,580
Little Zapadni	3,047	2,399	2,580	1,101	2,461	1,634	1,098	1,781	798	1,386
Zapadni Reef	1,291	598	718	425	723	451	380	685	177	308
Zapadni	6,329	6,627	4,614	4,172	5,384	3,710	2,195	4,445	2,306	3,561
Counted total	57,867	45,268	32,598	21,572	39,124	21,414	14,076	25,298	13,279	20,581
Estimated oversight 5%	2,893	2,263	1,630	1,079	1,956	1,071	704	1,265	664	1,029
Total	60,760	47,531	34,228	22,651	41,080	22,485	14,780	26,563	13,943	21,610
St. George Island										
North	3,883	2,242	2,525	792	1,854	1,561	971	1,567	444	866
Zapadni	2,019	1,740	704	446	1,263	1,196	578	1,197	260	636
East	1,347	504	502	272	676	764	201	824	187	522
Staraya Artil	2,514	1,435	1,041	767	1,186	1,152	770	1,055	640	1,243
Counted total	9,763	5,921	4,772	2,277	4,979	4,673	2,520	4,643	1,531	3,267
Estimated oversight 5%	488	296	239	114	249	234	126	232	76	163
Total	10,251	6,217	5,011	2,391	5,228	4,907	2,646	4,875	1,607	3,430
Pribilof Islands counted total [2/]	67,630	51,189	37,370	23,849	44,103	26,087	16,596	29,941	14,810	23,848
Estimated oversight 5%	3,381	2,559	1,869	1,193	2,205	1,305	830	1,497	740	1,192
Total	71,011	53,748	39,239	25,042	46,308	27,392	17,426	31,438	15,550	25,040

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

2/ Not included in the total are 2,228 dead pups counted on Sea Lion Rock (Sivutch) in 1966.

Table A-14.--Primary diagnoses of causes of death among 257 pups, by 7-day periods, St. Paul Island, 2 July to 15 August 1970

Cause of death	To 4 July	5-11 July	12-18 July	19-25 July	26 July to 1 Aug.	2-8 Aug.	9-15 Aug.	Total
	Number							
Malnutrition	1	9	7	17	12	4	5	55
Hookworm disease	0	7	13	45	13	17	10	105
Microbial infection	0	4	3	0	2	2	0	11
Trauma	2	4	1	2	0	0	0	9
Perinatal complex	3	2	2	0	0	0	0	7
Miscellaneous	2	5	4	1	0	0	0	12
Undetermined	3	16	2	1	0	0	0	22
Total	11	47	32	66	27	23	15	221
Unsuitable for examination	17	6	7	2	2	1	1	36
Total	28	53	39	68	29	24	16	257
Advanced post mortem degeneration	18	16	15	11	1	5	1	67

Table A-15. --Seal pups tagged and marked, Pribilof Islands, Alaska 1961-70

Year	Series	St. Paul Island	St. George Island	Location of tag	Checkmarks or marks
		------Number-------			
1961	N 1-10000		9, 988	Left front flipper	"V" notch near tip left front flipper
	N 10001-50000	39, 933		------do. ------	Do.
1962	O 1-10000		9, 980	Right front flipper	"V" notch near tip right front flipper
	O 10001-50000	39, 928		------do. ------	Do.
1963	P 1-5000		4, 993	Left front flipper	Tip of left front flipper sliced off
	P 5001-25000	19, 978		------do. ------	Do.
1964	Q 1-5000		4, 993	Right front flipper	Tip of right front flipper sliced off
	Q 5001-25000	19, 998		------do. ------	Do.
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
1966	S 1-2500		2, 499	Left front flipper	Tip of left front flipper sliced off
	S 2501-12500	10, 000		Right front flipper	Tip of 2d digit on right hind flipper sliced off
	Marked	9, 578		Not tagged	Tip of 3d digit on right hind flipper sliced off
	Marked		2, 503	---do. ---	Tip of 2d digit on left hind flipper sliced off
1967	T 9-2500		2, 492	Right front flipper	Tip of right front flipper sliced off
	T 5001-15000	9, 980		------do. ------	Do.
1968	U 1-2500		2, 475	Left front flipper	"V" notch near tip left front flipper
	U 2501-12500	9, 200		------do. ------	Do.
1969	Marked	20, 000		Not tagged	Tip of 1st digit (big toe) on left hind flipper sliced off
	Marked		5, 000	---do. ---	Tip of 1st digit (big toe) on right hind flipper sliced off
1970	Marked	20, 030		Not tagged	Tip of 2d digit on left hind flipper sliced off
	Marked		5, 000	---do. ---	Tip of 2d digit on right hind flipper sliced off

Table A-16. --Record of tags applied[1/] to male seals selected as yearlings and as 2-, 3-, and 4-year-olds on the basis of body length or size, St. Paul Island, 1961-63 and 1965-70

Age category and year	Tag series	Tag numbers	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
Ages 2-4			
1966	2S	30001-31500	1,483
1967	2T	1-1500	1,220
1968	2U	30001-31500	1,495
Ages 1-4			
1969	1V	1-3431	3,419
1970	1W	1-4000	3,779

1/ Each seal was double tagged; one tag was attached at the hairline of each front flipper. 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 1970, only male seals were selected for tagging.

Table A-17. --Record of 3,779 male seals tagged at ages 1 to 4 years, St. Paul Island, September and October 1970

Date	Area	Tag number (1W-series) 1/	Effective tags 2/
			Number
Sept.			
21	Northeast Point	1-200	172
21	Zapadni Reef	201-400	195
22	English Bay and Zapadni Reef	401-700	299
23	English Bay Sands	701-1100	398
24	Northeast Point	1101-1200	97
28	English Bay	1201-1575	367
30	English Bay	1576-1600	24
29	Northeast Point	1601-1707	104
30	Zapadni Reef	1708-1800	92
30	Zapadni	1800-1900	100
30	English Bay Sands	1901-1975	75
Oct.			
1	English Bay Sands	1976-2000	24
1	Northeast Point	2001-2100	95
1	English Bay Sands	2201-2325	125
1	Northeast Point	2326-2350	25
5	English Bay Sands	2401-2700	298
6	English Bay Sands	2701-2875	173
6	Zapadni	2876-2925	50
7	English Bay Sands	2926-3150	222
9	English Bay Sands	3151-3300	148
13	Northeast Point	3301-3325	25
13	English Bay Sands	3326-3450	123
14	Northeast Point	3451-3625	174
15	Northeast Point	3626-3738	113
16	English Bay Sands	3739-3750	12
15	Northeast Point	3751-3769	19
16	English Bay Sands	3770-3900	130
16	Northeast Point	3901-4000	100
	Total		3,779

1/ Tag numbers 1W2101-2200 and 1W2351-2400 were not applied.

2/ Total number of seals tagged within the series.

Table A-18.--Record of 167 male seals marked as pups in 1968 and 1969 or at ages 1 to 4 years in 1969 and given 1W-series tags at estimated ages 1 to 2 years, St. Paul Island, 21 September to 16 October 1970

U.S.A. tags and marks							U.S.S.R. and U.S.A. tags	
Tags[1]		Tags and marks[2]		Unpaired tags[3]			U.S.S.R.	U.S.A.
U-series	1W-series	LFV	RH1	1W-series	1W-series	1V-series	AB-series	1W-series
3834	156	53	292	170	188		924	251
6902	224	81	420	263	347		5222	1126
7450	302	211		265	331		659	1317
10590	330	293		306	336		2059	2491
3172	635	385		311	310			
11184	652	525		320	321			
9986	844	538		760	237			
5938	989	641		1082	333			
6125	991	686		1082	1083			
7763	998	841		1083	1084			
2957	1012	842	LH1	1108	1147		AM-series	
5624	1027	863		1146	1195		5219	65
805	1107	1282	203	1169	1170		5287	517
9959	1126	1469	230	1233	1234		420	619
11594	1127	1708	265-331	1248	1249		297	864
9119	1153	1935	390	1299	1239		2697	999
9584	1159	1952	499	1313	1314		917	1202
9186	1198	2240	706	1354	1355		7009	1785
11095	1211	2256	715	1401	1426		2005	1917
11685	1236	2287	1408	1402	1427		2595	2537
3832	1241	2587	1443	1403	1428			
10594	1256	2591	1501	1418		2523		
8877	1286	2675	2314	1473	1474			
2893	1424	2890	2565	1577	1578			
155	1473	2928	2842	1606	1113			
7109	1513	2968	2866	1616	1617			
10632	1581	2990	3158	1633	1122			
3199	1601	3166	3378	1774	1775			
9113	1626	3248	3476	1856		317		
9107	1656	3258	3494	1927		1197		
12262	1733	3387	3740	1987	1441			
11333	1736	3531	3742	2092	2093			
4345	1829	3751		2226		2975		
3135	1874	3857		2625	2626			
3999	1925	3990		2634	2233			
11534	1954			2711	2766			
6689	2479			2859	2730			
1590	2527			3025	3029			
192	2541			3100	2845			
5904	2590			3136	3036			
10750	2642			3189	3115			
11662	2677			3271	2518			
3998	2722			3360	3361			
1896	2780			3397	3426			
2626	2834			3477	3190			
4032	2981			3786	3787			
3155	3048							
11643	3050							
11678	3082							
12049	3126							
11634	3170							
9896	3205							
10880	3341							

1/ Seals with U-series tags applied in 1968 were given double 1W-series tags at age 2 years as indicated.

2/ Seals with a checkmark (LFV) applied in 1968 and seals with marks (RH1 and LH1) applied in 1969 were given double 1W-series tags at ages 2 and 1, respectively, in 1970. The marks are defined as follows: LFV: V-notch cut into leading edge of left front flipper near tip; each of these seals had also been originally marked with a U-series tag. RH1 and LH1: tip of first digit of right and left hind flippers, respectively, sliced off; these seals had never been marked with tags as pups.

3/ Double 1W-series tags were applied to seals in 1970 at estimated ages 1 to 2 years, and single 1W-series tags were attached to seals that had lost one of two 1V-series tags applied at estimated ages 1 to 2 years in 1969.

Table A-19. --Marked, tagged and lost-tag male seals recovered, by age, Pribilof Islands, Alaska, 24 June to 31 July 1970

Mark or tag series	Age	Marks or tags			Lost-tags[1/]			Grand total
		St. Paul Island	St. George Island	Total	St. Paul Island	St. George Island	Total	
	Years	Number			Number			Number
U	2	31	-	31	13	1	14	45
T	3	442	65	507	216	10	226	733
S	4	138	45	183	223	21	,244	427
Hind flipper (RH3)[2/]	4	305	29	334	-	-	-	334
Hind flipper (LH2)[2/]	4	46	77	123	-	-	-	123
Front flipper (RFV)[2/]	5	28	4	32	-	-	-	32
Hind flipper (RH1)[2/]	5	49	35	84	-	-	-	84
R	5	13	-	13	18	5	23	36
Q	6	6	4	10	6	1	7	17

1/ Seals that had lost their tags but were recognized by a marked flipper.

2/ Seals not tagged but marked by removing part of a flipper--tip of third digit right hind flipper (RH3), tip of second digit left hind flipper (LH2), V-notch right front flipper on leading edge near tip (RFV), tip of first digit right hind flipper (RH1).

