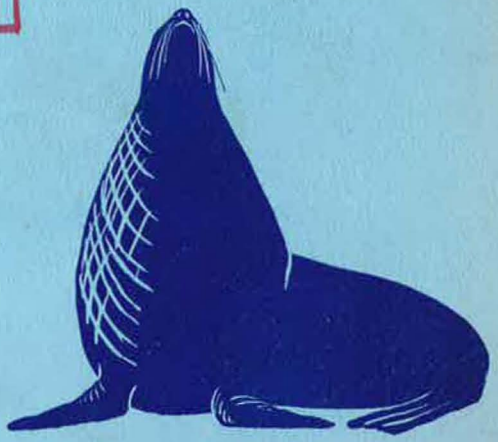
ALASKA FUR SEAL INVESTIGATIONS PRIBILOF ISLANDS, ALASKA



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ALASKA FUR SEAL INVESTIGATIONS

PRIBILOF ISLANDS, ALASKA

Report of Field Activities

June - October 1960

United States Fish and Wildlife Service
Bureau of Commercial Fisheries
Marine Mammal Biological Laboratory
Seattle 15, Washington

Carl E. Abegglen
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Alaska Fur Seal Investigations, Pribilof Islands, Alaska
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" ", paragraph 4	Line 4 . . . and evolutionary significance.
" 19, figure 6	(vertical) Kill at age 3 - males in 1000's
" " " "	(horizontal) 2-year-old male kill in 100's
" 39, table 13	22 August, Zapadni Reef, dead untagged 46
" 73, last paragraph	Line 1 . . . Data, by years, were . . . .
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" ", last paragraph	Line 10 . . (see Loss of Tags, p. 143).
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FUR SEAL INVESTIGATIONS

PRIBILOF ISLANDS, ALASKA

1960

SUMMARY

Introduction

1. The United States began an experiment designed to obtain maximum sustainable productivity of the fur-seal resources concurrently with the drafting of the Interim Convention on Conservation of North Pacific Fur Seals.

2. The experiment was based on knowledge that the Pribilof fur-seal herd grew rapidly at a relatively low population level but at high levels male returns no longer increased. Presumably, if the herd were then reduced to a level where environment permitted growth, its productivity should increase.

3. Since 1956 approximately 140,000 female seals have been removed from the Pribilof herd in the first phase of herd reduction. Acute fluctuations, in the male returns, have also been reflected in a reduced female recruitment; the effect of this reduction would be moderated if, as suspected, there is a better survival rate for females than for males.

4. Better estimates of the 1957 and 1958 year classes (in 1961 and 1962) will provide the basis for a decision about further reduction of females.

5. The search for mortality causes and how they operate, more knowledge of pelage characteristics, and prediction of returns require attention. These and other problems must be studied in order to carry on reasonable management, however, these problems should not direct attention from the primary problem, that of regulating forces that control the fur-seal population in order to achieve maximum sustainable productivity.

Population

Males

1. The 36,320 males killed during the 1960 season reflected an increase in 3-year-old male (1957 year class) returns over 1959 and emphasized the weakness of the 1956 year class. The 1960 peak kill occurred 10 days later than the preceding 5-year average. Such a shift may have been caused by discriminating mortality or a ~~physical~~ (in arrival) delay.

2. The 1960 male kill for the Pribilof Islands was below the average of the early fifties. The 1957 year class, age 3, contributed 81 percent of the entire Pribilof male kill; 4-year-old males contributed slightly in excess of 11 percent.

3. The total count of 12,799 harem bulls showed a 21 percent increase over 1959. The idle-bull count of 13,037 was far in excess of the 20-year average of 6,006.

4. The relationship of 2- to 3-year-old males and 3- to 4-year-old males in six previous year classes, as shown by the kills of two successive years provided the basis for determining male kill estimates for 1961. Two estimated 1961 male kills for St. Paul Island are given for 3- and 4-year-old males; age 3, 34,500 and 19,000; age 4, 13,500 and 5,500.

Females

1. The 1955 proposal for maximum yield through manipulation of the fur-seal herd components was not precipitated by marked fluctuations in returns. The theoretical possibility that such fluctuations would be probable at high population levels was considered along with the objective of creating a more productive herd.

2. Low survival from the large pup crops of recent years strengthens the basic theory that a maximum sustained yield, with a minimum of fluctuation, comes only from a herd held below the top of its growth potential. The land kill of females is presently the only satisfactory method of reducing the population to this level.

3. The scheduled kill of 17,500 females for 1960 was cut to 350 females per day on 22 July. The small female kill was requested

to provide continuity of research data from the program started in 1956.

4. Age composition of the 3,946 samples collected on both islands was similar. Age 5 females (22 percent) were most numerous, followed by the collective group classified as age 10+ (15 percent).

5. The largest contributing age group shifted from age 3 in 1958 to age 4 in 1959 and to age 5 in 1960. Thus, a large part of the kill, in these 3 years, has been taken from the 1955 year class. It is expected that future kills will be dominated by 3- and 4-year-olds. The 1960 female kill on St. Paul Island was composed of 46 percent age 2 through 5 and on St. George Island, 32 percent age 2 through 5.

6. Reproductive condition was determined for a sample of 2,946 females on St. Paul Island and for 1,000 females on St. George Island. In general, pregnancy rates were higher on St. Paul Island and lower on St. George Island than in 1959. A summary of pregnancy rates, by age, 1956 through 1960, does not show a trend for either increase or decrease in the rates. No significant change in pregnancy rate accompanied the shift in dominant age groups taken.

7. The 1960 reproductive condition of seals, by age and round for both islands, was similar to that found for the period 1956 through 1959, although the proportion of females taken from hauling grounds and harems has varied.

Tag Recoveries

1. Ninety-three percent of the male tag recoveries were from 3- and 4-year-olds surviving from 50,000 males tagged as pups. A comparison of tagged to untagged males shows a ratio of 1 to 20.94 age 3 males in 1959 and 1 to 14.78 in 1960; 1 to 14.41 age 4 males in 1960. [As agreed at the third International Fur Seal Commission meeting, 60,000 pups were tagged instead of the 50,000 tagged yearly, 1955-59.]

2. An increase in straying of male seals from Reef Rookery indicated a continuing closure of the hauling grounds on Reef Rookery to young males. This figure has increased annually from 29 percent in 1956 to 45 percent in 1960.

3. Several factors that might affect population estimates were studied.

a. Analysis of accumulated E, F, G, H, and I series tag recoveries infer that the sex ratio, at time of tagging, is equal. Since fetal sex ratios are shown to be almost equal, there are no apparent sexual differences in mortality on land.

b. Observations during tagging and limited examination of dead tagged pups showed that tags are attached reasonably near the correct position on the flipper.

c. Some of the "V" notch check marks on tagged 3-year-old males were found inadequate, probably because they were made too small on the pups. These faint check marks appeared most frequently among those overlooked by the tag-recovery men.

d. A limited study of the ratio of dead tagged to untagged pups does not indicate that tagging causes additional mortality.

e. A re-examination of carcasses revealed that 101, or 6 percent, of the available 1,691 tags and check marks were overlooked by the tag-recovery men.

Mortality

1. Pup mortality again increased in 1960 to 62,774 on St. Paul Island and 8,928 on St. George Island. The 1960 mortality was about midway between recent extremes.

2. The relation of weather and land mortality was continued with both 1959 and 1960 mortality figures fitting closely to the inverse correlation.

Seal weights

1. Weights of 1,200 live pups were obtained. The sex ratio was 49 percent males to 51 percent females; 39 percent of the animals weighed were tagged and 45 percent of the tagged pups were males. Weights ranged from 2.8 kilos to 18.9 kilos. Tagged males, from the commercial kill, were weighed and measured throughout the season.

Related Studies

1. Hookworm research entered its second year of a 3-year program. Efforts during 1960 were to determine the route by which seal pups are infected. All evidence of fetal infection has been nagative.

2. Live-pup counts were made on Tolstoi and Kitovi rookery areas, with results comparable to those obtained in 1959.

3. Pelage and dentition studies are continuing. Final analysis in the pelage study may show a relationship between season of most active molt and weight loss. The dentition study will give the timing of eruption, maturation, and disappearance of milk teeth and eruption and maturation of permanent teeth.

4. Tissue studies of blood and body organs may provide information usable in many fields. The findings of Blumberg, et al, in their study of seal blood serum and hemoglobin may have taxonomic and evolutinary significance.

5. The effectiveness of tranquilizing drugs upon bull fur seals was tested with negative results. Solutions of a nicotine alkaloid and succinylcholine chloride were used without satisfactory results; the dosages were either fatal or had no anesthetizing effect.

6. Age composition of the female component of the herd was extended to age 27 through analysis of the internal structure of teeth. A female life table was calculated from this new data; an additional female life table was calculated from pregnancy rates of the 1957 female kill.

7. Food-habits study was aided by seven drags made by the Exploratory fishing vessel John R. Manning in mid-August. Drags made 1 to 3 miles off St. Paul Island were unproductive. Drags southeast of St. George Island yielded muddab flounder and rock sole as the most abundant fishes.

8. An analysis of the lengths of female seals sampled in 1956-57-58-59 on St. Paul Island and in 1958 and 1959 from the United States pelagic catch showed little difference between females of the same age on St. Paul Island. Females of different reproductive conditions from pelagic samples were significantly different in length.

ALASKA FUR SEAL INVESTIGATIONS

PRIBILOF ISLANDS, ALASKA

1960

INTRODUCTION

The Problem

Concurrently with the drafting of the Interim Convention on Conservation of North Pacific Fur Seals by the four member nations, the United States began an experiment on the Pribilof Islands, intended to point the way toward ". . . achieving the maximum sustainable productivity of the fur-seal resources . . ." This is the major objective of both the North Pacific Fur Seal Commission and the United States in its research.

The experimental plan was based on the knowledge that the Pribilof fur-seal herd grew rapidly when at a relatively low population level but slowed in its growth or, in the case of the male kill, failed to increase after the herd reached higher levels. It was reasoned that if the herd were reduced to a level at which the environment permitted growth, productivity would be stimulated through decreased mortality and an increased birth rate. Productivity of a herd stabilized at a lower level would not necessarily be equal to that from a growing herd which had reached the same level.

Fundamental information for an experiment of this kind is the number of seals of various ages in both sexes taken in the kill, the number of pups born, and the number of sexually mature females. Ideally, the number of females at each age should be known. Some of this information can be obtained by direct methods; some must be found by indirect methods which require investigations of additional aspects of fur-seal biology.

Since 1956, about 140,000 female seals have been removed from the Pribilof population in the first phase of the experiment to bring the herd to a level at which maximum return will be favored.

The relatively stable survival rate of pups to killable age, that had persisted for about 17 years, began fluctuating in 1954. This year class produced about 42,700 male seals, the year class of 1955, 50,000, and the year class of 1956, the lowest of all to date, only 18,000 males as compared with totals ranging from 54,000 to 83,000 for the year classes from 1947 through 1953. The year class of 1957, still incompletely harvested, is expected to furnish about 45,000 males.

Population fluctuations can be readily demonstrated in other animals. The Pribilof fur-seal herd, during its known history, has been so strongly influenced by human predation that, until the current period, a high population level, a regulated kill, and scientific investigations have never coincided. No one had sufficient knowledge to forecast when acute fluctuations in the fur-seal population might begin. They began, unexpectedly, during the course of the experiment to find the point of maximum sustained productivity. As a result, there has been smaller recruitment of immature females and, possibly, the mortality causes that reduced recent year classes have also reduced the number of mature females. Countering this trend is the possibility that survival of females exceeds that of males.

The year classes of 1954 through 1957, which furnished reduced numbers of killable animals, began, according to estimates from tag recoveries, with large pup crops. When more complete estimates of the number of pups born in 1957 and 1958 have been made (1960-1961), a decision will be reached about further reduction in the number of females. If it can be demonstrated that the reduced kill is clearly a result of a low survival rate, then removal of females should be continued. The number to be removed will be recalculated from the most recent estimates of pups born.

In addition to finding the population level that allows good production and survival and moderate fluctuations, the search should be continued for the causes of mortality and for an understanding of how they operate.

Uncertainty about the number of seals to expect in a season's kill has increased the demand for ways to predict returns. Need is also expressed for much more complete knowledge of molt, fur growth, and pelage characteristics. These and other problems must be given attention in order to carry on reasonable management.

However, they cannot be allowed to divert attention from the primary problem, the forces that control the fur-seal population and how they can be regulated to achieve maximum sustainable productivity.

Personnel

The 1960 field season began 15 June with the arrival on St. Paul Island of Dr. O. Wilford Olsen and his assistant, Eugene Lyons. Under a contract with the University of Colorado, Dr. Olsen is studying the biology of the hookworm (*Uncinaria lucasi*).

Biologist-in-Charge Carl Abegglen and temporary employees Richard Bonn, biologist, fishery aids Thomas Juelson, Larry Nygren, James Olson, and David Riley arrived on St. Paul Island 22 June. Riley went to St. George Island 29 June and remained there until 23 August, returning to St. Paul Island on the supply ship. Ford Wilke, Laboratory Director, Marine Mammal Biological Laboratory, arrived on St. Paul Island 5 July. Biologist Alton Roppel arrived on St. Paul Island 6 July. Dr. D. G. Chapman, Laboratory of Statistical Research, University of Washington, arrived on St. Paul Island 8 August. For the past several years, Dr. Chapman has performed statistical analysis of fur-seal research data under a contract with the University. His visit to the Pribilof Islands provided personal acquaintance with the varied techniques used in the field. Departures from St. Paul Island, in chronological order, were:

11 July	O. Wilford Olsen
27 "	Carl Abegglen
22 August	Ford Wilke and D. G. Chapman
31 "	Richard Bonn
6 September	Alton Roppel, Thomas Juelson, Larry Nygren, James Olson, and David Riley
5 October	Eugene Lyons

Ford Wilke returned to St. Paul Island and spent the period 26 September to 11 October representing United States fur-seal research during the visit of three Soviet observers.

Research operations were examined by Mr. Ralph Silliman, Chief, Branch of Anadromous Fisheries, Washington, D. C., during his stay from 6 to 11 July. Activities were also inspected by Mr.

Samuel J. Hutchinson, Regional Director, Seattle; Mr. Cleo F. Layton, Chief, Division of Administration; Mr. C. Doyle Innis, Chief, Branch of Personnel; and Mr. Clarence R. Lucas, Chief, Section of Marine Mammals, Division of Resource Management, all from Washington, D. C.

W. J. L. Sladen, M. D., is presently on St. Paul Island studying upper respiratory infections under isolated conditions for a 2-year period. His work, for the Johns Hopkins Medical School, is sponsored by a grant from the Department of Health, Education, and Welfare. An avid ornithologist, Dr. Sladen did considerable background work during 1960 for the study of the rosy finch (Leucosticte tephrocotis umbrina) life cycle. He also banded several hundred least auklets (Aethia pusilla), locally called choochkies.

An exchange of scientific personnel was effected in 1960 as provided by the Interim Convention on Conservation of North Pacific Fur Seals. Dr. V. B. Scheffer, biologist, and Eugene Maltzeff, biologist-interpreter from the Bureau of Sport Fisheries and Wildlife, spent the period 29 August to 11 September on Soviet administered Robben Island in the Okhotsk Sea. Soviet representatives P. G. Nikulin, T. M. Kostarnov, and L. V. Kostin spent the period 18 September to 5 October on St. Paul Island. Unfortunately, the exchange was not realized until after completion of most research activities. Even so, the exchange was considered of mutual benefit by the representatives of both countries.

The research staff appreciates the assistance and cooperation given to them throughout the season by Mr. C. Howard Baltzo, Program Director; Mr. Clarence L. Olson, General Manager; Mr. Roy Hurd, St. Paul Island Manager; and Mr. Daniel Benson, St. George Island Manager.

POPULATION

Males

Age Classification

The commercial male kill was sampled in the manner established in 1956 (1956 report). On St. Paul Island, 3,348 upper right male canine teeth were taken as samples for age determination and 1,141 were taken on St. George Island. Sampling of the males killed was continued through the entire season to provide a better estimate of the number of age 2 males in the kill. In previous years, attention was concentrated on females at the conclusion of the male kill season and adequate sampling was not possible on the inadvertent kill of males during the remainder of the killing season.

Though the 1960 male kill fell below the average of the early fifties, it exceeded that of 1959 by 6,125 animals. Insofar as the 1959 male kill was a record low, the 1960 kill can be considered only as "improved." The percent cumulative male kill, by round, age and island, is shown in figures 1 and 2.

The female kill of 1956 could not have affected the 1959 male kill appreciably. The great increase in returns of 3-year-old males (227 percent of 1959 age 3 males) in 1960 supports this contention, especially since twice as many females were killed in 1957 as in 1956. The average contribution to the male kill from age-classes 1947 through 1957 was about 57,500 animals (table 1). Estimating a kill of 12,900 age 4 males in 1961, the expected total contribution from the 1957 age class is 45,204. This figure is comparable to the 1954 year class from which 42,695 males were killed. While it cannot be said that the female kill has had no effect on the male kill, such effects have been minimal to date. It still is unknown whether the female kills have or have not been beneficial.

The age composition of the kill can be examined with three points for consideration: actual number killed in each age class, the expected kill from each age class, and timing of the kill.

The actual number (29,137) of males killed on St. Paul Island was low in comparison to the average kill. Three- and four-year-old males dominate the average kill, each age group contributing 55 to 60 and 40 to 45 percent, respectively. In 1960, however, the relationship of these two major age groups, in their contribution to the

St. Paul Island kill, differed considerably from the average. Three-year-olds from the 1957 year class made up 83 percent of the male kill and 4-year-olds accounted for 9.5 percent. Thus, the 1960 kill was almost wholly dependent upon one age group.

From the low returns of 3-year-old males in 1959, a kill of approximately 2,500 age 4 males was predicted for St. Paul Island in 1960. The actual kill was 2,762. For 3-year-old males, the actual kill of 24,283 agreed well, after extending the season, with the prediction of 25,000 to 30,000. Tables 2 and 3 show the male age composition for 1954-60 and cumulative numbers of males killed during 1955-60, St. Paul Island.

An unusual and marked change in the date upon which the peak of the kill occurred distinguished the 1960 season. Figure 3 shows the peak kill occurring some 10 days later than the preceding 5-year average. The kill practically leveled between round 4 and 5, then started building up. Such a pause implies that a certain segment may have been delayed in arrival or suffered discriminatory mortality. The dotted line indicates that the peak would have coincided with the previous 5-year average if neither of the possibilities happened. However, any explanation is based upon speculation. Early season observers stated that, in their opinion, harem areas were also late in filling.

Figure 4, showing the percent of accumulated 3- and 4-year-old male seals killed, by round, 1956-60, facilitates comparison of these kills.

1. The years 1956 and 1959 were comparable in that both showed strong 4-year-old kills until the eighth round, when 3- and 4-year-olds were about equal.

2. The years 1957, 1958, and 1960, in that order, are examples of an increasing degree of weakness in the 4-year-age group.

3. The examples make apparent the fact that a satisfactory kill by present standards is obtained only when two "reasonably" strong year classes are combined.

4. The 1960 kill was dominated throughout by the 3-year-old males from the 1957 year class. The outlook for the season's kill, based upon the kill through the first five rounds, was very poor.

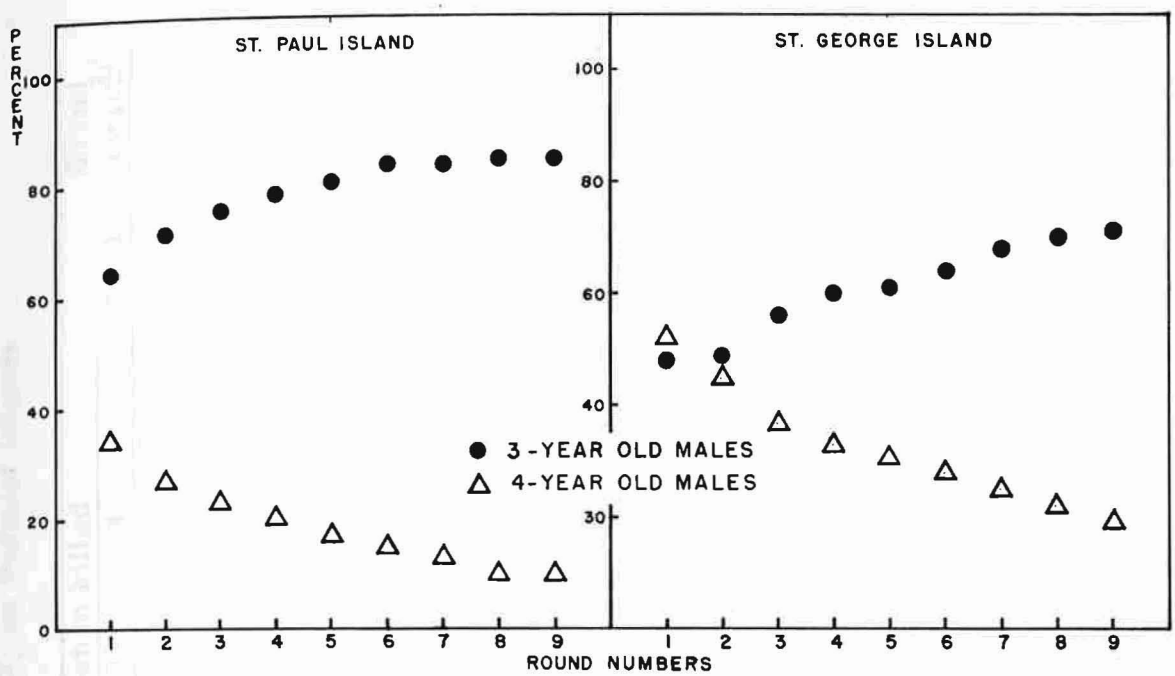


Figure 1.--Percent 3- and 4-year-old male seals in cumulative commercial kill, by round, St. Paul Island, 1960.

Figure 2.--Percent 3- and 4-year-old male seals in cumulative commercial kill, by round, St. George Island, 1960.

The following round gave some slight increase, but was considered too close to the usual termination date to be indicative of real improvement. However, from 27 July through 7 August, 15,528 males were killed on St. Paul Island, and from 27 July through 10 August, 3,883 males were killed on St. George Island. The killing of males was stopped on St. Paul Island after 7 August because of deterioration in pelt quality.

The outstanding feature of the 1960 kill was not in the number of males killed, but the period during which the bulk of the kill occurred. Killable males were still in evidence after 7 August.

Forecasts

The method of using the numbers of 2- and 3-year-old males killed during one season on St. Paul Island, to estimate the kill of

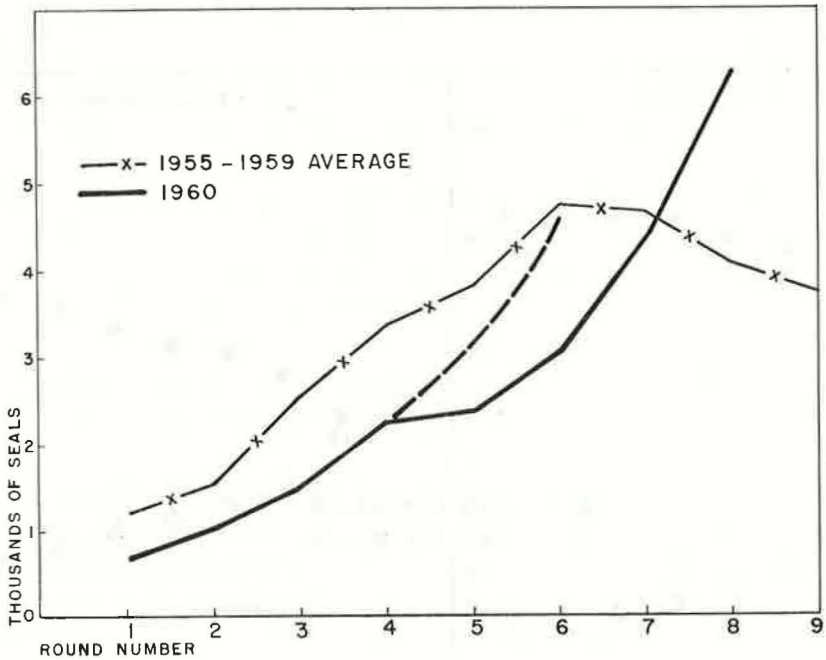


Figure 3.--Cumulative kill of male seals, by round, St. Paul Island.

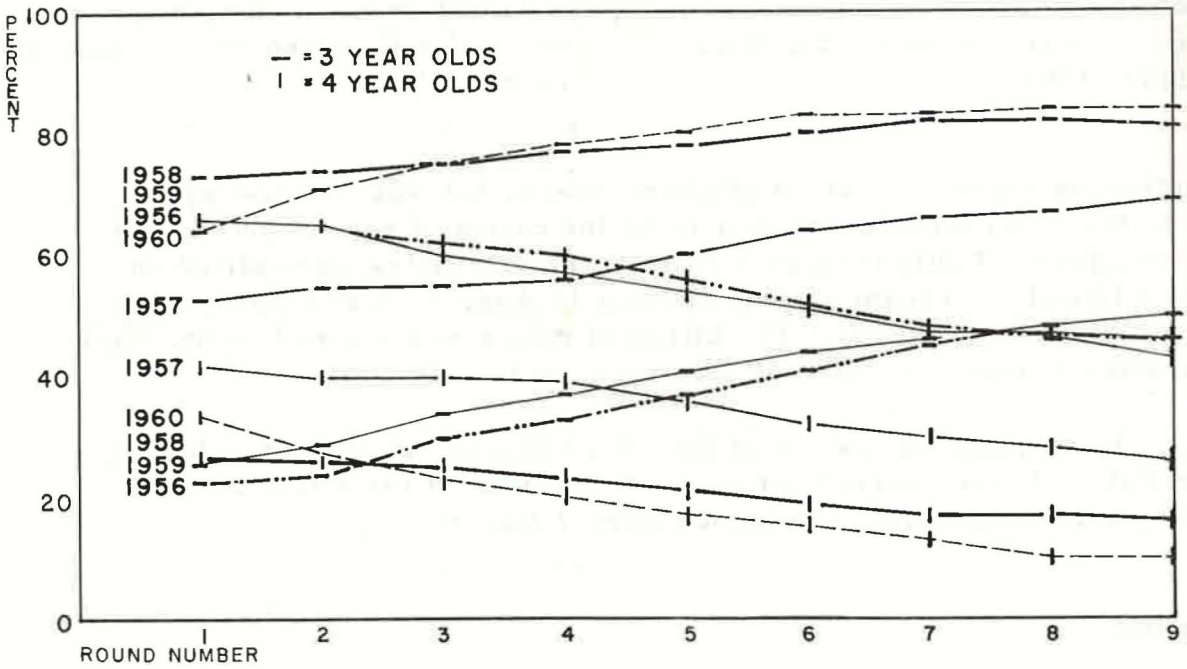


Figure 4.--Percent accumulated 3- and 4-year-old male seals killed, by round, 1956-60, St. Paul Island.

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

Year class	Age when killed 2	3	4	5	Total	Age when killed 2	3	4	5	Total	Grand total[2/]
	St. Paul					St. George					
1947	-	31567	19663	1542	52772	-	7384	3933	368	11685	64457
1948	486	29747	17476	103	47812	114	5949	4171	22	10256	58068
1949	504	31355	12326	249	44434	101	7485	2570	280	10436	54870
1950	1028	40656	15365	332	57381	245	8475	4793	98	13611	70992
1951	1384	32350	18083	3057	54874	288	7907	5336	681	14212	69086
1952	1735	30723	31410	675	64543	545	9067	8459	506	18577	83120
1953	839	38312	8855	54	48060	248	10611	3330	100	14289	62349
1954	2918	23873	5599	554	32944	535	6651	2769	162	10117	43061
1955[1/]	1615	27863	10555	115	40148	555	7246	2825	7	10633	50781
1956	885	10671	2762	-	14318	171	2251	1387	-	3809	18127
1957	2590	24283	-	-	-	242	5098	-	-	-	-

1/ Before 1956 age classification of St. George kill is estimated from small samples of canine teeth or by assuming the age classification of the male kill was the same as on St. Paul.

2/ Does not include Pribilof seals taken at sea or on Asian islands, plus 367 from St. George not classified.

Table 2. -- Percent age composition of male kill at various levels
St. Paul Island, 1954 - 1960

Date		Kill level	Age 3	Age 4
			Percent	Percent
1954	4 July	10,000	44	54
	11	20,000	49	49
	18	30,000	56	41
	27	50,000	65	31
1955	9 July	10,000	50	48
	16	20,000	54	44
	22	30,000	56	42
	31	50,000	62	36
1956	6 July	10,000	24	64
	11	20,000	30	62
	16	30,000	33	60
	26	50,000	41	52
1957	13 July	10,000	53	41
	24	20,000	63	33
	6 August	30,000	68	27
	10	34,055	69	26
1958	10 July	10,000	74	26
	18	20,000	78	22
	28	30,000	80	19
	31	33,325	82	17
1959	14 July	10,000	38	57
	26	20,000	44	51
	20 August	24,495	44	44
1960	22 July	10,000	81	16
	1 August	20,000	83	12
	7	28,819	84	10

Table 3. -- Cumulative number of male seals killed, St. Paul Island, 1955-1960

	1955		1956		1957		1958		1959		1960	
	Age											
Date	3	4	3	4	3	4	3	4	3	4	3	4
July												
1	1574	1962	1079	3056	1360	1071	1991	732	584	1474	699	368
6	3341	3643	2671	7060	2994	2161	3988	1383	1364	3028	1751	676
11	5929	6248	6145	12677	4507	3296	8038	2658	2625	4665	3274	988
16	10416	8999	9808	17954	6777	4651	12917	3912	4189	6425	5529	1385
21	15358	11648	14589	22159	9380	5602	17688	4839	6096	7949	7904	1717
26	21707	15638	20726	25999	13350	6784	22661	5279	8327	9721	10978	1968
31	30733	18083	26590	28560	16804	7547	27216	5556	10203	10446	15312	2347
August												
5			31701	29853	19823	8196	27454	5575	10263	10460	21610	2657
10			35502	30663	23473	8855	27863	5599	10326	10482	24201	2757
15			38290	31448					10491	10528	24283	2762
20									10671	10555		

1955 sealing ended 31 July
1956 " " 15 August
1957 " " 20 "
1958 " " 20 "
1959 " " 20 "
1960 " " 15 "

3- and 4-year-old males the following season, is now being used to estimate the 1961 St. Paul Island kill. Data for 2- and 3-year-old males killed between 27 June and 31 July, for the years 1955 through 1959, were plotted by the method of least squares. This provided two regression lines, one for each age, from which visual estimates of future kills could be made. The 31 July date was, until 1960, a close compromise between peak male kills and the termination date of male kills. Actual peak kills by year, for males age 2 and 3, were as follows:

Year	Age 2	Age 3
1955	31 July	29 July
1956	31 July	28 July
1957	5 August	27 July
1958	31 July	26 July
1959	31 July	28 July
1960	7 August	6 August

In 1960, the peak of the kill was about 8 to 10 days later than in the years 1955 through 1959. The effect of this change in timing upon estimates made from regression lines, derived from kills ending 31 July, is unknown. This change in 1960 has resulted in two estimates being made for the 3- and 4-year-old male kill in 1961. The first estimates for each age were obtained using the peak cumulative kills made in 1960, and the second estimates were made using the cumulative kills as of 31 July 1960. The estimate for the 3-year-old male kill in 1961, using the peak cumulative kill of 2-year-old males in 1960, is 34,500 (fig. 5). The cumulative kill of 2-year-old males as of 31 July 1960, when applied to the same regression line, shows the estimate for the 1961 3-year-old male kill to be 19,000.

Estimates for the 1961 4-year-old male kill are 13,500 and 5,500. The 13,500 kill estimate is obtained by applying the peak cumulative kill figure of 3-year-old males killed in 1960 to the regression line (fig. 6) and the 5,500 kill estimate is obtained by applying the cumulative 3-year-old male kill figure of 31 July 1960 to the regression line and reading the corresponding return value.

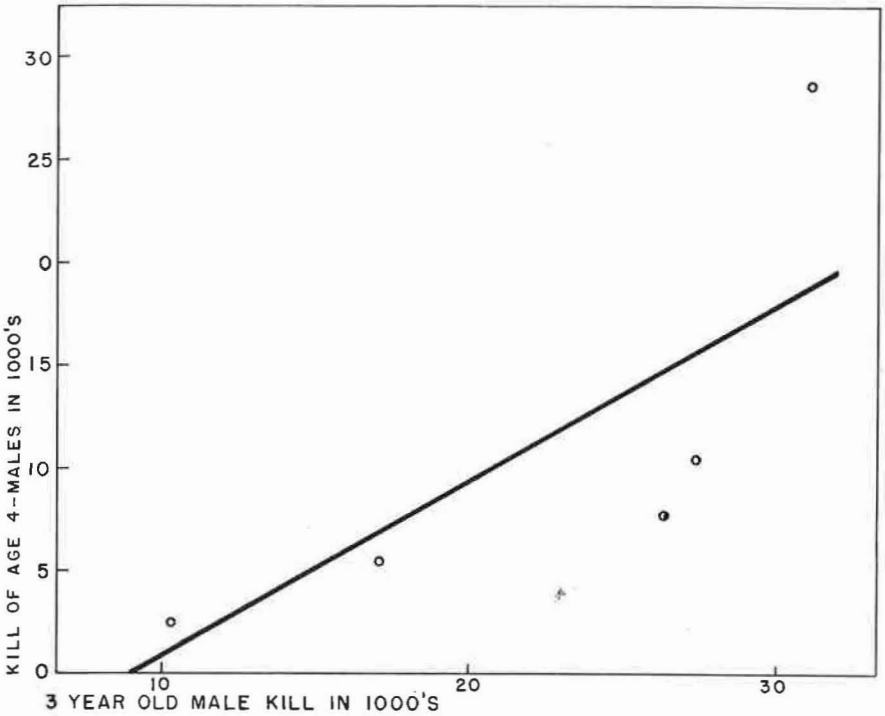


Figure 5.--Returns of males at age 3 vs. previous year's kill at age 2, St. Paul Island.

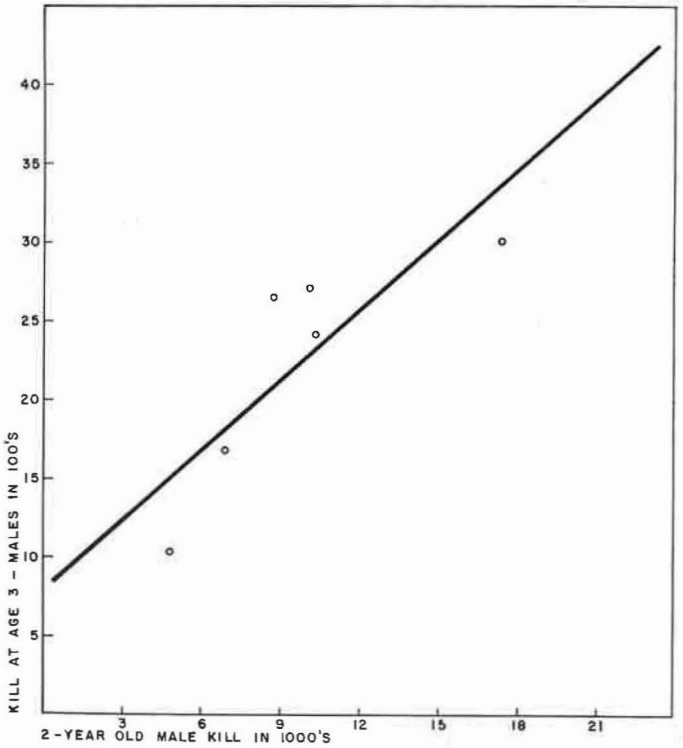


Figure 6.--Return of males at age 4 vs. previous year's kill at age 3, St. Paul Island.

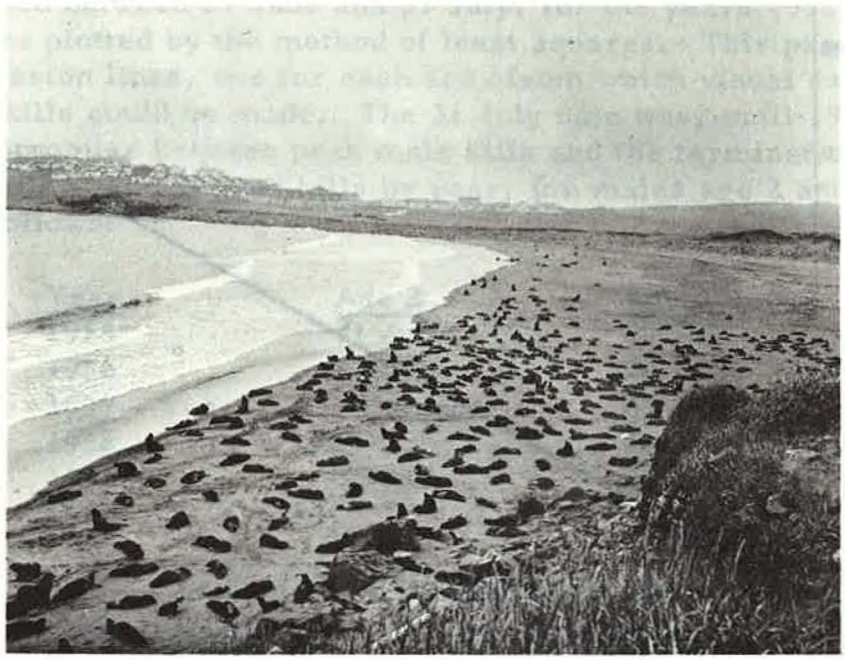


Figure 7.--Idle bulls on Zoltoi Sands, St. Paul Island, 10 July 1960.

Bull Counts

The 1960 bull counts are given in table 4 by island and by rookery. All bull counts since 1910 are presented in appendix table 32.

In total, the number of harem bulls increased by 2.1 percent of the 1959 count. Those on St. Paul Island increased 2.4 percent while those on St. George Island increased 1 percent.

Idle bulls decreased by 9.8 percent of the 1959 count. Unusually warm weather during part of the bull-counting period may account for this decrease. For example, a near record 62 degrees was recorded on 14 July, the day Zapadni rookeries were censused. The several hundred idle bulls were present as usual on the main Zapadni hauling ground prior to being driven into the water during the commercial sealing drive. Though these animals generally return in time to be included in the bull count, they did not do so on this day. Thus, only 175 idle bulls were present on the main Zapadni hauling ground this year as compared

Table 4. -- Harem and idle bull count, by rookery, Pribilof Islands, 1960

Date	Rookery	Bulls harem	Bulls idle	Total
St. Paul Island				
10 July	Gorbatch	881	820	1,701
	Ardiguen	141	98	239
	Reef	1,669	1,225	2,894
	Total	2,691	2,143	4,834
11 July	Polovina	351	1,025	1,376
	Polovina Cliffs	756	720	1,476
	Little Polovina	331	545	876
	Total	1,438	2,290	3,728
12 July	Morjovi	810	1,595	2,405
	Vostochni	1,587	1,669	3,256
	Total	2,397	3,264	5,661
13 July	Tolstoi	1,038	961	1,999
	Lukanin	211	256	467
	Kitovi	573	348	921
	Total	1,822	1,565	3,387
14 July	Zapadni	1,037	519	1,556
	Little Zapadni	570	315	885
	Zapadni Reef	292	311	603
	Total	1,899	1,145	3,044
St. Paul Island total		10,247	10,407	20,654
St. George Island				
15 July	East Reef	186	250	436
	East Cliffs	350	241	591
	Total	536	491	1,027
15 July	Staraya Artil	328	448	776
16 July	North	1,062	915	1,977
17 July	Zapadni	347	601	948
	South	279	175	454
	Total	626	776	1,402
St. George Island total		2,552	2,630	5,182
Pribilof Islands total		12,799	13,037	25,836

to 800 in 1959. Collectively, all three Zapadni rookeries showed a decrease of 979 (46 percent) idle bulls from 1959. The trend continued on St. George Island 15 July with a decrease in idle bulls of 22 percent on East Rookery and 17 percent on Staraya-Artil Rookery. Cooler weather prevailed during the census on the remaining rookeries. Idle bull counts on these rookeries were comparable to those of 1959. Idle bulls on Zoltoi Sands in July of 1960 are shown in figure 7. Weather does not visibly affect the stability of harem bulls during the active breeding season.

Females

Introduction

Five years of research into the problem of the impact of the large adult female population upon the productivity and stability of the Pribilof seal herd has helped create a general awareness that a problem exists. The low returns, beginning in 1957, brought the existence of the problem out much more clearly than it had been previously. There is not yet general agreement as to its cause or its solution.

Low survival from the large pup crops of recent years strengthened the basic theory that a maximum sustained yield with a minimum of fluctuation can be obtained only from a herd held slightly below the top of its growth potential. A land kill of females is the only satisfactory method of reducing the population to this level.

Approximately 140,000 females have been killed on the Pribilof Islands in the 5-year period, 1956-60. The first, 1956, was a test year in which it was to be learned how, when, and in what numbers females could be taken on land. Two early kills of females from harems were made; then harem raiding was abandoned.

The 27,599 females killed in 1956 were taken with a minimum size limit of 41 inches but no maximum limit. In 1957, a total of 47,413 females were taken within the same size restrictions as 1956. Parts of the harem areas on Polovina, Reef, and, to a limited extent, Northeast Point, were purposely used as sources for females. Many of the large skins from the older females taken from these and hauling-ground areas were subsequently found to be of low quality.

Excessive numbers of these skins were avoided in 1958 under the requirement that females be taken within the size limits set for males, 41 to 45-3/4 inches. None of the 31,101 females taken in 1958 were from harems. The 1959 sealing instructions planned for a kill of 50,000 females with as many as possible to be less than 46 inches in length. However, the limited number of females surviving to ages 3, 4, and 5 resulted in a kill of only 28,062. As in 1958, none of the females killed in 1959 were taken from harem areas.

During the 4-year period, 1956-59, studies of 27,154 genital tracts and accompanying canine teeth have provided basic reproduction and age data. Little year-to-year variation in pregnancy rates appeared at ages 3, 4, and 5, the ages for which the most adequate samples have been obtained. Depending upon the source of females, pregnancy rates varied considerably from sample to sample within older age groups. Samples from active harem females usually have a pregnancy rate in excess of 99 percent. The most productive age is about 7.

The 1960 commercial killing season began with plans to take 17,500 females. Of the total, 14,000 were to be taken on St. Paul Island and 3,500 on St. George Island. By mid-July, lack of males in expected numbers caused a decision to discontinue the female kill except for 350 per day, following cessation of male killing. The small female kill was requested to provide continuity of data for the program started in 1956. These females were to be obtained in the same manner and under the same size restrictions as would have applied to the original kill of 17,500.

Methods and Techniques used in Current Studies

Representative, unbiased, sampling is the most useful, single technique in the study of fur seals and also the most elusive. Sampling of the female component of the herd could provide an accurate basis for appraising its reproductive potential. Methods now used include sampling of teeth and genital tracts (approaching 20 percent of the commercial kill) for age determination and reproductive condition, tagging and tag-recoveries, and growth studies of seals as pups and when they return 3 and 4 years later. In 1958, laboratory sectioning of teeth from females classified as 9, 10 and 10+, by external growth ridges was adopted as a regular

procedure. Sectioning allows counts of the annual growth layers internally where they are more easily visible.

