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Fur Seal Investigations, 1986

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Edited by
Hiroshi Kajimura

November 1989

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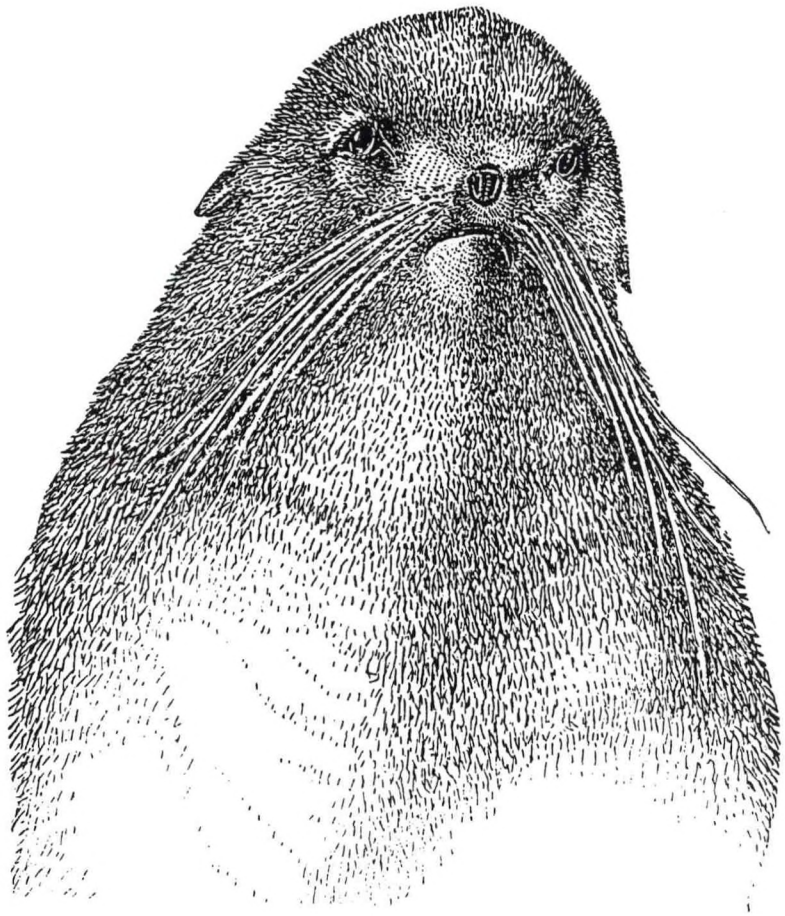

National Marine Mammal Laboratory
Alaska Fisheries Science Center
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7600 Sand Point Way NE, BIN C-15700
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ABSTRACT

Northern fur seal (Callorhinus ursinus) research in 1986 was conducted on the Pribilof Islands, Alaska, and on San Miguel Island and nearby Castle Rock in southern California.

Estimates made of the number of pups born on St. Paul Island in 1986 (167,656 ± 16,272) were not significantly different from the estimated total number born in 1985 (182,258 ± 18,887).

The estimated fractions of sheared animals determined from photographs and actual field counts (shearing-sampling method) taken during 1986 are not significantly different from each other.

Pelagic studies during 1986 were restricted to an analysis of feeding data collected near the Pribilof Islands during 1985. Studies showed that key predatory fish and fur seals consumed walleye pollock (Theragra chalcogramma) as a major dietary component. It was estimated that fur seals consumed as much pollock (132.5×10^3t) as walleye pollock did preying on pollock (134×10^3t).

Currently the population of the San Miguel Island fur seal colony appears to be slowly increasing and has now reached numbers observed in the late 1970's. The decline was associated with the 1983 El Niño event which brought about a 60% decline in pup production and a 48% decrease in numbers of adult females. In 1986 670 pups were born and a maximum female count was 422 or 65% and 67% of the 1982 values, respectively. On Castle Rock, a count of 576 pups represented an increase in pup production of 78.3% more pups than the 1985 count of 323 pups.

Preliminary indications are that fine growth lines are present in dentine of female northern fur seal teeth which may be related to feeding-nursing-fasting activities by the female during the breeding season.

Microprocessor time-depth recorders (MTDR) and radio transmitters attached to six subadult male northern fur seals indicate that entanglement of these animals in small pieces of trawl netting evidently increases the amount of time that they spend foraging at sea in addition to influencing the duration and depth of dives.

Selected rookery sections and nearby areas were cleaned of small debris of trawl and gillnet fragments, packing bands, etc., in which northern fur seals could potentially become entangled. These same areas were again cleaned about 2 months later. Observations suggest that pups become entangled in debris in the water rather than becoming entangled in debris on shore.

The magnitude of female entanglement (0.05%) was much less than generally observed for subadult males (0.42%); however, most entangled females were relatively young animals based on vibrissae color.

Entangled subadult males were captured and tagged during systematic roundups at hauling grounds and captured and tagged opportunistically during beach-walk surveys. For each entangled subadult male tagged, two nonentangled males were tagged as "controls" to study the effects of small net fragments on subadult male survival. In addition, two controls were tagged for each entangled subadult male which had been tagged in 1985. Of 85 entangled subadult males that were tagged in 1985, 12 (14.1%) were seen in 1986 compared to 37 of 176 controls (21%).

