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Fur Seal Investigations, 1985

Edited by
Patrick Kozloff
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Hiroshi Kajimura

September 1988

U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service

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Hiroshi Kajimura

National Marine Mammal Laboratory
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way N.E., BIN C-15700
Seattle, Washington 98115

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ABSTRACT

Northern fur seal (Callorhinus ursinus) research in 1985 was conducted on the Pribilof Islands and Bogoslof Island in Alaska, and on San Miguel Island and nearby Castle Rock in southern California.

Estimates made of the number of pups born in 1985 on St. Paul Island showed a slight but insignificant increase since 1984, whereas the pup population in 1985 on St. George Island decreased by about 8.2% since 1983.

Enlarging on previous studies, larger samples of maxillary canine teeth collected from males taken in the harvest were weighed for the years 1948-84. This study (confirmed that a density-dependent increase in tooth size occurred as the population declined.'

[Duration of feeding trips and reproductive success were examined for 47 females! 20 early-pupping, older females were compared to 27 late-pupping, young females. Early-pupping, older females had significantly shorter trips to sea (X=4.48 days) than did late-pupping, young females (X=6.70 days). By October, just prior to weaning, 34.6% of the pups of the young females had died, whereas only 7.4% of the early-pupping, older females had lost their pups.

Surveys of entanglement among young males were accomplished by capturing, tagging, and recording the nature of their entanglement. Control animals were tagged for future estimates of mortality rates.

In October, studies with captive pups demonstrated that trawl netting with mesh sizes as small as 15 cm (stretched mesh) present a risk of entanglement.

Surveys indicate entanglement rates in adult females on sample rookeries varied from 0.06 to 0.23% in 1985. Experimental entanglement resulted in doubling of feeding trip duration for adult females; up to one-half of experimentally entangled females did not return from their first, second, or third feeding trips. A total of 25 entangled juvenile females and 39 entangled pups were observed during late season surveys.

Serum samples were collected from 300 subadult males and 37 pups;- the pups were also given rectal swabs for calcivirus isolation studies.

Swim speeds of foraging females were greatest (3.5 m/second or 12.6 km/hour) during deep dives. Intragroup density of females did not decline as the population declined over the past 10 years, but remained relatively stable.

Radio transmitters and aerial surveys were used to study movement patterns of female northern fur seals at sea during June and July 1985. As in 1984, fur seals were located principally to the northwest and southwest of St. Paul Island at feeding locations about 205 km from the island.

Pelagic studies were conducted near the Pribilof Islands during August 1985, to assess food habits of fur seals in relation to prey abundance and distribution. Forty-three fur seals were collected and their digestive tracts analyzed; 23 midwater and 23 bottom trawls were also completed and the catch analyzed. Comparisons between fur seal prey items and species diversity and abundance from the trawl catches are currently being analyzed.

The small rookery at Bogoslof Island was surveyed during August 1985, and was found to contain about 103 fur seals older than pups and at least 9 pups.

The number of fur seal pups born at San Miguel Island decreased from 889 in 1984 to 781 in 1985. Estimates for the total number of females in the population were not obtained, although the number of pups born suggest that females numbers may have also decreased. The number of males has not appeared to have changed significantly in the past several years.

Mortality of pups at Adams Cove and Castle Rock was 3.7% and 3.4%, respectively.

Information obtained in 1985 indicates that 94.0% of the female population at Castle Rock and Adams Cove was composed of animals older than 6 years of age. During 1970-73, 10.0 to 35.0% of the female population was younger than 7 years of age.

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INTRODUCTION

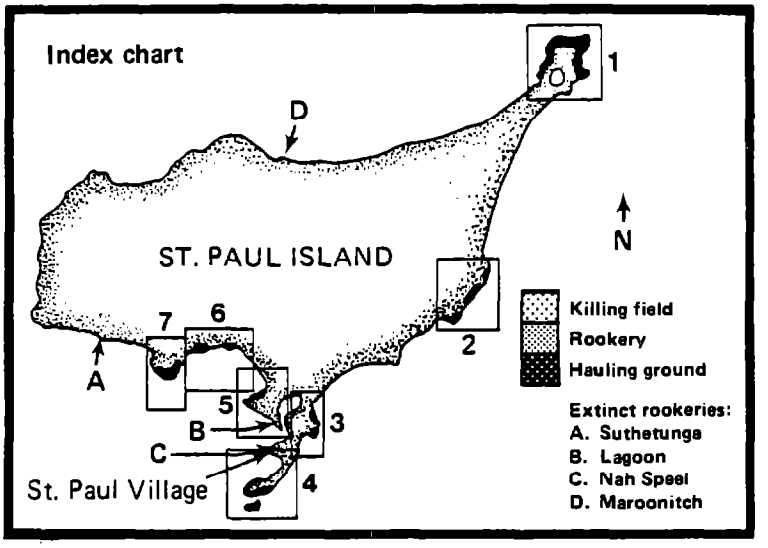
by

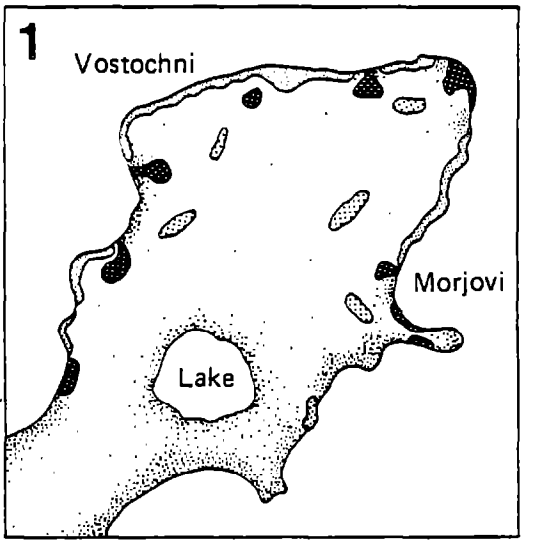
Charles W. Fowler and Patrick Kozloff

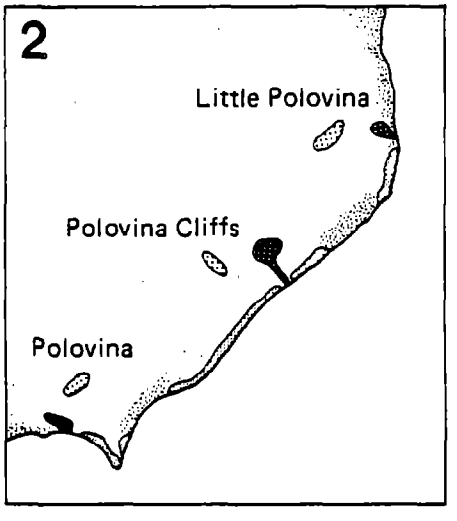
In 1985, the United States, Canada, Japan, and the Soviet Union cooperatively carried out research on the northern fur seal, Callorhinus ursinus, on land and at sea. Scientists from the National Marine Mammal Laboratory (NMML) in Seattle, Washington, have routinely conducted annual surveys and studies on U.S. islands under terms of the Interim Convention on the Conservation of North Pacific Fur Seals. Although this Convention lapsed in October of 1984, studies have continued annually by former member nations. In particular, studies have been conducted on the Pribilof Islands and Bogoslof Island in Alaska and San Miguel. Island off southern California where fur seals breed and haul out. This report summarizes the research carried out on these islands in 1984 and 1985.

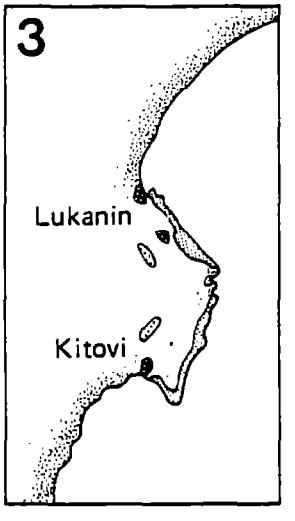
The Pribilof Islands of St. Paul (Fig. l), St. George (Fig. 2), and Sea Lion Rock (Fig. 1 - Sivutch) are host to breeding populations of northern fur seals. Two additional colonies containing approximately 2,000 to 4,000 northern fur seals breed on San Miguel Island and nearby Castle Rock off southern California (Fig. 3). A small colony of fur seals now breeds on Bogoslof Island, Alaska. The colony began in 1980 and in 1985 included about 112 animals.

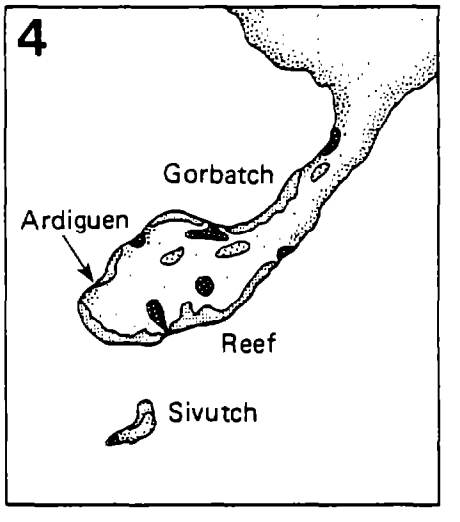
In 1985, fur seals were not commercially harvested on St. Paul Island. However, a total of 3,379 juvenile male fur seals (primarily 3-year-olds) were taken for subsistence.

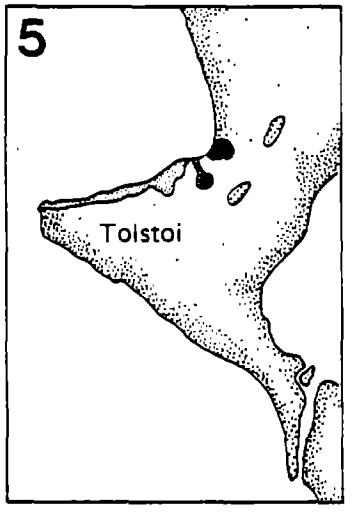


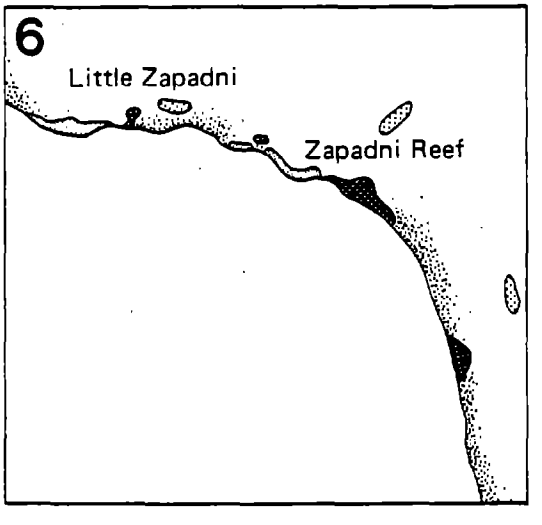












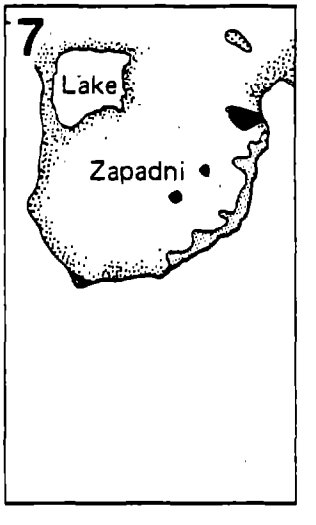
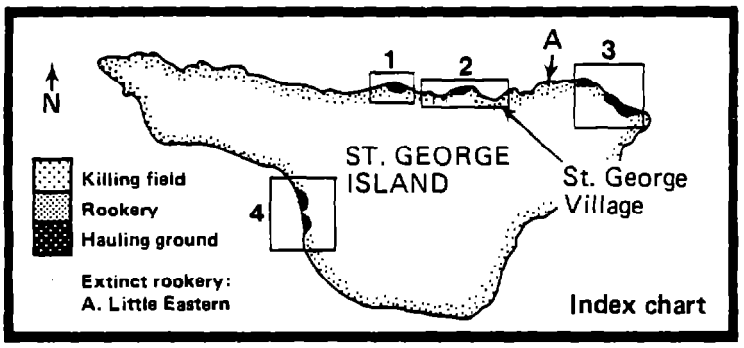
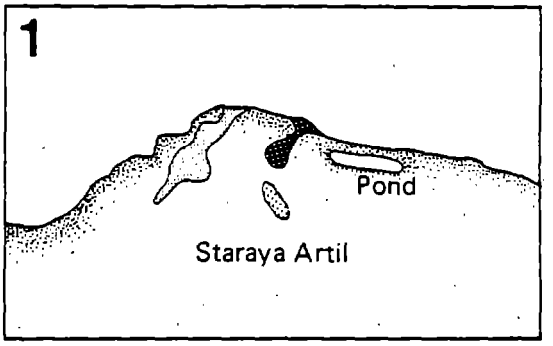
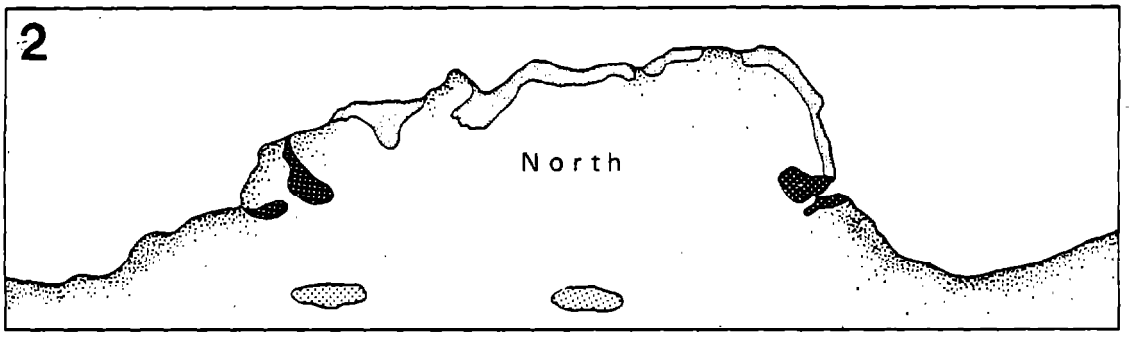
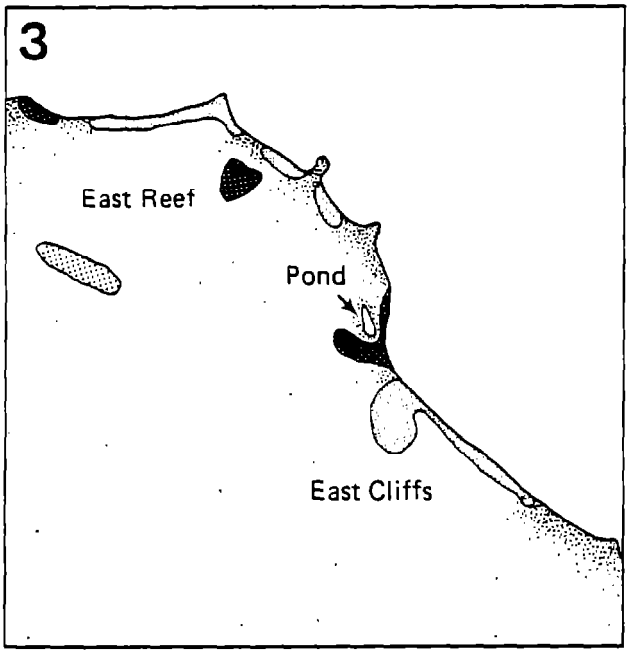


Figure 1.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. Paul Island, Alaska.









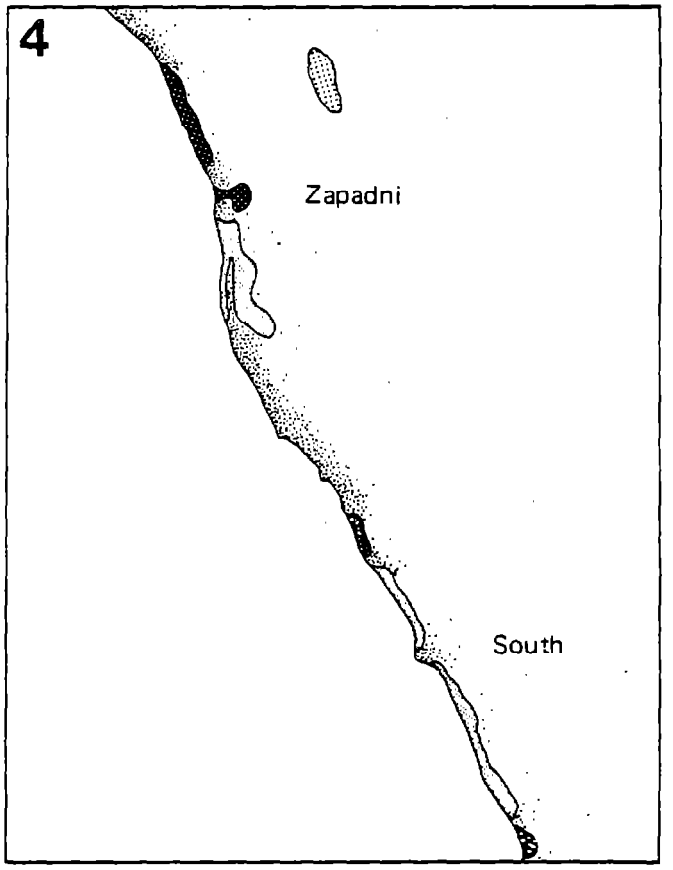


Figure 2.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. George Island, Alaska.

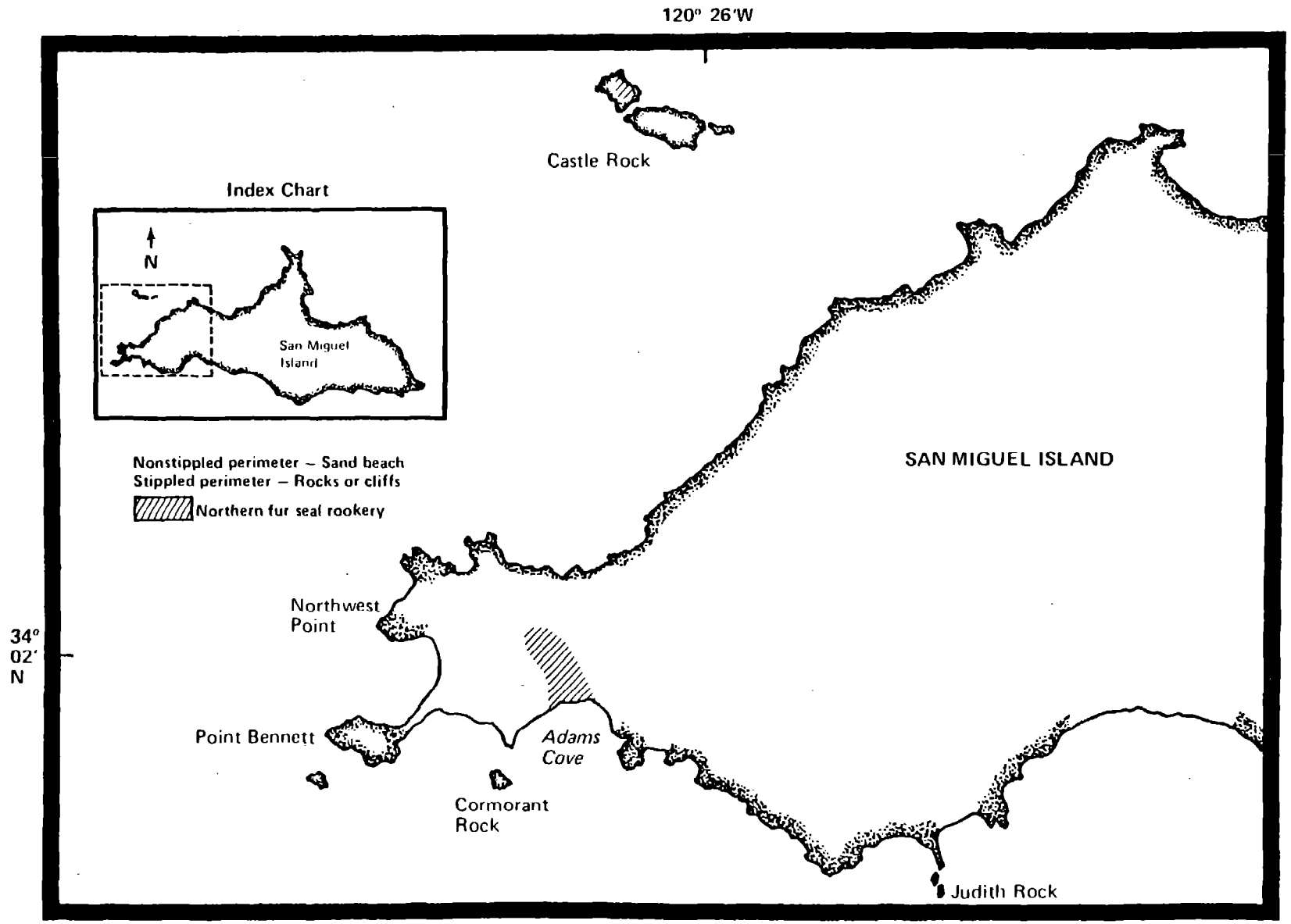


Figure 3.--Location of northern fur seal breeding colonies, San Miguel Island, California.

In the same year, 329 males were also taken on St. George Island for subsistence. A moratorium on the commercial harvesting of seals on St. George Island was imposed beginning in 1973 to permit research on the population as it reverted to its natural state. Fur seals are not harvested on Bogoslof Island, Castle Rock, San Miguel Island, or Sea Lion Rock. However, some males from these rookeries may be subjected to a harvest mortality since young male seals occasionally haul out at some distance from their rookeries of birth. There are four extinct rookeries on St. Paul Island (Fig. 1) and one on St. George Island (Fig. 2).

Terms having special meanings in northern fur seal research are defined in the glossary, and Russian names given to some of the rookeries of the Pribilof Islands following their discovery by Russian fur hunters in 1786 are translated.

Tabular data for this report are presented as appendices. Appendix A is the data customarily presented concerning general studies, Appendix B is entanglement-related data, and Appendix C is a list of personnel involved in fur seal research in 1985.

POPULATION ASSESSMENT, PRIBILOF ISLANDS, ALASKA

by

Patrick Kozloff and Anne E. York

In accordance with provisions originally established under terms of the Interim Convention on Conservation of North Pacific Fur Seals, the National Marine Mammal Laboratory (NMML) continues to monitor the status of the fur seal herd on the Pribilof Islands through the collection of specific kinds of information on population size, age and sex composition, and natural mortality.

Population Parameters

Herd characteristics monitored on the Pribilof Islands in 1985 included the 1) age and sex composition of seals harvested for food on St. Paul Island, 2) number and sex of seals taken for food on St. George Island, 3) number of live adult males and pups, and 4) number of dead pups and older seals.

Age and Sex Composition of Seals Harvested

Males--Drives (roundups) were made from several hauling grounds on St. Paul Island from 17 July to 6 August. Male seals were selected without restrictions on size, although smaller animals (2-4 years old) were preferred. Seals were not harvested on Saturdays or Sundays, and those identified as females were rejected. The age composition of the males taken was determined from a 20% sample of maxillary canine teeth collected in each harvesting area (Appendix Tables A-1 and A-2). The sizes of the year classes of male seals harvested since 1971 are

listed in Table 1. The age composition of males harvested on St. Paul Island since 1976 is shown in Table 2.

On St. George Island, 329 subadult male seals of approximate ages 2-5 years were taken for food from the east hauling ground of North Rookery.

Females--In 1985, five young females up to 4 years of age were inadvertently taken during the subsistence harvest of males on St. Paul Island because of their similarities in size and in whisker (vibrissae) color to 3-year-old males. The maxillary canine teeth and reproductive organs of some of those taken were collected for age and reproductive studies.

Living Adult Male Seals Counted

In 1985, 4,372 harem and 3,363 idle adult male fur seals (bulls) were counted on St. Paul Island from 10 to 21 July (Appendix Tables A-3, A-4, and A-5). On St. George Island, 1,268 harem and 1,601 idle bulls were counted from 17 to 19 July (Appendix Tables A-4 and A-5). Figure 4 illustrates the relative location of the different classes of adult males on a typical fur seal rookery-hauling ground complex on the Pribilof Islands.

Dead Seals Older Than Pups Counted

The rookeries and adjacent beaches of St. George Island were surveyed for dead seals older than pups on 16 August and the count totaled 35 females and 17 males. Table 3 lists the number of these seals counted on the Pribilof Islands since 1965.

Table 1. --Harvest of male northern fur seals, by age group, St. Paul Island, Alaska, 1971-83 year classes.[a]

Year class	Number of seals				
	Age group				Total harvested
	2	3	4	5	
1971	577	14,652	10,768	722	26,719
1972	1,025	15,186	8,050	707	24,968
1973	1,642	13,397	9,421	598	25,058
1974	893	16,476	8,955	470	26,794
1975	1,783	13,752	7,918	725	24,178
1976	1,479	15,245	8,183	651	25,558
1977	2,051	13,157	6,714	511	22,433
1978	2,180	14,224	7,016	414	23,834
1979	2,284	15,123	6,644	304	24,355
1980	2,065	15,587	4,601	4	22,257
1981[b]	3,047	13,976	496	-	17,519
1982[b]	3,133	2,645	-	-	5,778
1983[b]	234	-	-	-	234
Total	22,393	163,420	78,766	5,106	269,685
Mean	1,723	13,618	7,161	511	24,615[c]

a Includes only 2- to 5-year-olds taken during the harvest of male seals. In 1984, an upper limit of 22,000 fur seals was imposed in the harvest, and in 1985, the harvest was limited to a subsistence take for food.

b Incomplete returns.

c 1981, 1982, and 1983 year classes not included.

Table 2.--Age classification of male northern fur seals harvested, St. Paul Island, Alaska, 1976-85.

Year of harvest	Number of seals						
	Age group						Total harvested
	1	2	3	4	5	6	
1976	0	893	13,397	8,050	722	19	23,081
1977	0	1,783	16,476	9,421	707	9	28,396
1978	0	1,479	13,752	8,955	598	45	24,829
1979	0	2,051	15,245	7,918	470	18	25,702
1980	0	2,180	13,157	8,183	725	33	24,278
1981	0	2,284	14,224	6,714	651	19	23,892
1982	0	2,065	15,123	7,016	511	15	24,730
1983	16	3,047	15,587	6,644	414	20	25,728
1984[a]	0	3,133	13,976	4,601	304	20	22,034
1985[b]	0	234	2,645	496	4	0	3,379

[a] An upper limit of 22,000 male fur seals was imposed in the harvest.

[b] The harvest was limited to a subsistence take for food.

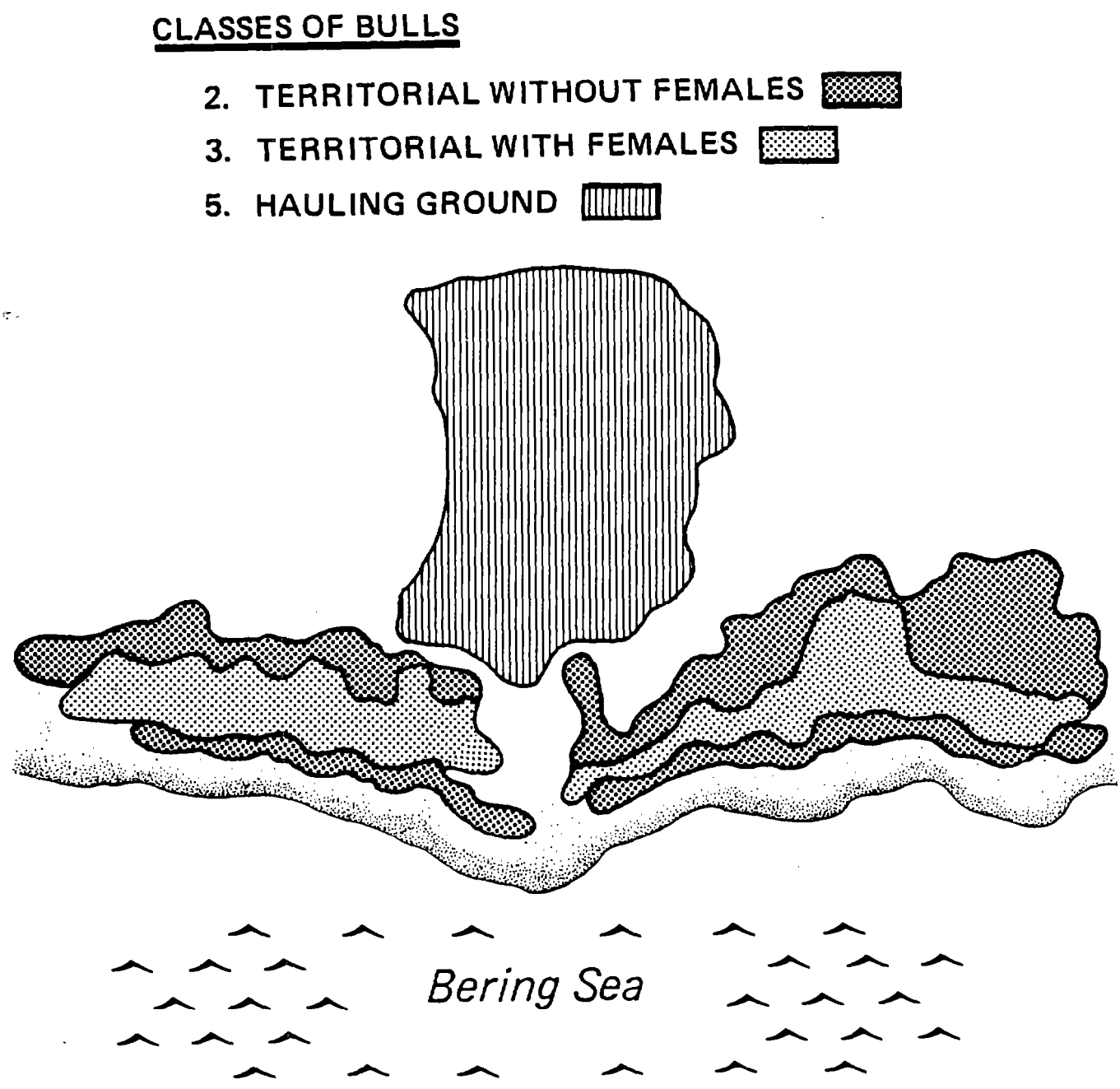


Figure 4.--General composition of a typical fur seal rookery (see Glossary for classification of adult male fur seals}.

Table 3. --Number of dead northern fur seals counted that were older than pups, Pribilof Islands, Alaska, 1965-85. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
1965	158	-	-	-	158	-
1966	181	172	41	55	222	227
1967	108	157	41	28	149	185
1968	98	141	33	22	131	163
1969	94	141	22	29	116	170
1970	52	124	4	53	56	177
1971	39	91	5	37	44	128
1972	46	111	22	30	68	141
1973	61	65	7	30	68	95
1974	33	30	4	15	37	45
1975	92	99	-	-	92	99
1976	46	64	-	-	46	64
1977	60	69	-	-	60	69
1978	57	87	-	-	57	87
1979	56	66	-*	-*	56	66
1980	102	117	14	65	116	182
1981	44	83	12	61	56	144
1982	47	117	-	-	47	117
1983	57	66	-	-	57	66
1984	66	72	-	-	66	72
1985	7	39	17	35	17	35

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

Dead Pups Counted

In 1985, 5,266 dead fur seal pups were counted on all rookeries of St. Paul Island from 22 August to 5 September (Appendix Table A-6). On 16 August, dead pup counts on St. George Island totaled 806 animals (Appendix Table A-6). The number of dead pups counted on both islands since 1976 are given Appendix Table A-7.

Number of Pups Born in 1985

St. Paul Island--The total number of pups alive at the time of shearing and its standard error have been estimated using the methods from York and Kozloff (1987). From the mean estimate from both sampling periods (Table 4) and the mid-July count of harem males (Appendix Table A-4), we computed the ratio of live pups to bulls on the sample rookeries. Following the procedure in the 1980 report of Fur Seal Investigations (Roppel et al. 1981), we estimated total numbers of pups born by multiplying the estimated ratio by total numbers of breeding males on all rookeries and adding the count of dead pups as follows:

Rookery	Pup count	Harem bulls	Ratio pups:bulls	r	r*
Gorbatch	12,884	320	40.26	40.30	40.25
Lukanin	3,742	106	35.30	40.60	38.46
Kitovi Amphitheater	890	18	49.44	40.20	40.83
Morjovi	10,473	300	34.91	41.34	33.99
Reef	20,586	474	43.43	39.20	46.84
Polovina Cliffs	16,683	376	44.37	39.24	46.59
Kitovi	8,758	243	36.04	40.94	36.40
Total	74,016	1,837	40.29		

Table 4.--Estimated number of northern fur seal pups in 1985 at times of shearing and birth on seven rookeries of St. Paul Island, Alaska. Pups were sheared 29 July and 3-9 August; sampling periods 1 and 2 were 22-24 and 26-28 August, respectively.

Item	Rookery							
	Gorbatch	Lukanin	Kitovi Amphitheater	Morjovi[a]	Reef	Polovina Cliffs	Kitovi	Total
No. pups sheared	1,236	384	64	1,212	1,938	1,593	878	7,305
No. 25-pup samples								
Period 1	80	41	12	74	124	149	87	-
Period 2	92	32	13	92	191	158	73	
No. sheared pups counted								
Period 1	200	111	21	231	277	377	223	-
Period 2	212	78	24	248	475	357	179	-
Total no. pups counted[b]								
Period 1	2,000	1,025	300	1,850	3,100	3,725	2,175	-
Period 2	2,300	800	325	2,300	4,775	3,950	1,825	-
Estimated no. pups alive[c]								
Period 1 sampling	12,360	3,546	914	9,706	21,689	15,740	8,563	72,518
Period 2 sampling	13,409	3,938	867	11,240	19,482	17,626	8,952	75,514
Mean, both period	12,884	3,742	890	10,473	20,586	16,683	8,758	74,016
No. dead pups counted	371	149	9	244	624	367	202	1,966
Estimated no. pups born[d]	13,255	3,891	899	10,717	21,210	17,050	8,960	75,982

a Does not include second point south of Sea Lion Neck.

b Number of samples X 25 = total number of sheared and unsheared pups.

c Estimated from N = MC/R. (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

d Sum of dead pups counted and mean estimate of pups alive at times of sampling.

where r is the ratio of pups to bulls on all but the particular sample rookery, and

$$r^* = 7r - 6\bar{r} \text{ where } r = \frac{\text{total pups}}{\text{breeding males}} = \frac{74,016}{1,837} = 40.29$$

The estimate of the ratio of pups to bulls (R) is

$$\hat{R} = 1/7 \sum_{j=1}^{7} r^*(j) = 40.48,$$

$$\text{and } \hat{Var}(\hat{R}) = \sum = \frac{r^*(j)^2 - 7\hat{R}^2}{42} = 3.347 \text{ and } SE(R) = 1.829.$$

Thus, an approximate 95% confidence interval for the ratio of live pups to harem males is 40.48 ± 4.32.