Age Classification

The 3,946 samples collected on both islands in 1960 came predominantly during the last 2 weeks of the season, 1-15 August. Age 5 (22 percent) was the most numerous group followed by the collective group classified as age 10+ (15 percent). Age compositions were similar on both islands. The poor return from the 1956 year class was reflected in the total number of age 4 females taken in 1960; they made up only 9 percent of the kill, a much lower proportion than in the samples of previous years. Also, the kill of age 3 females may have been less if age 3 females were late in arriving as were age 3 males. A minimum length limit prevents significant numbers of age 2 females from being taken. (See appendix tables 5 and 13 for female kill composition by age.)

The influence of year classes upon the female kill is shown in table 5.

Table 5.--Percent age composition of females sampled from commercial kill

1955 elus.

Year and island	Age									
	2	3	4	5	6	7	8	9	10	10+
1958										
St. Paul	2	37	29	13	11	3	1	1	2	1
St. George	1	20	22	17	13	9	4	3	2	9
1959										
St. Paul	1	6	25	14	11	12	6	4	4	17
St. George	-	6	20	14	10	13	7	6	5	19
1960										
St. Paul	1	8	14	23	14	9	8	7	4	12
St. George	-	3	9	20	12	8	10	9	5	24

The largest age group has shifted annually from age 3 in 1958 to age 5 in 1960. Thus, a large part of the kill, since 1957, has been taken from the 1955 year class. Table 6 shows the number

1955 also strong as shown by tag returns from Russian Islands in 1959 and in 1960. See Table I.

This table will be revised.

Table 6.--Year class contributions to kill by age[1/], of female seals on the Pribilof Islands

Approximations.

Year class	Age 2	3	4	5	6	7	8	9	10	10+	Total
1937	-	-	-	-	-	-	-	-	-	24	24
1938	-	-	-	-	-	-	-	-	17	-	17
1939	-	-	-	-	-	-	-	8	-	37	45
1940	-	-	-	-	-	-	16	-	15	53	84
1941	-	-	-	-	-	15	-	7	15	202	239
1942	-	-	-	-	12	-	13	7	39	175	246
1943	-	-	-	3	-	8	10	41	37	-	99
1944	-	-	4	-	11	9	57	43	38	-	162
1945	-	-	-	4	8	44	46	11	63	3540	3716
1946	-	-	4	4	60	62	11	20	2732	10125	13018
1947	-	-	1	30	115	46	26	1133	1773	770	3894
1948	-	-	80	156	94	64	1764	3120	678	5682	11638
1949	-	-	61	161	106	2144	3550	559	1172	1833	9586
1950	-	20	92	195	2934	4031	654	1289	301	-	9516
1951	-	8	73	4600	6343	1328	1957	429	-	-	14738
1952	-	13	6394	11465	3408	3516	442	-	-	-	25238
1953	-	2118	5800	4056	2958	409	-	-	-	-	15341
1954	128	1150	8493	3771	583	-	-	-	-	-	14125
1955	-	11468	7281	925	-	-	-	-	-	-	19674
1956	601	2063	554	-	-	-	-	-	-	-	3218
1957	422	293	-	-	-	-	-	-	-	-	715
1958	78	4	-	-	-	-	-	-	-	-	82
1959	14	-	-	-	-	-	-	-	-	-	14.

Should be a 1 year old column

1??

1/ Includes pelagic kill of United States and Canada.

of females killed by age and year class. It is expected that future kills will be dominated by 3- and 4-year-olds. When a year class reaches age 6 and older, accurate knowledge of its productivity and estimates of its abundance cannot be obtained with current size restrictions and the fact that harem females are no longer taken.

Ages 2 through 5 made up 46 percent of the kill on St. Paul Island in each of the years 1959 and 1960. Corresponding figures for these ages in the St. George Island kill were 40 and 32 percent.

Reproduction

Reproductive condition was determined for a sample of 2,946 females on St. Paul Island and 1,000 females on St. George Island. In general, pregnancy rates were higher on St. Paul Island and lower on St. George Island than in 1959. A summary of pregnancy rates, by age and island, shows the annual variations, table 7.

Table 7.--Annual variations in pregnancy rates, by age

	St. Paul Island					St. George Island				
Age	1956	1957	1958	1959	1960	1956	1957	1958	1959	1960
	Percent pregnant									
4	10	13	6	15	12	12	5	10	22	15
5	57	53	48	59	56	52	36	43	62	56
6	74	78	65	61	72	81	58	61	66	59
7	76	81	72	57	66	83	64	56	69	52
8	61	75	65	54	57	72	62	65	75	59
9	63	73	68	43	66	64	57	60	61	51
10	51	74	61	48	51	69	46	64	60	67
10+	36	51	35	39	49	53	51	45	51	45

Pregnancy rates for all ages have varied within what appears to be rather stable limits for each age according to conditions under which the herd presently exists. Stability, in this respect, is not categorized as either harmful or beneficial but simply viewed as no measurable change. No significant change in pregnancy rate accompanied the shift in dominant age groups in the sample. Considering that the pregnancy rate of the small Asian seal herds is apparently higher than that of the Pribilof herd, a higher rate for small year classes might seem possible. However, a single year-class probably has little influence on the female component as a whole.

Results of efforts, by both the United States and Canada, to provide a guide for field identification of reproductive conditions are not yet in usuable form. A redistribution of the work load is planned, whereby gaps in Canadian data can be filled by utilizing ovarian material from United States pelagic collections. An effort is being made to prepare United States 1960 material for analysis by early 1961.

The 1960 data agree with previous evidence that peak reproductive capacity is reached at ages 6, 7, and 8, followed by a decline. Tables 8 and 9 summarize the reproductive condition of female samples from St. Paul Island and St. George Island, respectively.

The 1960 reproductive condition of female seals, by round and age, for both islands is shown in figures 8 and 9. The similarity to the data for 1956 through 1959 is striking, although the proportion of females taken from hauling grounds and harems has varied.

A 4-year-old female examined 19 August 1959 on Reef Rookery showed evidence of simultaneous pregnancy in both uterine horns. Microscopic analysis of the tissue, by William Shapeero, has confirmed the original findings. This was the first recognized postpartum animal that had delivered twins on land. Though unconfirmed by microscopic methods as yet, a 6-year-old female taken on Tolstoi Rookery 2 August 1960 appeared to have delivered twins also.

A female examined 13 August 1960 on Little Zapadni Rookery, St. Paul Island, was carrying a fetus in the abdominal cavity. The fetus was full term in size; its head was in the anterior portion of the cavity. The female was in poor physical condition and there was no outward indication of pregnancy.

Tag Recoveries and Tagging

Tag Recoveries

Tagged seals were killed only if they were within the prescribed size limits for the kill. Table 10 lists 1960 tag recoveries by sex, age, and island. A female, age 19, bearing tag number USA 6683 was taken 30 August 1960, as one of four tagged females collected primarily for tissue study.

Tagging-1960

As agreed at the third North Pacific Fur Seal Commission meeting, 60,000 pups were tagged instead of the usual 50,000. Twenty percent (12,000) of the tags were attached to pups on St. George Island while the remainder (48,000) were used on St. Paul Island. Following standard procedure, tags were allotted to each

Table 8.--Summary of reproductive condition of female seals sampled from commercial kill, by age, St. Paul Island, 1960

Reproductive condition	Age 2	3	4	5	6	7	8	9	10	10+	Total
Nullipara											
number	18	245	361	235	29	14	5	1	1	2	911
percent	100	99	86	35	7	5	2	-	1	1	31
Primipara											
Pregnant											
number	-	2	43	261	116	37	17	10	3	2	491
percent	-	1	10	39	28	14	7	5	2	1	17
Nonpregnant											
number	-	-	6	32	32	17	15	1	-	1	104
percent	-	-	1	5	8	7	6	-	-	-	3
Multipara											
Pregnant											
number	-	-	6	119	186	136	118	118	60	170	913
percent	-	-	1	17	44	52	50	61	49	48	31
Nonpregnant											
number	-	-	7	26	56	56	82	65	59	176	527
percent	-	-	2	4	13	22	35	34	48	50	18
Total	18	247	423	673	419	260	237	195	123	351	2946
Percent	1	8	14	23	14	9	8	7	4	12	
Percent pregnant	-	1	12	56	72	66	57	66	51	49	

All females	number	percent
Pregnant	1,404	48
Nonpregnant	1,542	52
Total	2,946	

Primipara and multipara females	number	percent
Pregnant	1,404	69
Nonpregnant	631	31
Total	2,035	

Sample size in percent of kill: 89

Table 9.--Summary of reproductive condition of female seals sampled from commercial kill, by age, St. George Island, 1960

Reproductive condition	Age 3	4	5	6	7	8	9	10	10+	Total
Nullipara										
number	24	70	46	12	4	2	4	-	3	165
percent	85	74	23	10	5	2	5	-	1	16
Primipara										
Pregnant										
number	2	10	58	14	4	6	2	-	3	99
percent	7	11	30	12	5	6	2	-	1	10
Nonpregnant										
number	1	7	8	5	1	4	1	-	3	30
percent	4	7	4	4	1	4	1	-	1	3
Multipara										
Pregnant										
number	-	4	52	56	39	53	44	33	105	386
percent	-	4	26	47	47	53	49	67	44	39
Nonpregnant										
number	1	4	33	32	35	35	39	16	125	320
percent	4	4	17	27	42	35	43	33	53	32
Total	28	95	197	119	83	100	90	49	239	1000
Percent	3	9	20	12	8	10	9	5	24	
Percent pregnant	7	15	56	59	52	59	51	67	45	

All females	number	percent
Pregnant	485	48
Nonpregnant	515	52
Total	1000	

Primipara and multipara females	number	percent
Pregnant	485	58
Nonpregnant	350	42
Total	835	

Sample size in percent of kill: 98

Table 10.--Summary of tagged and tag-lost seals recovered by sex and age, Pribilof Islands, 1960

Series	Age	Tagged seals St. Paul	Tagged seals St. George	Tagged seals combined total	Tag-lost seals St. Paul	Tag-lost seals St. George	Tag-lost seals combined total	Grand total
				Male				
K	2	115	20	135	14	-	14	149
J	3	1,221	257	1,478	461	48	509	1,987
I	4	146	46	192	48	7	55	247
H	5	6	4	10	-	-	-	10
Total		1,488	327	1,815	523	55	578	2,393
				Female				
J	3	3	2	5	12	-	12	17
I	4	14	2	16	8	1	9	25
H	5	34	-	34	13	1	14	48
G	6	7	-	7	4	-	4	11
F	7	1	-	1	3	-	3	4
E	8	12	-	12	3	-	3	15
D	9	-	-	-	-	-	-	-
CS	11	2	-	2	-	-	-	2
B	12	7	-	7	-	-	-	7
A	13	-	-	-	1	-	1	1
Total		80	4	84	44	2	46	130

rookery according to the proportion of harem bulls counted on that rookery. A list of tagging locations and number of pups tagged at each is given in table 11.

All tags used in 1960 were of monel metal (style 19M, National Band and Tag Company, Newport, Kentucky, 0.9 x 9.5 x 101 mm. before folding) and had the series designation "M" stamped ahead of the number. The series designation and number were stamped on the clinch side of the tag, which is uppermost when in place on the pup. This permits a visual check of the clinch by the operator and prevents excessive wear of identifying letters and numbers. The lettering (Notify F. & W. Service, Washington, D. C.) was changed in 1960 to (Notify F. & W. Service, Seattle, Wash.). As in 1959,

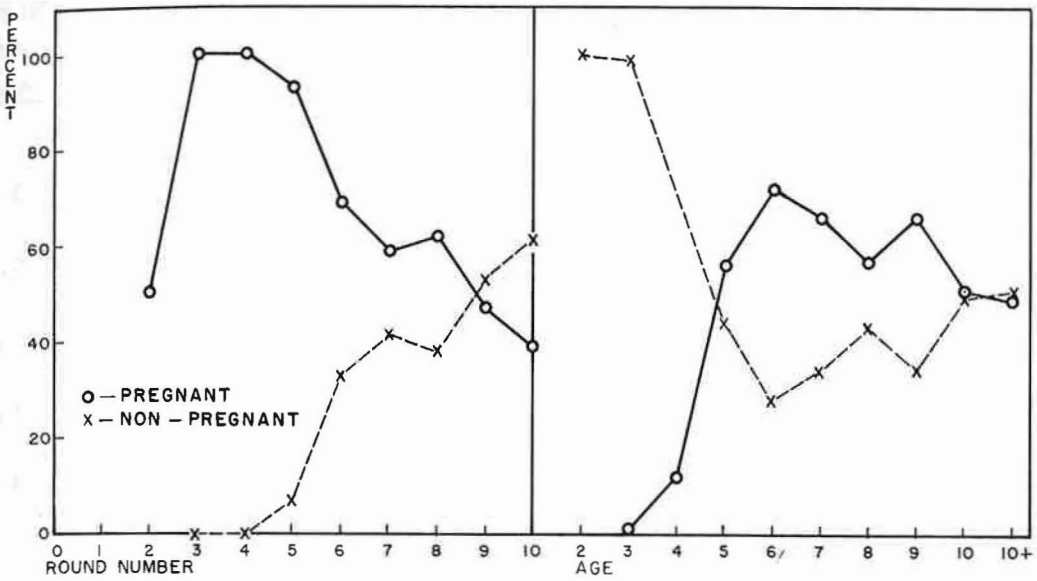


Figure 8.--Reproductive condition of female seals sampled from commercial kill, by round and age, St. Paul Island.

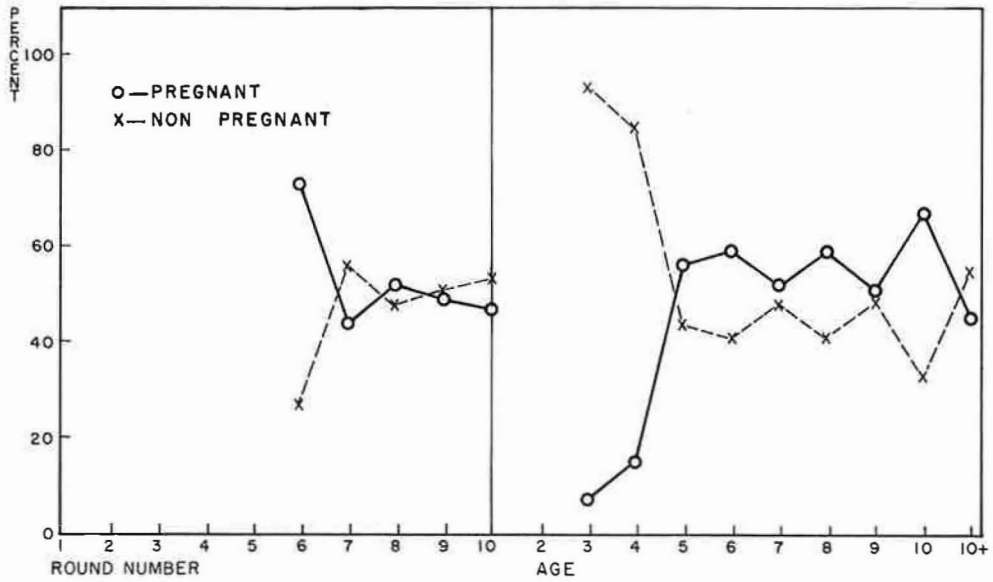


Figure 9.--Reproductive condition of female seals sampled from commercial kill, by round and age, St. George Island.

Table 11.--Seal tagging on the Pribilof Islands, 1960

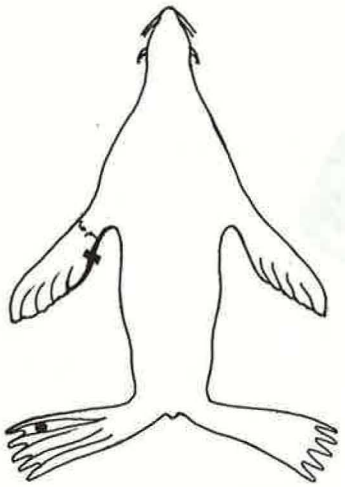
Date	Rookery	Percent	Number and series allotment	Tags spoiled	Number seals tagged
		St. Paul Island			
1, 2 and 3 September	Reef	26.3	12,600 M20901-33500	-	12,600
30 August 1 September	Polovina	10.9	5,200 M33501-38700	-	5.200
22 August	Little Polovina	3.1	1,500 M38701-40200	-	1,500
31 August 1 September	Northeast Point	23.3	11,200 M40201-51400	4	11,196
23 and 29 August	Tolstoi	10.2	4,900 M51401-56300	-	4,900
29 and 30 August 1 September	Lukanin-Kitovi	7.7	3,700 M56301-60000	-	3,700
23 and 29 August	Zapadni	10.2	4,900 M12001-16900	3	4,897
18 August	Zapadni Reef & Little Zapadni	8.3	4,000 M16901-20900	4	3,996
		Total		11	47,989
		St. George Island			
August					
20	Zapadni	24.2	2,900 M 1-2900	1	2,899
21	North	41.7	5,000 M7001-12000	3	4,997
21	Staraya	13.3	1,600 M2901-4500	4	1,596
20	East	20.8	2,500 M4501-7000	-	2,500
		Total		8	11,992
		Grand total		19	59,981

Figure 10.--Tag used in fur-seal tagging program showing lettering in relation to clinch side of tag (clinched length: 42 mm.).

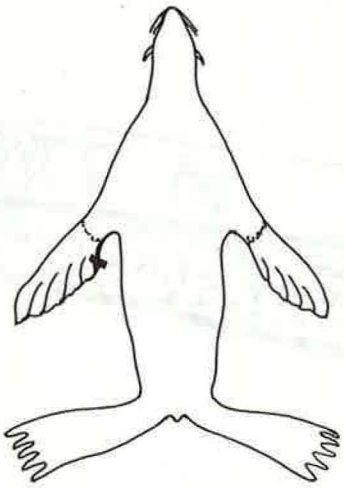
the lettering was stamped inside the tag, providing protection from wear (fig. 10). Tags applied in 1960 were attached to the rear edge of the right fore flipper where the fur meets the bare black skin. To permit identification of individuals that have lost their tags, 1/2 inch to 3/4 inch of the tip of the same flipper was cut off. Tag and check mark locations on fur-seal pups tagged since 1947 are shown in figure 11.

Fifty-thousand pups appear to be the maximum number that can be handled satisfactorily. Application of the extra 10,000 tags in 1960 caused considerable disturbance on parts of some rookeries because it was necessary to drive these areas several times to obtain sufficient numbers of pups. From this experience, however, it was noted that continual shifting of pups between land and water's edge occurs.

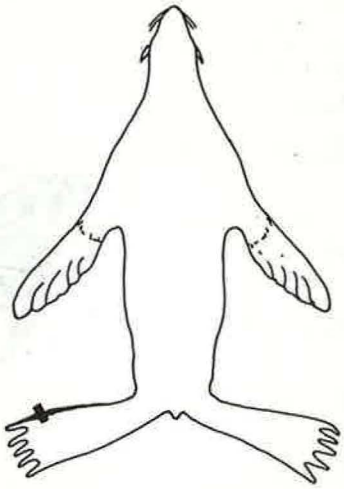
Tagging began 16 August on St. George Island and was completed 19 August, before arrival of the annual supply ship. On St. Paul Island, tagging began 18 August. Completion was delayed until 3 September, primarily because of preparation for a differential mortality study of tagged and untagged pups. Approximately 8 full days were required to tag the 48,000 pups on St. Paul Island.



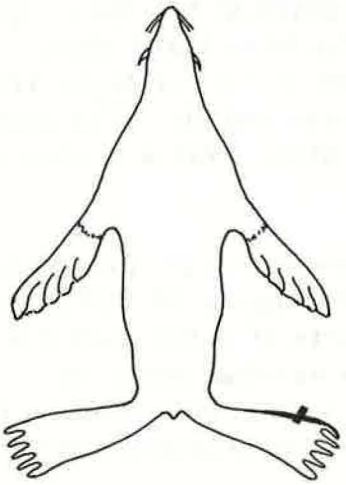
Series: A - 1947
Tag location: left front flipper
Check mark: 1/4" hole in hind left flipper
Number tagged: 19183



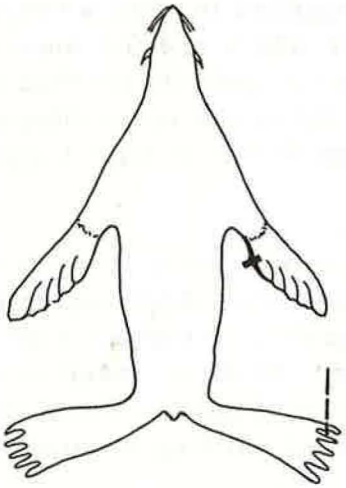
Series: B - 1948
Tag location: left front flipper
Check mark: none
Number tagged: 19532



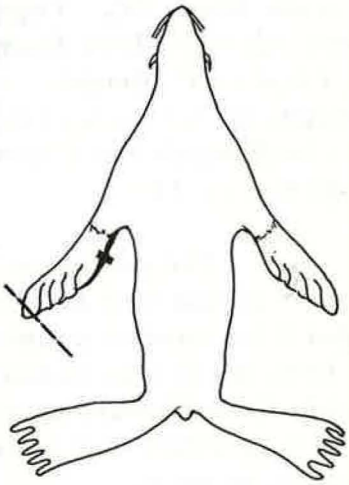
Series: CS - 1949
Tag location: left hind flipper
Check mark: none
Number tagged: 19960



Series: D - 1951
Tag location: right hind flipper
Check mark: none
Number tagged: 1000

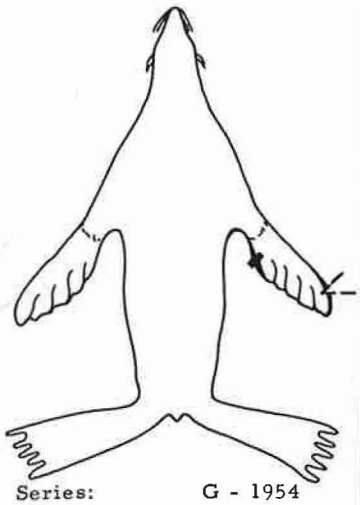


Series E - 1952
Tag location: right front flipper
Check mark: tip of digit on right hind flipper sliced off
Number tagged: 19979

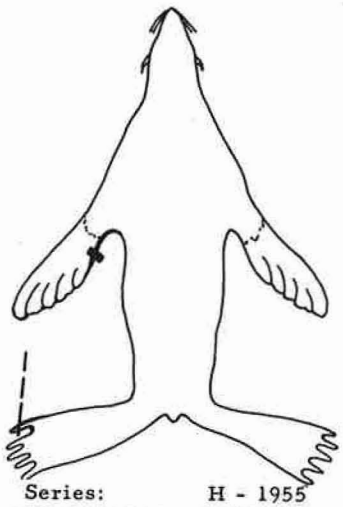


Series F - 1953
Tag location: left front flipper
Check mark: tip of left front flipper sliced off
Number tagged: 10388
G-1953 7001-7400

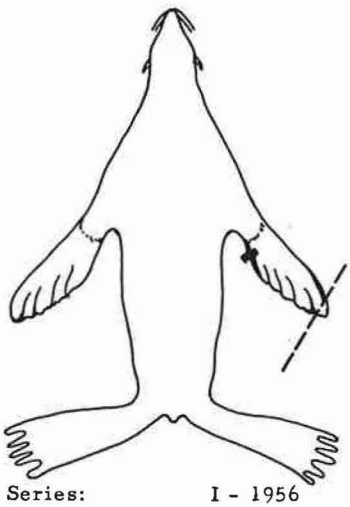
Figure 11.--Tag and check-mark locations, fur-seal pup tagging, Pribilof Islands, 1947-1960.



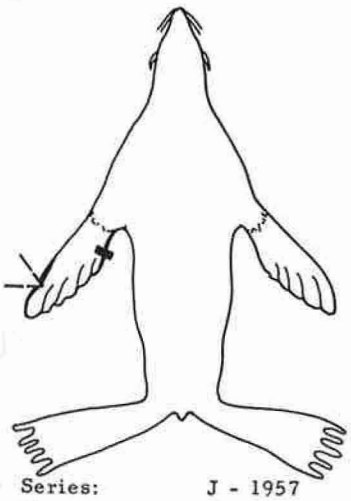
Series: G - 1954
Tag location: right front flipper
Check mark: "V" notch on right front flipper
Number tagged: 10000



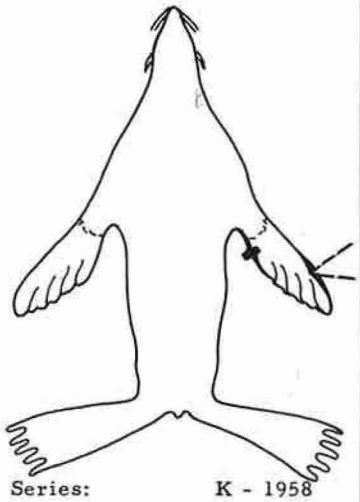
Series: H - 1955
Tag location: left front flipper
Check mark: tip of digit on left hind flipper sliced off
Number tagged: 49,870
H-1955 1-10000
No letter 10001-50000



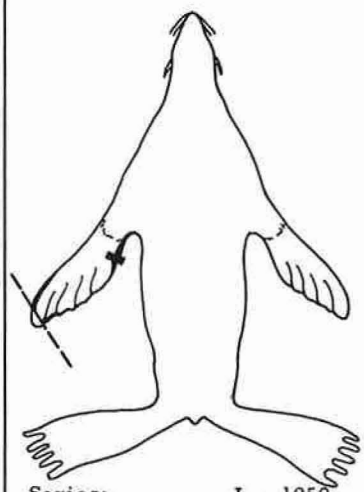
Series: I - 1956
Tag location: right front flipper
Check mark: tip of right front flipper sliced off
Number tagged: 49794



Series: J - 1957
Tag location: left front flipper
Check mark: "V" notch on left front flipper
Number tagged: 49842



Series: K - 1958
Tag location: right front flipper
Check mark: "V" notch on right front flipper
Number tagged: 49917



Series: L - 1959
Tag location: left front flipper
Check mark: tip of left front flipper sliced off
Number tagged: 49881

Figure 11.--Tag and check-mark locations, fur-seal pup tagging, Pribilof Islands, 1947-1960 (con.).

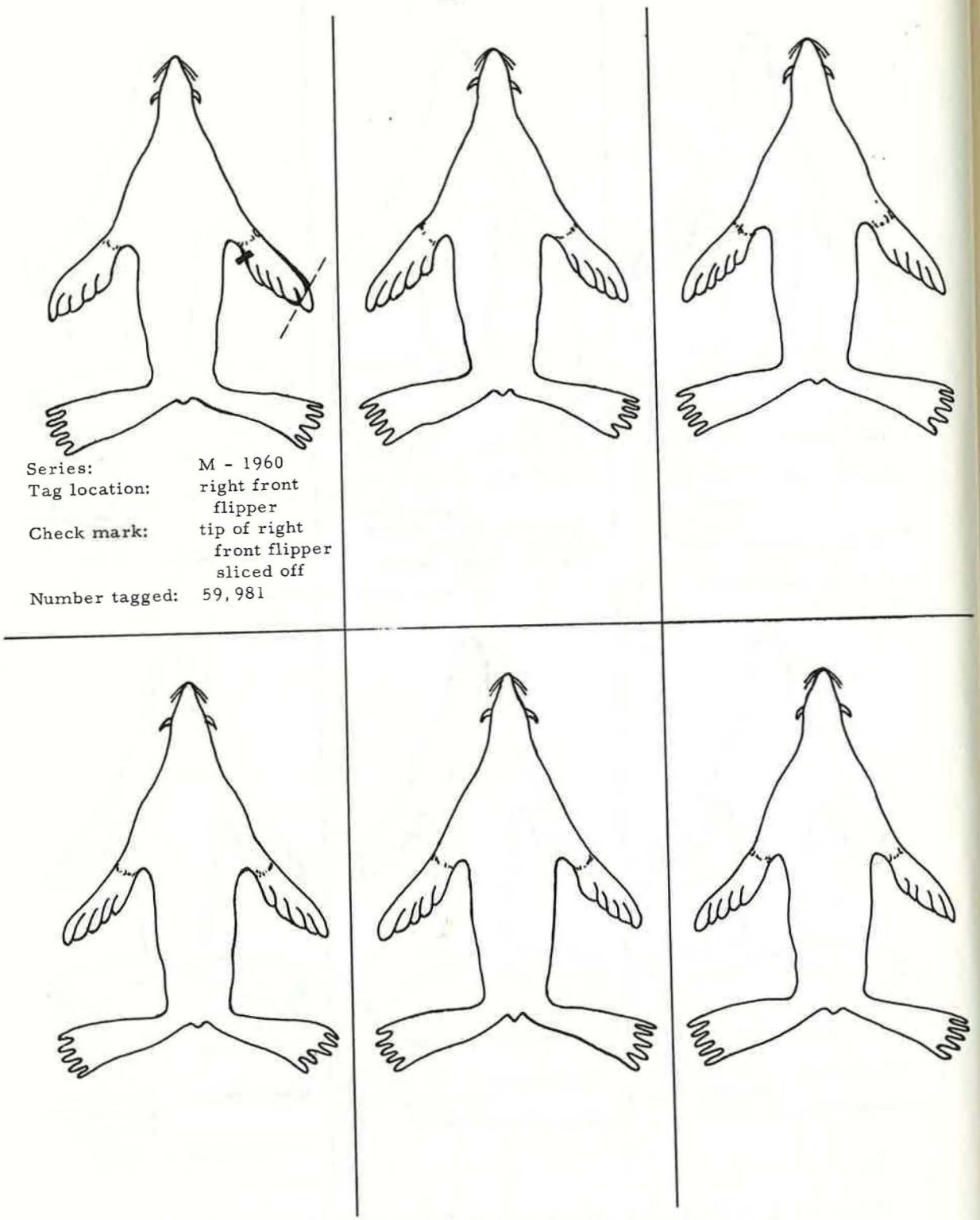


Figure 11.--Tag and check mark locations, fur-seal pup tagging, Pribilof Islands, 1947-1960 (con.).

Appraisal of Problems Involved in Tagging and Tag Recoveries

Several factors that might affect population estimates were listed in the 1959 report. Following are the current results of studies being made of these problems.

Mortality differential between sexes.--Reliable information on this subject is difficult to obtain. Presumably, the best source would be from the pelagic take, since it covers the period to age 3 when the heaviest mortality occurs. However, the data collected to date is inconclusive because of inadequate representation of younger age classes.

Segregation by sex at time of tagging.--The 8,522 tags recovered during the years 1956-59 from E, F, G, H, and I series were analyzed by Dr. D. G. Chapman to determine whether segregation by sex exists at time of tagging. The results of this analysis are given here because the evidence points not only to lack of segregation for most of the series but to equal mortality of the sexes on land as well. Of 2,047 fetuses collected pelagically in 1958 and 1959, males numbered 1,035 or slightly over half.

Each series of tags was grouped according to the serial order of the tag numbers. The number of male and female tag recoveries was determined for each group and a chi-square test of homogeneity applied to the groups within each series. The results in table 12 show that the E series were heterogeneous while the others were homogeneous, especially the F and H series. The series E recoveries were further analyzed by groups of 500 and 5,000. The hypothesis of homogeneity of returns by sex was rejected for both groupings (chi square = 119.19, $P < .001$ and chi-square = 27.54, $P < .001$, respectively). The proportions of male recoveries in the four groups of 5,000 indicate a deficiency of males in the early tag numbers and an excess later. Other series do not show this, but on the contrary, are strikingly homogeneous.

Application of tags.--Observations during tagging and limited examination of dead tagged pups showed that tags are attached reasonably near the correct position. This has been given in previous reports as 1/2 inch to 3/4 inch forward of the rear edge of the flipper in the fur near the juncture of furred and bare skin.

Application of check mark.--Figure 12 illustrates the varied appearance of the "V" notch check mark on flipper tips taken from J-series tagged seals. Check marks on those in the upper row are easily recognized. Those in the center row were cut too near the tip and, as a result, may be confused with the ragged appearance exhibited by many seals. The faint type of check mark is shown in the lower row. Of the 97 overlooked check marks, this type appeared most frequently.

Table 12.--Chi-square tests of homogeneity of sexes among 8,522 tag recoveries from the E, F, G, H, and I Series, Pribilof Islands, 1956-1959

Tag series	Number tagged	Group size	Number of groups	Mean ♂ recoveries per group	Mean ♀ recoveries per group	Chi-square	Probability level
E	20,000	100	200	6.61	4.89	292.74	<.001
F	9,600	100	96	7.89	2.40	36.37	1.000
G	10,400	100	104	4.78	2.64	94.67	.710
H	50,000	100	500	5.57	1.81	398.85	.999
I	50,000	2,000	25	27.64	3.44	32.71	.120

Figure 13 shows "V" notch check marks that were made too high on the flipper. However, this type is rare. Figure 14 illustrates the "slice" type of check mark.

Effects of Tagging

Following the killing season, two of the smaller rookeries were cleared of dead pups so that a check might be made on the ratio of dead tagged and untagged pups after tagging. Zapadni Reef was cleared 17 August and 2,915 pups were tagged 18 August, while on Little Polovina, the dead were removed 21 August and 1,500 pups tagged on 22 August.

The raw data is presented in table 13. Though there is no indication that tagging causes an increase in mortality, additional work on this aspect is needed before final conclusions can be drawn. A somewhat more detailed analysis is presented by Dr. D. G. Chapman in appendix A.

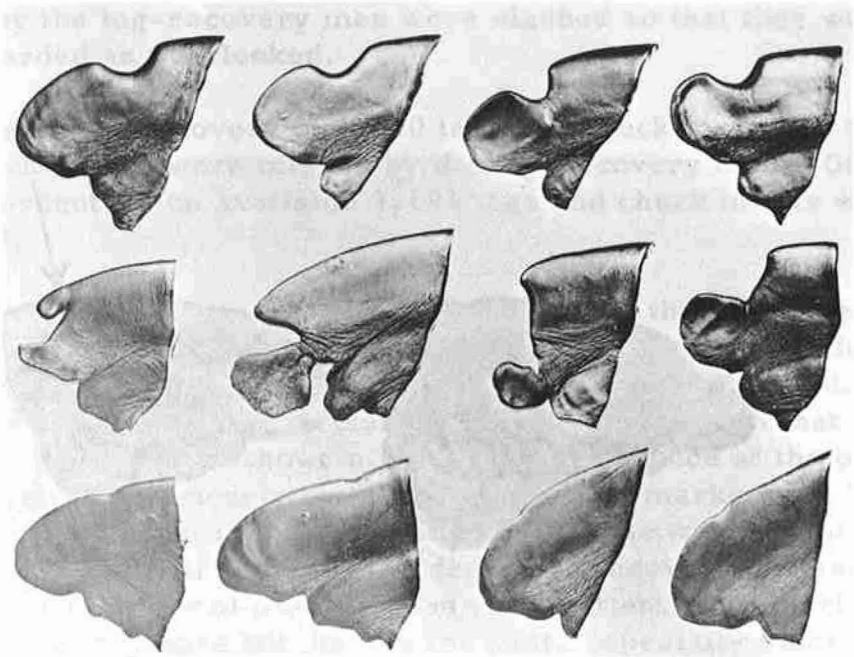


Figure 12.--Variances in check marks on J Series tagged seals.

Table 13.--Mortality of tagged and untagged pups after tagging, Zapadni Reef and Little Polovina rookeries, St. Paul Island, 1960

Date examined	Zapadni Reef dead tagged	Zapadni Reef dead untagged	Little Polovina dead tagged	Little Polovina dead untagged
22 August	57	47	-	-
26 "	18	15	4	39
30 "	17	22	1	25
3 September	7	8	2	17
Total	99	91	7	81

Tag-lost Animals

Through most of the 1960 season on St. Paul Island, all carcasses were re-examined in a search for tags or check marks overlooked by the tag-recovery men. Flippers with check marks

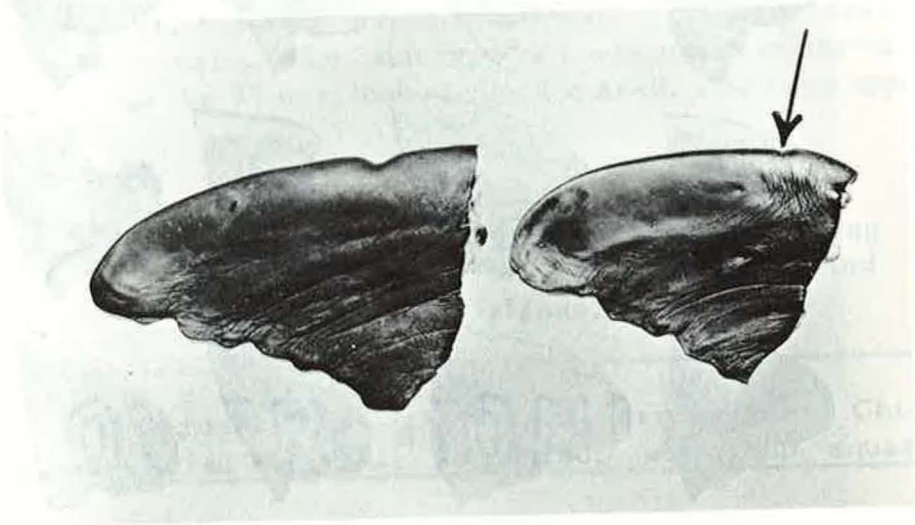


Figure 13.--Check marks placed too far from flipper tip.

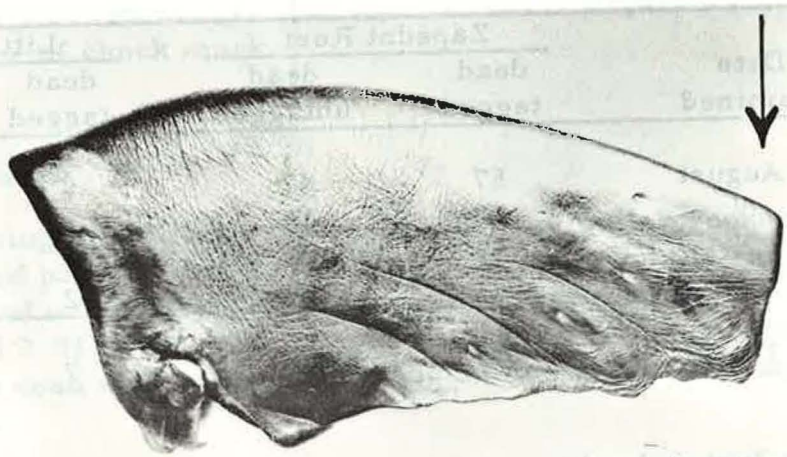


Figure 14.--Slice type check mark.

recorded by the tag-recovery men were slashed so that they would not be recorded as overlooked.

During the recovery of 1,590 tags and check marks, 4 tags and 97 check marks were missed by the tag-recovery men. On this basis, 6 percent of the available 1,691 tags and check marks were overlooked.

An analysis by Dr. D. G. Chapman shows that the difference between the 1956 and 1957 year class tag-lost to tagged ratio for St. Paul Island in 1960 is not significant (chi-square = .5, 1 d.f., P = .84). However, a comparison of the 1960 ratio, with that of 1959 on St. Paul Island, shows a significant difference at the one-percent level. Since nearly twice as many check marks were "recovered" in 1960 as in 1959, it is possible that the weighing of tagged animals in 1960 stimulated a higher degree of recovery efficiency. Certainly a good many of the workmen called attention to marked animals which they have not done in the past, especially since they knew they had to be weighed prior to being bled.

Results of this analysis may be found in more detail in appendix A.

Homing Tendency

Homing tendency of tagged male and female seals is shown in table 14 by rookery and in table 15 by age.

Male seals from Reef Rookery continue to maintain the highest straying record, as shown by tag recoveries. This agrees with the relatively small kill from Reef Rookery, though it is the largest rookery on St. Paul Island. Zapadni rookeries receive the largest percentage of Reef-tagged males. This figure averaged 36 percent for the past 5 years, increasing annually from 29 percent in 1956 to 45 percent in 1960. This annual increase indicates a continuing closure of the hauling grounds on Reef Rookery to young males by harem bulls.

Table 14.--Homing tendency of male and female seals, by rookery, Pribilof Islands, 1960

Rookery of tagging	Males			Females		
	Total recoveries	Recovered home rookery number	Recovered home rookery percent	Total recoveries	Recovered home rookery number	Recovered home rookery percent
			St. Paul			
NEP	403	280	69	9	8	89
TOL	165	50	30	6	5	83
L-K	112	29	26	2	-	-
ZAP-1	295	177	60	17	10	59
REEF	316	71	22	22	18	82
POL	205	96	47	25	21	84
			Mean			Mean
Total	1,496	703	47	81	62	76
			St. George			
ZAP-2	64	27	42	1	-	-
NOR	108	53	49	2	2	100
EAST	96	50	52	-	-	-
STAR	51	14	27	-	-	-
			Mean			Mean
Total	319	144	45	3	2	67

Seal-pup Weights

Objective

For the fourth consecutive year, live seal-pup weights were taken on St. Paul Island in 1960. These data are being collected to provide a condition factor that may be related to survival. Mean weight changes in pups from year to year may show some correlation with the numbers of an age class harvested three and four years later.

Table 15.--Homing tendency of male and female seals, by age, Pribilof Islands, 1960

Males				Females			
		Recovered home rookery				Recovered home rookery	
Age	Total recoveries	number	percent	Age	Total recoveries	number	percent
2	135	75	56	3	5	3	60
3	1478	670	45	4	16	12	75
4	192	100	52	5	34	27	79
5	10	2	20	6	7	5	71
				7	1	-	-
				8	12	9	75
				11	2	2	100
				12	7	6	86

Weights of tagged males and females in the commercial kill were taken in 1960 to check for weight changes by year, and to determine if a correlation exists between mean pup weights and mean weights of the same year class as subadults of various ages.

Procedure

Three hundred pups were weighed at Northeast Point, Polovina, Zapadni Reef, and Reef rookeries. The equipment and methods outlined in the 1959 report were used in 1960. Weight, to the nearest two-tenths (2/10) of a kilogram, sex, location, time, and tag number (if tagged) were recorded for each pup. Appendix table 34 lists the tag numbers and corresponding weights of the tagged pups, by rookery and by sex.

As in 1958 and 1959, weighing was done 1 and 2 September. Since growth of the pups is rapid, weighing should be done on or as close as possible to these days each year. Weighing in 1957 was accomplished 30 and 31 August.

Results

The 1960 sample was made up of 49 percent males and 51

percent females. The mean weight for tagged and untagged pups of both sexes increased slightly over 1959, with an over-all increase of 5.7 percent. Males ranged from 3.2 to 17.4 kg., while the range for females was 2.8 to 18.8 kg. Table 16 lists mean weights, by rookery and sex, for tagged and untagged pups. Table 17 compares the average weights of pups for the years 1957 to 1960.

Table 16.--Seal-pup weights, St. Paul Island, 1960

	Number		Mean weight (kg.)	
Rookery	male	female	male	female
Tagged pups				
NEP	9	17	8.7	8.3
POL	62	68	9.9	8.8
ZAP-REEF	91	116	8.7	8.1
REEF	48	51	9.2	8.6
Total	210	252	9.2	8.4
Untagged pups				
NEP	146	128	9.6	9.2
POL	79	89	9.8	8.9
ZAP-REEF	52	40	8.9	8.2
REEF	95	106	10.4	9.3
Total	372	363	9.8	9.1
All pups				
NEP	155	145	9.6	9.1
POL	143	157	9.8	9.0
ZAP-REEF	143	157	8.8	8.2
REEF	143	157	10.0	9.1
Total	584	616	9.6	8.8

Body Measurements of Tagged Subadult and Adult Seals

The first returns from two years of pup weighing (1957 and 1958) were weighed and measured in 1960 as tagged 2- and 3-year-old animals. Although other tagged seals were measured and weighed, statistical analyses were based solely upon males in ages 2, 3, and 4 because all other age groups, including all females, were poorly represented.