Thirty-nine of the 69 entangled fur seals observed during the late season surveys were captured and tagged (1 juvenile male, 14 pups, and 24 females). The 14 tagged pups were primarily entangled in trawl net webbing (64%) and trawl line (20%). Trawl net webbing was also the most common entangling debris (43%) on females.

CONTENTS

INTRODUCTION

by

Hiroshi Kajimura

The National Marine Mammal Laboratory (NMML) is responsible for collecting biological and management data on the northern fur seal (Callorhinus ursinus). This responsibility is mandated under the Fur Seal Act and the Marine Mammal Protection Act, in absence of the Fur Seal Convention which expired in 1984.

This report summarizes the research carried out by scientists from NMML at three northern fur seal breeding sites during 1986--two of the sites are major fur seal breeding colonies and are part of the Pribilof Islands in the eastern Bering Sea, and the third site is also a breeding colony on San Miguel Island, California. Pribilof Island fur seals are found on St. Paul (Fig. 1) and nearby Sea Lion Rock (Fig. 1--Sivutch), and on St. George Island (Fig. 2). The Pribilof Island breeding population consists of about 800,000 northern fur seals. Studies were not conducted during 1986 on seals found on Sea Lion Rock nor on Bogoslof Island. The latter is also located in the eastern Bering Sea and contains a small breeding colony of about 100 animals. The San Miguel Island and nearby Castle Rock (Fig. 3) breeding population fluctuates between 2,000 and 4,000 northern fur seals.

A total of 1,299 juvenile male fur seals (primarily 2- and 3-year-olds) were taken for local use as food on St. Paul Island in 1986. Similarly, on St. George Island, 124 juvenile male fur seals were harvested for local use as food. A moratorium on the commercial harvesting of seals on St. George Island was imposed beginning in 1973 and on St. Paul Island in 1985. Fur seals are not harvested on Sea Lion Rock, Bogoslof Island, Castle Rock,