The total number of harem males counted on all rookeries of St. Paul Island is 4,372 (Appendix Table A-4).

Thus, the estimated number of pups alive at the time of shearing is 172,922 ± 18,887. The number of dead pups counted was 5,266. Therefore, the estimate of number of pups born is 182,258 ± 18,887.

St. George Island--The number of pups born in 1985 is given in Table 5 and is based on shearing-sampling procedures developed in the 1960s.

Mark Recoveries

During the 1985 field season on Bogoslof and St. Paul Islands 19 seals marked by the Soviet Union were sighted. Appendix Table A-8 lists the number of Soviet tags observed by the United States in 1985.

Table 5.--Estimated number of northern fur seal pups in 1985 at times of shearing and birth on St. George Island, Alaska. Pups were sheared 12-15 August and sampled for marked to unmarked ratios 16 August.

Item	Rookery						Total
	South	Zapadni	East Cliffs	East Reef	Staraya Artil	North	
No. pups sheared	586	448	464	223	314	1,113	3,148
No. 25-pup samples	34	31	36	13	31	88	-
No. sheared pups counted	108	73	128	51	83	221	-
Total no. pups counted[a]	850	775	900	325	775	2,200	-
Estimated no. pups alive[b]	4,612	4,756	3,262	1,421	2,932	11,080	28,063
No. dead pups counted	128	134	106	22	99	317	806
Estimated no. pups born[c]	4,740	4,890	3,368	1,443	3,031	11,397	28,869

[a] Number of samples X 25 = total number of sheared and unsheared pups.

[b] Estimated for N = MC/R (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

[c] Sum of dead pups counted and estimate of pups alive at times of sampling.

HISTORICAL CHANGES IN THE MEAN WEIGHT OF MAXILLARY CANINE TEETH FROM MALES TAKEN IN THE COMMERCIAL HARVEST, ST. PAUL ISLAND, ALASKA

by

Jason Baker

Evidence of density-dependent responses in body size of the northern fur seal (Callorhinus ursinus) was first presented by Scheffer (1955) who observed a decrease in age-specific mean body size in a population which was rapidly increasing. Recently, the converse effect was observed by Fowler (1984) who reviewed information indicating that while the population of northern fur seals has been decreasing since the late 1950s, the mean body size has been concomitantly increasing. An analysis of tooth weights presented by Hartley (1982) showed that tooth weights were highly correlated with body length, and could, therefore, be used as an indicator of change in mean body size. The analysis of the tooth data by Hartley (1982) and Fowler (1984) were, in fact, in agreement with the results of other methods which showed a density-dependent increase in mean body size. However, these preliminary analyses of tooth weights were based on relatively small samples. The purpose of this report is to examine density dependence in fur seal body size by extending the tooth weight study to include a larger sample size.

Materials and Methods

The teeth used for this study were taken from 3- and 4-year-old male northern fur seals during the annual harvest on St. Paul Island. Upper canines were extracted at random from approximately 20% of the harvest. The teeth were treated and cleaned on the island, then sent to Seattle, Washington, where they were stored. Samples of teeth were weighed from the years 1948-84, excluding 1950 and 1951, for which no samples were available.

A total of 21,939 teeth were weighed; 14,245 were from 3-year-olds and 7,694 were from 4-year-olds (Table 6). Early in the study, all teeth available for a given year were weighed. However, it became evident that it would suffice, statistically, to subsample only a portion of the teeth from years with large numbers available. The subsamples selected reflect the proportion of 3- to 4-year-olds harvested as well as the percentages harvested by rookery in each year. Although distributing the subsamples evenly over age class and rookery may have been more desirable., it was impossible due to the uneven distributions of ages and rookeries among the teeth available. (See Table 6 for a summary of the sample sizes.)

The teeth were weighed individually on a digital scale accurate to 0.01 g. The scale was calibrated at the beginning of each weighing period.

The possibility of the teeth drying and thus losing weight over time was a concern during this study. If drying were to occur, it could account for the increase in mean tooth weight over time. There is also another complication which could occur in this regard. One would expect the drying

Table 6.--Number of northern fur seal teeth weighed by year, St. Paul Island, Alaska, 1948-84.

Year	3-year-olds			4-year-olds		
	Number available	Number weighed	Percent weighed	Number available	Number weighed	Percent weighed
1948	107	107	100	44	44	100
1949	31	31	100	15	15	100
1952	376	376	100	196	196	100
1953	393	393	100	204	204	100
1954	- *	287	-	- *	251	-
1955	- *	318	-	- *	293	-
1956	87	87	100	85	85	100
1957	43	43	100	29	29	100
1958	390	390	100	66	66	100
1959	35	35	100	33	33	100
1960	709	709	100	100	100	100
1961	838	838	100	383	383	100
1962	87	87	100	72	72	100
1963	4	4	100	27	27	100
1964	239	239	100	96	96	100
1965	174	174	100	174	174	100
1966	286	286	100	161	161	100
1967	295	295	100	137	137	100
1968	675	241	36	645	123	19
1969	315	315	100	112	112	100
1970	619	170	27	318	87	27
1971	2,310	86	4	2,195	142	6
1972	2,353	623	26	2,920	652	22
1973	3,156	705	22	2,035	483	24
1974	2,335	653	28	2,696	657	24
1975	2,523	137	5	1,847	100	5
1976	1,564	289	18	1,081	296	27
1977	3,021	740	24	1,928	505	26
1978	2,524	634	25	1,754	448	26
1979	3,449	171	5	1,757	89	5
1980	347	347	100	30	30	100
1981	532	532	100	309	309	100
1982	143	143	100	65	65	100
1983	2,083	2,083	100	677	677	100
1984	1,677	1,677	100	553	553	100
Total	33,720	14,245		22,744	7,694	
Average percent			42			34

* Number by age not available. There were a total of 1,200 teeth from all age classes in 1954; 45% of these were weighed (24% three-year-olds and 21% four-year-olds). The respective figures for 1955 are 1,916 teeth, of which 32% were weighed (17%).

process to be a response to a drop in the relative humidity of the environment in which the teeth are stored. Such a response could have occurred, for example, due to the move of the National Marine Mammal Laboratory (NMML) to a new building in August of 1984. Some teeth were weighed where they were originally stored, while others were weighed in the new laboratory. In addition, teeth from different years were weighed throughout 1984-85, so that varying seasonal relative humidity could possibly have affected the tooth weights.

In order to address these concerns, an experiment using teeth from the 1984 fur seal harvest was carried out to determine whether or not drying could have significantly affected the results of the study. All the teeth were individually identified and weighed immediately upon being received from St. Paul Island. Then, two subsamples were weighed several times at various dates and locations. One group was kept in the original storage area, while the other was moved to the new laboratory.

If the teeth were to lose weight through drying in the original storage area, it was expected that the decrease would be rapid at first and then level off. However, with the group of 1984 teeth which were stored there and reweighed, this did not occur. Upon the second weighing, conducted after 2 weeks, the teeth had actually gained an average of 0.02 g. Subsequently, their weights remained stable for 8 months. These teeth seemed to have first absorbed some weight, presumably water, then having reached an equilibrium with the new environment, remained stable. This indicates that the weights of the teeth in the original storage area probably have not changed over the years unless a change occurs after prolonged storage.

Next, there was the problem of the samples being weighed in two locations, the storage area and the new laboratory. The new laboratory tended to be less humid than the storage area, so it seemed likely that the teeth would lose weight there. The second subgroup of 1984 teeth was used to investigate this problem. These teeth were moved alternately between the storage area and the new laboratory and reweighed a number of times. It was observed that changes of 0.01 g (tooth weight) could occur overnight. When the 1984 subgroup was left in the new laboratory, the teeth continued to lose weight for 6 months (October 1984 to April 1985). After another 5 months, the teeth gained weight slightly. This weight gain was somewhat perplexing, but may also be explainable as a result of an unmeasured increase in the new laboratory's humidity over the last 5 months of the study (April to September 1985).

Thus, it appears that tooth weight undergoes some change in response to environmental conditions. However, it is reassuring that the magnitude of the changes are small. The teeth in the subgroup kept in the new laboratory lost only 1.8% of their original weight over a period of 70 days. Teeth from other years, excluding the 1984 subgroup, were kept in the new laboratory for no more than 20 days while being weighed. Compared with the observed differences in mean tooth weights between the early 1960s and 1984 (10%), the effects of drying do not appear substantial.

Results

Before tooth weight could be used in an analysis of density-dependent changes in body size, the relationship between tooth weight and body length had to be established. Figure 5 is a plot of tooth weight versus body length. of 1,043 fur seals between 1 and 6 years old, which were harvested and measured in 1983. The resulting relationship is significant at the 1.0% level ($r = 0.73$, $p < 0.01$), using major axis regression analysis (Ricker 1984) to account for each variable exhibiting its own variance.

Given this highly correlated relationship, mean tooth weight may be viewed as an index of mean body size. Figures 6 and 7, which are the result of calculating running means of three, weighted by sample size, indicate that mean tooth weights have been increasing since the early 1960s. During this same period, the overall fur seal population has declined. In order to examine the relationship of greater importance in terms of density dependence, Figures 8 and 9 show mean tooth weights versus the total number of fur seal pups born in a given year, the latter parameter being the best available index of population level. These graphs, however, involve a time lag. For example, Figure 8 plots the mean tooth weight of 3-year-olds against the number of pups born 3 years earlier. Considering what the parameters of these graphs represent, it appears that as the population decreases, the mean tooth weight and the mean body size of the animals increases.

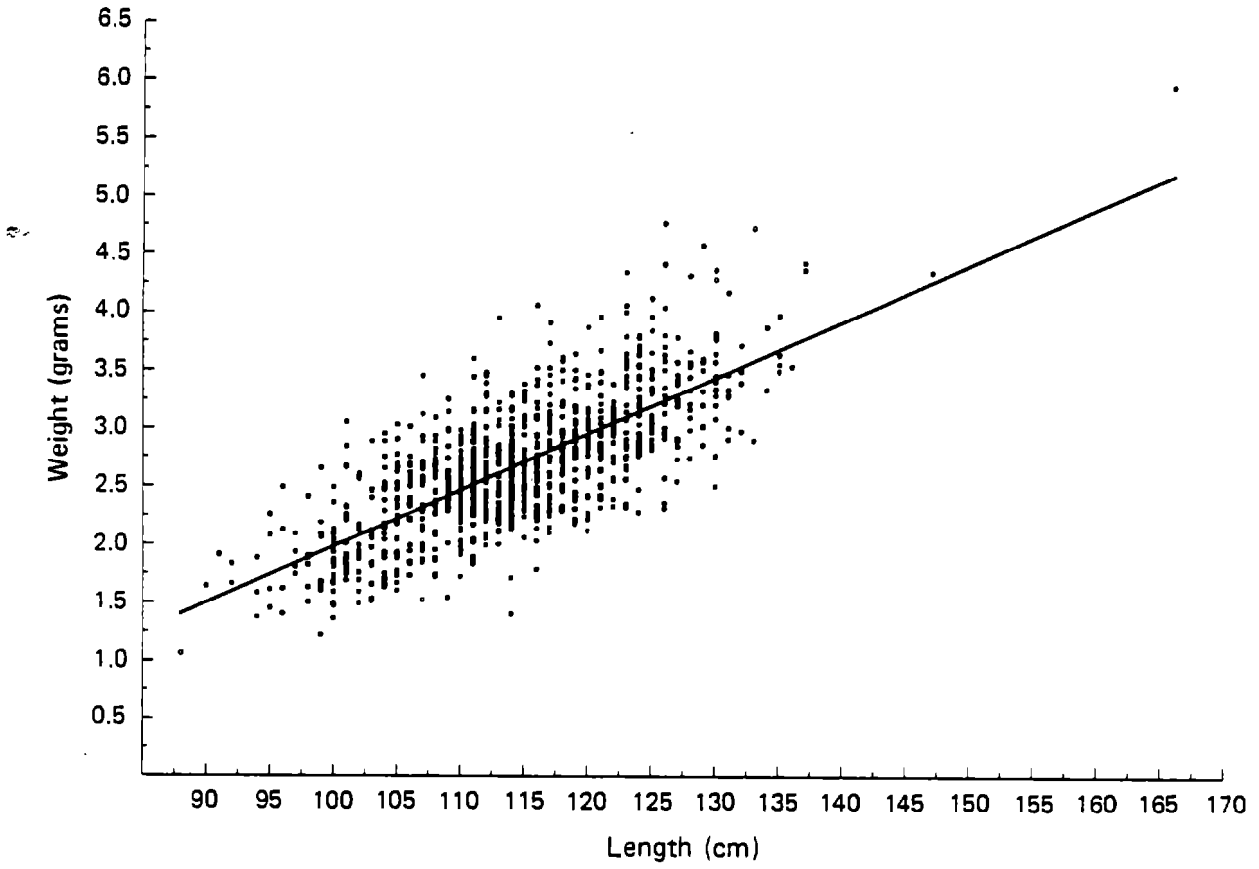


Figure 5.--Tooth weight versus body length of 1,043 male fur seals (1-6 years of age) which were harvested and measured' on St. Paul Island, Alaska, 1983.

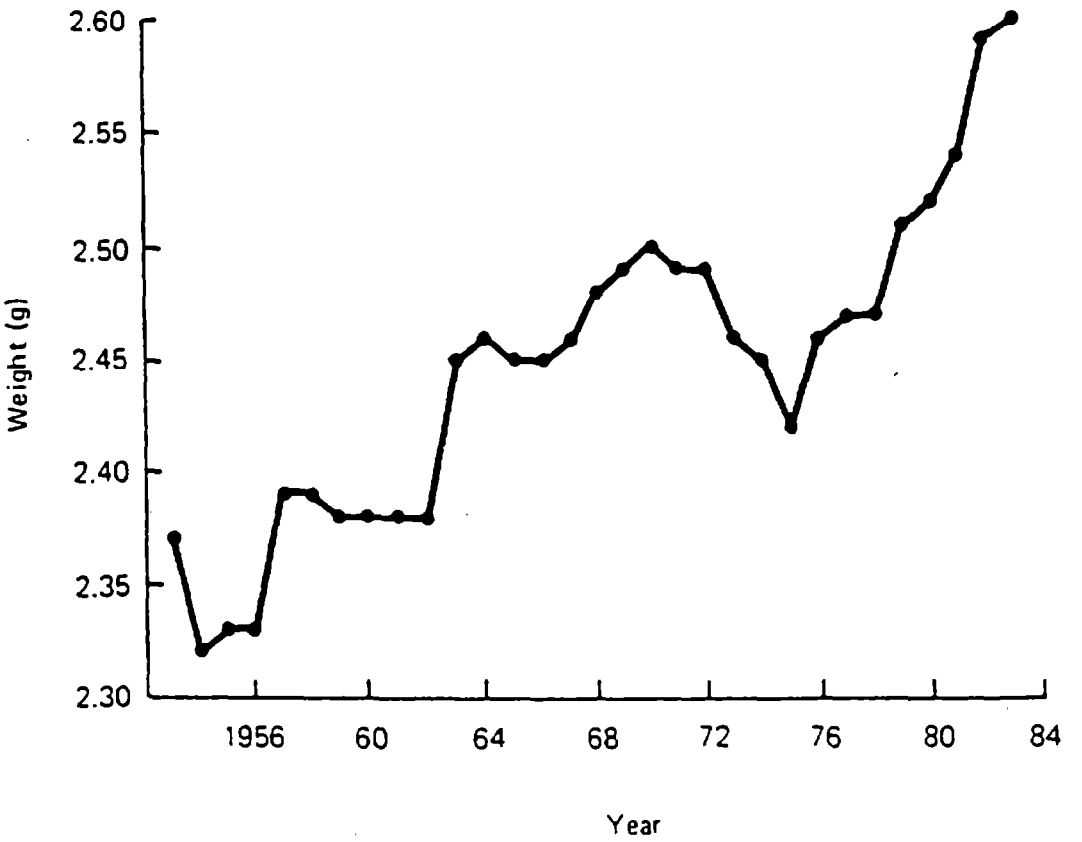


Figure 6.--Three-year running means of the tooth weight of 3-year-old males plotted in the year of sampling, St. Paul Island, Alaska.

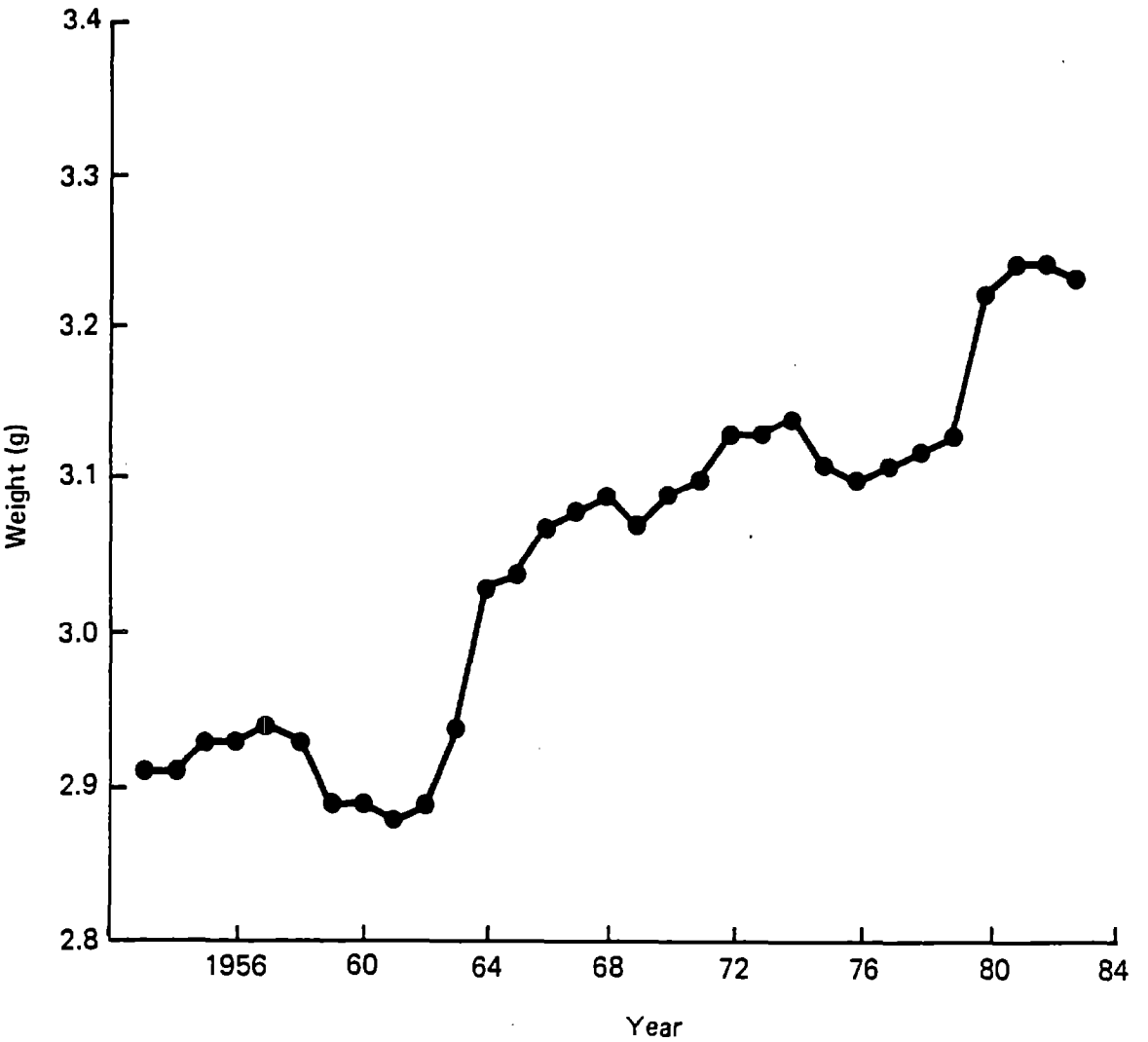


Figure 7.--Three-year running means of the tooth weight of 4-year-old males plotted in the year of sampling, St. Paul Island, Alaska.

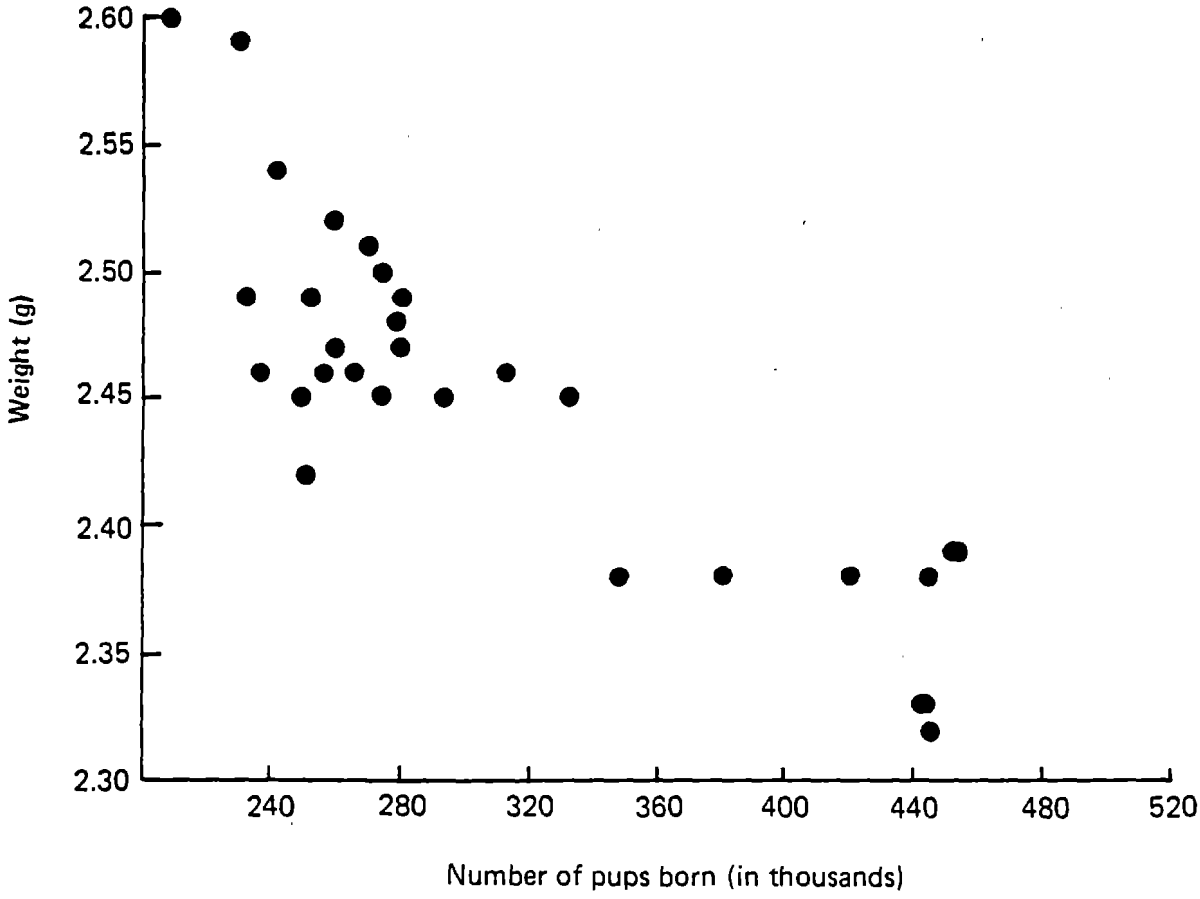


Figure 8.--Number of pups born in a given year and their mean tooth weights as age-3 cohorts, St. Paul Island, Alaska.

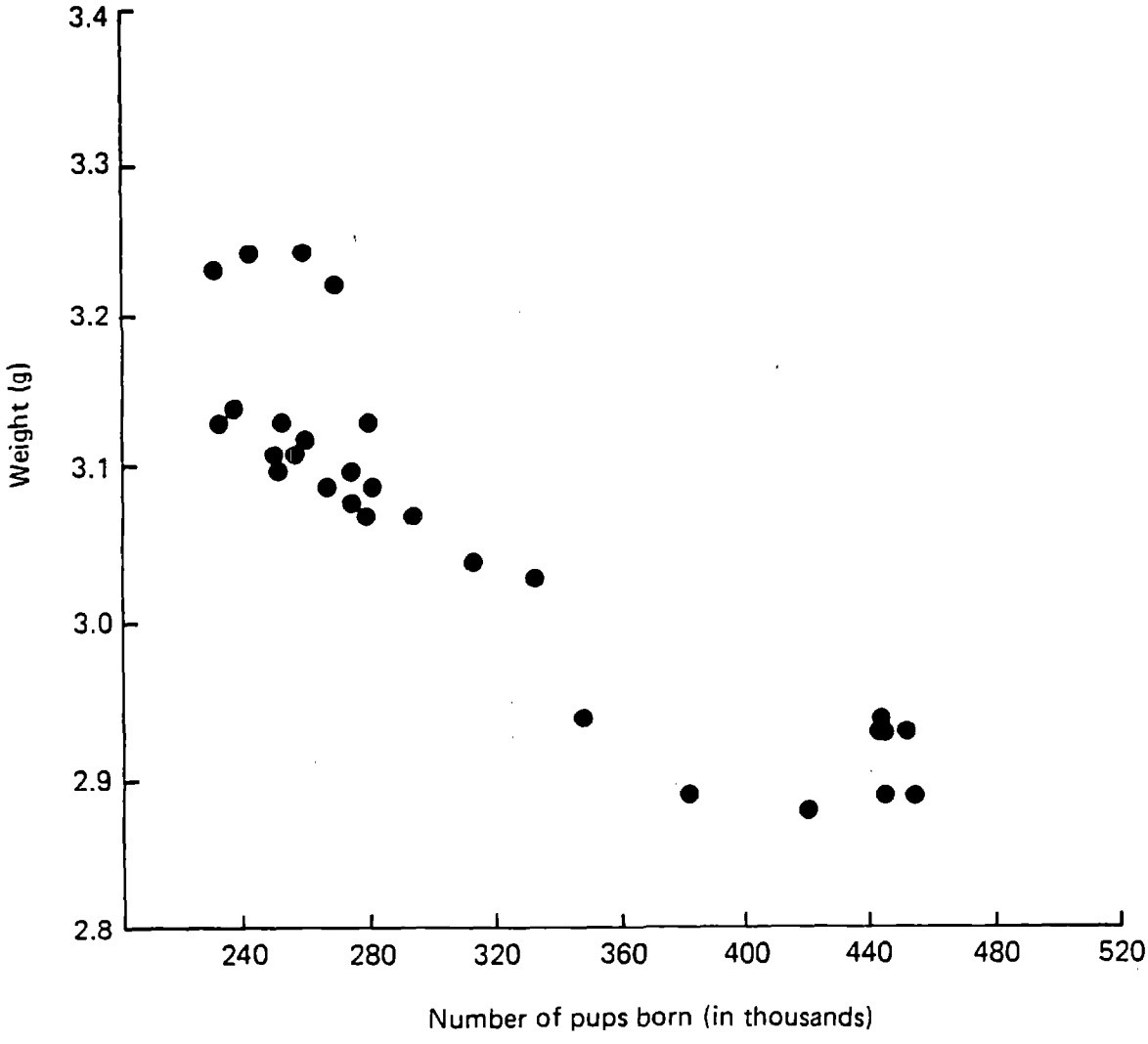


Figure 9.--Number of pups born in a given year and their mean tooth weights at age 4 years, St. Paul Island, Alaska.

The results of this study are, to a great extent, in agreement with the tooth studies presented in Fowler (1984) as based on Hartley (1982). This analysis, involving a larger sample size than that of the previous analysis, has reinforced the evidence that body size is density dependent. The implication of this in the context of the present situation is that the fur seal population is below its carrying capacity.

The possibility of a decreasing abundance and availability of prey-consumed by northern fur seals being responsible for their population decline seems unlikely. For if this were the case, the carrying capacity would in turn be lowered, leaving the fur seals on roughly the same nutritional plane. Their increased body size, however, suggests a lower population level with a higher abundance of food per individual. Therefore, it seems that other external factors, which do not affect carrying capacity, are responsible for the population decline. Although the results of this study and other density-dependent responses observed within the fur seal population do not indicate that the decline is the result of insufficient food resources, it must be noted that this particular study involved only young males. Fowler (1985) has suggested that entanglement in fishing debris is one source of the mortality for the fur seal population and its lack of recovery. Other limiting factors under consideration are disease, toxic substances, illegal or incidental taking at sea, and increased predation.

DURATION OF FEEDING TRIPS AND AGE-RELATED REPRODUCTIVE SUCCESS OF LACTATING FEMALES, ST. PAUL ISLAND, ALASKA

by

Michael E. Goebel

Preliminary results of an ongoing study of female diving patterns were documented in the 1984 report of fur seal investigations (Gentry et al. 1986). It was reported that females showing a deep diving pattern were large, older females and that small, young females tended to be shallow divers. The trends suggested that size or age may be important in determining which dive pattern a lactating female might exhibit. If experience influences diving patterns, a difference by age may be seen in other behaviors. In 1985, the effect of age and experience on feeding cycles of lactating females and survival of their pups was examined at Kitovi Rookery on St. Paul Island.

Methods

It was not possible to obtain known-age females. However, past data have shown that older females tend to arrive earlier in the season than do younger ones, thereby allowing an observer to qualitatively sample for older or younger females (Wilke 1953; Bigg 1986). Vibrissae color also indicates relative age (most females through age 3 years have black vibrissae; 4- and 5-year-olds generally have black and white; and females 6 and older have white vibrissae) (Scheffer 1962; Abeggelen et al. 1958). Therefore, by sampling only white-vibrissaed females before the peak of pupping and black-vibrissaed females thereafter, it was possible to obtain qualitatively different age samples.

A total of 47 females with pups were captured and tagged. All but one female were perinatal when captured; the exception, a mixed, mostly-white vibrissaed female, was captured on her second visit to shore. Each female was also marked by clipping guard hair on both shoulders to expose the lighter underfur which was then bleached, leaving a highly visible mark. All pups of the earlier-arriving females (20) were captured, marked and tagged between 29 June and 1 July. Only 13 pups of the late-arriving group of 27 females were captured and marked from 17 July to 2 August. Of the late-arriving group, 8 females were categorized as black vibrissae, 9 were categorized as mixed, mostly white vibrissae, and 10 were categorized as mixed, mostly black vibrissae.

Attendance patterns were recorded from mid-June until 24 August and again from 5 October until 31 October. Any time a female was observed on shore, it was recorded as present for that entire day; any day she was not seen was recorded as a day at sea (Gentry and Holt 1986). Observations in July and August were made 7-8 hours per day, and the rookery was scanned every 5 minutes. In October, observations were made at least twice a day for at least 1 hour each time, once shortly after dawn and again in the evening.

Analysis of variance (ANOVA) was used in comparisons of duration of feeding trips for the two groups of females. Females which had lost their pups by October were excluded from some analyses.

Results

The major results of this study can be divided into two categories: duration of feeding trips and reproductive success. Survival of pups to weaning was used as a measure of reproductive success.

Duration of Feeding Trips

The mean length of the first trip for early-arriving females was 3.55 days (20 trips, SD = 1.39) and for late-arriving females it was 6.00 days (19 trips, SD = 1.15). Early-arriving females, however, made as many as eight trips to sea ($x = 6.65$) by the time data collection was terminated on 25 August, while late-arriving females made as many as four trips ($x = 3.05$). Only the first 3 trips to sea were used in initial analyses to eliminate bias toward trips of early-arriving females. Females, which lost their pups before data collection was terminated, were not included in the analyses.

The difference in mean trip length between the two groups was significant ($p = 0.999$ ANOVA). The mean trip length of early-arriving females was 4.47 days (59 trips, SD = 1.60), compared to a mean of 6.70 days for late-arriving females (56 trips, SD = 2.34). When all females that had lost their pups by October were removed from the analysis, the significant difference remained ($p = 0.999$ ANOVA).

This difference, however, was not seen in trips recorded in October. Most females in each group had at least two trips; four from each group had only one trip. The total number of early- and late-arriving females observed with pups in October was 18 and 17, respectively. The mean length of trips to sea in October for females pupping early was 7.67 (SD = 1.32); and for late-pupping females, 7.93 (SD = 1.77).

Attendance patterns of the younger-aged sample differed in one other respect. Individual females from the early-arriving group tended to make either short or long trips. Females which tended toward short trips always had short trips, while those with long trips always had long trips (with both types, trips increased in length as the season progressed). Young females, however, exhibited much more variability in trip length within individuals; (that is, they would frequently make a short trip followed by a long one or vice versa. This may be a reflection of a lack of experience in foraging.

Reproductive Success

The difference in reproductive success between old and young females was significant ($p = 0.985$ Chi-square). By October, just prior to weaning, 34.6% (9/26) of the late-pupping black- and mixed-vibrissaed females had lost their pups. In contrast, only 7.4% (2/27) of early-pupping, white-vibrissaed females had lost pups.

The nature of this mortality is of interest both for when it occurred and to which females. Of the two white-vibrissaed females which lost pups, one was never observed in October. It was, therefore, not possible to determine whether the pup died and the female ceased returning as a result, or whether she failed to return for other reasons, resulting in the death of the pup. The other female lost her pup to an unknown cause after five trips to sea. This female had made regular trips up until the time the apparently healthy pup was no longer seen. The female actively searched for her pup on two protracted subsequent visits. Mortality in both cases occurred long after birth and did not appear related to bonding or behavior of the female or pup.

Late-pupping females that had lost their pups were predominantly younger black-vibrissaed and mixed, but mostly black-vibrissaed animals. Of these nine females three had all black vibrissae, five were mixed, mostly black, and only one was mixed, mostly white. Of these females, 78.0% lost their pups in the first 3 weeks after parturition.