Table 17.--Seal-pup weights, 1957-1960

Group	Sample size				Mean weight (kg.)			
	1957	1958	1959	1960	1957	1958	1959	1960
Males								
tagged	262	-	182	211	7.9	-	9.0	9.2
untagged	391	-	444	372	8.7	-	9.4	9.8
combined	653	127	626	584	8.4	11.4	9.3	9.6
Females								
tagged	196	-	188	254	7.4	-	8.0	8.4
untagged	351	-	386	363	7.7	-	8.1	9.1
combined	547	121	574	616	7.6	9.9	8.1	8.8
Both sexes								
tagged	458	-	370	465	7.7	-	8.5	8.8
untagged	742	-	830	735	8.2	-	8.8	9.4
combined	1200	248	1200	1200	8.0	10.7	8.7	9.2

The method of handling animals during the kill was developed in 1959 but not tested until 1960. A two-wheeled carriage supporting a scale, cradle, and ramp was assembled (fig. 15). The technique used proved to be simple and efficient. The animal to be processed was pulled up the ramp onto the cradle and the weight read directly from the dial in kilograms, to the nearest tenth. The standard length measurement, to the half centimeter, was read from a tape fixed to the cradle. Using a steel tape, the girth measurement was taken around the body posterior of the fore flippers, to the nearest half centimeter. The three measurements were taken on 1,672 animals during the 1960 season with no disruption in the killing routine. These measurements provided, for the first time, data in sufficient quantity to study the inter-relationships of length, weight, and girth. Also available for comparison are the field (management) and research lengths. These relationships were statistically analyzed by the EDP Center, University of Washington, using programs devised by the Biometrics Section, North Pacific Salmon Investigation, Bureau of Commercial Fisheries, Seattle, Washington.

Four variants were analyzed: inch-length measurement, centimeter-length measurement, body weight in kilograms, and girth-centimeter measurement. The mean and standard deviation values for each variant were calculated by day, round, and season

total. Further analysis provided a correlation coefficient factor for the six paired values of the four variants.

The values for mean inch and centimeter measurements were quite close on a seasonal basis for males in ages 2, 3, and 4; yet the correlation coefficients were markedly low for the same group of animals.

Table 18 lists the correlation coefficients by round, season, and age. Table 19 lists the mean values of the four variants by round, season, and age.

Table 18.--Correlation coefficients for four variants, known-age males, St. Paul Island, 1960

Age	Paired variants	Round 1	2	3	4	5	6	7	8	8	10	Season
2	In/Cm.	-	-	-	-	.56	.66	.51	.46	.52	-	.47
	In./Wt.	-	-	-	-	.75	.31	.49	.38	.58	-	.46
	In./Girth	-	-	-	-	.61	.27-	.25	.03	.45	-	.15
	Cm./Wt.	-	-	-	-	.44	.36	.53	.41	.82	-	.54
	Cm./Girth	-	-	-	-	.38	.23	.13	.02	.45	-	.16
	Wt./Girth	-	-	-	-	.90	.56	.56	.72	.73	-	.65
3	In./Cm.	.42	.54	.65	.46	.61	.46	.58	.76	.63	.47	.60
	In./Wt.	.63	.49	.62	.32	.51	.45	.52	.62	.59	.86	.53
	In./Girth	.29	.34	.29	.12	.31	.13	.17	.29	.36	.45	.24
	Cm./Wt.	.38	.48	.66	.42	.61	.54	.64	.67	.61	.53	.60
	Cm./Girth	.05	.24	.20	.12	.43	.33	.16	.30	.20	.31-	.26
	Wt./Girth	.44	.60	.66	.51	.65	.60	.66	.66	.53	.59	.61
4	In./Cm.	.72	.75	.26	.27	.54	.66	.80	.85	.58	-	.60
	In./Wt.	.47	.58	.06-	.61	.51	.10	.39	.69	.62	-	.42
	In./Girth	.66	.47	.23	.07	.23	.03-	.13-	.41	.22	-	.25
	Cm./Wt.	.61	.64	.79	.59	.32	.46	.31	.60	.69	-	.54
	Cm./Girth	.37	.31	.43	.60	.30	.22	.24	.19	.06	-	.23
	Wt./Girth	.41	.61	.60	.45	.69	.59	.54	.83	.74	-	.57

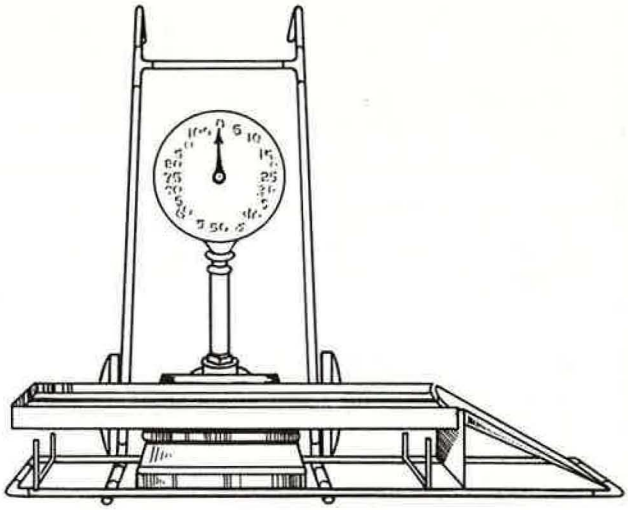


Figure 15.--Device used to weigh and measure tagged seals from the commercial kill.

MORTALITY

Background

The term mortality, when used in relation to fur seals, has come to mean, through long association, the death of pups on the Pribilof Islands, which takes place annually with varying degrees of intensity. Of equal concern, however, is the die-off at sea which results in no physical evidence which can be counted, although it is reflected in numbers of returning adults. Research to date has dealt almost exclusively with land mortality because of its manifestation, its role in population study, and the need to learn its cause.

Annual counts of dead pups on all rookeries have been continuous since 1948 (except for 1949 and 1952 when partial counts were made) on St. Paul Island, appendix table 4. Intermittent and partial counts were made on St. Paul Island from 1896 to 1948. In the past 10 years, pup mortality increased yearly through 1956. The two following years showed a decreasing tendency, then, after an almost record low mortality in 1958, the dead pup count increased in 1959 and 1960. Such fluctuations have been considered in excess of those exhibited by a growing herd and presumably are qualities of a herd at or near peak population.

Table 19.--Mean value from measurements of known-age males, St. Paul Island, 1960

Age	N	1	2	3	4	5	6	7	8	9	10	Season
					Mean length in inches							
2	92	-	-	-	-	41.0	41.0	41.5	41.5	41.5	-	41.44
3	1251	42.8	42.4	43.3	42.7	43.1	42.7	42.9	43.4	43.3	43.2	43.08
4	144	45.0	43.7	44.6	44.1	45.5	44.1	44.7	45.4	45.4	-	44.66
					Mean length in centimeters							
2	92	-	-	-	-	101.8	104.3	104.5	103.4	106.4	-	104.17
3	1251	110.7	109.5	109.2	110.6	110.3	111.4	110.4	110.9	111.0	114.8	110.64
4	144	119.9	116.6	116.5	116.1	117.4	117.5	114.2	116.5	120.2	-	116.66
					Mean weight in kilos							
2	92	-	-	-	-	20.3	20.8	22.1	21.4	22.3	-	21.69
3	1251	26.8	28.2	26.2	26.0	26.3	27.1	27.2	27.3	27.4	28.3	27.09
4	144	33.1	32.8	32.0	30.1	31.3	32.3	30.6	30.6	31.7	-	31.72
					Mean girth in centimeters							
2	92	-	-	-	-	60.5	58.0	60.3	61.0	60.0	-	60.35
3	1251	66.5	67.5	66.3	67.8	65.3	66.0	65.2	66.3	65.9	66.2	66.06
4	144	72.8	70.1	72.5	69.6	71.0	70.4	66.7	67.6	66.2	-	70.09

Dead pup counts are made following the end of the killing season and in recent years have been made near the end of August or in early September. This allows sufficient time for most of the land die-off to occur. It was learned that the pup mortality resulting from the kill of harem females was delayed at least 3 weeks after such females were killed. Because of this and other factors, the harvest of harem females for commercial purposes was stopped after the 1957 season. Hookworm infection is still the greatest single factor in pup mortality.

Dead-pup Counts

Total Counts

Pup mortality in 1960 increased by 57 percent of the 1959 count on St. Paul Island and 22 percent on St. George Island. Dead pup counts for both islands are given in table 20.

Violent fluctuations have been characteristic of land mortality since 1950. The effect of various causes of land mortality may continue into the ocean life of fur seal pups. Affected pups, though they have survived a period of rookery residence, may be incapable of withstanding the rigors of a marine environment. Table 21 lists tag recoveries from dead pups washed ashore along the Pacific coast during the years 1948 to 1960.

Each year, 5 percent has been added to the total number of dead pups as an allowance for those that are overlooked during the counts. In 1960, a check was made on the validity of this estimate. A total of 4,673 dead pups was counted on that part of Morjovi Rookery from Northeast Point through the dead pup study area. An immediate re-examination of the area revealed that 276 dead pups, or 5.9 percent of the count, had originally been overlooked. This agrees closely with the standard 5 percent addition, though the number of dead pups missed would probably vary from none on sand or pebble beaches to many on boulder beaches. For example, during the "clearing off" of dead pups on Zapadni Reef Rookery, 10 percent were overlooked. On Little Polovina Rookery, a negligible number were missed during the same procedure. Zapadni Reef is a boulder type beach while Little Polovina is mostly sand to small rock. The surface of Morjovi Rookery varies from sand to boulder type.

Table 20. -- Dead pup counts, Pribilof Islands, 1960

Rookery	Number
St. Paul Island	
Northeast Point	
Morjovi	6,825
Vostochni	11,333
Polovina	
Little Polovina	2,427
Polovina Cliffs	3,462
Polovina	5,268
Reef	
Ardiguen	331
Gorbatch	3,168
Reef	9,664
Sivutch	----
Kitovi, Lukanin, Tolstoi	
Kitovi	2,006
Lukanin	1,037
Tolstoi	5,237
Zapadni	
Little Zapadni	4,148
Zapadni Reef	1,472
Zapadni	6,450
Counted total	62,828
5 percent addition [Except on Little Polovina and Zapadni Reef]	2,946
Estimated total	65,774
St. George Island	
North	3,489
Zapadni	1,902
East	1,112
Staraya Artil	2,000
Counted total	8,503
5 percent addition	425
Estimated total	8,928
Summary - 1960	
Pribilof Islands counted total	71,331
5 percent addition [Except on Little Polovina and Zapadni Reef]	3,371
Estimated total	74,702

Table 21.--Tag recoveries from dead pups or yearlings reported by beachcombers along the Pacific Coast, 1948-1960

Year	Tag series	Number
1948	A	4
1949	B	2
1950	CS	1
1953	E	1
1954	F	19
1955	G	8
1956	H	2
1957	I	3
1958	J	22
1959	K	25
1960	L	9

Sample-area Counts, St. Paul Island

The sample-area counts were continued in 1960 as a part of the regular dead pup counts (table 22). For the fifth consecutive year, the results show that, if necessary, the sample-area counts can be used to calculate the total number of dead pups.

Year	1956	1957	1958	1959	1960
Sample area counts	31,301	19,729	11,802	14,125	20,374
Percent	32.0	32.5	37.8	34.3	32.4

The relationship of sample-area counts to their respective rookeries is shown in table 23 for the period 1956-60.

Factors Influencing Mortality

Weather

Continuing study was given to the possible influence of weather on pup mortality. Such a relationship has been determined to be

Table 22. -- Dead-pup counts, study areas, St. Paul Island, 1960

Rookery	Number
Northeast Point Rookeries	
Morjovi	3,077
Vostochni	2,576
Polovina Rookeries	
Little Polovina	1,248
Polovina	3,462
Reef Rookeries	
Gorbatch	952
Reef, area 1 (north)	799
Reef, area 2 (south)	1,781
Kitovi, Lukanin, Tolstoi Rookeries	
Tolstoi	1,882
Zapadni Rookeries	
Little Zapadni	1,275
Zapadni	3,322
Total	20,374

* * * * *

Table 23. -- Percent of complete rookery dead-pup counts represented by study area counts

Rookery	1956	1957	1958	1959	1960
			Percent		
Morjovi	42.0	33.1	29.8	30.8	45.1
Vostochni	20.6	25.1	14.4	29.0	22.7
Little Polovina	51.6	55.5	61.3	56.0	51.4
Polovina	26.3	36.6	48.5	42.3	65.7
Gorbatch	33.1	31.0	68.8	38.6	30.0
Reef	30.2	25.6	46.3	31.0	26.7
Tolstoi	52.3	43.8	48.4	44.9	35.9
Little Zapadni	39.2	28.3	30.0	31.6	30.7
Zapadni	51.3	52.2	50.9	47.7	51.5

indirect and involves hookworm mortality, the largest single direct mortality factor which has been isolated. The initial approach to the study was to determine, if possible, any direct relationship between local weather conditions and extent of pup die-off. It was evident that after severe weather during July and August the number of newly dead pups increased. While such a relationship may exist to a small degree, no evidence could be found to support a direct relationship between weather during the period when land mortality occurs, and the amount of mortality. Discovery was made, during this study, that there was an inverse correlation between annual mortality and air temperature for a greater period. Several periods were tried as were different approaches to weather data; 5-, 6-, 7-, 8-, and 9-month periods were used with annual average air temperatures, departure from long term means and monthly average air temperatures. An inverse correlation between average monthly temperature and annual pup mortality has been consistently shown since 1950.

The most recent approach has been to plot the mean of the monthly temperature averages for each month, starting with July and ending with June, against the annual land pup mortality in the subsequent months. The negative relationship of high temperature and low mortality, or vice versa, was apparent, figure 16. A scatter diagram is shown in figure 17. The coefficient of correlation is -0.853; this is significant at the 1 percent level.

One explanation of the meaning of such a relationship and how, as an indirect method, it can be plausible, follows: The one link between mortality and temperature was the hookworm. Earlier work on hookworms (Olsen, 1950-51) gave good evidence of their existence on land throughout the winter months, and that just prior to the peak of breeding activity, infectious hookworm larvae had developed from an earlier stage. Development of larvae may be a function of time and temperature. With this hypothesis in mind, it can be stated that high mean temperatures may accelerate development of the hookworm larvae and result in peak abundance of the larval form in its infectious stage, before many pups are born. Colder mean temperatures, however, may be inhibitive, so that larval development might be delayed enough to coincide with the time when large numbers of seal pups are present. This latter condition would obviously result in a higher pup mortality.

The 1959 report had data only through 1958. Data for 1959 was plotted and study of the most recent Weather Bureau data made it possible to plot the 1960 mortality against the previous 12-month period. Results for both 1959 and 1960 were consistent; increased mortality was associated with decreased mean temperature.

Other Factors

The significance of disease, aside from parasitism, on the pup survival of any given year, is unknown. Doyle (1958) could not isolate any disease that was associated with major mortality figures. Parasitism *per se* is still the greatest single known factor in pup mortality.

The relationship between returns and year-class size has been determined to be inverse; the relationship between returns and land mortality of given year classes is also inverse, as shown by table 24 for the year classes 1953-57. Since land-pup mortality is not sufficiently large to reduce a year class to the number returning at age 3, it would follow that mortality at sea is proportional to mortality on land; i.e., a direct relationship exists between land and ocean mortality.

RELATED STUDIES

Live-pup Counts

Live-pup counts were made 5 August on the Tolstoi and Kitovi rookery areas as outlined in the 1959 report. The 1960 counts are compared in table 25 with those made in 1959.

Of the three areas, Kitovi Amphitheater appears best suited for making live-pup counts. The terrain is relatively flat, without gullies or large boulders that tend to conceal pups. These situations exist to some degree in the other two areas. Furthermore, the natural boundaries of Kitovi Amphitheater prevent lateral shifting of pups in this area. Pups are free to move "outside" the other two areas. Lateral movement of the pups may be responsible for the sizable difference in the Tolstoi counts.

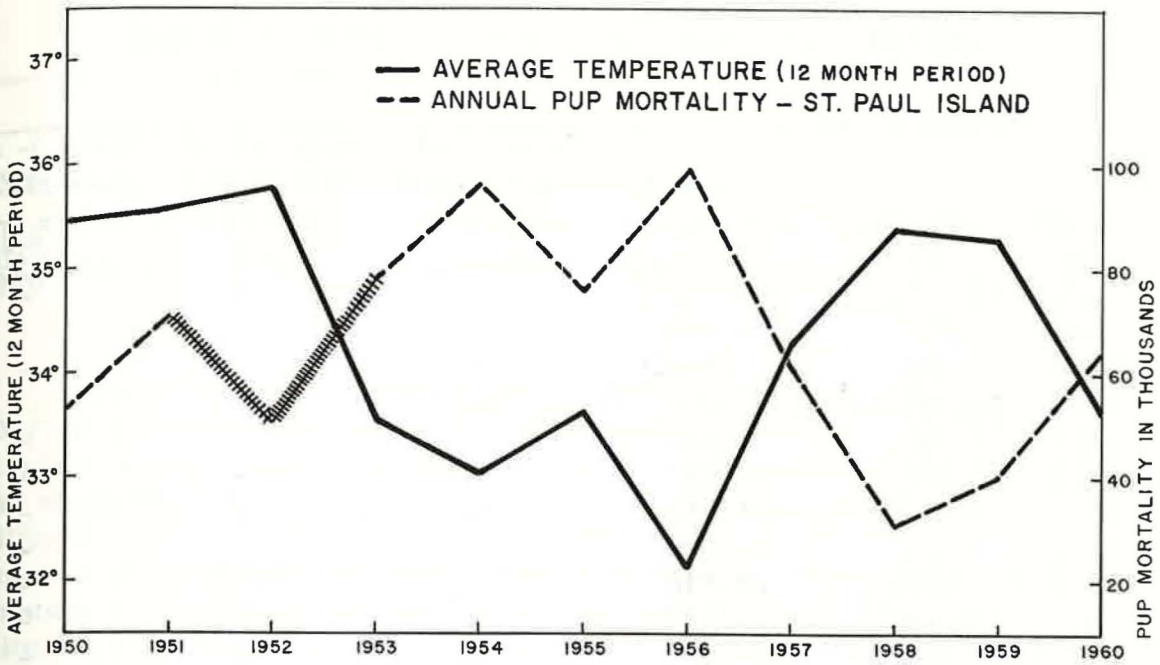


Figure 16.--Average temperature and annual pup mortality, St. Paul Island.

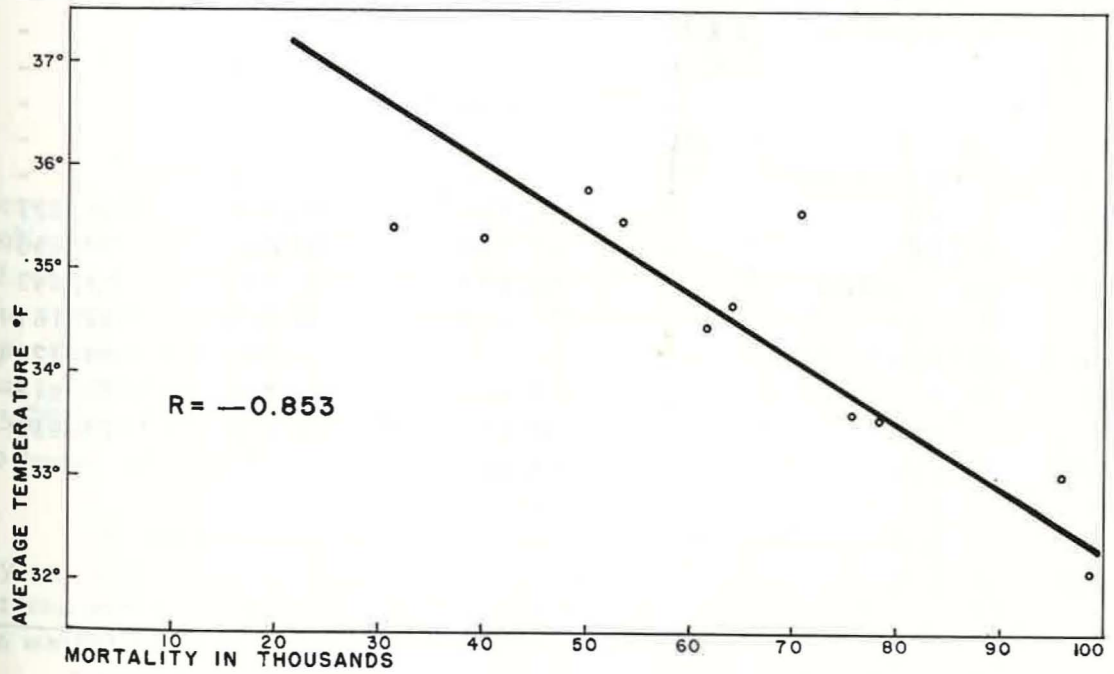


Figure 17.--Pup mortality in 1000's vs. average temperature, St. Paul Island.

Table 24.--St. Paul Island counted seal-pup mortality with male kill of 3 and 4 years later

Year class	Total no. dead pups	Total male seals taken 3 years later	3-year-old seals taken from year class	4-year-old seals taken from year class	Total 3- and 4-year-old seals taken from year class
1896	10,309 1/	102,617 1/	-	-	-
1908	3,003	12,466 2/	-	-	-
1909	3,786	11,053 3/	-	-	-
1912	Search in late October - none found				
1914	1,523	4,986	-	-	-
1915	1,607	27,503	-	-	-
1916	2,170	24,053	-	-	-
1917	3,437	22,220	-	-	-
1918	3,873	19,230	-	-	-
1919	4,298	26,035	-	-	-
1920	3,720	12,841	-	-	-
1921	3,840	13,453	-	-	-
1922	2,755	15,082	-	-	-
1923	not counted	16,231	-	-	-
1924	4,354	19,000	-	-	-
1925	not counted	23,003	-	-	-
1926	"	33,216	-	-	-
1927-40	"	-	-	-	-
1941	18,350	39,846	-	-	-
1942-49	not counted	-	-	-	-
1950	56,099		40,656 4/	15,365	56,021
1951	74,196		32,350	18,083	50,433
1952	not counted		30,733	31,410	62,143
1953	83,173		38,312	8,855	47,167
1954	100,978		23,873	5,599	29,472
1955	79,321		27,863	10,555	38,418
1956	103,642		10,671	2,762	13,433
1957	64,745		24,283		
1958	32,746				
1959	41,962				
1960	65,774				

1/ 28,858 seals taken at sea in addition to St. George Island kill.
2/ 18,105 seals taken at sea in addition to St. George Island kill.
3/ 14,139 seals taken at sea in addition to St. George Island kill.
4/ First year in which age classification, corresponding with dead-pup counts were available.

Table 25.--Live-pup counts, 1959 and 1960

	Rookery areas		
	Tolstoi	Kitovi	
Year	White Cross to No. 16	Amphitheater	Blind to No. 13
1959	702	1218	929
1960	405	1211	1072

For the Kitovi Amphitheater, a bull count of 75 was recorded 13 July and a dead pup count of 250 recorded 26 August. The unknown number of pups born after the count of live pups and the unknown number of counted pups that subsequently died makes use of these data difficult. Kenyon (1954) showed that 80 percent of the dead pups counted on a sample area died prior to 5 August. Therefore, approximately 20 percent of the total dead pup count made in late August on Kitovi Amphitheater would be deducted because they were part of the original count of live pups. The dead pup count of 250 + 5 percent overlooked = 263; 263 - 20 percent previously counted = 210; the live pup count of 1211 + 210 = 1421, the approximate number of pregnant females for the area.

Pelage Studies

Pelage samples representative of seven age groups and both sexes, collected in all months of the year are being studied. The collection will be completed about 1962. Each sample is a strip of skin, formalin-preserved, from the back of the seal. Soon after the sample is brought to Seattle, two kinds of permanent study-specimens are made from it: (1) a dry mount of a wafer of skin, cut lengthwise of the hair- and fur-fibers, and (2) a series of 10 to 15 microslides carrying horizontal serial sections from epidermis to bases of follicles.

In connection with the pelage study, an analysis of body weight, by age and month of year, is being made. Weight data are obtained at sea and on land. The final analysis will perhaps show a decline in weight at the season of most active molt.

Dentition Studies

A study of the eruption, maturation, and disappearance of the milk teeth, and the eruption and maturation of the permanent teeth is now under way. It is based on a collection of about 300 skulls, some of them taken as far back as 1940, some dry and some in alcohol. The study is scheduled for completion at the end of 1961. Cooperating in the study are two graduate dentists of the University of Washington, Peter Bokstrom and James H. Takano. These men are making roentgenograms of early fetal jaws. Certain critical ages are still lacking and it is hoped that the pelagic vessel Tacoma will bring early fetuses from seals taken in California waters in November and December 1960.

Extention of Age Classification of Females and Life Table Development from (1) Age Classification and (2) Pregnancy Rates

Background

Accurate age determination of the older females is difficult. Annual growth layers on the roots of canine teeth, used so successfully to determine the age of younger animals, become so obscured in later years that the external ridges are impossible to define. Longitudinal sectioning of these teeth has opened the way to age classification of the females previously grouped as 10+. This method allows an internal count of the annual growth layers. Not all teeth are alike, however, in that the growth layers of some are distinct, even beyond age 20, while others are clouded by a mother-of-pearl effect at the apex (base). Though imperfect, the method provides a valuable basis for determining life expectancy. Longevity of females has presently been extended to age 27 through the sectioning of canine teeth.

Methods

Teeth from the 1958 kill were not sectioned because size restrictions prevented the taking of more than a nominal number of old females. As described in the 1959 pelagic report, teeth from the 1957 kill were prepared for age determination by rasping, grinding, and polishing. Though laborious, it replaced the slower method outlined in the 1958 pelagic report. A new technique was

developed for preparation of teeth from the 1959 kill. Using a high-speed band saw for initial splitting of the teeth, a few seconds each on the polisher readied them for age determination. Two operators can process up to 1,000 teeth daily by this method.

The latter method, while faster, must be critically examined before the original grinding method is discarded. In splitting a tooth, the curvature of the root canal should be followed closely. This is especially important at the apex where 6 to 8 growth layers may be concentrated within an eighth of an inch. Though difficult, the grinding method is more precise in this respect than the band saw.

The S. S. White Industrial Division, Los Angeles, California, conducted tests on tooth samples to determine the feasibility of "air-brasive" technique in sectioning teeth. The air-brasive technique is potentially valuable as a tool in age analysis because of its flexibility and ease of handling. Further refinement of equipment is needed to make it suitable for tooth sectioning.

Application

Primary use of the extended age information is to develop a current life table for females. An estimate of the number of pups born each year is a basic requirement for construction of a life table. Ten yearly pup-crop estimates are available from tagging data and dead pup counts.

Studies concerning the sex ratio of pups have not indicated any change in a 1:1 relationship (Niggol, 1960). It has also been assumed that random age composition, beyond age 4, exists in the female land samples.

Female Life Table Development from Age Classification

Table 26 shows the complete age composition for females sampled from the 1957 and 1959 kills. Ages 2 through 8 were determined from external examination of the canine teeth, while those in ages 9, 10, and 11 to 27 were determined from sectioned teeth.

These figures have not been weighted by the daily kill and, thus, are subject to question as the basis for female life tables. The material is presented primarily for the purpose of developing a method.

Table 26.--Summary of females sampled from commercial kill, by age, St. Paul Island, 1957 and 1959

Age	1957 number	1957 percent	1959 number	1959 percent
1	-	-	-	-
2	-	-	30	1.0
3	127	2.0	257	6.0
4	632	10.0	978	25.0
5	1,543	23.0	551	14.0
6	984	15.0	431	11.0
7	714	11.0	470	12.0
8	525	8.0	280	7.0
9	477	7.0	188	5.0
10	291	4.0	163	4.0
11	270	4.0	154	4.0
12	215	3.0	113	3.0
13	182	3.0	95	2.0
14	153	2.0	75	2.0
15	159	2.0	54	1.0
16	97	1.0	38	1.0
17	80	1.0	26	1.0
18	54	1.0	17	0.4
19	34	0.5	6	-
20	17	0.25	7	-
21	20	-	10	0.25
22	17	0.25	2	-
23	3	-	2	-
24	3	-	2	-
25	6	0.1	-	-
26	-	-	1	-
27	-	-	1	-
Total	6,603		3,951	

Land samples have not been considered random because of the restrictions under which female kills take place. However, more data for an age-composition study was provided by land samples than pelagic samples. The age composition of United States pelagic females is shown in figure 18. A female life table is given in table 27 and figure 19.

Fair agreement of two methods from 6-27 years on. But what happens up to age 4.

Mortality sequence taken from smoothed (fig. 19) page ages 4-27

Rounding them off to nearest 5 introduces a series of humps.

Table 27. -- Life table for females

Age	Seals in each age class alive at start of year (percent) 1/	Seals dying naturally during year (percent) 1/	From 1955 pup crop 332,500 females	From pup crop 240,000 females 2/
0	100.00	31.00	332,500	240,000
1	69.00	20.50	229,425	165,600
2	48.50	12.50	161,262	116,400
3	36.00	9.50	119,700	86,400
4	26.50	7.00	88,112	63,600
5	19.50	5.25	64,838	46,800
6	14.25	4.00	47,381	34,200
7	10.25	2.75	34,081	24,600
8	7.50	1.50	24,938	18,000
9	6.00	1.00	19,950	14,400
10	5.00	1.00	16,625	12,000
11	4.00	0.75	13,300	9,600
12	3.25	0.75	10,806	7,800
13	2.50	0.50	8,312	6,000
14	2.00	0.50	6,650	4,800
15	1.50	0.50	4,988	3,600
16	1.00	0.25	3,325	2,400
17	0.75	0.15	2,494	1,800
18	0.60	0.10	1,995	1,440
19	0.50	0.10	1,662	1,200
20	0.40	0.05	1,330	960
21	0.35	0.05	1,164	840
22	0.30	0.05	998	720
23	0.25	0.05	831	600
24	0.20	0.05	665	480
25	0.15	0.05	499	360
26	0.10	0.05	332	240
27	0.05	0.025	166	120
28	0.025	0.025	83	60
29	0.025	-	-	-
30	-	-	--	-
Totals			1,198,412	865,020

1/ Of newborn stock.

These fluctuating 9000s are used to show the pup crop to within 4 or 5 significant figures.

2/ Estimated number used by Kenyon, et al., 1954.

The life table in figure 19 is a composite of the plottings, by age, of both 1957 and 1959 sample age composition. A smoothed line was then drawn from age 4 to age 27. Points for ages 1, 2, and 3 were estimated from ages 4 through 10 on the curve. The life table has been derived from the figure. Percent of animals alive at given ages provided the basis for numbers.

Data from the 1958 and 1959 Japanese pelagic operations (Reports of Japanese Fur Seal Research 1958-1959) were used to establish a curve showing percent age composition of the combined 1958 and 1959 female samples. Females older than age 10 were given specific ages in the 1959 sample and the same proportion by age were used for the 100 females older than 10 in the 1958 sample. Figure 20 illustrates the age composition of the combined Japanese samples (solid line) together with the points obtained from the combined 1958-1959 United States pelagic samples.

A comparison of the curves obtained from Japanese pelagic data and United States land kill data, shows the greatest difference to be in females younger than age 10. Tag recoveries by Japan are not adequate to determine the mixing of females of different origin by age. The possibility exists that Japanese samples are biased toward younger animals.

Life Table Development from Pregnancy Rates

A separate approach to the construction of a female life table used the reproductive condition of females sampled in 1957. Actual points of reference were less in number than data from the extended age composition; however, the slope of the two curves are closely allied in ages 5 through 10 (fig. 21).

A female life table, derived from reproductive-condition samples by age, is listed in table 28. Another female life table, derived from original pup-crop estimates and their subsequent annual mortality increments, is given in table 29.

The following steps were used to derive a life table from pregnancy rates; references a to f refer to table 28:

1. An arbitrary figure of 500,000 was used to represent the pup crop, since, for several years, the actual estimates approximated this number.

Table 28.--Calculation of age composition of the female herd element and contributions of the female age classes to the pup crop, based on pregnancy rates of the 1957 female sample, St. Paul Island

	Data from 1957 female sample				Calculation	
Age	Number in age	Percent pregnant (a)	Number pregnant (b)	Percent contribution to pup crop (d)	Percent contribution to pup crop (e)	Total females in herd (f)
4	632	13	82	2.1	10,500	80,769
5	1,543	53	818	21.1	105,500	199,050
6	982	78	766	19.8	99,000	126,923
7	700	81	567	14.6	73,000	90,123
8	576	75	432	11.2	56,000	74,667
9	483	73	352	9.1	45,500	62,329
10	257	74	190	4.9	24,500	48,039
10+	1,303	51	665	17.2	86,000	168,627
Total	6,476		3,872 (c)		500,000	769,758 1/

1/ Adding those females under age 4, the actual total is calculated at about 1,400,000. Basis for the number of females to age 5 are the percentages shown in figure 19.

2. The pregnancy rates (a) (i.e., percent pregnant) used were those determined for ages 4 through 10+ of the 1957 St. Paul Island sample.

3. The number of pregnant animals in each age group (b) was divided by the total sample (c) to obtain the percent contribution (d), by age, to the total pup crop of 500,000.

4. The percent contribution (d) was applied to the arbitrary pup crop of 500,000 to obtain the number contribution (e).

5. Calculation of the total females of each age (f) in the herd was made on the basis of percentage differences between pregnant and nonpregnant animals of the same age. For example, if 13 percent (pregnant) of age 4 females equal 10,500 (pups), then the difference,

Table 29.--Female life table based upon sample age compositions and annual pup crop estimates
(Mortality rates derived from age composition samples)

Year	Estimate of female pup crop	Age 1	2	3	4	5	6	7	8	9	10	11	12	13	14-28	Total
1960	290000	234600	174600	138600	116600	72150	47025	31775	19875	14701	12500	10000	8125	6250		1,176,801
1959	340000	248400	186725	158400	98050	64350	44175	27163	18376	15000	12500	10000	8125	6250		1,237,514
1958	360000	265650	213400	133200	87450	60450	37763	25113	18750	15000	12500	10000	8125			1,253,651
1957	385000	303600	179450	118800	82150	51675	34913	25625	18750	15000	12500	10000				1,251,838
1956	440000	255300	160050	111600	70225	47775	35625	25625	18750	15000	12500					1,216,825
1955	370000	227700	150350	95400	64925	48750	35625	25625	18750	15000						1,089,000
1954	330000	213900	128525	88200	66250	48750	35625	25625	18750							1,007,500
1953	310000	182850	118825	90000	66250	48750	35625	25625								948,550
1952	265000	169050	121250	90000	66250	48750	35625									892,175
1951	245000	172500	121250	90000	66250	48750										875,625
1950	250000	172500	121250	90000	66250											880,625
1949	250000	172500	121250	90000												880,625
1948	250000	172500	121250	90000	66250	48750	35625	25625	18750	15000	12500	10000	8125	6250		880,625
1947	250000															
1946																

Pup crop estimates based upon tag return data + land mortality count.
Individual years do not conform to "set" mortality standards as shown by 1956 pup crop.
The 1956 estimate was the highest in the current series yet the return was the lowest.
Obviously the mortality rates exceeded those used for the above table.

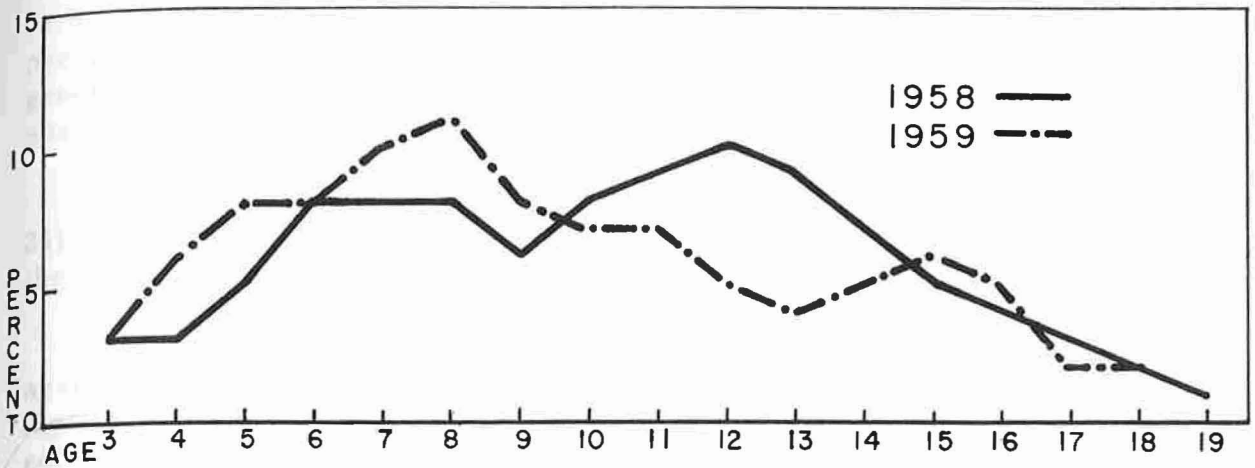


Figure 18. -- Age composition of females in United States pelagic collection.

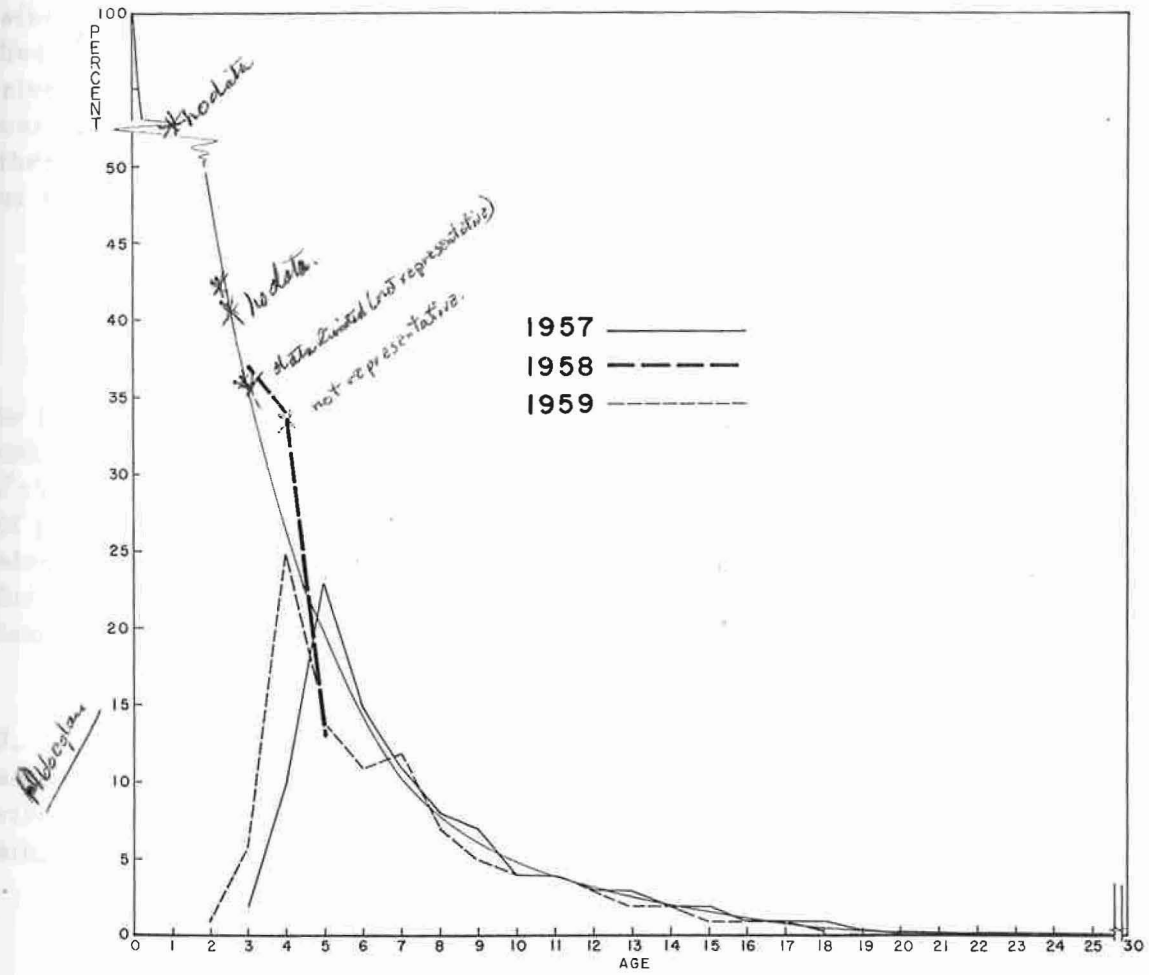


Figure 19. -- Percent age composition of female component as determined by age analysis of females sampled from the commercial kill in 1957, 1958, and 1959.

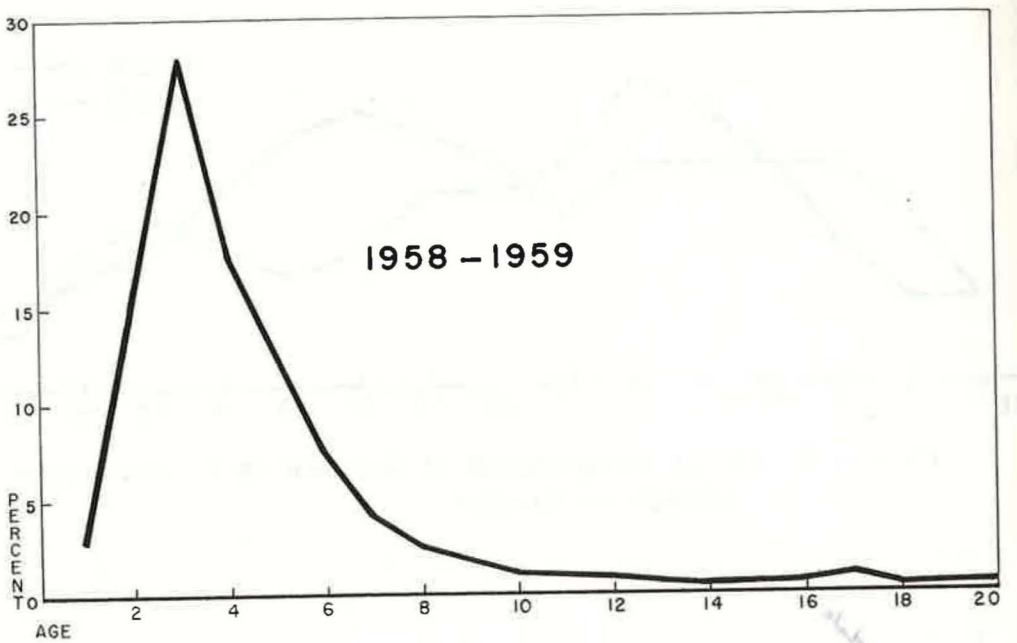


Figure 20.--Age composition of females in combined Japanese pelagic samples for 1958 and 1959.