Table A-20. --Tag recoveries[1/] from male seals that had been selected and tagged as yearlings and at age 2 or older in previous years, Pribilof Islands, Alaska, 1970

Year tagged and tag series	Age when: Tagged	Age when: Recovered	Total both islands
	Years	Years	Number
1966			
1S	1	5	6
1967			
1T	1	4	94
1T	2	5	5
1T	[2/] Unknown		7
1968			
1U	1	3	125
1U	2	4	46
1U	Unknown		10
1969			
1V	1	2	30
1V	2	3	914
1V	3	4	33
1V	4	5	2
1V	Unknown		53
1967			
2T	1	4	3
2T	2	5	24
2T	3	6	1
2T	Unknown		2
1968			
2U	1	3	16
2U	2	4	333
2U	3	5	10
2U	Unknown		27

1/ In addition to the seals listed, 139 males on St. Paul Island and 16 on St. George Island that had lost two 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-21.--Soviet tags recovered in the United States kill of fur seals, Pribilof Islands, Alaska, 24 June to 31 July 1970

Island and date	Tag number	Age	Sex	Island of tagging	Rookery of recovery
		Years			
St. Paul Island					
23 July	AM-2639	2	M	Medny	Polovina
15 July	AM-3186	2	M	Medny	Zapadni
20 July	AM-3293	2	M	Medny	Zapadni
22 July	X-17470	3	M	Robben	Northeast Point
22 July	X-17477	3	M	Robben	Northeast Point
21 July	X-19685	3	M	Bering	Reef
10 July	X-20475	3	M	Bering	Zapadni
27 July	X-20884	3	M	Bering	Northeast Point
27 July	X-21245	3	M	Bering	Northeast Point
24 July	X-21445	3	M	Bering	Zapadni
27 July	X-23107	3	M	Bering	Northeast Point
27 July	X-26164	3	M	Bering	Northeast Point
9 July	X-28450, X28456	3	M	Medny	Northeast Point
29 July	X-28826	3	M	Medny	Zapadni
6 July	X-29357, X-29358	3	M	Medny	Zapadni
24 July	X-29761, X-29762	3	M	Medny	Zapadni
24 July	X-30069, X-30070	3	M	Medny	Zapadni
16 July	X-30384	3	M	Medny	Reef
10 July	X-30900	3	M	Medny	Zapadni
15 July	X-31797	3	M	Medny	Zapadni
24 July	X-32453	3	M	Medny	Zapadni
24 July	X-32741	3	M	Medny	Zapadni
27 July	X-33342	3	M	Medny	Northeast Point
16 July	X-34118	3	M	Medny	Reef
17 July	X-34503	3	M	Medny	Northeast Point
3 July	X-34661	3	M	Medny	Northeast Point
14 July	X-34969	3	M	Medny	Northeast Point
15 July	X-35832	3	M	Medny	Zapadni
15 July	X-35899	3	M	Medny	Zapadni
25 June	X-36372	3	M	Medny	Zapadni
29 June	X-36851	3	M	Medny	Zapadni

Table A-21. --Soviet tags recovered in the United States kill of fur seals, Pribilof Islands, Alaska, 24 June to 31 July 1970--Continued

Island and date	Tag number	Age	Sex	Island of tagging	Rookery of recovery
		Years			
St. Paul Island--continued					
9 July	Y-17695	4	M	Bering	Northeast Point
2 July	Y-21986	4	M	Bering	Polovina
14 July	Y-25325, Y-25333	4	M	Bering	Northeast Point
27 July	Y-27051	4	M	Medny	Northeast Point
27 July	Y-27094	4	M	Medny	Northeast Point
23 July	Y-29944	4	M	Medny	Polovina
15 July	Y-30384	4	M	Medny	Zapadni
16 July	Y-31671	4	M	Medny	Reef
13 July	Y-31756	4	M	Medny	Polovina
7 July	Y-31939	4	M	Medny	Reef
28 July	Y-3244?	4	M	Medny	Tolstoi-Zapadni Reef
22 July	Y-33198	4	M	Medny	Northeast Point
15 July	Y-33703	4	M	Medny	Zapadni
6 July	Y-33770	4	M	Medny	Zapadni
St. George Island					
8 July	X-22262	3	M	Bering	Zapadni
24 July	X-32761	3	M	Medny	East

Table B-1.--List of chart units occupied by a research vessel off Washington, 3-31 March 1970, 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
V85-H45	1.3	16.1	21	1
V86-H44	9.4	1.1	11	1
V86-H45	9.6	8.5	82	5
V86-H46	0.8	0.0	0	0
V86-H47	1.0	2.0	2	0
V87-H44	1.4	25.0	35	0
V87-H45	24.4	10.8	264	34
V87-H46	3.6	3.8	14	3
V88-H45	10.9	8.4	92	9
V88-H46	7.0	6.1	43	3
V88-H47	1.5	6.0	9	1
V89-H45	1.3	1.5	2	0
V89-H46	8.2	5.0	41	3
V89-H47	6.0	6.1	37	9
V89-H48	0.8	11.2	9	3
V90-H44	1.7	0.0	0	0
V90-H45	1.6	0.0	0	0
V90-H46	7.1	5.9	42	13
V90-H47	5.6	3.0	17	5
V90-H48	5.1	2.7	14	5
V91-H45	1.4	0.0	0	0
V91-H46	3.6	0.2	1	0
V91-H47	3.4	3.5	12	2
V91-H48	5.1	3.9	20	5
V91-H49	1.7	17.0	29	2
V92-H46	1.2	0.8	1	1
V92-H47	3.4	2.6	9	3
V92-H48	8.5	4.0	34	5
V93-H46	1.7	0.0	0	0
V93-H47	5.0	0.8	4	1
V93-H48	7.5	4.1	31	13
V94-H46	1.0	0.0	0	0
V94-H47	2.1	1.4	3	0
V94-H48	1.2	0.0	0	0

1/ See footnote at end of table.

Table B-1.--List of chart units occupied by a research vessel off Washington, 3-31 March 1970, 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
V94-H49	0.1	0.0	0	0
V95-H46	0.5	0.0	0	0
V95-H47	0.8	0.0	0	0
V95-H48	1.0	0.0	0	0
V95-H49	1.8	2.2	4	1
V95-H50	1.3	0.7	1	0
V95-H51	0.6	1.6	1	0
V96-H49	1.1	4.5	5	2
V96-H50	1.5	2.0	3	1
V96-H51	1.4	0.7	1	1
V96-H52	0.8	0.0	0	0
V97-H50	1.3	0.7	1	0
V97-H51	4.6	2.8	13	2
V97-H52	1.2	0.0	0	0
V97-H53	1.1	0.0	0	0
V98-H52	4.0	0.5	2	0
V98-H53	2.9	2.7	8	1
V98-H54	1.1	2.7	3	2
V99-H47	0.5	0.0	0	0
V99-H48	0.5	0.0	0	0
V99-H52	1.2	0.8	1	1
V99-H53	1.0	1.0	1	1
V99-H54	1.4	5.0	7	1
V99-H55	1.0	1.0	1	1
V100-H48	0.3	0.0	0	0
V100-H49	1.2	0.0	0	0
V100-H50	0.2	5.0	1	0
V100-H51	1.0	0.0	0	0
V100-H52	1.3	0.0	0	0
V100-H53	0.8	0.0	0	0

1/ The base chart is USCGS No. 5052. 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.) and horizontal row numbering begins at the lower left corner.

Table B-2.--List of chart units occupied by a research vessel off Washington, 1-30 April 1970, 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
V85-H44	0.5	0.0	0	0
V85-H45	1.0	0.0	0	0
V85-H46	0.8	1.2	1	1
V85-H47	0.8	2.5	2	0
V85-H48	0.7	0.0	0	0
V85-H49	0.7	0.0	0	0
V85-H50	0.9	0.0	0	0
V85-H51	1.0	0.0	0	0
V85-H52	0.8	0.0	0	0
V85-H53	1.1	3.6	4	1
V85-H54	0.8	6.2	5	1
V86-H43	0.2	0.0	0	0
V86-H44	4.4	0.0	0	0
V86-H45	1.1	2.7	3	2
V86-H54	1.4	2.1	3	0
V87-H44	4.8	4.5	22	6
V87-H45	8.3	5.1	43	9
V87-H46	2.9	1.0	3	1
V87-H54	1.1	0.9	1	0
V88-H45	10.7	5.4	58	13
V88-H46	2.4	2.5	6	1
V88-H47	1.2	1.6	2	0
V88-H54	0.5	0.0	0	0
V88-H55	0.8	1.2	1	0
V88-H56	0.8	3.7	3	0
V88-H57	1.1	2.7	3	0
V88-H58	0.4	7.5	3	0
V89-H44	0.3	0.0	0	0
V89-H45	5.0	3.0	15	1
V89-H46	4.8	3.1	15	3

1/ See footnote at end of table.

Table B-2.--List of chart units occupied by a research vessel off Washington, 1-30 April 1970, 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
V89-H47	1.7	0.0	0	0
V89-H48	0.2	0.0	0	0
V89-H58	0.6	16.6	10	0
V89-H59	0.8	8.7	7	0
V89-H60	0.8	6.2	5	0
V89-H61	0.8	5.0	4	0
V89-H62	0.8	1.2	1	0
V90-H44	1.2	0.0	0	0
V90-H45	4.0	0.0	0	0
V90-H46	10.4	4.0	42	8
V90-H47	3.2	2.8	9	2
V90-H48	3.6	1.1	4	1
V90-H55	0.6	3.3	2	0
V90-H63	0.8	0.0	0	0
V90-H64	0.8	0.0	0	0
V90-H65	2.2	0.0	0	0
V91-H46	1.2	0.0	0	0
V91-H47	2.8	0.0	0	0
V91-H48	4.8	0.8	4	2
V91-H55	1.1	0.0	0	0
V91-H63	1.0	0.0	0	0
V91-H64	1.5	0.0	0	0
V92-H46	0.5	0.0	0	0
V92-H47	3.5	0.0	0	0
V92-H48	0.9	0.0	0	0
V92-H49	1.1	1.8	2	0
V92-H50	0.8	0.0	0	0
V92-H51	0.8	0.0	0	0
V92-H52	0.7	0.0	0	0
V92-H55	1.1	0.0	0	0
V93-H46	0.2	0.0	0	0
V93-H47	3.1	0.0	0	0
V93-H55	1.2	3.3	4	1

1/ See footnote at end of table.

Table B-2. --List of chart units occupied by a research vessel off Washington, 1-30 April 1970, 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
V94-H46	0.8	0.0	0	0
V94-H47	0.9	0.0	0	0
V94-H48	0.8	1.2	1	0
V94-H49	0.9	1.1	1	0
V94-H50	0.8	0.0	0	0
V94-H51	0.7	0.0	0	0
V94-H52	0.8	0.0	0	0
V94-H53	0.7	0.0	0	0
V94-H55	1.2	0.8	1	0
V95-H52	0.8	0.0	0	0
V95-H53	0.5	0.0	0	0
V95-H55	1.6	0.6	1	1
V96-H52	1.2	0.0	0	0
V96-H54	1.2	0.8	1	0
V97-H48	0.5	0.0	0	0
V97-H49	0.8	0.0	0	0
V97-H50	1.1	0.0	0	0
V97-H51	0.2	0.0	0	0
V97-H54	1.0	0.0	0	0
V97-H55	0.7	1.4	1	0
V98-H48	1.0	0.0	0	0
V98-H49	1.0	1.0	1	1
V98-H55	1.0	0.0	0	0
V99-H46	0.2	0.0	0	0
V99-H47	1.1	0.0	0	0
V99-H48	1.5	0.0	0	0
V99-H49	0.8	0.0	0	0
V99-H50	1.8	0.0	0	0
V99-H51	0.8	0.0	0	0

1/ See footnote at end of table.

Table B-2.--List of chart units occupied by a research vessel off Washington, 1-30 April 1970, 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
V99-H55	1.3	0.0	0	0
V100-H48	0.1	0.0	0	0
V100-H49	0.9	0.0	0	0
V100-H50	1.2	4.1	5	1
V100-H51	3.2	3.7	12	2
V100-H52	1.8	6.1	11	1
V100-H53	3.0	2.3	7	1
V100-H54	0.8	1.2	1	0
V100-H55	0.8	0.0	0	0
V100-H56	0.3	0.0	0	0

1/ The base chart is USCGS No. 5052. 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.) and horizontal row numbering begins at the lower left corner.

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V85-H46	0.4	0.0	0	0
V85-H47	0.7	0.0	0	0
V85-H48	0.8	1.2	1	0
V85-H49	1.0	0.0	0	0
V85-H50	0.8	0.0	0	0
V85-H51	1.8	2.2	4	1
V85-H52	0.9	1.1	1	0
V85-H53	1.0	0.0	0	0
V85-H54	0.6	0.0	0	0
V85-H55	0.2	0.0	0	0
V86-H43	0.2	0.0	0	0
V86-H44	2.5	0.0	0	0
V86-H45	2.5	0.0	0	0
V86-H46	3.6	0.0	0	0
V86-H47	3.8	1.0	4	2
V86-H48	2.5	0.4	1	0
V86-H49	1.4	3.5	5	2
V86-H50	2.4	2.9	7	4
V86-H51	8.0	3.0	24	16
V86-H56	3.1	3.2	10	1
V86-H57	1.6	5.0	8	1
V87-H44	2.6	0.0	0	0
V87-H45	2.5	0.4	1	0
V87-H46	3.4	0.2	1	1
V87-H48	2.7	1.4	4	3
V87-H49	3.7	1.3	5	4
V87-H50	3.6	1.1	4	1
V87-H51	3.9	1.2	5	3
V87-H52	2.5	1.2	3	1
V87-H53	1.6	2.5	4	2

1/ See footnote at end of table..