The younger females differed behaviorally from the older females in respects other than their attendance patterns. These differences apparently affect their reproductive success. For example, two of these females were intercepted by peripheral males upon arrival at the rookery and appeared unable to escape to more desirable pupping areas. These females repeatedly attempted to escape but eventually gave birth in the intertidal zone. Within groups of females, the younger females often had more difficulty in reuniting with their pups, once separated. They often appeared intimidated and submissive in their interactions with the older, larger females. These same behaviors were also apparent when they were defending their pups from nearby females. Some of this mortality can also be attributed to problems with mother-pup bonding during the period immediately following parturition. In one case, a female was observed giving birth but then failed to call to the pup in the usual manner. Later, this female allowed her pup to suckle, but when separated, she turned in the direction of her calling pup but did not otherwise respond. Some of these differences will be quantified in future studies.

Discussion

Attendance patterns in Otariids, as in other species, have often been suggested as possible indicators of environmental quality and resource availability (Antonelis and Delong 1985; Chapman 1961; Gentry and Kooyman 1986; Loughlin et al. 1987). The results of this study indicate that care should be taken to avoid bias when sampling females for attendance patterns. Sampling is often biased toward early-arriving animals. It also appears that experience and age play important roles in determining reproductive success. Diving records of young females may also provide further insight into the role of experience in foraging behavior. Four such records from young females with vibrissae of mixed color were collected this year, the results of which will be reported in a. future publication.

FUR SEAL ENTANGLEMENT STUDIES: JUVENILE MALES AND NEWLY-WEANED PUPS, ST. PAUL ISLAND, ALASKA

by

John L. Bengtson, Charles W. Fowler, Hiroshi Kajimura, Richard L. Merrick, Kazumoto Yoshida, and Shigeru Nomura

Over the past several decades, northern fur seals on the Pribilof Islands have been observed entangled in various types of marine debris. The incidence of entangled fur seals observed ashore increased from the mid-1960s to the early 1970s. Estimated entanglement rates of harvested juvenile males were approximately 0.4% from the early 1970s through 1984, the year of the most recent commercial harvest.

From 1967 to 1984, the entanglement rate of juvenile males was estimated annually from the commercial harvest. However, with the shift to subsistence harvest in 1985, different methods were used to evaluate the status and impact of entanglement on various portions of the fur seal population. To investigate the potential impact of entanglement on young age classes, two new research programs were initiated in 1985 on St. Paul Island: 1) entanglement research roundups (drives) of juvenile males on haul-out areas, and 2) experimental entanglement studies on captive, nearly-weaned pups.

Entanglement Research Roundups

The three principal objectives for conducting entanglement research roundups were: 1) to estimate the entanglement rate of juvenile males on haul-out areas, 2,) to estimate the relative mortality rate of juvenile males entangled in debris, and 3) to assess the fate and impact

of debris on seals that were tagged in previous years. The roundups were conducted similarly to the method used for rounding-up seals during harvest operations. However, once the seals on a certain haul-out area had been prevented from escaping to the sea, they were not driven further. Instead, they were allowed to return to sea in small groups or as a "stream" of individuals, allowing observers to count the number of seals of harvestable size, and examine individuals for tags, debris, or net marks. This procedure was very efficient for handling and checking large numbers of seals in a relatively short period of time, and was less stressful to the seals because they were not driven long distances or held for prolonged periods.

From 8 July to 10 August 1985, 63 entanglement research roundups were conducted; over 22,000 seals were examined during these roundups (Table 7). A total of 98 seals were observed entangled in debris during this project. Of these, 76 were tagged for the first time in 1985 (Table 8). Some tagged individuals were resighted during subsequent roundups (Table 9). An additional 22 had been tagged in previous seasons (Table 10). All entangled seals of harvestable size were restrained, flipper-tagged with orange "Allflex"[1/] tags (if not previously tagged), and inspected for the type of debris and potential wounds caused by the debris (Table 8). When possible, a sample of the debris was taken for identification of net webbing gear. Seals with netmarks (aberrations of the fur indicating former entanglement from

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[1/] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 7.--Summary of northern fur seal males sampled in 1985 during entanglement studies at St. Paul Island, Alaska. A dash indicates no data.

Date	Location	Sample	Number[a]	Number of tags applied		Not tagged	
				Debris	Control	Debris	Netmark
8 Jul.	Polovina	D	432	0	0	0	0
9 Jul.	Gorbatch	D	367	3	8	0	0
10 Jul.	Tolstoi	D	280	1	4	1[b]	0
11 Jul.	Zapadni	D	558	4	10[c]	0	4
12 Jul.	NE Point E	D	303	2	6	0	0
15 Jul.	Zapadni	D	257	1	2[d]	0	1
16 Jul.	Gorbatch	D	422	3	6	0	0
17 Jul.	NE Point E	H	326	0	0	0	0
17 Jul.	NE Point W	H[e]	357	1	2	0	2
18 Jul.	Polovina	H	411	1	2	0	2
19 Jul.	Little Zap.	H	499	1	4	1[h]	0
20 Jul.	Zap. Reef	D	-[f]	1	2	0	-
20 Jul.	Tolstoi	D	860	2	4	0	1
21 Jul.	Polovina	D	744	1	2	0	1
22 Jul.	Zapadni	H	210	0	0	0	0
22 Jul.	Little Zap.	H	205	0	0	0	0
22 Jul.	Kitovi	D	824	1	2	0	0
23 Jul.	Gorbatch	H	920	2	4	0	5
24 Jul.	NE Point W	H	126	2	0	0	0
24 Jul.	NE Point E	H	278	0	6	1[h]	1
25 Jul.	Lukanin	H	233	1	0	0	1
25 Jul.	Kitovi	H	425	0	0	0	1
26 Jul.	Tolstoi	H	326	1	2	0	2
26 Jul.	Zap. Reef	D	191	0	2	0	0
27 Jul.	Castle Rock	D	1515	6	12	1[h]	2
27 Jul.	NE Point E	D	590	0	0	0	1
27 Jul.	NE Point W	D	279	0	0	0	0
28 Jul.	Lukanin	D	123	0	0	0	0
28 Jul.	Kitovi	D	76	0	0	0	0
29 Jul.	Zapadni	H	726	1	2	0	1
29 Jul.	Polovina	D	446	1	2	0	1
29 Jul.	Zap. Reef	D	430	2	4	0	2
30 Jul.	Gorbatch	H	396	0	0	0	1
30 Jul.	Tolstoi	D	989	2	4	0	2
31 Jul.	NE Point W	H	235	0	0	0	0
31 Jul.	Zolotoi S.	D	378	2	4	0	0
31 Jul.	Castle Rock	D	1208	2	4	0	5
1 Aug.	Kitovi	D	257	0	0	1[g]	1
1 Aug.	Lukanin	D	82	0	0	0	0
1 Aug.	Polovina	H	440	1	2	0	1
2 Aug.	Tolstoi	H	341	0	0	0	1
4 Aug.	Zap. Reef	D	958	3	7	0	2
5 Aug.	Zapadni	H	230	1	2	0	1

Table 7 .--Continued.

Date	Location	Sample	Number[a]	Number of tags applied: Debris	Number of tags applied: Control	Not tagged: Debris	Not tagged: Netmark
5 Aug.	Little Zap.	H	159	0	0	0	1
6 Aug.	Zolotoi S.	H	495	1	2	0	0
6 Aug.	NE Point E	H	418	1	2	0	6
7 Aug.	Gorbatch	D	721	2	5	1[h]	1[h]
7 Aug.	Polovina	D	230	1	2	0	2
7 Aug.	Castle Rock	I	-[e]	2	4	0	-
7 Aug.	Tolstoi	D	935	2[i]	4	0	1
8 Aug.	Zapadni	I	-[e]	7	0	2[j]	-
8 Aug.	Zap. Reef	I	-[e]	1[j]	0	0	-
9 Aug.	Zap. Reef	I	-[e]	1	0	0	-
9 Aug.	NE Point E	I	-[e]	5	0	0	-
9 Aug.	NE Point W	I	-[e]	3	0	2	-
9 Aug.	Zapadni	I	-[e]	0	14	0	-
9 Aug.	Tolstoi	I	-[e]	0	2	0	-
9 Aug.	Lukanin	I	-[e]	0	4	0	-
9 Aug.	Kitovi	I	-[e]	0	2	0	-
9 Aug.	Castle Rock	I	-[e]	0	3	0	-
10 Aug.	NE Point E	I	-[e]	0	4	0	-
10 Aug.	NE Point W	I	-[e]	1	12	0	-
10 Aug.	Zap. Reef	I	-	0	1	0	-
Totals			22211	76	172	10	53

[a] Only seals of harvestable size were counted in these totals
[b] Died during handling
[c] Excluding 0017 and 0032, which had netmark but no debris
[d] Excluding 0042, which had netmark but no debris
[e] Driven as part of harvest but no seals harvested
[f] Number of seals driven not counted
[g] Seal of harvestable size
[h] Seal larger than harvestable size
[i] Debris accidentally removed during handling
[j] Female with pup

NOTES
Sample: seals sampled from harvests (H), entanglement drives (D), or incidentally to other activities (I).
Number: total number of harvestable-sized individuals.
Tags applied:
debris - seals entangled in debris.
control - unentangled seals tagged as controls.
Not tagged:
debris - seals entangled in debris, but not tagged because too large to capture and tag, or escaped during drive.
netmark - seals with netmarks were not tagged, but were sheared and released.

Table 8. --Summary of data for northern fur seal males tagged in 1985 during debris entanglement studies on St. Paul Island, Alaska. A dash indicates no data.

Tag no.	Debris type and color	Quantity	Mesh size	Twine size	Number meshes	Tight/ loose	Degree wound
0001	white cord	S	--	--	1	T	360
0002	gray trawl	S	--	2.5	1	T	22
0004	green/gray trawl	M	21.0	4.0	7	T	0
0013	green trawl	S	25.5	3.0	3	T	0
0018	green trawl	L	22.5	3.5	17	TNB	0
0019	poly line, gillnet	S	--	6.2	-	T	180
0028	black poly line	S	--	3.1	1	T	180
0033	black trawl	S	--	2.0	5	L	0
0036	green trawl	M	21.5	3.5	17	T	0
0037	black line	S	--	2.5	1	T	355
0044	syn. white cord	S	27.0	1.5	3	L	0
0047	white line or cord	S	--	6.2	1	T	360
0050	yellow band	S	--	--	1	L	0
0054	green trawl	S	--	2.5	1	T	360
0055	green band	S	--	--	1	L	0
0058	green trawl	S	26.0	3.5	-	TNB	0
0065	white band	S	--	--	1	VT	360
0066	gray trawl	M	11.5	3.7	3	--	360
0069	blue trawl	S	22.0	3.0	-	--	0
0072	gray trawl	S	22.5	3.0	6	TNB	0
0075	blue trawl	M	24.0	3.5	-	T	0
0078	blue trawl	S	--	--	1	T	<90
0081	brown line	S	--	--	1	L	0
0084	gray trawl	M	20.0	--	-	TNB	0
0085	gray trawl	S	20.0	--	3	--	0
0086	green trawl	M	20.0	3.0	12	TNB	0
0095	yellow band	S	--	--	1	L	0
0096	green band	S	--	--	1	L	0
0099	gray line	S	--	1.8	2	T	180
0102	white line	S	--	--	1	VT	360
0103	green trawl	S	--	--	-	VT	360
0108	gray trawl	S	--	3.4	-	T	360
0109	white cord	S	--	--	1	L	0
0118	green trawl	S	23.0	3.1	-	T	0
0119	green trawl	M	22.5	3.5	15	T	0
0122	green gillnet	S	--	0.5	-	VT	30
0125	blue trawl	S	22.5	2.0	-	T	50
0128	gray trawl	S	22.0	4.5	5	T	360
0131	gray trawl	S	22.5	3.3	-	L	0
0134	green/gray trawl	L	37.0	3.2	-	TNB	0
0137	blue trawl	S	22.5	2.5	-	T	360
0140	orange trawl	S	19.0	4.0	-	TNB	0
0143	syn. black line	S	--	--	1	T	0
0144	blue trawl	M	23.0	2.4	12	T	0

Table 8.--Continued.

Tag no.	Debris type and color	Quantity	Mesh size	Twine size	Number meshes	Tight/ loose	Degree wound
0149	gray trawl	S	--	4.2	4	--	0
0152	gray trawl	S	--	--	3	T	360
0155	gray trawl	S	--	--	3	T	360
0156	green trawl	M	23.0	3.0	25	L	0
0161	green trawl	M	23.5	5.0	-	TNB	0
0164	gray trawl	S	--	--	4	--	0
0167	green trawl	M	23.5	2.4	12	T	0
0170	yellow band	S	--	--	1	VT	360
0175	orange trawl	S	25.5	5.0	4	L	0
0177	blue trawl	M	24.0	3.5	-	TNB	0
0180	blue trawl	S	--	--	-	VT	120
0181	gray trawl	L	23.5	3.5	>5	T	0
0186	green line	S	--	5.0	1	VT	270
0187	ivory trawl*	S	20.5	3.5	1	VT	200
0192	green trawl	L	23.0	4.0	>10	TNB	0
0193	gray trawl	M	--	3.0	3	TNB	0
0194	green trawl	S	--	3.0	1	VT	120
0195	orange line/handle	S	--	5.0	1	TNB	0
0196	green trawl	S	23.0	2.5	5	TNB	0
0197	green/pink trawl	M	23.5	2.0	4	TNB	0
0198	green trawl	S	--	3.0	3	VT	360
0199	gray trawl	S	--	3.5	3	T	0
0200	green trawl	S	21.0	3.0	2	TNB	0
0201	gray trawl	S	--	4.5	2	VT	360
0202	green trawl	M	22.0	2.5	7	TNB	0
0203	yellow band	S	--	--	1	VT	360
0204	green trawl	S	21.5	2.5	3	TNB	0
0205	yellow band	S	--	--	1	VT	360
0206	white cord	S	--	--	2	VT	360
0207	gray trawl	S	24.0	2.0	4	TNB	0
0208	gray trawl	M	23.0	7.0	2	T	0
0238	green trawl	S	--	2.0	2	TNB	0

* Cut off during handling.

NOTES

Tags: all tags applied in 1985 were orange Allflex.

Quantity: S = < 150 grams of debris.
M = 150 - 500 grams of debris.
L = > 500 grams of debris.

Mesh size: measurements indicate stretch mesh length (cm).

Twine size: measurements indicate twine diameter (mm).

Number meshes: number of strands of debris looped around neck.

Tight/loose: L = debris attached loosely.
TNB = debris tight but not binding.
T = debris attached tightly.
VT = debris attached very tightly.

Degree Wound: open wound along point of entanglement expressed as degrees of a circle.

Table 9.--Tags resighted on northern fur seals at St. Paul Island, Alaska, in 1985 during harvest and research activities.

Tag no.	Tag color	Date	Location	Comment[a]
507	blue	6 July	Zapadni Reef	female (1984)
2705	white	6 July	Zapadni Reef	female (1984)
bA642	monel, silver	8 July	Polovina	no debris or marks (USSR)
404	blue	9 July	Gorbatch	entangled
534	blue	9 July	Gorbatch	netmark but no debris
3448	yellow	10 July	Tolstoi	entangled
581	blue	10 July	Tolstoi	entangled
1224	white	10 July	Tolstoi	no debris or marks
2710	white	10 July	Zapadni Reef	female (1984)
308	blue	12 July	Zapadni Reef	female (1984)
0005	orange	11 July	Zapadni	control
0016	orange	11 July	Zapadni	control
579	blue	11 July	Zapadni	no debris or marks
817/818	pink	12 July	NE Point E	netmark
0018	orange	15 July	Zapadni	entangled
811	pink	16 July	Gorbatch	netmark
0003	orange	16 July	Gorbatch	control
0004	orange	16 July	Gorbatch	entangled
0001	orange	16 July	Gorbatch	entangled
1224	white	16 July	Gorbatch	no debris or marks
534	blue	16 July	Grobatch	no debris or marks
5220	yellow	16 July	Gorbatch	no debris or marks
527[b]	blue	17 July	NE Point E	killed
544	blue	17 July	NE Point E	no debris or marks
MA2990	monel, silver	17 July	NE Point E	killed (USSR)
540	blue	17 July	NE Point E	no debris or marks
2575	yellow	17 July	NE Point E	no debris or marks
0041	orange	17 July	NE Point E	control
0008	orange	18 July	Polovina	control
HB7716+ HB7725	monel, silver	18 July	NE Point W	female (additional tag #5069 white applied) (USSR)
436	blue	19 July	Little Zap.	entangled
0044	orange	19 July	Little Zap.	entangled
TM9373	monel, silver	19 July	Little Zap.	killed (USSR)
0062	orange	20 July	Zapadni Reef	control
560	blue	20 July	Zapadni Reef	entangled
3665	yellow	20 July	Zapadni Reef	no debris or marks
0033	orange	20 July	Tolstoi	entangled
0061	orange	20 July	Tolstoi	control
0042	orange	20 July	Tolstoi	netmark
204	yellow	21 July	Polovina	netmark
809/810	pink	21 July	Polovina	netmark
0058	orange	21 July	Polovina	entangled
0059	orange	21 July	Polovina	control
0008	orange	22 July	Kitovi	control

Table 9. --Continued.

Tag no.	Tag color	Date	Location	Comment[a]
555	blue	22 July	Kitovi	entangled
476	blue	22 July	Kitovi	no debris or marks
0030	orange	23 July	Gorbatch	control
0020	orange	23 July	Gorbatch	control
0051	orange	23 July	Gorbatch	control
563	blue	25 July	Lukanin	entangled
555	blue	25 July	Kitovi	entangled
476	blue	25 July	Kitovi	netmark
1130	yellow	25 July	Kitovi	netmark
YM2269	monel, silver	26 July	Tolstoi	no debris or marks (USSR)
2363	yellow	27 July	Castle Rock	no debris or marks
1122	blue	27 July	Castle Rock	no debris or marks
821/822	pink	27 July	Castle Rock	netmark (photo)
429	blue	27 July	Castle Rock	no debris or marks
0042	orange	27 July	NE Point E	netmark
0005	orange	27 July	NE Point E	control
0091	orange	27 July	NE Point E	control
0089	orange	27 July	NE Point E	control
TM9809	monel	28 July	Lukanin	USSR
0098	orange	28 July	Lukanin	entangled
2707	white	28 July	Zapadni Reef	female (1984)
0106	orange	29 July	Polovina	control
741	yellow	29 July	Polovina	no debris or marks
0075	orange	29 July	Polovina	entangled
0070	orange	29 July	Zapadni Reef	control
0102	orange	29 July	Zapadni Reef	entangled
0081	orange	29 July	Zapadni Reef	entangled
0002	orange	29 July	Zapadni Reef	entangled
552	blue	29 July	Zapadni	entangled
MC2049	monel, silver	29 July	Zapadni	no debris or marks (USSR)
0002	orange	29 July	Zapadni	entangled
0102	orange	29 July	Zapadni	entangled
0129	orange	30 July	Tolstoi	control
0034	orange	30 July	Tolstoi	control
0070	orange	30 July	Tolstoi	control
0126	orange	30 July	Tolstoi	control
581	blue	30 July	Tolstoi	entangled
557	blue	30 July	Tolstoi	no debris or marks
585	blue	30 July	Tolstoi	netmark
0130	orange	30 July	Gorbatch	control
0117	orange	30 July	Gorbatch	control
0128	orange	31 July	Zolotoi Sands	entangled
0121	orange	31 July	Zolotoi Sands	control
TM9809	monel, silver	31 July	Castle Rock	USSR
0108	orange	31 July	Castle Rock	entangled
0095	orange	31 July	Castle Rock	entangled

Table 9.--Continued.

Tag no.	Tag color	Date	Location	Comment[a]
0122	orange	31 July	Castle Rock	entangled
0105	orange	31 July	Castle Rock	control
0053	orange	31 July	Castle Rock	control
0096	orange	31 July	Castle Rock	entangled
0132	orange	31 July	Castle Rock	control
492	blue	1 Aug.	Gorbatch blind	entangled female
0075	orange	1 Aug.	Polovina	entangled
563	blue	1 Aug.	Polovina	entangled
BA1129	monel, silver	2 Aug.	Tolstoi	no debris or marks (USSR)
4964	yellow	4 Aug.	Zapadni Reef	no debris or marks
0016	orange	4 Aug.	Zapadni Reef	control
0127	orange	5 Aug.	Zapadni	control
TM9925	monel, silver	5 Aug.	Little Zap.	no debris or marks (USSR)
bA825	monel, silver	6 Aug.	Zolotoi Sands	no debris or marks (USSR)
549	blue	6 Aug.	Zolotoi Sands	no debris or marks
YM2332	monel, silver	6 Aug.	NE Point E	no debris or marks (USSR)
2841	yellow	6 Aug.	NE Point E	no debris or marks
0074	orange	7 Aug.	Gorbatch	control
534	blue	7 Aug.	Gorbatch	netmark
0152	orange	7 Aug.	Gorbatch	entangled
0117	orange	7 Aug.	Gorbatch	control
TM8237	monel, silver	7 Aug.	Polovina	no debris or marks (USSR)
573	blue	7 Aug.	Castle Rock	entangled
527[b]	blue	7 Aug.	Castle Rock	entangled
0164	orange	7 Aug.	Castle Rock	entangled
558	blue	7 Aug.	Tolstoi	entangled
0027	orange	7 Aug.	Tolstoi	control
0158	orange	7 Aug.	Tolstoi	control
0034	orange	7 Aug.	Tolstoi	control
595	blue	8 Aug.	Zapadni Reef	female (1984)
TM9508	monel, silver	8 Aug.	Zapadni	no debris or marks (USSR)
YM2332	monel, silver	9 Aug.	NE Point E	no debris or marks (USSR)
548	blue	9 Aug.	NE Point E	entangled
424	blue	9 Aug.	Zapadni	entangled

[a] A separate list of USSR tags is given in Appendix Table A-8.

[b] This tag number is repeated and hence in error in one or both cases.

Table 10.--Northern fur seals resighted in 1985 at St. Paul Island, Alaska, tagged[a] in previous years during entanglement studies. A dash indicates no data.

Tag no.	1983	1954	1985
404	green net[b] T-360°	-	entangled
424	green net VT-360°	-	entangled
429	green net TNB-0°	no debris or marks	no debris or marks
436	green net TNB-cut	net - bad cut	entangled
476	plastic mesh T-0°	netmark	netmark
492	gray net TNB-0°	-	entangled
527	-	yellow band T-0°	harvested
534	-	gillnet T-180°	netmark
540	-	black & white band TNB-0°	no debris or marks
544	-	gray net T-90°	no debris or marks
548	-	gray net T-0°	entangled
549	-	gray net VT-0°	no debris or marks
552	-	blue net T-330°	entangled
555	-	gray net TNB-0°	entangled
557	-	gray net T-0°	no debris or marks

Table 10.--Continued.

Tag no.	1983	1984	1985
558	-	green net T-0°	entangled
560	-	manila-string VT-0°	entangled
563	-	gray net T-0°	entangled
573	-	yellow band T-160°	entangled
579	-	yellow rope TNB-0°	no debris or marks
581	-	green net TNB-0°	entangled
585	-	gillnet T-[c]	netmark

a Blue jumbo Roto tag.
b TNB = debris tight but not binding.
T = debris attached tightly.
VT = debris attached very tightly.
T-360° = debris attached tightly and open wound expressed as degrees of a circle.
c Seal had a series of small unconnected open wounds 360° around its neck.

which they had escaped) were counted but not tagged (these individuals were given pelage marks by shearing to identify that they had already been counted during the season).

A total of 124 previously tagged seals were sighted during research and harvest activities in 1985 (Table 9). Of these, 22 had been entangled at the time when they were first tagged. Table 10 outlines the status of entangled seals tagged in 1983 and 1984 and resighted during the 1985 season. A comparison of types of debris observed on fur seals during harvest and research activities from 1981-85 is given in Table 11.

For each entangled seal that was tagged (or had a tag from a previous season), two unentangled seals from the same haul-out site were tagged and released to serve as experimental controls (Table 12). Resighting efforts in subsequent seasons will allow the estimation of mortality rates (tag returns) for both the entangled seals and the control seals. By comparing these rates, it will be possible to evaluate the impact that relatively small (<1 kg) pieces of netting and other debris have on the survival of juvenile males.

Because there was no commercial harvest of fur seals on St. Paul Island in 1985, estimates of entanglement rates for that season cannot be considered strictly comparable with past estimates. Seals counted in research roundups were released unharmed; during harvests in past years, most of them were killed. Therefore, some seals could be released and counted again during research roundups. To eliminate multiple counts of the same seal, only those entangled seals seen for the first time are counted. To make the estimates from roundups as

Table 11. --Types of entangling debris observed on northern fur seals during the harvest or entanglement research roundups on St. Paul Island, Alaska, 1981-85.

Type of debris	Number of seals					
	1981	1982	1983	1984	1985*	Total
Net fragment						
mesh size over 20 cm	45	52	52	37	34	220
mesh size under 20 cm	4	5	6	3	2	20
undetermined mesh size	19	5	21	10	17	72
Mõnofilament gillnet fragment	0	3	2	4	2	11
Cord used in net construction/repair	3	4	2	2	5	16
Plastic packing band	20	26	18	20	8	92
String	5	3	2	4	0	14
Rope or line	1	2	2	5	7	17
Rubber band	3	0	1	0	0	4
Plastic ring	1	0	1	1	0	3
Plastic gasket	0	0	2	0	0	2
Monofilament line	0	1	0	0	0	1
Plastic six-pack holder	0	1	0	0	0	1
Plastic packing web	0	0	1	0	0	1
Plastic object	0	0	0	1	0	1
Lawn chair material	1	0	0	0	0	1
Cloth sack band	0	0	1	0	0	1
Metal headlight ring	0	0	1	0	0	1
Plastic line with handle	0	0	0	0	1	1
Total	102	102	112	87	76	479

* Does not include seals resighted from previous years entanglement studies (see Table 10).

Table 12.--Northern fur seal males tagged in 1985 as part of debris entanglement studies on St. Paul Island, Alaska. All tags are orange Allflex.

Tag no.	Debris type/color	Date	Location
0001	white band	9 July	Gorbatch
0002	gray trawl	9 July	Gorbatch
0003	control	9 July	Gorbatch
0004	gray/green trawl	9 July	Gorbatch
0005	control	9 July	Gorbatch
0006	control	9 July	Gorbatch
0007	control	9 July	Gorbatch
0008	control	9 July	Gorbatch
0009	control	9 July	Gorbatch
0010	control	9 July	Gorbatch
0011	control	9 July	Gorbatch
0012	control	10 July	Tolstoi
0013	green trawl	10 July	Tolstoi
0014	control	10 July	Tolstoi
0015	control	10 July	Tolstoi
0016	control	10 July	Tolstoi
0017	netmark	11 July	Zapadni
0018	green trawl	11 July	Zapadni
0019	rope/gill net	11 July	Zapadni
0020	control	11 July	Zapadni
0021	control	11 July	Zapadni
0022	control	11 July	Zapadni
0023	control	11 July	Zapadni
0024	TAG NOT USED		
0025	control	11 July	Zapadni
0026	control	11 July	Zapadni
0027	control	11 July	Zapadni
0028	black line	11 July	Zapadni
0029	control	11 July	Zapadni
0030	control	11 July	Zapadni
0031	control	11 July	Zapadni
0032	netmark	11 July	Zapadni
0033	black trawl	11 July	Zapadni
0034	control	12 July	NE Point E
0035	control	12 July	NE Point E
0036	green trawl	12 July	NE Point E
0037	black line	12 July	NE Point E
0038	control	12 July	NE Point E
0039	control	12 July	NE Point E
0040	control	12 July	NE Point E
0041	control	12 July	NE Point E
0042	netmark	15 July	Zapadni
0043	control	15 July	Zapadni

Table 12. --Continued.

Tag no.	Debris type/color	Date	Location
0044	white line	15 July	Zapadni
0045	control	15 July	Zapadni
0046	control	16 July	Gorbatch
0047	white line	16 July	Gorbatch
0048	control	16 July	Gorbatch
0049	control	16 July	Gorbatch
0050	yellow band	16 July	Gorbatch
0051	control	16 July	Gorbatch
0052	control	16 July	Gorbatch
0053	control	16 July	Gorbatch
0054	green trawl	16 July	Gorbatch
0055	green trawl	17 July	NE Point W
0056	control	17 July	NE Point W
0057	control	17 July	NE Point W
0058	green trawl	18 July	Polovina
0059	control	18 July	Polovina
0060	control	18 July	Polovina
0061	control	19 July	Little Zapadni
0062	control	19 July	Little Zapadni
0063	control	19 July	Little Zapadni
0064	control	19 July	Little Zapadni
0065	white band	19 July	Little Zapadni
0066	gray trawl	20 July	Zapadni Reef
0067	control	20 July	Zapadni Reef
0068	control	20 July	Zapadni Reef
0069	blue trawl	20 July	Tolstoi
0070	control	20 July	Tolstoi
0071	control	20 July	Tolstoi
0072	gray trawl	20 July	Tolstoi
0073	control	20 July	Tolstoi
0074	control	20 July	Tolstoi
0075	blue trawl	21 July	Polovina
0076	control	21 July	Polovina
0077	control	21 July	Polovina
0078	blue band	23 July	Gorbatch
0079	control	23 July	Gorbatch
0080	control	23 July	Gorbatch
0081	brown rope	23 July	Gorbatch
0082	control	23 July	Gorbatch
0083	control	23 July	Gorbatch
0084	gray trawl	24 July	NE Point W
0085	gray trawl	24 July	NE Point W
0086	green trawl	22 July	Kitovi

Table 12.--Continued.

Tag no.	Debris type/color	Date	Location
0087	control	22 July	Kitovi
0088	control	22 July	Kitovi
0089	control	24 July	NE Point E
0090	control	24 July	NE Point E
0091	control	24 July	NE Point E
0092	control	24 July	NE Point E
0093	control	24 July	NE Point E
0094	control	24 July	NE Point E
0095	yellow band	25 July	Lukanin
0096	green band	26 July	Tolstoi
0097	control	26 July	Tolstoi
0098	control	26 July	Tolstoi
0099	gray line	29 July	Zapadni
0100	control	26 July	Zapadni Reef
0101	control	26 July	Zapadni Reef
0102	white line	27 July	Castle Rock
0103	green trawl	27 July	Castle Rock
0104	control	27 July	Castle Rock
0105	control	27 July	Castle Rock
0106	control	27 July	Castle Rock
0107	control	27 July	Castle Rock
0108	gray trawl	27 July	Castle Rock
0109	white twine	27 July	Castle Rock
0110	control	27 July	Castle Rock
0111	control	27 July	Castle Rock
0112	control	27 July	Castle Rock
0113	control	27 July	Castle Rock
0114	control	27 July	Castle Rock
0115	control	27 July	Castle Rock
0116	control	27 July	Castle Rock
0117	control	27 July	Castle Rock
0118	green trawl	27 July	Castle Rock
0119	green trawl	27 July	Castle Rock
0120	control	29 July	Zapadni
0121	control	29 July	Zapadni
0122	green gill net	29 July	Polovina
0123	control	29 July	Polovina
0124	control	29 July	Polovina
0125	blue trawl	29 July	Zapadni Reef
0126	control	29 July	Zapadni Reef
0127	control	29 July	Zapadni Reef
0128	gray trawl	29 July	Zapadni Reef
0129	control	29 July	Zapadni Reef
0130	control	29 July	Zapadni Reef

Table 12. --Continued.

Tag no.	Debros type/color	Date	Location
0131	gray trawl	30 July	Tolstoi
0132	control	30 July	Tolstoi
0133	control	30 July	Tolstoi
0134	green/gray/white tr.	30 July	Tolstoi
0135	control	30 July	Tolstoi
0136	control	30 July	Tolstoi
0137	blue trawl	31 July	Zolotoi Sands
0138	control	31 July	Zolotoi Sands
0139	control	31 July	Zolotoi Sands
0140	orange trawl	31 July	Zolotoi Sands
0141	control	31 July	Zolotoi Sands
0142	control	31 July	Zolotoi Sands
0143	black rope	31 July	Castle Rock
0144	green trawl	31 July	Castle Rock
0145	control	31 July	Castle Rock
0146	control	31 July	Castle Rock
0147	control	31 July	Castle Rock
0148	control	31 July	Castle Rock
0149	gray trawl	1 Aug.	Polovina
0150	control	1 Aug.	Polovina
0151	control	1 Aug.	Polovina
0152	gray trawl	4 Aug.	Zapadni Reef
0153	control	4 Aug.	Zapadni Reef
0154	control	4 Aug.	Zapadni Reef
0155	gray trawl	4 Aug.	Zapadni Reef
0156	green trawl	4 Aug.	Zapadni Reef
0157	control	4 Aug.	Zapadni Reef
0158	control	4 Aug.	Zapadni Reef
0159	control	4 Aug.	Zapadni Reef
0160	control	4 Aug.	Zapadni Reef
0161	green trawl	5 Aug.	Zapadni
0162	control	5 Aug.	Zapadni
0163	control	5 Aug.	Zapadni
0164	gray trawl	6 Aug.	Zolotoi Sands
0165	control	6 Aug.	Zolotoi Sands
0166	control	6 Aug.	Zolotoi Sands
0167	green trawl	6 Aug.	NE Point E
0168	control	6 Aug.	NE Point E
0169	control	6 Aug.	NE Point E
0170	yellow band	7 Aug.	Gorbatch
0171	control	7 Aug.	Gorbatch
0172	control	7 Aug.	Gorbatch
0173	control	7 Aug.	Gorbatch
0174	control	7 Aug.	Gorbatch

Table 12.--Continued.