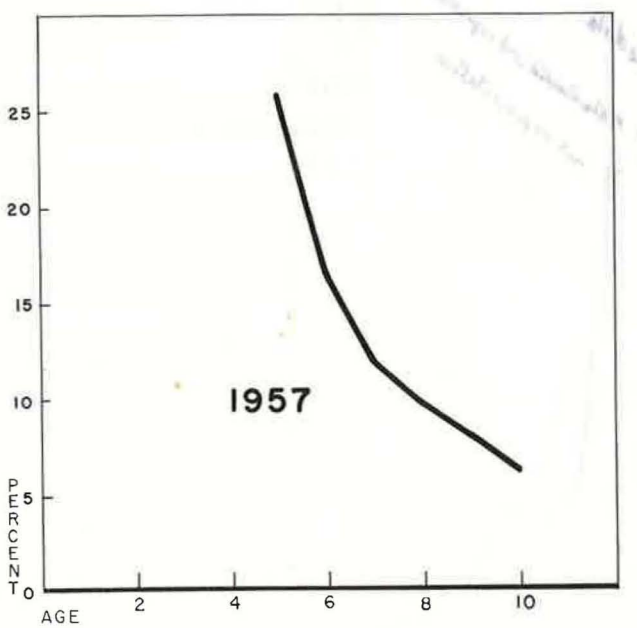


Figure 21.--Age composition of females, ages 5 to 10, as determined by pregnancy rates.

or 87 percent, (nonpregnant) is 70,269 females. Combination of the pregnant and nonpregnant females yields the total number in each group. [Since the kill and therefore the research sample was not adequate for age group 4, this age was not plotted.]

6. Each age (5 to 10) was assigned a point on the chart (fig. 21); the connected points showed a descending curve comparable to the curve derived solely from age classification.

In summary, much of the material in evidence is not in agreement; however, a considerable age span in the preceding figures has much in common. The confidence interval is undoubtedly large when specific numbers are in question but the general trend reflected is expected to be reliable.

The total mass of a population is dependent upon the original size of the age classes and the varying mortalities to which they have been subjected. It is then impractical to rely upon a life table derived from one source of data. Each year class will contribute a certain proportion of its original number to the total population but there is no assurance that the proportion and numbers are constant or consistent.

Tissue Studies

Blood samples, taken in 1958 on St. Paul Island, were sent to B. S. Blumberg, M. D., N. I. H., Bethesda, Maryland, for analysis. This analysis resulted in a publication (Blumberg, et al., February 1960) which contributes to the comparative biochemistry of proteins and reports on the effectiveness of starch gel and paper electrophoresis studies on the hemoglobin and serum of the Alaskan fur seal, ground squirrel, and marmot. The results may have taxonomic and evolutionary significance.

Several dozen seal blood samples were collected by Dr. W. J. L. Sladen, Department of Health, Education, and Welfare. The sera will be studied primarily to determine whether fur seals carry viruses transmittable to humans, with emphasis on viruses responsible for upper respiratory infections.

Blood samples, whole livers and hearts were collected for Dr. Thomas Richardson, Chemist, Food Technology Department, Bureau of Commercial Fisheries, University of California, Davis, California. He is studying cell mitochondria and is comparing cells of mammals, living exclusively on a marine diet, with cells of other mammals and with those of fish. Collection and study of fresh material is scheduled through the spring of 1961, utilizing material obtained during the pelagic research operation. Only unfrozen material held on ice for less than 48 hours is usable.

Hookworm Studies

In 1960, research efforts by Dr. O. W. Olsen and Gene Lyons were concentrated on the aspect of prenatal infection. Fetuses from females taken pelagically off the Pribilof Islands were examined for presence of hookworm larvae. Unborn pups were taken by Caesarean section through the summer on land; some were killed immediately and examined for hookworm larvae, while others were held in captivity for several weeks and observed for signs of hookworm infection. Tissue and milk samples were also taken from the pregnant females. All results apparently were negative, though the report on 1960 hookworm research has not yet been received.

Rookery sand samples were again examined to provide additional data on the time of disappearance and reappearance of hookworm larvae. Viscera from several pups found dead on the rookeries were also examined.

Skull Measurements

It was agreed by the Standing Scientific Committee, at the third meeting of the North Pacific Fur Seal Commission, that the United States would provide Soviet scientists with adult, breeding male, fur-seal skulls for comparative morphometric study. During the 1960 season, 24 skulls were obtained and are ready to be forwarded to the U.S.S.R.

Earlier studies of females showed little evidence of morphometric differences great enough to separate Asian from North American fur seals. Wilke (1951), compared 151 skulls from Japan with 105 skulls from North America. Taylor, et al., (1955), studied

the skulls of 523 female fur seals, age 6 and older, from the Pribilof Islands, North American pelagic, and Japanese pelagic collections.

Anesthetizing Bull Fur Seals for Study

Periodic anesthetization of bull fur seals from June through August would provide the means for tracing weight changes through the breeding season and for making physiological studies.

Accordingly, the Long Range Projector, a carbon-dioxide powered, syringe-shooting rifle, was purchased from the Palmer Chemical and Equipment Company, Inc., Atlanta, Georgia. "Cap Chur Sol," the trade name given to a nicotine alkaloid by the Palmer Company, was used in first attempts to reduce bull fur seals to a state of tranquility. "Quelicin," or succinylcholine chloride, was used later.

A study was made of recorded experiments with "Cap Chur" equipment, and the different tranquilizing solutions used. However, because of the rarity of fur seals in zoos, no information dealing specifically with fur seals was available.

All information concerning the use of nicotine solution as a tranquilizer emphasized the low tolerance of animals to excessive dosages. With this in mind, the first dose administered to a bull fur seal was 300 mg. "Cap Chur Sol." A 2-1/2" needle with a medium shoulder was used. The shot was injected intramuscularly (I/M) but bounced out with the needle broken, and the solution continued to squirt from the projectile as it lay on the ground. It was impossible to determine if any of the solution had been received by the animal.

The second shot was a successful I/M injection with a 2-1/2" needle into the rump, using 300 mg. of "Cap Chur Sol." There was no noticeable effect upon the animal after 15 minutes.

Dosages were increased, with no visible effects up to 15 minutes. Using a 1-1/2" needle with a medium shoulder, a shot with 1,000 mg. of "Cap Chur Sol" gave first results on a bull. The animal went to the ground 3 minutes after being hit but would rise to its fore flippers when approached. Following 9 minutes of this behavior pattern, the bull then moved about 50 yards and was in

apparently normal condition. Observation was continued for an additional 30 minutes, with no change.

The next dosage was increased to 1,500 mg., injected I/M above the left hip. This bull showed no effect until 3 minutes had elapsed; it then went down but was up immediately warding off another bull. Fifteen minutes from receipt of the drug, the animal was in apparent discomfort, lying on its stomach with both hind flippers waving. No other bulls in the immediate area were waving their flippers, the usual sign of heat distress. A continuous watch was kept on this animal for an additional 30 minutes. This animal was found dead on the following day.

Bull No. 6 was given 2,000 mg. of "Cap Chur Sol" I/M in the left shoulder. After being hit, the bull turned and ran a gauntlet of three other bulls. No effect was noticeable after 15 minutes. A continued watch was made for 2 hours, during which time the animal did not appear to behave differently from the surrounding bulls. This animal was also found dead the following day.

Shots at bulls designated as Nos. 7 and 8 failed but No. 9 received 2,500 mg. of "Cap Chur Sol" I/M in the left shoulder from a 1-1/2" needle with a medium shoulder. No effect was noticed for 9 minutes, then the animal collapsed and began to tremble violently. The heartbeat stopped 12 minutes after the injection. Weight of the bull was 160.7 kilograms.

The preceding shots were made on 27 June 1960 and a total of four of the bulls shot were found dead within 2 days. Body measurements were taken from two of these bulls and skulls collected from all.

At this time, there is little explanation for such a delayed reaction to the nicotine solution. One may surmise that, during the breeding season, harem bulls are not susceptible to ordinarily effective doses of a tranquilizer and may even withstand, for extreme periods, lethal mass dosages of a drug before succumbing. This is apparently the reaction which took place. Such being the case, at least with nicotine, it seems impractical to continue the experiment with such a drug.

Further tests were made with "Quelicin" but without apparent results. The drug neither tranquilized nor caused subsequent death at dosages up to 60 mg. per shot.

An equipment change was made too late in the season for use and evaluation. Projectile needles, with small barbs, were substituted for needles with medium shoulders. This was done to assure retention of the projectile by the animal and to avoid variation in dosage.

According to instructions furnished by the manufacturer, the tablet that provides the gas to force the injection is placed into the tablet retainer whole. However, it was found that the whole tablet dissolved too slowly to provide rapid and complete delivery of the solution after syringe impact. The mechanism functioned quite effectively when a powder, made by crushing the tablet in the palm of the hand, was used instead of a whole tablet.

Evaluation of the data from the animals subjected to nicotine shows that at no time, within a 2-hour period, did any of the six bulls receiving the entire dosage, or any part of it, become anesthetized. The seventh bull died shortly after showing the first visual effect of the drug, without demonstrating a condition resembling anesthesia. According to the experience (personal communication) of Dr. Vahn Flyger, Senior Biologist, Department of Research and Education, State of Maryland, no animals have died "from nicotine alkaloid without going into deep anesthesia." The range of dosages, 300 mg. to 2,500 mg., did not at any time cause insensibility. The expected anesthesia did not take place, but instead we were impressed by an increased and acute awareness exhibited by each animal after receiving a shot. The relationship between body weight and dosage could not be worked out from the early results; delayed death served only to confuse the problem of establishing a dosage level. The best body location for the shot must also be determined.

Food Habits

Stomachs from one male (collected 16 July) and three female (collected 11 August) fur seals taken commercially on St. Paul Island were observed to contain food. Sea poacher (*Podothecus acipenserinus*) and sandfish (*Trichodon trichodon*) were found in the male's stomach. Pacific cod (*Gadus macrocephalus*), walleye pollack (*Theragra chalcogramma*), sandfish, and unidentified shrimp were found in the stomachs from the female seals. The shrimp had probably originally been eaten by the cod or pollack. Identifications were made by Karl Niggol (Marine Mammal Biological Laboratory, Seattle, Washington).

The Exploratory Fishing vessel John R. Manning made three drags off St. Paul Island, 20 July 1960, as part of a mission of sampling potential trawl bottoms in the eastern Bering Sea. Potential food items, as shown by the catch table (table 30), were few. On the following day, the Manning made four more drags on a line roughly 75 to 120 nautical miles east from St. George Island and 120 miles north of Unimak Pass. Table 31 shows the results of the drags.

Table 30.--Otter trawl drags by John R. Manning
20 July 1960
St. Paul Island, Alaska

Vessel drag No. :	9	10	11
Location :	3 mi. S. of S. W. Point	3 mi. S. E. of Tonki Point	1 mi. E. of Big Lake
Time on bottom :	23 minutes	20 minutes	15 minutes
Depth :	28 fathoms	18 fathoms	12 fathoms
Type of bottom :	Gray sand and shell	Green mud and sand	Green mud and sand
Yellowfin sole (Limanda aspera) :	41, 15-33 mm.	2, 18 and 24 mm.	-
Halibut (Hippoglossus stenolepis) :	2, 22 and 26 mm.	4, 18-54 mm.	-
Arrowtooth flounder: (Atheresthes stomias)	4, 15-22 mm.	-	-
Sea poacher :	5	-	3
Sandfish :	-	1, 15 mm.	5, 12-15 mm.
Sandlance (Ammodytes hexapterus) :	-	1	30
Tanner crab :	35, small	2	1
Horse crab :	6, large	2	3
Starfish :	150, small	60, medium-large	10, small

Comment: No evidence of shrimp, which are usually entangled in web to some extent. The sandlance in drag No. 11 were apparently taken from a school close to the surface, being only temporarily caught in the large mesh. A flock of birds was actively feeding on them. The largest halibut in drag No. 10 had eight freshly consumed sandlance in its stomach.

Table 31.--Otter trawl drags by John R. Manning
21 July 1960

Succession of drags	1	2	3	4
Longjaw flounder	24	14	20	40
Flathead sole (*Hippoglossoides elassodon*)	94	17	25	30
Other sole	-	-	34	-
Walleye pollack	14	12	10	30
Cod	5	-	-	1
Tomcod (*Microgadus proximus*)	6	-	-	12
Sculpin Cottidae	2	2	-	18
Sea poacher	10	-	-	12
Eelpout Zoarcidae	-	-	-	6
Capelin (*Mallotus villosus*)	-	-	8	-
Skate Rajidae	-	-	-	3
Tanner crab	41	7	15	20
King crab	2	1	4	3
Starfish	-	50	300	1200
Sea pens	-	-	-	15

Comparison of Lengths of Female Samples

The original study of length-reproductive condition of fur seals began in 1952 (Taylor, *et al.*). Data from pelagic samples taken by Japan and the United States indicated that pregnant females were longer than nonpregnant females of the same age. This condition existed again in 1958 pelagic samples data but was not evident in land samples. A study was made to determine the relationships of age, length, and reproductive condition for both pelagic and land samples. Data for this study include St. Paul Island samples from 1956 through 1959 and the 1958 and 1959 United States pelagic samples. Statistical analysis was done by Dr. D. G. Chapman, University of Washington.

Data, by years, was subjected to an analysis of variance test with the comparisons being made between three groups jointly [pregnant, nulliparous, and nonpregnant parous animals] as well as two

additional paired comparisons. These are pregnant versus nonpregnant and parous versus nulliparous females. However, any group with fewer than 10 animals was not included in the sample. Tabular data for six analysis of variance tests are presented in appendix table 39.

St. Paul Island Samples

The parous nonpregnant animals are the largest and the nulliparous the smallest. Thirty comparisons between pregnant (P) and nonpregnant parous (M) sample means, showed that pregnant females were smaller in 26 cases, table 32. This is significant at the 1 percent level. Of the 20 possible comparisons between means of pregnant and nulliparous females, nulliparous females were smaller in 14 cases, with one tie. This is almost significant at the 5 percent level. The St. Paul Island samples indicate that, within each age group, nulliparous females are the shortest, pregnant females are intermediate in the length order, and nonpregnant (parous) females the longest. However, the differences in length are small and nonsignificant except for 1957. In 1957 data, 5 of the 12 paired comparisons are significantly different at the 1 percent level.

Pelagic Samples

The pelagic samples indicate almost the opposite of the land samples. Table 32 also lists the order of sample means for the pelagic groups. Of 15 comparisons, the pregnant animals are longer in 13 instances, smaller in one, and tied in one. Pregnant females are significantly longer than the nonpregnant (parous) females.

Table 32.--Orders of sample means within age and year

	Age							
Date	4	5	6	7	8	9	10	10+
				St. Paul Island samples				
1956	NP	PNM	PNM	NPM	PNM	PM	PM	PM
1957	NMP	PNM	NPM	NPM	NPM	PM	PM	PM
1958	NP	NPM	NPM	NPM	PM	MP	PMN	MP
1959	NPM	[N=P]M	NPM	NPM	NPM	PM	MP	PM
				Pelagic samples				
1958		NP	NMP	PM	MP	MP	MP	MP
1959	NP	NMP	MNP	MP	[M=P]	MP	MP	MP

N: nulliparous; P: pregnant; M: parous nonpregnant
The order indicated is according to increasing mean length

OTHER WILDLIFE SPECIES

Sea Lions

Using the pelagic research vessel M/V Windward, Walrus Island was visited by the research staff 15 July for the purpose of tagging sea-lion (Eumatopias jubata) pups. Participating were Ford Wilke, Thomas Juelson, James Olsen, Larry Nygren, Gene Lyons, Richard Bonn, Gene Whitaker, and Lavrenty Stepetin. Clifford Fiscus and Karl Kenyon estimated a sea-lion pup population of 2,500 to 2,800 on the island.

Within the series XA-201 to 800, 530 pups were tagged during the 4-hour period 1130 to 1530. Using the special sea-lion tags, one was attached to a fore flipper of each pup, usually the left. One-half to two-thirds of each tag was left projecting to allow growth of the flipper. Figure 22 shows two biologists tagging a sea-lion pup on Walrus Island 15 July 1960.

No recoveries have been made from the 1959 tagging of 100 sea-lion pups.

Whales

Three species of whales were found beached on St. Paul Island during the period June through October 1960. The number and name of each species is listed below:

2 Fin whales (Balaenoptera physalus)
1 Beluga - white whale (Delphinapterus leucas)
1 Little piked, minke (Balaenoptera acutorostrata)

Lemmings

One live lemming (Lemmus nigripes) was delivered to the University of Puget Sound for a study of electro-phoretic blood proteins. This is part of a taxonomic blood study of North American mammals sponsored by the National Science Foundation.

Reindeer

Census

The reindeer were counted 16 August by Ford Wilke, Alton Roppel, Dr. D. G. Chapman, Thomas Juelson, Larry Nygren, James Olsen, and Lavrenty Stepetin.

The search began by dividing the men into three groups and proceeding toward Crater Hill. One group began at Ridge Wall, another at Southwest Point, and the third at a point midway between these areas. From Ridge Hill, the main herd was located between Rush Hill and Tsammana Lake. During the afternoon, a group of 20 bulls was found near Low Hill.

Counts of 341, 395, and 400 were made of the main herd before the animals sensed human presence and crowded together, making subsequent counts very difficult. A count of 370 was obtained from a photograph taken of the herd in the crowded condition, figure 23.

A further attempt to obtain counts was made by driving the reindeer past observers stationed on Rush Hill. Though the drive was successful, reliable counts were not obtained because of continued crowding and movement. However, from the various counts, including the 20 bulls detached from the main herd, it is believed that the reindeer presently number about 400 animals.

Round-up

Mr. Vern Hirsch, reindeer expert from the Bureau of Indian Affairs, arrived on St. Paul Island 8 September to inspect the range, herd, facilities, and methods, and to supervise the round-up and kill. He was assisted by Mr. George Palmer, an expert Eskimo herder from Nunivak Island.

The round-up was unsuccessful again this year and no reindeer were taken. It became apparent that the corral is ineffective in its present location, especially so since the Coast Guard loran station was constructed near the approach. Mr. Hirsch agreed that Lake Hill would be a desirable corral site. Accordingly, the corral will be removed from its present location and reconstructed around

Figure 22.--Sea-lion tagging, Walrus Island, 15 July 1960.

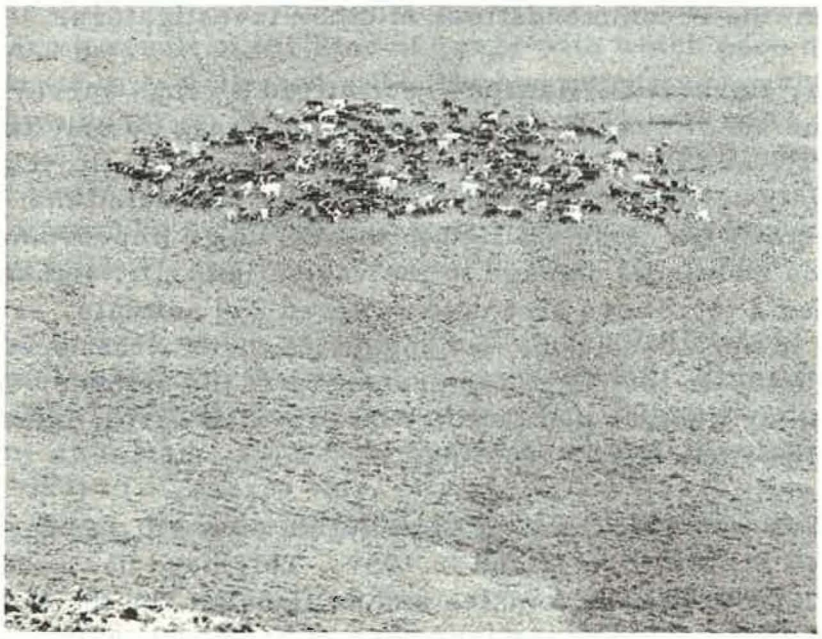


Figure 23.--Reindeer herd, St. Paul Island, 16 August 1960.

Lake Hill Lake, with collecting pens at a natural exit on the east rim. The new corral site will be accessible by road.

Management

Reindeer were first introduced to St. Paul Island in 1911. Twenty-five animals were brought in, of which 4 were males and 21 were females. By 1930, the herd numbered about 400 animals. During this 20-year period, 240 were killed for food purposes. By 1938, the herd had erupted to a peak of about 2,000 and a total of 471 had been taken for food. The varied complexities of over-population, occupation of the island by military personnel, and icing of the snow from freezing rain were responsible for the "crash-die-off" that followed, leaving only 3 reindeer by 1951.

In 1951, 31 reindeer were reintroduced on St. Paul Island. Seven of these were males and 24 were females. This latter introduction formed the nucleus for the 400 animals now on St. Paul Island.

Mr. Hirsch suggested that the herd could be managed at a sustained level of 1,200 to 1,500 animals. However, his views differ from the recommendations of other investigators.

Dr. Herbert C. Hanson[1/] conducted a range survey on St. Paul Island 20-21 June 1952. He rated the range as only fair to poor and stated that 5 to 10 years would be required for the range to reach fair-to-good condition. He further suggested that the reindeer increment be closely allied to that of range improvement so as to preclude additional damage to the vegetation. Dr. Hanson recommended a total herd size not to exceed 250 animals, even with the range in peak condition. He suggested further that open sheds be constructed on the range for protection of the reindeer during severe winter weather and that hay be provided during infrequent, prolonged periods of ice-crusting.

Klein (1959) estimated a population of 1,350 reindeer on uninhabited St. Matthew Island in 1957. This herd has resulted from the introduction of 5 males and 24 females, by the U. S. Coast Guard, in 1944. Though the land area of St. Matthew Island is

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1/ Professor of Biology, Catholic University, Washington, D. C.

roughly three times that of St. Paul Island, it is more barren and overgrazing is already a threat to continuation of the herd at its present level. A crash decline, similar to that which occurred on St. Paul Island, may occur.

According to several investigators, lichens are not only the preferred food of reindeer but of vital necessity as a winter staple. Scheffer (1951) suggested that adverse winter weather coupled with inadequate lichen reserves were basically responsible for the decline of the St. Paul Island herd. The St. Matthew Island range displays luxurient lichen growth 3 to 4 inches deep on most parts seldom frequented by the reindeer. Lichen growth on the remainder is badly shattered and reduced from feeding activities of the reindeer, often showing a growth of only 1 inch. Adjacent Hall Island, which has no reindeer, supports a dense lichen growth throughout.

Considering all factors, it seems unwise to support 1,200 to 1,500 reindeer on the St. Paul Island range. According to Palmer (1929), the maximum number allowable is 10 to 16 reindeer per square mile for safe use of any range. A St. Paul Island herd of 400 to 600 would exceed these limits since the deer seem to avoid the extensive sand dune areas covered with beach rye grass.

The different recommendations of Mr. Hirsch and Dr. Hanson probably are a result of the kind of range with which each has worked. The standards of Mr. Hirsch, who has had extensive recent experience with reindeer on Nunivak Island, are doubtless quite different than those of Dr. Hanson. The open sheds and feeding with hay, suggested by Dr. Hanson, are obviously the kind of suggestions that would be offered by a cattleman. In our opinion, sheds would be completely futile.

The history of the reindeer herd on St. Paul Island does not support the supposition that lichens are essential. Lichens have long been destroyed on most parts of St. Paul Island but the herd has grown, as stated, from 31 to over 400 animals (including 38 killed in 1958) in 10 years. Mr. Hirsch stated that the deer on St. Paul were large, fat animals as compared with Nunivak Island reindeer.

Those responsible for management of the St. Paul reindeer herd will find it necessary to select a course of action suited to the specific situation. Recommendations of experts can be utilized

insofar as they assist in reaching the planned objective. We believe that production of the maximum possible number of reindeer on the range is not an objective. Instead, we hold strongly to the viewpoint that a small herd, held well within the carrying capacity of the range, best serves the present requirements of the Pribilof Island program.

Emphasis should be placed on the fact that heavy cropping of the herd is not nearly as damaging to the herd and to the island as overzealous protection.

Sea Otter

A coastal survey of the Pribilof Islands was made 14-18 July by Karl Kenyon in an effort to locate sea otters (*Enhydra lutra*) from the 1959 transplant (Kenyon, 1960). A party of staff biologists revisited Otter Island 19 August.

Using a dory, Kenyon maintained a distance of about 1/4 mile offshore while searching the waters surrounding Sea Lion Rock, St. Paul Island, and 5 miles of the southern coastline of St. George Island. Otter Island was surveyed both from the dory and on foot along the cliff edges. Walrus Island was covered from land only.

Though no sea otters were observed, fair weather prevailing during the survey might have induced the animals beyond the range of observation. According to Kenyon, sea otters will spend several days at a time 6 to 10 miles offshore during periods of quiet weather. It is hoped that the sea otters will be observed during late winter when storms and ice force them close to shore.

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Appendix A

Appendix table 1.

Age classification of male seals in commercial kill,
St. Paul Island, 27 June to 15 August 1960

Date	Rookery	Males killed	Tooth sample size	Percent in each age class				Estimated number killed from age class			
				2	3	4	5	2	3	4	5
27 June	NEP	240	24	-	62	38	-	-	150	90	-
28	TLK	109	12	-	50	42	8	-	55	45	9
29	ZAP	442	44	-	73	27	-	-	323	119	-
30	REEF	149	16	-	69	25	6	-	103	37	9
1 July	POL	145	17	-	47	53	-	-	68	77	-
Round total		1085	113	-	-	-	-	-	699	368	18
2 July	NEP	396	42	-	74	26	-	-	292	104	-
3	TLK	124	12	-	83	17	-	-	103	21	-
4	ZAP	642	64	2	78	20	-	13	501	128	-
5	REEF	72	8	-	50	38	12	-	36	27	9
6	POL	157	17	-	76	18	6	-	120	28	9
Round total		1391	143	-	-	-	-	13	1052	308	18
7 July	NEP	407	42	-	79	21	-	-	322	85	-
8	TLK	80	8	-	100	-	-	-	80	-	-
9	ZAP	1057	100	2	80	16	2	21	846	169	21
10	REEF	106	35	3	57	40	-	3	61	42	-
11	POL	230	30	-	93	7	-	-	214	16	-
Round total		1880	215	-	-	-	-	24	1523	312	21
12 July	NEP	897	90	2	85	13	-	18	762	117	-
13	TLK	364	49	2	82	16	-	7	299	58	-
14	ZAP	958	93	2	86	12	-	19	824	115	-
15	REEF	251	31	-	81	16	3	-	203	40	8
16	POL	246	37	5	68	27	-	12	167	67	-
Round total		2716	300	-	-	-	-	56	2255	397	8
17 July	NEP	948	96	3	82	15	-	28	778	142	-
18	TLK	351	37	5	87	8	-	18	305	28	-
19	ZAP	1037	103	2	87	11	-	21	902	114	-
20	REEF	332	34	3	82	12	3	10	272	40	10
21	POL	134	32	6	88	6	-	8	118	8	-
Round total		2802	302	-	-	-	-	85	2375	332	10
22 July	NEP	740	77	1	91	8	-	7	674	59	-
23	TLK	792	86	2	91	7	-	16	721	55	-
24	ZAP	1135	116	2	89	9	-	23	1010	102	-
25	REEF	294	33	-	91	9	-	-	268	26	-
26	POL	456	52	10	88	2	-	46	401	9	-
Round total		3417	364	-	-	-	-	92	3074	251	-
27 July	NEP	1594	158	4	91	5	-	64	1450	80	-
28	TLK	418	53	8	81	11	-	33	339	46	-
29	ZAP	2027	201	10	85	5	-	203	1723	101	-
30	REEF	489	47	11	74	15	-	54	362	73	-
31	POL	567	58	5	81	14	-	28	460	79	-
Round total		5095	517	-	-	-	-	382	4334	379	-
1 August	NEP	2595	266	10	84	6	-	260	2179	156	-
2	TLK	767	86	7	89	4	-	54	682	31	-
3	ZAP	2441	252	14	83	3	-	342	2026	73	-
4	REEF	395	60	15	80	3	2	59	316	12	8
5	POL	1273	144	10	86	3	1	127	1095	38	13
Round total		7471	808	-	-	-	-	842	6298	310	21
6 August	NEP	1925	211	11	84	4	1	212	1617	77	19
7	TLK	1037	124	10	88	2	-	104	912	21	-
8	ZAP	43	29	38	62	-	-	16	27	-	-
9	REEF	40	25	24	72	4	-	10	29	1	-
10	POL	24	19	69	26	5	-	17	6	1	-
Round total		3069	408	-	-	-	-	359	2591	100	19
11 August	NEP	27	21	52	43	5	-	14	12	1	-
12	TLK	39	38	61	39	-	-	24	15	-	-
13	ZAP	59	39	62	33	5	-	37	19	3	-
14	REEF	47	43	63	35	2	-	30	16	1	-
15	POL	39	37	49	51	-	-	19	20	-	-
Round total		211	178	-	-	-	-	124	82	5	-
Season total		29137	3348	-	-	-	-	1977	24283	2762	115

Appendix table 2.

Cumulative age classification of male seals in commercial kill, by day, St. Paul Island, 27 June to 15 August 1960

Date	Rookery	Estimated kill from each age class				Total kill	Percent kill from each age class			
		2	3	4	5		2	3	4	5
27 June	NEP	-	150	90	-	240	-	62	38	-
28	TLK	-	205	135	9	349	-	59	39	2
29	ZAP	-	528	254	9	791	-	67	32	1
30	REEF	-	631	291	18	940	-	67	31	2
1 July	POL	-	699	368	18	1085	-	64	34	2
2	NEP	-	991	472	18	1481	-	67	32	1
3	TLK	-	1094	493	18	1605	-	68	31	1
4	ZAP	13	1595	621	18	2247	1	71	27	1
5	REEF	13	1631	648	27	2319	1	70	28	1
6	POL	13	1751	676	36	2476	1	71	27	1
7	NEP	13	2073	761	36	2883	-	72	27	1
8	TLK	13	2153	761	36	2963	-	73	26	1
9	ZAP	34	2999	930	57	4020	1	75	23	1
10	REEF	37	3060	972	57	4126	1	74	24	1
11	POL	37	3274	988	57	4356	1	75	23	1
12	NEP	55	4036	1105	57	5253	1	77	21	1
13	TLK	62	4335	1163	57	5617	1	77	21	1
14	ZAP	81	5159	1278	57	6575	1	79	19	1
15	REEF	81	5362	1318	65	6826	1	79	19	1
16	POL	93	5529	1385	65	7072	1	78	20	1
17	NEP	121	6307	1527	65	8020	1	79	19	1
18	TLK	139	6612	1555	65	8371	2	79	18	1
19	ZAP	160	7514	1669	65	9408	2	80	18	-
20	REEF	170	7786	1709	75	9740	2	80	17	1
21	POL	178	7904	1717	75	9874	2	80	17	1
22	NEP	185	8578	1776	75	10614	2	81	16	1
23	TLK	201	9299	1831	75	11406	2	81	16	1
24	ZAP	224	10309	1933	75	12541	2	82	15	1
25	REEF	224	10577	1959	75	12835	2	82	15	1
26	POL	270	10978	1968	75	13291	2	83	15	-
27	NEP	334	12428	2048	75	14885	2	83	14	1
28	TLK	367	12767	2094	75	15303	2	83	14	1
29	ZAP	570	14490	2195	75	17330	3	84	13	-
30	REEF	624	14852	2268	75	17819	4	83	13	-
31	POL	652	15312	2347	75	18386	4	83	13	-
1 August	NEP	912	17491	2503	75	20981	5	83	12	-
2	TLK	966	18173	2534	75	21748	4	84	12	-
3	ZAP	1308	20199	2607	75	24189	5	84	11	-
4	REEF	1367	20515	2619	83	24584	6	83	11	-
5	POL	1494	21610	2657	96	25857	6	84	10	-
6	NEP	1706	23227	2734	115	27782	6	84	10	-
7	TLK	1810	24139	2755	115	28819	6	84	10	-
8	ZAP	1826	24166	2755	115	28862	6	84	10	-
9	REEF	1836	24195	2756	115	28902	6	84	10	-
10	POL	1853	24201	2757	115	28926	6	84	10	-
11	NEP	1867	24213	2758	115	28953	6	84	10	-
12	TLK	1891	24228	2758	115	28992	6	84	10	-
13	ZAP	1928	24247	2761	115	29051	7	83	10	-
14	REEF	1958	24263	2762	115	29098	7	83	10	-
15	POL	1977	24283	2762	115	29137	7	83	10	-

Appendix table 3.

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. Paul Island, 27 June to 15 August 1960

	Age										
	2	3	4	5	6	7	8	9	10	10+	Total
27 June-1 July	No females killed										
2 July											
Primipara pregnant	-	-	-	1	-	-	-	-	-	-	1
4 July											
Nullipara	-	-	1	-	-	-	-	-	-	-	1
Round 2 total	-	-	1	1	-	-	-	-	-	-	2
9 July											
Primipara pregnant	-	-	1	-	-	-	-	-	-	-	1
Multipara pregnant	-	-	-	-	1	-	-	-	-	-	1
Round 3 total	-	-	1	-	1	-	-	-	-	-	2
12 July											
Primipara pregnant	-	-	1	1	-	-	-	-	-	-	2
14 July											
Primipara pregnant	-	-	-	1	-	-	-	-	-	-	1
15 July											
Multipara pregnant	-	-	-	1	1	1	-	-	-	-	3
16 July											
Multipara pregnant	-	-	-	-	-	-	1	1	-	-	2
Primipara pregnant	-	-	1	2	-	-	-	-	-	-	3
Multipara pregnant	-	-	-	1	1	1	1	1	-	-	5
Round 4 total	-	-	1	3	1	1	1	1	-	-	8
17 July											
Primipara pregnant	-	-	1	4	-	-	-	-	-	-	5
Multipara pregnant	-	-	-	1	-	-	1	-	1	1	4
19 July											
Primipara pregnant	-	-	1	-	-	-	-	-	-	-	1
Multipara pregnant	-	-	-	-	2	-	1	-	-	1	4
nonpregnant	-	-	-	-	-	-	-	1	-	-	1
Primipara pregnant	-	-	2	4	-	-	-	-	-	-	6
Multipara pregnant	-	-	-	1	2	-	2	-	1	2	8
nonpregnant	-	-	-	-	-	-	-	1	-	-	1
Round 5 total	-	-	2	5	2	-	2	1	1	2	15
22 July											
Nullipara	-	-	1	-	-	1	-	-	-	-	2
Primipara pregnant	-	-	-	2	1	1	-	-	-	-	4
Multipara pregnant	-	-	-	-	1	-	1	-	-	-	2
23 July											
Nullipara	-	-	-	1	-	-	-	-	-	-	1
Primipara pregnant	-	-	-	1	4	-	-	-	1	1	7
Multipara pregnant	-	-	-	1	-	2	4	1	-	2	10
nonpregnant	-	-	-	-	-	-	1	-	1	4	6

Appendix table 3. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. Paul Island, 27 June to 15 August 1960

	Age										
	2	3	4	5	6	7	8	9	10	10+	Total
24 July											
Nullipara	-	-	1	-	-	-	-	-	-	-	1
Primipara											
pregnant	-	-	-	2	-	-	-	-	-	-	2
Multipara											
nonpregnant	-	-	-	-	-	-	1	-	-	2	3
25 July											
Multipara											
pregnant	-	-	-	-	-	-	1	-	-	-	2
26 July											
Primipara											
pregnant	-	-	1	1	-	-	-	-	-	-	2
Nullipara	-	-	2	1	-	1	-	-	-	-	4
Primipara											
pregnant	-	-	1	6	5	1	-	-	1	1	15
Multipara											
pregnant	-	-	-	1	2	2	6	1	-	2	14
nonpregnant	-	-	-	-	-	-	2	-	1	6	9
Round 6 total	-	-	3	8	7	4	8	1	2	9	42
27 July											
Nullipara	-	1	-	-	-	-	1	-	-	-	2
Primipara											
pregnant	-	-	-	1	2	-	-	-	-	-	3
nonpregnant	-	-	-	-	1	-	2	-	-	-	3
Multipara											
pregnant	-	-	1	-	-	-	-	3	1	2	7
nonpregnant	-	-	-	-	-	-	-	-	1	-	1
28 July											
Nullipara	-	-	1	-	-	-	-	-	-	-	1
Primipara											
pregnant	-	-	1	1	-	2	-	1	-	-	5
Multipara											
pregnant	-	-	-	-	1	-	1	-	-	1	3
nonpregnant	-	-	-	-	-	1	-	1	-	1	3
29 July											
Nullipara	-	1	-	3	-	-	-	-	-	-	4
Primipara											
pregnant	-	-	1	1	1	-	-	-	-	-	3
nonpregnant	-	-	-	-	-	-	1	-	-	-	1
Multipara											
pregnant	-	-	-	2	-	1	3	1	1	2	10
nonpregnant	-	-	-	-	-	1	2	-	-	1	4
30 July											
Nullipara	-	-	-	1	-	-	-	-	-	-	1
Primipara											
pregnant	-	-	-	1	-	-	-	-	-	-	1
Multipara											
pregnant	-	-	-	-	2	-	-	-	1	1	4
nonpregnant	-	-	-	-	-	-	-	1	-	4	5
31 July											
Nullipara	-	-	2	-	-	-	-	-	-	-	2
Primipara											
pregnant	-	-	-	2	2	-	1	-	-	-	5
nonpregnant	-	-	-	-	-	1	-	-	-	-	1
Multipara											
pregnant	-	-	-	-	-	1	-	-	-	-	1
nonpregnant	-	-	-	-	-	-	-	1	-	-	1

Appendix table 3. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. Paul Island, 27 June to 15 August 1960

	Age										
	2	3	4	5	6	7	8	9	10	10+	Total
Nullipara	-	2	3	4	-	-	1	-	-	-	10
Primipara											
pregnant	-	-	2	6	5	2	1	1	-	-	17
nonpregnant	-	-	-	-	1	1	3	-	-	-	5
Multipara											
pregnant	-	-	1	2	3	2	4	4	3	6	25
nonpregnant	-	-	-	-	-	2	2	3	1	6	14
Round 7 total	-	2	6	12	9	7	11	8	4	12	71
1 August											
Nullipara	-	2	8	7	1	-	1	-	-	-	19
Primipara											
pregnant	-	-	2	14	8	5	1	-	-	-	30
nonpregnant	-	-	-	1	-	-	-	-	-	1	2
Multipara											
pregnant	-	-	-	4	7	4	9	6	3	6	39
nonpregnant	-	-	-	-	1	3	10	7	4	5	30
2 August											
Nullipara	-	1	4	6	-	-	-	-	-	-	11
Primipara											
pregnant	-	-	-	9	1	1	-	-	-	-	11
nonpregnant	-	-	-	-	1	-	-	-	-	-	1
Multipara											
pregnant	-	-	-	2	7	5	1	6	-	6	27
nonpregnant	-	-	-	-	2	2	2	5	1	6	18
3 August											
Nullipara	-	4	4	7	1	-	-	-	-	-	16
Primipara											
pregnant	-	-	2	8	8	-	2	-	-	-	20
Multipara											
pregnant	-	-	-	6	5	5	2	5	2	7	32
nonpregnant	-	-	-	4	4	4	2	1	1	8	24
4 August											
Nullipara	-	4	12	7	-	1	-	-	-	-	24
Primipara											
pregnant	-	-	6	14	7	-	1	-	-	-	28
nonpregnant	-	-	1	1	1	-	-	-	-	-	3
Multipara											
pregnant	-	-	-	9	10	6	10	6	6	5	52
nonpregnant	-	-	-	-	4	-	7	2	5	3	21
5 August											
Nullipara	-	1	13	9	2	-	-	-	-	-	25
Primipara											
pregnant	-	-	5	20	4	2	-	1	-	-	32
nonpregnant	-	-	-	3	-	1	1	-	-	-	5
Multipara											
pregnant	-	-	-	16	22	16	13	11	3	15	96
nonpregnant	-	-	-	1	4	4	9	1	1	9	29
Nullipara	-	12	41	36	4	1	1	-	-	-	95
Primipara											
pregnant	-	-	15	65	28	8	4	1	-	-	121
nonpregnant	-	-	1	5	2	1	1	-	-	1	11
Multipara											
pregnant	-	-	-	37	51	36	35	34	14	39	246
nonpregnant	-	-	-	5	15	13	30	16	12	31	122
Round 8 total	-	12	57	148	100	59	71	51	26	71	595

Appendix table 3. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. Paul Island, 27 June to 15 August 1960

	Age										
	2	3	4	5	6	7	8	9	10	10+	Total
6 August											
Nullipara	-	5	18	14	1	-	-	-	-	-	38
Primipara											
pregnant	-	-	3	13	11	-	1	2	-	-	30
nonpregnant	-	-	-	1	3	3	1	-	-	-	8
Multipara											
pregnant	-	-	1	9	13	6	4	8	1	9	51
nonpregnant	-	-	-	-	4	2	6	2	2	5	21
7 August											
Nullipara	-	1	16	8	5	-	-	-	-	-	30
Primipara											
pregnant	-	-	-	12	6	1	-	1	-	-	20
nonpregnant	-	-	-	2	2	2	-	-	-	-	6
Multipara											
pregnant	-	-	1	2	6	12	14	10	3	16	64
nonpregnant	-	-	-	1	3	5	4	8	6	18	45
8 August											
Nullipara	1	9	14	16	3	1	-	-	-	-	44
Primipara											
pregnant	-	-	1	15	8	2	1	2	-	-	29
nonpregnant	-	-	-	5	5	1	2	-	-	-	13
Multipara											
pregnant	-	-	-	4	10	5	4	3	5	9	40
nonpregnant	-	-	-	1	3	2	7	1	4	8	26
9 August											
Nullipara	-	18	27	15	3	2	1	1	-	-	67
Primipara											
pregnant	-	-	-	20	17	3	1	-	1	-	42
nonpregnant	-	-	-	2	2	3	1	-	-	-	8
Multipara											
pregnant	-	-	-	12	17	9	7	10	7	18	80
nonpregnant	-	-	-	1	12	4	6	13	6	23	65
10 August											
Nullipara	1	38	36	24	2	1	-	-	1	2	105
Primipara											
pregnant	-	-	5	23	8	1	2	-	-	-	39
nonpregnant	-	-	1	3	5	-	-	-	-	-	9
Multipara											
pregnant	-	-	-	7	16	13	4	6	7	10	63
nonpregnant	-	-	1	3	5	6	6	1	3	11	36
Nullipara	2	71	111	77	14	4	1	1	1	2	284
Primipara											
pregnant	-	-	9	83	50	7	5	5	1	-	160
nonpregnant	-	-	1	13	17	9	4	-	-	-	44
Multipara											
pregnant	-	-	2	34	62	45	33	37	23	62	298
nonpregnant	-	-	1	6	27	19	29	25	21	65	193
Round 9 total	2	71	124	213	170	84	72	68	46	129	979
11 August											
Nullipara	1	27	32	18	3	1	2	-	-	-	84
Primipara											
pregnant	-	-	2	29	8	3	3	-	-	-	45
nonpregnant	-	-	1	3	3	1	2	-	-	-	10
Multipara											
pregnant	-	-	1	14	17	13	9	6	5	6	71
nonpregnant	-	-	1	4	5	6	4	6	3	10	39

Appendix table 3. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. Paul Island, 27 June to 15 August 1960

	Age										
	2	3	4	5	6	7	8	9	10	10+	Total
12 August											
Nullipara	1	17	60	27	1	2	-	-	-	-	108
Primipara											
pregnant	-	-	2	15	7	6	1	1	1	-	33
nonpregnant	-	-	2	5	3	3	1	1	-	-	15
Multipara											
pregnant	-	-	-	10	12	4	8	8	2	5	49
nonpregnant	-	-	3	3	3	5	4	2	9	14	43
13 August											
Nullipara	1	30	32	27	3	2	-	-	-	-	95
Primipara											
pregnant	-	-	4	18	6	3	1	1	-	-	33
nonpregnant	-	-	-	4	2	-	2	-	-	-	8
Multipara											
pregnant	-	-	-	5	10	7	5	10	8	17	62
nonpregnant	-	-	1	2	5	4	3	9	3	21	48
14 August											
Nullipara	12	33	34	17	-	2	-	-	-	-	98
Primipara											
pregnant	-	2	2	14	4	2	1	1	-	1	27
nonpregnant	-	-	-	-	2	1	1	-	-	-	4
Multipara											
pregnant	-	-	-	8	17	10	6	9	2	24	76
nonpregnant	-	-	1	3	1	6	6	1	6	18	42
15 August											
Nullipara	1	53	45	28	4	1	-	-	-	-	132
Primipara											
pregnant	-	-	2	18	3	5	1	-	-	-	29
nonpregnant	-	-	1	2	2	1	1	-	-	-	7
Multipara											
pregnant	-	-	2	6	8	16	9	8	2	7	58
nonpregnant	-	-	-	3	-	1	2	2	3	5	16
Nullipara	16	160	203	117	11	8	2	-	-	-	517
Primipara											
pregnant	-	2	12	94	28	19	7	3	1	1	167
nonpregnant	-	-	4	14	12	6	7	1	-	-	44
Multipara											
pregnant	-	-	3	43	64	50	37	41	19	59	316
nonpregnant	-	-	6	15	14	22	19	20	24	68	188
Round 10 total	16	162	228	283	129	105	72	65	44	128	1232
Season total	18	247	423	673	419	260	237	195	123	351	2946

Appendix table 4.