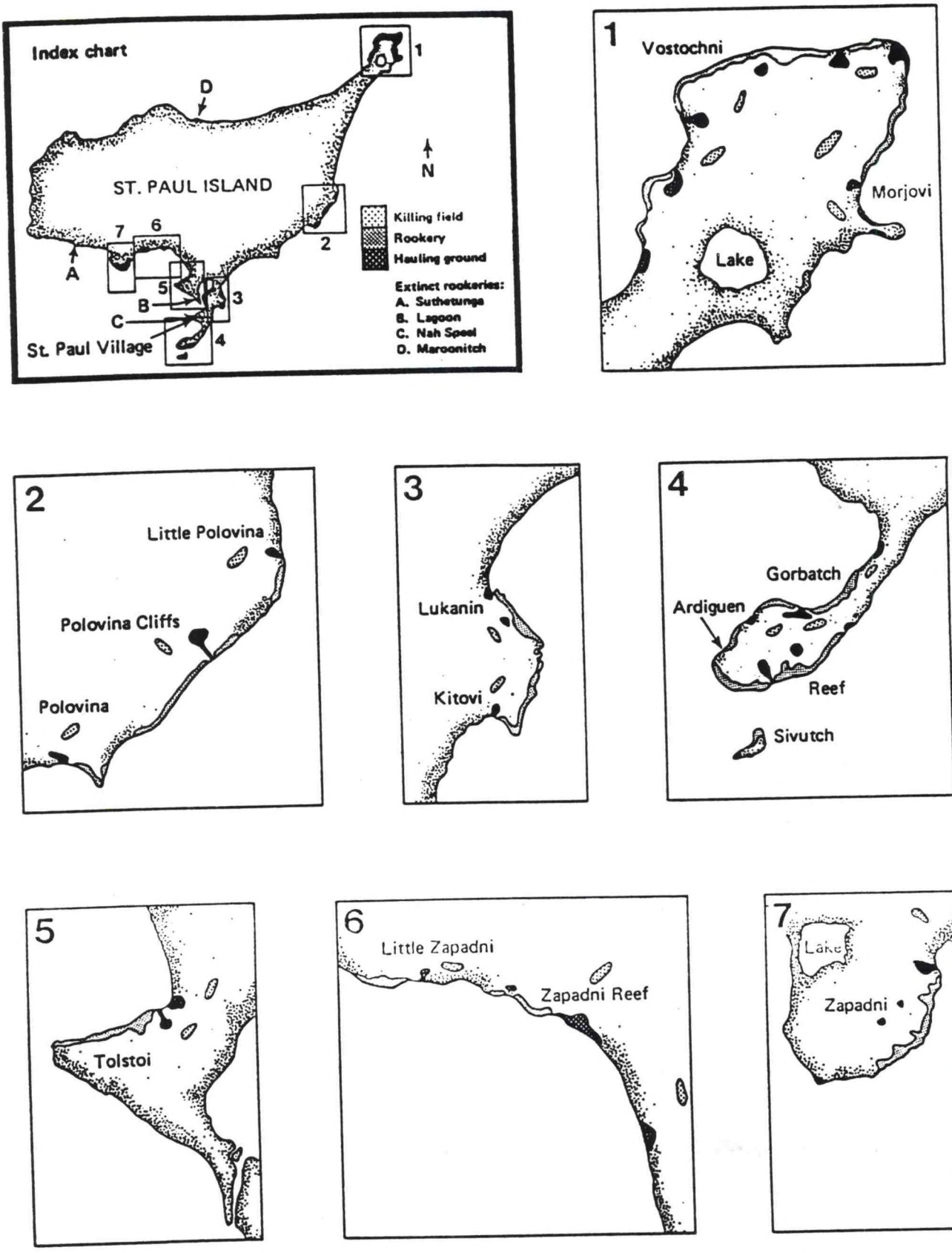

Figure 1.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. Paul Island, Alaska.

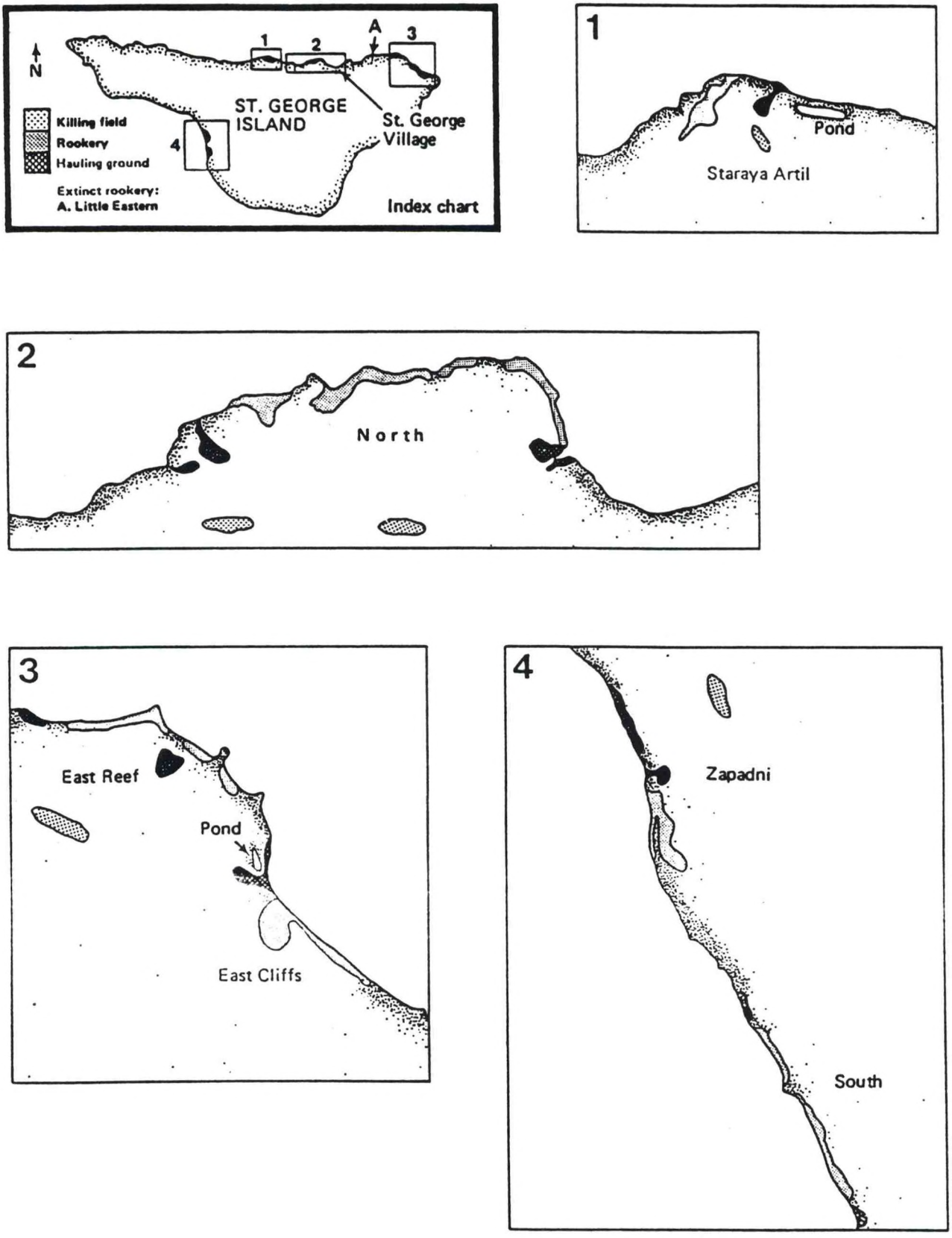

Figure 2.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. George Island, Alaska.