Tag no.	Debris type/color	Date	Location
0175	orange trawl	7 Aug.	Gorbatch
0176	control	7 Aug.	Gorbatch
0177	green trawl	7 Aug.	Polovina
0178	control	7 Aug.	Polovina
0179	control	7 Aug.	Polovina
0180	blue trawl	7 Aug.	Castle Rock
0181	gray trawl	7 Aug.	Castle Rock
0182	control	7 Aug.	Castle Rock
0183	control	7 Aug.	Castle Rock
0184	control	7 Aug.	Castle Rock
0185	control	7 Aug.	Castle Rock
0186	green line	7 Aug.	Tolstoi
0187	ivory trawl[a]	7 Aug.	Tolstoi
0188	control	7 Aug.	Tolstoi
0189	control	7 Aug.	Tolstoi
0190	control	7 Aug.	Tolstoi
0191	control	7 Aug.	Tolstoi
0192	green trawl[b]	8 Aug.	Zapadni Reef
0193	gray trawl	8 Aug.	Zapadni
0194	green trawl	8 Aug.	Zapadni
0195	orange line w/handle	8 Aug.	Zapadni
0196	green trawl	8 Aug.	Zapadni
0197	green/pink trawl	8 Aug.	Zapadni
0198	green trawl	8 Aug.	Zapadni
0199	gray trawl	8 Aug.	Zapadni
0200	green trawl	9 Aug.	Zapadni Reef
0201	gray trawl	9 Aug.	NE Point E
0202	green trawl	9 Aug.	NE Point E
0203	yellow band	9 Aug.	NE Point E
0204	green trawl	9 Aug.	NE Point E
0205	yellow band	9 Aug.	NE Point E
0206	white cord	9 Aug.	NE Point W
0207	gray trawl	9 Aug.	NE Point W
0208	gray trawl	9 Aug.	NE Point W
0209	control	9 Aug.	Zapadni
0210	control	9 Aug.	Zapadni
0211	control	9 Aug.	Zapadni
0212	control	9 Aug.	Zapadni
0213	control	9 Aug.	Zapadni
0214	control	9 Aug.	Zapadni
0215	control	9 Aug.	Zapadni
0216	control	9 Aug.	Zapadni
0217	control	9 Aug.	Zapadni
0218	control	9 Aug.	Zapadni

Table 12.--Continued.

Tag no.	Debris type/color	Date	Location
0219	control	9 Aug.	Zapadni
0220	control	9 Aug.	Zapadni
0221	control	9 Aug.	Zapadni
0222	control	9 Aug.	Zapadni
0223	control	9 Aug.	Tolstoi
0224	control	9 Aug.	Tolstoi
0225	control	9 Aug.	Lukanin
0226	control	9 Aug.	Lukanin
0227	control	9 Aug.	Lukanin
0228	control	9 Aug.	Lukanin
0229	control	9 Aug.	Kitovi
0230	control	9 Aug.	Kitovi
0231	control	9 Aug.	Castle Rock
0232	control	9 Aug.	Castle Rock
0233	control	9 Aug.	Castle Rock
0234	control	10 Aug.	NE Point E
0235	control	10 Aug.	NE Point E
0236	control	10 Aug.	NE Point E
0237	control	10 Aug.	NE Point E
0238	green trawl	10 Aug.	NE Point W
0239	control	10 Aug.	NE Point W
0240	control	10 Aug.	NE Point W
0241	control	10 Aug.	NE Point W
0242	control	10 Aug.	NE Point W
0243	control	10 Aug.	NE Point W
0244	control	10 Aug.	NE Point W
0245	control	10 Aug.	NE Point W
0246	control	10 Aug.	NE Point W
0247	control	10 Aug.	NE Point W
0248	control	10 Aug.	NE Point W
0249	control	10 Aug.	NE Point W
0250	control	10 Aug.	NE Point W
0251	control	10 Aug.	Zapadni Reef

[a] Debris cut off during handling.
[b] Female with pup.

Table 13.--Northern fur seals entangled in fishing debris and other materials, St. Paul Island, Alaska, 1967-85.[a]

Year	Number of seals in drives of harvestable size	Number of entangled seals observed in drives[b]	Percent of harvest or entanglement drives
1967	50,229	75	0.15
1968	46,893	75	0.16
1969	32,819	66	0.20
1970	36,307	101	0.28
1971	27,289	113	0.41
1972	33,173	144	0.43
1973	28,482	137	0.48
1974	33,027	190	0.58
1975	29,148	206	0.71
1976	23,096	97	0.42
1977	28,444	99	0.35
1978	24,885	115	0.46
1979	25,762	104	0.40
1980	24,327	119	0.49
1981	23,928	102	0.43
1982	24,828	102	0.41
1983	25,768	112	0.43
1984	22,066	87	0.39
1985[c]	22,211	101[d]	0.45

[a] Some of these data are different from previously published tables (see Scordino, J., and R. Fisher. 1983. Investigations of fur seal entanglement in net fragments, plastic bands, and other debris in 1981 and 1982, St. Paul Island, Alaska. Unpub. manuscr., 33 p. plus appendix. Northwest Regional Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.)

b Includes both sexes.

c Data only included from entanglement research roundups where all individuals were counted. Calculations will differ from previous years because seals were released after roundups rather than killed as in the commercial harvests.

d Includes only seals encountered in roundups or subsistence harvests where all seals of harvestable age were counted. To achieve comparability with previous data 32 seals that were resighted (Table 9) were included with the 69 seen for the first time (Table 7) all from roundups from 8 July to 7 August (Table 7).

comparable as possible to the data from the harvest, the roundup sample can be used as samples taken with replacement. To do this, all entangled seals sighted in roundups are counted (even if they have been seen previously). Such a comparison of numbers of juvenile males encountered in commercial harvests and-entanglement research roundups is presented in Table 13.

Experimental Studies on Nearly-weaned Pups

The principal objective of this part of the 1985 entanglement studies was to determine the various sizes of trawl net in which nearly-weaned pups (approximately 14 weeks old) could become entangled. From 2-13 October 1985, large pups were captured from Little Zapadni Rookery on St. Paul Island, temporarily placed in a circular pool (5 m diameter and 1.5 m deep), and exposed to net fragments (1 m^2) of various mesh sizes.

A total of 22 trials were run, with 5 pups in the pool per trial. Pups were used in one trial before being released. In each trial, 3-6 pieces of netting (all of the same mesh size) were placed in the pool, where they floated at the surface. Mesh sizes from 12-22-cm stretch mesh were tested (two trials per mesh size). If a pup became entangled in the netting for at least 30 minutes, it was scored as being entangled for the trial. Each trial lasted up to 5 hours, although a trial was terminated sooner if all pups had become entangled.

Figure 10 illustrates the mesh sizes in which pups became entangled. Being caught by the face was defined to occur when the netting became lodged anterior to the ears; netting lodged posterior to the ears was defined as being caught by neck., There was an abrupt shift from the mesh sizes in which no pups were caught to those in which all pups were caught. All mesh sizes greater than 15 cm stretch mesh entangled pups by their neck at a high rate.

Mesh sizes smaller than 20 cm are clearly a threat to pups, but are not often seen on juvenile males observed ashore (Fig. 11). The ability of pups to entangle themselves in mesh sizes 16-20 cm and larger suggests a potentially great impact on young, naive seals just after weaning. The low incidence of this mesh size observed on individuals that survive entanglement may indicate a high mortality of post-weaning seals that become entangled in marine debris.

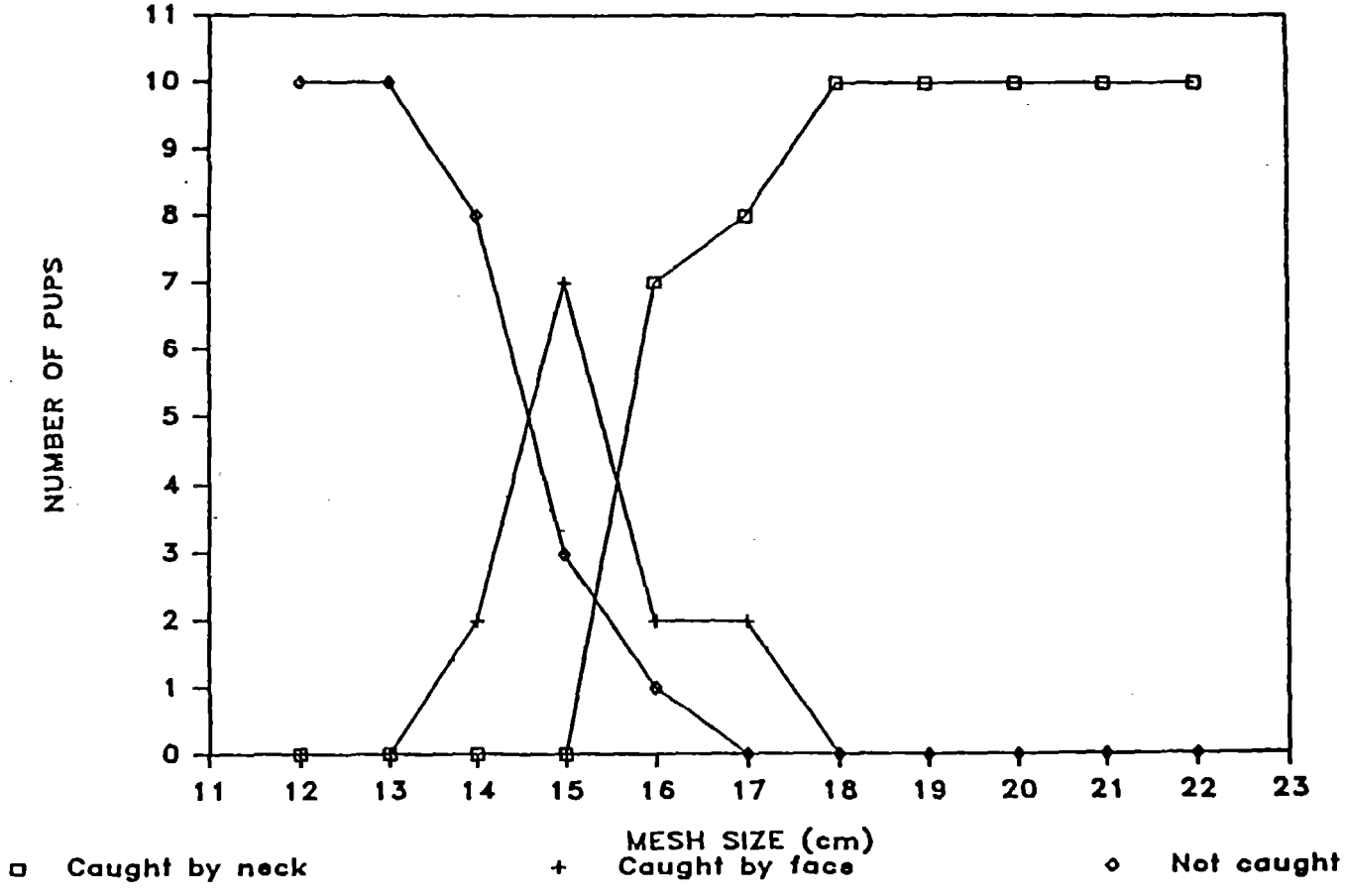

Figure 10.--Results of entanglement experiments on captive, nearly-weaned pups, Net fragments of the mesh size indicated were experimentally presented to pups.

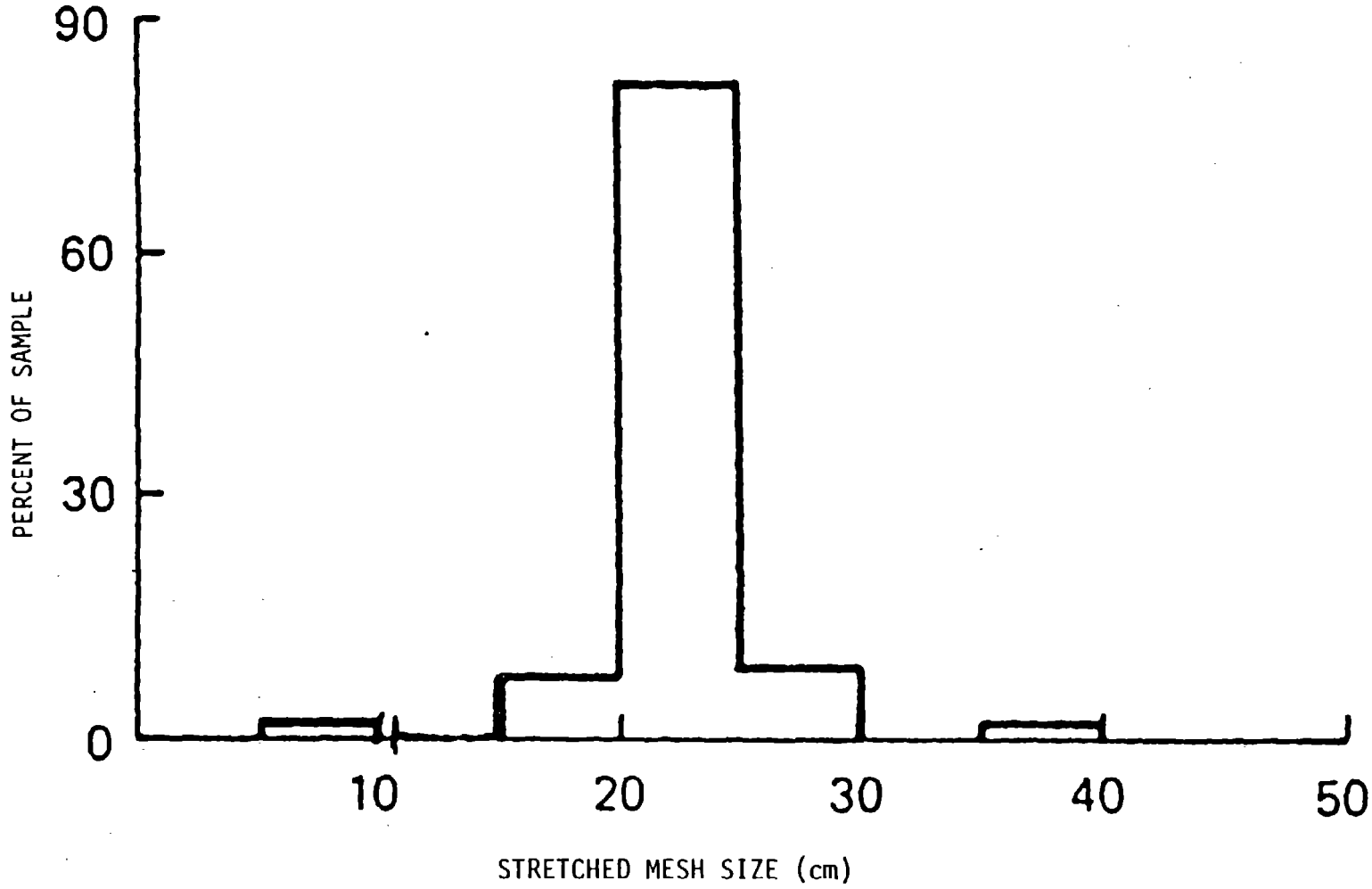

Figure 11.--Frequency distribution of mesh sizes found on juvenile males (n=58) taken in the commercial harvest on St. Paul Island, Alaska.

INCIDENCE AND IMPACT OF ENTANGLEMENT IN NETTING DEBRIS ON NORTHERN FUR SEAL PUPS AND ADULT FEMALES, ST. PAUL ISLAND, ALASKA

by

Robert L. DeLong, Pierre Dawson, and Patrick J. Gearin

The decline of the Pribilof Islands northern fur seal population has been attributed to increased mortality due to entanglement in marine debris and has been based mainly upon studies of juvenile males (Fowler 1982, 1985). If entanglement is responsible for the population decline, females would have to be suffering substantial mortality from entanglement. However, past surveys of entanglement in adult females have indicated that fewer females than juvenile males become entangled (See "Fur Seal Entanglement Studies in 1984, St. Paul Island, Alaska" in this report; Bigg 1979). Therefore, in 1985 a series of studies was carried out on St. Paul Island between July and November to assess the incidence and effects of entanglement on adult and juvenile females and pups as follows:

1. Conduct serial surveys on sample areas to assess entanglement rates among adult females on the rookeries at St. Paul Island.
2. Assess the impact of entanglement on lactating females by experimentally entangling a group of females and comparing their attendance patterns, mortality rate, and the growth of their pups to a group of unentangled females and their pups (controls).

3. Assess the energetic cost of entanglement to adult females during foraging trips and to pups when swimming.
4. Assess the incidence of entanglement in juvenile females and pups late in the season.

A summary of these studies are included here, and a complete report is available from the National Marine Mammal Laboratory.

Surveys of Entangled Adult Females

Five to eight surveys were conducted every other day on sample areas of Tolstoi and Polovina Cliffs rookeries and on all of Lukanin rookery during July, August, and September in order to observe postpartum females using these rookeries. These surveys were necessary as postpartum females are expected ashore only about 20.0% of the time, the remainder being spent at sea feeding to maintain lactation. Survey areas were chosen where observations could be made from cliff tops without disturbing seals in the rookeries. Surveys were conducted using 8 x 40 or 10 x 50 binoculars, examining and counting all females which could be seen clearly. A total of 16 entangled females were seen on the three study sites. In addition, 12 females were observed with neck scars. Five of the 12 seals had been entangled during the past year or earlier as evidenced by the abraded guard hairs on the anterior shoulder areas. The remaining 7 seals had either been in debris and escaped or could have had small pieces of line still embedded deep in the fur or flesh creating the apparent scar around the neck.

To convert the observed incidence of entanglement to an entanglement rate, the number of pups counted or estimated on the study areas was used as a measure of the number of parturient females using the rookeries. Rates of female entanglement (excluding females which had been recently entangled) ranged from 0.06% on Lukanin rookery to 0.23% on the study areas on Tolstoi rookery (Table 14). The mean rate for the three rookeries was 0.15%.

Table 14.--Female northern fur seal entanglement on three study sites, St. Paul Island, Alaska, 1985.

Location	Number entangled		Number of pups[a]	Percent of entanglement[b]
	White- or mixed-whiskered	Black-whiskered		
Tolstoi	10	2	5,144	0.23
Lukanin	1	2	4,635	0.06
Polovina Cliffs	0	1	1,651	0.06
Total	11	5	11,430	

a The number of pups counted or estimated on the rookeries were used as a measure of the number of parturient females using the areas.

b Calculated from total of actual entanglement plus those animals with evidence of having been entangled (rubs and scars).

One female which was nursing a pup at Tolstoi Rookery appeared to have become recently entangled in a piece of trawl web while feeding in the Bearing Sea during the summer. She was first seen in September with a pup in good condition.

Impacts of Entanglement on Adult Females and Their Pups

In order to assess the impact of entanglement on parturient females and their pups, an experimental study was carried out at Zapadni Reef rookery. Forty adult, newly parturient females and their pups were captured between 8 and 14 July. They were alternately assigned as experimental and control animals. Experimental females were entangled in a 200-g piece of 23-cm trawl web. The 1.4- x 0.6-m piece of web was folded twice to form a mass with an approximate 0.7- x 0.3-m dimension. The folded trawl web piece was placed over the head of a physically-restrained female by sliding the seal's head through the center meshes. Radio transmitting tags were attached with epoxy resin to the pelage on the heads of both experimental and control females, they were double-tagged with white Allflex tags (Table 15) and released with their pups back into the territory from which they were captured. The pups were weighed and marked with a bleached number in their pelage.

The attendance cycles and at-sea feeding cycles of the adult females were monitored continuously by a programmable receiver and strip chart recorder. In addition, all tag frequencies were scanned manually twice a day and the animals were observed daily between 22 July and 13 October from a 5-m high observation tower to check the condition of entangled and control seals, and to see whether the nets or radio transmitters had been lost. No attempt was made to remove the trawl web entangling the females; their survival is to be compared

Table 15.--Adult northern fur seal females double-tagged in entanglement study at Zapadni Reef Rookery, St. Paul Island, Alaska, 1985.

Tag number[a]	Status[b]
5001	Entangled
5002	Control
5003	Entangled
5004	Control
5005	Entangled
5006	Control
5007	Entangled
5008	Entangled
5009	Entangled
5010	Control
5011	Entangled
5012	Control
5013	Entangled
5014	Entangled
5015	Control
5016	Entangled
5017	Control
5018	Entangled
5019	Control
5020	Entangled
5021	Control
5022	Entangled
5023	Control
5024	Entangled
5025	Entangled
5026	Entangled
5027	Entangled
5028	Entangled
5029	Entangled
5030	Entangled
5031	Control
5032	Control
5033	Control
5034	Control
5035	Control
5036	Control
5037	Control
5038	Control
5039	Control
5040	Control

[a] White Allflex tags.

b "Entangled" were entangled in about 200 g of 22 cm (stretched mesh) trawl web and radio tagged. "Controls" were radio tagged only.

with the controls during the 1986 field season. At approximately 1 month of age, pups were recaptured, weighed, and tagged with white Allflex tags; these pups were again captured in September for a final weighing.

Results of the entanglement study on adult females were as follows: 1) three females freed themselves from the nets; 2) 9 of 17 remaining experimentally entangled females did not return from the first (3), second (4), or third (2) trip to sea; 3) one control female did not return from the second or subsequent feeding trips; and 4) at-sea times for entangled females averaged about twice as long as trips for control females (Table 16).

At approximately 1 month of age, pups of entangled and control females were captured, weighed, and tagged with white Allflex tags (Appendix Table B-l) in August. These pups were again captured in September to determine average weight gain of pups in the two groups as shown below:

	11 August	18-28 September
Experimental	1.20 kg (n = 12)	2.20 (n = 7)
Control	2.10 kg (n = 19)	3.60 (n = 14)

Eleven of 17 pups of entangled females and one pup of a control female died during the study.

It was apparent from the results that the 200 g of trawl web had created a significant encumberance to the adult females while foraging at sea. The nine females that did not return either abandoned their pups and remained at sea or alternatively may have died at sea. By

Table 16. --Length of at-sea feeding trips (in days) for experimentally entangled and control female northern fur seals, Zapadni Reef rookery, St. Paul Island, Alaska, 10 July to 10 October 1985. A dash indicates no data.

	Trip number							
	1	2	3	4	5	6	7	8
Entangled								
Mean	9.9	12.5	12.7	15.2	-	-	-	-
Std. deviation	2.6	2.6	2.2	2.3	-	-	-	-
n	14	9	6	4	-	-	-	-
Control								
Mean	5.1	6.8	6.9	6.8	7.5	7.5	7.0	8.2
Std. deviation	1.2	1.3	1.2	1.8	2.1	1.8	1.5	1.6
n	20	19	19	19	15	13	11	8

mid-October, 3 months after the females were entangled, none of the entanglements had created open wounds which could be observed visually. Thus, there was no conclusive evidence that the entanglement had caused mortality among these females during the 3 months of their entanglement. The survival and reproductive success of the entangled and control females will be assessed from observations in 1986. These observations will clarify the fate of the entangled females which did not return from feeding trips during 1985, that is, if they are not present in 1986, they probably perished as a result of the entanglement. The entangled females will be recaptured and freed from the trawl web entanglements.

The prolonged at-sea feeding cycles observed among entangled females had the effect of decreasing their pups' weight gain. As expected, the pups of the entangled females which did not return perished from starvation.

Energetic Cost of Entanglement to Northern Fur Seal Females and Pups.

Three pups were captured at St. Paul Island in mid-November 1985 and transported to Long Marine Laboratory at Santa Cruz, California, where energetic measurements on entangled and control pups will be made.

Surveys of Entanglement in Juvenile Females and Pups.

Surveys of juvenile female entanglement were planned to assess whether entanglement rates for young females were comparable to those for juvenile males. It has been generally noted that only a few young

females are entangled in marine debris during the summer fur seal breeding season. Juvenile females apparently do not begin arriving back on the rookeries and hauling grounds until August and September after the harvest and when most of the scientific survey activity has been completed. Thus, previous surveys had never been conducted specifically to assess the presence or absence of entangled females.

Pup entanglement has been known to occur, based upon anecdotal reports from the Pribilofs, but had not been systematically documented.

Between 11 September and 16 October 1985, all rookeries and hauling grounds on St. Paul Island were surveyed for the presence of entangled juvenile (black-whiskered) females and pups. Most entangled animals were captured, the nature of the entanglements were recorded, and the animals were tagged with orange Allflex tags.

During the surveys, 21 entangled juvenile females plus three with neck scars and one with an open wound encircling the neck were observed. Twelve of the 25 females were captured and tagged (Appendix Table B-2). The debris entangling the young females was as follows: Trawl web or twine (14), monofilament gillnet (3), and plastic or rubber bands (4). Attempts to translate entanglement observations into entanglement rates for juvenile females failed because of our inability to assess the total number of juvenile females on the rookeries and hauling grounds.

Although we do not know how the rates of entanglement among juvenile females compare to those for juvenile males, it was interesting to note that during this survey when 17 entangled juvenile females were recorded, a total of 28 entangled juvenile males were observed. The comparison of these figures suggests that the incidence of entanglement in juvenile females is -less than that of males of the same age; however', the same result could be caused by fewer females than males of the same age returning to the islands at the same time.

The first entangled pup was seen on 12 September, roughly 1 month after the pups began going into the Bering Sea for the first time. Between 11 September and 16 October, 39 entangled pups were observed. Five pups were entangled in a single piece of orange trawl web which had become wrapped around a channel marker anchor line. Another five pups became entangled in a large piece of blue trawl web (16 cm mesh) and washed ashore at Zoltoi Sands. Two pups came ashore at Gorbatch rookery in a 500-g piece of trawl web. The remaining (29) pups were single-animal entanglements in pieces of trawl web (16), packing bands (6), rope or twine (3), cloth (2), neoprene (l), and a balloon (1).

Five of the 39 entangled pups were dead when first observed. Each of these was entangled in large pieces of trawl netting--three in the netting which became snagged on the channel marker anchor line, and one each in pieces of trawl web about 0.5 kg and greater than 1.0 kg in mass.

Twenty-two of the live entangled pups were captured and sexed; of these, 19 were weighed and tagged with orange Allflex tags (Appendix Table B-2).

Surveys of the rookeries and beaches of St. Paul Island and the beaches of the islands in the Unimak Pass area of the eastern Aleutian Islands were conducted in mid-November to look for dead entangled fur seal pups. The number of fur seal pups was quite low on St. Paul Island because roughly 50 to 70% of the pup population had already departed the island. One tagged entangled pup and one newly-entangled pup were seen on St. Paul Island. Both were in good condition and entered the water with other pups. No dead entangled pups were observed on St. Paul Island. The surveys for entangled pups on the beaches around Unimak Pass did not result in any sightings of entangled Pups.

Many tagged fur seals were observed during surveys of rookeries and hauling grounds (Appendix Table B-3).

DISEASE STUDIES, ST. PAUL ISLAND, ALASKA

by

Robert L. DeLong

Blood serum samples were collected from 300 bachelor male northern fur seals taken in the subsistence harvest on St. Paul Island. Samples are being screened for antibodies to leptospires and a series of viral pathogens. Serum samples and swabs for calcivirus isolation were taken from 37 pups from Northeast Point and Little Zapadni rookeries on 10 and 11 November, respectively. Twenty-nine of these pups were tagged with monel cattle ear tags on both front flippers (Appendix Table B-4).

FUR SEAL ENTANGLEMENT STUDIES IN 1984, ST. PAUL ISLAND, ALASKA

by

Joe Scordino, Hiroshi Kajimura, Norihisa Baba, and Akira Furuta

This section reports fur seal entanglement data collected during the second year of a 3-year cooperative U.S.-Japan study on St. Paul Island, Alaska. This portion of the cooperative study emphasizes the examination of debris entangled on fur seals observed during the 1984 harvest of subadult males. Results of the first year's studies are reported in Scordino et al. (1984). Information collected on St. Paul Island in 1984 include the type of entangling debris, the mesh sizes of entangling webbing material, pathological examinations on the type of and the degree of injury, the age and size of seals that were entangled, the incidence of scarred seals (indicative of a prior entanglement), and the returns of entangled seals tagged during the harvest in 1983. In addition, some of the entangled subadult males in the 1984 harvest were tagged and released with the debris intact. Surveys were also conducted to record sightings of entangled seals in haul-out and breeding areas and to find entangled seals that were tagged and released during 1983 and 1984. Two beach areas were also surveyed and cleared of debris for the second and third consecutive years.

From a total of 22,066 seals harvested in 1984, 87 subadult males (0.39%) were observed with entangling debris around their heads, necks, or shoulders (Appendix Table B-5). In recent years (1976-84), the incidence of entanglement has averaged about 0.42% of the subadult

males harvested. Entangled females were not observed among subadult males driven in the harvest in 1984. The incidence of entangled females in the harvest is rare; only two have been observed in the last 4 years (1981-84).

Trawl net webbing was the predominate debris found entangled on seals in the harvest and accounted for 55.0% of the entangling debris observed on seals (Table 17). Plastic packing bands were the second most frequently occurring debris, accounting for 23.0% of the entangling debris. Seventy-four percent of the trawl net fragment samples taken off the entangled seals had a mesh size greater than 20.0 cm (Table 18). The trawl webbing mesh sizes ranged from 13.5 to 28.0 cm with the 23.0-, 21.5-, and 24.0-cm mesh sizes occurring most frequently. Most entangled seals observed in the harvest were entangled in small fragments weighing less than 200.0 g and in mesh loops rather than in holes or tears in the webbing. A detailed account of entangled seals examined during the harvest is shown in Appendix Table B-6.

The severity of trauma caused by entangling debris was determined by measuring the length of open wounds along the point of entanglement (usually about the neck) and is expressed as degrees of a circle in this report. Many seals with entangling debris did not have open wounds; however, of the 33 entangled seals with wounds, 38.0% had open wounds that extended over 270" of the line of entanglement (Table 19). Of the seals entangled with debris, open wounds occurred in 40.0% of the seals in trawl nets, 21.0% of those in plastic bands, 100.0% of those in gillnets, and 38.0% of those in other debris.

Table 17. --Types of entangling debris observed on northern fur seals during the harvest and frequency of occurrence in 1984.

Type of debris	Frequency (percent)
Trawl webbing	55
Plastic packing band	23
Rope	6
Gillnet	5
String	5
Trawl webbing and plastic packing band	2
Cord used in net construction and repair	2
Plastic ring	1
Plastic object	1

Table 18.--Mesh sizes of trawl webbing entangled on northern fur seals during the harvest and frequency of occurrence in 1984.

Mesh size (cm)	Frequency (percent)
10-14	2
15-19	4
20-24	66
25-29	8
Undetermined	20

Table 19.--Incidence of open wounds in northern fur seals during the harvest with entangling debris in 1984.

Degree of open wound	Frequency (percent)
No open wound	61
0°-90°	7
91°-180°	8
181°-270°	5
271°-360°	18
Undetermined	1

A comparison of the ages of entangled seals taken during studies in 1982-84 to the incidence of wounds show that the frequency of wounds increases with age (Table 20). Of entangled seals ages 5 years and older, 82.0% had open wounds while 50.0% of the 4-year-olds and 30.0% of the 3-year-old seals had open wounds.

In addition to the entangled animals, 67 seals were observed to have scars or wounds that were indicative of previous entanglement (Appendix Table B-6). Another 17 seal pelts examined in the processing plant on St. Paul Island (Appendix Table B-7) showed similar entanglement scars or bruises on the dermis of the skin (after the blubber was removed). The incidence of entanglement-scarred seals (without debris) was the same (0.39%) as the incidence of seals with entangling debris (Appendix Table B-5). These observations demonstrate that some animals can extricate themselves from entangling debris within a relatively short period of time and can survive an entanglement episode even when such entanglement causes an open wound. Four of these entanglement-scarred seals (without debris) had open wounds, two of which were 360" wounds, suggesting the animals had very recently extricated themselves from the debris. Table 21 shows harvested fur seals observed during 1982-84 with scars or bruises indicative of a previous entanglement.

To better understand the progression of skin trauma and mortality, 56 of the 87 entangled seals encountered in the 1984 harvest of subadult males were tagged and released with the debris

Table 20.--Incidence of open wounds by age of entangled northern fur seals, 1982-84[a].

Age (year)	Sample size (number)	Incidence of wound (percent)
2	17	24
3	63	30
4	34	50
5+	17	82

[a] Scordino and Fisher (1983); Scordino et al. (1984).

Table 21.--Northern fur seals observed without entangling debris, but having scars or bruises indicative of a previous entanglement, 1982-84.

Year	Number of unentangled but scarred seals observed	Additional scarred skins observed after blubber removal	Total seals or skins observed on St. Paul with entanglement scars	Percent of harvest	Additional scarred skins observed after guard hair removal[a]	Total scarred skins[a]	Percer of harves
1982	20	34	54	0.22	37	91	0.37
1983	51[b]	33	85	0.33	-	-	-
1984	68[b]	17	85	0.39	-	-	-

[a] Data not yet available for 1983-84.
[b] Includes oversized males recorded during the harvest.

intact as in 1983 (Scordino et al. 1984) so they could be followed through time. Some of these tagged, entangled seals (tagged in 1983 and in 1984) were resighted in 1984 without their entangling debris.

Of 75 entangled or entanglement-scarred seals tagged in 1984, 18 were resighted during the same year (Appendix Table B-8); of that 18, 14 were entangled and 4 were scarred from entanglement. One seal (tag no. 574) which had a small quantity of net on its neck extricated itself from the debris within 2 days after tagging.

Twenty-five percent of the entangled seals tagged in 1983 were sighted in 1984 (Appendix Table B-9). Eighteen (19%) of these sightings were during the subadult male harvest and the remainder were sighted during the few cursory hauling ground surveys. In order to compare these returns with the return rates of unentangled seals, we reviewed similar efforts to sight tagged, unentangled, subadult males during the harvest on St. Paul Island in 1978 and 1979. Griben (1979) tagged 356 and 1,236 subadult males during the harvests in 1977 and 1978 respectively. In 1978, Griben sighted 193 (54%) of the 1977-tagged seals during intensive sighting efforts on St. Paul Island both during the harvest and during daily surveys of all haul-out areas. In 1979, the harvesting crew on St. Paul sighted 324 (26%) of the 1978-tagged seals exclusively during the harvest operation on St. Paul Island. Because all of the 1984 sightings of tagged entangled seals during the harvest were initiated by the harvesting crew as was the case in 1979, these 1979 data were determined to be more appropriate for comparison than the 1978 returns by Griben (1979) which were the

result of considerably greater resighting effort. Comparing tag returns of 'normal" subadult males in the 1979 harvest with tag returns of entangled subadult males in the 1984 harvest shows no statistical difference (P 2 0.95) (Anne E. York, NMML, personal commun., 1984).

These tagging studies suggest that the mortality of entangled subadult male seals is not significantly different than that of unentangled subadult male seals over at least a one l-year period. This finding contrasts with previous reports of an assumed short time-frame mortality in entangled seals (Fowler 1982). However, it should be noted that 50% of the 1984 returns of 1983 tagged entangled seals were seals that had extricated themselves of the previously entangling debris. The loss of debris was not considered in past assumptions on entanglement mortality and obviously would be a significant factor. Nonetheless, the returns demonstrate that an entangled seal can survive over 1 year with the debris intact similar to a "normal" unencumbered seal in spite of the trauma caused by the debris.