Dead pup counts by rookery, St. Paul Island, 1941, 1948-60

Rookery	1941	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Morjovi	933	(20600	2600	3000	3592	-	3764	8049	5571	10278	4253	2290	4560	6825
Vostochni	7708	(	12966	13120	18450	-	19503	25233	14473	20498	12732	7247	7105	11333
Little Polovina	292	-	1600	1740	2208	-	2211	3852	2782	4443	1695	975	1597	2427
Polovina Cliffs	(2356	-	-	3800	5580	2954	5451	6413	5964	8637	4425	1826	2586	3462
Polovina	(	-	1779	5660	6402	3200	5036	6459	4660	7463	5432	2184	3311	5268
Ardiguen	42	-	-	170	242	-	189	282	387	364	249	102	141	331
Gorbatch	896	-	-	2810	3559	-	3679	4900	4789	6291	3801	1655	2100	3168
Reef	2269	-	-	9520	11007	-	13661	12959	15145	14399	11301	5550	6052	9664
Kitovi	(404	-	800	1160	1517	-	1695	1669	2610	2892	1588	608	882	2006
Lukanin	(	-	635	770	712	-	1086	1129	1129	1718	870	324	631	1037
Tolstoi	1623	-	-	4230	6033	-	6154	7552	6489	6789	5659	2823	3691	5237
Little Zapadni	372	-	-	2120	2804	-	2446	4979	3555	4611	2325	1312	1691	4148
Zapadni Reef	171	-	575	660	353	-	1116	2278	1383	1674	917	246	608	1472
Zapadni	1284	-	-	4660	8204	-	12221	10424	6607	8650	6415	4045	5009	6450
Total	18350	20600 1/	20955 1/	53420	70663	6154 1/	78212	96178	75544	98707	61662	31187	39964	62828

1/ Partial counts.

No counts made in years 1942 through 1947.

Appendix table 5.

Age classification of females in commercial kill,
St. Paul Island, Alaska, 27 June to 15 August 1960

Date	Rookery	Females killed	Daily sample	Number in each age class of sample										Percent in each age class of sample										Estimated number killed from each age class									
				2	3	4	5	6	7	8	9	10	10+	2	3	4	5	6	7	8	9	10	10+	2	3	4	5	6	7	8	9	10	10+
27 June-1 July		No females killed																															
July 2	NEP	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
3	TLK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	ZAP	1	1	-	-	1	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
5	REEF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	POL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round total		2	2	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
July 7	NEP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	TLK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	ZAP	3	2	-	-	1	-	1	-	-	-	-	-	-	-	50	-	50	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-
10	REEF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	POL	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round total		4	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-
July 12	NEP	2	2	-	-	1	1	-	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
13	TLK	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	ZAP	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
15	REEF	3	3	-	-	-	1	1	1	-	-	-	-	-	-	-	33	34	33	-	-	-	-	-	-	-	1	1	1	-	-	-	-
16	POL	2	2	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	1	1	-	-
Round total		10	8	-	-	1	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	1	1	1	-	-
July 17	NEP	10	9	-	-	1	5	-	-	1	-	1	1	-	-	11	56	-	-	11	-	11	11	-	-	1	6	-	-	1	-	1	1
18	TLK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	ZAP	6	6	-	-	1	-	2	-	1	1	-	1	-	-	17	-	32	-	17	17	-	17	-	-	1	-	2	-	1	1	-	1
20	REEF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	POL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round total		16	15	-	-	2	5	2	-	2	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	6	2	-	2	1	1	2
July 22	NEP	14	8	-	-	1	2	2	2	1	-	-	-	-	-	12	25	25	25	13	-	-	-	-	-	1	4	4	4	1	-	-	-
23	TLK	29	24	-	-	-	3	4	2	5	1	2	7	-	-	-	13	17	8	21	4	8	29	-	-	-	4	5	2	6	1	2	9
24	ZAP	9	6	-	-	1	2	-	-	1	-	-	2	-	-	17	33	-	-	17	-	-	33	-	-	2	3	-	-	1	-	-	3
25	REEF	2	2	-	-	-	-	1	-	1	-	-	-	-	-	-	-	50	-	50	-	-	-	-	-	-	-	1	-	1	-	-	-
26	POL	2	2	-	-	1	1	-	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Round total		56	42	-	-	3	8	7	4	8	1	2	9	-	-	-	-	-	-	-	-	-	-	-	-	4	12	10	6	9	1	2	12
July 27	NEP	19	16	-	1	1	1	3	-	3	3	2	2	-	6	6	6	19	-	19	19	13	12	-	1	1	1	4	-	4	4	2	2
28	TLK	12 1/	12	-	-	2	1	1	3	1	2	-	2	-	-	17	8	8	25	8	17	-	17	-	-	2	1	1	3	1	2	-	2
29	ZAP	23	22	-	1	1	6	1	2	6	1	1	3	-	4	4	28	4	10	28	4	4	14	-	1	1	6	1	2	6	1	1	4
30	REEF	11	11	-	-	-	2	2	-	-	1	1	5	-	-	-	18	18	-	-	9	9	46	-	-	-	2	2	-	-	1	1	5
31	POL	12	10	-	-	2	2	2	2	1	1	-	-	-	-	20	20	20	20	10	10	-	-	-	-	2	2	2	2	2	2	-	-
Round total		77	71	-	2	6	12	9	7	11	8	4	12	-	-	-	-	-	-	-	-	-	-	-	2	6	12	10	7	13	10	4	13
August 1	NEP	130	120	-	2	10	26	17	12	21	13	7	12	-	2	8	22	14	10	17	11	6	10	-	3	10	29	18	13	22	14	8	13
2	TLK	84	68	-	1	4	17	11	8	3	11	1	12	-	2	6	25	16	12	4	16	1	18	-	2	5	21	13	10	4	13	1	15
3	ZAP	127	92	-	4	6	25	18	9	6	6	3	15	-	4	6	27	20	10	7	7	3	16	-	5	8	34	25	13	9	9	4	20
4	REEF	173	128	-	4	19	31	22	7	18	8	11	8	-	3	15	24	17	6	14	6	9	6	-	5	26	42	29	10	25	10	16	10
5	POL	250	187	-	1	18	49	32	23	23	13	4	24	-	-	10	27	17	12	12	7	2	13	-	-	25	68	42	30	30	18	5	32
Round total		764	595	-	12	57	148	100	59	71	51	26	71	-	-	-	-	-	-	-	-	-	-	-	15	74	194	127	76	90	64	34	90
August 6	NEP	252	148	-	5	22	37	32	11	12	12	3	14	-	3	15	25	22	8	8	8	2	9	-	8	38	63	55	20	20	20	5	23
7	TLK	195	165	-	1	17	25	22	20	18	19	9	34	-	-	10	15	13	12	11	12	6	21	-	-	20	29	25	23	22	23	12	41
8	ZAP	152	152	1	9	15	41	29	11	14	6	9	17	-	6	10	27	19	7	9	4	6	12	1	9	15	41	29	11	14	6	9	17
9	REEF	263	262	-	18	27	50	51	21	16	24	14	41	-	7	10	19	20	8	6	9	5	16	-	18	27	51	51	21	16	24	14	41
10	POL	253	252	1	38	43	60	36	21	12	7	11	23	-	15	17	24	14	8	5	3	5	9	1	38	43	60	37	21	12	7	11	23
Round total		1115	979	2	71	124	213	170	84	72	68	46	129	-	-	-	-	-	-	-	-	-	-	2	73	143	244	197	96	84	80	51	145
August 11	NEP	250	249	1	27	37	68	36	24	20	12	8	16	-	11	15	27	14	10	8	5	3	7	1	27	38	68	35	25	20	12	7	17
12	TLK	252	248	1	17	67	60	26	20	14	12	12	19	-	7	27	24	10	8	6	5	5	8	1	17	68	60	25	20	15	13	13	20
13	ZAP	250	246	1	30	37	56	26	16	11	20	11	38	-	12	15	23	11	7	4	8	4	16	1	30	37	57	28	17	10	20	10	40
14	REEF	253	247	12	35	37	42	24	21	14	11	8	43	5	14	15	17	10	9	6	4	3	17	13	35	38	43	25	23	15	10	8	43
15	POL	248	242	1	53	50	57	17	24	13	10	5	12	-	22	21	24	7	10	5	4	2	5	1	54	52	60	17	25	12	10	5	12
Round total		1253	1232	16	162	228	283	129	105	72	65	44	128	-	-	-	-	-	-	-	-	-	-	17	163	233	288	130	110	72	65	43	132
Season total 2/		3297	2946	18	247	423	673	419	260	237	195	123	351	-	-	-	-	-	-	-	-	-	-	19	253	466	760	478	296	271	222	135	394

1/ Management record lists a kill of 9 females.

2/ The estimated numbers killed from each age class total 3294 because no samples were taken on 11 and 13 July.

Appendix table 6.

Cumulative age classification of female seals in commercial kill, by day,
St. Paul Island, 27 June to 15 August 1960

Date	Rookery	Number killed from age class										Total killed	Percent killed from age class									
		2	3	4	5	6	7	8	9	10	10+		2	3	4	5	6	7	8	9	10	10+
27 June-1 July		No females killed																				
July																						
2	NEP	-	-	-	1	-	-	-	-	-	-	1	-	-	-	100	-	-	-	-	-	-
3	TLK	-	-	-	1	-	-	-	-	-	-	1	-	-	-	100	-	-	-	-	-	-
4	ZAP	-	-	1	1	-	-	-	-	-	-	2	-	-	50	50	-	-	-	-	-	-
5	REEF	-	-	1	1	-	-	-	-	-	-	2	-	-	50	50	-	-	-	-	-	-
6	POL	-	-	1	1	-	-	-	-	-	-	2	-	-	50	50	-	-	-	-	-	-
7	NEP	-	-	1	1	-	-	-	-	-	-	2	-	-	50	50	-	-	-	-	-	-
8	TLK	-	-	1	1	-	-	-	-	-	-	2	-	-	50	50	-	-	-	-	-	-
9	ZAP	-	-	3	1	1	-	-	-	-	-	5	-	-	60	20	20	-	-	-	-	-
10	REEF	-	-	3	1	1	-	-	-	-	-	5	-	-	60	20	20	-	-	-	-	-
11	POL	-	-	3	1	1	-	-	-	-	-	5	-	-	60	20	20	-	-	-	-	-
12	NEP	-	-	4	2	1	-	-	-	-	-	7	-	-	57	29	14	-	-	-	-	-
13	TLK	-	-	4	2	1	-	-	-	-	-	7	-	-	57	29	14	-	-	-	-	-
14	ZAP	-	-	4	3	1	-	-	-	-	-	8	-	-	50	37	13	-	-	-	-	-
15	REEF	-	-	4	4	2	1	-	-	-	-	11	-	-	36	36	19	9	-	-	-	-
16	POL	-	-	4	4	2	1	1	1	-	-	13	-	-	31	31	14	8	8	8	-	-
17	NEP	-	-	5	10	2	1	2	1	1	1	23	-	-	21	43	9	4	9	5	4	5
18	TLK	-	-	5	10	2	1	2	1	1	1	23	-	-	21	43	9	4	9	5	4	5
19	ZAP	-	-	6	10	4	1	3	2	1	2	29	-	-	20	34	14	4	10	7	4	7
20	REEF	-	-	6	10	4	1	3	2	1	2	29	-	-	20	34	14	4	10	7	4	7
21	POL	-	-	6	10	4	1	3	2	1	2	29	-	-	20	34	14	4	10	7	4	7
22	NEP	-	-	7	14	8	5	4	2	1	2	43	-	-	16	32	19	12	9	5	2	5
23	TLK	-	-	7	18	13	7	10	3	3	11	72	-	-	10	25	18	10	14	4	4	15
24	ZAP	-	-	9	21	13	7	11	3	3	14	81	-	-	11	26	16	9	13	4	4	17
25	REEF	-	-	10	21	14	7	12	3	3	14	84	-	-	12	25	17	8	14	4	4	16
26	POL	-	-	10	22	14	7	12	3	3	14	85	-	-	12	26	16	8	14	4	4	16
27	NEP	-	1	11	23	18	7	16	7	5	16	104	-	1	11	22	17	7	15	7	5	15
28	TLK	-	1	13	24	19	10	17	9	5	18	116	-	1	11	21	16	9	15	8	4	15
29	ZAP	-	2	14	30	20	12	23	10	6	22	139	-	1	10	22	14	9	17	7	4	16
30	REEF	-	2	14	32	22	12	23	11	7	27	150	-	1	9	21	15	8	16	7	5	18
31	POL	-	2	16	34	24	14	25	13	7	27	162	-	1	10	21	15	9	15	8	4	17
August																						
1	NEP	-	5	26	63	42	27	47	27	15	40	292	-	2	9	22	14	9	16	9	5	14
2	TLK	-	7	31	84	55	37	51	40	16	55	376	-	2	8	22	15	10	13	11	4	15
3	ZAP	-	12	39	118	80	50	60	49	20	75	503	-	2	8	23	16	10	12	10	4	15
4	REEF	-	17	65	160	109	60	85	59	36	85	676	-	3	10	24	16	9	12	9	5	12
5	POL	-	17	90	228	151	90	115	77	41	117	926	-	2	10	25	16	10	12	8	4	13
6	NEP	-	25	128	291	206	110	135	97	46	140	1178	-	2	11	25	18	9	11	8	4	12
7	TLK	-	25	148	320	231	133	157	120	58	181	1373	-	2	11	23	17	10	11	9	4	13
8	ZAP	1	34	163	361	260	144	171	126	67	198	1525	-	2	11	24	17	10	11	8	4	13
9	REEF	1	52	190	412	311	165	187	150	81	239	1788	-	3	11	23	17	9	11	8	5	13
10	POL	2	90	233	472	348	186	199	157	92	262	2041	-	4	11	23	17	9	10	8	5	13
11	NEP	3	117	271	540	383	211	219	169	99	279	2291	-	5	12	24	17	9	10	7	4	12
12	TLK	4	134	339	600	408	231	234	182	112	299	2543	-	5	13	24	16	9	9	7	5	12
13	ZAP	5	164	376	657	436	248	244	202	122	339	2793	-	6	13	24	16	9	9	7	4	12
14	REEF	18	199	414	700	461	271	259	212	130	382	3046	1	6	14	23	15	9	9	7	4	12
15	POL	19	253	466	760	478	296	271	222	135	394	3294	1	8	14	23	14	9	8	7	4	12

Appendix table 7.

Number pregnant and nonpregnant among female seals 4 or more years old and 5 or more years old, St. Paul Island, 1960

Date	Daily kill	Daily sample	Daily sample less 2 & 3 yr. olds	Ages 4-10+ pregnant	Ages 4-10+ non-pregnant	Daily sample less 2, 3, & 4 yr. olds	Ages 5-10+ pregnant	Ages 5-10+ non-pregnant
27 June-1 July	No females killed							
July								
2	1	1	1	1	-	1	1	-
3	-	-	-	-	-	-	-	-
4	1	1	1	-	1	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
9	3	2	2	2	-	1	1	-
10	-	-	-	-	-	-	-	-
11	1	-	-	-	-	-	-	-
12	2	2	2	2	-	1	1	-
13	2	-	-	-	-	-	-	-
14	1	1	1	1	-	1	1	-
15	3	3	3	3	-	3	3	-
16	2	2	2	2	-	2	2	-
17	10	9	9	9	-	8	8	-
18	-	-	-	-	-	-	-	-
19	6	6	6	5	1	5	4	1
20	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-
22	14	8	8	6	2	7	6	1
23	29	24	24	17	7	24	17	7
24	9	6	6	2	4	5	2	3
25	2	2	2	2	-	2	2	-
26	2	2	2	2	-	1	1	-
27	19	16	15	10	5	14	9	5
28	9	12	12	8	4	10	7	3
29	23	22	21	13	8	20	12	8
30	11	11	11	5	6	11	5	6
31	12	10	10	6	4	8	6	2
August								
1	130	120	118	69	49	108	67	41
2	84	68	67	38	29	63	38	25
3	127	92	88	52	36	82	50	32
4	173	128	124	80	44	105	74	31
5	250	187	186	128	58	168	123	45
6	252	148	143	81	62	121	77	44
7	195	165	164	84	80	147	83	64
8	152	152	142	69	73	127	68	59
9	263	262	244	122	122	217	122	95
10	253	252	213	102	111	170	97	73
11	250	249	221	116	105	184	113	71
12	252	248	230	82	148	163	80	83
13	250	246	215	95	120	178	91	87
14	253	247	200	101	99	163	99	64
15	248	242	188	87	101	138	83	55
Total	3,294	2,946	2,681	1,402	1,279	2,258	1,353	905

Appendix table 8.

Length of female seals sampled from commercial kill, by age, St. Paul Island, 1960

Length in inches		Age 2	3	4	5	6	7	8	9	10	10+	Total
37	number	1	-	-	-	-	-	-	-	-	-	1
	percent	6	-	-	-	-	-	-	-	-	-	-
38	number	2	-	-	-	-	-	-	-	-	-	2
	percent	11	-	-	-	-	-	-	-	-	-	-
39	number	7	8	-	2	-	-	-	-	-	-	17
	percent	39	3	-	-	-	-	-	-	-	-	1
40	number	4	43	11	1	-	-	-	-	-	-	59
	percent	22	18	2	-	-	-	-	-	-	-	2
41	number	1	90	46	19	5	1	2	1	-	-	165
	percent	6	36	11	3	1	-	1	1	-	-	6
42	number	1	59	109	84	29	7	7	5	2	3	306
	percent	6	24	26	12	7	3	3	2	2	1	10
43	number	-	28	118	161	74	37	19	13	11	15	476
	percent	-	11	28	24	18	14	8	7	9	4	16
44	number	1	14	89	179	105	65	42	34	21	47	597
	percent	5	6	21	27	25	25	18	17	17	13	20
45	number	-	4	32	141	112	75	63	53	31	77	588
	percent	-	2	8	21	27	29	27	27	25	22	20
46	number	-	-	17	58	59	44	64	46	22	76	386
	percent	-	-	4	9	14	17	27	24	18	22	13
47	number	-	-	1	22	25	18	24	30	29	67	216
	percent	-	-	-	3	6	7	10	15	23	19	8
48	number	1	-	-	4	8	5	12	8	5	44	87
	percent	5	-	-	1	2	2	5	4	4	12	3
49	number	-	1	-	2	2	8	3	2	1	16	35
	percent	-	-	-	-	-	3	1	1	1	5	1
50	number	-	-	-	-	-	-	1	2	1	3	7
	percent	-	-	-	-	-	-	-	1	1	1	-
51	number	-	-	-	-	-	-	-	1	-	3	4
	percent	-	-	-	-	-	-	-	1	-	1	-
Total		18	247	423	673	419	260	237	195	123	351	2,946
Percent		1	8	14	23	14	9	8	7	4	12	

Appendix table 9.

Number pregnant and nonpregnant among female seals 4 or more years old and 5 or more years old, St. George Island, 1960

Date	Daily kill	Daily sample	Daily sample less 2 & 3 yr. olds	Ages 4-10+ pregnant	Ages 4-10+ non-pregnant	Daily sample less 2, 3, & 4 yr. olds	Ages 5-10+ pregnant	Ages 5-10+ non-pregnant
27 June-18 July	No females killed							
July								
19	1	1	1	-	1	1	-	1
20	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-
23	3	3	3	2	1	3	2	1
24	3	3	3	1	2	3	1	2
25	2	2	2	2	-	2	2	-
26	3	3	3	3	-	3	3	-
27	1	1	1	-	1	1	-	1
28	-	-	-	-	-	-	-	-
29	7	7	7	3	4	7	3	4
30	3	3	3	2	1	3	2	1
31	12	12	12	5	7	11	5	6
August								
1	16	16	16	9	7	15	8	7
2	10	10	10	6	4	10	6	4
3	37	37	36	20	16	35	20	15
4	2	2	2	1	1	1	1	-
5	21	21	21	9	12	20	9	11
6	5	5	5	1	4	4	1	3
7	98	98	97	42	55	86	41	45
8	108	100	98	50	48	92	49	43
9	105	100	97	56	41	85	53	32
10	80	77	75	38	37	63	38	25
11	100	100	97	48	49	87	47	40
12	101	100	96	43	53	87	41	46
13	100	100	96	51	45	91	49	42
14	100	100	96	42	54	88	42	46
15	100	99	95	49	46	79	46	33
Total	1,018	1,000	972	483	489	877	469	408

Appendix table 10.

Age classification of male seals in commercial kill,
St. George Island, 27 June to 15 August 1960

Date	Rookery	Males killed	Tooth sample size	Percent in each age class					Estimated number killed from age class				
				2	3	4	5	6	2	3	4	5	6
27 June	ZAP	114	13	-	31	69	-	-	-	35	79	-	-
28	NOR	92	9	-	56	44	-	-	-	52	40	-	-
29	EAST	79	8	-	50	50	-	-	-	39	40	-	-
30	STAR	31	4	-	50	50	-	-	-	16	15	-	-
1 July	NOR	58	12	-	67	33	-	-	-	39	19	-	-
Round total		374	46	-	-	-	-	-	-	181	193	-	-
2 July	ZAP	111	22	-	41	41	18	-	-	46	46	19	-
3	NOR	67	14	-	43	50	7	-	-	29	34	4	-
4	EAST	69	14	-	57	36	7	-	-	39	25	5	-
5	STAR	20	10	-	40	60	-	-	-	8	12	-	-
6	NOR	102	30	3	63	27	7	-	3	64	28	7	-
Round total		369	90	-	-	-	-	-	3	186	145	35	-
7 July	ZAP	160	32	-	66	19	13	2	-	106	30	21	3
8	NOR	88	18	-	50	50	-	-	-	44	44	-	-
9	EAST	179	36	8	53	28	11	-	14	95	50	20	-
10	STAR	65	14	-	79	14	7	-	-	51	9	5	-
11	NOR	149	41	-	76	24	-	-	-	113	36	-	-
Round total		641	141	-	-	-	-	-	14	409	169	46	3
12 July	ZAP	148	29	-	65	35	-	-	-	96	52	-	-
13	NOR	70	19	-	58	37	5	-	-	41	26	3	-
14	EAST	137	28	4	79	14	3	-	6	108	19	4	-
15	STAR	47	15	-	60	20	20	-	-	29	9	9	-
16	NOR	102	20	-	75	15	10	-	-	77	15	10	-
Round total		504	111	-	-	-	-	-	6	351	121	26	-
17 July	ZAP	106	31	3	65	29	3	-	3	69	31	3	-
18	NOR	124	23	-	70	22	8	-	-	87	27	10	-
19	EAST	131	26	-	66	15	15	4	-	87	20	20	4
20	STAR	26	10	-	60	30	10	-	-	16	8	2	-
21	NOR	194	34	-	68	26	6	-	-	132	50	12	-
Round total		581	124	-	-	-	-	-	3	391	136	47	4
22 July	ZAP	90	18	-	72	28	-	-	-	65	25	-	-
23	NOR	178	36	-	78	19	3	-	-	139	34	5	-
24	EAST	197	36	2	67	25	6	-	4	132	49	12	-
25	STAR	62	17	-	82	12	6	-	-	51	7	4	-
26	NOR	242	42	9	67	19	5	-	22	162	46	12	-
Round total		769	149	-	-	-	-	-	26	549	161	33	-
27 July	ZAP	111	24	-	63	25	12	-	-	70	28	13	-
28	NOR	149	29	-	90	10	-	-	-	134	15	-	-
29	EAST	493	50	6	86	8	-	-	30	424	39	-	-
30	STAR	129	25	8	68	20	4	-	10	88	26	5	-
31	NOR	233	22	-	82	18	-	-	-	191	42	-	-
Round total		1115	150	-	-	-	-	-	40	907	150	18	-
1 August	ZAP	243	48	6	75	19	-	-	15	182	46	-	-
2	NOR	213	23	5	78	17	-	-	11	166	36	-	-
3	EAST	415	42	10	78	7	5	-	41	324	29	21	-
4	STAR	60	14	7	64	22	7	-	4	39	13	4	-
5	NOR	333	33	12	67	15	6	-	40	223	50	20	-
Round total		1264	160	-	-	-	-	-	111	934	174	45	-
6 August	ZAP	200	19	5	74	16	5	-	10	148	32	10	-
7	NOR	225	24	13	66	21	-	-	29	149	47	-	-
8	EAST	589	50	26	70	4	-	-	153	412	24	-	-
9	STAR	210	26	3	89	8	-	-	6	187	17	-	-
10	NOR	280	34	3	94	3	-	-	8	263	9	-	-
Round total		1504	153	-	-	-	-	-	206	1159	129	10	-
11 August	ZAP	6	-	)					2	3	1	-	-
12	NOR	2	-	) No sample 1/					1	1	-	-	-
13	EAST	-	-	)					-	-	-	-	-
14	STAR	45	11	36	46	18	-	-	16	21	8	-	-
15	NOR	9	6	33	67	-	-	-	3	6	-	-	-
Round total		62	17	-	-	-	-	-	22	31	9	-	-
Season total		7183	1141	-	-	-	-	-	431	5098	1387	260	7

1/ Ages for 11 and 12 August estimated from sample for 14 August.

Appendix table 11.

Cumulative age classification of male seals in commercial kill, by day, St. George Island, 27 June to 15 August 1960

Date	Rookery	Estimated kill from each age class					Total kill	Percent kill from each age class				
		2	3	4	5	6		2	3	4	5	6
27 June	ZAP	-	35	79	-	-	114	-	31	69	-	-
28	NOR	-	87	119	-	-	206	-	42	58	-	-
29	EAST	-	126	159	-	-	285	-	44	56	-	-
30	STAR	-	142	174	-	-	316	-	45	55	-	-
1 July	NOR	-	181	193	-	-	374	-	48	52	-	-
2	ZAP	-	227	239	19	-	485	-	47	49	4	-
3	NOR	-	256	273	23	-	552	-	47	49	4	-
4	EAST	-	295	298	28	-	621	-	48	48	4	-
5	STAR	-	303	310	28	-	641	-	48	48	4	-
6	NOR	3	367	338	35	-	743	1	49	45	5	-
7	ZAP	3	473	368	56	3	903	1	52	41	6	-
8	NOR	3	517	412	56	3	991	1	52	41	6	-
9	EAST	17	612	462	76	3	1170	1	52	40	7	-
10	STAR	17	663	471	81	3	1235	1	54	38	7	-
11	NOR	17	776	507	81	3	1384	1	56	37	6	-
12	ZAP	17	872	559	81	3	1532	1	58	36	5	-
13	NOR	17	913	585	84	3	1602	1	57	37	5	-
14	EAST	23	1021	604	88	3	1739	-	60	35	5	-
15	STAR	23	1050	613	97	3	1786	1	59	35	5	-
16	NOR	23	1127	628	107	3	1888	1	60	33	6	-
17	ZAP	26	1196	659	110	3	1994	1	60	33	6	-
18	NOR	26	1283	686	120	3	2118	1	61	32	6	-
19	EAST	26	1370	706	140	7	2249	1	61	31	6	1
20	STAR	26	1386	714	142	7	2275	1	61	31	6	1
21	NOR	26	1518	764	154	7	2469	1	61	31	6	1
22	ZAP	26	1583	789	154	7	2559	1	62	31	6	-
23	NOR	26	1722	823	159	7	2737	1	63	30	6	-
24	EAST	30	1854	872	171	7	2934	1	63	30	6	-
25	STAR	30	1905	879	175	7	2996	1	64	29	6	-
26	NOR	52	2067	925	187	7	3238	2	64	28	6	-
27	ZAP	52	2137	953	200	7	3349	2	64	28	6	-
28	NOR	52	2271	968	200	7	3498	1	65	28	6	-
29	EAST	82	2695	1007	200	7	3991	2	68	25	5	-
30	STAR	92	2783	1033	205	7	4120	2	68	25	5	-
31	NOR	92	2974	1075	205	7	4353	2	68	25	5	-
1 August	ZAP	107	3156	1121	205	7	4596	2	69	24	5	-
2	NOR	118	3322	1157	205	7	4809	2	69	24	5	-
3	EAST	159	3646	1186	226	7	5224	3	70	23	4	-
4	STAR	163	3685	1199	230	7	5284	3	70	23	4	-
5	NOR	203	3908	1249	250	7	5617	4	70	22	4	-
6	ZAP	213	4056	1281	260	7	5817	4	70	22	4	-
7	NOR	242	4205	1328	260	7	6042	4	70	22	4	-
8	EAST	395	4617	1352	260	7	6631	6	70	20	4	-
9	STAR	401	4804	1369	260	7	6841	6	70	20	4	-
10	NOR	409	5067	1378	260	7	7121	6	71	19	4	-
11	ZAP	411	5070	1379	260	7	7127	6	71	19	4	-
12	NOR	412	5071	1379	260	7	7129	6	71	19	4	-
13	EAST	412	5071	1379	260	7	7129	6	71	19	4	-
14	STAR	428	5092	1387	260	7	7174	6	71	19	4	-
15	NOR	431	5098	1387	260	7	7183	6	71	19	4	-

Appendix table 12.

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. George Island, 27 June to 15 August 1960

	Age									
	3	4	5	6	7	8	9	10	10+	Total
27 June-18 July	No females killed									
19 July										
Multipara										
nonpregnant	-	-	-	-	-	-	-	-	1	1
Round 5 total	-	-	-	-	-	-	-	-	1	1
23 July										
Multipara										
pregnant	-	-	-	-	-	-	-	1	1	2
nonpregnant	-	-	-	-	-	-	-	-	1	1
24 July										
Multipara										
pregnant	-	-	-	-	-	-	-	-	1	1
nonpregnant	-	-	-	-	-	-	-	-	2	2
25 July										
Multipara										
pregnant	-	-	-	-	-	-	-	1	1	2
26 July										
Multipara										
pregnant	-	-	1	-	-	-	1	-	1	3
Multipara										
pregnant	-	-	1	-	-	-	1	2	4	8
nonpregnant	-	-	-	-	-	-	-	-	3	3
Round 6 total	-	-	1	-	-	-	1	2	7	11
27 July										
Multipara										
nonpregnant	-	-	-	-	1	-	-	-	-	1
29 July										
Multipara										
pregnant	-	-	-	1	-	-	1	-	1	3
nonpregnant	-	-	-	-	-	-	-	1	3	4
30 July										
Primipara										
pregnant	-	-	-	-	-	1	-	-	-	1
Multipara										
pregnant	-	-	-	1	-	-	-	-	-	1
nonpregnant	-	-	-	-	-	-	-	-	1	1
31 July										
Nullipara	-	1	1	-	-	-	-	-	-	2
Multipara										
pregnant	-	-	1	-	-	1	-	-	3	5
nonpregnant	-	-	1	-	1	-	-	-	3	5
Nullipara	-	1	1	-	-	-	-	-	-	2
Primipara										
pregnant	-	-	-	-	-	1	-	-	-	1
Multipara										
pregnant	-	-	1	2	-	1	1	-	4	9
nonpregnant	-	-	1	-	2	-	-	1	7	11
Round 7 total	-	1	3	2	2	2	1	1	11	23
1 August										
Multipara										
pregnant	-	1	-	1	-	1	-	2	4	9
nonpregnant	-	-	1	1	-	-	-	-	5	7
2 August										
Multipara										
pregnant	-	-	2	1	-	1	1	1	-	6
nonpregnant	-	-	-	-	1	1	1	-	1	4

Appendix table 12. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. George Island, 27 June to 15 August 1960

	Age									
	3	4	5	6	7	8	9	10	10+	Total
3 August										
Nullipara	1	-	-	-	-	-	-	-	-	1
Primipara										
pregnant	-	-	3	1	-	-	-	-	-	4
nonpregnant	-	1	-	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	-	3	2	3	4	-	4	16
nonpregnant	-	-	-	1	-	-	5	-	9	15
4 August										
Primipara										
nonpregnant	-	1	-	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	1	-	-	-	-	-	-	1
5 August										
Nullipara	-	1	-	-	-	-	-	-	-	1
Primipara										
nonpregnant	-	-	1	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	2	2	-	-	-	-	5	9
nonpregnant	-	-	2	1	1	1	2	-	3	10
Nullipara	1	1	-	-	-	-	-	-	-	2
Primipara										
pregnant	-	-	3	1	-	-	-	-	-	4
nonpregnant	-	2	1	-	-	-	-	-	-	3
Multipara										
pregnant	-	1	5	7	2	5	5	3	13	41
nonpregnant	-	-	3	3	2	2	8	-	18	36
Round 8 total	1	4	12	11	4	7	13	3	31	86
6 August										
Nullipara	-	1	-	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	-	-	-	-	-	-	1	1
nonpregnant	-	-	-	-	-	-	1	-	2	3
7 August										
Nullipara	1	10	1	-	-	-	1	-	-	13
Primipara										
pregnant	-	1	4	-	-	-	-	-	-	5
nonpregnant	-	-	1	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	12	3	7	4	4	1	6	37
nonpregnant	-	-	6	4	6	5	3	2	16	42
8 August										
Nullipara	2	3	2	2	-	-	-	-	-	9
Primipara										
pregnant	-	1	4	-	-	-	-	-	-	5
nonpregnant	-	2	-	-	-	-	-	-	-	2
Multipara										
pregnant	-	-	3	5	8	4	8	6	11	45
nonpregnant	-	-	1	6	7	6	4	5	10	39
9 August										
Nullipara	3	7	4	2	-	-	1	-	-	17
Primipara										
pregnant	-	2	2	1	-	-	-	-	-	5
nonpregnant	-	2	-	-	-	-	-	-	-	2
Multipara										
pregnant	-	1	5	11	6	10	6	3	9	51
nonpregnant	-	-	3	2	7	2	3	-	8	25

Appendix table 12. (con.)

Reproductive condition of female seals sampled from commercial kill, by age, date, and round, St. George Island, 27 June to 15 August 1960

	Age									
	3	4	5	6	7	8	9	10	10+	Total
10 August										
Nullipara	1	12	5	-	-	-	-	-	-	18
Primipara										
pregnant	-	-	6	2	2	2	-	-	-	12
nonpregnant	1	-	-	-	-	-	-	-	-	1
Multipara										
pregnant	-	-	2	4	-	7	5	2	6	26
nonpregnant	-	-	3	3	2	3	-	3	6	20
Nullipara	7	33	12	4	-	-	2	-	-	58
Primipara										
pregnant	-	4	16	3	2	2	-	-	-	27
nonpregnant	1	4	1	-	-	-	-	-	-	6
Multipara										
pregnant	-	1	22	23	21	25	23	12	33	160
nonpregnant	-	-	13	15	22	16	11	10	42	129
Round 9 total	8	42	64	45	45	43	36	22	75	380
11 August										
Nullipara	3	8	2	1	3	1	-	-	-	18
Primipara										
pregnant	-	1	9	-	-	-	-	-	-	10
nonpregnant	-	1	1	1	-	-	1	-	-	4
Multipara										
pregnant	-	-	4	6	3	8	6	2	9	38
nonpregnant	-	-	5	6	4	2	1	2	10	30
12 August										
Nullipara	4	6	14	-	1	-	-	-	-	25
Primipara										
pregnant	-	2	5	1	-	-	-	-	-	8
nonpregnant	-	-	2	1	-	1	-	-	-	4
Multipara										
pregnant	-	-	5	11	2	6	5	2	4	35
nonpregnant	-	1	-	2	-	4	8	1	12	28
13 August										
Nullipara	1	1	2	3	-	1	2	-	2	12
Primipara										
pregnant	2	-	3	2	1	-	1	-	2	11
nonpregnant	-	-	-	-	-	-	-	-	1	1
Multipara										
pregnant	-	2	9	2	4	4	2	4	15	42
nonpregnant	1	2	8	4	2	4	4	1	8	34
14 August										
Nullipara	4	8	9	3	-	-	-	-	1	25
Primipara										
pregnant	-	-	7	-	1	3	-	-	-	11
nonpregnant	-	-	2	2	1	2	-	-	1	8
Multipara										
pregnant	-	-	5	2	5	3	-	5	11	31
nonpregnant	-	-	2	1	3	2	4	-	13	25
15 August										
Nullipara	4	12	6	1	-	-	-	-	-	23
Primipara										
pregnant	-	3	15	7	-	-	1	-	1	27
nonpregnant	-	-	1	1	-	1	-	-	1	4
Multipara										
pregnant	-	-	-	3	2	1	1	3	12	22
nonpregnant	-	1	1	1	-	5	3	1	11	23
Nullipara	16	35	33	8	4	2	2	-	3	103
Primipara										
pregnant	2	6	39	10	2	3	2	-	3	67
nonpregnant	-	1	6	5	1	4	1	-	3	21
Multipara										
pregnant	-	2	23	24	16	22	14	16	51	168
nonpregnant	1	4	16	14	9	17	20	5	54	140
Round 10 total	19	48	117	61	32	48	39	21	114	499
Season total	28	95	197	119	83	100	90	49	239	1000

Appendix table 13.

Age classification of females in commercial kill,
St. George Island, Alaska, 27 June to 15 August 1960

Date	Rookery	Females killed	Daily sample	Number in each age class of sample									Percent in each age class of sample									Estimated number killed from each age class								
				3	4	5	6	7	8	9	10	10+	3	4	5	6	7	8	9	10	10+	3	4	5	6	7	8	9	10	10+
27 June-15 July		No females killed																												
July 17	ZAP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	NOR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	EAST	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	1
20	STAR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	NOR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round total		1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
July 22	ZAP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	NOR	3	3	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	34	66	-	-	-	-	-	-	-	1	2
24	EAST	3	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	3
25	STAR	2	2	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	1	1
26	NOR	3	3	-	-	1	-	-	-	1	-	1	-	-	34	-	-	-	33	-	33	-	-	1	-	-	-	1	-	1
Round total		11	11	-	-	1	-	-	-	1	2	7	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	2	7
July 27	ZAP	1	1	-	-	-	-	1	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	1	-	-	-	-
28	NOR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	EAST	7	7	-	-	-	1	-	-	1	1	4	-	-	-	14	-	-	14	14	58	-	-	-	1	-	-	1	1	4
30	STAR	3	3	-	-	-	1	-	1	-	-	1	-	-	-	34	-	33	-	-	33	-	-	-	1	-	1	-	-	1
31	NOR	12	12	-	1	3	-	1	1	-	-	6	-	8	25	-	9	8	-	-	50	-	1	3	-	1	1	-	-	6
Round total		23	23	-	1	3	2	2	2	1	1	11	-	-	-	-	-	-	-	-	-	-	1	3	2	2	2	1	1	11
August 1	ZAP	16	16	-	1	1	2	-	1	-	2	9	-	6	6	13	-	6	-	13	56	-	1	1	2	-	1	-	2	9
2	NOR	10	10	-	-	2	1	1	2	2	1	1	-	-	20	10	10	20	20	10	10	-	-	2	1	1	2	2	1	1
3	EAST	37	37	1	1	3	5	2	3	9	-	13	3	3	8	14	5	8	24	-	35	1	1	3	5	2	3	9	-	13
4	STAR	2	2	-	1	1	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
5	NOR	21	21	-	1	5	3	1	1	2	-	8	-	5	24	14	5	5	9	-	38	-	1	5	3	1	1	2	-	8
Round total		86	86	1	4	12	11	4	7	13	3	31	-	-	-	-	-	-	-	-	-	1	4	12	11	4	7	13	3	31
August 6	ZAP	5	5	-	1	-	-	-	-	1	-	3	-	20	-	-	-	-	20	-	60	-	1	-	-	-	-	1	-	3
7	NOR	98	98	1	11	24	7	13	9	8	3	22	1	11	25	7	13	9	8	3	23	1	11	24	7	13	9	8	3	22
8	EAST	108	100	2	6	10	13	15	10	12	11	21	2	6	10	13	15	10	12	11	21	2	6	11	14	16	11	13	12	23
9	STAR	105	100	3	12	14	16	13	12	10	3	17	3	12	14	16	13	12	10	3	17	3	12	15	17	14	13	10	3	18
10	NOR	80	77	2	12	16	9	4	12	5	5	12	2	16	21	12	5	16	6	6	16	2	13	17	10	4	13	4	4	13
Round total		396	380	8	42	64	45	45	43	36	22	75	-	-	-	-	-	-	-	-	-	8	43	67	48	47	46	36	22	79
August 11	ZAP	100	100	3	10	21	14	10	11	8	4	19	3	10	21	14	10	11	8	4	19	3	10	21	14	10	11	8	4	19
12	NOR	101	100	4	9	26	15	3	11	13	3	16	4	9	26	15	3	11	13	3	16	4	9	27	15	3	11	13	3	16
13	EAST	100	100	4	5	22	11	7	9	9	5	28	4	5	22	11	7	9	9	5	28	4	5	22	11	7	9	9	5	28
14	STAR	100	100	4	8	25	8	10	10	4	5	26	4	8	25	8	10	10	4	5	26	4	8	25	8	10	10	4	5	26
15	NOR	100	99	4	16	23	13	2	7	5	4	25	4	16	23	13	2	7	5	4	26	4	16	23	13	2	7	5	4	26
Round total		501	499	19	48	117	61	32	48	39	21	114	-	-	-	-	-	-	-	-	-	19	48	118	61	32	48	39	21	115
Season total		1018	1000	28	95	197	119	83	100	90	49	239	-	-	-	-	-	-	-	-	-	28	96	201	122	85	103	90	49	244

Appendix table 14.