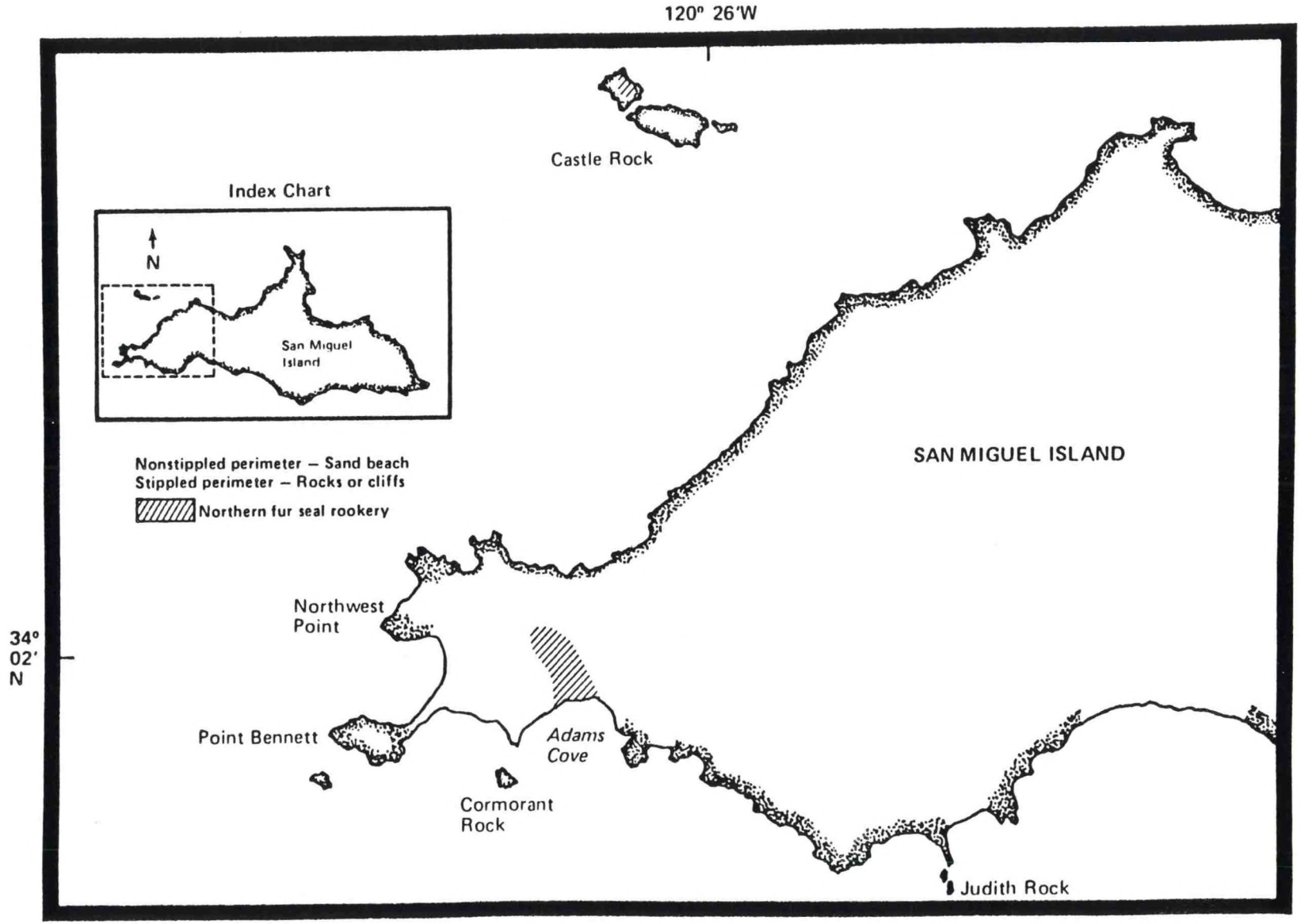

Figure 3.--Location of northern fur seal breeding colonies, San Miguel Island, California.

or San Miguel Island. Some juvenile males from these rookeries, however, may be subjected to a slight harvest mortality because they occasionally haul out at some distance from their rookeries of birth.

Terms having special meanings in northern fur seal research are defined in the glossary (Appendix A), and Russian names given to some of the rookeries of the Pribilof Islands following their discovery by Russian fur hunters in 1786 are translated in Table 1.

Tabular data for this report are presented as appendices. Appendix B includes the data presented concerning general studies, Appendix C includes entanglement related data, and Appendix D is a list of personnel involved in fur seal research in 1986.

This research was conducted under the authority of Marine Mammal Permit No. 561.

Table 1.--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	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 harvested 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.

POPULATION ASSESSMENT, PRIBILOF ISLANDS, ALASKA

by

Hiroshi Kajimura, Anne E. York, and Charles W. Fowler

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 in accordance with provisions originally established under terms of the Interim Convention on Conservation of North Pacific Fur Seals.

Population Parameters

Herd characteristics monitored by NMML personnel on the Pribilof Islands in 1986 included 1) age and sex composition of seals harvested for food on St. Paul Island, 2) number and sex of seals harvested for food on St. George Island, 3) number of live pups and adult males, and 4) number of dead pups and older seals.