Seventy-five percent of the entangled seals did not have open wounds when they were tagged in 1983 and many of these still had no marks or scars when resighted in 1984, suggesting that the wounds caused by entangling debris may take over a year to develop. Nine of the 24 resighted seals had open wounds when they were tagged in 1983; 5 of these had deep 360" wounds in 1983 and still had deep 360" wounds with debris intact in 1984.

In addition to the efforts made to observe entangled seals in the harvest, specific and opportunistic surveys were conducted to determine the incidence of entangled seals in the breeding areas and haul-out areas. These surveys were conducted from mid-June until the end of October (Appendix Table B-10).

The incidence of entanglement among adult females was significantly less than that observed among subadult males (Table 22). The late-season (September-October) surveys (Appendix Table B-10) also resulted in relatively very few sightings of entangled females; however, it is very difficult to distinguish the sex of young animals using these observational techniques.

Two beach areas, a rocky boulder beach on the west side of Northeast Point and the Zolotoi Sands beach, were surveyed and cleared of debris for the second and third consecutive years, respectively. All removable pieces of net, rope, string, and plastic banding material on both beaches were collected, and samples were taken from both beaches. Totals of 30.0 kg and 40.0 kg of webbing were collected from Northeast Point and Zolotoi Sands beaches, respectively. Samples of beach survey debris (1982-84), net webbing collected off seals (1983-84), and debris other than net webbing (bands, strings, etc.) taken off seals (1981-84) were sent to Japan for examination. A separate report on these examinations will be prepared by the Japanese scientists involved in these studies.

Table 22.--Incidence of entangled northern fur seal females during breeding area entanglement surveys in 1984.

Date (July)	Rookery	Estimated number of females surveyed	Number of females with entangling debris	Incidence of entanglement (percent)
7	Reef	6,200	2	0.032
8	Northeast Point	3,200	1	0.031
14	Reef	4,000	1	0.025
15	Northeast Point	5,800	1	0.017
25	Reef	1,200	1	0.083
29	Reef	1,200	2	0.167
	Total	21,600	8	

BEHAVIOR AND BIOLOGY OF NORTHERN FUR SEALS, PRIBILOF ISLANDS, ALASKA

by

Roger L. Gentry, Wendy E. Roberts, and Michael E. Goebel

The research effort of the NMML Behavior and Biology Task in 1985 centered on: 1) baseline fur seal behavioral studies, 2) survival and pregnancy rates of marked females, 3) behavior of peripheral males at Staraya Artil rookery (St. George Island), 4) diving behavior of females at St. Paul Island for comparison with past St. George Island data, 5) identification of feeding areas for animals located at sea by telemetry, 6) behavioral monitoring at Kitovi rookery, St. Paul Island, 7) swim speeds of females during feeding excursions, and 8) diving behavior of adult males (a pilot study).

This report discusses the study of swim speeds and changes in female numbers and distribution at St. George Island from 1974 through 1985 (preliminary results). The tags applied to fur seals at St. George and St. Pau I Islands in 1985 are summarized in Table 23.

Swim Speeds

The foraging behavior of northern fur seals has been studied for 10 years in an attempt to relate changes in food resources to population trends of northern fur seals. This correlation was Proposed in the document that established the St. George Island project (Anon. 1973). Mechanical time-depth recorders (TDRs) were devised to measure foraging effort in a complex and inexpensive way. The behavior of foraging seals has been reported elsewhere (Gentry et al. 1986; Gentry and Kooyman

Table 23.--Tags applied to northern fur seals on St. George and St. Paul Islands, Alaska, in 1985 for studies of behavior.[a]

Type and color of tag	Tag number	Age-sex class	Number of seals tagged	Rookery
White Monel	X501-X506 X510-X511	Adult males	4	Staraya Artil[b]
Pink Roto	853-854	Female pup	1	Kitovi[b]
	855-862	Adult females	4	Kitovi
White Riese	2801-2815	Adult females	15	Kitovi
	2816-2817, 2819	Female pups	3	Kitovi
	2818	Male pup	1	Kitovi
Green Roto	808, 810	Male pups	2	Kitovi
	811	Female pup	1	Kitovi
Yellow Riese	5922-5926, 5928-5929, 5932-5934, 5936-5940	Male pups	15	Kitovi
	5921, 5927, 5930-5931, 5935	Female pups	5	Kitovi
White Allflex	5082-5084,[c] 5201-5236	Adult females	37	Kitovi

a All seals were tagged on the trailing edges of both front flippers near the hair line.

b Staraya Artil is located on St. George Island; Kitovi is on St. Paul Island.

c White Allflex 5084 is a retag of yellow Riese 5084.

1986). The existing data provide a baseline for comparisons of foraging effort if the seal population decline resumes at its former level, or if food availability declines.

Several major questions about fur seal pelagic behavior arose from these past investigations (Gentry and Kooyman 1986). For example: 1) How far do fur seals forage from the islands? 2) How far and how fast do they move between feeding bouts (when they are known to be active)? 3) How does-swim speed vary with depth? 4) Do seals catch prey by burst swimming?; 5) At what angle relative to the surface do fur seals descend and ascend from feeding dives? 6) Do swim speed and distance traveled on a feeding trip vary with body size (or with age because body size increases with. age)?

To address these questions, a contract was established with Micromonitors[1/] (Sunnyvale, California) to provide microprocessors (MPs) that sample swim velocity and depth over time. velocity was measured with a small paddle-wheel device attached to the side of the waterproof MP housing. Depth was monitored with an electronic pressure transducer in the rear wall of the MP. The MP recorded the time hourly, the start and maximum depth of each dive, the velocity at the surface once every 4 minutes, and the velocity during diving once every 15 seconds. The MP had 4,000 bytes of memory on nonvolatile chips. The memory was dumped to a minicomputer by way of a modem after the instrument was retrieved from a seal. The units, which weighed about 0.75 kg, were attached to female fur seals by nylon harnesses designed for use with conventional TDRs.

1/ Reference to trade names does not imply endorsement by the National Marine Fisheries Services, NOAA.

Seven deployments of MP-carrying females were made in July and August using two MP units. One unit was programmed to record swim velocity until 10 m depth was attained, and to then record maximum depth. The other MP unit was programmed to record swim velocity every 15 seconds during diving, and maximum depth of dives greater than 10 m in depth. Because of a malfunction in one unit, only one complete and two partial records were obtained of swim velocity at the surface; four records were obtained of swim velocity during dives.

The durations of trips to sea were slightly longer for females carrying MP units than for uninstrumented animals, but they were not longer than for females carrying conventional TDRs. Unlike deployments With TDRs, females carrying MP units did not consistently gain weight on feeding excursions. In fact, four females lost weight while two gained weight. For this reason, MP units were not placed on females that weighed less than 37 kg.

The MP data are presently being analyzed. Empirically, it appears that the maximum swim velocity attained during deep dives was about 3.5 m/second (12.6 m/hour). Swim speed during dives varied, but no brief bursts of high-speed swimming, suggesting prey pursuit, were seen. Since swim speeds were not measured for the smallest females (26-36 kg), the correlation of swim speed with size (aye) will remain incomplete. All distance estimates will be made by summing the products of velocity (x) sampling interval for all data points. Descent and ascent angles will be estimated from calculating the sine of an acute angle of a right triangle in which the vertical distance (depth) is known, and the hypotenuse is the sum of velocity readings (x) sampling interval.

Changes in the Adult Female Population

At the inception of the St. George Island program, we anticipated that the female population would change in size and perhaps in distribution during the 15-year study period. To measure these changes, grids were painted on two study sites with intersections every 10 m. The Zapadni grid measured 100 m x 40 m, and the grid at East Reef measured 100 m x 30 m. Maps of these grid systems were duplicated on standard-size grid paper with a scale of 1 inch = 10 m. Each day of each reproductive season (about 15 June through 1 August) a map was drawn depicting as closely as possible the shape, size, and location of each female and pup group. The number of animals in each group was recorded on the map; sampling occurred at around 1100 hours each day. Maps are available for both sites from 1974 through 1984, and for East Reef only in 1985.

Analysis of these maps is now under way. Preliminary analysis showed that the population on shore (usually about 1/5 of the total number of females using an area) peaked from 7 through 14 July. This report summarizes preliminary analysis of maps for the East Reef rookery made from 7 through 14 July for the years 1975-84. These are the most consistent data available because they were collected by only two observers (J. M. Francis, 1975-80; M. E. Goebel, 1981-84). Single females were deleted from all data analysis because observers differed in whether they recorded area occupied by such females. Therefore, reported census values will be somewhat lower than actual counts of females.

The maps were reduced by digitizing images using a video camera and a computer program called Image Measure. To use this program, a technician positioned a moveable cursor on a group drawn on the digitized map, and the computer calculated the area and the x-y coordinates of the group center. The technician then typed in the number of females in that group. Thus, a file was created with data for each day to give area, numbers, and x-y coordinates of each female group.

The data were analyzed by collating files using the statistical package MINITAB. A total census and a total area occupied were calculated for each day by summing the results for each group. These daily totals were used to calculate a daily density value (females/m^2). Yearly density, area, and census values were taken as the average of the eight daily values.

Roth the total number of animals counted and the areas occupied by these animals declined from 1975 through 1984 (Fig. 12). The group sizes changed from a few large groups to many small groups in this period (e.g., see Figs. 8a and 8b in Gentry et al. 1980).

The extent of the decline in female numbers and area occupied closely mirrors the pup estimates for St. Paul Island made in the same years (Fig. 12; note that no estimates exist for 1977 and 1978). The pairwise correlations among these three parameters were excellent (area versus number, r = 0.99; area versus St. Paul pups, r = 0.94; number versus St. Paul pups, r = 0.93). Thus, the East Reef rookery changes occurred in close parallel with the St. Paul Island pup production during this 10-year period.

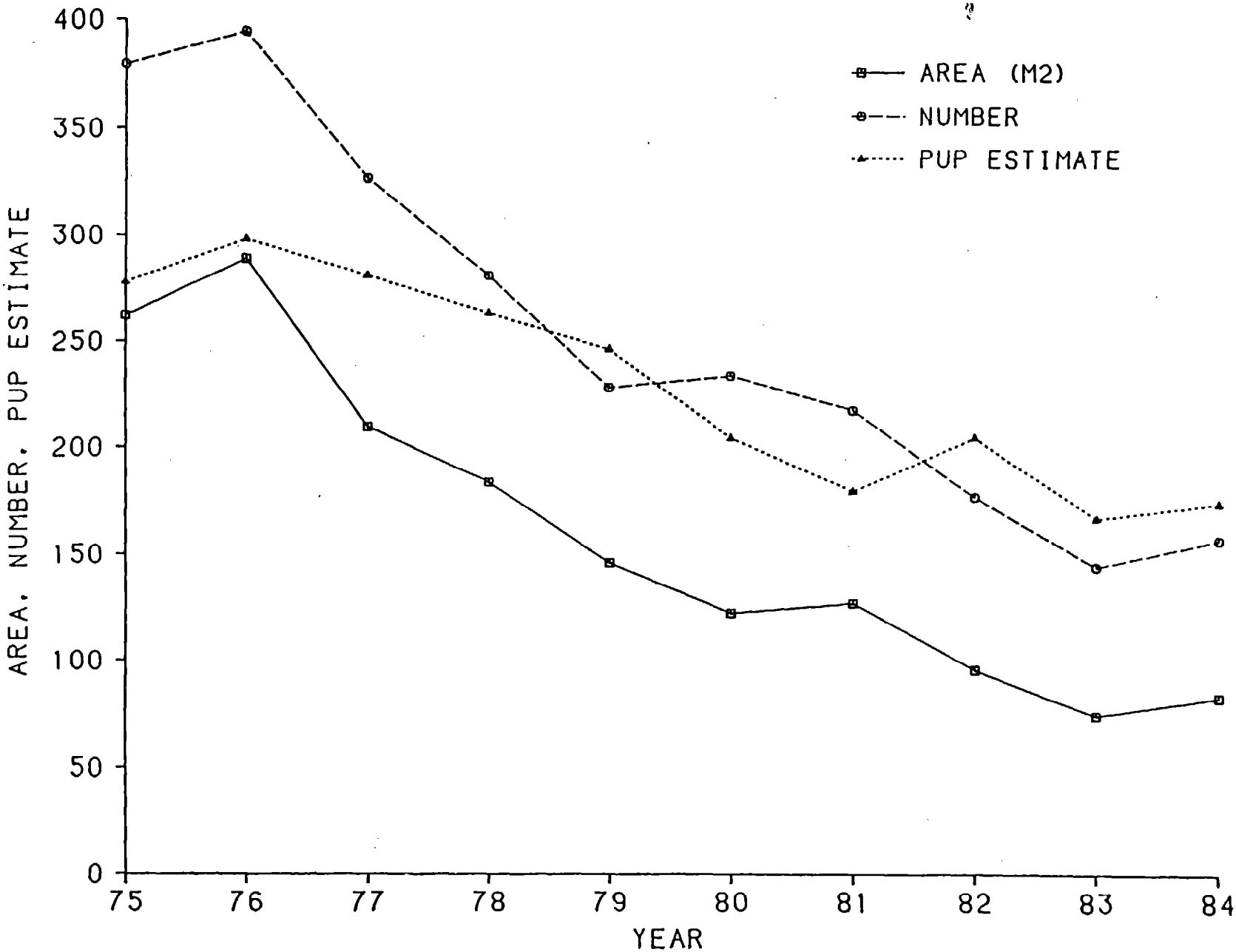

Figure 12 .--Changes in the number and area occupied by adult females at East Reef rookery, St. George Island, Alaska, and estimates of pups born at St. Paul Island, Alaska, over a lo-year period.

The data show that intragroup density of females did not decline as population size declined; area and numbers of seals remained closely correlated through the study period. This correlation is seen best by plotting area occupied against numbers of seals in the same years (Fig. 13)--a virtually straight-line result. When the annual density values are plotted by year, density appears to have increased with time (Fig. 14). The two ends of the graph, 1975 and 1984, are statistically different from each other ($t = p<0.002$). Table 24 lists the values used in the statistical analysis. The conclusion from this analysis is that if intragroup density varies with population size it varies inversely.

The East Reef fur seal population has changed relatively less than other rookeries on St. George Island since 1974 (Gentry and Francis 1981). Since the changes at East Reef closely correlate with pup production at St. Paul Island, other St. George Island rookeries have apparently changed relatively more than those on St. Paul Island.

Intrayroup density is undoubtedly under behavioral control of individual females. Spacing among individuals is enforced by threats and other aggression, and by movement out of high density (frequent aggression) areas. Since the spacing between neighbors is controlled by behavioral tendencies of individuals, our observation that intragroup density is relatively stable is the expected result.

The apparent increase in intragroup density from 1975 through 1984 may be real. The male population increased as the female population was decreasing and changing from a few large groups to many small ones. The increasing numbers of males may have had more effect on the density in small female groups than on large ones, thus increasing density over

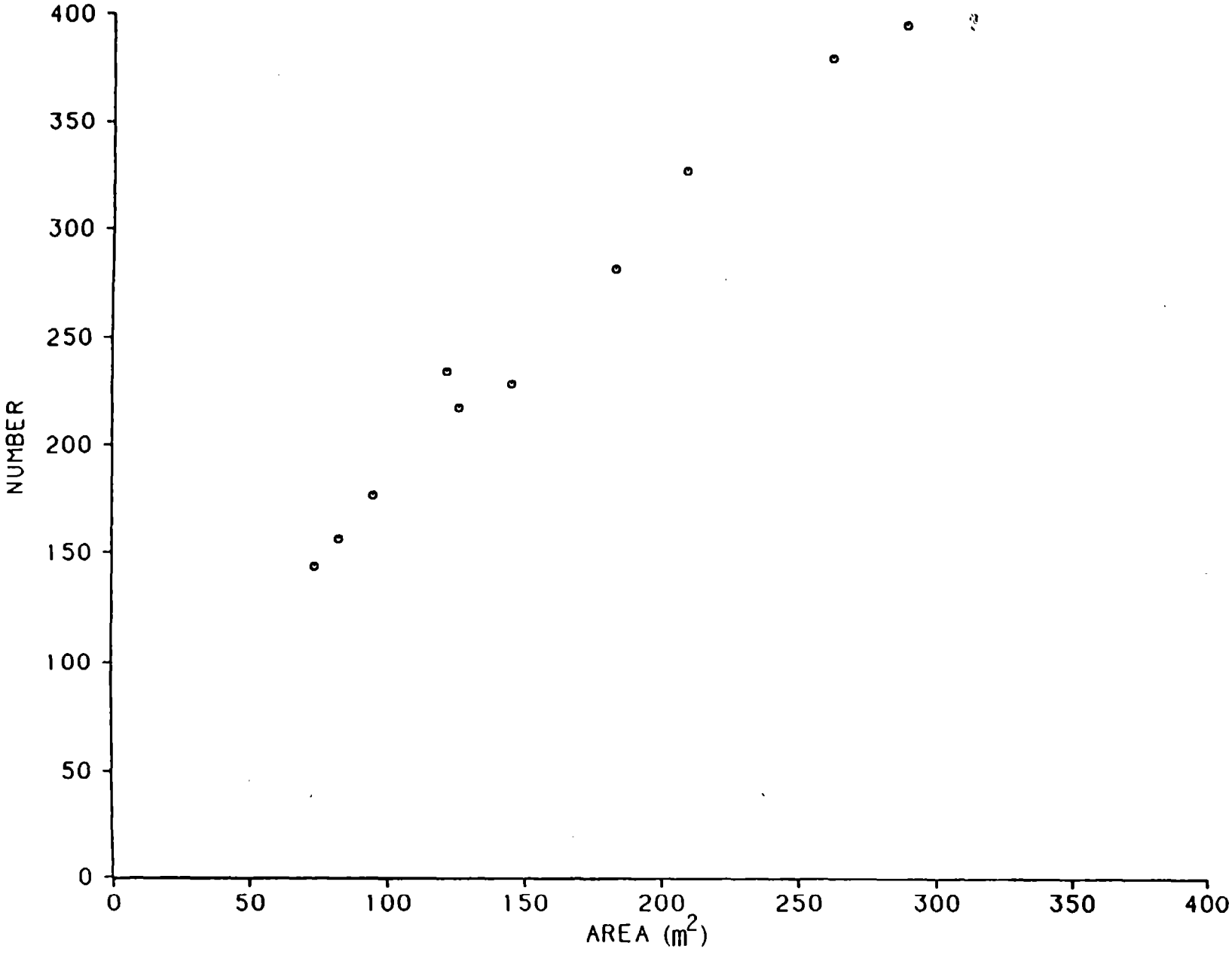

Figure 13.--Relationships between the number and the area occupied by adult females at East Reef rookery, St. George Island, Alaska, over a lo-year period (1975-84).

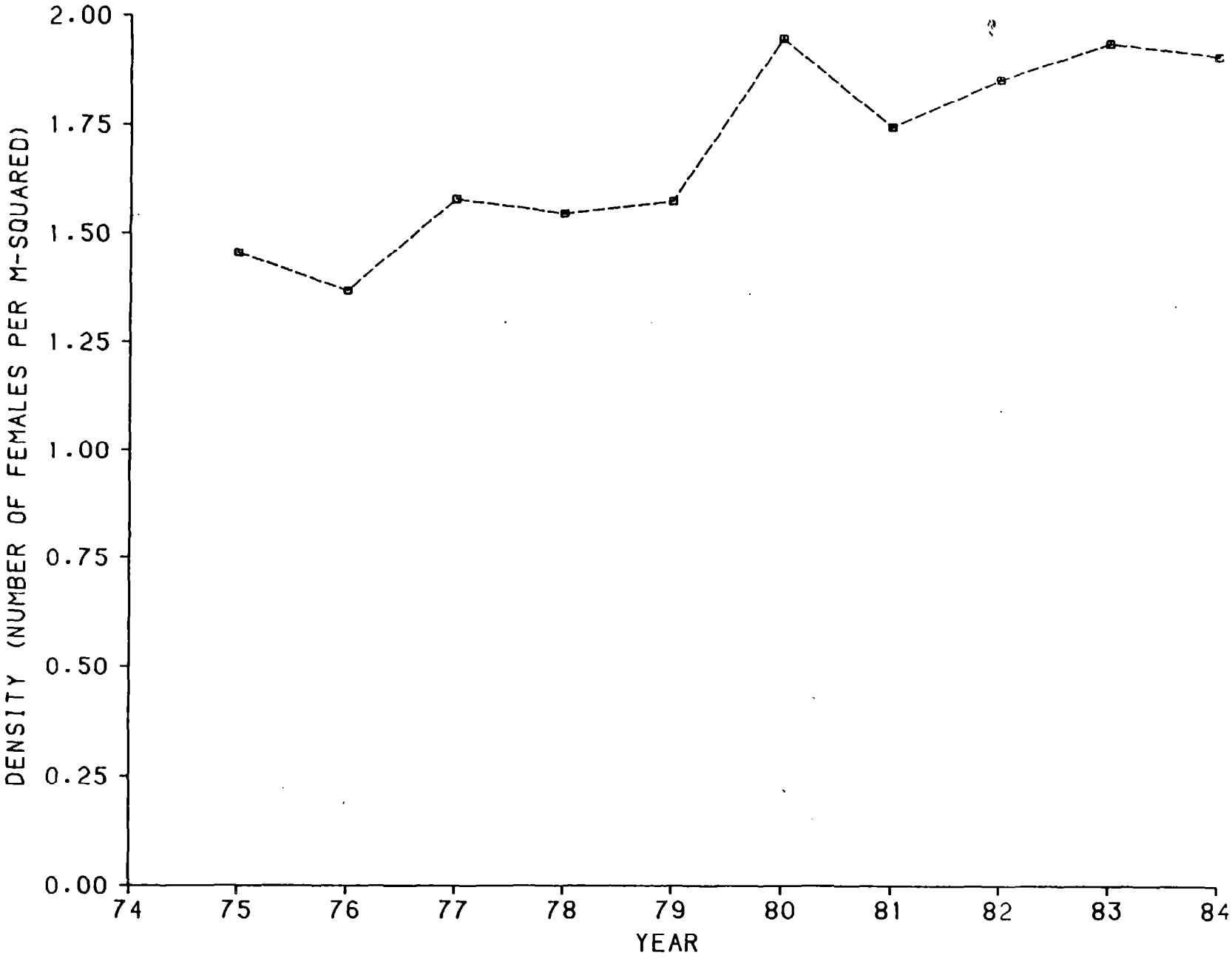

Figure 14.--Changes In the intragroup densities of adult female groups at East Reef rookery, St. George. Island, Alaska, over a lo-year period.

Table 24.--Differences in the abundance of northern fur seal female population at East Reef rookery, St. George Island, Alaska, in 1975 and 1984.

	1975		1984	
	Mean	S.D.	Mean	S.D.
Area occupied (m^2)	262.00	26.00	83.00	11.60
Number of females	379.00	38.40	156.00	7.10
Density (females/m^2)	1.46	0.16	1.91	0.30

S.D. = Standard deviation

years. This hypothesis can be tested by examining separately the densities of same size groups over the 10-year period. Females tend to avoid contact with males by forming groups with other females. If male avoidance was the only factor affecting female behavior, then we would have expected to see smaller numbers of large female groups form as the female numbers declined. Our observation that large numbers of small female groups were formed does fit the hypothesis that female density is balanced between breeding as close to preferred sites as possible (Gentry et al. 1980) and remaining within female groups.

The apparent increase in intragroup density may be an artifact. The two individual observers recorded single females differently, and may have judged group size differently. Furthermore, the size of small groups that do not cross grid lines is more difficult to estimate on maps than the size of large groups that cross several lines. Since the number of small groups increased and large groups decreased through the years, this bias may have been progressive. Similar changes in intragroup density will be examined using Zapadni data which were collected by at least seven different observers.

Density of female groups is an important issue in fur seal management. The assumption of density-dependent mortality underlay the abortive 1956-68 herd reduction program. Density has different meanings depending on the unit of area considered. As the herd size declines, density at sea declines, but because of the behavioral tendencies of individuals, density within groups on land during the breeding season does not decline and may even increase. The importance of this

difference for management 1s that density cannot be considered a unitary concept in searching for causes of mortality. Causes of mortality that are associated with social processes, such as death by trauma, communicable diseases, or stress from social interactions, may not vary directly with herd Size.

NORTHERN FUR SEAL SURVEY, BOGOSLOF ISLAND, ALASKA, AND PELAGIC INVESTIGATIONS, BERING SEA

by

Thomas R. Loughlin, George A. Antonelis, Jr.,

Michael Perez, and Robert v. Miller

The Bering Sea Task of the Pinniped program conducted researchon fur seals in three major catagories: pelagic collection of fur seals for diet information, assessment of the colony at Bogoslof Island, and radio-tracking of females to determine feeding locations. Results from the first two categories are presented below; results of radio-tracking studies are presented in the following chapter.

Feeding Habits Study

In the southeast Bering Sea the consumption of finfish by marine mammals has the potential impact of commercial fishing on marine mammal stocks and their prey, and the consumption of common food items by marine fish are issues to be considered during the development of fishery management plans. The primary objective of this study was to compare the species composition and relative abundance of fish found in northern fur seal stomachs and marine fish stomachs to the species composition and relative abundance of fish in the watercolumn.

Methods

The NOAA ship Miller Freeman was used as the investigative vessel from 4 August 1985 to 23 August 1985. Observations and collection activities occurred within 100 nautical miles (nmi) of the Pribilof Islands, Alaska.

Fur seals were collected in predetermined sampling areas where they were presumed to be feeding (Fig. 15). The date, time, location (latitude and longitude), water temperature, and water depth were recorded immediately after each seal was collected.

Fur seals taken at sea were returned to the ship for processing within 1 hour after collection. In addition to recording each animal's standard morphometric measurements and total weight, and after removing the digestive tract for food habit analysis, a variety of other samples were collected to maximize the amount of biological information collected. The canine teeth and reproductive organs were collected for the determination of age and reproductive status, respectively. Blood samples of 25 cc were taken for disease and reproductive hormone studies: pituitary glands were collected for the development of a reproductive hormone assay technique; and rectal swabs were placed in culture media for eventual screening for viral diseases.

Sampling for groundfish was done with an 83/112 eastern bottom trawl (with roller gear when needed); midwater fish were sampled with a Diamond midwater trawl and a Marinovich herring trawl. Fish sampling was done in areas which coincided with the collection or occurrence of fur seals. Nocturnal and evening fish sampling was conducted throughout most of the cruise; however, daytime fishingwas conducted at times when inclement weather conditions prohibited collection of fur seals. Tows were generally 30 minutes in duration, and trawling speed was approximately 3 nmi/hour. No tows were made until the seal collection party returned to the ship.

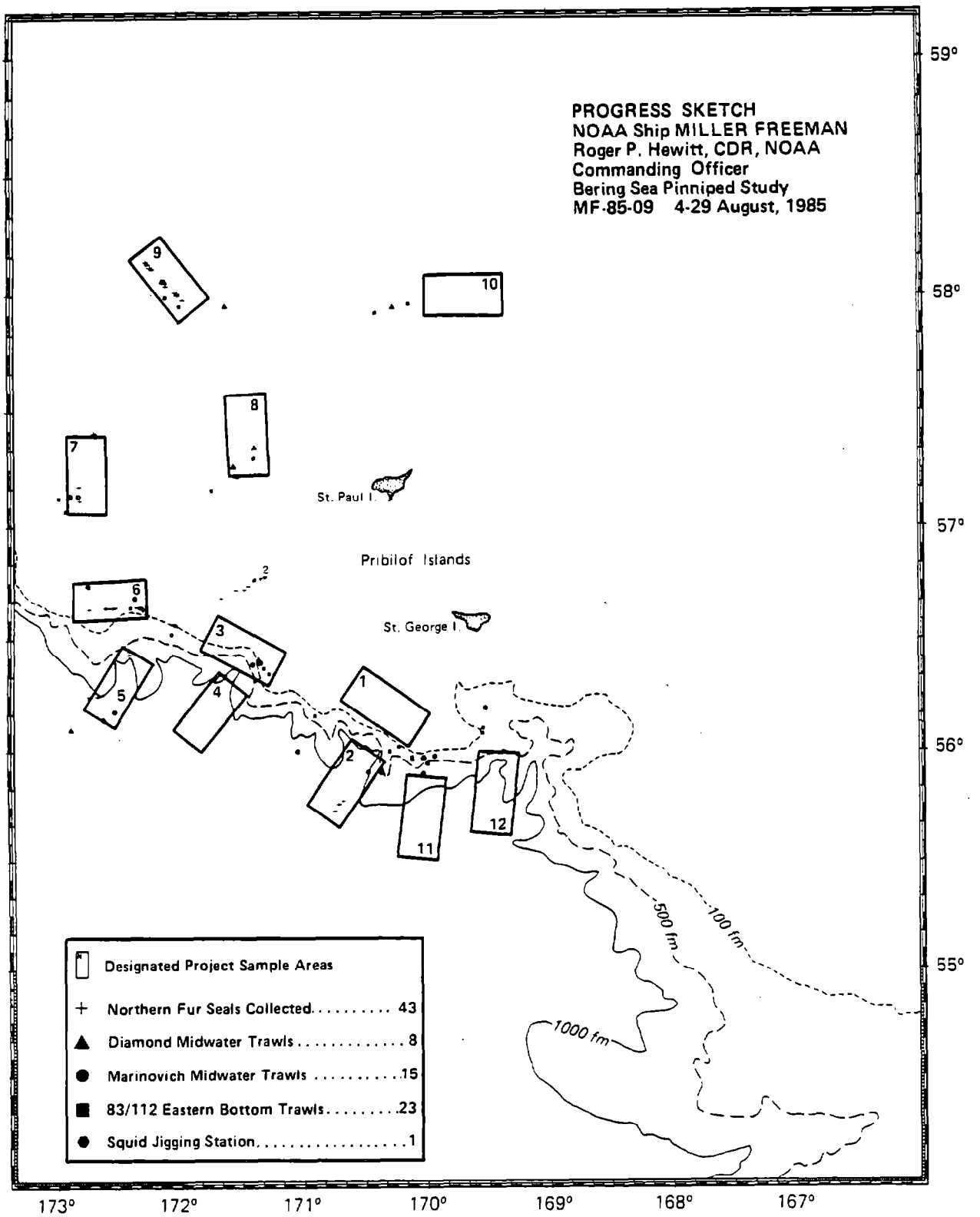

Figure 15.--collecction areas for northern fur seals used on the 1985 of the NOAA ship Miller Freeman.

Results

A total of 43 fur seals were collected in the waters adjacent to the Pribilof Islands from 6 to 15 August. The collection date, time, location, depth, and number are shown in Table 25.

A total of 23 midwater tows and 23 bottom tows were completed. Table 26 shows the total weight caught per species and the number of fish stomach samples collected by species. The total weight caught during the cruise was 36,403.4 lb and the total number of fish stomachs collected was 1,172. Selected whole fish and squid specimens were retainedand frozen for NMML energetic studies, fish otolith and squid beak collections, and virology studies.

Approximately 195 specimens were retained for energetic studies, 48 specimens for virology studies, and 284 specimens for the otolith examinations. The cephalopods and a subsample of the fish collected on this cruise will also be used for several other research projects at the NMML, including: 1) Northern fur seal energetics studies, which rely on fresh frozen specimens for the determination of caloric energy value of the prey: 2) An ongoing prey species identification program, which maintains a collection of fish otoliths and cephalopod beaks that are frequentlyused as a primary means of marine mammal prey identification. Otoliths and beaks are also used to estimate the size of a specific prey when a sufficient number of specimens are available; and 3) Studies of northern fur sealswhere selected fish species are examined as potential vectors of viral diseases.

Table 25.--Date, time, waterdepth, surface temperature, and location of northern fur seals (Callorhinus ursinus) collected during the research cruise of the NOAA ship Miller Freeman, 6-16 August 1985. A dash indicates no data.

Date (Aug.)	Time	Depth (m)	Temp. (°C)	Sample area[a]	Latitude	Longitude	Seal number
06	15:15	3073	9.9	2	55°43'	170°44'	1
06	15:38	3018	9.9	2	55°45'	170°43'	2
06	15:44	3000	10.3	2	55°45'	170°42'	3
06	16:11	2972	10.3	2	55°46'	170°41'	4
10	18:27	115	10.4	5	56°40'	171°39'	5
10	19:35	122	9.4	5	56°42'	171°32'	6
10	20:24	123	9.5	5	56°43'	171°28'	7
10	20:46	123	9.5	5	56°44'	171°26'	8
10	21:24	123	9.7	5	56°46'	171°20'	9
10	21:45	121	9.7	5	56°46'	171°18'	10
10	21:55	121	9.7	5	56°46'	171°17'	11, 12
12	08:41	1417	10.1	5	56°26'	172°23'	13
12	08:51	1555	10.1	5	56°25'	172°24'	14
12	09:21	2285	10.1	5	56°23'	172°27'	N/R[b]
12	11:04	2325	9.5	5	56°14'	172°39'	15
12	13:00	2560	-	5	56°14'	172°43'	16
12	19:30	136	10.6	6	56°37'	172°43'	17
12	20:30	142	10.6	6	56°38'	172°35'	18
12	20:49	142	12.6	6	56°38'	172°35'	19
12	21:06	150	12.6	6	56°38'	172°32'	20
12	21:18	163	12.6	6	56°38'	172°31'	21
12	21:26	165	11.4	6	56°38'	172°30'	22
12	22:19	159	11.4	6	56°38'	172°20'	23
12	22:30	166	11.3	6	56°37'	172°18'	24
12	22:44	154	11.3	6	56°38'	172°17'	25
12	22:53	159	11.3	6	56°37'	172°17'	26
13	09:04	121	10.3	7	57°06'	172°48'	27
13	09:44	119	10.3	7	57°10'	172°48'	28
13	11:46	119	-	7	57°18'	172°48'	N/R[b]
13	13:30	123	10.2	7	57°24'	172°41'	29
13	13:45	123	10.2	7	57°24'	172°41'	30
13	14:03	121	-	7	57°24'	172°39'	31
13	14:11	121	-	7	57°24'	172°39'	32
13	19:52	106	10.6	8	57°13'	171°31'	33
16	19:14	112	9.5	9	58°08'	172°15'	34
16	19:26	112	9.5	9	58°08'	172°15'	35
16	19:59	112	10.8	9	58°07'	172°13'	36
16	20.05	112	10.8	9	58°07'	172°12'	37
16	21:07	112	9.6	9	58°02'	172°05'	38
16	21:47	112	9.6	9	58°01'	172°01'	39

Table 25.-Continued.