Cumulative age classification of female seals in commercial kill, by day, St. George Island, 27 June to 15 August 1960

Date	Rookery	Number killed from age class 3	4	5	6	7	8	9	10	10+	Total killed	Percent killed from age class 3	4	5	6	7	8	9	10	10+
27 June-																				
18 July		No females killed																		
July																				
19	EAST	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	100
20	STAR	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	100
21	NOR	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	100
22	ZAP	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	100
23	NOR	-	-	-	-	-	-	-	1	3	4	-	-	-	-	-	-	-	25	75
24	EAST	-	-	-	-	-	-	-	1	6	7	-	-	-	-	-	-	-	14	86
25	STAR	-	-	-	-	-	-	-	2	7	9	-	-	-	-	-	-	-	22	78
26	NOR	-	-	1	-	-	-	1	2	8	12	-	-	8	-	-	-	8	17	67
27	ZAP	-	-	1	-	1	-	1	2	8	13	-	-	8	-	8	-	8	15	61
28	NOR	-	-	1	-	1	-	1	2	8	13	-	-	8	-	8	-	8	15	61
29	EAST	-	-	1	1	1	-	2	3	12	20	-	-	9	9	9	-	5	8	60
30	STAR	-	-	1	2	1	1	2	3	13	23	-	-	4	9	4	4	9	13	57
31	NOR	-	1	4	2	2	2	2	3	19	35	-	3	11	6	6	6	6	8	54
August																				
1	ZAP	-	2	5	4	2	3	2	5	28	51	-	4	10	8	4	5	4	10	55
2	NOR	-	2	7	5	3	5	4	6	29	61	-	3	11	8	5	8	7	10	48
3	EAST	1	3	10	10	5	8	13	6	42	98	1	3	10	10	5	8	14	6	43
4	STAR	1	4	11	10	5	8	13	6	42	100	1	4	11	10	5	8	13	6	42
5	NOR	1	5	16	13	6	9	15	6	50	121	1	4	13	11	5	8	12	5	41
6	ZAP	1	6	16	13	6	9	16	6	53	126	1	5	10	12	5	7	13	5	42
7	NOR	2	17	40	20	19	18	24	9	75	224	1	8	18	9	8	8	11	4	33
8	EAST	4	23	51	34	35	29	37	21	98	332	1	7	15	10	11	9	11	6	30
9	STAR	7	35	66	51	49	42	47	24	116	437	2	8	15	12	11	10	11	5	26
10	NOR	9	48	83	61	53	55	51	28	129	517	2	9	16	12	10	11	10	5	25
11	ZAP	12	58	104	75	63	66	59	32	148	617	2	9	17	12	10	11	10	5	24
12	NOR	16	67	131	90	66	77	72	35	164	718	2	9	18	13	9	11	10	5	23
13	EAST	20	72	153	101	73	86	81	40	192	818	2	9	19	12	9	11	10	5	23
14	STAR	24	80	178	109	83	96	85	45	218	918	3	9	19	12	9	10	9	5	24
15	NOR	28	96	201	122	85	103	90	49	244	1018	3	9	20	12	8	10	9	5	24

Appendix table 15.
Reproductive condition of female seals sampled from commercial kill, by length, St. Paul Island, 1960

Length in inches		Nullipara	Primipara pregnant	Primipara non-pregnant	Multipara pregnant	Multipara non-pregnant	Total
37	number	1	-	-	-	-	1
	percent	-	-	-	-	-	-
38	number	2	-	-	-	-	2
	percent	-	-	-	-	-	-
39	number	17	-	-	-	-	17
	percent	2	-	-	-	-	-
40	number	58	1	-	-	-	59
	percent	7	-	-	-	-	2
41	number	141	11	1	9	3	165
	percent	16	2	1	1	1	6
42	number	186	51	5	52	12	306
	percent	21	10	5	6	2	10
43	number	190	116	16	112	42	476
	percent	21	24	15	12	8	16
44	number	156	122	26	202	91	597
	percent	17	25	25	22	17	21
45	number	94	117	28	220	129	588
	percent	10	24	27	24	24	20
46	number	47	50	13	176	100	386
	percent	5	10	12	19	19	13
47	number	13	18	9	82	94	216
	percent	1	4	9	9	18	8
48	number	4	2	5	42	34	87
	percent	-	-	5	5	6	3
49	number	2	3	1	15	14	35
	percent	-	1	1	2	3	1
50	number	-	-	-	2	5	7
	percent	-	-	-	-	1	-
51	number	-	-	-	1	3	4
	percent	-	-	-	-	1	-
Total		911	491	104	913	527	2,946
Percent		31	17	3	31	18	

Appendix table 16.
Length of female seals sampled from commercial kill, by age, St. George Island, 1960

Length in inches		Age 3	4	5	6	7	8	9	10	10+	Total
39	number	2	-	-	-	-	-	-	-	-	2
	percent	7	-	-	-	-	-	-	-	-	-
40	number	4	4	1	1	-	-	-	-	-	10
	percent	14	4	-	1	-	-	-	-	-	1
41	number	13	11	7	1	-	1	1	-	1	35
	percent	46	12	4	1	-	1	1	-	-	4
42	number	5	25	28	7	4	5	1	3	5	83
	percent	18	26	14	6	5	5	1	6	2	8
43	number	3	22	43	24	8	10	10	3	17	140
	percent	11	23	22	20	10	10	11	6	7	14
44	number	1	21	55	43	29	28	18	10	40	245
	percent	4	22	28	36	35	28	20	21	17	24
45	number	-	7	37	28	20	28	23	14	66	223
	percent	-	8	19	23	24	28	26	29	28	22
46	number	-	5	18	11	13	20	24	11	59	161
	percent	-	5	9	9	16	20	27	22	25	16
47	number	-	-	5	2	6	7	9	6	31	66
	percent	-	-	3	2	7	7	10	12	13	7
48	number	-	-	1	2	1	1	4	2	11	22
	percent	-	-	-	2	1	1	4	4	4	2
49	number	-	-	2	-	1	-	-	-	5	8
	percent	-	-	1	-	1	-	-	-	2	1
50	number	-	-	-	-	1	-	-	-	4	5
	percent	-	-	-	-	1	-	-	-	2	1
Total		28	95	197	119	83	100	90	49	239	1,000
Percent		3	9	20	12	8	10	9	5	24	

Appendix table 17.
Reproductive condition of female seals sampled from commercial kill, by length, St. George Island, 1960

Length in inches		Nullipara	Primipara pregnant	Primipara non-pregnant	Multipara pregnant	Multipara non-pregnant	Total
39	number	2	-	-	-	-	2
	percent	1	-	-	-	-	-
40	number	8	1	-	-	1	10
	percent	5	1	-	-	-	1
41	number	27	6	-	2	-	35
	percent	16	6	-	1	-	4
42	number	31	23	5	11	13	83
	percent	19	23	17	3	4	8
43	number	33	16	3	47	41	140
	percent	20	16	10	12	13	14
44	number	40	26	13	105	61	245
	percent	24	27	43	27	19	25
45	number	17	19	5	89	93	223
	percent	10	19	17	23	29	22
46	number	6	7	3	88	57	161
	percent	4	7	10	23	18	16
47	number	1	-	1	29	35	66
	percent	1	-	3	7	11	7
48	number	-	-	-	12	10	22
	percent	-	-	-	3	3	2
49	number	-	1	-	1	6	8
	percent	-	1	-	-	2	1
50	number	-	-	-	2	3	5
	percent	-	-	-	1	1	-
Total		165	99	30	386	320	1000
Percent		16	10	3	39	32	

Appendix table 18.

Summary of length classes of tagged and tag-lost 3- and 4-year-old male seals, by rookery of recovery, Pribilof Islands, Alaska, 1960

Length	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul							St. George					Grand
in inches	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
Age 3																										
39	-	-	-	1	-	-	1	1	1	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
40	8	5	1	-	-	8	22	3	1	1	-	5	27	2	-	2	-	1	-	5	-	-	-	1	1	6
41	27	20	10	4	11	39	111	15	14	4	8	41	152	13	9	4	2	4	15	47	3	-	1	3	7	54
42	88	41	3	20	39	94	285	31	28	8	18	85	370	35	5	5	6	10	29	90	5	8	3	3	19	109
43	118	55	15	24	45	122	379	15	29	8	6	58	437	50	16	8	11	18	58	161	2	9	-	-	11	172
44	75	27	16	18	28	87	251	20	15	5	6	46	297	32	7	4	8	13	30	94	2	3	1	-	6	100
45	39	14	4	3	14	42	116	10	5	2	1	18	134	17	11	1	3	4	15	51	1	2	-	1	4	55
46	15	4	1	2	6	13	41	1	-	-	-	1	42	2	-	-	-	-	6	8	-	-	-	-	-	8
47	3	7	-	1	1	2	14	1	-	-	-	1	15	1	1	-	-	1	1	4	-	-	-	-	-	4
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
49	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	374	173	50	73	144	407	1221	97	93	28	39	257	1478	152	49	24	30	51	155	461	13	22	5	8	48	509
Age 4																										
41	1	-	-	-	1	1	3	2	1	-	-	3	6	-	-	-	-	-	-	-	-	-	-	-	-	-
42	3	1	-	-	-	5	9	2	-	1	-	3	12	3	-	-	-	-	2	5	-	2	1	-	3	8
43	6	3	-	2	2	13	26	2	2	-	1	5	31	3	-	-	1	-	1	5	-	2	-	-	2	7
44	11	5	-	3	1	6	26	5	5	-	3	13	39	8	-	-	3	1	6	18	-	-	1	-	1	19
45	12	6	1	6	2	17	44	3	1	1	4	9	53	2	1	-	1	-	4	8	-	1	-	-	1	9
46	5	4	-	3	2	7	21	-	4	-	1	5	26	2	1	-	-	-	5	8	-	-	-	-	-	8
47	2	-	-	-	-	5	7	3	1	-	2	6	13	-	-	-	1	-	1	2	-	-	-	-	-	2
48	1	1	-	1	4	1	8	2	-	-	-	2	10	-	-	-	-	-	1	1	-	-	-	-	-	1
49	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	42	20	1	15	13	55	146	19	14	2	11	46	192	18	2	-	6	1	21	48	-	5	2	-	7	55

Appendix table 19.

Summary of length classes of tagged and tag-lost 3- and 4-year-old female seals, by rookery of recovery, Pribilof Islands, Alaska, 1960

Length	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul							St. George					Grand
in inches	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
Age 3																										
40	-	-	-	1	-	-	1	-	-	-	-	-	1	-	2	-	-	1	-	3	-	-	-	-	-	3
41	-	-	-	-	2	-	2	-	2	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	6	-	-	-	-	-	6
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	2
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	-	1	2	-	3	-	2	-	-	2	5	-	2	-	3	4	3	12	-	-	-	-	-	12
Age 4																										
40	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	-	-	-	1
42	-	2	-	3	1	-	6	1	-	-	-	1	7	-	1	-	-	-	-	1	-	-	-	-	-	1
43	-	4	-	1	-	1	6	-	-	-	-	-	6	2	1	-	2	-	1	6	-	-	-	-	-	6
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
45	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	6	-	4	3	1	14	2	-	-	-	2	16	2	2	-	2	1	1	8	1	-	-	-	1	9

Appendix table 20.

Length classes of tagged and tag-lost 3-year-old male seals, by rookery of recovery and by round, Pribilof Islands, Alaska, 1960

Length in inches	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul						St. George					Grand
	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
Round number 1																										
41	1	2	-	-	-	1	4	1	-	1	1	3	7	-	-	-	-	-	-	-	-	-	-	-	-	-
42	2	6	-	-	2	1	11	1	2	1	1	5	16	1	-	-	-	2	-	3	-	-	-	-	-	3
43	4	1	-	1	2	2	10	-	-	-	-	-	10	1	1	-	1	-	3	6	-	-	-	-	-	6
44	2	-	-	1	1	1	5	-	-	-	-	-	5	1	-	-	-	-	-	1	-	-	-	-	-	1
45	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
46	1	-	-	-	1	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	10	10	-	2	6	6	34	2	2	2	2	8	42	3	1	-	1	2	3	10	-	-	-	-	-	10
Round number 2																										
40	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	-	-	-	1
41	3	2	-	-	1	2	8	1	-	-	-	1	9	-	-	-	1	1	2	4	-	-	-	-	-	4
42	7	1	-	-	1	5	14	1	-	-	1	2	16	2	-	-	1	-	-	3	-	-	-	-	-	3
43	7	1	2	2	2	7	21	-	-	-	-	-	21	2	1	-	-	-	-	3	-	-	-	-	-	3
44	1	2	-	1	-	4	8	1	-	-	-	1	9	1	-	-	-	-	-	1	-	-	-	-	-	1
45	-	-	-	-	-	1	1	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	1
Total	18	6	2	3	4	20	53	3	-	-	1	4	57	5	2	-	2	2	2	13	-	-	-	-	-	13
Round number 3																										
40	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	1
41	6	-	1	1	1	-	9	1	2	-	1	4	13	1	-	-	-	-	-	1	-	-	-	-	-	1
42	7	-	-	2	6	10	25	2	2	-	1	5	30	2	1	-	-	-	1	4	-	-	1	-	1	5
43	13	-	-	-	2	2	17	2	3	1	-	6	23	4	-	-	-	2	1	7	-	-	-	-	-	7
44	13	-	-	-	2	8	23	1	-	1	1	3	26	4	-	-	-	1	-	5	-	-	-	-	-	5
45	5	-	-	-	1	3	9	1	1	-	-	2	11	4	-	-	-	1	-	5	-	-	-	-	-	5
46	3	-	-	-	1	2	6	-	-	-	-	-	6	-	-	-	-	-	1	1	-	-	-	-	-	1
47	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	1
Total	48	1	1	3	13	25	91	7	8	2	3	20	111	16	1	-	-	4	3	24	-	-	1	1	2	26
Round number 4																										
39	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
40	1	-	-	-	-	3	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
41	5	1	-	-	-	9	15	-	1	-	2	3	18	2	-	-	-	1	3	6	-	-	-	-	-	6
42	9	6	1	2	3	12	33	3	1	-	4	8	41	3	-	-	1	1	5	10	-	-	-	1	1	11
43	7	6	-	-	1	9	23	1	2	-	-	3	26	2	2	-	2	2	4	12	-	-	-	-	-	12
44	2	1	-	-	-	4	7	-	-	1	1	2	9	2	2	1	1	-	3	9	-	-	-	-	-	9
45	-	1	-	-	-	-	1	-	-	-	-	-	1	2	2	-	-	-	-	4	-	-	-	-	-	4
46	-	1	-	1	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	1	-	1	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	24	17	1	4	4	37	87	4	5	1	7	17	104	11	6	1	4	4	15	41	-	-	-	1	1	42
Round number 5																										
39	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
40	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
41	3	2	-	1	-	3	9	1	1	-	-	2	11	-	1	-	-	-	-	1	-	-	-	-	-	1
42	10	4	1	1	-	6	22	2	1	-	2	5	27	4	2	-	2	1	5	14	-	1	-	-	1	15
43	14	5	-	2	1	15	37	-	-	-	-	-	37	8	2	-	2	1	4	17	-	-	-	-	-	17
44	9	-	1	1	-	11	22	3	1	-	-	4	26	6	-	-	1	-	4	11	-	-	-	-	-	11
45	3	1	1	-	1	-	6	1	-	-	-	1	7	2	1	-	-	-	2	5	-	-	-	-	-	5
46	1	-	-	-	-	1	2	-	-	-	-	-	2	1	-	-	-	-	3	4	-	-	-	-	-	4
47	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	41	12	3	5	3	36	100	8	3	-	2	13	113	21	6	-	5	2	18	52	-	1	-	-	1	53
Round number 6																										
40	1	1	-	-	-	2	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
41	2	7	3	-	1	10	23	2	-	-	1	3	26	1	2	-	-	1	2	6	1	-	-	1	2	8
42	8	12	1	2	1	10	34	7	2	2	1	12	46	7	-	3	-	-	3	13	1	-	-	-	1	14
43	18	18	2	1	3	7	49	1	1	1	-	3	52	6	2	1	1	1	7	18	-	-	-	-	-	18
44	6	5	-	1	3	5	20	1	4	-	-	5	25	2	2	-	1	4	1	10	-	-	-	-	-	10
45	5	2	-	-	3	4	14	2	1	-	-	3	17	2	3	-	2	-	-	7	-	-	-	-	-	7
46	-	-	-	-	1	1	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1
Total	40	45	6	4	12	39	146	13	8	3	2	26	172	18	9	4	4	7	13	55	2	-	-	1	3	58
Round number 7																										
39	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
40	3	1	-	-	-	1	5	1	-	-	-	1	6	2	-	1	-	-	-	3	-	-	-	-	-	3
41	5	-	5	2	6	2	20	4	4	1	1	10	30	8	-	2	1	-	1	12	-	-	-	1	1	13
42	20	-	-	7	9	10	46	6	8	3	1	18	64	8	1	1	2	-	9	21	1	3	-	1	5	26
43	21	4	1	2	9	19	56	1	7	3	-	11	67	11	-	-	1	5	11	28	1	3	-	-	4	32
44	16	2	4	7	5	17	51	2	4	1	-	7	58	8	-	-	3	1	2	14	1	1	-	-	2	16
45	7	2	-	1	2	14	26	1	2	-	-	3	29	-	1	-	1	1	3	6	-	-	-	-	-	6
46	1	-	-	-	-	2	3	1	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	73	9	10	20	31	65	208	17	25	8	2	52	260	37	2	4	8	7	27	85	3	7	-	2	12	97
Round number 8																										
40	2	2	1	-	-	1	6	1	1	-	-	2	8	-	-	1	-	-	-	1	-	-	-	-	-	1
41	2	2	1	-	2	10	17	4	1	-	1	6	23	1	3	2	-	1	5	12	2	-	-	1	3	15
42	25	3	-	6	17	19	70	5	6	-	5	16	86	8	1	-	-	6	4	19	1	1	1	-	3	22
43	34	8	6	12	25	36	121	6	9	-	3	18	139	16	2	4	3	7	11	43	-	1	-	-	1	44
44	25	6	7	5	17	23	83	8	3	-	1	12	95	8	2	1	2	7	6	26	1	1	1	-	3	29
45	19	2	1	2	7	14	45	3	1	-	-	4	49	7	2	-	-	2	4	15	-	-	-	1	1	16
46	9	2	1	1	3	5	21	-	-	-	-	-	21	1	-	-	-	-	-	1	-	-	-	-	-	1
47	2	4	-	-	-	1	7	-	-	-	-	-	7	-	1	-	-	-	-	1	-	-	-	-	-	1
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	119	29	17	26	71	109	371	27	21	-	10	58	429	41	11	8	5	23	30	118	4	3	2	2	11	129
Round number 9																										
40	-	-	-	-	-	-	-	1	-	1	1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	4	-	-	-	2	6	1	5	1	1	8	14	-	3	-	-	-	2	5	-	-	-	-	-	5
42	-	8	-	-	-	21	29	3	6	1	3	13	42	-	-	1	-	-	2	3	2	3	1	1	7	10
43	-	12	4	1	-	25	42	3	7	3	3	16	58	-	6	3	1	-	17	27	1	5	-	-	6	33
44	1	11	4	-	-	14	30	4	3	1	1	9	39	-	1	2	-	-	14	17	-	1	-	-	1	18
45	-	6	2	-	-	5	13	2	-	2	-	4	17	-	1	1	-	-	6	8	1	2	-	-	3	11
46	-	1	-	-	-	2	3	-	-	-	-	-	3	-	-	-	-	-	2	2	-	-	-	-	-	2
47	-	1	-	-	-	1	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	1	43	10	1	-	70	125	14	21	9	9	53	178	-	11	7	1	-	44	63	4	11	1	1	17	80
Round number 10																										
41	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	1	-	1	1
42	-	1	-	-	-	-	1	1	-	1	1	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	3	-	-	3	1	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	2	-	-	2	-	-	1	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	1	-	5	-	-	6	2	-	3	1	6	12	-	-	-	-	-	-	-	-	-	1	-	1	1
Grand total	374	173	50	73	144	407	1221	97	93	28	39	257	1478	152	49	24	30	51	155	461	13	22	5	8	48	509

Appendix table 21.

Length classes of tagged and tag-lost 4-year-old male seals, by rookery of recovery and by round, Pribilof Islands, Alaska, 1960

Length	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul							St. George					Grand
in inches	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
Round number 1																										
42	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1	-	1	-	-	1	2
43	-	-	-	1	-	-	1	-	-	-	1	1	2	1	-	-	1	-	-	2	-	-	-	-	-	2
44	2	-	-	-	-	2	4	-	-	-	3	3	7	-	-	-	-	1	-	1	-	-	-	-	-	1
45	3	2	-	1	-	3	9	-	-	-	2	2	11	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	-	-	1	1	-	1	-	-	1	2	1	1	-	-	-	-	2	-	-	-	-	-	2
47	-	-	-	-	-	2	2	1	-	-	1	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	1	-	1	2	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	6	2	-	2	1	8	19	3	1	-	7	11	30	3	1	-	1	1	-	6	-	1	-	-	1	7
Round number 2																										
41	-	-	-	-	-	1	1	-	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
42	1	-	-	-	-	2	3	-	-	-	-	-	3	1	-	-	-	-	-	1	-	-	-	-	-	1
43	2	-	-	-	-	3	5	1	-	-	-	1	6	-	-	-	-	-	1	1	-	-	-	-	-	1
44	2	-	-	-	-	-	2	2	1	-	-	3	5	1	-	-	-	-	-	1	-	-	-	-	-	1
45	1	-	1	-	1	4	7	1	-	-	-	1	8	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	6	1	1	-	2	10	20	4	2	-	-	6	26	2	-	-	-	-	1	3	-	-	-	-	-	3
Round number 3																										
41	1	-	-	-	1	-	2	2	-	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	1	1	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	4	2	-	1	-	1	8	-	1	-	-	1	9	3	-	-	-	-	2	5	-	-	-	-	-	5
45	2	-	-	-	-	1	3	1	-	1	1	3	6	-	-	-	-	-	-	-	-	-	-	-	-	-
46	2	-	-	-	1	1	4	-	1	-	-	1	5	1	-	-	-	-	3	4	-	-	-	-	-	4
47	1	-	-	-	-	1	2	1	-	-	1	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	10	2	-	1	4	5	22	4	2	2	2	10	32	4	-	-	-	-	5	9	-	-	-	-	-	9
Round number 4																										
42	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1
43	2	1	-	1	2	4	10	-	1	-	-	1	11	1	-	-	-	-	-	1	-	1	-	-	1	2
44	-	1	-	1	-	1	3	-	-	-	-	-	3	3	-	-	-	-	-	3	-	-	-	-	-	3
45	1	1	-	1	-	-	3	-	-	-	-	-	3	-	-	-	-	-	2	2	-	-	-	-	-	2
46	-	-	-	-	-	1	1	-	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1
48	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	3	3	-	4	2	7	19	-	2	-	-	2	21	4	-	-	1	-	3	8	-	1	-	-	1	9
Round number 5																										
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1
43	-	1	-	-	-	-	1	1	1	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
44	-	1	-	-	-	1	2	1	1	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
45	1	-	-	1	-	2	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
46	1	1	-	1	-	2	5	-	-	-	-	-	5	-	-	-	-	-	1	1	-	-	-	-	-	1
47	-	-	-	-	-	-	-	1	1	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	2	3	-	2	-	5	12	3	3	-	-	6	18	-	-	-	-	-	3	3	-	1	-	-	1	4
Round number 6																										
42	-	-	-	-	-	1	1	2	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
43	1	1	-	-	-	2	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
44	1	1	-	1	1	-	4	-	1	-	-	1	5	1	-	-	-	-	-	1	-	-	-	-	-	1
45	-	-	-	2	-	-	2	1	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	1	-	-	1	-	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2	2	-	4	2	3	13	3	2	-	-	5	18	1	-	-	-	-	-	1	-	-	-	-	-	1
Round number 7																										
42	-	1	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	1	-	1	2
43	1	-	-	-	-	3	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	1	1	-	1	-	-	1	2	-	-	-	2	-	1	3	-	-	-	-	-	3
45	2	-	-	1	1	3	7	-	1	-	-	1	8	-	-	-	-	-	-	-	-	1	-	-	1	1
46	1	-	-	1	-	1	3	-	-	-	-	-	3	-	-	-	-	-	1	1	-	-	-	-	-	1
47	1	-	-	-	-	1	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	6	1	-	2	1	9	19	-	2	-	-	2	21	1	-	-	2	-	2	5	-	1	1	-	2	7
Round number 8																										
42	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1
43	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	1	2
44	2	-	-	-	-	-	2	1	-	-	-	1	3	-	-	-	1	-	1	2	-	-	-	-	-	2
45	2	-	-	-	-	2	4	-	-	-	1	1	5	2	1	-	1	-	1	5	-	-	-	-	-	5
46	1	1	-	-	1	1	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1
48	1	1	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	7	2	-	-	1	4	14	1	-	-	1	2	16	3	1	-	2	-	4	10	-	1	-	-	1	11
Round number 9																										
43	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	2	2	-	-	-	-	-	2
45	-	3	-	-	-	2	5	-	-	-	-	-	5	-	-	-	-	-	1	1	-	-	-	-	-	1
46	-	1	-	-	-	-	1	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	4	-	-	-	4	8	1	-	-	1	2	10	-	-	-	-	-	3	3	-	-	-	-	-	3
Round number 10																										
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1
Grand total	42	20	1	15	13	55	146	19	14	2	11	46	192	18	2	-	6	1	21	48	-	5	2	-	7	55

Appendix table 22.

Length classes of tagged and tag-lost 3-year-old female seals, by rookery of recovery and by round, Pribilof Islands, Alaska, 1960

Length	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul							St. George					Grand
in inches	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
												Round number 8														
41	-	-	-	-	1	-	1	-	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1
Total	-	-	-	-	1	-	1	-	1	-	-	1	2	-	-	-	-	1	-	1	-	-	-	-	-	1
												Round number 9														
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	3	-	-	-	-	-	3
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	2
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	3	7	-	-	-	-	-	7
												Round number 10														
40	-	-	-	1	-	-	1	-	-	-	-	-	1	-	2	-	-	-	-	2	-	-	-	-	-	2
41	-	-	-	-	1	-	1	-	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	2
Total	-	-	-	1	1	-	2	-	1	-	-	1	3	-	2	-	2	-	-	4	-	-	-	-	-	4
Grand total	-	-	-	1	2	-	3	-	2	-	-	2	5	-	2	-	3	4	3	12	-	-	-	-	-	12

Appendix table 23.

Length classes of tagged and tag-lost 4-year-old female seals, by rookery of recovery and by round, Pribilof Islands, Alaska, 1960

Length	Tags recovered													Tags lost												
	St. Paul							St. George					Grand	St. Paul							St. George					Grand
in inches	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total	ZAP	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP	total	total
												Round number 6														
42	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	1
												Round number 8														
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1
												Round number 9														
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1
												Round number 10														
40	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	2	-	3	-	-	5	1	-	-	-	1	6	-	1	-	-	-	-	1	-	-	-	-	-	1
43	-	4	-	1	-	1	6	-	-	-	-	-	6	2	1	-	1	-	-	4	-	-	-	-	-	4
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
45	-	-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	6	-	4	2	1	13	2	-	-	-	2	15	2	2	-	1	-	-	5	1	-	-	-	1	6
Grand total	-	6	-	4	3	1	14	2	-	-	-	2	16	2	2	-	2	1	1	8	1	-	-	-	1	9

Appendix table 24.

Recovery location of tagged seals in commercial kill, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
K-series - 2-year-old seals, males													
ZAP-1	21	-	4	-	-	-	25	-	1	-	-	1	26
TOL	4	5	-	-	1	2	12	1	1	-	-	2	14
L-K	1	2	4	1	-	1	9	-	-	-	-	-	9
REEF	4	2	-	6	-	3	15	-	1	1	-	2	17
POL	2	1	-	-	11	2	16	1	1	-	-	2	18
NEP	6	1	-	-	1	21	29	1	2	-	-	3	32
NOR	-	3	-	-	-	1	4	3	-	-	-	3	7
EAST	1	1	-	-	-	2	4	-	3	-	-	3	7
STAR	-	-	-	-	-	-	-	1	1	-	-	2	2
ZAP-2	-	-	-	-	-	1	1	-	1	-	1	2	3
Total	39	15	8	7	13	33	115	7	11	1	1	20	135
J-series - 3-year-old seals, males													
ZAP-1	137	38	6	3	9	30	223	6	7	1	2	16	239
TOL	56	38	1	1	6	18	120	5	3	1	2	11	131
L-K	12	23	25	1	10	16	87	4	7	1	1	13	100
REEF	85	45	5	53	9	38	235	7	7	2	2	18	253
POL	19	3	2	3	77	52	156	5	3	2	5	15	171
NEP	34	12	7	6	17	228	304	10	10	4	-	24	328
NOR	11	6	1	1	4	9	32	41	9	2	3	55	87
EAST	9	4	1	1	5	10	30	6	38	1	2	47	77
STAR	3	3	1	2	5	3	17	9	3	12	1	25	42
ZAP-2	8	1	1	2	2	3	17	4	6	2	21	33	50
Total	374	173	50	73	144	407	1221	97	93	28	39	257	1478
I-series - 4-year-old seals, males													
ZAP-1	18	1	-	-	-	7	26	-	1	-	1	2	28
TOL	6	7	-	-	2	2	17	-	-	-	1	1	18
L-K	-	-	-	-	1	2	3	-	-	-	-	-	3
REEF	14	6	-	12	-	7	39	3	-	-	2	5	44
POL	-	1	-	1	8	5	15	-	-	-	-	-	15
NEP	2	4	-	-	2	30	38	-	1	-	1	2	40
NOR	-	-	1	1	-	1	3	9	1	-	1	11	14
EAST	-	1	-	1	-	-	2	1	9	-	-	10	12
STAR	-	-	-	-	-	1	1	3	1	2	-	6	7
ZAP-2	2	-	-	-	-	-	2	3	1	-	5	9	11
Total	42	20	1	15	13	55	146	19	14	2	11	46	192
H-series - 5-year-old seals, males													
ZAP-1	1	-	-	-	-	-	1	-	1	-	-	1	2
TOL	1	-	-	-	-	-	1	1	-	-	-	1	2
REEF	-	-	-	-	-	1	1	1	-	-	-	1	2
POL	-	-	-	1	-	-	1	-	-	-	-	-	1
NEP	-	-	-	1	-	1	2	-	-	-	1	1	3
Total	2	-	-	2	-	2	6	2	1	-	1	4	10
J-series - 3-year-old seals, females													
ZAP-1	-	-	-	-	-	-	-	-	1	-	-	1	1
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
ZAP-2	-	-	-	-	-	-	-	-	1	-	-	1	1
Total	-	-	-	1	2	-	3	-	2	-	-	2	5

Appendix table 24. (con.)

Recovery location of tagged seals in commercial kill, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
I-series - 4-year-old seals, females													
ZAP-1	-	3	-	-	-	-	3	-	-	-	-	-	3
TOL	-	3	-	-	-	-	3	-	-	-	-	-	3
L-K	-	-	-	-	1	-	1	-	-	-	-	-	1
REEF	-	-	-	4	-	-	4	-	-	-	-	-	4
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
NOR	-	-	-	-	-	-	-	2	-	-	-	2	2
Total	-	6	-	4	3	1	14	2	-	-	-	2	16
H-series - 5-year-old seals, females													
ZAP-1	9	1	-	-	-	-	10	-	-	-	-	-	10
TOL	-	2	-	-	-	-	2	-	-	-	-	-	2
L-K	-	-	-	-	1	-	1	-	-	-	-	-	1
REEF	-	2	-	8	-	-	10	-	-	-	-	-	10
POL	-	2	-	-	4	-	6	-	-	-	-	-	6
NEP	-	-	-	-	1	4	5	-	-	-	-	-	5
Total	9	7	-	8	6	4	34	-	-	-	-	-	34
G-series - 6-year-old seals, females													
ZAP-1	-	1	-	-	-	-	1	-	-	-	-	-	1
REEF	-	-	-	3	-	1	4	-	-	-	-	-	4
NEP	-	-	-	-	-	2	2	-	-	-	-	-	2
Total	-	1	-	3	-	3	7	-	-	-	-	-	7
F-series - 7-year-old seals, females													
TOL	1	-	-	-	-	-	1	-	-	-	-	-	1
E-series - 8-year-old seals, females													
ZAP-1	1	-	-	-	-	1	2	-	-	-	-	-	2
REEF	1	-	-	1	-	-	2	-	-	-	-	-	2
POL	-	-	-	-	6	1	7	-	-	-	-	-	7
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	2	-	-	1	6	3	12	-	-	-	-	-	12
CS-series - 11-year-old seals, females													
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
B-series - 12-year-old seals, females													
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	5	1	6	-	-	-	-	-	6
Total	-	-	-	1	5	1	7	-	-	-	-	-	7

Appendix table 25.

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 1 - 2-year-old seals, males													
NEP	-	-	-	-	1	-	1	-	-	-	-	-	1
Round 2 - 2-year-old seals, males													
POL	-	-	-	-	1	-	1	-	-	-	-	-	1
Round 4 - 2-year-old seals, males													
ZAP-1	-	-	1	-	-	-	1	-	-	-	-	-	1
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	1	-	-	1	2	-	-	-	-	-	2
Round 5 - 2-year-old seals, males													
ZAP-1	1	-	-	-	-	-	1	-	-	-	-	-	1
TOL	1	-	-	-	-	-	1	-	-	-	-	-	1
L-K	1	-	-	-	-	-	1	-	-	-	-	-	1
POL	1	-	-	-	-	-	1	-	-	-	-	-	1
NEP	1	-	-	-	-	3	4	-	-	-	-	-	4
EAST	-	-	-	-	-	-	-	-	1	-	-	1	1
ZAP-2	-	-	-	-	-	-	-	-	-	-	1	1	1
Total	5	-	-	-	-	3	8	-	1	-	1	2	10
Round 6 - 2-year-old seals, males													
ZAP-1	2	-	-	-	-	-	2	-	-	-	-	-	2
TOL	2	1	-	-	-	-	3	-	-	-	-	-	3
L-K	-	1	-	-	-	1	2	-	-	-	-	-	2
Total	4	2	-	-	-	1	7	-	-	-	-	-	7
Round 7 - 2-year-old seals, males													
ZAP-1	8	-	-	-	-	-	8	-	1	-	-	1	9
TOL	1	1	-	-	1	-	3	-	-	-	-	-	3
L-K	-	-	1	1	-	-	2	-	-	-	-	-	2
REEF	-	-	-	2	-	1	3	-	1	-	-	1	4
POL	-	1	-	-	3	-	4	-	-	-	-	-	4
NEP	3	-	-	-	-	4	7	-	-	-	-	-	7
EAST	-	-	-	-	-	1	1	-	-	-	-	-	1
STAR	-	-	-	-	-	-	-	1	-	-	-	1	1
ZAP-2	-	-	-	-	-	-	-	-	1	-	-	1	1
Total	12	2	1	3	4	6	28	1	3	-	-	4	32
Round 8 - 2-year-old seals, males													
ZAP-1	7	-	2	-	-	-	9	-	-	-	-	-	9
L-K	-	1	2	-	-	-	3	-	-	-	-	-	3
REEF	4	1	-	2	-	1	8	-	-	-	-	-	8
POL	1	-	-	-	6	1	8	-	-	-	-	-	8
NEP	2	-	-	-	-	5	7	-	-	-	-	-	7
NOR	-	1	-	-	-	-	1	-	-	-	-	-	1
EAST	1	-	-	-	-	-	1	-	-	-	-	-	1
ZAP-2	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	15	3	4	2	6	8	38	-	-	-	-	-	38
Round 9 - 2-year-old seals, males													
ZAP-1	1	-	1	-	-	-	2	-	-	-	-	-	2
TOL	-	3	-	-	-	2	5	-	1	-	-	1	6
L-K	-	-	1	-	-	-	1	-	-	-	-	-	1
REEF	-	1	-	1	-	1	3	-	-	1	-	1	4
POL	-	-	-	-	-	1	1	1	1	-	-	2	3
NEP	-	1	-	-	-	8	9	1	2	-	-	3	12
NOR	-	1	-	-	-	1	2	3	-	-	-	3	5
EAST	-	1	-	-	-	1	2	-	2	-	-	2	4
STAR	-	-	-	-	-	-	-	-	1	-	-	1	1
Total	1	7	2	1	-	14	25	5	7	1	-	13	38

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 10 - 2-year-old seals, males													
ZAP-1	2	-	-	-	-	-	2	-	-	-	-	-	2
TOL	-	-	-	-	-	-	-	1	-	-	-	1	1
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	1	-	1	-	-	-	-	-	1
NOR	-	1	-	-	-	-	1	-	-	-	-	-	1
Total	2	1	-	1	1	-	5	1	-	-	-	1	6
Round 1 - 3-year-old seals, males													
ZAP-1	3	4	-	-	-	-	7	-	-	-	-	-	7
TOL	-	3	-	-	1	-	4	-	-	-	-	-	4
L-K	2	-	-	-	1	1	4	-	-	-	-	-	4
REEF	1	2	-	2	-	1	6	1	-	-	-	1	7
POL	2	-	-	-	3	1	6	-	-	-	-	-	6
NEP	-	1	-	-	1	2	4	1	1	1	-	3	7
NOR	-	-	-	-	-	1	1	-	-	1	-	1	2
EAST	1	-	-	-	-	-	1	-	1	-	-	1	2
ZAP-2	1	-	-	-	-	-	1	-	-	-	2	2	3
Total	10	10	-	2	6	6	34	2	2	2	2	8	42
Round 2 - 3-year-old seals, males													
ZAP-1	6	1	-	1	-	1	9	-	-	-	-	-	9
TOL	1	1	-	-	1	1	4	-	-	-	-	-	4
L-K	2	-	1	-	-	-	3	-	-	-	-	-	3
REEF	7	3	-	1	-	4	15	-	-	-	-	-	15
POL	-	-	-	-	1	3	4	-	-	-	1	1	5
NEP	1	1	-	-	1	10	13	2	-	-	-	2	15
NOR	-	-	-	-	-	-	-	1	-	-	-	1	1
EAST	-	-	-	1	-	1	2	-	-	-	-	-	2
STAR	1	-	1	-	-	-	2	-	-	-	-	-	2
ZAP-2	-	-	-	-	1	-	1	-	-	-	-	-	1
Total	18	6	2	3	4	20	53	3	-	-	1	4	57
Round 3 - 3-year-old seals, males													
ZAP-1	19	1	-	-	3	1	24	1	-	-	-	1	25
TOL	8	-	-	1	1	-	10	-	1	-	-	1	11
L-K	-	-	1	-	1	-	2	1	-	-	-	1	3
REEF	12	-	-	2	1	3	18	-	-	-	-	-	18
POL	2	-	-	-	5	1	8	-	-	-	1	1	9
NEP	2	-	-	-	2	18	22	2	2	1	-	5	27
NOR	3	-	-	-	-	1	4	2	-	-	-	2	6
EAST	-	-	-	-	-	-	-	-	2	-	-	2	2
STAR	1	-	-	-	-	1	2	1	1	1	-	3	5
ZAP-2	1	-	-	-	-	-	1	-	2	-	2	4	5
Total	48	1	1	3	13	25	91	7	8	2	3	20	111
Round 4 - 3-year-old seals, males													
ZAP-1	13	4	-	-	1	2	20	-	-	-	-	-	20
TOL	3	3	-	-	-	2	8	-	-	-	2	2	10
L-K	1	1	-	-	-	2	4	-	1	-	-	1	5
REEF	3	8	1	2	-	6	20	-	-	-	-	-	20
POL	1	-	-	1	3	2	7	-	-	-	-	-	7
NEP	2	1	-	-	-	21	24	-	-	-	-	-	24
NOR	-	-	-	-	-	2	2	2	1	-	1	4	6
EAST	1	-	-	-	-	-	1	2	3	-	-	5	6
STAR	-	-	-	-	-	-	-	-	-	1	-	1	1
ZAP-2	-	-	-	1	-	-	1	-	-	-	4	4	5
Total	24	17	1	4	4	37	87	4	5	1	7	17	104

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 5 - 3-year-old seals, males													
ZAP-1	14	3	-	-	-	1	18	1	-	-	-	1	19
TOL	8	2	-	-	-	1	11	1	1	-	-	2	13
L-K	1	2	3	-	1	2	9	-	1	-	-	1	10
REEF	7	3	-	1	-	5	16	-	-	-	-	-	16
POL	3	1	-	1	2	4	11	-	-	-	-	-	11
NEP	4	1	-	3	-	20	28	-	-	-	-	-	28
NOR	1	-	-	-	-	1	2	2	-	-	-	2	4
EAST	2	-	-	-	-	2	4	1	-	-	1	2	6
STAR	-	-	-	-	-	-	-	3	-	-	-	3	3
ZAP-2	1	-	-	-	-	-	1	-	1	-	1	2	3
Total	41	12	3	5	3	36	100	8	3	-	2	13	113
Round 6 - 3-year-old seals, males													
ZAP-1	22	10	-	-	1	2	35	-	-	-	1	1	36
TOL	1	-	-	-	-	3	4	-	-	-	-	-	4
L-K	3	15	4	-	-	2	24	1	1	-	-	2	26
REEF	6	9	-	2	2	3	22	-	1	-	-	1	23
POL	-	2	1	1	6	7	17	1	-	-	1	2	19
NEP	5	2	1	1	-	20	29	1	1	-	-	2	31
NOR	3	1	-	-	1	1	6	9	1	-	-	10	16
EAST	-	2	-	-	2	1	5	1	4	1	-	6	11
STAR	-	3	-	-	-	-	3	-	-	1	-	1	4
ZAP-2	-	1	-	-	-	-	1	-	-	1	-	1	2
Total	40	45	6	4	12	39	146	13	8	3	2	26	172
Round 7 - 3-year-old seals, males													
ZAP-1	20	2	3	-	2	8	35	1	1	-	-	2	37
TOL	19	3	-	-	-	2	24	2	-	-	-	2	26
L-K	-	-	4	1	2	1	8	-	-	1	-	1	9
REEF	14	3	1	15	1	3	37	1	2	-	-	3	40
POL	4	-	1	-	17	5	27	1	-	-	-	1	28
NEP	9	-	1	1	2	44	57	3	4	2	-	9	66
NOR	3	1	-	1	1	1	7	6	3	1	-	10	17
EAST	2	-	-	-	3	-	5	-	13	-	-	13	18
STAR	1	-	-	1	3	1	6	2	2	3	-	7	13
ZAP-2	1	-	-	1	-	-	2	1	-	1	2	4	6
Total	73	9	10	20	31	65	208	17	25	8	2	52	260
Round 8 - 3-year-old seals, males													
ZAP-1	39	3	2	2	2	9	57	3	3	-	1	7	64
TOL	16	9	1	-	3	4	33	1	-	-	-	1	34
L-K	3	3	8	-	5	5	24	1	2	-	-	3	27
REEF	35	9	2	22	5	9	82	3	2	-	1	6	88
POL	7	-	-	-	40	18	65	3	2	-	-	5	70
NEP	11	2	3	1	11	56	84	-	-	-	-	-	84
NOR	1	2	1	-	2	1	7	11	-	-	-	11	18
EAST	3	1	-	-	-	4	8	-	10	-	-	10	18
STAR	-	-	-	1	2	1	4	3	-	-	-	3	7
ZAP-2	4	-	-	-	1	2	7	2	2	-	8	12	19
Total	119	29	17	26	71	109	371	27	21	-	10	58	429