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V87-H54	1.3	1.5	2	2
V87-H55	2.4	1.6	4	2
V87-H56	8.4	4.7	40	9
V87-H57	2.6	5.0	13	6
V87-H58	1.0	1.0	1	0
V87-H59	1.2	4.1	5	0
V87-H60	1.1	0.9	1	0
V87-H61	1.0	3.0	3	0
V87-H62	1.5	4.0	6	1
V87-H63	1.5	7.3	11	1
V87-H64	1.7	4.1	7	2
V87-H65	1.0	1.0	1	0
V87-H66	1.2	5.8	7	2
V87-H67	1.9	6.8	13	2
V87-H68	1.2	6.6	8	2
V87-H69	1.5	8.6	13	5
V87-H70	1.7	4.7	8	2
V87-H71	1.7	10.0	17	3
V87-H72	1.2	3.3	4	3
V88-H45	2.1	0.4	1	0
V88-H46	2.4	1.6	4	1
V88-H47	2.3	0.0	0	0
V88-H48	1.9	0.5	1	1
V88-H49	0.8	0.0	0	0
V88-H50	0.9	0.0	0	0
V88-H51	1.3	3.0	4	1
V88-H52	1.1	3.6	4	1
V88-H53	1.4	0.0	0	0
V88-H54	2.0	0.0	0	0
V88-H55	2.9	1.7	5	1

1/ See footnote at end of table.

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V88-H56	3.7	2.1	8	2
V88-H57	2.3	3.4	8	3
V88-H58	4.8	3.5	17	4
V88-H59	1.2	1.6	2	1
V88-H60	0.1	0.0	0	0
V88-H80	0.8	1.2	1	0
V89-H46	0.7	0.0	0	0
V89-H47	1.5	0.6	1	0
V89-H48	1.0	1.0	1	0
V89-H54	0.7	2.8	2	1
V89-H56	0.8	2.5	2	0
V89-H57	1.1	1.8	2	0
V89-H58	1.5	3.3	5	2
V89-H59	1.2	0.8	1	1
V89-H60	1.2	4.1	5	2
V89-H61	1.2	8.3	10	2
V89-H62	1.1	6.3	7	5
V89-H63	1.6	5.0	8	5
V89-H64	2.2	4.0	9	7
V89-H65	0.1	0.0	0	0
V89-H66	1.2	1.6	2	0
V89-H67	0.9	3.3	3	1
V89-H68	1.2	4.1	5	1
V89-H69	1.5	10.0	15	3
V89-H70	1.2	4.1	5	2
V89-H71	1.7	2.9	5	1
V89-H72	1.6	11.2	18	4
V89-H73	1.9	7.3	14	5
V89-H74	0.8	3.7	3	0
V89-H77	1.4	6.4	9	1

1/ See footnote at end of table.

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V89-H78	1.1	0.9	1	0
V89-H79	1.4	2.1	3	0
V89-H80	1.4	3.5	5	2
V89-H81	1.8	0.5	1	0
V89-H82	1.5	2.0	3	1
V89-H83	2.2	0.4	1	0
V90-H46	1.5	0.0	0	0
V90-H47	2.0	0.5	1	1
V90-H48	1.0	0.0	0	0
V90-H49	0.6	0.0	0	0
V91-H47	1.3	0.0	0	0
V91-H48	0.5	4.0	2	0
V91-H61	0.2	0.0	0	0
V91-H62	0.9	0.0	0	0
V91-H63	0.8	0.0	0	0
V91-H64	1.0	0.0	0	0
V91-H65	0.5	2.0	1	0
V92-H47	1.2	0.8	1	1
V92-H48	0.2	0.0	0	0
V92-H56	0.6	1.6	1	0
V92-H65	0.4	2.5	1	0
V92-H66	0.9	5.5	5	0
V92-H67	1.1	2.7	3	0
V92-H68	0.4	2.5	1	0
V93-H47	0.8	0.0	0	0
V93-H48	1.1	0.0	0	0
V93-H56	1.2	0.0	0	0
V93-H68	0.6	0.0	0	0
V93-H69	1.0	1.0	1	0
V93-H70	4.8	7.0	34	9

1/ See footnote at end of table.

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V93-H71	1.8	5.0	9	5
V93-H72	1.8	2.7	5	3
V93-H73	0.4	10.0	4	0
V94-H46	0.8	0.0	0	0
V94-H47	0.9	0.0	0	0
V94-H48	2.0	0.5	1	0
V94-H49	0.7	0.0	0	0
V94-H50	0.8	0.0	0	0
V94-H51	1.0	0.0	0	0
V94-H52	0.6	0.0	0	0
V94-H53	1.2	1.6	2	1
V94-H54	0.2	0.0	0	0
V94-H56	1.5	0.6	1	0
V94-H57	0.6	0.0	0	0
V94-H68	0.7	1.4	1	1
V94-H69	1.2	2.5	3	1
V94-H70	2.6	4.2	11	1
V94-H71	2.6	1.5	4	2
V94-H72	0.2	0.0	0	0
V95-H48	0.8	0.0	0	0
V95-H49	1.1	0.0	0	0
V95-H54	0.9	0.0	0	0
V95-H55	1.2	1.6	2	0
V95-H56	0.2	0.0	0	0
V96-H48	0.9	0.0	0	0
V96-H49	2.0	0.5	1	0
V96-H50	0.2	0.0	0	0
V96-H51	0.1	0.0	0	0
V96-H52	1.0	0.0	0	0
V96-H53	0.9	0.0	0	0

1/ See footnote at end of table.

Table B-3.--List of chart units occupied by a research vessel off Washington, 1-31 May 1970, 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
V97-H48	0.7	0.0	0	0
V97-H49	1.6	0.0	0	0
V97-H50	1.2	0.0	0	0
V97-H51	0.8	0.0	0	0
V98-H47	0.8	0.0	0	0
V98-H48	1.8	0.5	1	0
V98-H49	1.2	0.8	1	0
V98-H50	0.1	0.0	0	0
V99-H47	1.0	0.0	0	0
V99-H48	0.8	0.0	0	0
V100-H48	0.1	0.0	0	0
V100-H49	0.8	0.0	0	0
V100-H50	0.9	0.0	0	0
V100-H51	1.9	1.5	3	0
V100-H52	2.5	2.8	7	2
V100-H53	3.2	0.3	1	0
V100-H54	0.8	1.2	1	0
V101-H51	0.3	0.0	0	0

1/ The base chart is USCGS No. 5052. 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.) and horizontal row numbering begins at the lower left corner.

Table B-4. --List of chart units occupied by a research vessel off Washington, 1-9 June 1970, 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
V85-H61	0.9	0.0	0	0
V85-H62	0.8	0.0	0	0
V85-H63	0.9	0.0	0	0
V85-H64	0.5	6.0	3	1
V86-H43	0.2	0.0	0	0
V86-H44	1.8	0.0	0	0
V86-H45	1.6	0.0	0	0
V86-H46	1.2	0.0	0	0
V86-H47	0.7	0.0	0	0
V86-H48	0.8	0.0	0	0
V86-H49	0.8	0.0	0	0
V86-H50	0.7	0.0	0	0
V86-H51	0.8	0.0	0	0
V86-H52	0.9	0.0	0	0
V86-H53	0.8	0.0	0	0
V86-H54	0.8	0.0	0	0
V86-H55	1.0	0.0	0	0
V86-H56	0.8	0.0	0	0
V86-H57	1.3	1.5	2	0
V86-H58	1.2	1.6	2	0
V86-H59	1.2	2.5	3	0
V86-H60	1.2	2.5	3	1
V86-H61	0.2	0.0	0	0
V86-H64	1.1	0.0	0	0
V87-H44	0.4	0.0	0	0
V87-H45	1.0	0.0	0	0
V87-H46	2.2	0.4	1	0
V87-H63	1.2	0.0	0	0
V87-H64	1.2	0.0	0	0
V88-H46	1.4	0.0	0	0
V88-H47	2.5	1.2	3	2
V88-H61	0.5	0.0	0	0
V88-H62	0.8	0.0	0	0
V88-H63	1.0	0.0	0	0
V89-H47	0.4	0.0	0	0

1/ See footnote at end of table.

Table B-4.--List of chart units occupied by a research vessel off Washington, 1-9 June 1970, 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
V89-H48	2.6	0.3	1	0
V89-H49	0.2	0.0	0	0
V90-H48	1.2	0.0	0	0
V90-H49	0.7	0.0	0	0
V90-H50	0.8	0.0	0	0
V90-H51	0.1	0.0	0	0
V91-H48	1.2	0.0	0	0
V91-H51	0.8	0.0	0	0
V91-H52	0.8	1.2	1	0
V91-H53	0.3	3.3	1	0
V92-H47	0.2	0.0	0	0
V92-H48	0.7	0.0	0	0
V92-H53	0.6	1.6	1	0
V92-H54	1.0	1.0	1	0
V93-H54	1.5	0.0	0	0
V94-H54	0.4	0.0	0	0
V95-H46	0.8	0.0	0	0
V95-H47	1.0	0.0	0	0
V96-H47	0.2	0.0	0	0
V96-H48	1.2	0.0	0	0
V96-H49	0.3	0.0	0	0
V97-H49	1.2	0.0	0	0
V97-H50	0.2	0.0	0	0
V98-H50	1.2	1.6	2	2
V98-H51	0.4	0.0	0	0
V99-H51	0.4	0.0	0	0
V99-H52	1.8	0.0	0	0
V99-H53	0.6	0.0	0	0
V99-H54	0.7	0.0	0	0
V100-H52	0.3	6.6	2	2
V100-H53	5.2	5.0	26	18
V100-H54	2.9	2.0	6	4

1/ The base chart is USCGS No. 5052. 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.) and horizontal row numbering begins at the lower left corner.

Table B-5. --Number of seals seen, and number seen per boat-hunting day, by 10-day periods, [1/] off Washington, 3 March to 9 June 1970

Period	Boat-hunting days[2/]	Total seals seen	Seals seen per boat-hunting day	Seals seen per 10-day interval
	Number	Number	Number	Percent
3-10 Mar.	6.00	212	35.3	11.2
11-20 Mar.	5.25	240	45.7	12.7
21-31 Mar.	6.75	480	71.1	25.5
1-10 Apr.	1.50	102	68.0	5.4
11-20 Apr.	7.50	156	20.8	8.3
21-30 Apr.	5.00	72	14.4	3.8
1-10 May	7.50	129	17.2	6.8
11-20 May	9.00	298	33.1	15.8
21-31 May	5.75	139	24.2	7.4
1-9 June	5.75	58	10.1	3.1
Total	60.00	1,886	31.4	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-6. --Number of seals collected, and number collected per boat-hunting day, by 10-day periods[1/], off Washington, 3 March to 9 June 1970

Period	Boat-hunting days[2/]	Seals collected			Seals collected per boat-hunting day	
		Males	Females	Total		
	Number	Number	Number	Number	Number	Percent
3-10 Mar.	6.00	3	34	37	6.2	9.2
11-20 Mar.	5.25	2	45	47	9.0	11.7
21-31 Mar.	6.75	1	56	57	8.4	14.1
1-10 Apr.	1.50	0	24	24	16.0	6.0
11-20 Apr.	7.50	7	21	28	3.7	6.9
21-30 Apr.	5.00	2	6	8	1.6	2.0
1-10 May	7.50	5	24	29	3.9	7.2
11-20 May	9.00	3	89	92	10.2	22.8
21-31 May	5.75	1	50	51	8.9	12.7
1-9 June	5.75	9	21	30	5.2	7.4
Total	60.00	33	370	403	73.1	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-7. --Total seals sighted, collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-70

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
Total	48,344	12,183	25.2	1,882	3.9	1,599	3.3

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-8.--Total seals shot, percentage collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-70

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
Total	15,664	12,183	77.8	1,882	12.0	1,599	10.2

1/ Includes 16 days during November and December 1966.

2/ Includes 25 days during November and December 1967.