Date (Aug.)	Time	Depth (m)	Temp. (°C)	Sample area[a]	Latitude	Longitude	Seal number
16	21:58	108	9.6	9	58°00'	172°00'	40
16	22:08	108	9.6	9	58°00'	172°00'	41
16	22:16	108	9.6	9	58°00'	172°00'	42
16	22:51	108	-	9	57°58'	172°57'	43

[a] See Figure 15.

[b] N/R = Seal taken, but not recovered from water.

Table 26.--Summary of catch weight (in pounds) and stomach collections by species. A dash indicates no data.

Species	Total weight (lb)	Number of fish stomachs
Pacific cod, Gadus macrocephalus	3,780.9	228
Flathead sole, Hippoglossoides elassodon	740.5	250
Arrowtooth flounder, Atheresthes stomias	1,695.0	209
Yellowfin sole, Limanda aspera	664.5	39
Greenland turbot, Reinhardtius hippoglossoides	123.5	4
Pacific halibut, Hippoglossus stenolepis	506.3	26
Sablefish, Anoplopoma fimbria	221.3	7
Walleye pollock, Theragra chalcogramma	20,994.0	409
Rockfish	1,808.5	-
Sculpins	700.1	-
Miscellaneous fish	2,847.6	-
Invertebrates	1,914.0	-
Crabs	407.2	-
Totals	36,403.4	1,172

Conclusion

Weather conditions did not limit fishing operations; however, the collection of seals was frequently limited by inclement weather. During thecruise, therewere only 33.5 hours of good weather for collecting seals. However, the data from the 43 fur seals collected should yield sufficient information to allow for characterization and historical comparison of fur seal diet. The completion of numerous secondary objectives, such as the assessment of the northern fur seal population on Bogoslof Island, the marine mammal survey in the waters adjacent to the Pribilof Islands, the collection of samples for specific biological studies on the northern fur seal, and the collection of fish and cephalopods for food habit and energetic studies, combine to produce data that will be useful in ongoing and future fur seal studies. Detailed reports on this research are being prepared.

Assessment of Fur Seals on Bogoslof Island

On 18 August, the NCAA ship Miller Freeman traveled to Bogoslof Island to conduct population studies. A field party consisting of six scientific personnel and three ship crew members larded on the island and counted a total of 112 northern fur seals. Most of the-animals were located in the rocky boulder area near the southeast corner of Kenyon Dome, while three to five adult males were located on the level grassy area to the east of the main concentration of animals. The sex and approximate age composition of the fur seals present on the island were as follows:

27 adult males (>5 years of age),

39 bachelor males (2-5 years of age),

37 females (at least 50% >6 years of age (white-whiskered)), and 9 pups of the year.

Eighty seals were herded out of the boulders and onto the adjacent grassy area for tagging. In addition to double-tagging as many fur seals as possible with blue Riese-tags, those animals that had lost tags from a previous tag application were retagged. A total of 16 females and 9 subadult males were tagged (Table 27), and the remaining 55 males were released because they were too large to safely restrain and tag.

Five previously tagged fur seals were observed (Table 28). Four (3 females and 1 male) were originally tagaged with blue Riese-tags on 11 August 1983 at Bogoslof Island. One female was originally tagged on the left foreflipper (silver Monel tag OM7719) on Medney Island, USSR, as a pup in 1976, and was subsequently tagged in the right foreflipper on Bogoslof Island in 1983 with a blue Riese-tag (2008). Since the blue Riese-tag was not attached during our observation of this animal, we attached another blue Riese-tag (2040) to the right foreflipper. Tag losses were also observed on two other females, and replacement blue Riese-tags were applied (Table 27).

All tags applied in 1983 and resighted on fur seals in 1985 had changed in color from blue to green. This was also true for a "blue" Riese-tag (2020) which was found in the grassy area near the tagging site.

Nine pups were counted in the boulder area; however, more may have been present but went undetected because of their location in caves under the rocky substrate. The pups were not tagged because they were in accessible in crevasses between boulders.

Other marine mammal sightings at Bogoslof Island included a pod of four killer whales (one large male and three relatively smaller individuals). The northern sea lions on the island were either near the shoreline (mostly mothers and pups) or in the water (not on rookery or haul-out areas), which made it impossible to estimate their numbers.

Table 27.-Northern fur seals double-tagged on Bogoslof Island, Alaska, 18 August 1985. A dash indicates no data.

Tag number[a]	Sex	Status[b]	Remarks
2040	F	WW	Right tag only; left tag, silver Monel OM719 - USSR
2041	M	B	
2042	F	-	
2043	F	-	
2044	F	WW	Left tag only; right tag blue-Riese 2009
2045	F	WW	Left tag only; right tag blue-Riese 2020
2046	F	-	
2047	M	B	
2048	F	-	
2049	F	-	
2050	F	-	
2051	F	-	
2052	M	B	
2053	F	-	
2054	M	B	
2055	F	-	
2056	F	B & WW	
2057	M	B	
2058	F	B & WW	
2059	M	B	
2060	F	B & WW	
2061	F	B & WW	
2062	M	B	
2063	M	B	
2064	M	B	
2065	M	B	

[a] Blue Riese-Tags.
[b] B = Bachelor.
WW = White whiskers.
B & WW = Black and white whiskers.

Table 28.-Northern fur seal tag resights on Bogoslof Island, Alaska, 18 August 1985.

Tag type	Tag number Left/Right	Sex	Island of tagging	Date of tagging	Age at time of tagging
Blue Riese	2001/2001	F	Bogoslof	11 Aug. 83	>6 years
Silver Monel	QM7719/Lost	F	Medney	1976	pup
Blue Riese	Lost/2009	F	Bogoslof	11 Aug. 83	>6 years
Blue Riese	2026/2026	F	Bogoslof	11 Aug. 83	>6 years
Blue Riese	2031/2031	M	Bogoslof	11 Aug. 83	2-5 years

RADIO-TRACKING STUDIES, ST. PAUL ISLAND, ALASKA

by

John L. Bengtson, Richard L. Merrick, and Thomas R. Loughlin

The northern fur seal population of the Pribilof Islands has been experiencing a decline of about 6.5% per year. The reasons for the decline are not specifically known, but entanglement in debris, changes in reproductive vital rates, competition with commercial fisheries for common fish resources, and other potential causes have been postulated. The objectives of this research project were to assess the interactionof commercial fisheries and female fur seals while at sea on feedingtrips and to determine the locations of feeding sites. It has already been established that fur seals consume food items similar to those taken in commercial fisheries. The next logical steps were to determine if fur seals feed in areas of commercial fishing activity (thus competing for the same resource spatially and temporally) and to assess the overlap in their feeding locations with areas of planned oil exploration.

The primary interest in 1985 was to determine the location of feeding activity and the general pattern of movements to and from the feeding location by female fur seals. Emphasis during 1984 was to provide a delineation of the movment patterns and other information concerning individual feeding trips, while in 1985 a more general overview of the distribution an feeding locations was emphasized.

Methods

Female northern fur seals from rookeries on St. Paul Islandwere capturedwith noose poles andplaced on a restraint board where they were flipper tagged and had radio transmitters attached to their heads. In 1984, 40 transmitters were attached (Loughlin and Bengtson 1986); 50 were attached in 1985. The transmitterswere frequency modulating (FM) blocking oscillators made by Cedar Creek; they were attached with Devcon-40 quick-drying epoxy resin. The animals were released into the rookery once the resin had hardened-a matter of only l0-15 minutes.

The females were monitored for their presence on or absence from the rookery using Esterline-Angus event recorders wired to frequency-scanning radioreceivers.

In 1985, we assessed the relative location of as many animals as possiblewhile at sea and located them from the air rather than from a ship as was done in 1984. A Piper Navajo twin-engine airplane, mounted with a two-element Yagi antennae on each side, was used. Flights originated from St. Paul Island, were flown at l00-120 knots and at an altitude of about 1,200 m, and totaled about 60 hours of flight time.

Results

In 1985, the distribution of animals was similar to that of 1984 and previous year in that the seals were principally located to the northwest and southwest of the Pribilofs (Fig. 15)--none were located northeast or southeast of the islands, even though there was effort to locate them there:

	1984	1985
Number of fur seals	40	50
Number located	11	17
% located	28	34
% located NW	64	63
% located SW	36	37
Max. dist. from St. Paul	100 nmi (185 km)	ca. 205 nmi (380 km)
Survey coverage	1,728 nmi (3,200 km)	65,000 nmi^2 (120,000 km^2)

It was learned that animals encountered at feeding locations my be from any of a number of different rookeries on St. Paul Island. During 1984, fur seals were tagged at Zapadni rookery only, which is on the south side of the island, yet individual animals were followed that were tagged again at Zapadni Reef and at Northeast Point rookeries. When they were located at sea, it was found that the animals from Zapadni Reef went to the south and north of the island and those from Northeast Point went principally to the north of St. Paul Island.

Discussion

This study demonstrated that there is a substantial overlap between areas of proposed gas and oil explorations and areas where fur seals feed. A geographical comparison of fur seal movements at sea and the location of fishing effort by trawl vessels in the Bering Sea in 1984 for all fisheries also shows substantial overlap. The trawl locations along the shelf edge and elsewhere are where fisheries concentrate on walleye pollock, Theragra chalcogramma Pacific cod, Gadus macrocephalus, and other ground fish important to the fur seal's diet.

POPULATION AND BEHAVIORAL STUDIES OF NORTHERN FUR SEALS SAN MIGUEL ISLAND, CALIFORNIA (ADAMS COVE AND CASTLE ROCK)

by

George A. Antonelis, Jr., Robert L. DeLong and Brent S. Stewart

Adams Cove

The 1985 field season in the Channel Islands of California extended from 11 June to 28 August. Research activities included population monitoring through daily censuses, a pug tagging program, and a female nursing and at-sea feeding cycle study.

Population Information

On 11 June there were 16 large adult males, 6 subadult males (bachelors), 16 adult females, and 7 live pups on the rookery. A total of 458 pups were born at the Adams Cove colony in 1985. Maximal counts of 28 large males, 13 small adults, and 54 bachelorswere recordedon 3 July, 19 June, and 23 June, respectively. The greatest number of adult females on land occurredon 1 July when 315 were counted. Population information for the Adams Cove colony is summarized in Table 29 for 1980-85.

Since pup production at Adams Cove has not yet reached the number recorded in 1982 (1,029), it appears that the 1983 El Nino event, which resulted in a 60% decline in pup production and a 48.0% decrease in counts of adult females, is having a long-term effect on the population. This decline may have also resulted from either a relocation of females to other areas (e.g., Pribilof Islands) or from an increased mortality among adult female population.

Table 29.-Summary of some observations of the northern fur seal colony in Adams Cove, San Miguel Island, California, 1980-85.

Observations	1980	1981	1982	1983	1984	1985
Season span[a]						
Beginning date	17 May	9 June	9 June	10 June	13 June	11 June
Ending date	23 Sept.	13 Sept.	6 Dec.	20 Aug.	4 Aug.	28 Aug.
First male	17 May[b]	9 June[c]	9 June[d]	10 June[e]	13 June[f]	11 June[g]
First female	23 May	9 June[c]	9 June[d]	10 June[e]	13 June[f]	11 June[g]
First birth	24 May	9 June[c]	9 June[d]	10 June[e]	13 June[f]	11 June[g]
Mean birth date	29 June	26 June	25 June[h]	2 July	25 June[h]	1 July
Median birth date	30 June	28 June	28 June	1 July	26 June	30 June
Total births	896	941	1,029	408	478	458
Total pup deaths	103	289	51	89	44	17
Total females (maximum counted & date)[i]	665	717	628	377	333	315
	31 Aug.	1 July	8 July	15 July	6 July	1 July
Total large adult males	9	10	30	31	26[j]	28[j]
Total small adult males	10	11	22[k]	30[k]	18[k]	13[k]
Total bachelors[l]	68	95	88	37	49	54

a Beginning and ending dates of continuous operations.
b Two adult males present 17 May--arrived prior to 17 May.
c Seven adult males, 86 females, and 24 pups present 9 June--arrived prior to 9 June.
d Seven adult males, 28 subadult males, 20 females, and 5 pups present.
e Five large adult males, 1 small adult male, 11 subadult males, 4 females, and 1 pup present 10 June--arrived prior to 10 June.
f Eleven large adult males, 8 small adult males, 15 subadult males, 101 females and 55 pups present 13 June--arrived prior to 13 June.
g Sixteen large adult males, 6 bachelors, 16 females and 7 pups present 11 June--arrived prior to 11 June.
h Estimated from previous breeding season information.
i A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
j Maximum single count.
k None of these males were territorial.
l Subadult males about 104-127 cm in body length, tip of nose to tip of tail.

To estimate the relative age structure of females in the population, the number of females with white facial vibrissae, mixed vibrissae, and black vibrissae were determined, since vibrissae color can be used as an indicator of age. For females, facial vibrissae are black at birth and remain black through age 3 years, became mixed (black and white) at ages 4 and 5 years, and by age 7 are usually entirely white.

Of 67 females examined at Adams Cove, 60 had white facial vibrissae and seven had mixed vibrissae. At Castle rock, we examined 45 females and found that 41 had white vibrissae and four had mixed vibrissae. In addition, another 22 mange-identified females were examined closely enough to determine that they all had white vibrissae. These data suggest that in 1985 the population at Castle Rock and Adams Cove was composed predominantly of older females (94.0% of all females observed were older than 6 years, based on vibrissae color) and that very few females younger than age 7 gave birth. These data differ from those reported for previous years (1970-73) when 10.0 to 35.0% of the females observed were younger than 7 years of age (based on vibrissae color ratios and known ages of tagged females, from DeLong 1982).

Foraging Characteristics of Northern Fur Seals and California Sea Lions

From 28 June to 15 August, scientists from the National Marine Mammal Laboratory and the Southwest Fisheries Center in La Jolla, California, conducted a study designed to compare the foraging strategies of northern fur seal and California sea lions, Zalophus californianus. The two species occur sympatrically during the summer breeding season on San Miguel Island where they utilize the sandy beaches of Adams Cove for rookery space.

Radio tags were attached with a guick-drying epoxy to the pelage on the heads of 25 parturient females of both species. The frequency of each transmitter was unique, allowing the activity patterns of individuals to be monitored regularly. All 50 frequencies were monitored at least four times daily to determine when each animal departed the rookery for the open seato feed and when each returned. The distribution of tagged animals at sea was determined by flying a series of transects to the northwest, west, and southwest of the island in an aircraft equipped with radio-tracking receivers and antennas.

Preliminary results from the study indicate that the two species differmarkedly in foraging strategy Feeding bouts for fur seals averaged from 3.8 to 8.4 days per trip. These animals were frequently found over the continental slope in water which averaged 520 fathoms (n - 18, SD = 332.6, range 20-1500). The average feeding bouts for sea lions averaged 1.7 to 2.8 days per trip. Individuals were often located over the continental shelf in water which averaged 205 fathoms (n = 15, SD = 215.7, range 40-850).

Tagging Program and Records

The 1985 field season resightings of fur seals that were tagged as pups in Adams Cove from 1980 to 1982 are shown in Appendix Table A-9. Tag resightings are also reported when dead or emaciated pups of the year are found on beaches or at sea. Most of the tag recoveries have been recorded north of Point Conception, California, and along the coasts of Oregon, Washington, and British Columbia. In 1985, the southernmost

resighting of a taggednorthern fur seal pup of the year (pink Roto-tag A531) was reported on the western coast of Baja California, 6 miles south of Ensenada, Mexico (31°45' N lat., 116°34'W long.).

In 1985, there were no sightings of fur seals in Adams Cove from other islands. The date of first resighting for 9 females tagged as adults in Adams Cove arepresented in Appendix Table A-10.

On 24 September, 100 fur seal pups were double-tagged with pink Roto-tags (hard plastic). In 1985, Roto-tags were used exclusively on pups because their numbers can be read at greater distances than those on monel tags. All tagged pups were checkmarked by removing the cartilaginous extension of the third digit on the left hind flipper (Appendix Table A-11). Twenty-one adult females were double-tagged with Yellow Riese-tags from 29 June through 7 July as part of the foraging study mentioned above (Appendix Table A-12).

Mortality on Land

The mortality of fur seal pups born in Adams Cove decreased from 9.0% (44) in 1984 to 3.7% (17) in 1985. Thirteen (76.0%) of these pups apparently died from heat prostration during a period of warm environmental conditionswhich occurred from 30 June to 8 July. High air and sand temperature, solar radiation, and low wind speed combine to raise a fur seal's body temperature and cause heat prostration. Two pups were stillborn and one pup apparently died of emaciation syndrome. The cause of death for the one pup was undetermined.

Castle Rock

In 1985, a count of 323 pups (312 live and 11 dead) was obtained on 4 August. This represents a decrease in pup production of 88 animals (21.0%) from 1984. A summary of census information for Castle Rock is presented in Table 27 for 1980-85.

On l July, 36 breeding males were counted on Castle Rock fromaerial photographs, representing an increaseof 3 breeding males from the 1984 count.

On 26 September, 100 fur seal pups were double-tagged with pink Rota-tags (hard plastic). All tagged pups were checked by removing the cartilaginous extension of the third digit on the left hind flipper (Appendix Table A-13).

On 4 August a tagged fur seal (pink Roto-tag C28) from the 1981 cohort was resighted on Castle Rock, the rookery of its birth.

Table 30.--Summary of numbers observed and date of observation during censuses of northern fur seals, Castle Rock, California, 1980-85.

Observations	Year					
	1980	1981	1982	1983	1984	1985
Females	563(+)[a] 1 Aug	597(+)[a] 27 July	680(+)[a] 31 July	245(+)[a] 3 Aug.	411[a] 8 Aug.	323[a] 4 Aug.
Pups (total observed)[b]	563[c] 1 Aug.	597[c] 27 July	680[c] 31 July	227[c] 3 Aug.	411[c] 8 Aug.	323[c] 4 Aug.
Pups (dead observed)	38[c] 1 Aug.	29[c] 27 July	34[c] 31 July	18[c] 3 Aug.	32[c] 8 Aug.	11[c] 4 Aug.
Reproductive large adult males[d]	27[e] 1 July	28[e] 2 July	27[e] 2 July	20[e] 1 July	33[e] 1 July	36[e] 1 July
Total large adult males	32[e] 1 July	29[e] 2 July	38[e] 2 July	40[e] 1 July	43[e] 1 July	43[e] 1 July
Total small adult males	2[e] 1 July	12[e] 2 July	7[e] 2 July	13[e] 1 July	3[e] 1 July	1[e] 1 July

a Minimum estimate from pup count.
b Includes dead pup count.
c Land-based counts from afoot.
d Territorial adult males with females.
e Counts were obtained through aerial photographs.

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GLOSSARY

The following terms used in fur seal research and management on the Pribilof Islands, Bogoslof Island, San Miguel Island, and Castle Rock have special meanings or are not readily found in standard dictionaries:

Bachelor-Young male seal of age 2-5 years.

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

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

Escapement-Seals that were not commercially harvested because they were too old, too large, or not available.

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

Haul out-The act of sealsmoving from the sea to a rookery or hauling ground on shore.

Kleptogyny--The act of an adult male seal (primarily classes 1, 2, or 3)seizing an adult female from another male's territory.

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

Marked--Describes a seal that has been marked by removing the cartilaginous tip of a digit from a hind flipper; attaching an inscribed metal or plastic tag to one or more of its flippers, freeze marking, hair-clipping, or bleaching.

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

Rookery-An area on which breeding seals congregate. See Hauling ground

Vibrissae (facial whiskers)--To determine the relative age structure of females in a population, the color of their facial whiskers are used. Facial vibrissae are black at birth and remain black through age 3 years; become mixed (black and white) at ages 4 and 5 years; and by age 7, the vibrissae usually are entirely white.

Classifications of adult male fur seals

Class 1 (shoreline)-Full-grownmales apparently attached to "territories" spaced along the water's edge at intervals of l0-15 m. Most of these animals are wet or partly wet, and some acquire harems of one to four females between 10 and 20 July. They would then be called harem males (Class 3). Class l males should not be confused with Class 2 animals. The latter definitely have territories, whereas the shoreline males appear to be attached to such sites but may not be in all cases.

Class 2 (territorial without females) --Full-grown males that have no females, but are actively defending territories. Most of these animals are located on the inland fringe of a rookery, same are etween Class 1 (Shoreline) and Class 3 (Territorial with females) males, and a few are completely surrounded by Class 3 males and their harems.

Class 3 (territorial with females) --full-grown males actively defending territories and females. Most Class 3 males and their harems combine to form a compact mass of animals. Isolated

individuals, usually with small harems, may be observed at each end of a rookery, on sandy beaches, and in corridors leading to inland hauling grounds. Some territorial males have as few as one or two females. Should these females be absent during the counts, their pups are used as a basis for putting the adult male in to class 3 rather than Class 2.

Class 4 (back fringe)--Full-and partly-grown males on the inland fringe of a rookery. A few animals too young and too small to include in the count maybe foundhere. Though some Class 4 males may appear to be holding territories, most will flee when approached or when prodded with a pole.

Class 5 (hauling ground)--The hauling grounds contain males from May to late July and a mixture of males and females from then on. The counts include males that obviously are adults and all others that have a mane and the body coformation of an adult. Males included in this count are approximately 7 years of age and older.

Prior to 1966, Class 3 males were called harm bulls, and Classes 1, 2, 4, and 5 were collectively called idle bulls. From 1966 through 1974, the adult male seals were classified into five groups (Classes 1, 2, 3, 4, and 5). Beginning in 1975, Classes 1 and 2 were combined and designated as Class 2, Class 3 remained the same, and Classes 4 and 5 were combined and designated as Class 5.

Table 31 lists English translations of Russian names given to some of the rookeries or hauling grounds by Russian fur hunters in late 1700s.

Table 31.--English translations of Russian names for Pribilof Island rookeries and hauling grounds.

Island and Russian name	English translation	Comments and derivation of name
St. Paul Island		
Vostochni	---	From "Novoctoshni" meaning "place of recent growth"; applied to Northeast Point which was apparently at one time an island that has since been connected to St. Paul Island by drifting sand.
Morjovi	Walrus	Historically, walruses hauled out here in summer.
Polovina	Halfway	Halfway to Northeast Point from the village.
Kitovi	Of "kit" or whale	When whaling fleets were active in the Bering Sea between 1849 and 1856, a large right whale killed by some ship's crew drifted ashore here.
Gorbatch	Humpback	Apparently refers to the "hump like" nature of the scoria slope above the rookery.
Tolstoi	Thick	In this case, thick headland on which the rookery is located.
Zapadni	West	Western part of the island.
Lukanin	---	So named after a Russian pioneer sailor who was said to have taken over 5,000 sea otters from St. Paul Island in 1787.
Zoltoi (hauling ground)	Golden	So named to express the metallic shimmering of the sands.
St. George Island		
Staraya Artil	---	Old settlement or village. There was once a settlement or village adjacent to the rookery.
Sea Lion Rock		
Sivutch	Sea lion	These animals haul out but do not breed here.

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APPENDIX A

Tabulations of northern fur seal data collected on the Pribilof Islands, Alaska, and on San Miguel Island and nearby Castle Rock, California, in 1985.

APPENDIX A (Continued)

Table A-1.--Daily aye classification of male northern fur seals taken in the subsistence harvest on St. Paul Island, Alaska, 17 July to 6 August 1985.

Date	Rookery*	Males harvested	Tooth sample	Percent in each age group of sample				Estimated number harvested by age group			
				2	3	4	5	2	3	4	5
July 17	NEP (e)	200	50	2.0	86.0	12.0	0.0	4	172	24	0
18	POL	200	41	2.5	82.9	14.6	0.0	5	166	29	0
19	L.ZAP	197	50	10.0	72.0	18.0	0.0	20	142	35	0
22	ZAP	149	31	0.0	87.1	12.9	0.0	0	130	19	0
22	L.ZAP	54	11	0.0	63.6	36.4	0.0	0	34	20	0
23	REEF	500	97	0.0	86.6	13.4	0.0	0	433	67	0
24	NEP(e)	116	25	0.0	64.0	36.0	0.0	0	74	42	0
24	NEP (w)	85	18	0.0	94.4	5.6	0.0	0	80	5	0
25	L-K	199	49	4.1	85.7	10.2	0.0	8	171	20	0
26	TOL	200	37	8.1	73.0	18.9	0.0	16	146	38	0
29	ZAP	200	49	8.2	79.6	12.2	0.0	16	159	25	0
30	REEF	199	49	20.4	73.5	6.1	0.0	41	146	12	0
31	NEP (w)	202	41	4.9	82.9	12.2	0.0	10	167	25	0
Aug. 1	POL	225	50	10.0	82.0	8.0	0.0	22	185	18	0
2	TOL	215	36	13.9	61.1	25.0	0.0	30	131	54	0
5	ZAP	188	46	4.4	71.7	21.7	2.2	8	135	41	4
5	L.ZAP	50	13	38.5	61.5	0.0	0.0	19	31	0	0
6	ZOL	200	46	17.4	71.7	10.9	0.0	35	143	22	0

* NEP (e) = East side of Northeast Point (Morjovi)
NEP (w) = West side of Northeast Point (Vostochni)
TOL = Tolstoi
POL = Polovina
ZAP = Zapadni
REEF = Reef and Gorbatch
L-K = Lukanin and Kitovi
L.ZAP = Little Zapadni
ZOL = Zoltoi Sands

Table A-2.--Cumulative age classification of male northern fur seals taken in the subsistence harvest on St. Paul Island, Alaska, 17 July to 6 August 1985.

Date	Rookery*	Estimated number harvested by age group				Total harvest to date	Percent harvested by age group			
		2	3	4	5		2	3	4	5
July 17	NEP (e)	4	172	24	0	200	2	86	12	0
18	POL	9	338	53	0	400	2	85	13	0
19	L.ZAP	29	480	88	0	597	5	80	15	0
22	ZAP	29	610	107	0	746	4	82	14	0
22	L.ZAP	29	644	127	0	800	4	80	16	0
23	REEF	29	1,077	194	0	1,300	2	83	15	0
24	NEP (e)	29	1,151	236	0	1,416	2	81	17	0
24	NEP (w)	29	1,231	241	0	1,501	2	82	16	0
25	L-K	37	1,402	261	0	1,700	2	83	15	0
26	TOL	53	1,548	299	0	1,900	3	81	16	0
29	ZAP	69	1,707	324	0	2,100	3	81	16	0
30	REEF	110	1,853	336	0	2,299	5	80	15	0
31	NEP (w)	120	2,020	361	0	2,501	5	81	14	0
Aug. 1	POL	142	2,205	379	0	2,726	5	81	14	0
2	TOL	172	2,336	433	0	2,941	6	79	15	0
5	ZAP	180	2,471	474	4	3,129	6	79	15	0
5	L.ZAP	199	2,502	474	4	3,179	6	79	15	0
6	ZOL	234	2,645	496	4	3,379	7	78	15	0

* NEP (e) = East side of Northeast Point (Morjovi)
NEP (w) = West side of Northeast Point (Vostochni)
TOL = Tolstoi
POL = Polovina
ZAP = Zapadni
REEF = Reef and Gorbatch
L-K = Lukanin and Kitovi
L.ZAP = Little Zapadni
ZOL = Zoltoi Sands

Table A-3.--Number of adult male northern fur seals counted, by class[a] and rookery section, St. Paul Island, Alaska, 10-21 July 1985. A dash indicates no numbered sections.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Lukanin															
2	10	10	-	-	-	-	-	-	-	-	-	-	-	-	20
3	57	49	-	-	-	-	-	-	-	-	-	-	-	-	106
5	49	9	-	-	-	-	-	-	-	-	-	-	-	-	58
Kitovi[b]															
2	9(7)	2	13	11	8	-	-	-	-	-	-	-	-	-	50
3	47(18)	18	57	62	59	-	-	-	-	-	-	-	-	-	261
5	0(0)	3	0	2	63	-	-	-	-	-	-	-	-	-	68
Reef															
2	5	14	13	5	5	4	7	4	2	5	3	-	-	-	67
3	46	73	63	42	45	46	28	52	42	29	8	-	-	-	474
5	5	1	0	0	127	0	186	66	4	13	9	-	-	-	411
Gorbatch															
2	11	15	4	4	2	9	-	-	-	-	-	-	-	-	45
3	97	59	51	18	34	61	-	-	-	-	-	-	-	-	320
5	57	2	0	106	0	3	-	-	-	-	-	-	-	-	168
Araiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Morjovi[c]															
2	10(6)	16	6	16	8	15	-	-	-	-	-	-	-	-	77
3	40(25)	46	40	67	56	51	-	-	-	-	-	-	-	-	325
5	84(4)	0	16	3	13	0	-	-	-	-	-	-	-	-	120
Vostochni[d]															
2	10	7	13	11	-	53	16	19	20	5	11	14	26	6	211
3	43	20	40	34	-	97	54	67	49	22	40	60	111	67	704
5	61	0	0	24	-	96	0	0	30	0	0	48	43	22	324
Little Polovina															
2	5	4	-	-	-	-	-	-	-	-	-	-	-	-	9
3	22	14	-	-	-	-	-	-	-	-	-	-	-	-	36
5	52	9	-	-	-	-	-	-	-	-	-	-	-	-	61
Polovina															
2	12	8	-	-	-	-	-	-	-	-	-	-	-	-	20
3	49	22	-	-	-	-	-	-	-	-	-	-	-	-	71
5	200	24	-	-	-	-	-	-	-	-	-	-	-	-	224
Polovina Cliffs															
2	12	6	7	14	19	33	24	-	-	-	-	-	-	-	115
3	30	29	34	56	53	64	110	-	-	-	-	-	-	-	376
5	0	0	0	0	0	0	7	-	-	-	-	-	-	-	7
Tolstoi															
2	16	5	14	1	13	12	21	41	-	-	-	-	-	-	123
3	61	49	92	47	84	98	88	86	-	-	-	-	-	-	605
5	0	0	0	0	0	0	0	237	-	-	-	-	-	-	237
Zapadni Reef															
2	6	23	-	-	-	-	-	-	-	-	-	-	-	-	29
3	36	103	-	-	-	-	-	-	-	-	-	-	-	-	139
5	38	24	-	-	-	-	-	-	-	-	-	-	-	-	62
Little Zapadni															
2	5	11	20	24	9	28	-	-	-	-	-	-	-	-	97
3	15	33	72	99	47	100	-	-	-	-	-	-	-	-	366
5	3	0	0	10	0	86	-	-	-	-	-	-	-	-	99
Zapadni[e]															
2	17(0)	27	26	23	35	41	29	7	-	-	-	-	-	-	205
3	59(0)	89	67	105	71	70	76	10	-	-	-	-	-	-	547
5	0(87)	22	12	9	164	0	11	149	-	-	-	-	-	-	454

[a] See glossary for a description of the classes of adult male seals.
[b] Numbers in parentheses are the adult males counted in Kitovi Amphitheater.
[c] Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.
[d] Section 6 includes adult males counted in section 5.
[e] Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-4.--Number of adult male northern fur seals counted, by rookery, Pribilof Islands, Alaska, July 1985.

Island and rookery	Date (July)	Class of adult male* 2	3	5	Total
St. Paul Island					
Lukanin	13	20	106	58	184
Kitovi	13	50	261	68	379
Reef	19	67	474	411	952
Gorbatch	19	45	320	168	533
Ardiguen	19	2	42	0	44
Morjovi	15	77	325	120	522
Vostochni	15	211	704	324	1,239
Little Polovina	10	9	36	61	106
Polovina	10	20	71	224	315
Polovina Cliffs	10	115	376	7	498
Tolstoi	19	123	605	237	965
Zapadni Reef	21	29	139	62	230
Little Zapadni	13	97	366	99	562
Zapadni	11	205	547	454	1,206
Island total		1,070	4,372	2,293	7,735
St. George Island					
Zapadni	17	42	79	155	275
South	17	82	217	70	369
North	19	231	531	287	1,049
East Reef	18	44	99	57	200
East Cliffs	17, 19	118	255	291	664
Staraya Artil	17	114	105	111	330
Island total		630	1,286	971	2,887

* See glossary for a description of the classes of adult male seals.

Table A-5.--Number of harem and idle male northern fur seals counted in mid-July, Pribilof Islands, Alaska, 1976-85. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Harem	Idle	Harem	Idle	Harem	Idle
1976	5,324	4,041	1,093	996	6,417	5,037
1977	6,457	3,845	1,610	899	8,067	4,744
1978	6,496	3,908	1,590	1,220	8,086	5,128
1979	6,242	4,457	1,716	1,942	7,958	6,399
1980	5,490	4,248	1,563	1,795	7,053	6,043
1981	5,120	4,003	1,472	1,646	6,592	5,649
1982	5,767	4,009	1,410	1,319	7,177	5,328
1983	4,827	4,242	-	-	4,827	4,242
1984	4,803	3,977	1,473	1,452	6,276	5,429
1985	4,372	3,363	1,286	1,601	5,658	4,964

Table A-6.--Number of dead northern fur seal pups counted, by rookery section, Priblof islands, Alaska, 1985. A dash indicates no data.

Island and rookery	Date	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
St. Paul Island																
Morjovi	9/5	74[a]	38	71	17	26	21	-	-	-	-	-	-	-	-	247
Vostochni	8/23	16	40	32	17	121	56	37	17	5	20	7	23	149	64	604
Little Polovina	8/28	22	7	-	-	-	-	-	-	-	-	-	-	-	-	29
Polovina Cliffs	8/28	12	26	40	48	95	99	47	-	-	-	-	-	-	-	367
Polovina	8/22	27	29	-	-	-	-	-	-	-	-	-	-	-	-	56
Aralguen[b]	8/22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Gorbatch	8/22	90	96	87	20	35	43	-	-	-	-	-	-	-	-	371
Reef	8/22	32	94	108	79	76	48	143	29	7	5	3	-	-	-	624
Kitovi	8/28	43[c]	10	55	65	38	-	-	-	-	-	-	-	-	-	211
Lukanin	8/22	85	64	-	-	-	-	-	-	-	-	-	-	-	-	149
Tolstoi	9/4	83[d]	-	123	71	170[e]	-	204	268	-	-	-	-	-	-	919
Little Zapadni	9/4	12	56	125	162	96	34	-	-	-	-	-	-	-	-	485
Zapadni Reef	9/4	38	159	-	-	-	-	-	-	-	-	-	-	-	-	197
Zapadni	9/3	65	145	147	245	119	138	127	15	-	-	-	-	-	-	1,001
															Total	5,266

Table A-6.--Continued.