Age and Sex Composition of Seals Harvested

Males Island residents made drives for the subsistence harvest from various hauling grounds on St. Paul Island during July and August. Smaller male seals (2-4 years old) were selected, although there were no restrictions on size. The age composition of the males taken was determined from a sample of 656 seals from which maxillary canine teeth were collected during the subsistence harvest (Appendix Tables B-1 and B-2). The sizes of the year classes of male seals harvested since 1971 are listed in Table 2. The age composition of males harvested on St. Paul Island since 1976 is shown in Table 3.

On St. George Island, 124 subadult male seals of approximate ages 2-3 years were taken for food from the east hauling ground of North rookery.

Females--In 1986, 15 young females through 6 years of age were inadvertently taken during the 27 September subsistence harvest of males on St. Paul Island because of their similarities in size and in vibrissae color to 3 to 4-year-old males. However, one female seal killed accidently was older than 10 years of age. 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 1986, 4,603 harem (class 3, see Appendix A for definition) and 1,865 idle (class 1, 2, 4, and 5) adult male fur seals (bulls) were counted on St. Paul Island from 11 to 21 July (Appendix Tables B-3, B-4, and B-5). On St. George Island, 1,394 harem and 1,342 idle bulls were counted from 13 to 14 July (Appendix Tables B-4 and B-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. Class 2 in Figure 4 corresponds to classes 1 and 2 of Appendix A; class 5 corresponds to classes 4 and 5 of Appendix A.

Dead Seals Older Than Pups Counted

The rookeries and adjacent beaches of St. Paul Island were surveyed for dead seals older than pups from 15 to 18 August. The count of dead seals totaled 91 animals (67 females and 24 males). Table 3 lists the number of these seals counted on the Pribilof Islands since 1965.

Table 2.--Numbers of male northern fur seals harvested by age group, St. Paul Island, Alaska, 1971-84 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	3,047	13,976	496	5	17,524
1982[b]	3,133	2,645	81	-	5,859
1983[b]	234	542	-	-	776
1984[b]	521	-	-	-	521
Total	22,914	163,962	78,847	5,111	270,834
Mean	1,637	12,612	6,570	465	19,345[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 on the harvest, and following 1985, the harvest was limited to a subsistence take for food.

[b]Incomplete returns.

[c]1982, 1983, and 1984 year classes not included.

Table 3.--Age classification of the numbers of male northern fur seals harvested, St. Paul Island, Alaska, 1976-86.

Year of harvest	Number of seals: Age group 1	2	3	4	5	6	Total harvested
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
1986[b]	3	521	542	81	5	0	1,149

[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. Numbers shown are based on tooth samples collected during the subsistence harvest.