Table B-9.--Number of seals per group among 1,886 seals sighted off Washington, 3 March to 9 June 1970

Number of seals in group	Group	Seals	
	Number	Number	Percent
1	556	556	29.5
2	255	510	27.0
3	120	360	19.1
4	44	176	9.3
5	25	125	6.6
6	12	72	3.8
7	5	35	1.9
8	4	32	1.7
20	1	20	1.1
Total	1,022	1,886	100.0

Table B-10. --Monthly mean lengths of pregnant female seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
5	7	119.0	2	118.0	4	116.7	-	-	13	118.2	4.12
6	10	118.6	4	120.0	11	120.1	1	125.0	26	119.7	4.80
7	11	128.1	1	119.0	4	120.5	-	-	16	125.6	6.46
8	4	130.2	6	126.7	9	127.0	-	-	19	127.6	3.32
9	9	126.8	1	126.0	6	129.2	1	127.0	17	127.6	3.71
10	4	125.2	1	126.0	3	128.0	-	-	8	126.4	4.78
11	7	126.7	-	-	4	126.0	-	-	11	126.5	2.38
12	4	121.2	2	130.5	3	126.7	-	-	9	125.1	5.88
13	5	131.4	1	134.0	3	129.0	-	-	9	130.9	4.54
14	-	-	-	-	1	117.0	-	-	1	117.0	-
15	1	134.0	-	-	4	127.7	-	-	5	129.0	3.87
16	2	128.5	-	-	1	132.0	-	-	3	129.7	-
18	-	-	-	-	1	123.0	-	-	1	123.0	-
Total	64		18		54		2		138		

Table B-11.--Monthly mean weights of pregnant female seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
5	7	30.0	2	31.5	4	31.3	-	-	13	30.6	3.04
6	10	30.4	4	34.0	11	33.5	1	38.0	26	32.6	3.15
7	11	37.6	1	35.0	4	34.2	-	-	16	36.6	3.52
8	4	38.2	6	37.7	9	39.4	-	-	19	38.6	3.18
9	9	39.3	1	40.0	6	39.2	1	42.0	17	39.5	3.00
10	4	40.2	1	35.0	3	42.0	-	-	8	40.2	3.24
11	7	38.9	-	-	4	39.0	-	-	11	38.9	1.81
12	4	37.2	2	43.5	3	41.0	-	-	9	39.9	4.51
13	5	42.0	1	48.0	3	40.7	-	-	9	42.2	4.29
14	-	-	-	-	1	39.0	-	-	1	39.0	-
15	1	48.0	-	-	4	45.7	-	-	5	46.2	3.49
16	2	44.5	-	--	1	42.0	-	-	3	43.7	-
18	-	-	-	-	1	40.0	-	-	1	40.0	-
Total	64		18		54		2		138		

Table B-12.--Monthly mean lengths of nonpregnant female seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	3	72.3	3	73.3	3	77.3	-	-	9	74.3	4.24
2	3	93.0	2	91.0	12	90.1	-	-	17	90.7	3.90
3	14	101.9	7	99.7	36	101.4	5	105.0	62	101.6	4.47
4	10	108.8	9	110.3	36	110.2	11	113.5	66	110.5	4.23
5	15	115.9	2	118.5	6	115.8	1	115.0	24	116.0	4.16
6	9	120.0	4	117.2	1	123.0	1	116.0	15	119.2	3.67
7	1	120.0	-	-	2	123.5	-	-	3	122.3	-
8	1	127.0	1	124.0	2	127.5	-	-	4	126.5	-
9	1	124.0	1	135.0	3	123.3	-	-	5	125.8	5.81
10	2	128.0	1	125.0	2	125.5	-	-	5	126.4	2.07
11	1	118.0	1	129.0	1	129.0	-	-	3	125.3	-
12	2	126.0	1	127.0	1	131.0	-	-	4	127.5	-
13	2	124.0	1	123.0	2	120.5	-	-	5	122.4	3.36
18	3	128.7	-	-	1	130.0	1	124.0	5	128.0	3.39
19	1	128.0	-	-	1	126.0	-	-	2	127.0	-
21	1	136.0	-	-	-	-	-	-	1	136.0	-
Total	69		33		109		19		230		

Table B-13.--Monthly mean weights of nonpregnant female seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	3	7.3	3	8.0	3	8.0	-	-	9	7.8	1.99
2	3	12.7	2	13.0	12	12.5	-	-	17	12.6	1.46
3	14	19.1	7	18.3	36	17.2	5	18.2	62	17.9	2.13
4	10	22.3	9	22.1	36	21.8	11	24.7	66	22.4	2.75
5	15	26.8	2	25.0	5	23.0	1	23.0	23	25.7	3.11
6	9	27.9	4	26.3	1	26.0	1	27.0	15	27.3	1.87
7	1	29.0	-	-	2	28.5	-	-	3	28.7	-
8	1	37.5	1	36.0	2	29.5	-	-	4	33.1	-
9	1	35.0	1	38.0	3	32.3	-	-	5	34.0	3.32
10	2	38.0	1	37.0	2	32.0	-	-	5	35.4	3.29
11	1	32.0	1	39.0	1	37.0	-	-	3	36.0	-
12	2	36.0	1	37.0	1	42.0	-	-	4	37.7	-
13	2	32.5	1	43.0	2	34.0	-	-	5	35.2	5.89
18	3	44.3	-	-	1	40.0	1	38.0	5	42.2	3.11
19	1	40.0	-	-	1	35.0	-	-	2	37.5	-
21	1	56.0	-	-	-	-	-	-	1	56.0	-
Total	69		33		108		19		229		

Table B-14. --Monthly mean lengths of male seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	2	84.5	4	80.0	2	75.5	3	85.3	11	81.5	5.18
2	-	-	-	-	4	98.5	3	102.0	7	100.0	4.47
3	4	109.7	3	111.3	2	110.5	3	117.0	12	112.1	4.12
4	-	-	2	115.5	1	118.0	-	-	3	116.3	-
Total	6		9		9		9		33		

Table B-15. --Monthly mean weights of male seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March		April		May		June		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	2	12.5	4	10.5	2	9.5	3	12.7	11	11.3	2.20
2	-	-	-	-	4	16.7	3	20.0	7	18.1	2.85
3	4	20.5	3	23.3	2	24.0	3	26.0	12	23.2	3.49
4	-	-	2	29.0	1	29.0	-	-	3	29.0	-
Total	6		9		9		9		33		

Table B-16. --Monthly mean lengths and weights of fur seal fetuses collected pelagically by the United States off Washington, 3 March to 9 June 1970

Period	Male			Female		
	Fetuses	Mean length	Mean weight	Fetuses	Mean length	Mean weight
	Number	Cm.	Kg.	Number	Cm.	Kg.
3-10 Mar.	6	32.2	0.9	9	32.8	1.0
11-20 Mar.	10	35.8	1.3	14	36.1	1.2
21-31 Mar.	15	40.8	1.7	12	39.0	1.4
1-10 Apr.	5	44.2	1.9	1	40.0	1.5
11-20 Apr.	3	47.3	2.3	6	46.2	2.1
21-30 Apr.	1	51.0	2.6	2	43.0	1.9
1-10 May	2	50.5	2.7	1	45.0	2.0
11-20 May	21	55.4	3.6	20	53.3	3.5
21-31 May	5	55.4	3.6	5	53.8	3.4
1-9 June	1	53.0	3.3	1	59.0	4.3
Total	69			71		

Table B-17.--Reproductive condition of female fur seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	Nulliparous			Primiparous				Multiparous				
				Nonpregnant			Pregnant	Nonpregnant			Pregnant	
	Ovulated			Ovulated				Ovulated				
	Yes	No	Total	Yes[1/]	No	Total		Yes[1/]	No	Total		Total
Years	Number											
March												
1	-	3	3	-	-	-	-	-	-	-	-	3
2	-	3	3	-	-	-	-	-	-	-	-	3
3	-	14	14	-	-	-	-	-	-	-	-	14
4	-	10	10	-	-	-	-	-	-	-	-	10
5	4	11	15	-	-	-	5	-	-	-	2	22
6	1	3	4	4	1	5	4	-	-	-	6	19
7	1	-	1	-	-	-	1	-	-	-	10	12
8	-	-	-	-	-	-	1	1	-	1	3	5
9	-	-	-	-	-	-	-	1	-	1	9	10
10	1	-	1	-	-	-	-	1[1-R]	-	1	4	6
11	-	-	-	1	-	1	-	-	-	-	7	8
12	-	-	-	-	-	-	-	2	-	2	4	6
13	-	-	-	-	-	-	-	2	-	2	5	7
15	-	-	-	-	-	-	-	-	-	-	1	1
16	-	-	-	-	-	-	-	-	-	-	2	2
18	-	-	-	-	-	-	-	3	-	3	-	3
19	-	-	-	-	-	-	-	1	-	1	-	1
21	-	-	-	-	-	-	-	-	1	1	-	1
Total	7	44	51	5	1	6	11	11	1	12	53	133
April												
1	-	3	3	-	-	-	-	-	-	-	-	3
2	-	2	2	-	-	-	-	-	-	-	-	2
3	-	7	7	-	-	-	-	-	-	-	-	7
4	-	9	9	-	-	-	-	-	-	-	-	9
5	-	2	2	-	-	-	2	-	-	-	-	4
6	1	2	3	1	-	1	2	-	-	-	2	8
7	-	-	-	-	-	-	1	-	-	-	-	1
8	-	-	-	1	-	1	-	-	-	-	6	7
9	-	-	-	-	-	-	-	1	-	1	1	2
10	-	-	-	-	-	-	-	1	-	1	1	2
11	-	-	-	-	-	-	-	1	-	1	-	1
12	-	-	-	-	-	-	-	1	-	1	2	3
13	-	-	-	-	-	-	-	1	-	1	1	2
Total	1	25	26	2	-	2	5	5	-	5	13	51
May												
1	-	3	3	-	-	-	-	-	-	-	-	3
2	-	12	12	-	-	-	-	-	-	-	-	12
3	-	36	36	-	-	-	-	-	-	-	-	36
4	1	35	36	-	-	-	-	-	-	-	-	36
5	1	5	6	-	-	-	4	-	-	-	-	10
6	-	1	1	-	-	-	2	-	-	-	9	12
7	1	-	1	1	-	1	1	-	-	-	3	6
8	-	-	-	1	-	1	1	1[1-R]	-	1	8	11
9	1	-	1	-	-	-	-	1	1	2	6	9
10	-	-	-	1	-	1	-	-	1	1	3	5
11	-	-	-	-	-	-	-	1[1-A]	-	1	4	5
12	-	-	-	-	-	-	-	1	-	1	3	4
13	-	-	-	-	-	-	-	2[1-A]	-	2	3	5
14	-	-	-	-	-	-	-	-	-	-	1	1
15	-	-	-	-	-	-	-	-	-	-	4	4
16	-	-	-	-	-	-	-	-	-	-	1	1
18	-	-	-	-	-	-	-	1	-	1	1	2
19	-	-	-	-	-	-	-	1[1-A]	-	1	-	1
Total	4	92	96	3	-	3	8	8	2	10	46	163
June												
3	-	5	5	-	-	-	-	-	-	-	-	5
4	-	11	11	-	-	-	-	-	-	-	-	11
5	-	-	-	1[1-A]	-	1	-	-	-	-	-	1
6	-	1	1	-	-	-	1	-	-	-	-	2
9	-	-	-	-	-	-	-	-	-	-	1	1
18	-	-	-	-	-	-	-	1	1	1	-	1
Total	-	17	17	1	-	1	1	1	1	1	1	21

1/ The nonpregnant ovulated columns include seals that aborted a conceptus (indicated [number-A] thus) or whose uterine horn contained a resorbing conceptus (indicated [number-R] thus).

Table B-18. --Pregnancy rates of female seals collected pelagically by the United States off Washington, 3 March to 9 June 1970

Age	March			April			May			June			Combined data	
	Seals	Pregnant		Seals	Pregnant		Seals	Pregnant		Seals	Pregnant		Mar.-June	1958-70 pelagic collections
Years	Number	Number	Percent	Number	Number	Percent	Number	Number	Percent	Number	Number	Percent	Pregnant Percent	Pregnant Percent
3	14	-	0.0	7	-	0.0	36	-	0.0	5	-	0.0	0.0	0.3
4	10	-	0.0	9	-	0.0	36	-	0.0	11	-	0.0	0.0	3.1
5	22	7	31.8	4	2	50.0	10	4	40.0	1	-	0.0	35.1	38.2
6	19	10	52.6	8	4	50.0	12	11	91.7	2	1	50.0	63.4	71.9
7	12	11	91.7	1	1	100.0	6	4	66.7	-	-	-	84.2	79.8
8	5	4	80.0	7	6	85.7	11	9	81.8	-	-	-	82.6	86.0
9	10	9	90.0	2	1	50.0	9	6	66.7	1	1	100.0	77.3	89.5
10	6	4	66.7	2	1	50.0	5	3	60.0	-	-	-	61.5	88.5
11	8	7	87.5	1	-	0.0	5	4	80.0	-	-	-	78.6	88.6
12	6	4	66.7	3	2	66.7	4	3	75.0	-	-	-	69.2	87.8
13	7	5	71.4	2	1	50.0	5	3	60.0	-	-	-	64.3	86.0
14	-	-	-	-	-	-	1	1	100.0	-	-	-	100.0	83.2
15	1	1	100.0	-	-	-	4	4	100.0	-	-	-	100.0	82.4
16	2	2	100.0	-	-	-	1	1	100.0	-	-	-	100.0	80.1
18	3	-	0.0	-	-	-	2	1	50.0	1	-	0.0	16.7	67.2
19	1	-	0.0	-	-	-	1	-	0.0	-	-	-	0.0	54.3
21	1	-	0.0	-	-	-	-	-	-	-	-	-	0.0	58.6