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 9, 3-year-old seals, males													
ZAP-1	1	9	1	-	-	6	17	-	3	1	-	4	21
TOL	-	17	-	-	-	5	22	1	1	1	-	3	25
L-K	-	2	4	-	-	3	9	1	2	-	1	4	13
REEF	-	8	1	1	-	4	14	2	2	1	1	6	20
POL	-	-	-	-	-	11	11	-	1	2	2	5	16
NEP	-	4	2	-	-	37	43	1	2	-	-	3	46
NOR	-	2	-	-	-	1	3	6	4	-	2	12	15
EAST	-	1	1	-	-	2	4	2	5	-	1	8	12
STAR	-	-	-	-	-	-	-	-	-	4	1	5	5
ZAP-2	-	-	1	-	-	1	2	1	1	-	1	3	5
Total	1	43	10	1	-	70	125	14	21	9	9	53	178
Round 10, 3-year-old seals, males													
ZAP-1	-	1	-	-	-	-	1	-	-	-	-	-	1
REEF	-	-	-	5	-	-	5	-	-	1	-	1	6
NOR	-	-	-	-	-	-	-	2	-	-	-	2	2
STAR	-	-	-	-	-	-	-	-	-	2	-	2	2
ZAP-2	-	-	-	-	-	-	-	-	-	-	1	1	1
Total	-	1	-	5	-	-	6	2	-	3	1	6	12
Round 1, 4-year-old seals, males													
ZAP-1	3	1	-	-	-	4	8	-	-	-	-	-	8
TOL	1	1	-	-	1	-	3	-	-	-	1	1	4
REEF	2	-	-	1	-	-	3	-	-	-	-	-	3
NEP	-	-	-	-	-	4	4	-	-	-	1	1	5
NOR	-	-	-	1	-	-	1	1	-	-	1	2	3
ZAP-2	-	-	-	-	-	-	-	2	1	-	4	7	7
Total	6	2	-	2	1	8	19	3	1	-	7	11	30
Round 2, 4-year-old seals, males													
ZAP-1	5	-	-	-	-	1	6	-	-	-	-	-	6
TOL	1	1	-	-	-	-	2	-	-	-	-	-	2
L-K	-	-	-	-	1	-	1	-	-	-	-	-	1
POL	-	-	-	-	1	2	3	-	-	-	-	-	3
NEP	-	-	-	-	-	5	5	-	-	-	-	-	5
NOR	-	-	1	-	-	1	2	3	1	-	-	4	6
EAST	-	-	-	-	-	-	-	-	1	-	-	1	1
STAR	-	-	-	-	-	1	1	1	-	-	-	1	2
Total	6	1	1	-	2	10	20	4	2	-	-	6	26
Round 3, 4-year-old seals, males													
ZAP-1	4	-	-	-	-	-	4	-	-	-	1	1	5
TOL	-	-	-	-	1	-	1	-	-	-	-	-	1
REEF	5	2	-	1	-	-	8	2	-	-	-	2	10
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
NEP	-	-	-	-	1	5	6	-	-	-	-	-	6
NOR	-	-	-	-	-	-	-	2	-	-	-	2	2
EAST	-	-	-	-	-	-	-	-	1	-	-	1	1
STAR	-	-	-	-	-	-	-	-	1	2	-	3	3
ZAP-2	1	-	-	-	-	-	1	-	-	-	1	1	2
Total	10	2	-	1	4	5	22	4	2	2	2	10	32
Round 4, 4-year-old seals, males													
TOL	1	1	-	-	-	1	3	-	-	-	-	-	3
L-K	-	-	-	-	-	1	1	-	-	-	-	-	1
REEF	1	-	-	3	-	2	6	-	-	-	-	-	6
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
NEP	1	1	-	-	-	3	5	-	-	-	-	-	5
EAST	-	1	-	1	-	-	2	-	2	-	-	2	4
Total	3	3	-	4	2	7	19	-	2	-	-	2	21

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 5, 4-year-old seals, males													
REEF	2	1	-	2	-	1	6	1	-	-	-	1	7
NEP	-	2	-	-	-	4	6	-	1	-	-	1	7
NOR	-	-	-	-	-	-	-	2	-	-	-	2	2
EAST	-	-	-	-	-	-	-	-	2	-	-	2	2
Total	2	3	-	2	-	5	12	3	3	-	-	6	18
Round 6, 4-year-old seals, males													
ZAP-1	2	-	-	-	-	-	2	-	-	-	-	-	2
TOL	-	1	-	-	-	-	1	-	-	-	-	-	1
REEF	-	1	-	3	-	1	5	-	-	-	-	-	5
POL	-	-	-	1	2	-	3	-	-	-	-	-	3
NEP	-	-	-	-	-	2	2	-	-	-	-	-	2
NOR	-	-	-	-	-	-	-	1	-	-	-	1	1
EAST	-	-	-	-	-	-	-	1	2	-	-	3	3
STAR	-	-	-	-	-	-	-	1	-	-	-	1	1
Total	2	2	-	4	2	3	13	3	2	-	-	5	18
Round 7, 4-year-old seals, males													
ZAP-1	2	-	-	-	-	1	3	-	1	-	-	1	4
TOL	1	-	-	-	-	1	2	-	-	-	-	-	2
REEF	1	1	-	2	-	1	5	-	-	-	-	-	5
POL	-	-	-	-	-	2	2	-	-	-	-	-	2
NEP	1	-	-	-	1	4	6	-	-	-	-	-	6
EAST	-	-	-	-	-	-	-	-	1	-	-	1	1
ZAP-2	1	-	-	-	-	-	1	-	-	-	-	-	1
Total	6	1	-	2	1	9	19	-	2	-	-	2	21
Round 8, 4-year-old seals, males													
ZAP-1	2	-	-	-	-	-	2	-	-	-	-	-	2
TOL	2	1	-	-	-	-	3	-	-	-	-	-	3
REEF	3	1	-	-	-	2	6	-	-	-	1	1	7
POL	-	-	-	-	1	1	2	-	-	-	-	-	2
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
STAR	-	-	-	-	-	-	-	1	-	-	-	1	1
Total	7	2	-	-	1	4	14	1	-	-	1	2	16
Round 9, 4-year-old seals, males													
ZAP-1	-	-	-	-	-	1	1	-	-	-	-	-	1
TOL	-	2	-	-	-	-	2	-	-	-	-	-	2
L-K	-	-	-	-	-	1	1	-	-	-	-	-	1
REEF	-	-	-	-	-	-	-	-	-	-	1	1	1
POL	-	1	-	-	-	-	1	-	-	-	-	-	1
NEP	-	1	-	-	-	2	3	-	-	-	-	-	3
ZAP-2	-	-	-	-	-	-	-	1	-	-	-	1	1
Total	-	4	-	-	-	4	8	1	-	-	1	2	10
Round 1, 5-year-old seals, males													
TOL	1	-	-	-	-	-	1	-	-	-	-	-	1
NEP	-	-	-	1	-	-	1	-	-	-	-	-	1
Total	1	-	-	1	-	-	2	-	-	-	-	-	2
Round 2, 5-year-old seals, males													
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Round 3, 5-year-old seals, males													
ZAP-1	-	-	-	-	-	-	-	-	1	-	-	1	1

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 4, 5-year-old seals, males													
POL	-	-	-	1	-	-	1	-	-	-	-	-	1
NEP	-	-	-	-	-	-	-	-	-	-	1	1	1
Total	-	-	-	1	-	-	1	-	-	-	1	1	2
Round 5, 5-year-old seals, males													
ZAP-1	1	-	-	-	-	-	1	-	-	-	-	-	1
TOL	-	-	-	-	-	-	-	1	-	-	-	1	1
Total	1	-	-	-	-	-	1	1	-	-	-	1	2
Round 6, 5-year-old seals, males													
REEF	-	-	-	-	-	1	1	-	-	-	-	-	1
Round 9, 5-year-old seals, males													
REEF	-	-	-	-	-	-	-	1	-	-	-	1	1
Round 8, 3-year-old seals, females													
ZAP-1	-	-	-	-	-	-	-	-	1	-	-	1	1
POL	-	-	-	-	1	-	1	-	-	-	-	-	1
Total	-	-	-	-	1	-	1	-	1	-	-	1	2
Round 10, 3-year-old seals, females													
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	1	-	1	-	-	-	-	-	1
ZAP-2	-	-	-	-	-	-	-	-	1	-	-	1	1
Total	-	-	-	1	1	-	2	-	1	-	-	1	3
Round 6, 4-year-old seals, females													
L-K	-	-	-	-	1	-	1	-	-	-	-	-	1
Round 10, 4-year-old seals, females													
ZAP-1	-	3	-	-	-	-	3	-	-	-	-	-	3
TOL	-	3	-	-	-	-	3	-	-	-	-	-	3
REEF	-	-	-	4	-	-	4	-	-	-	-	-	4
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
NOR	-	-	-	-	-	-	-	2	-	-	-	2	2
Total	-	6	-	4	2	1	13	2	-	-	-	2	15
Round 5, 5-year-old seals, females													
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Round 7, 5-year-old seals, females													
TOL	-	1	-	-	-	-	1	-	-	-	-	-	1
Round 8, 5-year-old seals, females													
ZAP-1	2	-	-	-	-	-	2	-	-	-	-	-	2
L-K	-	-	-	-	1	-	1	-	-	-	-	-	1
REEF	-	-	-	4	-	-	4	-	-	-	-	-	4
POL	-	1	-	-	1	-	2	-	-	-	-	-	2
NEP	-	-	-	-	1	1	2	-	-	-	-	-	2
Total	2	1	-	4	3	1	11	-	-	-	-	-	11

Appendix table 25. (con.)

Recovery location of tagged seals in commercial kill, by round, Pribilof Islands, 1960

Rookery of tagging	Rookery of Recovery: St. Paul Island							St. George Island					Grand total
	ZAP-1	TOL	L-K	REEF	POL	NEP	total	NOR	EAST	STAR	ZAP-2	total	
Round 9, 5-year-old seals, females													
ZAP-1	4	-	-	-	-	-	4	-	-	-	-	-	4
REEF	-	1	-	1	-	-	2	-	-	-	-	-	2
POL	-	1	-	-	1	-	2	-	-	-	-	-	2
NEP	-	-	-	-	-	2	2	-	-	-	-	-	2
Total	4	2	-	1	1	2	10	-	-	-	-	-	10
Round 10, 5-year-old seals, females													
ZAP-1	3	1	-	-	-	-	4	-	-	-	-	-	4
TOL	-	1	-	-	-	-	1	-	-	-	-	-	1
REEF	-	1	-	3	-	-	4	-	-	-	-	-	4
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
Total	3	3	-	3	2	-	11	-	-	-	-	-	11
Round 8, 6-year-old seals, females													
ZAP-1	-	1	-	-	-	-	1	-	-	-	-	-	1
REEF	-	-	-	1	-	1	2	-	-	-	-	-	2
Total	-	1	-	1	-	1	3	-	-	-	-	-	3
Round 9, 6-year-old seals, females													
REEF	-	-	-	2	-	-	2	-	-	-	-	-	2
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	-	2	-	1	3	-	-	-	-	-	3
Round 10, 6-year-old seals, females													
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Round 9, 7-year-old seals, females													
TOL	1	-	-	-	-	-	1	-	-	-	-	-	1
Round 6, 8-year-old seals, females													
ZAP-1	1	-	-	-	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	1	-	-	-	-	1	2	-	-	-	-	-	2
Round 8, 8-year-old seals, females													
ZAP-1	-	-	-	-	-	1	1	-	-	-	-	-	1
REEF	1	-	-	-	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	3	-	3	-	-	-	-	-	3
Total	1	-	-	-	3	1	5	-	-	-	-	-	5
Round 9, 8-year-old seals, females													
POL	-	-	-	-	1	-	1	-	-	-	-	-	1
NEP	-	-	-	-	-	1	1	-	-	-	-	-	1
Total	-	-	-	-	1	1	2	-	-	-	-	-	2
Round 10, 8-year-old seals, females													
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
Total	-	-	-	1	2	-	3	-	-	-	-	-	3
Round 8, 11-year-old seals, females													
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
Round 8, 12-year-old seals, females													
POL	-	-	-	-	3	1	4	-	-	-	-	-	4
Round 10, 12-year-old seals, females													
REEF	-	-	-	1	-	-	1	-	-	-	-	-	1
POL	-	-	-	-	2	-	2	-	-	-	-	-	2
Total	-	-	-	1	2	-	3	-	-	-	-	-	3

Appendix table 26.
Length of tagged 3-year-old male seals, by date of recovery, St. Paul Island, 1960

Date	Length in inches											Total
	39	40	41	42	43	44	45	46	47	48	49	
27 June	-	-	1	1	5	1	1	-	-	-	-	9
28	-	-	2	6	2	-	-	-	1	-	-	11
29	-	-	1	3	5	3	-	1	-	-	-	13
30	-	-	-	-	2	1	-	-	-	-	-	3
1 July	-	-	-	4	2	1	-	1	-	-	-	8
Total	-	-	4	14	16	6	1	2	1	-	-	44
2 July	-	1	4	5	7	4	1	-	-	-	-	22
3	-	-	2	1	4	2	1	-	-	-	-	10
4	-	-	3	9	9	2	-	-	-	-	-	23
5	-	-	1	1	2	1	-	-	-	-	-	5
6	-	1	2	1	2	-	-	-	-	-	-	6
Total	-	2	12	17	24	9	2	-	-	-	-	66
7 July	-	-	-	11	3	8	3	3	-	-	-	28
8	-	1	1	1	-	-	-	-	-	-	-	3
9	-	-	7	9	17	17	9	3	2	-	-	64
10	-	-	1	2	-	-	-	-	-	-	-	3
11	-	-	1	6	4	3	2	1	-	-	-	17
Total	-	1	10	29	24	28	14	7	2	-	-	115
12 July	-	3	12	17	13	7	-	-	-	-	-	52
13	-	-	1	7	8	4	3	1	1	-	-	25
14	-	1	7	12	9	4	2	-	-	-	-	35
15	-	-	-	3	2	1	-	1	1	-	-	8
16	-	-	1	4	3	-	-	-	-	-	-	8
Total	-	4	21	43	35	16	5	2	2	-	-	128
17 July	-	-	3	11	19	15	2	4	-	-	-	54
18	-	-	3	7	7	1	3	-	-	-	-	21
19	-	1	3	14	22	15	5	2	-	-	-	62
20	-	-	1	3	4	2	-	-	-	-	-	10
21	-	-	-	1	2	-	1	-	1	-	-	5
Total	-	1	10	36	54	33	11	6	1	-	-	152

Appendix table 26. (con.)
Length of tagged 3-year-old male seals, by date of recovery, St. Paul Island, 1960

Date	Length in inches											Total
	39	40	41	42	43	44	45	46	47	48	49	
22 July	-	2	12	13	14	6	4	1	-	-	-	52
23	-	1	12	16	23	7	5	-	-	-	-	64
24	-	1	3	15	24	8	7	-	-	-	-	58
25	-	-	-	2	2	2	2	-	-	-	-	8
26	-	-	2	1	4	7	3	1	1	-	-	19
Total	-	4	29	47	67	30	21	2	1	-	-	201
27 July	-	1	3	19	30	19	17	2	1	-	-	92
28	-	2	7	2	5	6	3	-	-	-	-	25
29	-	5	13	28	32	24	7	1	-	-	-	110
30	1	-	3	9	3	10	2	-	-	-	-	28
31	-	-	6	9	14	6	3	-	-	-	-	38
Total	1	8	32	67	84	65	32	3	1	-	-	293
1 August	-	1	15	23	47	29	18	5	1	-	-	139
2	-	4	8	4	20	16	5	3	5	-	-	65
3	-	2	3	33	50	33	26	10	2	-	1	160
4	-	-	-	6	15	7	2	1	-	-	-	31
5	-	-	3	23	32	24	9	3	-	-	-	94
Total	-	7	29	89	164	109	60	22	8	-	1	489
6 August	-	-	4	23	42	28	11	4	1	1	-	114
7	-	-	7	9	25	18	10	1	1	-	-	71
8	-	-	-	-	-	1	-	-	-	-	-	1
9	-	-	-	-	2	-	-	-	-	-	-	2
10	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	11	32	69	47	21	5	2	1	-	188
11 August	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	1	-	-	-	-	-	-	-	1
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	3	2	-	-	-	-	-	5
15	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	1	3	2	-	-	-	-	-	6
Season total	1	27	158	375	540	345	167	49	18	1	1	1,682

Appendix table 27.
Length of tagged 3-year-old male weals, by date of recovery, St. George Island, 1960

Date	Length in inches									Total
	39	40	41	42	43	44	45	46	47	
27 June	-	-	1	1	-	-	-	-	-	2
28	-	-	-	1	-	-	-	-	-	1
29	-	-	-	2	-	-	-	-	-	2
30	-	-	1	1	-	-	-	-	-	2
1 July	-	-	1	-	-	-	-	-	-	1
Total	-	-	3	5	-	-	-	-	-	8
2 July	-	-	-	1	-	-	-	-	-	1
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	1	1	-	1	-	-	-	3
Total	-	-	1	2	-	1	-	-	-	4
7 July	-	1	1	1	-	1	-	-	-	4
8	-	-	-	2	1	-	-	-	-	3
9	-	-	2	2	3	-	1	-	-	8
10	-	-	-	1	1	1	-	-	-	3
11	-	-	1	-	1	1	1	-	-	4
Total	-	1	4	6	6	3	2	-	-	22
12 July	-	-	2	5	-	1	-	-	-	8
13	-	-	-	1	-	-	-	-	-	1
14	1	-	1	1	2	-	-	-	-	5
15	-	-	-	-	-	1	-	-	-	1
16	-	-	-	2	1	-	-	-	-	3
Total	1	-	3	9	3	2	-	-	-	18
17 July	-	-	-	2	-	-	-	-	-	2
18	1	-	-	2	-	1	1	-	-	5
19	-	-	1	2	-	1	-	-	-	4
20	-	-	-	-	-	-	-	-	-	-
21	-	-	1	-	-	2	-	-	-	3
Total	1	-	2	6	-	4	1	-	-	14

Appendix table 27. (con.)
Length of tagged 3-year-old male seals, by date of recovery, St. George Island, 1960

Date	Length in inches									Total
	39	40	41	42	43	44	45	46	47	
22 July	-	-	2	1	-	-	-	-	-	3
23	-	-	2	4	-	1	-	-	-	7
24	-	-	-	2	1	4	1	-	-	8
25	-	-	-	2	1	-	-	-	-	3
26	-	-	1	4	1	-	2	-	-	8
Total	-	-	5	13	3	5	3	-	-	29
27 July	-	-	2	2	-	-	-	-	-	4
28	-	-	1	3	-	1	-	-	1	6
29	-	-	4	11	10	5	2	-	-	32
30	-	-	1	3	3	1	-	-	-	8
31	-	1	3	4	2	2	1	1	-	14
Total	-	1	11	23	15	9	3	1	1	64
1 August	-	-	2	5	3	1	1	-	-	12
2	-	-	2	3	-	5	2	-	-	12
3	-	1	1	7	10	4	1	-	-	24
4	-	-	-	1	-	1	-	-	-	2
5	-	1	4	3	6	4	1	-	-	19
Total	-	2	9	19	19	15	5	-	-	69
6 August	-	1	1	4	3	1	-	-	-	10
7	-	1	-	3	2	1	2	-	-	9
8	-	-	5	9	12	4	2	-	-	32
9	-	1	1	2	3	1	2	-	-	10
10	-	-	1	2	2	3	1	-	-	9
Total	-	3	8	20	22	10	7	-	-	70
11 August	-	-	-	1	-	-	-	-	-	1
12	-	-	-	1	1	-	-	-	-	2
13	-	-	-	-	-	-	-	-	-	-
14	-	-	2	1	-	1	-	-	-	4
15	-	-	-	-	-	-	-	-	-	-
Total	-	-	2	3	1	1	-	-	-	7
Season total	2	7	48	106	69	50	21	1	1	305

Appendix table 28.
Length of tagged 4-year-old male seals, by date of recovery, St. Paul Island, 1960

Date	Length in inches											Total
	41	42	43	44	45	46	47	48	49	50	51	
27 June	-	-	-	2	3	1	2	-	-	-	-	8
28	-	-	-	-	2	1	-	-	-	-	-	3
29	-	2	1	2	3	1	-	-	-	-	-	9
30	-	-	2	-	1	-	-	-	-	-	-	3
1 July	-	-	-	1	-	-	-	1	-	-	-	2
Total	-	2	3	5	9	3	2	1	-	-	-	25
2 July	1	2	4	-	4	-	-	-	-	-	-	11
3	-	-	-	-	1	1	-	-	-	-	-	2
4	-	2	2	3	1	-	-	-	-	-	-	8
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	1	-	-	1	-	-	-	2
Total	1	4	6	3	7	1	-	1	-	-	-	23
7 July	-	1	-	3	1	4	1	-	-	-	-	10
8	-	-	-	2	-	-	-	-	-	-	-	2
9	1	-	-	7	2	3	1	-	-	-	-	14
10	-	-	-	1	-	-	-	-	-	-	-	1
11	1	-	-	-	-	1	-	1	-	-	1	4
Total	2	1	-	13	3	8	2	1	-	-	1	31
12 July	-	2	4	1	2	1	-	-	-	-	-	10
13	-	-	1	1	1	-	-	-	-	-	-	3
14	-	-	3	3	1	-	-	-	-	-	-	7
15	-	-	1	1	1	-	1	1	-	-	-	5
16	-	-	2	-	-	-	-	-	-	-	-	2
Total	-	2	11	6	5	1	1	1	-	-	-	27
17 July	-	-	-	1	2	3	-	1	1	-	-	8
18	-	-	1	1	-	1	-	-	-	-	-	3
19	-	-	-	-	1	1	-	-	-	-	-	2
20	-	-	-	-	1	1	-	-	-	-	-	2
21	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	1	2	4	6	-	1	1	-	-	15

Appendix table 28. (con.)
Length of tagged 4-year-old male seals, by date of recovery, St. Paul Island, 1960

Date	Length in inches											Total
	41	42	43	44	45	46	47	48	49	50	51	
22 July	-	1	2	-	-	-	-	-	-	-	-	3
23	-	-	1	1	-	-	-	-	-	-	-	2
24	-	-	1	2	-	-	-	-	-	-	-	3
25	-	-	-	1	2	1	-	-	-	-	-	4
26	-	-	-	1	-	-	-	1	-	-	-	2
Total	-	1	4	5	2	1	-	1	-	-	-	14
27 July	-	-	3	2	3	2	1	-	-	-	-	11
28	-	1	-	-	-	-	-	-	-	-	-	1
29	-	1	1	-	2	1	1	-	1	-	-	7
30	-	-	-	2	1	1	-	-	-	-	-	4
31	-	-	-	-	1	-	-	-	-	-	-	1
Total	-	2	4	4	7	4	2	-	1	-	-	24
1 August	-	1	-	1	3	1	2	-	-	-	-	8
2	-	-	-	-	1	1	-	1	-	-	-	3
3	-	1	1	2	4	1	-	1	-	-	-	10
4	-	-	-	1	1	-	-	-	-	-	-	2
5	-	-	-	-	-	1	-	-	-	-	-	1
Total	-	2	1	4	9	4	2	2	-	-	-	24
6 August	-	-	1	2	3	-	-	1	-	-	-	7
7	-	-	-	-	3	1	-	-	-	-	-	4
Total	-	-	1	2	6	1	-	1	-	-	-	11
Season total	3	14	31	44	52	29	9	9	2	-	1	194

Appendix table 29.
Length of tagged 4-year-old male seals, by date of recovery, St. George Island, 1960

Date	Length in inches								Total
	41	42	43	44	45	46	47	48	
27 June	-	-	1	3	2	-	1	-	7
28	-	-	-	-	-	-	-	1	1
29	-	1	-	-	-	1	-	-	2
1 July	-	-	-	-	-	-	1	1	2
Total	-	1	1	3	2	1	2	2	12
3 July	-	-	1	1	-	-	-	-	2
4	1	-	-	1	-	-	-	-	2
6	-	-	-	1	1	-	-	-	2
Total	1	-	1	3	1	-	-	-	6
7 July	-	-	-	-	1	-	1	-	2
8	2	-	-	-	1	-	1	-	4
9	-	-	-	1	-	1	-	-	2
10	-	1	-	-	1	-	-	-	2
Total	2	1	-	1	3	1	2	-	10
14 July	-	-	2	-	-	1	-	-	3
19 July	-	1	1	1	-	-	1	-	4
21	-	-	1	1	-	-	1	-	3
Total	-	1	2	2	-	-	2	-	7
24 July	-	-	-	1	-	1	-	-	2
26	-	2	-	-	1	-	-	-	3
Total	-	2	-	1	1	1	-	-	5
29 July	-	-	-	1	2	-	-	-	3
30	-	1	-	-	-	-	-	-	1
Total	-	1	-	1	2	-	-	-	4
1 August	-	-	-	-	1	-	-	-	1
3	-	-	1	-	-	-	-	-	1
5	-	-	-	1	-	-	-	-	1
Total	-	-	1	1	1	-	-	-	3
6 August	-	-	-	-	-	1	-	-	1
7	-	-	-	1	-	-	-	-	1
Total	-	-	-	1	-	1	-	-	2
14 August	-	-	-	1	-	-	-	-	1
Season total	3	6	7	14	10	5	6	2	53

Appendix table 30.
Length of tagged 3- and 4-year-old female seals, by date of recovery, Pribilof Islands, 1960

Date	Length in inches						Total
	40	41	42	43	44	45	
			3-year-old females				
3 August	-	1	-	-	-	-	1
5	-	1	1	-	-	-	2
Total	-	2	1	-	-	-	3
6 August	-	-	-	2	-	1	3
9	-	-	1	-	-	-	1
10	-	1	2	-	-	-	3
Total	-	1	3	2	-	1	7
12 August	2	-	-	-	-	-	2
13	-	1	-	-	-	-	1
14	1	-	2	-	-	-	3
15	-	1	-	-	-	-	1
Total	3	2	2	-	-	-	7
Season total	3	5	6	2	-	1	17
			4-year-old females				
22 July	-	-	-	1	-	-	1
26	-	-	1	-	-	-	1
Total	-	-	1	1	-	-	2
4 August	-	-	-	1	-	-	1
10 August	-	1	-	-	-	-	1
11 August	-	-	-	1	-	-	1
12	1	-	4	5	-	-	10
13	-	-	-	2	-	-	2
14	-	-	3	2	-	-	5
15	-	1	-	-	1	1	3
Total	1	1	7	10	1	1	21
Season total	1	2	8	12	1	1	25

Appendix table 31.

Record of fur seal pups tagged on Pribilof Islands

Year	Series	Kind of metal	Number tagged on St. Paul	Number tagged on St. George	Marks
1941	USA 1-5000	Monel	5000	-	Branded-nape of neck
"	USA5001-10000	Stainless	5000	-	Branded-nape of neck
1945	10001-11000	Monel	973	-	No check mark
1947	A 1-20000	Monel	19183	-	1/4" hole between 1st and 2nd digits left hind flipper
1948	B 1-20000	Monel	19532	-	No check mark
1949	CS 1-20000	Monel	19960	-	No check mark
1951	D 1-1000	Monel	1000	-	1/2 left ear on 100 tagged pups removed
1952	E 1-20000	Monel	19979	-	Tip of digit on right hind flipper sliced off
1953	F 1-10000	Monel	9990	-	Tip of left front flipper sliced off
"	G7001-7400	Monel	398	-	Tip of left front flipper sliced off
1954	G 1-7000	Monel	7000	-	"V" notch on right front flipper, leading edge near tip
"	G7401-10400	Monel	3000	-	
1955	H 1-10000	Monel		-	Tip of digit on left hind flipper sliced off
"	10001-50000 (without prefix H)	Monel	49870	-	
1956	I 1-10000	Monel	-	9894	Tip of right front flipper sliced off
"	I 10001-50000	Monel	39900	-	Tip of right front flipper sliced off
1957	J 1-10000	Monel	-	9972	"V" notch leading edge left front flipper near tip
"	J10001-50000	Monel	39870	-	
1958	K 1-10000	Monel	-	9994	"V" notch leading edge right front flipper near tip
"	K10001-50000	Monel	39923	-	
"	K10001-15000	Monel	5000	-	Duplicate tags on left front flipper
1959	L 1-10000	Monel	-	9980	Tip of left front flipper sliced off
"	L10001-50000	Monel	39901	-	Tip of left front flipper sliced off
1960	M 1-12000	Monel	-	11992	Tip of right front flipper sliced off
"	M12001-60000	Monel	47989	-	Tip of right front flipper sliced off

Appendix table 32.

Bull counts, Pribilof Islands, 1911-1960

Year	St. Paul Island		St. George Island		Both islands	
	harem	idle	harem	idle	harem	idle
1911	1,090	258	266	71	1,356	329
1912	1,077	93	281	20	1,358	113
1913	1,142	77	261	28	1,403	105
1914	1,316	159	243	13	1,559	172
1915	1,789	546	362	127	2,151	673
1916	2,948	2,278	552	354	3,500	2,632
1917	4,166	2,341	684	365	4,850	2,706
1918	4,610	2,245	734	199	5,344	2,444
1919	4,573	2,158	585	81	5,158	2,239
1920	3,542	1,078	524	83	4,066	1,161
1921	3,443	711	466	36	3,909	747
1922	3,184	493	378	15	3,562	508
1923	3,051	303	361	9	3,412	312
1924	3,127	375	389	15	3,516	390
1925	3,103	283	423	28	3,526	311
1926	3,478	368	556	55	4,034	423
1927	3,916	846	727	126	4,643	972
1928	5,059	1,208	991	241	6,050	1,449
1929	5,998	1,339	1,189	294	7,187	1,633
1930	6,823	1,555	1,489	344	8,312	1,899
1931	7,557	1,519	1,676	369	9,233	1,888
1932	8,268	1,940	1,820	409	10,088	2,349
1933	8,334	1,933	1,879	408	10,213	2,341
1934	8,841	1,860	1,929	422	10,770	2,282
1935	9,444	2,082	2,103	453	11,547	2,535
1936	10,055	2,253	-	-	-	-
1937	10,689	2,516	2,411	515	13,100	3,031
1938	10,720	1,787	-	-	-	-
1939	9,122	2,616	1,858	357	10,980	2,973
1940	9,662	3,968	1,988	571	11,650	4,539
1941	10,089	5,059	1,942	396	12,031	5,455
1942	-	-	-	-	-	-
1943	10,948	3,523	2,107	330	13,055	3,853
1944	11,080	2,539	2,294	450	13,374	2,989
1945	10,750	4,055	2,434	750	13,184	4,805
1946	10,566	3,605	2,430	611	12,996	4,216
1947	10,160	3,331	1,808	479	11,968	3,810
1948	10,386	3,400	1,814	563	12,200	3,963
1949	9,304	2,861	1,745	552	11,049	3,413
1950	9,442	3,152	1,959	574	11,401	3,726
1951	9,434	3,581	1,825	549	11,259	4,130
1952	9,318	4,717	1,983	605	11,301	5,322
1953	9,848	5,912	2,285	826	12,133	6,738
1954	9,906	6,847	2,228	1,311	12,134	8,158
1955	9,034	8,650	2,130	1,902	11,164	10,552
1956	9,384	9,016	-	-	-	-
1957	9,562	10,060	2,423	2,693	11,985	12,753
1958	9,970	9,510	2,619	3,030	12,589	12,540
1959	10,003	11,485	2,527	2,699	12,530	14,184
1960	10,247	10,407	2,552	2,630	12,799	13,037

Appendix table 33.
Reproductive condition of female seals sampled from commercial kill, by rookery of recovery, Pribilof Islands, 1960

	St. Paul Island						
	ZAP	TOL	L-K	REEF	POL	NEP	Total
Pregnant							
number	239	217	12	315	327	294	1,404
percent	45	44	50	48	47	53	48
Nonpregnant							
number	289	276	12	338	368	259	1,542
percent	55	56	50	52	53	47	52
Total	528	493	24	653	695	553	2,946
Percent	18	17	1	22	23	19	

	St. George Island				
	ZAP	NOR	EAST	STAR	Total
Pregnant					
number	58	197	127	103	485
percent	48	46	51	50	48
Nonpregnant					
number	64	226	121	104	515
percent	52	54	49	50	52
Total	122	423	248	207	1,000
Percent	12	42	25	21	

Appendix table 34.
Tag numbers (M-series) and weights of live male and female fur-seal pups, by rookery, St. Paul Island, 1 and 2 September 1960

Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)
			ZAPADNI - males				
17037	9.0	18354	7.6	18872	9.0	19452	7.2
17337	9.2	18450	9.4	18902	10.0	19463	6.2
17407	10.0	18467	8.2	18918	17.4	19469	7.4
17451	8.0	18470	5.4	18924	11.4	19506	9.6
17769	7.6	18490	7.4	18930	10.2	19592	7.2
17816	9.0	18491	11.2	18953	9.8	19606	11.4
17838	8.2	18492	8.8	18977	7.0	19626	8.4
17852	8.0	18493	9.4	18979	11.8	19649	6.4
17874	5.6	18522	10.6	19004	10.4	19650	8.4
17879	10.2	18553	8.8	19088	5.8	19715	6.2
17885	8.8	18596	9.2	19096	9.6	19723	10.6
17913	12.0	18626	7.8	19113	7.6	19738	9.4
17965	8.4	18628	8.8	19135	9.2	19753	10.6
18062	10.0	18647	12.8	19137	6.2	19824	8.2
18066	10.2	18685	8.6	19157	6.0	18940	6.2
18074	9.0	18742	9.6	19180	5.8	18954	6.2
18078	6.2	18754	9.4	19185	7.2	19861	9.2
18105	7.0	18757	9.2	19210	7.6	19878	7.6
18140	9.4	18772	6.4	19257	12.0	19887	9.4
18236	11.6	18775	9.0	19261	10.2	19895	8.4
18247	7.6	18815	10.0	19413	3.2	19916	7.8
18255	7.4	18826	6.8	19437	11.2	19979	9.2
18339	9.0	18827	7.0	19448	10.8		
			ZAPADNI - females				
17421	10.2	17978	5.0	18110	7.4	18199	10.0
17443	2.8	18007	7.6	18135	7.4	18224	7.2
17726	5.0	18037	7.2	18142	11.4	18225	7.6
17821	4.4	18057	11.6	18175	7.4	18276	6.2
17882	6.4	18079	11.8	18178	8.8	18284	6.4
17883	8.4	18093	8.2	18180	9.8	18346	10.2
17909	10.6	18097	7.6	18181	5.4	18356	10.6
17920	9.0	18103	8.4	18195	8.2	18389	7.0

Appendix table 34. (con.)
Tag numbers (M-series) and weights of live male and female fur-seal pups, by rookery, St. Paul Island, 1 and 2 September 1960

Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)
		ZAPADNI - females - (con.)					
18394	9.0	18839	12.6	19171	8.8	19553	6.0
18410	6.4	18841	8.4	19201	11.6	19570	6.0
18419	9.8	18850	6.6	19208	3.8	19587	8.4
18472	10.4	18851	9.0	19237	6.8	19598	6.8
18551	10.2	18869	9.0	19249	6.6	19645	11.6
18587	7.4	18883	8.0	19256	7.0	19734	9.2
18590	7.4	18901	9.2	19272	6.6	19766	11.0
18611	9.0	18932	7.4	19278	6.6	19795	3.6
18616	11.4	18965	7.4	19292	7.0	19807	10.6
18629	7.0	18967	9.6	19323	10.6	19843	8.8
18657	9.8	18971	8.8	19344	7.0	19844	5.2
18672	9.8	18997	10.0	19400	7.6	19867	9.2
18688	8.0	19010	6.0	19409	7.2	19884	7.0
18694	7.0	19011	6.2	19410	6.4	19898	10.0
18765	5.8	19015	7.6	19412	7.2	19934	7.2
18768	7.2	19047	7.0	19426	9.8	19941	10.0
18789	10.4	19054	4.8	19438	11.4	19957	5.8
18798	7.4	19104	8.8	19472	6.4	19963	7.6
18799	9.4	19108	7.6	19489	8.4	19965	8.3
18811	8.4	19152	9.4	19514	6.8	19997	9.4
18822	9.8	19158	6.6	19543	10.2	19998	10.0
		NORTHEAST POINT - males					
41142	8.4	45078	7.6	50555	7.4	50671	10.0
41261	7.0	50058	9.2	50594	9.8	51346	9.4
41263	9.2						
		NORTHEAST POINT - females					
41137	7.8	46119	10.0	50554	7.6	50621	7.4
41215	13.2	50047	10.6	50567	8.4	50647	6.2
41238	11.4	50513	6.2	50571	9.8	50755	4.2
41278	7.6	50553	6.6	50613	6.4	50829	9.6
41324	8.6						

Appendix table 34. (con.)

Tag numbers (M-series) and weights of live male and female fur-seal pups, by rookery, St. Paul Island, 1 and 2 September 1960

Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)
			POLOVINA - males				
33599	9.2	36287	7.4	38111	8.6	38307	12.2
33797	7.4	36295	10.0	38126	12.2	38345	5.4
33861	9.8	36391	9.8	38141	8.2	38370	11.2
33881	11.0	36401	11.6	38151	8.6	38380	9.4
33902	10.0	36515	10.2	38161	12.6	38383	9.4
33993	8.4	36562	10.4	38171	6.2	38388	9.8
36033	8.4	36565	11.8	38173	8.6	38390	11.4
36054	13.6	36586	9.0	38210	14.2	38391	8.8
36093	13.2	36634	14.0	38231	7.6	38392	10.6
36122	7.6	36802	12.8	38239	8.6	38400	8.6
36166	7.6	36872	8.4	38254	13.6	38417	8.6
36248	8.0	37006	12.2	38266	12.6	38427	8.0
36254	11.0	37337	10.8	38272	12.6	* 59041	12.6
36265	8.2	38061	9.4	38277	7.4	* 59856	6.8
36268	8.4	38086	10.2	38283	11.0	* Migrated from	
36269	12.4	38110	8.0	38300	7.2	Lukanin-Kitovi	
			POLOVINA - females				
33845	8.4	36297	9.4	36648	7.0	38200	7.2
33850	10.0	36299	12.8	36698	7.6	38209	8.4
33869	9.0	36315	9.2	36720	10.8	38214	8.8
33874	9.8	36324	10.0	36817	5.6	38259	5.4
33905	8.2	36352	9.6	36833	7.6	38263	10.8
33915	8.4	36377	12.4	36863	8.6	38267	10.0
33946	8.4	36378	7.8	36927	8.2	38312	10.2
33958	8.4	36421	7.0	36982	7.8	38331	9.2
33994	9.6	36424	9.2	37118	10.0	38335	8.6
36039	9.4	36461	8.4	38057	7.2	38414	7.6
36041	9.6	36493	5.2	38108	10.4	38422	9.2
36184	10.6	36498	12.6	38128	8.8	38425	9.4
36187	11.0	36512	11.0	38137	9.6	38469	6.6
36191	8.8	36528	7.0	38155	7.8	38477	9.4
36217	9.0	36547	7.2	38175	11.0	38521	6.6
36222	10.0	36592	9.2	38190	8.4	38560	8.8
36257	6.8	36627	8.0	38199	7.4	38918	8.6

Appendix table 34. (con.)
Tag numbers (M-series) and weights of live male and female fur-seal pups, by rookery, St. Paul Island, 1 and 2 September 1960

Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)	Tag number	Weight (kg.)
			REEF - males				
22029	8.6	22240	9.4	22655	9.4	32706	7.4
22037	10.2	22315	8.0	22722	9.8	32848	11.0
22044	9.6	22370	8.8	22750	14.0	32915	6.6
22053	12.4	22461	8.4	22794	7.2	32919	8.4
22063	6.8	22510	8.2	22873	8.6	32921	8.8
22071	8.6	22538	10.4	22900	9.6	32924	6.8
22086	9.4	22584	6.8	22967	11.6	32966	11.8
22154	9.2	22598	12.6	32511	10.4	33004	11.0
22158	8.4	22610	5.6	32551	10.6	33019	13.4
22168	8.2	22635	10.6	32619	11.2	33066	9.0
22194	6.6	22649	8.8	32650	5.6	33091	7.2
22217	9.8	22653	7.0	32654	9.2	33208	9.2
			REEF - females				
22051	6.6	22393	10.6	22883	7.0	32967	7.6
22066	11.0	22423	8.6	22895	7.2	33044	9.6
22076	5.0	22498	6.2	22929	7.8	33067	10.2
22098	5.0	22519	10.0	26141	9.4	33077	8.2
22125	9.0	22525	8.4	26579	9.8	33080	7.0
22155	8.6	22570	8.2	28344	9.8	33095	9.2
22171	9.2	22636	7.4	32625	7.6	33152	9.0
22213	9.4	22665	8.6	32679	9.8	33184	8.6
22224	8.6	22670	8.8	32702	8.6	33205	10.0
22260	10.4	22684	7.2	32709	9.2	33269	8.8
22269	6.6	22716	9.4	32857	7.0	33277	6.8
22284	6.8	22787	7.2	32881	10.4	33377	9.4
22359	7.8	22813	9.2	32964	7.8		

Appendix table 35.
Comparison of lengths of females in samples - analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1956 St. Paul Island sample					
4	Pregnant vs. nulliparous	.49	1	.49	.374	.54
	Error	1031	790	1.31		
5	Between all groups	19	2	9.50		
	Pregnant vs. nonpregnant	5.7	1	5.7	3.22	.07
	Parous vs. nulliparous	1.4	1	1.4	.79	.35
	Error	1135	640	1.77		
6	Between all groups	16	2	8		
	Pregnant vs. nonpregnant	9.4	1	9.4	5.91	.02
	Parous vs. nulliparous	0	1	0	0	1.00
	Error	742	466	1.59		
7	Between all groups	18	2	9		
	Pregnant vs. nonpregnant	5.6	1	5.6	3.06	.08
	Parous vs. nulliparous	5.1	1	5.1	2.79	.10
	Error	556	304	1.83		
8	Between all groups	8	2	4		
	Pregnant vs. nonpregnant	7.2	1	7.2	3.71	.06
	Parous vs. nulliparous	0.1	1	0.1	.51	.82
	Error	450	231	1.95		
9	Pregnant vs. nonpregnant	15	1	15	7.73	.01
	Error	246	127	1.94		
10	Pregnant vs. nonpregnant	1.21	1	1	.38	.54
	Error	190	73	2.60		
10+	Pregnant vs. nonpregnant	20	1	20	7.43	.01
	Error	1810	674	2.69		

Appendix table 35. (con.)
Comparison of lengths of females in samples - analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1957 St. Paul Island sample					
4	Pregnant vs. nulliparous	.63	1	.63	.27	.60
	Error	1427	623	2.29		
5	Between all groups	47	2	23.5		
	Pregnant vs. nonpregnant	44.5	1	44.5	16.24	<.001
	Parous vs. nulliparous	35.8	1	35.8	13.07	<.001
	Error	4218	1528	2.74		
6	Between all groups	40	2	20		
	Pregnant vs. nonpregnant	9.9	1	9.9	3.19	.07
	Parous vs. nulliparous	4.1	1	4.1	1.32	.25
	Error	3030	979	3.1		
7	Between all groups	8	2	4		
	Pregnant vs. nonpregnant	6.4	1	6.4	2.08	.15
	Parous vs. nulliparous	0.4	1	0.4	.13	.72
	Error	2139	695	3.08		
8	Between all groups	74	2	37		
	Pregnant vs. nonpregnant	30	1	30	8.75	<.01
	Parous vs. nulliparous	27	1	27	7.87	<.01
	Error	1965	573	3.43		
9	Pregnant vs. nonpregnant	15	1	15	4.17	.04
	Error (parous)	1715	477	3.60		
10	Pregnant vs. nonpregnant	19	1	19	4.37	.04
	Error (parous)	1106	254	4.35		
10+	Pregnant vs. nonpregnant	63	1	63	16.67	<.001
	Error (parous)	4917	1301	3.78		

Appendix table 35. (con.)
Comparison of lengths of females in samples - analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1958 St. Paul Island sample					
4	Pregnant vs. nulliparous	2	1	2	1.09	.30
	Error	2103	1152	1.83		
5	Between all groups	17	2	8.5		
	Pregnant vs. nonpregnant	2.4	1	2.4	1.11	.30
	Parous vs. nulliparous	8.6	1	8.6	3.98	.05
	Error	1134	526	2.16		
6	Between all groups	51	2	25.5		
	Pregnant vs. nonpregnant	22	1	22	4.26	.04
	Parous vs. nulliparous	49.4	1	49.4	9.57	<.001
	Error	2359	457	5.16		
7	Between all groups	5	2	2.5		
	Pregnant vs. nonpregnant	0	1	0	0	1.00
	Parous vs. nulliparous	3.7	1	3.7	1.34	.25
	Error	327	118	2.77		
8	Pregnant vs. nonpregnant (parous)	.21	1	.21	.07	.80
	Error	174	54	3.22		
9	Pregnant vs. nonpregnant (parous)	5	1	5	1.20	.28
	Error	146	35	4.17		
10	Pregnant vs. nonpregnant (parous)	6	1	6	1.94	.18
	Error	183	57	3.10		
10+	Pregnant vs. nonpregnant (parous)	.06	1	.06	.02	.88
	Error	.144	38	3.79		

Appendix table 35. (con.)
Comparison of lengths of females in samples -
analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1959 St. Paul Island sample					
4	Between all groups	2	2	1		
	Pregnant vs. nonpregnant	.7	1	.7	.32	.57
	Parous vs. nulliparous	1.1	1	1.1	.50	.48
	Error	2158	975	2.21		
5	Between all groups	14	2	7		
	Pregnant vs. nonpregnant	3.5	1	3.5	1.35	.25
	Parous vs. nulliparous	0	1	0	0	1.00
	Error	1420	548	2.59		
6	Between all groups	5	2	2.5		
	Pregnant vs. nonpregnant	.1	1	.1	.03	.87
	Parous vs. nulliparous	3.2	1	3.2	1.10	.30
	Error	1238	426	2.91		
7	Between all groups	10	2	5		
	Pregnant vs. nonpregnant	1.4	1	1.4	.43	.52
	Parous vs. nulliparous	5.1	1	5.1	1.56	.21
	Error	1516	464	3.27		
8	Between all groups	7	2	3.5		
	Pregnant vs. nonpregnant	.2	1	.2	.02	.88
	Parous vs. nulliparous	5	1	5	.57	.46
	Error	2208	250	8.83		
9	Pregnant vs. nonpregnant (parous)	.37	1	.37	.10	.75
	Error	640	166	3.86		
10	Pregnant vs. nonpregnant (parous)	.01	1	.01	.003	.96
	Error	444	145	3.06		
10+	Pregnant vs. nonpregnant (parous)	2	1	2	.48	.49
	Error	2835	685	4.14		

Appendix table 35. (con.)
Comparison of lengths of females in samples - analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1958 United States pelagic sample					
5	Between groups	17	2	8.50	2.37	10
	Pregnant vs. nonpregnant	16.3	1	16.3	4.55	.04
	Within groups	240	67	3.58		
6	Between groups	22	2	11.00	3.02	.05
	Pregnant vs. nonpregnant	13	1	13.00	3.57	.07
	Within groups	349	96	3.64		
7	Between groups	6	1	6.00	1.96	.16
	Within groups	309	101	3.06		
8	Between groups	35	1	35	9.61	.005
	Within groups	344	99	3.64		
9	Between groups	.3	1	.3	.01	.92
	Within groups	262	79	3.31		
10	Between groups	14	1	14	3.43	.07
	Within groups	388	95	4.08		
10+	Between groups	13	1	13	3.63	.06
	Within groups	2299	643	3.58		

Appendix table 35. (con.)
Comparison of lengths of females in samples - analysis of variance table

Age		S.S.	d.f.	M.S.	F	P
	1959 United States pelagic sample					
4	Between groups	24	2	12		
	Pregnant vs. nonpregnant	22.7	1	22.7	7.27	<0.01
	Within groups	278	89	3.12		
5	Between groups	139	2	69.5		
	Pregnant vs. nonpregnant	100.6	1	100.6	35.8	<0.001
	Within groups	309	110	2.81		
6	Between groups	11	2	5.5		
	Pregnant vs. nonpregnant	10.6	1	10.6	.99	.35
	Within groups	1207	113	10.68		
7	Between groups	9	2	4.5		
	Pregnant vs. nonpregnant	6.8	1	6.8	2.37	.13
	Within groups	402	287	2.87		
8	Between groups	.01	1	.01	.003	.98
	Within groups	534	162	3.26		
9	Between groups	12	1	12	7.19	<0.01
	Within groups	177	106	1.67		
10	Between groups	5	1	5	5.40	.02
	Within groups	86	93	0.925		
10+	Between groups	6	1	6	1.74	.19
	Within groups	1823	529	3.45		

Appendix B

POPULATION ANALYSIS OF THE PRIBILOF FUR SEAL HERD WITH SPECIAL EMPHASIS OF THE POPULATION DYNAMICS OF THE HERD

Douglas G. Chapman
16 December 1960

SUMMARY

1. The best estimate of the number of pups born on St. Paul Island in 1956 is 802,000 with the all-Pribilof total 992,000. Corresponding estimates for 1957 are 627,000 and 777,000. The still very tentative 1958 estimates are 676,000 and 841,000.