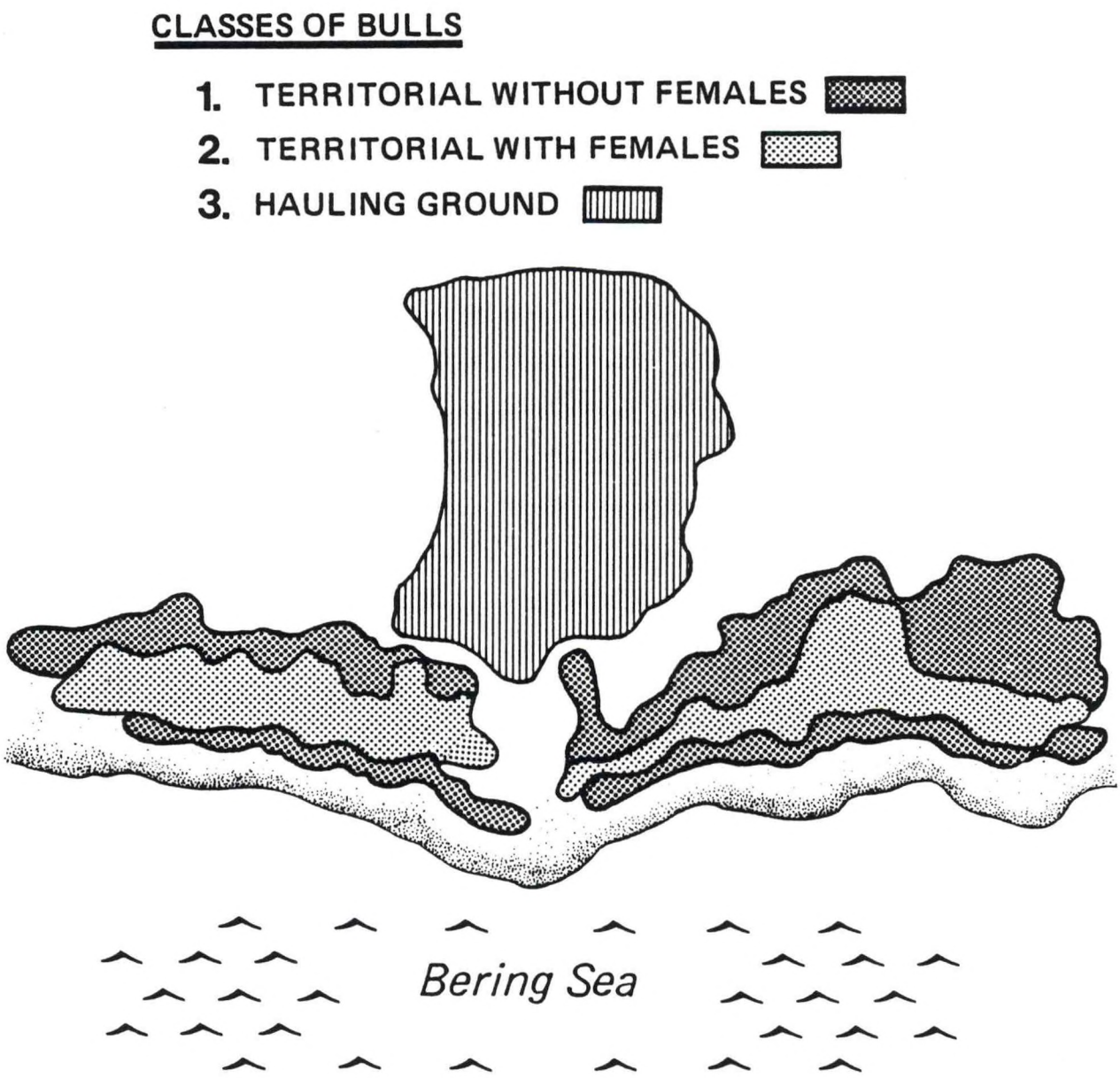

Figure 4.-- General composition of a typical fur seal rookery. Class 2 as depicted here corresponds to classes 1 and 2 of Appendix A and class 5 corresponds to classes 4 and 5 of Appendix A.

Table 4.--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	5	34	17	35	22	69
1986	24	67	-	-	24	67

*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 1986, 7,771 dead fur seal pups were counted on all rookeries of St. Paul Island from 15 to 21 August (Appendix Table B-6). Counts of dead pups were not made on St. George Island during 1986. The numbers of dead pups counted on both islands by rookery since 1976 are given in Appendix Table B-7.

Number of pups born in 1986 at St. Paul Island

The estimated total number of pups alive at the time of shearing and its standard error were calculated using subsamples of rookeries since 1980. The ratio of live pups to bulls on the sample rookeries was computed from the mean estimate from both sampling periods (Table 5) and the mid-July count of harem males (Appendix Table B-4). The estimate of the ratio of number of pups born was computed by multiplying the estimated ratio by total numbers of breeding males on all rookeries and adding the count of dead pups as follows:

Rookery	Number of pups	Number of breeding males	Ratio pups/bulls	r	r*
Vostochni	24,895	736	34.43	35.30	33.84
Polovina Cliffs	14,115	391	37.74	34.14	37.33
Polovina	2,437	58	41.17	34.72	35.57
Tolstoi	18,797	581	33.08	35.85	32.20
Total	60,244	1,766	34.11		

where r is the ratio of pups to bulls on all but the particular sample rookery and $r^* = 4r-3r$ where r^* is the ratio of pups to breeding males on all the sample rookeries (Kozloff 1982). The jackknife estimate of the ratio of pups to bulls is

Table 5.--Estimated number of northern fur seal pups in 1986 at times of shearing and sampling on four rookeries of St. Paul Island, Alaska; pups were sheared 9-12 August; sampling periods 1 and 2 were 15-16 and 19-20 August, respectively.

	Rookery				
	Polovina	Polovina Cliffs	Tolstoi	Vostochni	Total
No. pups sheared	367	1,713	2,427	2,858	7,365
No. 25-pup samples					
Period 1	68	422	315	518	-
Period 2	40	340	265	477	-
No. sheared pups counted					
Period 1	259	1,223	977	1,446	-
Period 2	155	988	852	1,359	-
Estimated No. pups alive*					
Period 1	2,409	14,777	19,563	25,596	62,345
Period 2	2,368	14,737	18,872	25,078	61,055
Mean, both periods	2,388	14,757	19,218	25,337	61,700
Number of dead pups counted	67	591	1,062	891	2,611
Total number born	2,455	15,348	20,280	26,228	64,311

*Estimated from $n = mc/r$ (m is the number of pups sheared, c is the total number of pups counted, and r is the number of sheared pups counted).

$$\hat{R} = \frac{1}{4} \sum_{i=1}^{4} r_i^* = 34.735$$

with variance:

$$\hat{V} = \frac{1}{4} \sum_{i=1}^{4} \frac{(r_i^* - \hat{R})^2}{3} = 1.221.$$

Thus, an approximate 95% confidence interval for the ratio of live pups to harem males is 34.7 ± (1.105) (3.182) or 34.735 ± 3.5161. The total number of breeding males counted on all rookeries of St. Paul Island was 4,603 (Appendix Table B-4). Therefore, the estimated number of pups alive at shearing was 159,885 ± 16,272. The total number of dead pups counted on all rookeries of St. Paul was 7,771 and the estimated number of pups born (with approximate 95% confidence interval) was 167,656 ± 16,184. The mortality rate of pups on the rookeries was approximately 4.64%.