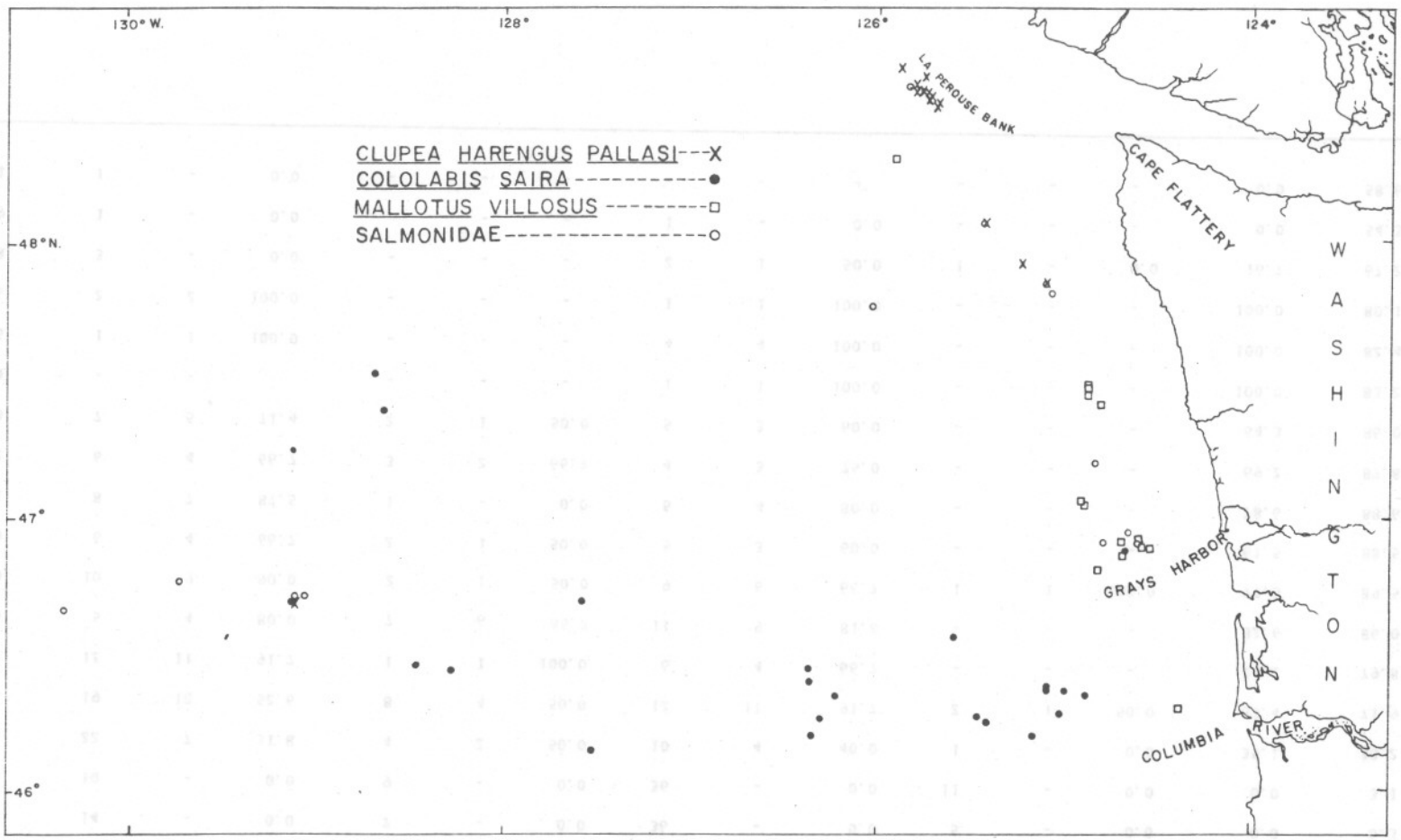

Figure B-1. --Locations where fur seal stomachs collected off Washington in 1970 contained Clupea harengus pallasi (15 occurrences), Cololabis saira (22 occurrences), Mallotus villosus (14 occurrences), and Salmonidae (13 occurrences).

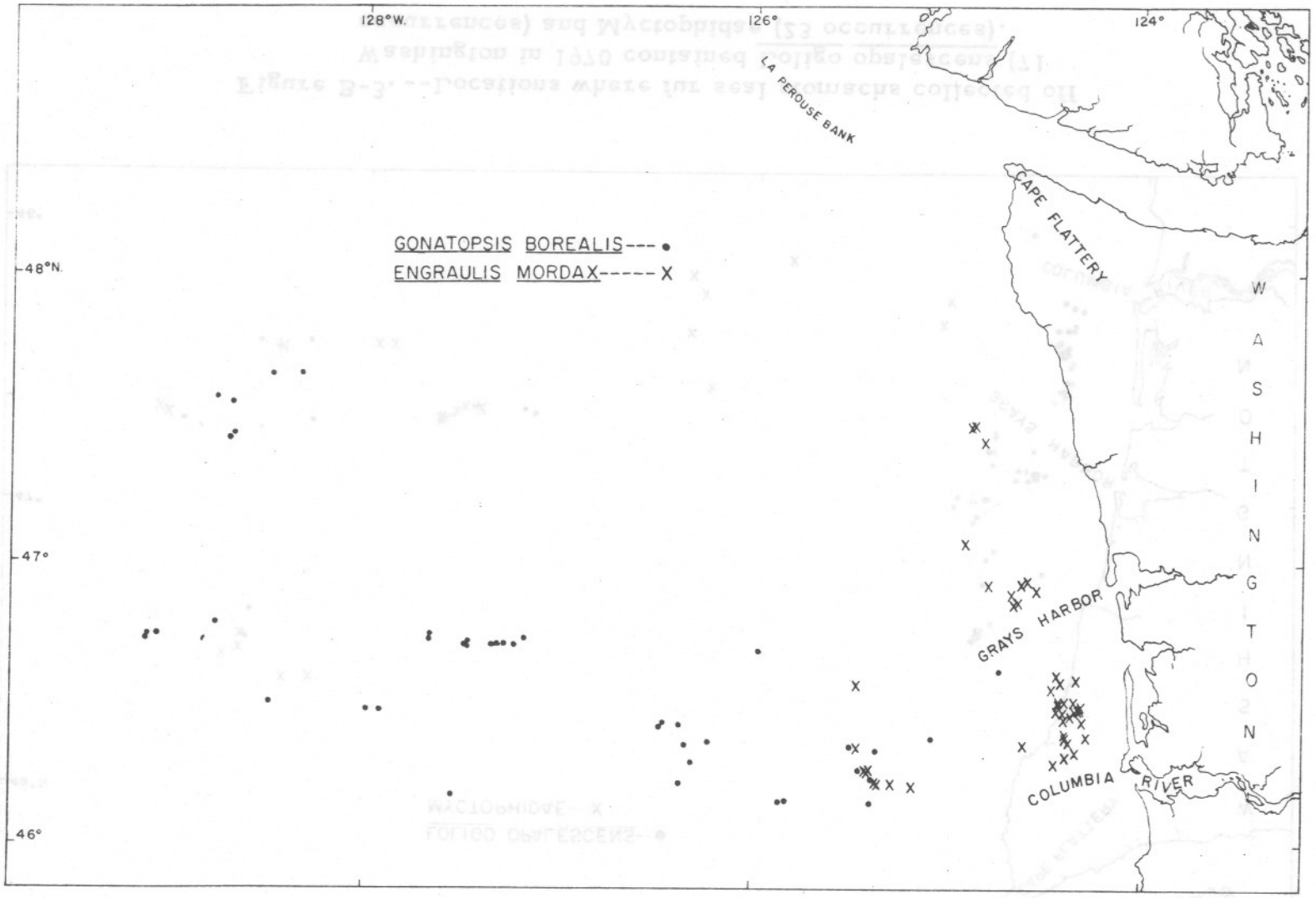

Figure B-2. --Locations where fur seal stomachs collected off Washington in 1970 contained Gonatopsis borealis (41 occurrences) and Engraulis mordax (47 occurrences).

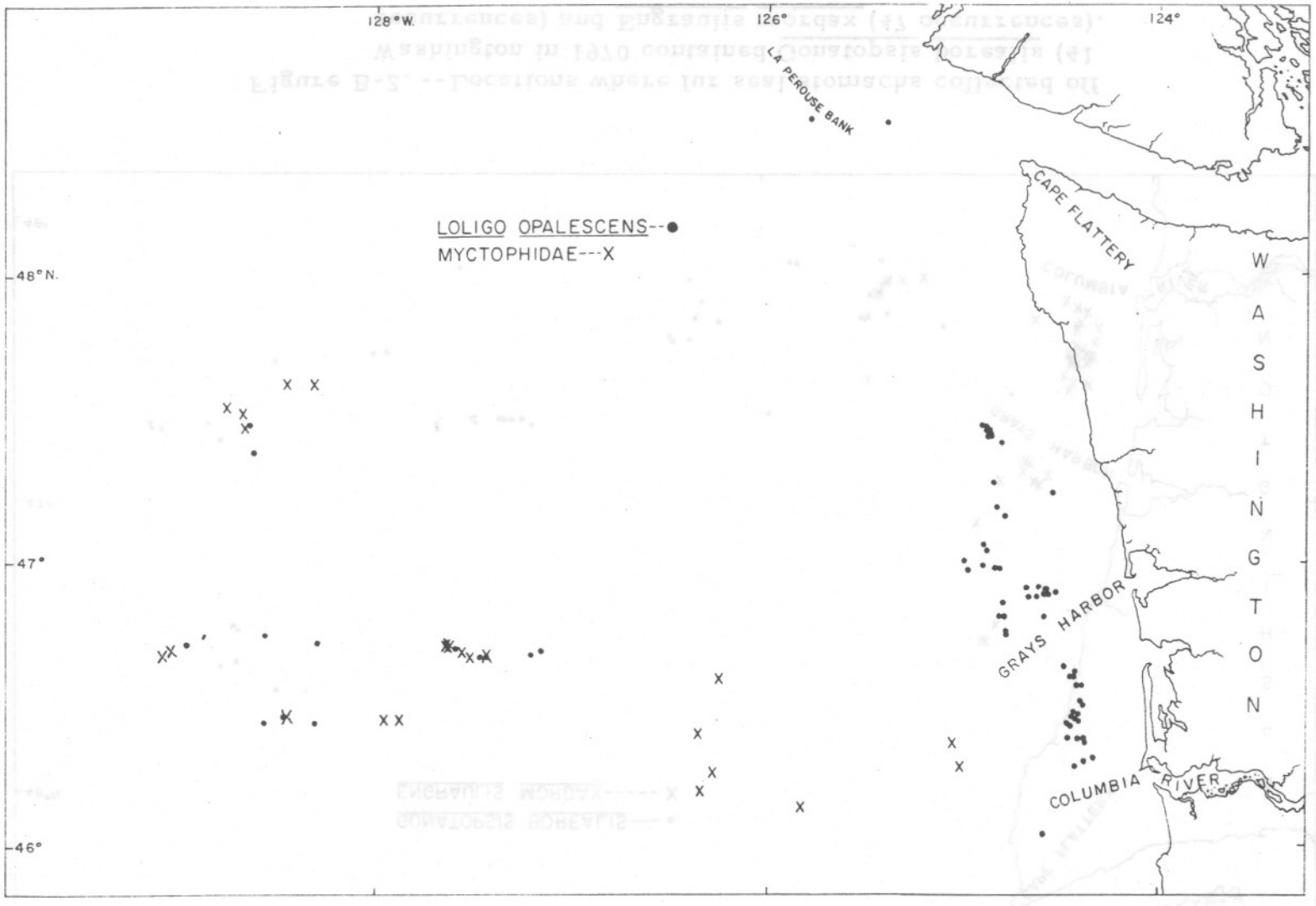

Figure B-3. --Locations where fur seal stomachs collected off Washington in 1970 contained Loligo opalescens (71 occurrences) and Myctophidae (23 occurrences).