Island and rookery	Date	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
St. George Island																
North	8/16	41	68	34	87	23	64	-	-	-	-	-	-	-	-	317
Zapadni[f]	8/16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	134
South	8/16	5	24	999	-	-	-	-	-	-	-	-	-	-	-	128
East Reef[b]	8/16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
East Cliffs	8/16	60	46	-	-	-	-	-	-	-	-	-	-	-	-	106
Staraya Artil	8/16	57	42	-	-	-	-	-	-	-	-	-	-	-	-	99
															Total	806
															Grand total	6,072

[a] Includes 3 dead pups counted on second point south of Sea Lion Neck.
[b] No numbered sections.
[c] Includes 9 dead pups counted in Kitovi Amphitheater.
[d] Includes dead pups coutned in section 2.
[e] Includes dead pups counted in section 6.
[f] Dead pups were not counted by rookery section.
[g] Includes dead pups counted in section 4.

Table A-7.--Number of dead northern fur seal pups counted, by rookery, Pribilof Islands. 1976-85[a]. A dash indicates no data.

Island and rookery	Year									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
St. Paul Island										
Morjovi	1,829	870	606	269	508	346	348	274	336	247
Vostochni	3,826	2,021	1,041	573	932	889	837	747	973	604
Little Polovina	316	103	90	28	77	41	49	46	14	29
Polovina Cliffs	1,862	733	761	433	627	463	570	438	397	367
Polovina	378	160	151	85	127	89	97	79	75	56
Ardiguen	212	112	15	31	76	38	49	33	46	6
Gorbatch	1,341	860	475	260	699	379	399	414	522	371
Reef	2,055	1,233	593	651	790	623	654	649	411	624
Kitovi	846	331	203	171	256	187	269	223	142	211
Lukanin	385	250	197	132	206	102	139	171	104	149
Tolstoi	4,241	3,291	1,488	1,645	1,488	1,547	1,332	1,178	1,407	919
Little Zapadni	1,977	1,133	674	637	645	377	779	562	580	485
Zapadni Reef	638	427	129	161	243	266	276	258	301	197
Zapadni	3,770	2,559	1,650	1,368	1,185	1,451	1,503	925	807	1,001
Counted total	23,676	14,083	8,073	6,444	7,859	6,798	7,301	5,997	6,115	5,266
Estimated oversight 5%[b]	1,184	704	404	322	393	340	365	300	306	263
Total	24,860	14,787	8,477	6,766	8,252	7,138	7,666	6,297	6,421	5,529
St. George Island										
North	791	408	1,068	774	949	810	649	367	-	317
Zapadni	373	92	179	277	350	186	190	124	-	134
South	280	98	225	186	197	177	110	111	-	128
East Reef	37	60	164	104	121	74	56	25	-	22
East Cliffs	354	140	292	285	284	402	340	128	-	106
Staraya Artil	454	410	590	565	484	376	315	148	-	99
Counted total	2,289	1,208	2,518	2,191	2,385	2,025	1,660	903	-	806
Estimated oversight 5%[b]	114	60	126	110	119	101	83	45	-	40
Total	2,403	1,268	2,644	2,301	2,504	2,126	1,743	948	-	846

Table A-7.--Continued.

Island and rookery	Year									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Pribilof Islands counted total	25,965	15,291	10,591	8,635	10,244	8,823	8,961	6,900	6,115	6,072
Estimated oversight 5%[b]	1,298	764	530	432	512	441	448	345	306	303
Total	27,263	16,055	11,121	9,067	10,756	9,264	9,409	7,245	6,421	6,375

[a] Dead pups are counted after 15 August each year; most mortality has occurred by that date.

[b] As established by a survey conducted in 1960: C. E. Abegglen, A. Y. Roppel, and F. Wilke. 1960. Alaska fur seal investigations, Pribilof Islands, Alaska. Unpubl. manuscr., 165 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

Table A-8.--Sightings of northern fur seals with Soviet tags, St. Paul and Bogoslof Islands, Alaska, 1985. A dash indicates no data.

Date of sighting	Tag number	Sex	Island	Island of tagging*	Rookery of sighting	Age	Comments
July	HB 3295	F	St. Paul	B	Kitovi	13	
July	HB 7716	F	St. Paul	B	Polovina	13	
July	HB 7725	-	St. Paul	B	Northeast Point	13	
August	HM 7915	F	St. Paul	M	Zapadni Reef	13	
August	OB 6896	F	St. Paul	B	Gorbatch	9	
August	OM 7719	F	Bogoslof	M	-	9	
August	XM 4825	F	St. Paul	M	Polovina Cliffs	7	
July	XM 9453	F	St. Paul	M	Zapadni Reef	7	
July	YM 586	F	St. Paul	M	Kitovi	6	
July	YM 2269	-	St. Paul	M	Tolstoi	4	
August	YM 2332	-	St. Paul	M	Northeast Point	4	
October	YM 3018	F	St. Paul	M	Reef	4	Entangled in fishing debris
July	bA 642	F	St. Paul	B	Polovina	3	
August	bA 825	-	St. Paul	B	Reef	3	
August	bA 1129	-	St. Paul	B	Tolstoi	3	
July	MA 2990	-	St. Paul	M	Northeast Point	3	Taken in subsistence harvest
August	TM 8237	-	St. Paul	M	Polovina	3	
July	TM 9373	-	St. Paul	M	Little Zapadni	3	Taken in subsistence harvest
August	TM 9508	-	St. Paul	M	Zapadni	3	
July	TM 9809	-	St. Paul	M	Lukanin	3	
August	TM 9925	-	St. Paul	M	Little Zapadni	3	
July	MC 2049	-	St. Paul	M	Zapadni	2	

* M = Medney;
B = Bering.

Table A-9. --Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, and the dates first observed at Adams Cove in 1985.

Tag number/color[a]		Sex	Year tagged	Date of first resighting
Left flipper	Right flipper			
441 Pink	NTR	M	1980	25 June
475 Pink	475 Pink	F[b]	"	20 July
481 Pink	NTR	M	"	3 August
NSL	488 Pink	F[b]	"	9 July
485 Pink	NSR	F[b]	"	1 August
651 Pink	651 Pink	M	"	23 June
SMI 2124 Monel	NSR	M	"	19 June
NTR	SMI 2160 Monel	M	1981	19 June
A1 Pink	NSR	F	"	26 July
A2 Pink	A2 Pink	M	"	19 June
NSL	A7 Pink	M	"	27 June
A19 Pink	NSR	F	"	25 July
A44 Pink	A44 Pink	F	"	25 July
A52 Pink	NSR	F	"	25 July
NSL	A67 Pink	M	"	19 June
A82 Pink	A82 Pink	M	"	23 June
Pink	A90 Pink	M	"	11 June
A55 Green	NSR	F	"	25 July
A158 Pink	NSR	M	1982	3 August

[a] NSR or NSL = Right (R) or Left (L) flipper not visible; presence or absence of tag not confirmed.

NTR or NTL = Right (R) or Left (L) flipper was observed and no tag was present.

[b] Known to be parturient.

Table A-10.--Northern fur seal females double-tagged with white Roto-tags in Adams Cove, San Miguel Island. California, on 18 November 1979. and dates first resighted, 1980-85. A dash indicates no data.

Tag number[a]			Date resighted[b]					
Right flipper	Left flipper	Vibrissae color[c]	1980	1981	1982	1983	1984	1985
401	402	white	23 July*	6 July*	-	-	-	-
404	403	mixed	10 Aug.*	5 July*	19 Nov.	-	-	-
405	406	white	5 July*	5 July	3 Nov.*	-	-	-
407	408	white (tag lost, right side)	-	-	-	-	-	-
410	409	white	1 July*	18 June	17 Sept.	-	-	25 June
411	412	white	6 July**	-	18 Oct.*	-	-	-
413	414	mixed	5 July	15 July	1 Sept.	-	-	18 July*
416	415	white	21 June**	11 July	17 June*	-	-	-
417	419	white	5 July*	23 July*	29 Sept.	-	-	25 June*
420	421	white	4 July	9 July	4 Nov.*	-	-	23 June
422	423	white	18 July*	15 July	2 Sept.	15 July	14 July	-
424	425	white	15 Aug.	19 July	3 Sept.	-	-	-
426	427	white	27 June*	6 July*	11 July*	19 June	14 July	5 July*
428	430	white	21 June*	6 July*	29 June*	-	-	25 June
431	432	white	29 July	12 Aug.	10 Sept.*	-	-	-
433	434	white	29 July	13 Aug.*	17 July	-	-	-
435	437	white	2 June	18 June	-	-	-	25 June*
438	439	white	5 July	20 June	2 Sept.	-	-	-
440	441	white	5 July*	15 July	2 Oct.	-	-	19 July*
442	443	mixed	18 June*	23 July	22 Aug.*	-	-	-
445	444	mixed	23 July**	-	22 Aug.	-	-	-
447	446	white	6 Sept.	29 June**	9 Sept.*	-	-	-
448	449	white	16 Aug.[d]			-	-	-
450	451	white	28 June*	24 June	23 June*	-	13 July	23 June

Table A-IO.--Continued.

Tag number[a]			Date resighted[b]					
Right flipper	Left flipper	Vibrissae color[c]	1980	1981	1982	1983	1984	1985
452	453	white	-	-	-	-	-	-
454	455	white	-	-	-	-	-	-
456	457	white	-	-	25 July*	-	-	-
458	459	white	21 June	23 Sept.[e]	-	23 July	-	-
460	461	white	13 Aug.*	-	-	-	-	-

a Tags destroyed: 418, 429 and 436.
b Symbol "*" indicates the female was known parturient that year and "**" indicates the pup was stillborn or died shortly after birth.
c Mixed = combination of black and white. See glossary for a description of vibrissae color.
d Died due to cliff collapse, right-side tag lost.
e Resighted on Castle Rock.

Table A-11.--One hundred northern fur seal pups double-tagged with pink Roto-tags in Adams Cove, San Miguel Island, California, on 24 September 1985. All animals were checkmarked by removal of the cartilaginous extension of the third digit on the left hind flipper. A dash indicates no data.

Tag number	Sex	Weight (kg)	Remarks
A-501	M	14.5	-
502	M	13.0	-
503	M	10.5	-
504	F	10.7	-
505	M	14.7	-
506	M	12.2	-
507	F	10.7	-
508	F	10.5	-
509	F	9.2	-
510	F	11.2	-
511	F	10.7	-
512	M	13.0	-
513	M	12.4	-
514	M	11.5	-
515	M	9.2	-
516	F	10.2	-
517	M	15.7	-
518	M	13.5	-
519	F	13.2	-
520	M	11.2	-
521	M	15.7	-
522	M	12.2	-
523	M	11.5	-
524	M	11.5	-
525	M	12.0	-
526	M	14.5	-
527	F	10.7	-
528	M	12.7	-
529	M	12.7	-
530	F	9.0	-
531	M	12.0	-
532	M	11.2	-
533	F	11.0	-
534	M	12.0	-
535	F	10.5	-
536	F	12.0	-
537	M	12.0	-
538	M	11.2	-
539	M	10.5	-
540	M	11.0	-
541	F	7.7	-
542	M	10.7	-

Table A-11 **.--Continued.**

Tag number	Sex	Weight (kg)	Remarks
A-543	F	8.5	-
544	F	11.5	-
545	M	14.2	-
546	M	11.7	-
547	M	11.7	-
548	M	16.5	-
549	F	11.5	-
550	F	10.5	-
551	M	10.5	-
552	M	12.5	-
553	F	9.0	-
554	F	11.0	-
555	M	0.0	-
556	M	11.0	-
557	M	13.5	-
558	F	11.5	-
559	M	13.5	-
560	F	12.0	-
561	F	9.0	-
562	M	11.0	-
563	F	11.2	-
564	F	8.7	-
565	F	11.0	-
566	F	10.7	-
567	F	9.7	-
568	M	12.0	-
569	F	10.5	-
570	M	13.5	-
571	M	11.7	Vesicles on fore-flippers
572	M	10.5	-
573	M	16.5	-
574	F	8.2	-
575	F	10.7	-
576	M	17.0	-
577	M	7.2	-
578	M	11.2	-
579	F	14.5	-
580	M	14.0	-
581	F	12.5	-
582	M	12.5	-
583	F	12.5	-
584	M	12.0	-
585	M	10.0	-

Table A-11.--Continued.

Tag number	Sex	Weight (kg)	Remarks
586	M	11.7	-
587	F	10.0	-
588	M	9.5	-
589	F	7.7	-
590	F	8.0	-
591	F	12.7	-
592	F	7.5	-
593	M	10.2	-
594	F	7.7	-
595	F	9.5	-
596	M	13.2	-
597	M	9.5	-
598	M	15.5	-
599	F	10.5	-
600	F	9.7	-

Table A-12 .--Twenty-one parturient female northern fur seals tagged on each foreflipper with yellow Riese-tags in Adams Cove, San Miguel Island, California, 29 June to 7 July 1985.

Tag number[a]	Vibrissae color[b]
F-49	white
50	"
51	"
52	"
53	"
54	"
55	"
56	"
57	"
58	"
59	"
60	"
61	mixed
62	white
63	"
64	"
65	"
66	"
67	"
68	"
69	"
70	"

[a] The same tag number was used for both right and left foreflippers.

[b] Mixed = combination of black and white. See glossary for a description of vibrissae color.

Table A-13. --One hundred northern fur seal pups double-tagged with pink Roto-tags at Castle Rock, San Miguel Island, California, on 26 September 1985. All animals were checkmarked by removal of the cartilaginous extension of the third digit on the left hind flipper. A dash indicates no data.

Tag number	Sex	Weight (kg)	Remarks
C-401	M	14.5	-
402	F	10.5	-
403	F	9.0	-
404	M	10.7	-
405	M	11.2	-
406	F	19.5	-
407	M	10.5	-
408	M	9.7	-
409	F	10.0	-
410	M	13.0	-
411	M	15.7	-
412	F	14.7	-
413	F	11.5	-
414	M	8.7	-
415	F	9.5	-
416	M	9.5	-
417	F	8.7	-
418	M	10.7	-
419	M	12.5	-
420	F	9.2	Vesicles sampled
421	M	11.2	-
422	M	14.7	-
423	M	10.5	-
424	M	13.2	-
425	F	10.2	-
426	F	10.5	-
427	F	9.2	Possible ruptured vesicle
428	M	13.7	-
429	M	13.0	-
430	F	10.0	-
431	M	9.7	-
432	F	10.7	-
433	F	12.7	-
434	F	11.7	-
435	M	9.7	-
436	M	8.0	-
437	M	15.0	-
438	F	7.7	-
439	M	10.7	-
440	M	12.0	-
441	F	7.2	-
442	M	13.7	-

Table A-13.--Continued.

Tag number	Sex	Weight (kg)	Remarks
C-443	M	14.2	-
444	M	12.5	-
445	F	10.0	-
446	M	10.5	-
447	F	11.5	-
448	F	11.7	-
449	F	10.2	-
450	F	8.7	-
451	M	13.2	-
452	M	14.0	-
453	F	7.7	-
454	F	12.5	-
455	M	10.0	-
456	F	9.2	-
457	F	13.7	-
458	M	12.0	-
459	F	12.5	-
460	M	11.5	-
461	F	10.2	-
462	M	11.2	-
463	F	9.5	-
464	F	8.5	-
465	F	12.2	-
466	M	12.0	-
467	M	12.2	-
468	M	8.7	-
469	M	11.0	-
470	F	9.5	-
471	M	10.0	-
472	M	11.5	-
473	M	11.7	-
474	F	7.7	-
475	M	12.7	-
476	M	10.2	-
477	M	8.2	-
478	F	13.0	-
479	F	11.5	-
480	M	11.2	-
481	M	17.0	-
482	F	12.0	-
483	M	12.2	-
484	M	12.0	-
485	F	11.7	-
486	F	10.0	-

Table A-13.--Continued.

Tag number	Sex	Weight (kg)	Remarks
487	F	12.0	-
488	M	12.2	-
489	M	8.2	-
490	M	9.7	-
491	F	8.2	-
492	M	12.0	-
493	M	13.5	-
494	F	9.5	-
495	M	12.5	-
496	M	9.0	-
497	M	9.0	-
498	M	11.7	-
499	F	10.5	-
500	F	10.5	-

APPENDIX B

Tabulations of northern fur seal entanglement data.

Table B-1.--Tags applied to pups of entangled and control northern fur seal females, Zapadni Reef Rookery, St. Paul Island, Alaska, 11 August 1985.

Pup tag number*	Sex	Weight (kg)	Entangled/control female tag number
401	F	9.2	Control - 5002
403	M	7.5	Entangled - 5003
404	M	11.0	Control - 5004
406	F	10.5	Control - 5006
407	F	6.0	Entangled - 5007
408	M	7.0	Entangled - 5008
409	F	8.0	Entangled - 5018
410	F	9.0	Control - 5010
412	M	9.0	Control - 5012
414	F	7.0	Entangled - 5014
415	M	8.0	Control - 5015
417	M	13.5	Control - 5017
419	F	10.0	Control - 5019
421	F	8.0	Control - 5021
422	F	6.0	Entangled - 5022
423	M	9.0	Control - 5023
424	F	9.0	Entangled - 5024
425	M	11.0	Entangled - 5025
426	M	9.0	Entangled - 5026
427	M	6.0	Entangled - 5027
428	F	7.0	Entangled - 5028
429	M	7.5	Entangled - 5029
430	F	9.0	Entangled - 5030
431	F	9.0	Control - 5031
432	F	8.0	Control - 5032
433	M	10.0	Control - 5033
434	F	8.5	Control - 5034
435	F	7.5	Control - 5035
436	F	7.5	Control - 5036
438	F	11.0	Control - 5038
440	F	7.0	Control - 5040

* Tags are yellow jumbo Roto-tags.

Table B-2. --Tags applied to entangled northern fur seals during juvenile female and pup surveys, St. Paul Island, Alaska, 28 September to 12 October 1985.

Tag number[a]	Date	Location	Age[b]	Sex	Debris type	Stretch mesh (cm)
252	28 Sept.	Zap. Reef	pup	M	white trawl	15.0
253	29 Sept.	Zap. Reef	pup	M	blue trawl	13.0
254	30 Sept.	Little Zap.	BW	F	blue twine	no sample
255	30 Sept.	Little Zap.	pup	M	white pack band	no sample
256	30 Sept.	Little Zap.	SAM	M	white trawl	21.0
257	30 Sept.	Little Zap.	SAM	M	white pack band	no sample
258	3 Oct.	Zap. Reef	pup	M	blue-green band	no sample
259	3 Oct.	Zap. Reef	SAM	M	green trawl	22.0
260	3 Oct.	Zap. Reef	SAM	M	white trawl	22.0
261	5 Oct.	Kitovi	pup	F	white hemp	no sample
262	5 Oct.	Kitovi	BW	F	green trawl	no sample
263	5 Oct.	Kitovi	SAM	M	grey trawl	22.5
264	5 Oct.	Kitovi	BW	F	yellow band	no sample
265	5 Oct.	Kitovi	BW	F	red rubber band	no sample
266	5 Oct.	Kitovi	SAM	M	white pack band	no sample
267	5 Oct.	Kitovi	WW	F	green trawl	21.5
268	6 Oct.	Lukanin	pup	F	orange trawl	18.0
269	6 Oct.	Lukanin	pup	M	white trawl	22.5
270	6 Oct.	Lukanin	pup	F	blue pack band	no sample
271	8 Oct.	Gorbatch	pup	M	white cloth	no sample
272	8 Oct.	Lukanin	BW	F	green band	no sample
273	9 Oct.	Gorbatch	SAM	M	green trawl	21.5
274	9 Oct.	Reef	SAM	M	green trawl	no open mesh
275	9 Oct.	Reef	pup	M	red cloth	no sample
276	9 Oct.	Reef	pup	F	grey trawl	19.0
277	9 Oct.	Reef	pup	F	red pack band	no sample
278	9 Oct.	Reef	SAM	M	grey trawl	no sample
279	9 Oct.	Reef	BW	F	grey trawl	no sample
280	10 Oct.	Tolstoi	BW	F	grey trawl	18.5
281	10 Oct.	Tolstoi	BW	F	green band	no sample
282	10 Oct.	Tolstoi	WW	F	green trawl	28.5
283	10 Oct.	Polovina	pup	F	green trawl	no open mesh
284	11 Oct.	Zap. Reef	pup	M	green & blue trawl	blue-10.5 grn.-13.5
285	11 Oct.	Zapadni	pup	M	grey trawl	21.0
286	12 Oct.	Tolstoi	pup	F	orange trawl & buoy	18.5
287	12 Oct.	Zapadni	BW	F	green trawl	15.5
288	12 Oct.	Zapadni	pup	F	yellow balloon	no sample
289	12 Oct.	Zapadni	BW	F	green and grey trawl	22.0-grey
290	12 Oct.	Zapadni	pup	F	green trawl	18.0
301	11 Oct.	Little Zap.	pup	F	grey trawl	32.0-broken

[a] Orange Allflex tags.
[b] BW = Black-whiskered female;
WW = White-whiskered female;
SAM = Subadult male.

Table B-3. --Miscellaneous tags recorded on northern fur seals, St. Paul Island, Alaska, 1985. A dash indicates no data.

Date	Tag number	Color[a]	Sex	Location	Comments
30 July	839	green	F	Zap. Reef	with pup
30 July	841	green	F	Zap. Reef	-
2 Aug.	856	green	F	Zap. Reef	-
9 Aug.	OB-6896	Monel	F	Gorbatch	-
21 Sept.	569	green	F	Zap. Reef	with pup
22 Sept.	557	blue	F	Tolstoi	-
26 Sept.	5075	white	F	Vostochni	transmitter present
28 Sept.	859	green	F	Zap. Reef	with pup
28 Sept.	837	green	F	Zap. Reef	-
28 Sept.	591	blue	F	Zap. Reef	-
28 Sept.	0019	orange	M	Zap. Reef	entangled
30 Sept.	854	green	F	Zap. Reef	with pup
1 Oct.	167	orange	M	Zap. Reef	-
1 Oct.	593	blue	F	Zap. Reef	with pup
6 Oct.	807	pink	M	Pol. Cliffs	rub
7 Oct.	0053	orange	M	Ardiguen	control
9 Oct.	YM-3018	Monel	F	Reef	-
10 Oct.	188	orange	M	Tolstoi Beach	control
12 Oct.	198	orange	M	Zapadni	entangled
13 Oct.	0019	orange	M	Zap. Reef	entangled
13 Oct.	-	pink	M[b]	Vostochni Beach	entangled
23 July	XM-9453	Monel	F	Zap. Reef	with pup
23 July	588	blue Roto	F	Zap. Reef	-
3 Aug.	855	blue Roto	F	Zap. Reef	-
12 Aug.	861	blue Roto	F	Zap. Reef	-
12 Aug.	592	blue Roto	F	Zap. Reef	-
20 Aug.	513	blue Roto	F	Zap. Reef	-
21 Aug.	HM-7915	Monel	F	Zap. Reef	-
22 Aug.	XM-4825	Monel	F	Pol. Cliffs	with pup
24 Aug.	838	blue Roto	F	Zap. Reef	with pup
25 Aug.	830	blue Roto	F	Zap. Reef	-
25 Aug.	838	blue Roto	F	Zap. Reef	-
9 Sept.	831	blue Roto	F	Zap. Reef	-
15 Sept.	507	blue Roto	F	Zap. Reef	-
18 Aug.	1811	white Roto	F	Tolstoi	with pup

[a] Monel tags applied by U.S.S.R. See Appendix Table A-8 for additional data.
[b] Adult male; all other males are subadults.

Table B-4.--Tag numbers of northern fur seal pups from which serum samples and rectal swabs for calcivirus isolation were collected, St. Paul Island, Alaska, 1985.

Rookery	Tag number*	Sex	Date (November)
Northeast Point			
	296	F	10
	297	M	10
	298	F	10
	299	M	10
	300	F	10
	302	F	10
	303	F	10
	304	M	10
	305	M	10
	306	F	10
	307	M	10
	308	F	10
	309	M	10
	310	F	10
	311	M	10
	312	F	10
	313	M	10
Little Zapadni			
	314	M	11
	315	M	11
	316	M	11
	317	M	11
	318	M	11
	319	F	11
	320	M	11
	321	M	11
	321b	M	11
	322	F	11
	323	F	11
	324	F	11
	325	M	11
	326	M	11
	327	M	11
	328	M	11
	329	F	11
	330	F	11
	331	M	11
	332	F	11

* Orange Allflex tags; numbers 321b and 326-332 were not given tags and refer to sample number only. Tag number 301 was destroyed.

Table B-S.--Entangled northern fur seals observed during the commercial harvest. St. Paul Island, Alaska, 1984.

Kill no.	Date	Location[a]	Seals harvested	Seals entangled in debris and percent harvested		Seals observed in field with scars from prior entanglement	Skins observed in plant with entanglement scars	Field and plant entanglement scars and percent harvested		Total seals with entangling debris or scars and percent harvested	
			No.	No.	Percent	No.	No.	No.	Percent	No.	Percent
1	7/2	NEP	792	3	0.38	0	1	1	0.13	4	0.51
2	7/3	POL,L-K	629	1	0.16	1	1	2	0.32	3	0.48
3	7/5	ZAP,TZR	1,013	11	1.09	4	1	5	0.49	16	1.58
4	7/6	REEF	899	3	0.33	1	0	1	0.11	4	0.44
5	7/9	NEP	741	5	0.67	5	0	5	0.67	10	1.35
6	7/10	POL,L-K	756	2	0.26	2	0	2	0.26	4	0.53
7	7/11	ZAP	958	4	0.42	3	1	4	0.42	8	0.84
8	7/12	TZR	210	1	0.48	1	0	1	0.48	2	0.95
9	7/13	REEF	1,059	6	0.57	7	0	7	0.66	13	1.23
10	7/16	NEP	703	4	0.57	5	0	5	0.71	9	1.28
11	7/17	POL,L-K	1,234	7	0.57	4	3	7	0.57	14	1.13
12	7/18	ZAP	1,124	6	0.53	2	0	2	0.18	8	0.71
13	7/19	TZR	588	4	0.68	2	1	3	0.51	7	1.19
14	7/20	REEF	992	1	0.11	3	1	4	0.40	5	0.50
15	7/23	NEP	813	2	0.25	3	2	5	0.62	7	0.86
16	7/24	POL,L-K	1,039	2	0.19	3	0	3	0.29	5	0.48
17	7/25	ZAP	805	6	0.75	0	0	0	0.00	6	0.75
18	7/26	TZR	434	0	0.00	1	0	1	0.23	1	0.23
19	7/27	REEF	1,414	2	0.14	3	2	5	0.35	7	0.49
20	7/30	NEP	1,341	1	0.07	5	1	6	0.45	7	0.52
21	7/31	POL,L-K	1,336	4	0.30	3	1	4	0.30	8	0.60
22	8/1	ZAP	1,562	5	0.32	7	2	9	0.58	14	0.90
23	8/2	TZR	456	2	0.44	1	0	1	0.22	3	0.66
24	8/3	REEF	1,168	5	0.43	2	0	2	0.17	7	0.60
Totals			22,066	87		68	17	85		172	
Average percent					0.39				0.39		0.78

[a] See Figure 1. Abbreviations are: TZR = Tolstoi, Zapadni Reef, Little Zapadni; ZAP = Zapadni; NEP = Northeast Point; POL = Polovina, Little Polovina, and Polovina Cliffs; L-K = Lukanin and Kitovi; REEF = Reef, Gorbatch, Zolotoi Sands.

Table B-6.--Entangled and entanglement-scarred northern fur seals examined during the commercial harvest, St. Paul Island. Alaska, 1984. A dash indicates no data.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loosed[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/2	NEP-E	4001	-	Net-green	S	210.0	23.0	3.2	Y	T	0	Neck	-	132	36.3
"	"	4002	-	Net-green	M	750.0	23.0	2.7	Y	L	0	Neck	-	112	23.1
7/2	NEP-W	4003	-	Net-gray	S	175.0	21.5	3.2	Y	T	0	Neck	4	128	-
7/3	KIT	4004	-	Band-green	-	-	-	-	-	T	0	Neck	2	104	-
"	"	4005[e]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
7/5	TOL	4006[f]	-	Rope-manila	-	-	-	-	-	L	0	Low neck	-	-	-
"	"	4007	-	Gillnet	S	0.3	12.0	0.5	N	T	360	Low neck	2	-	-
"	"	4008	-	Net-gray	S	35.0	23.0	2.7	Y	T	0	Neck	3	-	-
7/5	ZAP REEF	4009[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
7/5	LIT ZAP	4010	-	Net-gray	S	20.0	21.5	3.2	Y	VT	340	Neck	4	-	-
"	"	4011[e]	-	No debris-scar	-	-	-	-	-	-	-	Neck	-	-	-
"	"	4012	-	No debris-scar	-	-	-	-	-	-	0	Neck	3	109	-
"	"	4013[h]	-	Net-green	L	1330.0	15.0	3.2	N	T	360	Neck	-	-	-
"	"	4014	-	Net-gray	S	40.0	25.5	4.3	Y	VT	360	Neck	5	-	-
"	"	4015	-	Net-blue	S	50.0	24.0	3.2	Y	T	270	Neck	5	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/5	ZAP	4016[h]	-	Band-pink	-	-	-	-	-	VT	0	Neck	-	-	-
"	"	4017	-	Net-gray	S	20.0	23.0	3.2	Y	T	360	Low neck	3	-	-
"	"	4018[e]	-	No debris-scar	-	-	-	-	-	-	360	Neck	-	-	-
"	"	4019	-	Band-yellow	-	-	-	-	-	T	0	Neck	3	115	-
"	"	4020	-	Net-gray	M	95.0	24.0	3.2	Y	T	60	Neck/flipper	4	117	-
7/6	REEF	4021	-	Net-gray	S	235.0	23.0	6.8	Y	L	0	Neck	3	115	30.4
"	"	4022	-	Net-green	S	20.0	24.0	3.2	Y	T	100	Neck	3	110	24.0
"	"	4023	-	Band-lt.green	-	-	-	-	-	T	360	Neck	6	130	38.6
"	"	4024	-	No debris-scar	-	-	-	-	-	-	10	Neck	4	112	27.7
7/9	NEP-E	4025[f]	-	Band-yellow	-	-	-	-	-	-	-	Low neck	-	-	-
"	"	40269	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4027	526	Net-gray	S	-	24.0	6.0	Y	L	0	Neck	-	-	-
"	"	4028	527	Band-yellow	-	-	-	-	-	T	0	Neck	-	-	-
"	"	4029	-	Net-gray and band-white	S	4.5	24.0	2.3	Y	T[i]	360	Neck	3	106	20.4

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/9	NEP-E	4030[g]	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	-	-	-
"	"	4031	-	Net-gray	S	8.0	-	1.7	Y	T	300	Neck	4	115	34.5
"	"	4032[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4033[g]	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	-	-	-
7/9	NEP-W	4034	-	No debris-scar	-	-	-	-	-	-	0	Neck	3	113	24.5
7/10	LIT POL	4035	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	4	120	-
7/10	POL	4036[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4037	-	Gillnet	S	20.0	11.0	0.6	N	T	360	Low neck	5	129	38.1
7/10	LUK	4038	-	Net-gray	S	50.0	21.5	3.8	Y	T	0	Neck	3	113	24.5
7/11	ZAP	4039	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	4	128	39.0
"	"	4040	528	Net-gray	L	-	13.5	2.7	N	VT	0	Neck	-	-	-
"	"	4041[j]	-	String-yellow	-	-	-	-	-	L	120	Low neck	-	-	-
"	"	4042	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	109	24.5
"	"	4043	-	String-white	-	-	-	-	-	T	0	Head	3	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loosed[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/11	ZAP	4044	529	Net-green	S	-	-	-	-	T	120	Neck	-	-	-
"	"	4045	530	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/12	ZAP REEF	4046[e]	-	-	-	-	-	-	-	-	-	-	-	-	-
7/12	LIT ZAP	4047	531	Net-green & band-green	L	-	21.5	3.2	Y	T[i]	0	Neck, head	-	-	29.9
7/13	REEF	4048[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	-[k]	532	Control	-	-	-	-	-	-	-	-	-	-	-
"	"	4049	533	Net-gray	M	-	21.5	3.2	Y	T	0	Neck	-	-	30.8
"	"	4050[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4051	534	Gillnet	S	-	-	-	N	T	180	Neck	-	-	24.5
"	"	4052	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	113	25.4
"	"	4053	-	No debris-scar	-	-	-	-	-	-	0	Low neck	2	112	25.4
"	"	4054[l]	535	Band-yellow	-	-	-	-	-	L	0	Neck	-	-	40.8
"	"	4055	536	String-brown	-	-	-	-	-	VT	270	Low neck	-	-	-
"	"	4056	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	5	129	42.6