The estimated number of pups born on St. Paul during 1986 was not significantly different from the estimated number born during 1985 (182,258 ± 18,807). Figure 5 shows the total number of pups with approximate 95% confidence intervals for those years during 1970-86 in which the shearing-sampling procedure was carried out on at least two sample rookeries and bull counts were conducted on all rookeries. The number of pups born on St. Paul Island decreased sharply during 1975-81 (approximately 7.8% per year); the number of pups born on St. Paul Island has not decreased significantly ($P < 0.05$) since 1981.

Mark Recoveries

During the 1986 field season on St. Paul and San Miguel Islands, 36 seals marked by the Soviet Union were resighted (Appendix Table B-8).

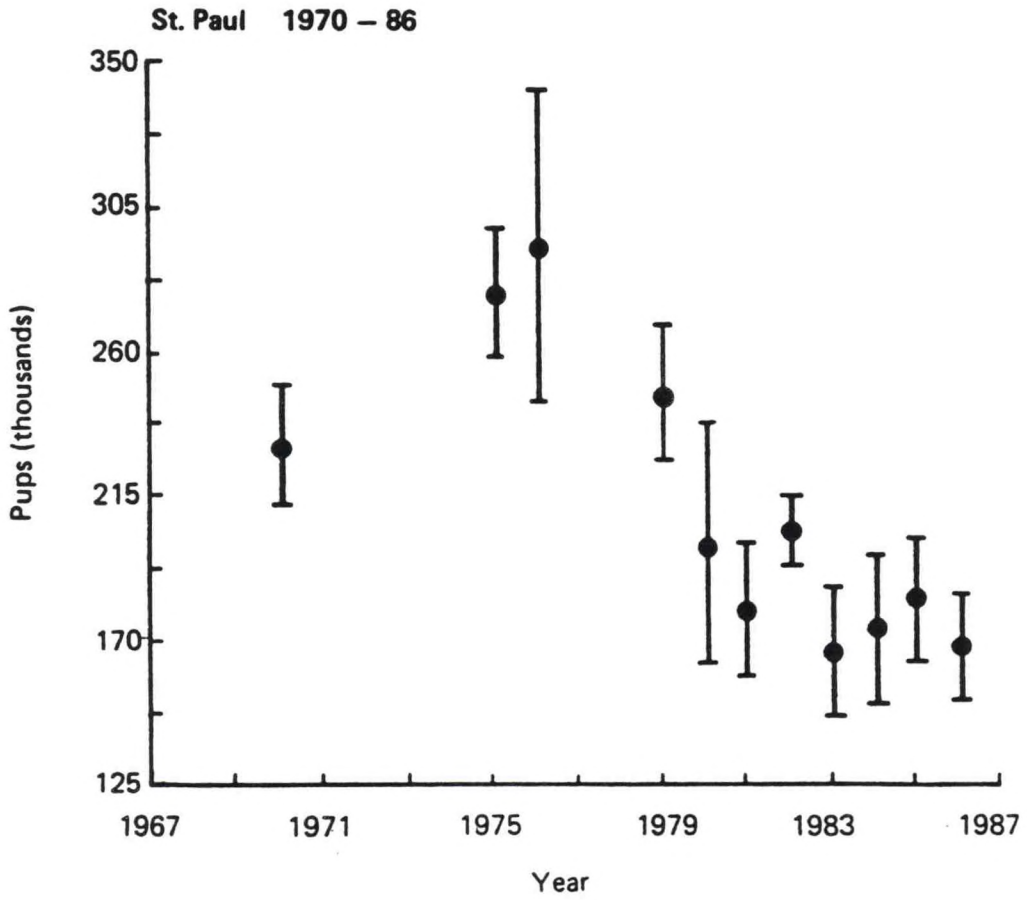

Figure 5.--Number of pups born on St. Paul Island, Alaska, 1970, 1975-76, and 1978-86 (approximate 95% confidence intervals).

STUDIES ON THE BIAS OF THE SHEARING-SAMPLING METHOD

by

Anne E. York

Since 1961, the number of fur seal pups on the Pribilof Islands has been estimated using the shearing-sampling method, a type of mark-resighting procedure. During the first or second week of August, a crew passes through the rookeries and marks large numbers of pups by shearing a small portion of hair from the top of the head. The shearing exposes the pale underfur and produces an easily identifiable mark. Major concerns during "shearing-sampling" are the safety of the crew, the accuracy of the estimate, and the minimization of disturbance to the rookeries. Because it is extremely dangerous to do this work when the breeding males are actively defending their territories, the shearing-sampling is done as the breeding structure breaks up, but before the pups begin spending large amounts of time in the water.

Because of the pups' tendency to cluster in large groups, it is necessary to distribute the marking effort throughout a rookery so that each pup has an approximately equal chance of being marked. The number of pups to be sheared within a particular rookery section (in the mid-1960's, the rookeries were subdivided into numbered sections) is proportional to the number of territorial adult males with females counted there in mid-July (Chapman and Johnson 1968). The marks are then distributed randomly throughout each rookery subsection. The total number of pups to be sheared on St. Paul Island is approximately 10% of the number of pups estimated during the previous estimation period.