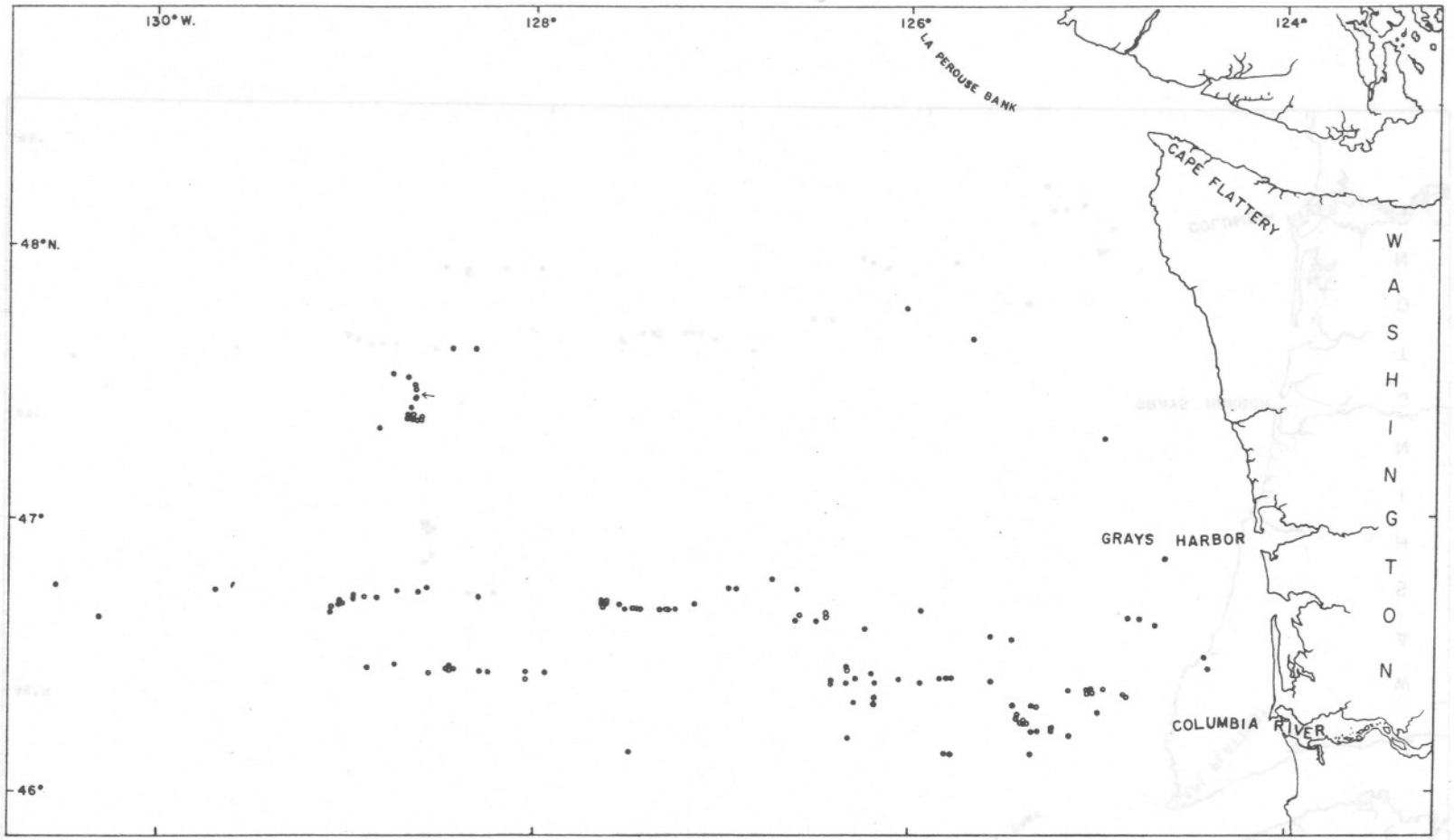

Figure B-4. --Locations where fur seal stomachs collected off Washington in 1970 contained Onychoteuthis sp. (128 occurrences).

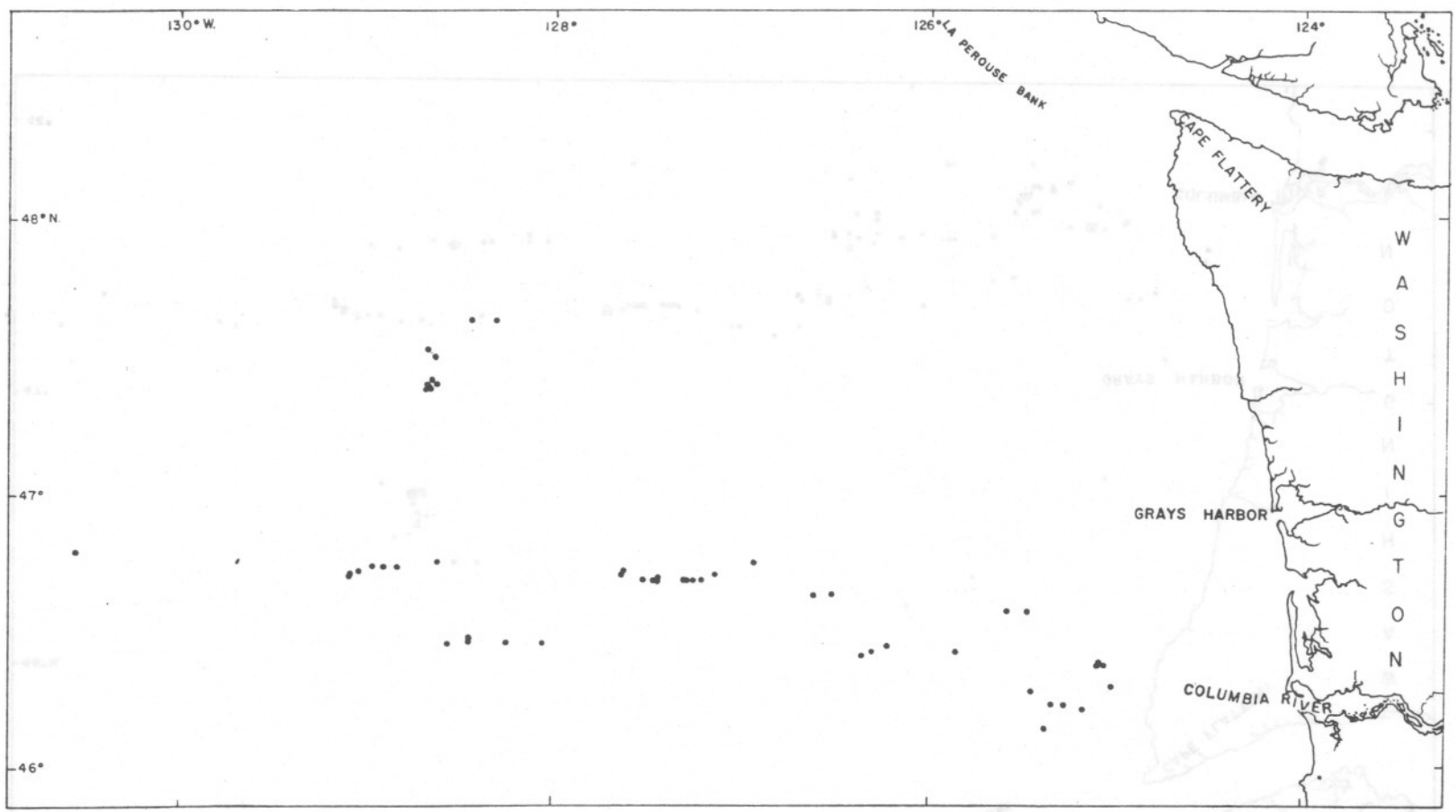

Figure B-5. --Locations where fur seal stomachs collected off Washington in 1970 contained Abraliopsis sp. (52 occurrences).

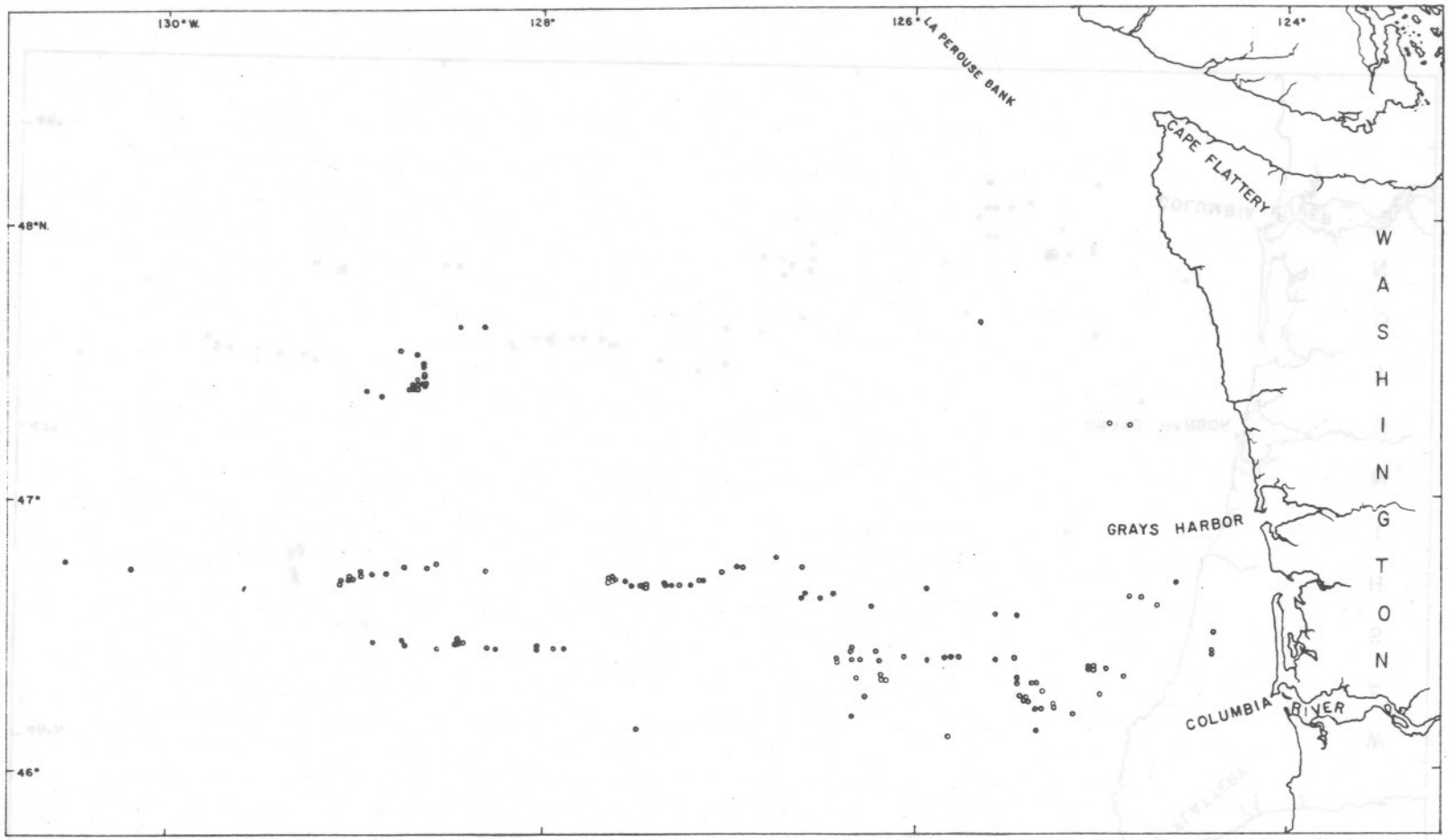

Figure B-6. --Locations where fur seal stomachs collected off Washington in 1970 contained Gonatidae (133 occurrences).