2. The stratified estimates agree very closely with the Peterson-type estimates in total, though a higher proportion of the total is attributed to St. George Island.

3. The fall sampling program to estimate the pup population shortly after tagging appears worth a full scale tryout. On the basis of this year's trial it is suggested that the fall sampling program be modified in 1961, using sampling transects rather than sampling stations. Two hundred and fifty transects with three samples per transect (on the average) for a total of 750 samples are suggested for St. Paul Island.

4. Different forecast equations yield very different forecasts for the 1961 male kill on St. Paul Island. They range from 25,000 to 75,000. One method clearly gives an estimate too low for 4-year-old kill in 1961; the other gives an unreasonably high 3-year-old kill estimate. Combining the methods which seem more reliable yields an estimate of a kill of 40,000 for St. Paul Island in 1961 and hence, 50,000 for both islands.

5. Two equations are given for the relationship between the pup population size (E) and returns of 3-year-old males (N_M). The best fitting equation is

$$N_M = .0234E^{3/2} - .0008E^2$$

(all values in thousands).

6. From this equation the maximum sustainable male kill can be estimated immediately. To estimate the maximum sustainable kill of both sexes, it is necessary to estimate the female survival rate particularly from ages 0 to 3, and the pregnancy rate of the female herd. Using best present estimates for these parameters, a maximum sustainable kill of 96,000 (80,000 on St. Paul Island) is suggested. Of this, 63,000 would be male, 33,000 female.

7. The optimum kill should be obtained with a St. Paul Island pup population of 371,000 and hence a St. Paul Island female herd size (age 3 and older) of 618,000. The female herd size on St. Paul Island was 1,333,000 in 1956 and according to the best estimate is now down to 857,000. This is still much over the indicated optimum level and hence a continuing female kill is recommended.

Discussion of Methods of Pup Population Estimation

Prior to 1956, tagging was carried out only on St. Paul Island. Basic population estimates were made for St. Paul Island, then extrapolated to St. George Island on the basis of harem bull counts. While this procedure was reasonable, it was not fully exact because of the movement of animals between islands. Since St. Paul Island has much the larger population, errors caused by the smaller number moving from St. George Island are relatively small. However, if the St. George Island population were to be estimated without considering this movement, the results might be meaningless.

Alternatively, it is possible to treat the two islands as a whole, as we have done, in fact, for St. Paul Island. There, the several rookeries, which have separate pup populations initially, are considered as a single population. For this purpose, we will amalgamate the tag recoveries and the kill, by age class for the two islands. This will be the initial approach.

Loss of Tags

The loss of tags has always been recognized and, for this reason, additional marks have been used to identify tagged animals. However, animals with only a check mark may be overlooked in the confusion of the sealing operation. As pointed out in earlier population analyses, such oversight leads to an estimate biased upward. To check on this, an additional search for tag-lost animals was made on St. Paul Island in 1960. The results of this are indicated in table 1.

Table 1.--Tag-lost to tagged ratio

Year class	Sex	Recovery location and year		Tag lost	Tagged	Ratio
1957	♂	Both islands	1959	13	144	.090
		St. George	1960	48	257	.187
		St. Paul	1960	461	1,221	.378
1956	♂	Both islands	1959	83	534	.155
		St. George	1960	7	46	.152
		St. Paul	1960	48	146	.329

The difference between the 1956 and 1957 year class tag-lost to tagged ratio for St. Paul Island in 1960 is not significant (chi-square = .5, 1 d.f., P = .84). On the other hand, differences between these tag-lost to tagged ratios and those for the recoveries on both islands in 1959 or for St. George Island in 1960 are significant at the 1 percent level. It is, therefore, reasonable to assume that some tag-lost animals were overlooked on both islands in 1959 and on St. George Island in 1960. In the statistical analysis, an adjustment has been made for such overlooked animals. More precisely, the tag-lost to tagged ratio found on St. Paul Island in 1960 has been used for both islands in 1959 and for St. George Island in 1960.

All Pribilof Pup-population Estimates from 1959-1960 Tag Recoveries

Table 2 shows the usual Peterson formula estimates and the data on which it is based. The formula is:

$$N = \frac{(n+1)(t+1)}{s+1}$$

where N = population estimate (of the number of pups on both islands at the time of tagging)

n = number of seals from the specified age group in the commercial kill, estimated from tooth-age analysis

t = number of seal pups originally tagged in this year class

s = number of tagged and tag-lost seals recovered from the commercial kill of the specified year class

Table 2.--Estimates based on 1959-1960 recoveries from 1956, 1957, and 1958 taggings

Year class	Tag series	t	Year of recoveries and sex		n	s 1/	N (1000's)
1956	I	49,794	1959	♂	12,454	709	873
		"	1960	♂	4,149	255	807
		"	Combined	♂	16,603	964	857
		"	1959	♀	2,016	105	948
		"	1960	♀	554	25	1,063
		"	Combined ♂ and	♀	19,173	1,094	872

Table 2 (con.).--Estimates based on 1959-1960 recoveries from 1956, 1957, and 1958 taggings

Year class	Tag series	t	Year of recoveries and sex		n	s 1/	N (1000's)
1957	J	49,842	1959	♂	1,317	85	764
		"	1960	♂	28,381	2,036	695
		"	Combined	♂	29,698	2,121	698
		"	1959	♀	218	8	1,207
		"	1960	♀	287	17	797
		"	Combined	♀	505	25	968
		"	Combined ♂ and	♀	30,203	2,145	702
1958	K	49,917	1960	♂	2,408	149	802

1/ The tag recoveries are adjusted according to the tag-lost to tagged ratio that was obtained on St. Paul Island in 1960.

If these total population estimates are allocated between the two islands on the basis of the harem bull ratio which, in 1955, 1957, and 1958, was 4 on St. Paul Island to 1 on St. George Island, we have the breakdown shown in table 3.

Table 3.--Pup-population estimates in 1,000's, by island

Year class	St. Paul Island at time of tagging	St. Paul Island dead-pup count	St. Paul Island total	St. George Island at time of tagging	St. George Island dead-pup count	St. George Island total
1956	698	104	802	174	16	190
1957	562	65	627	140	10	150
1958	642	34	676	160	5	165

Stratified Estimates

Each island may be regarded as a stratum and we may determine the stratified estimates by the method outlined in Kenyon, et al. (1954, pp. 67-68). The method is simpler here, since there are only two equations in two unknowns. Adjusting the tag-lost counts

as we have done in "all Pribilof" estimates, p. 86, we have the data shown in table 4.

Table 4.--Stratified population estimates in 1,000's, by island (at time of tagging)

Year class	Year of recovery and sex		St. Paul	St. George	Total	Proportion on St. George out of total
1956	1959	♂	676	255	931	27.4
1956	1960	♂	543	250	793	31.5
1956	1959 and 1960 combined	♂	642	252	894	28.2
1957	1960	♂	563	182	745	24.4

There are insufficient returns (of females) to base estimates of this type on other than male tag recoveries. The agreement between these estimates and those from tag returns, table 2, are remarkable, particularly with respect to all Pribilof totals. However, the proportion of the population attributed to St. George Island is higher than the harem-bull count proportion. There is a large standard error to these stratified estimates and this discrepancy may be due merely to sampling error. It is an aspect that needs to be kept in mind as further data becomes available.

Total Year Class Population Estimates

The following table gives the Peterson estimate based on all recoveries to date. For the 1947-55 year classes, these estimates were calculated for St. Paul Island and extrapolated to the two islands by multiplying by the factor 1.17. For 1956-57-58, the basic estimates were given in table 2. The reasoning underlying use of the factor 1.17 was given in Chapman (1957). In the 1959 report, a different method of weighting male and female estimates was studied. This is not considered here. Not only are the recent estimates calculated on a different basis, but they are calculated using an adjusted tag-lost to tagged ratio (see Loss of Tags, p. ~~85~~ 83). No attempt has been made to extend this adjustment to earlier estimates since the

tag-lost to tagged ratio will vary with year class and other factors.

Table 5.--Pup population estimates in 1,000's, Pribilof Islands, 1947-58 year classes

Year class	Population at time of tagging	Dead-pup count		Total pup population
		St. Paul	St. George 2/	
1947	498	-	-	-
1948	532	60	-	592
1949	550	-	-	-
1950	-	55	(8)	
1951	484	76	(10)	570
1952	529	(77) 1/	(10)	616
1953	704	83	(8)	795
1954	727	101	10	838
1955	778	79	(11)	868
1956	872	104	16	992
1957	702	65	10	777
1958	802 3/	33	5	840
1959	-	42	7	-

1/ The 1952 St. Paul Island dead-pup count was estimated by interpolation from dead-pup ratios in 1951 and 1953.

2/ St. George Island dead-pup counts in parentheses were estimated from St. Paul Island counts.

3/ The 1958 estimate must be considered provisional, since it is based on 2-year-old male tag recoveries only.

Fall Pup Sampling and Pup Population Estimates

The sampling of live pups and the several successive counts of dead pups subsequent to tagging on Zapadni Reef and Little Polovina Rookeries provide data to estimate the 1960 pup population on these rookeries. The results are shown in table 6.

Table 6.--Results of fall sampling experiment on Zapadni Reef and Little Polovina Rookeries, 1960

Rookery	Estimated mean proportion tagged	Confidence limits for mean proportion tagged	Number tagged	Population estimates	Confidence limits for population estimates
		Live-pup sampling estimates			
Zapadni Reef	.366	.196 - .536	2,915	7,964	(5,438-14,872)
Little Polovina	.144	.052 - .236	1,500	10,417	(6,356-28,847)
		Dead-pup count estimates			
Zapadni Reef	.521	.449 - .593	2,915	5,595	(4,916-6,492)
Little Polovina	.0795	.0218-.1372	1,500	18,868	(10,933-68,807)

The mean proportion tagged differs markedly between live-pup and dead-pup samples. Neither difference is significant and it is to be remarked that the two rookeries show opposite effects. On Zapadni Reef, the proportion of tagged dead animals is higher than for the live sampling, but on Little Polovina, the reverse holds. There is no indication of mortality due to tagging, though this question cannot be finally resolved until additional evidence is available.

The live-pup sample estimate is based on 336 pups sampled at 14 stations (Zapadni Reef) and 411 pups at 17 stations (Little Polovina). The dead-pup sample estimate is based on 4 counts of 190 dead pups (Zapadni Reef) and 3 counts of 88 dead pups (Little Polovina). There is much less variability among the dead-pup counts than among the live-pup counts. This partially compensates for the smaller number. As a result, one of the confidence intervals for the tagged to untagged ratio in the population, based on the dead-pup counts, is smaller than the similar interval based on live-pup samples.

Since there is no significant difference between live-pup and dead-pup samples, we proceed to obtain a pooled estimate (table 7) of the populations of these rookeries and, in turn, extrapolate these to the whole of St. Paul Island on the basis of the harem bull count (table 8).

Table 7.--Pooled sampling estimate, fall sampling experiment, 1960

Rookery	Estimated mean proportion tagged	Confidence limits for mean proportion tagged	Number tagged	Population estimates	Confidence limits for population estimates
Zapadni Reef	.497	.431 - .563	2,915	5,865	(5,178-6,763)
Little Polovina	.0975	.0307-.1283	1,500	15,385	(11,691-48,860)

Table 8.--Estimates of St. Paul Island fall pup population, in 1,000's, from fall sampling, 1960

Area	Proportion of harem bull count out of St. Paul total	Pup population estimate	Confidence limits
Zapadni Reef	.0285	206	(182-237)
Little Polovina	.0323	476	(362-1,507)
Combined areas	.0608	350	(277-912)

The estimates are below the population estimates for St. Paul Island in the early or mid-1950's, and the confidence intervals are very broad. However, they do not reflect the variability of the number of pups per harem. Since we have little information at present on the variations of harem size between different rookeries, it is impossible to take this factor into account.

In evaluating the possibilities of this method, it is necessary to discuss two aspects: (1) possible bias and (2) the variance of the resulting estimates. It will not be possible to clearly establish that this sampling program leads to unbiased estimates until a more extensive program is undertaken and until comparisons are possible with the usual estimates. However, there is some favorable evidence viz. the comparability of the live-pup and dead-pup sample estimates. Further, the range of possibilities encompasses observations of the past decade.

The preliminary sampling done this year is useful to indicate the overall sampling required to estimate the total St. Paul Island population with 95 percent confidence to within $\pm$ 100,000.

The number of samples (k) required to estimate the population size (N) within ($\pm$E) with 90 percent confidence can be found from the formula:

$$k = \frac{2.7\, N^4\, o^2}{t^2 E^2}$$

where t = number of tags placed (it is assumed that these are placed approximately proportionately to population size)

o^2 = the variance of the tagged proportions from live-pup samples of 25.

For the two areas sampled this year, o^2 = .0361 and .0961 respectively. A weighted average of these is approximately .06. If we assume N equals 500,000 and have the error of estimate E equal 100,000 for 40,000 tags placed (on St. Paul Island) then:

$$k = \frac{2.7(625)10^{20}(.06)}{(16)(10)^8(10)^{10}} = 632.8 \text{ or } 633.$$

If the variance (o^2) were as low as that obtained in the Little Polovina sample, the required number of samples would be reduced to only 381 while if o^2 were .0961, as occurred at Zapadni Reef, the suggested k is 1014. In any case, the k determined from the average o^2 is larger than the number of samples that was indicated in advance of the preliminary study. Also, it was found in the preliminary sampling that many sample stations yielded no pups and hence no estimate.

For these reasons, it seems desirable to modify the plan to replace the sampling stations by sampling transects. Such transects would in general run perpendicular to the beach and the plan calls for sampling pods of pups (each containing 25 pups or as close as possible to this number) along each transect line from the beach shorewards. If an average of three pods were sampled on each transect, 250 transects would yield 750 samples, somewhat more than the indicated k. In this scheme, transects which yield fewer than three samples would be balanced by transects in areas where the pups spread far up from the beach and more than three samples are possible. Obviously, modifications must be made at some locations for terrain.

Experience with this sampling may prove that it is possible to reduce the number of samples or to concentrate the same number of samples on smaller areas which might, in turn, be chosen on some sample basis. Consideration should also be given to dead-pup sampling as was done on the sample areas in 1960, both to cast further light on the question of mortality following tagging and as a supplement to the live sampling for the fall pup estimation.

Male Escapement

The estimates of escapement serve two purposes; (1) the 3-year escapement yields an estimate of the 4-year-old kill of the following year, and (2) the 4-year escapement estimate is needed to estimate the total returns from any year class.

The methods of estimating escapement were studied in earlier reports (Chapman, appendix KK, [in Abegglen, et al., 1957] and Chapman, appendix B [in Abegglen, et al., 1958]). Particular attention was paid to the post-season escapement and, while the method seemed to give slightly low estimates, the bias was moderate and an empirical correction factor was developed.

The through-the-season escapement that results from limiting the kill to the 41 to 45 inch range is more difficult to evaluate. Several reasons are involved. The method of killing is such that the sealers must estimate the size of the males to be selected. Inevitably, some undersize and some oversize animals are selected. Secondly, the measuring process is performed rapidly under difficult conditions and is hence subject to error. For some purposes this error may be negligible, but the estimation of the outsize escapement depends on the frequencies of each inch class. Thus, these errors complicate the procedure which is based on only five frequencies in any case (tagged animals in the inch-length frequencies of 41, 42, 43, 44, and 45).

However, the measurement of almost all tagged animals by the biologists during the 1960 season on St. Paul Island obviate two of these problems. The errors of the field measurements are avoided and, also, a more detailed length-frequency curve is available.

Table 9 shows the post-season escapements in 1960, calculated by the usual method but applied to both the St. George Island kill and to the St. Paul Island tag returns. The method is the estimation of the incomplete "tail" of a normal curve.

Table 9.--Estimate of post-season escapement, 1960

Age group	Basis of estimate	Escapement proportion	Number escapement	Total return
3	St. Paul kill	.604	37,109	61,392
3	St. Paul tag-returns	.783	---	---
3	St. George kill	.560	6,485	11,579
4	St. Paul kill	.113	353	3,115
4	St. Paul tag-returns	.108	---	---
4	St. George kill	.137	219	1,597

The numbers of tagged animals escaping are not of interest and have not been calculated. The striking thing about the data in table 9 is the unusual high post-season escapement estimates for 3-year-old males. All three estimates show this tendency. However, it should be noted that a confidence interval for the St. Paul Island escapement can be calculated from the separate escapement estimates for the five hauling-ground areas. From this calculation, the 90 percent confidence interval for the post-season escapement proportion is .60 ± .25 with a range of .35 to .85.

The escapement that occurs throughout the season, as undersize and oversize animals that are not killed, is shown in table 10. These estimates are based on the size-frequency distribution of tagged animals.

Table 10.--Estimates of through-the-season escapement, 1960

Age group	Basis of estimate	Undersize escapement proportion	Oversize escapement proportion	Total escapement proportion
3	Research measurements (St. Paul)	.006	.077	.083
	Field lengths (both islands)	.027	-	.027
4	Research measurements (St. Paul)	0.0	.47	.47

The estimates based on field lengths have generally indicated a very small or negligible through-the-season escapement. For the whole year class, the discrepancy between the mean length obtained from the field measurements and the mean length obtained from research measurements is considerable. For 3-year-old males, the means are 42.92 inches (field length) and 43.77 inches (research measurements converted from centimeters to inches). The means and standard deviations of recent year classes are shown in table 11. Since all values prior to 1960 are based on field lengths, those in 1960 are computed from these measurements also. It should be re-emphasized that these estimates are computed for the whole year class, not just for the kill, which is size selective. The 1952 year class, which had excellent survival, and the 1956 year class, which had extremely poor survival, do not stand out particularly, in respect to length, from other year classes.

Table 11.--Comparison of mean length and standard deviation of 3- and 4-year-old males, 1947-57 year classes

Year class	Age 3 mean	Age 3 standard deviation	Age 4 mean	Age 4 standard deviation	Average increase in length
1947	41.90	1.39	44.93	2.00	3.03
1948	42.09	1.54	45.28	1.36	3.19
1949	42.68	1.16	44.85	1.29	2.17
1950 1/	-	-	-	-	-
1951 2/	-	-	-	-	-
1952	42.80	1.30	44.45	1.38	1.65
1953	42.53	1.55	44.43	1.47	1.80
1954	42.57	1.50	44.44	1.36	1.87
1955	43.13	1.50	45.09	1.75	1.96
1956	42.00	1.80	44.43	1.51	2.43
1957	42.92	1.43			

1/ No tags were placed on the 1950 year class.
2/ Too few tags were placed on the 1951 year class to obtain an estimate.

Forecast of Male Kill on St. Paul Island in 1961

In the 1959 report, an equation was given relating returns of any year class at ages 2, 3, and 4 to estimates of the original population size of the year class. This may be used as a basis for forecasting the return of 3-year-old males. If the fall sampling program proves to be satisfactory, the forecast can be based on estimates so obtained. In the meantime, the forecast must be based on population size estimates from the 2-year-old male kill.

Since the return equation was developed for St. Paul Island, for which the longest series of data is available, it will be applied now to this island. The return equation is:

1. $P = 29.4 - 0.0385E$

where P = percent return of males
E = fall population estimate (1000's)

This in turn gives;

2. $N_m = .294E - .000385E^2$

where N_m = return of males (1000's)

Table 12 shows estimates of the St. Paul Island fall population only and the estimated returns predicted from equation (2).

Table 12.--Estimates of St. Paul Island fall pup population in 1,000's, and estimates of returns

Year	Population estimate	Predicted male return N_m	Observed kill to date 1/
1956	709	14.9	13.9
1957	610	36.0	26.9
1958	646	29.3	2.0

1/ No estimate was made of escapement or natural mortality from ages 2 to 3 and 3 to 4.

A second method of estimating total returns can be based

on the dead-pup counts. The data to date (table 13) indicates that a linear relationship holds between returns and dead-pup count.

Table 13.--Dead-pup counts and male returns in 1,000's, St. Paul Island, 1950-56

Year	Dead-pup count	Return[1/]
1950	55	59
1951	76	55
1953	83	46
1954	101	30
1955	79	38
1956	104	14

1/ From Chapman, appendix A, p. 71, table 11 (in Abegglen, et al., 1959), with 1956 year-class data added.

The estimated relationship between dead-pup counts (D) and male returns (N_m) is:

$$3. \quad N_m = 110.84 - .8395D$$

It should be pointed out that this relationship, if real, can only hold for certain population levels. If the population were small, D would be small (as was observed in the past), and this equation cannot be the relationship between D and N_m. In fact, at low population levels, the relationship between D and N_m should be an increasing one rather than the decreasing relationship indicated by (3).

The forecasts by the several methods and estimated standard errors are indicated in table 14. The standard error involves not only the errors of the linear relationship, but also, in the case of the 1958 year class, the error in estimation of the original size of this class from 2-year-old male returns.

In predicting the kill, an additional factor must be taken into account, the fraction of the return taken as 3-year-old males and the fraction taken as 4-year-old males. This varies with the size of the return, the timing of the return of 3-year-old males, the

termination date of the kill, and possible other factors. However, over the period of study of year-class returns (1947-56 year classes), the 3-year-old male kill averaged 64.3 percent of the estimated total return. This factor has been used in table 14.

Table 14.--Forecast of male returns and kill in 1960 (1,000's)

Age group	Year class	Predicted total return	Predicted 1961 kill	Standard error
	Method 1. Population-Return Relationship			
3	1958	29.1	18.7	39.1
4	1957	36.0	6.8 1/	16.5
		Total	25.5	
	Method 2. Dead-pup Count-return Relationship			
3	1958	82.3	52.9	13.4
4	1957	55.4	21.5 2/	9.5
		Total	74.4	
	Method 3. 1960 Escapement Estimates			
4	1957	61.4	31.7 3/	
	Combined Estimates from (1) and (2)			
3	1958	76.7	49.3	
4	1957	50.6	20.6	
		Total	69.9	

1/ Escapement for 1961 estimated at 1,000.
2/ Escapement for 1961 estimated at 3,500, using the average percent escapement (6.4 percent) from 1947-57 year classes.
3/ Escapement for 1961 estimated at 3,900 as in (2).

The combined estimates are closer to those given from the dead-pup count to return relationship because of the smaller standard error associated with these estimates. The large standard error of the predicted 3-year-old male return is caused by the variability that is associated with the population estimates from 2-year-old male tag recoveries.

It should further be pointed out that these forecasts are for St. Paul Island only and represent approximately 80 percent of the total kill. It should also be pointed out that a kill of 49,000 3-year-old males on St. Paul Island would well exceed any harvest of this age class since 1950. It is clear that this excessive estimate must be discounted considerably. However, it is also apparent from the escapement estimates and the strong showings of 3-year-old males during the late rounds in 1960 that the predicted total return of 36,000 from the 1957 year class is low. A conservative prediction for the St. Paul Island kill in 1961 is 20,000 3-year-old males (from method 1) and 20,000 4-year-old males (from method 2), a total of 40,000.

Optimum Population Level

As noted in the previous section, an equation was given relating the percentage return of males to the population size of the year class at the time of tagging. In the 1959 report (Chapman, appendix B, p. 73, [in, Abegglen, et al., 1959]) this equation was given as:

$$P = 58.8 - 0.077E$$

where P = percent return of both sexes
E = fall population estimate (1,000's)

This equation is, however, partially incorrect; it has been derived from the observed male returns. It was then assumed that female returns to age 4 would be the same as male returns. However, the forecast equation has been based on recent tagging estimates and these estimates are inconsistent with this assumption.

Consequently, we now properly consider the relationship of male returns and the fall population estimate. This was the equation 2

$$N_m = .294E - 0.000385E^2$$

given in "Forecast of Male Kill in 1961," page ~~96~~ 159. This equation is the most appropriate one for forecasting male returns in the immediate future, though it is not necessarily the best equation that can be obtained to determine the optimum population level. This equation is based only on the data of the past decade, during which sharp declines in male returns have occurred. It is reasonable to

attribute the declines to overpopulation pressure, especially since these observations all occur at high, or very high, population levels. Nevertheless, other factors may be contributing to or aggravating the situation.

There are also some pup population estimates and return data from the early 1920's when population levels were much lower than at present. Table 15 shows the total returns of males to age 3 from the year classes 1920-22 and 1947-55 (it is necessary to work with age 3 rather than 4 in handling the early data).

Table 15.--Returns of males to age 3 for year classes, 1920-22, 1947-52 (omitting 1950), and 1953-55, St. Paul Island

Year class	2	3	4	Breeding reserve	Escapement 1/ or native kill	Adjusted 2/ total
1920 3/	527	11,725	232	8,416	2,267	23,190
1921 3/	697	12,726	396	6,826	1,556	22,241
1922 3/	346	13,630	491	7,424	2,583	24,523
Mean 1920-22						23,318
1947	826 4/	31,746	19,658	-	6,139	60,949
1948	788	30,014	17,995	-	4,903	55,990
1949	133	29,697	12,502	-	3,904	47,876
1951	1,391	32,350	18,083	-	5,647	59,844
1952	1,735	30,733	31,448	-	2,122	69,395
Mean 1947-52						58,811
1953	839	38,290	8,855	-	881	49,839
1954	2,858	23,473	5,599	-	58	33,128
1955	1,015	27,912	10,438	-		40,409
Mean 1953-55						41,125

1/ Figures for the years 1920-22 are native kills while those from 1947-55 are escapement.

2/ Age 4 plus escapement increased by 10 percent for mortality from age 3 to age 4.

3/ Age classification was estimated from lengths only in 1920-22; this data is taken from the annual report, "Alaska Fishery and Fur-Seal Industries," U. S. Fish and Wildlife Service (Bureau of Fisheries prior to 1940).

4/ Estimated from the kill of 2-year-old males in 1950 and 1952; 1951 was slightly exceptional as the sealing crew was instructed to take larger animals, the length limit being increased by 1".

'56 & '57 Bull estimated into August.

rate of exploitation since '56 has been 90% or higher.

Reliability of estimates of escapement ← sampling error - see 1958 Report
non-sampling errors - see

In considering the returns of the early 1920's, no attempt has been made to estimate escapement except for those animals which were deliberately spared and marked in some way for the breeding reserve. At this time, there was still a considerable pelagic kill by natives. In United States reports, the pelagic kill was classified by sex. This was not true of Canadian reports. Hence, the proportion of males taken by Indians off Washington and Alaska has been used to estimate the males killed by Canadian natives. Also, all of this kill has been attributed to the younger ages which is reasonable since then, as now, the older males form a negligible proportion of the total herd.

One further problem remains in regard to the male returns of the early 1920's. At that time, age was estimated entirely on the basis of length. We learned in the 1950's that this was an unsatisfactory basis. Whether it was or was not satisfactory in the 1922-26 period is unanswerable. However, we have used a method of analysis which mitigates this problem. Precisely, the analysis has been based on the average population size and returns for the year classes of three periods, 1920-22, 1947-52 (excluding 1950 because no population estimate is available) and 1953-55. These represent three distinct population levels, low, high, and very high. Furthermore, year to year fluctuations and errors are minimized and the uncertainty of age estimates of the early 1920's need not concern us.

The basic observations from table 15, the three period averages used in the estimation of the relationships and two fitted curves are shown in figure 1. The two fitted curves are:

4. $N_m = .223E - .00023E^2$
5. $N_m = .0234E^{3/2} - .0008E^2$

The first of these is obtained from assuming returns are linearly related to population size, i.e., $\frac{N_m}{E} = A-BE$. This is the simplest possible equation though it has no theoretical justification.* The second equation is more complicated. However, it has some theoretical basis and gives a somewhat better fit. A discussion of the justification of this model will be given later.

The indicated population level for maximum male returns is: from equation (4) $E_{Max} = 485,000$ $N_{m\,(Max)} = 54,000$

from equation (5) $E_{Max} = 481,000$ $N_{m(Max)} = 61,700$

While equations (4) and (5) appear to be substantially different, they lead to amazingly similar results in regard to maximum male returns.

Two comments are pertinent here. First, these estimates apply to St. Paul Island only; the usual extrapolation must be made to "all Pribilof" totals. Secondly, the estimated maximum male return is very close to the actual average kill from 1939 to 1956.

However, when the dynamics of the fur seal population were studied in 1955, it was suggested that the maximum kill would include a continuing kill of females. The determination of the population level for maximum total kill (male and female) is more complicated because the estimates of the female survival rates are still not firmly established and even less is known about the total returns of females at age 3. It is necessary, however, to assume that the survival of females at the youngest ages is greater than that of males.

Let N_m = male returns at age 3
N_f = female returns at age 3

Assume $N_f = \lambda N_m \quad (\lambda > 1)$

Now let (p) be the average pregnancy rate among females 3 and older. Let (a) be the average annual mortality rate among females 3 and older.

Then, if the relationship between male returns and initial population size is of the form:

$$N_m = AE + BE^2$$

we have an equation for sustainable kill (K):

$$K = N_m + N_f - H - a\frac{E}{p}$$

where (H) is the number of males spared to join the breeding stock. We assume simply that this is set at (say) 5,000 and it will not further influence our calculations.

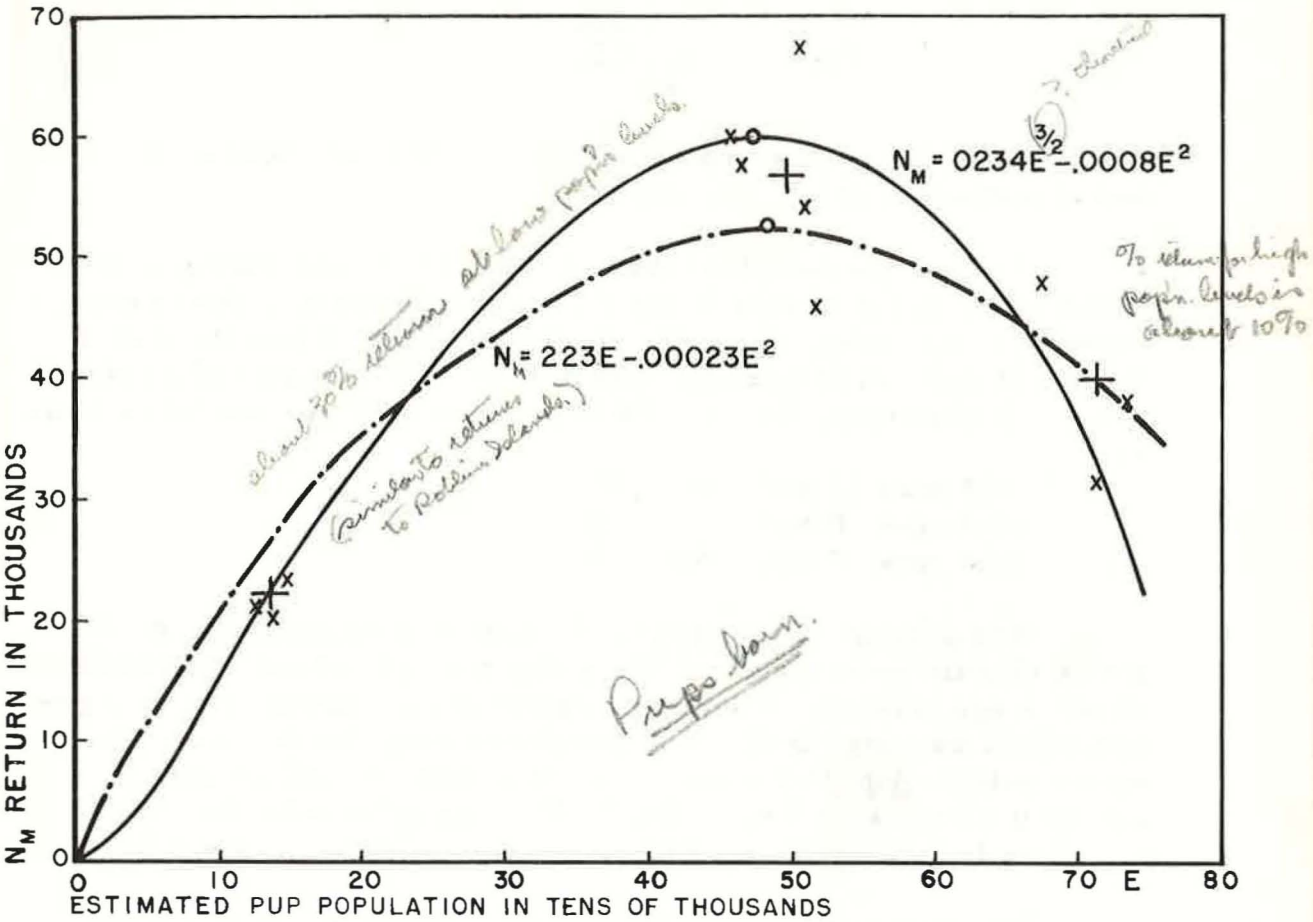

Figure 1.--Male Population-return Relationship, year classes 1920-22, 1947-49, 1951-52, and 1953-55.

The term $(\frac{E}{p})$ is the size of the female component of the herd and hence $(a\frac{E}{p})$ is the annual replacement necessary to maintain this female component at a stable size.

Now putting $N_m = AE - BE^2$

$$N_f = \lambda (AE + BE^2)$$

we have $$K = E[A(1+\lambda) - \frac{a}{p}] - B(1+\lambda)E^2$$

From this, it follows that the level of (E) for maximum total kill

$$E_M = \frac{A - \frac{a}{p(1+\lambda)}}{2B}$$

A and B were estimated earlier as .223 and .00023. We turn now to estimates of (a), (p), and (λ).

The pelagic samples taken in 1958, 1959, and 1960 give estimates of the survival rate in the older age classes but, due to unrepresentative sampling, not in the younger groups. Using Heincke's method (discussed in Chapman and Robson "The analysis of a catch curve," Biometrics, Vol. 16 (1960) pp. 354-368), the mortality rates are:

1958	ages 12 and older	.25
1959	ages 8 and older	.18
1960	ages 9 and older	.20

The average of these is 0.21; it is convenient to use 0.20, giving slightly more weight to the estimates of 1959 and 1960 based on more age classes. A lower mortality seems indicated at younger ages; 0.05 was used in the 1952 population study but in view of the recent pelagic data this seems low. We have adopted a mortality rate of 0.10 for ages 3 to 10 and 0.20 for ages 10 and older. For the whole female herd, this yields an average value of a = 0.14.

Having an estimate of the mortality rate, it is straight forward to determine a weighted estimate of the pregnancy rate (p). This is necessary since the youngest ages, which have the lowest pregnancy rates, are under-represented in the pelagic sample.

Weighted estimates of the pregnancy rate among female seals age 3 and older obtained from the 1958, 1959, and 1960 pelagic samples are .591, .596, and .593. A rounded estimate of (p) is 0.6.

Now if p = 0.6 the St. Paul Island pup population estimate of 800,000 in 1956 implies there were then 1,333,000 females. However, if the returns of females were equal to returns of males, the total number of females would have been about 650,000 (Chapman, appendix B, in Abegglen, et al., 1959). Hence, we have an estimate ($f\lambda$) as $\frac{1333}{650} = 2.0$ (approximately).

Now with $p = 0.6$ $\quad \frac{a}{p(1+\lambda)} = .078$

$a = 0.14$

$\lambda = 2.0$

$\tilde{E}_M = 315,000$

$\tilde{K}_M = 64,000$ (41,000 males)
(23,000 females)

A similar treatment can be followed with the population-return equation (5). Using equation (5) we have with $p = 0.6$ $a = 0.14$ $\lambda = 2.0$

$\tilde{\tilde{E}}_M = 371,000$

$\tilde{\tilde{K}}_M = 80,000$ (52,000 males)
(28,000 females)

A maximum pup population of 371,000 and a pregnancy rate of 0.6 implies a female population 3 and older of 618,000.

We can estimate the level at which the female population is now by considering the gains and losses since 1956 using a natural mortality rate of 0.14 for the whole herd and an estimate of $\lambda = 2.0$ (this is the estimate of differential female survival).

St. Paul Island female population in 1,000's,
1956-1960

Estimated 1956 total (3 and over) 1,333
1957 estimates = 1,333 - 186 (natural mortality) - 18 (kill in 1956) + 100 (recruitment) = 1,229
1958 estimates = 1,229 - 172 (natural mortality) - 38 (kill in 1957) + 66 (recruitment) = 1,085
1959 estimates = 1,085 - 152 (natural mortality) - 24 (kill in 1958) + 81 (recruitment) = 990
1960 estimate = 990 - 139 (natural mortality) - 24 (kill in 1959) + 30 (recruitment) = 857

These estimates can in turn be used to give pup population estimates. Continuing to use an estimate of p (pregnancy rate) as 0.6 we have:

1957 pup population = 0.6 (1229) = 737,000
1958 pup population = 0.6 (1085) = 541,000

The 1957 figure is higher than that given for St. Paul (627,000) but in good agreement with the 1958 estimate of 676,000. All of those figures are estimates and furthermore we do not yet know the magnitude of year-to-year fluctuations in pregnancy rate of the whole herd.

In any case, this suggests the female herd is still above the indicated optimum level and suggests further that so far the main factor in the reduction of the herd has been the natural one. That is, recruitment has been insufficient to balance natural mortality.

It is probable also that there will be a continuing reduction through this natural cause, at least in 1961 and 1962. At the same time a kill of females is indicated to move the population towards the level at which the maximum sustainable yield is to be expected. A suggested level is one slightly in excess of the indicated maximum female kill, say 30,000 to 35,000 animals.

Some final comments should be made about the estimates of optimum herd size, present level of the female herd and indicated level of female kill.

Firstly, it is not possible to put confidence limits on these estimates for several reasons--the estimates are complex and in any case we do not have a method of estimating the confidence in the basic equations, such as the population-return relationship.

Secondly, there is evidence that the mortality rate of the adult females was lower prior to the recent population decline. If the improved condition of the herd should lead to a lower rate again then the sustainable kill will be greater than the levels here indicated. Also, the improved herd condition could result in an increased pregnancy rate that would mean the maximum yield could be attained with a lower herd size.

Thirdly, the development is predicated on the assumption of no lags in the response of the herd to change in its size. If, for example, the decline in returns in recent years is due to excessive pressure on the food supply around the islands there may be a lag before the food supply is back in balance with the fur seal herd.

Finally, the need that has long been realized for more accurate data on the female component of the herd is reemphasized. What is needed are independent estimates of the number of adult females and better estimates of survival rates of the females from age 0 to about 10. This might be accomplished by a program of tagging young females; part of it might also be accomplished by a program designed to check female tags in substantial numbers without killing the animals.

The numerical results given in Forecast of Male Kill on St. Paul Island in 1961 (page 154) and Optimum Population Level (page 157) apply to St. Paul Island. They have been extrapolated to St. George Island by assuming the usual 4:1 ratio holds between the two islands. This is the basis for the all-Pribilof totals given in the initial summary.