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/13	REEF	40579	-	No debris-scar	-	-	-	-	-	-	-	Neck	-	-	-
"	"	4058[l]	537	Net-gray	M	280.0	24.0	7.3	Y	T	120	Neck	6	-	42.6
"	"	40599	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4060[f]	-	Net-green	S	-	-	-	-	VT	360	Low neck	-	-	-
7/16	NEP-E	4061	538	Net green	L	-	20.5	3.2	Y	T	-[m]	Neck	-	-	35.4
"	"	4062	539	Net-green/gray	S	-	23.0	3.2	Y	TNB	0	Neck	-	-	34.9
"	"	4063	-	No debris-scar	-	-	-	-	-	-	0	Low neck	3	116	26.3
"	"	40649	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4065	540	Band-black & white	-	-	-	-	-	TNB	0	Neck	-	-	-
"	"	4066	541	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4067	-	Plastic ring	-	-	-	-	-	T	0	Neck	3	118	28.6
"	"	40689	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/16	NEP-W	40699	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/17	POL	4070	542	Rope-green	-	-	-	-	-	TNB	0	Neck	-	-	31.8
"	"	4071	543	Band-blue	-	-	-	-	-	TNB	0	Neck	-	-	23.6
"	"	4072	544	Net-gray	S	-	24.0	2.7	Y	T	90	Neck	-	-	33.6
7/17	KIT	4073	545	Net-gray	S	-	21.5	3.2	Y	VT	360	Neck	-	-	-
"	"	4074[g]	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4075	546	Band-green	-	-	-	-	-	VT	0	Neck	-	-	-
7/17	LUK	4076	547	Rope-white	-	-	-	-	-	L	0	Low neck	-	-	-
"	"	4077	548	Net-gray	M	-	21.5	3.2	Y	T	0	Neck	-	-	-
"	"	4078[g]	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4079[g]	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4080[g]	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/18	ZAP	4081	549	Net-gray	M	-	23.0	3.2	Y	VT	0	Neck	-	-	26.3
"	"	4082	550	Band-blue	-	-	-	-	-	TNB	330	Neck	-	-	-
"	"	4083	551	Cord-gray	-	-	-	-	-	T	180	Low neck	-	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/18	ZAP	4084	552	Net-blue	S	-	-	4.3	Y	T	330	Neck	-	-	-
"	"	4085	553	Net-green	L	-	23.0	5.0	Y	T	0	Neck	-	-	39.0
"	"	40869	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4087	-	No debris-scar	-	-	-	-	-	-	0	Low shoulder	4	122	34.5
"	"	4088	554	Band-blue	-	-	-	-	-	TNB	0	Neck	-	-	-
7/19	LIT ZAP	4089	555	Net-gray	S	-	23.0	3.8	Y	TNB	0	Neck	-	-	-
"	"	4090	556	Band-blue	-	-	-	-	-	T	360	Neck	-	-	-
7/19	ZAP REEF	4091	557	Net-gray	S	-	23.0	6.7	Y	T	0	Neck	-	-	28.1
"	"	40929	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	-	-	-
7/19	TOL	40939	-	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4094	558	Net-green	S	-	23.0	3.8	Y	T	0	Neck	-	-	30.8
7/20	REEF	4095	559	Net-gray	S	-	21.5	3.2	Y	T	0	Neck	-	-	29.0
"	"	40969	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	40979	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	40989	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/23	NEP-E	4099	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	4	131	40.4
"	"	4100	560	String-manila	-	-	-	-	-	VT	0	Neck	-	-	26.3
"	"	4101	803/ 804	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4102	561	Net-orange	M	-	19.0	5.2	Y	T	0	Neck	-	-	-
"	"	4103	805/ 806	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/24	LIT POL	4104	562	Net-gray	S	-	21.5	5.0	Y	T	0	Neck	-	-	26.3
7/24	POL	4105	807/ 808	No debris-scar	-	-	-	-	-	-	0	Head	-	-	-
"	"	4106	809/ 810	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4107	563	Net-gray	S	-	25.5	4.3	Y	T	0	Low neck	-	-	22.7
7/24	KIT	4108	811/ 812	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/25	ZAP	4109	564	Band-blue	-	-	-	-	-	T	0	Neck	-	-	27.2
"	"	4110	565	Net-green	S	-	-	-	Y	VT	0	Neck	-	-	36.3
"	"	4111	566	Band-white	-	-	-	-	-	T	0	Head	-	-	-
"	"	4112	567	Net-gray	S	-	28.0	4.3	Y	T	90	Neck	-	-	-
"	"	4113	568	Band-blue	-	-	-	-	-	TNB	0	Neck	-	-	31.8
"	"	4114	569	Net-gray	S	-	23.0	3.5	Y	L	0	Neck	-	-	25.4
7/26	TOL	4115	813/ 814	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/27	ZOL	4116	-	No debris-scar	-	-	-	-	-	-	5	Shoulder	4	123	26.3
7/27	REEF	4117[n]	570	Net-gray	M	325.0	24.0	2.8	Y	T	360	Low neck	-	-	-
"	"	4118[e]	-	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
"	"	4119	571	Net-green	S	-	26.5	2.3	Y	VT	270	Neck	-	-	-
"	"	4120	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	120	33.6

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
7/30	NEP-E	4121	-	No debris-scar	-	-	-	-	-	-	0	Head, neck	2	107	24.5
"	"	4122	572	Band-white	-	-	-	-	-	L	0	Neck	-	-	-
"	"	4123	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	120	32.2
7/30	NEP-W	4124	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	113	24.0
"	"	4125	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	116	26.3
"	"	4126	815/ 816	No debris-scar	-	-	-	-	-	-	0	Low neck	-	-	-
7/31	LUK	4127	-	No debris-scar	-	-	-	-	-	-	0	Neck	2	-	20.9
"	"	4128	573	Band-yellow	-	-	-	-	-	T	160	Low neck	-	-	-
"	"	4129	817/ 818	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4130	574	Net-blue	S	-	-	3.8	Y	TNB	0	Neck	-	-	-
"	"	4131	-	No debris-scar	-	-	-	-	-	-	0	Low neck & shoulder	3	121	36.3
"	"	4132	-	Plastic	-	-	-	-	-	T	-[n]	Lower jaw/ mouth	2	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loose[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
8/1	ZAP	4133	-	No debris-scar	-	-	-	-	-	-	0	Neck	2	107	23.6
"	"	4134	-	No debris-scar	-	-	-	-	-	-	0	Neck	3	114	29.0
"	"	4135	575	Net-gray	S	-	-	2.7	Y	TNB	0	Neck	-	-	-
"	"	4136	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	2	110	-
"	"	4137	-	No debris-scar	-	-	-	-	-	-	0	Low neck	3	120	31.3
"	"	4138	576	Net-orange	S	-	-	-	Y	TNB	270	Neck	-	-	-
"	"	4139	577	Net-gray	M	-	21.5	2.7	Y	T	0	Neck	-	-	-
"	"	4140	-	No debris-scar	-	-	-	-	-	-	0	Low neck	3	112	27.7
"	"	4141	578	Band-blue	-	-	-	-	-	TNB	0	Neck	-	-	-
"	"	4142	579	Rope-yellow	-	-	-	-	-	TNB	0	Neck	-	-	-
"	"	4143	819/ 820	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-
"	"	4144	821/ 822	No debris-scar	-	-	-	-	-	-	0	Neck	-	-	-

Table B-6.--Continued.

Date	Haul out area[a]	Specimen no.	Tag. no.	Type & color of debris[b]	Description of net fragment: Quan. of net[c]	Weight of net(g)	Mesh size (cm)	Twine size (mm)	Single mesh entang.	Tight/ loosed[d]	Degree of open wound	Area of entanglement or scar	Age	Body length (cm)	Body weight (kg)
8/2	TOL	4145	580	Net-gray	M	-	21.5	5.0	Y	T	0	Neck	-	-	-
"	"	4146	581	Net-green	S	-	-	2.3	Y	TNB	0	Neck	-	-	-
"	"	4147	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	119	30.8
8/2	LUK	4148	582	Cord-brown	-	-	-	-	-	T	310	Neck	-	-	-
8/3	REEF	4149	823/ 824	Rope-green	-	-	-	-	-	T	0	Neck	-	-	-
"	"	4150	-	No debris-scar	-	-	-	-	-	-	0	Shoulder	3	122	32.7
"	"	4151	583	Net gray	S	-	21.5	2.6	Y	TNB	0	Neck	-	-	-
"	"	4152	584	Band-blue	-	-	-	-	-	TNB	0	Neck	-	-	-
"	"	4153	585	Gillnet	S	-	-	0.3	N	T	-[e]	Head/low neck	-	-	-
"	"	4154	586	Net-green	S	-	-	-	Y	TNB	0	Neck	-	-	32.7
"	"	4155	-	No debris-scar	-	-	-	-	-	-	0	Low neck	3	113	28.6

Table B-6.--Continued.

a See Figure 1 and footnote ([a]) in Appendix Table B-1.

b Includes seals without debris that had a scar indicative of prior entanglement (no debris).

c Quantity of net: Small (S) = < 150 g; Moderate (M) = 151-500 g; Large (L) = > 501 g.

d Tight (T) = debris tightly bound; Very Tight (VT) = constricting; Tight Not Binding (TNB) = appears tight; Loose (L) = debris can be easily removed.

e Oversized seal (> 125 cm) released alive; not tagged.

f Oversized seal (> 125 cm) released alive with debris intact; not tagged.

g Entanglement-scarred seal released alive; not tagged.

h Oversized seal (> 125 cm) released alive after debris was removed; not tagged.

i Net was tight; band was loose.

j Debris came off of seal during restraint procedure; seal released alive; not tagged.

k No specimen number assigned. Seal was not entangled nor did it have entanglement scars. Seal was tagged as a "control" animal.

l Seal died on restraint board.

m Seal with minimum 90° open wound. Ventral and lateral areas of neck were not accessible for examination.

n Seal was entangled about its lower jaw. The tongue was cut, but no wounds were visible in epidermis on lower jaw.

o Seal had a series of small unconnected open wounds 360° around its neck.

Table B-7.--Entanglement-scarred northern fur seal skins observed in the skin processing plant, St. Paul Island, Alaska, 1984.

Date	Location[a] where harvested	Specimen no.	Area of entanglement	Observations of dermis	Fur marks	Skin quality[b]
7/2	NEP	4501	Neck	360° faint pink band	No obvious marks	C
7/3	POL, LUK-KIT	4502	Neck	360° faint pink line	No obvious marks	C
7/5	ZAP, TZR	4503	Neck	360° intermittent indentation, 1 cm wide	3-90° lines, white hair	R
7/11	ZAP	4504	Neck	360° faint blue line, 2 cm wide	No obvious marks	C
7/17	POL, LUK-KIT	4505	Neck	90° indentation, 2 cm wide	Obvious 90° line in hair	C
"	"	4506	Neck	270° indentation, 1-2 cm wide	Faint mark	C
"	"	4507	Neck	360° thickened tissue, skin cut ventrally by machine	No obvious marks	R
7/19	TZR	4508	Neck	240° indentation with stitch appearance	Obvious mark	R
7/20	REEF	4509	Neck	Machine cut along entanglement line, yellowish margin	Cut by machine	R
7/23	NEP	4510	Neck	360° pink line	No obvious marks	C
"	"	4511	Neck	360° pink line	No obvious marks	C
7/27	REEF	4512	Neck	Machine cut	Rub line over left shoulder	R
"	"	4513	Neck	90° thickened tissue ("lump line")	No obvious marks	C

Table B-7.--Continued.

Date	Location[a] where harvested	Specimen no.	Area of entanglement	Observations of dermis	Fur marks	Skin quality[b]
7/30	NEP	4514	Neck	90° new skin growth	Rub line	C
7/31	POL, LUK-KIT	4515	Shoulders	90° indentations (two), 1 cm wide	No obvious marks	C
8/1	ZAP	4516	Neck	90° indentation, machine cut	Rub line and black hair line	C
"	"	4517	Neck	320° indentation	Slight 360° line	C

[a] See Figure 1.

[b] Pelts with significant damage due to the entanglement are rejected from the commercial production; C = commercial; R = reject.

Table B-8.--Resightings of entangled northern fur seals tagged and released in 1984, Pribilof Islands, Alaska. A dash indicates no data.

Date and location[a] of tagging	Tag. no.	Observations when tagged in 1984	Date and location of resighting[b] 1984	Observations when resighted
7/9 NEP-E	526	Net-gray, loose, no wound	7/16* NEP-W	Net on tight; not cutting into skin; large mesh; heavy twine
7/9 NEP-E	527	Band-yellow, tight, no wound	7/20* REEF	Yellow band on tight
7/11 ZAP	528	Net-gray, very tight, no wound	7/13* REEF	Gray net; no cuts; small dress; one loop around flipper
			7/20* REEF	-
7/11 ZAP	529	Net-green, tight, 120° wound	7/18* ZAP	-
7/13 REEF	532	Control	7/20* REEF	-
7/13 REEF	534	Gillnet, tight, 180° wound	7/20* REEF	-
7/17 POL	543	Band-blue, TNB, 330° wound	8/10 Gorbatch	-
7/17 POL	544	Net-gray, tight, 90° wound	7/24* POL	-
7/17 LUK	547	Rope-white, loose, no wound	7/24* LUK	-
			7/27* REEF	-
7/17 LUK	548	Net-gray, tight, no wound	7/24* LUK	-
7/19 LIT ZAP	555	Net-gray, TNB, no wound	8/11 St. George	Gray net; fur rubbed on neck; subadult male
7/19 LIT ZAP	556	Band-blue, tight, 360° wound	7/27* REEF	-
7/25 ZAP	564	Band-blue, tight, no wound	8/1* ZAP	Blue band on tight; doesn't appear cut; dangling piece of band-ventrally; black whiskers

Table B-8.--Continued.

Date and location[a] of tagging	Tag. no.	Observations when tagged in 1984	Date and Location of resighting [b] 1984	Observations when resighted
7/31 LUK	573	Band-yellow, tight, 160° wound	8/2* LUK	Band on tight; doesn't appear cut
7/31 LUK	574	Net-blue, TNB, no wound	8/2* KIT	No debris; no cuts; rub on neck
			8/3* REEF	-
7/23 NEP-E	803/804	Scar, no open wound, low neck	7/30* NEP-E	360° scar line on low neck; deeper ventrally; appears to be a recently healed 270° wound
7/24 POL	807/808	Scar, no open wound, head	7/31* LIT POL	-
7/24 POL	809/810	Scar, no open wound, low neck	7/31* LIT POL	-
7/26 TOL	813/814	Scar, no open wound, low neck	8/2* TOL	Scar; white whiskers

[a] See Figure 1 and footnote (a) in Appendix Table B-1.

[b] Asterisk (*) indicates sighting occurred during the commercial harvest on St. Paul Island. See Footnote (a) for locations.

Table B-9.--Sightings made in 1984 of entangled northern fur seals tagged and released in 1983, Pribilof Islands. Alaska. A dash indicates no data.

Tag no.	Date	Location of in 1983[a]	Observtions when in 1983	Date	Location of 1984[b]	Observations in 1984
411	7/8/83	REEF	Band-yellow on low neck; no wounds; TNB.	7/27	*REEF	No debris; no wounds; slight indentation on left shoulder extending to dorsal; white whiskers; double-tagged.
423	7/11/83	ZAP REEF	Net-green on low neck; 360° wound; tight; small amount of net; 21 cm mesh.	7/10	*LUK	Debris on tight; 360° wound, 2 cm wide; seal weak.
				7/13	*REEF	Green net on tight; 360° wound; one mesh loop around neck; skin bulging dorsally; long white whiskers, but seal is size of a 4 year old; short trailers from two knots.
				7/14	REEF	-
425	7/12/83	ZAP	Band-white on neck; 180° wound; loose.	7/11	*ZAP	Seal not seen, but tag was found during drive; seal must not have had any debris or marks or it would have been observed.
428	7/13/83	NEP-E	Net-green on neck; no wounds; TNB; small amount of net; 28 cm mesh.	7/6	*REEF	No debris; no marks.
429	7/13/83	NEP-E	Net-green on low neck & flipper; no wounds; TNB; 5 strands around neck; medium amount of net; 26 cm mesh.	7/6	*REEF	-
				7/20	*REEF	No debris; no marks.

Table B-9.--Continued.

Tag no.	Date	Location of tagging in 1983[a]	Observations when tagged and released in 1983	Date	Location of sighting in 1984[b]	Observations in 1984
430	7/13/83	NEP-E	Net-green; 18 strands around neck; no wounds; TNB; large amount of net; 24 cm mesh.	7/2	*NEP-E	No debris; no marks; healthy appearance.
				7/9	*NEP-E	-
				7/21	St.George I. Zapadni	No sign of net or net scars; recorded as blue tag 30, but must be 430 as no other seal has such tags.
436	7/14/83	POL	Net-green, 5 strands around neck; no wounds; TNB; small amount of net; 23 cm mesh.	7/29	St. George I. East Cliffs	Green net around neck; cut badly into flesh; double-tagged, tags faded.
				7/31	"	Green net on subadult male.
				8/1	"	Green net on subadult male.
442	7/15/83	REEF	Net-gray on neck; 270° wound; very tight; one mesh total.	7/5	*LIT ZAP	Yellowish tips of something; barely visible; 360° wound, 1 cm wide; tag on right flipper only.
				7/19	*LIT ZAP	No debris; healed wound; deep groove in skin ventrally, but not an open cut; skin bulging 300°, but not dorsal; just rub mark dorsally, not recently cut; rub line on shoulders posterior to wound; tag on right flipper only.
444	7/18/83	LIT ZAP	Net-gray, 5 strands around neck; no wound; loose; small amount of net; 23 cm mesh.	7/26	*LIT ZAP	Gray net on tight; 360° wound; skin bulging ventrally & dorsally, but more so ventrally; one mesh trailer, broken meshes; black whiskers; double-tagged.

Table B-9.--Continued.

Tag no.	Date	Location of tagging in 1983[a]	Observations when tagged and released in 1983	Date	Location of sighting in 1984[b]	Observations in 1984
464	7/22/83	REEF	Rope-greenish on neck; 270° wound; very tight; tied with knot.	7/6	*REEF	One strand of debris with knot in front and 3 cm hanging; 360° wound.
				7/13	*REEF	Yellowish band; 360° wound.
466	7/26/83	ZAP	Net-gray, 2 strands around neck; 360° wound; loose; small amount of debris; 23 cm mesh.	6/24	St. George Zapadni	Gray net around neck removed by biologists; recorded as blue tag 66, but must be 466 as no other seal has such tags.
468	7/26/83	ZAP	Net-brownish red, 2 strands around neck; no wound; tight; small amount of net; 21.5 cm mesh.	8/1	*ZAP	Yellowish or manila string on neck; 360° wound; matted hair from oil or blubber; black & white whiskers; wide wound-skin separated; blubber exposed.
471	7/27/83	NEP-E	Net-gray, 10 strands around neck; no wound; tight; medium amount of net; 21.5 cm mesh.	7/6	*REEF	Gray net; no visible wound; debris tight, but not binding; medium dress.
				7/13	*REEF	Gray net; tight.
				7/20	*REEF	Gray net; no cuts.
472	7/27/83	NEP-E	Net-gray, 8 strands around neck; no wound; tight; medium amount of net; 23 cm mesh.	8/2	*TOL	Gray net; 360° wound, not deep, but through skin; net on tight; small dress.

Table B-9.--Continued.

Tag no.	Date	Location of tagging in 1983[a]	Observations when tagged and released in 1983	Date	Location of sighting in 1984[b]	Observations in 1984
476	7/28/83	KIT	Plastic packing material on shoulder; no wound; tight.	7/24	*KIT	No debris; no marks.
					*REEF	No debris; very slight 60° fur mark on right shoulder, two slight lines, not very obvious; black whiskers; double-tagged.
				7/31	*KIT	No debris; very faint line over right shoulder, barely visible; black whiskers; double-tagged.
				8/2	*KIT	No debris; no wounds.
477	7/29/83	REEF	String; 70° wound on each shoulder; left cut deeper than right.	7/6	*REEF	No debris; obvious marks on shoulders; left shoulder has an indented fur rub that looks like a recently healed wound; right shoulder has obvious fur rub; tag on right flipper only.
				7/17	*KIT	Scars on both shoulders, 3 cm wide rub, 60° over each shoulder; tag on right flipper only.
480	7/29/83	REEF	Net-green, more than 2 strands around neck; 360° wound; very tight; small amount of net; 24 cm mesh.	7/27	*REEF	Green net on neck very tight; 180° wound dorsally, skin bulging; doesn't appear cut ventrally; fur rub marks around gape of mouth; small dress, couples of meshes bunched on left; appears to be one or two mesh loops around neck; black and white whiskers; double-tagged.

Table B-9.--Continued.

Tag no.	Date	Location of tagging in 1983[a]	Observations when tagged and released in 1983	Date	Location of sighting in 1984[b]	Observations in 1984
482	7/29/83	REEF	Net-gray, two strands around neck; no wounds; loose; small amount of net; 22 cm mesh.	7/22	St. George East Cliffs	No debris; net scars present on neck.
487	8/3/83	NEP-E	Net-green on neck; no wounds; tight, not binding; large amount of net; 16.5 cm mesh.	7/17	*KIT	Gray net; 360° deep wound; very deep cut dorsally, large skin bulge, one strand of debris around neck; large knot in debris ventrally.
489	8/3/83	NEP-W	Plastic gasket on neck; 360° wound; tight.	7/6	*REEF	Plastic gasket; 360° deep wound to muscle; gasket cut off of seal and collected; seal was released.
				7/7	REEF	No debris; deep scar; tag on left flipper only; indented skin.
				7/23	*NEP-E	No debris; wound healed; beaded tissue in groove in hair; deeper dorsally.
493	8/5/83	REEF	Red rubber gasket on neck; wounds; tight.	7/25	St. George East Cliffs	No further notes.
				8/1	St. George East Cliffs	No debris; faint net scars present; double-tagged.
495	8/5/83	REEF	Net-gray on neck & flipper; no wounds; loose; neck in two holes in net; small amount of net.	6/24	St. George Zapadni	No debris.
				6/25	St. George Zapadni	No debris.

Table B-9.--Continued.

Tag no.	Date	Location of tagging in 1983[a]	Observations when tagged and released in 1983	Date	Location of sighting in 1984[b]	Observations in 1984
497	8/5/83	REEF	Net-gray, 4 strands on neck; 360° deep wound; tight.	6/24	St. George Zapadni	Hemp-colored net around neck; cutting very badly.
498	8/5/83	REEF	Cloth band on neck; no wounds; loose.	7/27	*REEF	No debris; no marks; healthy appearance; black and white whiskers; 4 years old.

[a] All seals were tagged during the harvest on St. Paul Island, 1983. See Figure 1.

[b] All locations are St. Paul Island (Fig. 1) unless otherwise indicated. An asterisk (*) indicates the observation was made during the commercial harvest on St. Paul Island.

Table B-10.--Observations of entangled northern fur seals (exclusive of the commercial harvest), Pribilof Islands, Alaska, 1984. A dash indicates no data.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
6/12	Tolstoi	H	80	0	-	JS
6/13	NEP-E, Catwalk	B	2 females and undetermined number of adult males	1	Green net on female.	JS
6/13	Polovina	H	50	0	-	JS
6/13	Little Zapadni	H	70	0	-	JS
6/14	Tolstoi	H	100	0	-	JS
6/30	Tolstoi	B	1200 females and undetermined number of adult males	0	-	JS
6/30	Tolstoi	H	250	1	Gray net on small male; medium amount.	JS
6/30	Lukanin Beach	-	-	1	Green net on large male; seal was on a beach area that is not a normal haul-out area; seal came ashore for few minutes then went back to sea.	JS

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
7/7	Reef Catwalk (survey specifically for entangled females)	B	6200 females and undetermined number of adult males	4	1) Green rope on neck of female; tight; no visible cuts. 2) Thin line scar around neck of female. 3) White net on neck of female; medium amount; tight; entangled in mesh loop. 4) Scar mark around head of emale; skin indented; debris may be imbedded in skin; no open wounds.	JS, NB, AF
7/7	Reef	H	75	1	No debris; deep scar; blue tag 489.	JS, NB, AF
7/7	Reef-Castle Rock	H	50	0	-	JS, NB, AF
7/7	Reef Point	-	-	1	Green net on adult male; large amount of net; seal was inland away from breeding area.	JS, NB, AF
7/8	NEP-E Catwalk (survey specifically entangled females)	B	3200 females and undetermined number of adult males	2	1) White band and gray net on young male; this subadult male was in breeding area near females and adult males (unusual occurrence). 2) Single strand of debris (possibly a band) on neck of female; very tight.	JS, NB, AF
7/9	NEP-W (during bull count)	B & H	485 adult (harem) males, 153 adult (territorial) males, 206 adult (idle) males, and undetermined number of females	1	Deep scar/cut on territorial bull; debris not visible.	JS, PK

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
7/9	NEP-E Catwalk	B & H	140 adult (harem) males, 85 adult (territorial) males, 149 adult (idle) males, and 3000 females	0	-	JS, PK
7/9	NEP-E (during bull count)	B & H	186 adult (harem) males, 58 adult (territorial) males, 197 adult (idle) males, and undetermined number of females	1	Scar on low neck of territorial bull.	JS, PK
7/9	NEP-E (during bull count)	B & H	334 adult (harem) males, 123 adult (territorial) males, and undetermined number of females	1	Blue net on female; medium amount of net. 102 adult (idle) males,	JS, PK
7/10	Polovina	H	80	0	-	JS, NB, AF
7/13	Little Zapadni	H	-	1	Blue net on female; medium amount of net.	JS, NB, AF
7/14	Reef Catwalk (survey specifically for entangled females)	B	4000 females and undetermined number of adult males	1	Green net on female; medium amount.	NB, AF, HK

Table B-10 .--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
7/14	Reef	H	-	3	1) Entangled male 2) Entangled male 3) Entangled male; blue tag 423.	NB, AF, HK
7/15	NEP-E Catwalk (survey specifically for entangled females)	B	5800 females and undetermined number of adult males	1	Green net on neck of female; tight; small amount.	JS, NB, AF, HK
7/14	NEP-E Area 1	H	100	1	Green net on neck of young male.	JS, NB, AF, HK
7/15	NEP-E Area 1	H	-	1	Green net on neck of young male; observed during round-up for harvest, but seal escaped and is not included in harvest tally; same seal as 7/14.	NB
7/19	Zapadni Reef	H	-	1	Green net on adult male; observed during round-up for harvest, bu t seal escaped and is not include d in harvest tally.	NB
7/21	Zolotoi Sands	H	150	0	-	JS, NB, HK, AF
7/24	St. George I. East Cliffs	B		1	Blue net on neck of female; medium quantity of net.	JS
7/25	Reef Catwalk	B	1200 females and undetermined number of adult males	1	Orange net on neck of females; entangled in mesh loop; small amount of net.	JS

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
7/29	Reef Catwalk (survey specifically for entangled females)	B	1200 females and undetermined number of adult males	3	1) Green net on neck of female; medium amount of net; same seal as 7/14. 2) Orange net on neck of female; same seal as 7/25. 3) Scar on low neck of female; appears cut; has a pup.	JS, NB, AF
8/4	NEP-W Area 1	H	150 females and two adult males	0	-	JS, HK, SZ
8/4	NEP-W Area 2	H	30 adult males and 10 subadult males	1	Green net on subadult male.	JS, HK, SZ
8/4	NEP-E Area 1	H	20	1	Green net on subadult male; large quantity of net.	JS, HK, SZ
8/5	Zapadni Reef	B	-	2	1) Net on adult male holding females (harem bull); net on neck over shoulders. 2) Scars on female; 90° healed wound dorsally; female had been tagged.	HK
8/6	Zapadni Reef	B	-	1	White net on pup.	HK
8/10	Gorbatch	H	-	2	1) Entangled; blue tag 543. 2) Green net; blue tag not read.	HK

Table B1-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
9/18	Reef	B	-	1	Band or scar on female.	HK
8/18	Reef	H	75-100	2	1) Green net on seal; large quantity of net. 2) Green net on seal.	HK
9/18	Zapadni Reef	B	800-1000 females	3	Three entangled seals observed (probably all females).	HK
9/19	Zapadni Reef	B	200	1	Gillnet around shoulders of pup; pup with a female in rookery area.	HK
9/20	Zapadni Reef	B	200	0	-	HK
9/21	Zapadni Reef	B	200	1	Blue net on neck (probably female); net twine diameter approximately 0.6 cm; no open wounds.	HK
9/22	Zapadni Reef	B	200	0	-	HK
9/23	Zapadni Reef	B	200	0	-	HK
9/24	Zapadni Reef	B	200	0	-	HK
9/25	NEP	B & H	-	0	-	HK
9/25	Zapadni Reef	B & H	200	0	-	HK

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
9/25	Little Zapadni	H	50	0	-	HK
9/25	Polovina	B	300	0	-	HK
9/26	Zapadni Reef	H	200	1	Green net on neck of young seal (probably male).	HK
9/26	Tolstoi	H	200-300	3	1) Green/white net around neck of young male.	HK
					2) Scar on neck of young male; scar 3-4 cm wide.	HK
					3) Green net on young male; deep wound; net twine diameter approximately. 0.6 cm; strands dangling.	
9/26	Zapadni Reef	B	700-800	1	Gillnet on young female; black and white whiskers.	HK
9/27	NEP-W	B	500	0	-	HK
9/27	NEP-W	H	150-200	2	1) Green net around neck of male seal; small quantity of net.	HK
					2) Blue net around neck of male seal.	
9/27	Zapadni Reef	B	150	1	Gillnet around neck/shoulder of pup; same seal as 9/19; pup was nursing.	HK
9/27	Lukanin	B	100	0	-	HK

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
9/29	Tolstoi	B	1200-1500	1	Gray net on female seal; large quantity of net; net had barnacles attached; black and white whiskers .	HK
9/29	Tolstoi	H	200	0	-	HK
9/29	Zolotoi Sands	H	100	0	-	HK
9/30	Zapadni Reef	B	700-800	0	-	HK
10/23	Zapadni Reef	H	-	1	Green net on subadult male; on neck; no visible wound.	PK
10/24	Reef	B	-	5	1) Blue net on pup; on shoulders; no visible wound. 2) Green net on mixed-whiskered female[c]; on neck trailing to ground; no visible wounds. 3) Green net on subadult male; on neck; no visible wound. 4) Green net on black-whiskered female[c]; on neck; no visible wound. 5) Green net on white-whiskered female; on neck; 360° wound.	PK
10/25	NEP-E	-	-	1	Gray net on white-whiskered female; on neck; no visible wound.	PK

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
10/26	Kitovi	B	-	2	1) Green net on white-whiskered female; on neck; no visible wound. 2) Unknown debris on white-whiskered female; on neck; 360° wound.	PK
10/26	Lukanin	B	-	2	1) Blue net on black-whiskered female[c]; on neck; no visible wound. 2) Blue net on black-whiskered female[c]; on neck; no visible wound.	PK PK
10/27	Polivina Cliffs	-	-	1	Gray net on pup; on neck; no visible wound.	PK
10/28	Zapadni	B	-	3	1) Unknown debris on black-whiskered female[c]; on neck; 360° wound. 2) Green net on mix-whiskered female[c]; on neck; 90° ventral wound. 3) Gray net on subadult male; on neck; 360 wound.	PK
10/29	Little Zapadni	-	-	1	Blue net on subadult male; on neck; no visible wound.	PK

Table B-10.--Continued.

Date	Location[a]	Haul-out(H) or breeding area (B)	Estimated number of seals observed	Number of seals entangled or scarred	Description	Observer initials[b]
10/30	Tolstoi	B	-	6	1) Green net on black-whiskered female[c]; on neck; no visible wound. 2) Green net on black-whiskered female[c]; on low neck; no visible wound. 3) Blue net on black-whiskered female[c]; on low neck; no visible wound. 4) Unknown debris on black-whiskered female[c]; on neck; no visible wound, but animal lethargic. 5) Unknown debris on white-whiskered female; on low neck; no visible wound, but animal lethargic. 6) Green net on black-whiskered female[c]; on neck; no visible wound.	PK

a See Figure 1; Footnote ([a]) in Appendix Table B-1. All sightings were on St. Paul Island, except where noted.

b Observers: JS=Joe Scordino; NB=Norihisa Baba; AF=Akira Furuta; PK=Patrick Kozloff; HK=Hiroshi Kajimura; SZ=Steven Zimmerman.

c Seals classified as mix-whiskered or black-whiskered females may actually be subadult males that were indistinguishable from young females.

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APPENDIX C

Scientific staff engaged in northern fur seal research in 1985

National Marine Mammal Laboratory (NMML)
Howard W. Braham, Director
Robert V. Miller, Deputy Director
Charles W. Fowler, Manager, Fur Seal Program

Name	Affiliation	Assignment
Permanent		
Patrick Kozloff	NMML	Population Assessment
Hiroshi Kajimura	NMML	Population Assessment
Laurie L. Briggs	NMML	Population Assessment
John L. Bengtson	NMML	Population Assessment
Roger L. Gentry	NMML	Behavior and Biology
Robert L. DeLong	NMML	Entanglement and and Feeding Behavior
Michael E. Goebel	NMML	Entanglement and Feeding Behavior
George A. Antonelis	NMML	Foraging Behavior and Food Habits
Thomas R. Loughlin	NMML	Pelagic Studies and Biology
Michael A. Perez	NMML	Pelagic Studies and Biology
Anne E. York	NMML	Population Dynamics
Temporary		
Robin Manasse	NMML	Entanglement Studies
Jason Baker	NMML	Tooth Studies
Wendy E. Roberts	NMML	Behavior and Biology
Jason W. Simeonoff	NMML	Population Assessment

APPENDIX C (Continued)

Name	Affiliation	Assignment
Mamant Kochergin	NMML	Population Assessment
Isaac Zacharof	NMML	Population Assessment
Robert M. Olsen	NMML	Population Assessment
Andrew R. Lestenkof	NMML	Population Assessment
Alfey L. Hanson	NMML	Population Assessment
Mekey E. Borenin	NMML	Population Assessment
Amos T. Philemonoff	NMML	Population Assessment
Charles A. Melovidov	NMML	Population Assessment
Anthony Philemonoff	NMML	Population Assessment
Jason Bourdukofsky, Jr.	NMML	Population Assessment
Richard L. Merrick	NMML	Pelagic Studies and Biology
Cooperators[a]		
Joe Scordino	NWR[b]	Fur Seal Entanglement
John M. Francis	Univ. Calif., Santa Cruz	Behavior and Biology
Brent S. Stewart	Hubbs Marine Research Inst., San Diego, Calif.	Behavior and Biology
Steven Jeffries	Wash. Dept. Game	Pup Tagging Project
Robin Brown	Oreg. Dept. Game	Pup Tagging Project
Douglas Skilling	Oreg. St. Univ., Corvallis	Pup Tagging Project
Gene Berry	Oreg. St. Univ., Corvallis	Pup Tagging Project

APPENDIX C (Continued)

Name	Affiliation	Assignment
Jeff Barlow	Oreg. St. Univ., Corvallis	Pup Tagging Project
Wayne Perryman	SWFC[c], La Jolla, Calif.	Foraging Behavior Studies
John Scholl	Calif. Dept. Fish & Game	Foraging Behavior Studies
Jan Roletto	Calif. Marine Mammal Center, Fort Cronkhite	Foraging Behavior Studies
Kazumoto Yoshida	Far Seas Fish. Res. Lab., Shimizu, Japan	Fur Seal Entanglement
Norihisa Baba	Far Seas Fish. Res. Lab.,. Shimizu, Japan	Fur Seal Entanglement
Shigeru Nomura	Izu-Mito Sea Paradise, Numazu, Japan	Fur Seal Entanglement
Akira Furuta	Izu-Mito Sea Paradise, Numazu, Japan	Fur Seal Entanglement

[a] Financed wholly or in part by the National Marine Mammal Laboratory or other agency.

[b] NWR = NMFS Northwest Regional Office.

[C] SWFC = NMFS Southwest Fisheries Center.