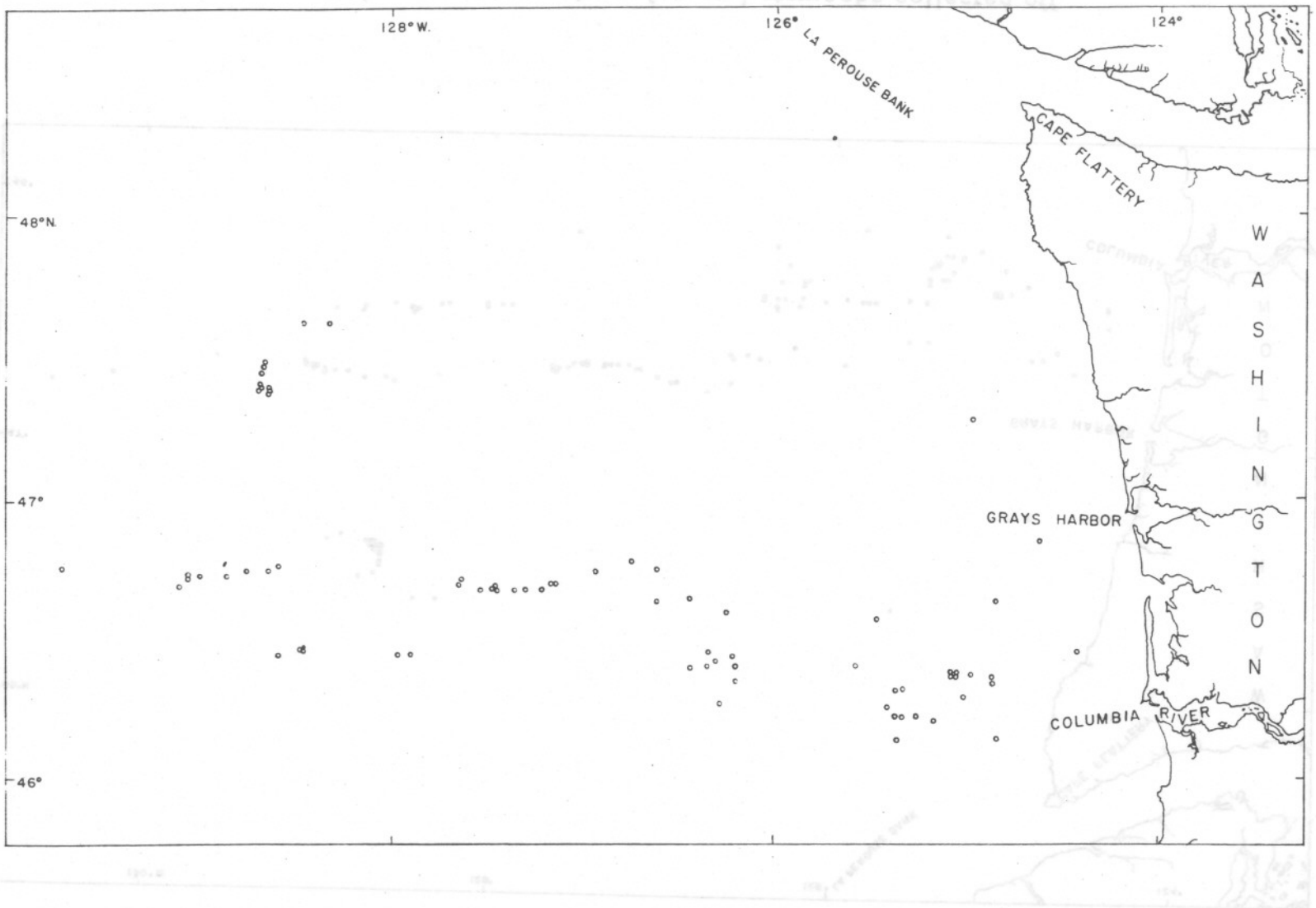

Figure B-7. --Locations where fur seal stomachs collected off Washington in 1970 contained Gonatus sp. (75 occurrences).

Appendix C

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1970

Name	Field work schedule: Start	Finish	Affiliation	Work
Pribilof Islands				
Permanent employees				
Patrick Kozloff	22 May	17 Oct.	Marine Mammal Biological Lab.	Seal research, general
Alton Y. Roppel	17 June	30 July	------do.------	Do.
Mark C. Keyes	1 July 4 Nov.	8 Aug. 11 Nov.	------do.------	Seal research, mortality
Ancel M. Johnson	29 July	13 Aug.	------do.------	Seal research, general
Lavrenty Stepetin	When needed		St. Paul Island resident	Do.
Temporary employees				
Agafon Krukoff, Jr.	22 May	17 Oct.	St. Paul Island resident	Seal research, general
Andrew M. Spear	17 June	21 Aug.	Graduate, Westminster College	Do.
George A. Swan	17 June	8 Oct.	Graduate, U. of Wash.	Do. and tourist guide
Dionsey Bourdukofsky	22 June	17 Oct.	St. Paul Island resident	Seal research, general
Ronald G. Pletnikoff	24 June	9 Sept.	Student, Southwestern College, Winfield	Do.
Perfenia Pletnikoff, Jr.	24 June	23 Sept.	Student, Western Wash. State College	Do.
Dave E. Fly	1 July	21 Aug.	Student, U. of Calif. Davis	Seal research, mortality
Pelagic Investigations				
Permanent employees				
Clifford H. Fiscus	2 Mar. 15 May	5 May 19 June	Marine Mammal Biological Lab.	Seal research, general
Hiroshi Kajimura	21 Mar.	10 June	------do.------	Do.
Temporary employees				
Stephen D. Treacy	2 Mar.	10 June	Marine Mammal Biological Lab.	Seal research, general
Robert E. Atkinson	2 Mar.	10 June	-------do.-----	Do.

APPENDIX D

FORECAST OF THE KILL OF MALE SEALS

The forecast for 1970 shows the same error as did the forecasts for 1968 and 1969; the actual kill was considerably less than that predicted. The actual kill depends on the survival of immature males and on the timing of their return at ages 3 and 4 years. It depends also on management decisions based on other than biological factors. For example, the ending date of the killing season. Before 1968, the kill ended 5 August or later for several seasons. Had the 1970 season ended on that date (4 more working days), the St. Paul Island kill might have reached nearly 42, 000.

Another point of discrepancy is of possible greater biological significance. Up to 1968 the kill on St. George Island was usually about 20 percent of the total for the Pribilof Islands, and occasionally exceeded this figure slightly. In 1969, the kill there was only 15 percent of the total and in 1970, 14 percent. If the season in 1970 had ended 5 August and the kill on St. George Island had again been 20 percent of the total for the Pribilof Islands, the total kill might have been 52, 500 as against a forecast of 53, 700. Nevertheless, some basic biological questions remain unresolved. For example: Are some unknown factors affecting the herd on St. George Island adversely? And why has the total Pribilof Islands population responded so slowly to our removal of an excess number of females?

Although these questions are fundamental, which if adequately answered would lead to better predictions, we also thought it worthwhile to look again at information available from the kill of 2-year-olds. As noted, forecasts are based on an attempt to obtain information directly or indirectly on survival and timing of the return of young males. Accurate estimates of the population of 2-year-old males would solve the forecasting problem because by age 2 the most variable phase of juvenile natural mortality is over. The data on the kill of 2-year-olds was examined carefully when forecasting was initiated in the early 1960's, but was not found to have any predictive value. However, a longer series of adequate age samples is now available; also for a number of years, the lower length limit was removed for some part of the season to try to obtain a representative sample of 2-year-olds present on the hauling grounds in late July. The analysis of these and other data associated with kill of 2-year-olds is discussed on page 149 under Forecast of the kill of 3-year-old male seals.

Forecast of the Kill of 4-year-old Male Seals

Table D-1 gives the basic data used to forecast the kill of 4-year-old males from the observed kill of 3-year-olds, with allowances for the timing of returns and for considerable variations in starting and ending dates of the kill. The regression equation derived from these data is:

$$Y = -8.75 + 0.64X_1 + 3.16X_2 - 0.30X_3$$

where

X_1 = 3-year-old kill on St. Paul Island to 31 July in thousands

X_2 = median date of 3-year-old kill on St. Paul Island in days after 15 July

X_3 = starting date of harvest in days after 22 June

Y = kill of 4-year-olds adjusted as indicated in the footnote to table D-1.

R^2, the proportion of the variability of Y explained by X_1, X_2, X_3 is 0.79. X_1 contributes 0.47; X_2, 0.29; and X_3, 0.03. The variable X_3 clearly might be dropped but since it is available, we retain it.

For the 1967 year class, $X_1 = 22.2$, $X_2 = 3.2$, $X_3 = 2$ and hence $\hat{Y} = 15.0$

The standard error of this forecast is 3.6 thousand.

The alternative method used to forecast the kill of 4-year-old males in 1970 was based upon the yearling population estimate. The data are shown in table D-2.

Before using the data in table D-2, we note that as a year class passes through the kill, our estimate of the effective number of tags originally placed on seals of that year class is revised each year. Thus, estimates now made for these populations based on recoveries at age 3 are slightly different from those given in table D-2.

Table D-1.--Data for regression of the kill of 4-year-old male seals on the kill of 3-year-old male seals, median date of the kill of 3-year-old male seals and starting date, 1952-66 year classes, St. Paul Island

Year class	Kill of 3-year-old males to 31 July X_1	Median date of kill of 3-year-old males after 15 July X_2	Starting date of kill of 3-year-old males after 22 June X_3	Adjusted kill of 4-year-old males Y
	Thousands			Thousands
1952	31	5.7	0	29
1953	27	4.6	5	17
1954	17	3.6	5	11
1955	27	1.5	5	11
1956	10	3.4	5	3
1957	15	4.5	5	20
1958	30	5.3	10	27
1959	20	3.8	10	17
1960	12	5.1	10	12
1961	18	4.3	9	14
1962	12	6.9	15	16
1963	21	5.4	15	14
1964	22	3.0	5	16
1965	17	3.6	4	12
1966	17	3.5	3	12

1/ Kill of 4-year-old males to 31 July, plus 80 percent of the kill of 3-year-old males of the previous August.

Table D-2.--Observed kill of 3- and 4-year-old male seals on St. Paul Island, and estimated number of yearlings on the Pribilof Islands, year classes 1961-62 and 1964-66

Year class	Estimates of number of yearlings on Pribilof Islands[1/] Y_e	Kill of 3- and 4-year-old males on St. Paul Island K_{3+4}
	Thousands	Thousands
1961	80.2	34.5
1962	85.3	31.2
1964	128.6	40.3
1965	94.0	29.3
1966	74.0	29.4

1/ The estimate is based on recoveries at age 3 and made in the season of these recoveries.

In using these data for forecasting, however, we must use the estimate from recoveries of 3-year-olds made at that time and not when better estimates become available. Consequently, in defining a relationship between K_{3+4} and Y_e, it is necessary to use the yearling estimate Y_e that will in fact be available. The relationship between K_{3+4} and Y_e is

$$K_{3+4} = 0.364 Y_e$$

Since for the 1967 year class, $Y_e = 87.6$ and $K_{3+4} = 31.9$, the kill of 3-year-olds on St. Paul Island was 22.2 thousand, leaving a balance of 9.7 thousand. The standard error of this forecast is 4.7 thousand.

Also available is our estimate of survival of the 1967 year class to the time of tagging in autumn 1969. This population estimate (64.4 thousand) is discussed below in "Estimates of yearling population in 1969" and is compared with those for year classes 1964-66 in table D-3.

The estimate for the 1964 year class, obviously too high, exceeds the best estimate of the number of yearlings(125, 065). If the yearling estimate is reasonable, the number of seals that survived to age 2 (years) ranged between 80 and 95 thousand. For the two reasonable estimates, K_{3+4} is almost exactly 50 percent of the 2-year-old population estimate. If this figure is applied to the 1967 year class, we have an estimate of K_{3+4} equal to 32.2 thousand, which agrees closely with the estimate from the yearling population estimate (31.9 thousand).

Estimate of Yearling Population in 1969

Before considering the estimate of the kill of 3-year-old males, we must first obtain an estimate of the 1969 yearling population (these seals are survivors of the 1968 year class and will be 3 years old in 1971).

Table D-3.--Estimated number of 2-year-old male seals of the Pribilof Islands compared with the kill of 3- and 4-year-old males seals on St. Paul Island, year classes 1964-67

Year class	Estimated number of 2-year-olds in autumn	Kill of male seals on St. Paul Island at ages 3 and 4 (years) K_{3+4}
	Thousands	
1964	126.1	40.3
1965	57.8	29.3
1966	60.1	29.4
1967	64.4	-

Table D-4.--Combined estimates of the kill of 4-year-old male seals, St. Paul Island

Method	Estimate	Standard error
	Thousands	Thousands
Regression on kill at age 3, median date and initial date	15.0	3.6
Estimate derived from yearling population estimate	9.7	4.7
Weighted average	13.0	2.9

No attempt was made in 1969 to estimate the ages (from length) of seals selected at age 1 and older for tagging. When seals of the 1968 year class have reached age 5 and tag recoveries from it are essentially complete, we can quite closely determine the age composition of marked animals from the ages of some of their number recovered in the kill. Other approaches, however, must be used now if population estimates are to be obtained at this time.

Two methods are developed that yield rather similar estimates. We begin by estimating utilization rates of yearlings at age 2. The basic data are shown in table D-5.

Included are 53 animals for which age could not be determined and 155 that had lost both tags. If these 53 and 155 seals are prorated according to the numbers identified in each category, we can estimate the 1V-series recoveries as follows:

Age in 1969	1	2	3	4
Recovered in 1970	34.4	1,049.3	37.9	2.3

It might now be suggested that the number of yearlings tagged in 1969 was 34.4 ÷ 0.019 or 1,810.5. However, all five series recoveries of yearling tags at age 2 have been high, or in other words, the estimate of the yearling population based on recoveries at age 2 has been low. This condition is indicated in table D-6. Thus the (weighted average) correction is 107.8/200 or 0.41. Applying this factor to the 34.4 tag recoveries yields a corrected number of 14.1; 14.1 ÷ 0.019 or 742.1 is the estimated number of yearlings tagged in 1969.

The second method used is to estimate the utilization rate of each age group, i.e., the proportion of the population alive at the beginning of the season and taken in the commercial harvest that year. The basic data are:

Average kill by age	1961-65 St. Paul Island
2	2,049
3	22,542
4	11,966
5	1,260

Table D-5.--Utilization rate of yearling male seals at age 2, Pribilof Islands, Alaska

Year class	Estimated number of yearlings	Kill at age 2 to 31 July	Utilization rate
1961	81,523	913	0.011
1962	79,239	1,682	0.021
1964	125,065	2,881	0.025
1965	102,232	2,058	0.020
1966	72,666	1,456	0.020
Average			0.019

Table D-6. --Actual and expected recoveries of yearling tags at age 2, St. Paul Island

Year class	Estimates of yearling population $\hat{N}$	Number of effective tags t	Number of 2-year-old males killed n	Expected tag recoveries	Actual tag recoveries
1961	81,523	609	2,019	15.1	28
1962	79,239	523	2,726	18.0	41
1964	125,065	728	3,534	20.6	40
1965	102,232	1,146	2,940	33.0	88
1966	72,666	724	2,116	21.1	63
Totals				107.8	260

The escapement at age 5 is estimated at 3,250 as follows:

Average count of adult males, 1966-70 (St. Paul Island)	10,494
Annual replacement rate (0.33)	3,463
Decrease in population of adult males, 1965-70	7,351
Average annual rate of decrease	1,470

Hence, the estimated annual recruitment of adult males for the period 1965-70 is about 2,000.

If we use a mortality rate of 0.20, assume that the males are recruited into the breeding stock at age 7, and allow for a kill at age 6 of about 100, our estimate of escapement is 3,250. With this escapement estimate and a mortality rate of 0.20, the following utilization rates are obtained:

Age 5 $$\frac{1260}{1260+3250} = \frac{1260}{4510} = 0.28$$

Age 4 $$\frac{11966}{11966+(4510)(0.80)} = \frac{11966}{17604} = 0.68$$

Age 3 $$\frac{22542}{22542+(17600)/(0.80)} = \frac{22542}{44547} = 0.51$$

Age 2 $$\frac{2049}{2049+(44547)/(0.80)} = \frac{2049}{55684} = 0.036$$

This reconstruction permits first an estimate of the average mortality rate from age 1 to 2, since we have an estimate of the average number of yearlings that survived from year classes 1961-62 and 1964-66. Because this number is 92,145, the estimated survival rate is 55,684 ÷ 92,145 = 0.604 and the complementary mortality rate 0.396. Secondly, the estimated numbers of animals tagged in 1969 (as yearlings or older) and alive in 1970 prior to harvest are:

Age 2 $$\frac{14.1}{0.030} = 391.7$$ (14.1 is the corrected figure as calculated above.)

Age 3 $$\frac{1049.3}{0.51} = 2,057.5$$

Age 4 $$\frac{37.9}{0.68} = 55.7$$

Age 5 $$\frac{2.3}{0.28} = 8.2$$

To calculate the numbers alive at the time of tagging, we allow for one year's natural mortality at a rate of 0.396 for age 2 and a rate of 0.20 for ages 3, 4, and 5.

The estimated number of animals tagged are:

Age 2	648.5
Age 3	2,571.8
Age 4	69.6
Age 5	10.2
Total	3,300.1

The total is close but not exactly equal to the number tagged (3,419). It should first be noted that the escapement estimate applies to escapement to the adult males in 1966-70 that is from the 1959-63 year class. The length of the season has been reduced in recent years so that the escapement from 1961 to 1965 year classes may be slightly higher than 3,250. Using estimated escapements of 4,000 and 5,000, the estimates shown in table D-7 are obtained (the same mortality rate at ages 2 to 5, viz, 0.20, and the same method is used).

Finally, interpolating we have the following estimates of the number tagged by age in 1969 (of animals known to be yearlings or older):

Age 1	635
Age 2	2,695
Age 3	76
Age 4	13
Total	3,419

The number of yearlings estimated to be tagged by method 1 was 742; by method 2, 635. Considering the assumptions involved, the agreement is good. The smaller estimate is used here because of supplementary evidence. Of 3,419 tagged seals in 1969, 110 had been marked as pups. The ages of these seals were known, and 107 of the 110 were 2-year-olds and only three were 1-year-olds. This fact can be used to provide another estimate of the number of age classes 1 and 2 in the whole group of tagged animals. For example, only 91 of 3,419 seals tagged were 1-year-olds according to these proportions. The figure seems unreasonably low, but suggests that the lower estimate is preferable to the higher one.

Table D-7. --Estimates of utilization and reconstruction of ages of seals tagged in 1969 as yearlings or older

Age	Estimated utilization 1/	Seals tagged in 1969 and alive at beginning of 1970 season	Seals tagged in 1969, yearlings or older
Years		Number	Number
	(i) Escapement estimated at 4,000		
2	0.034	414.7	2/ 638.0
3	0.49	2,141.4	2/ 2,676.8
4	0.63	60.2	2/ 75.3
5	0.24	9.6	2/ 12.0
Total			3,402.1
	(ii) Escapement estimated at 5,000		
2	0.034	414.7	3/ 634.8
3	0.48	2,186.0	3/ 2,732.5
4	0.60	63.2	3/ 79.0
5	0.20	11.5	3/ 14.4
Total			3,454.2

1/ Utilization = $\frac{\text{Number killed at age indicated}}{\text{Estimated number at this age at beginning of harvest}}$.

2/ Estimated survival rate from age 1 to 2 is 0.65 with this reconstruction.

3/ Estimated survival rate from age 1 to 2 is 0.653 with this reconstruction.

Having obtained estimates of the number of tags placed in 1969, estimates of yearling and 2-year-old populations are found by the usual Petersen formula ($\hat{N} = MC/R$ where M = number tagged, C = number in kill, R = tag recoveries).

The basic data are:

Year class	C	M	R	$\hat{N}$
1968 (yearlings in 1969)	1,823	635	14.1	82,100
1967 (2-year-olds in 1969)	25,092	2,695	1,049.3	64,446

The recoveries at age 2 are adjusted as indicated in the discussion above. Because the kill figures given are for both islands, the estimates refer to the population on both islands. The estimate of the 2-year-old population (64,446) has already been referred to in the previous section.

Forecast of the Kill of 3-year-old Male Seals

After we found the basic relationship between number of pups born and the return of subadult males an inadequate tool, we have relied primarily on a regression of the kill at ages 3 and 4 on the variables average pup weight, average annual air temperature on St. Paul Island for the year ending in June following birth of the year class the previous summer, and occasionally the dead pup counts. However, the regression of the kill on the first two of these variables was rather unsatisfactory. For the period 1957-66 the coefficient of determination, R^2 is only 0.25, that is, only 25 percent of the variation in the kill data is explained by these variables. The apparent strong linear relationship of returns on mean air temperatures observed in the 1950's has now largely disappeared in more recent data. An alternative forecast equation developed by Anas (unpublished report) using different weather data was also tried. The regression is:

$$K_{(2,5)} = -27.66+0.14B-0.46D+2.74N+2.65O+0.75S$$
$$-5.75A+5.12J-0.42U+1.15T+0.35W$$

where

$K_{(2,5)}$ = Total kill from year class at ages 2 to 5.

B = Estimated number of pups born in a year class
D = Dead pup count
N = Temperature deviation from normal in November (St. Paul Island)
O = Temperature deviation from normal in October (St. Paul Island)
S = Temperature deviation from normal in September (St. Paul Island)
A = Temperature deviation from normal in August (St. Paul Island)
J = Temperature deviation from normal in July (St. Paul Island)
U = Temperature deviation from normal in June (St. Paul Island)
T = Average winter temperature at Annette Island (Ketchikan)
W = Average winter wind speed at Annette Island (Ketchikan)

(All data refer to the period immediately following birth of the year class in summer.)

For this set of variables and for year classes 1950-65, excluding 1952, $R^2 = 0.975$. Of these 10 variables, only the first three (B, D, and N) have significant regression coefficients. In using these data, it is necessary to estimate the total pup population for the 1967 year class, since the pups were sheared and sampled on two rookeries only in this year. The population can be estimated in two ways--five available estimates (1963-66 and 1969 year classes) can be averaged on the assumption that there are only random differences between them. Alternatively, one can assume a real trend from the high estimate of 1966 (298.9 thousand) to the low estimate of 1969 (232.9 thousand). The two procedures yield estimates for the 1967 year class of 268.6 and 276.9 thousand, respectively. Applying the lowest estimate and appropriate values for other variables yields an estimate of K of 58.9 thousand, with a standard error of 4.0 thousand.

Although this kill figure is a possible value (the kill from the 1958 year class was 66, 171), it exceeds considerably the kill in all year classes since 1958. The estimate is totally out of line with two estimates given below and is therefore discarded.

An alternate estimate can be based upon the relationship between K_{3+4} (kill at ages 3 and 4 and an estimate of the yearling population). This relationship as derived above is

$$K_{3+4} = 0.36Y_e$$

and because $Y_e = 82, 100$, $\hat{K}_{3+4} = 29, 600$. If two-thirds of these seals are taken at age 3, an estimated 19.8 thousand 3-year-olds will be killed.

We mentioned earlier that a multiple regression of the kill at age 3 on several variables involving the 2-year-old kill data and other factors might give some indication of the timing of returns. Of several variables tried, a reasonable relationship was determined from the data given in table D-8. The resulting regression is

$$K_3 = 13.62 + 0.0097X_1 + 2.41X_2 - 0.0068X_3 + 29.72X_4$$

For the 1968 year class $X_1 = 1, 725$, $X_2 = 3.2$, $X_3 = 4, 009$, $X_4 = 0.181$ and $\hat{K}_3 = 16.18$. It is, of course, possible to calculate a standard error for this forecast; however, it is more difficult to attach any real validity to such a standard error because the series of data is so short and because these variables have been selected from a larger set because their <u>past</u> relationship with the predicted variable is greatest. Under the circumstances, we prefer to take an unweighted average of the estimates (from the regression given in table D-8 and from the yearling population estimate). The result is an estimate of a 3-year-old kill on St. Paul Island of 18.0 thousand to 31 July.

Table D-8. --Data for the forecast of the kill of 3-year-old male seals, St. Paul Island

Year class	2-year-old kill to 31 July X_1	Median date of 3-year-old kill to 31 July for same year as column 2 X_2	3-year-old kill last 5 days of July for same year as column 2 X_3	Proportion of last 5 days of 3-year-old kill to total 3-year-old kill to 31 July X_4	3-year-old kill to 31 July from year class K_3
1960	522	3.8	2,966	0.146	11.6
1961	424	5.1	2,681	0.231	17.6
1962	1,235	4.3	4,419	0.251	12.1
1963	584	6.9	3,690	0.304	21.4
1964	2,606	5.4	5,371	0.251	22.2
1965	1,614	3.0	4,030	0.181	16.6
1966	1,153	3.6	3,549	0.257	16.9
1967	2,272	3.5	4,361	0.262	22.2

Estimate of the Total Kill of Male Seals in 1971

The forecast of the total kill on the Pribilof Islands by age is shown in table D-9. The estimated kills at ages 2 and 5 are the averages of recent years.

The extrapolation to St. George Island is based on the average ratio of the kill there by age group to the total for the Pribilof Islands in 1969 and 1970, which is significantly lower than that for the early 1960's. This situation is true also for the ratios for 3-year-olds alone (1963-68 average 0.204, 1969-70 average 0.124) and thus there is no evidence that a return to the earlier ratio is to be expected in 1971.

This forecast is appropriate only if the harvest ends 31 July. Should the kill last approximately 5 more days, the total kill should exceed the forecast by 5 to 7 thousand. An evaluation of the forecast made in 1969 for 1970 is shown in table D-10.

Douglas G. Chapman

Table D-9.--Forecast of the kill of male seals in 1971, by age, Pribilof Islands, Alaska

Island	Age			Total
	2 and 5	3	4	
	----------Number----------			
St. Paul	3,000	18,000	13,000	34,000
St. George	900	2,500	2,600	6,000
Total	3,900	20,500	15,600	40,000

Table D-10.--Forecasted and actual kill of male seals, by age, Pribilof Islands, Alaska, 1970

Island	Age			Total
	2 and 5	3	4	
	Number			
St. Paul				
Actual	2,456	22,176	11,548	36,180
Forecast	3,500	27,800	11,600	42,900
St. George				
Actual	645	2,916	2,274	5,835
Forecast	900	7,000	2,900	10,800
Combined				
Actual	3,101	25,092	13,822	42,015
Forecast	4,400	34,800	14,500	53,700