At least 3 days after the marking, the rookeries are sampled to determine the ratio of marked to unmarked animals. Two or three samplers begin at one end of a rookery and proceed, more or less abreast, to the opposite end. The person nearest to the water stays ahead of the others (approximately 5 m) so that pups near the shoreline are not driven into the water before a count can be obtained. Samplers begin their count by sighting on a fixed object and count different groups of pups. Twenty-five pups are counted within the vicinity of the object, along a line away from the object, or as the pups file past the object. The number of sheared pups within each group of 25 is noted in a waterproof notebook. The procedure of beginning the counts in the vicinity of a fixed object is intended to eliminate the tendency of the human eye to be attracted to a marked pup. The samplers do not discuss their results until the completion of the survey. Each rookery is sampled on two separate occasions (at 3- to 4-day intervals) to estimate the ratio of marked to unmarked animals. This is done to determine if estimates from the two sampling periods are consistent and to allow the calculation of estimates of the variance of the population estimate for each rookery.

Potential sources of bias of the shearing-sampling method are violations of the assumptions required for the mark-recapture estimate to be unbiased. Most importantly, during the marking phase each pup must have an equal chance of being marked and during the resighting phase, the marked pups must have the same probability of being observed as the unmarked pups. The only direct method of assessing the bias of estimates based on shearing-sampling has been to count the total number of living pups. Such counts, however, can be satisfactorily made on only 3 or 4 of the 21 rookeries on

the Pribilof Islands. Total pup counts require 6 to 10 individuals: two are primary counters, two keep the pups moving between the counters, and the rest prevent counted pups from mixing with the uncounted animals. Pups are then driven past the counters and tallies made of the total. In the past, separate tallies were not made of the sheared and nonsheared animals; in the future, if counting is done on a rookery, it is recommended that such data be collected as an additional check on the shearing-sampling estimate.

When the shearing-sampling method was first developed, studies were done to determine if the method tended to be biased. For several years, both total pup counts and shearing-sampling estimates were made on some small rookeries. Although these early data tended to support the idea that the two methods produced similar estimates of the total pup population (Chapman and Johnson 1968), it is important to monitor the accuracy of an estimation procedure from time to time. Various components of the process might have changed since the method was first developed. For example, persons doing the sampling have varied from year to year and, if a bias were introduced gradually over time, it would seriously affect any estimate of the rate of decrease of the number of pups born.

The purposes of the present report are to: 1) reanalyze data where total pup counts and shearing-sampling estimates were made during the same season, and 2) study the accuracy and reliability of the shearing-sampling estimate based on photographs of groups of sheared and nonsheared pups. Photographs of groups of sheared and nonsheared pups are available from North rookery on St. George Island for 1976 and 1977; from Polovina Cliffs, Kitovi, and Reef rookeries on St. Paul Island for 1985; and from Tolstoi, Polovina Cliffs, and Polovina rookeries for 1986. Since the quality and

suitability of the photographs vary substantially, I used the photographs taken during 1986 on St. Paul Island in this first analysis because they were the best photographs taken under the most controlled conditions.

Methods

During the 1986 field season, color transparencies of groups of fur seal pups were taken during the second sampling period of the census on Tolstoi, Polovina, and Polovina Cliffs rookeries. Three persons counted sheared and nonsheared animals and one person photographed pups. The photographer alternated among the samplers, attempting to photograph approximately an equal number of photos from behind each counter and attempting to take the photograph in the direction of the line of sight of the sampler.

Two persons counted pups from projected transparencies. They made separate counts of sheared and nonsheared pups for each slide and counted an animal only if (as best they could determine) the top of the head was visible. To assess the consistency of the counters, each counter replicated counts for one roll of film.

The fraction of sheared animals in the photographs and its standard error were computed for each rookery (Table 6). Because the quality of photographs varied substantially, the overall fraction of sheared animals from the photographs was estimated using a general linear model (Nelder and Wedderburn 1982) with weights proportional to the standard error of the proportions. Standard errors were computed using the observations of the two counters as independent replicates. These were compared to fractions obtained from field counts (Table 6).

Rookeries for which both total pup counts and shearing-sampling estimates exist were assembled from the annual reports of fur seal investigations (Table 7). I found 12 cases for which both shearing-sampling and counts were available. The standard error of the shearing-sampling estimate was computed as described in the introduction of this paper. Chapman and Johnson (1968) compared the counts and shearing-sampling estimates using a sign test. Six of 12 counts were less than the shearing-sampling estimate and 6 were greater; on that basis one would not reject a hypothesis that the counts were the same. I also tested the hypothesis that each count is the same as the shearing-sampling estimate by comparing the "studentized" difference of the two estimates (that is, the difference of the estimates divided by the standard error of the shearing-sampling estimate) to a Student's t distribution with 1 degree of freedom. York and Kozloff (1987) found that this was a satisfactory method of computing confidence intervals for the shearing-sampling estimate; this procedure rejects the hypothesis of equality of the counts and the shearing-sampling estimates if the counts lie outside a specified confidence interval of the shearing-sampling estimates. In addition, I compared the distribution of the difference of the counts and the shearing-sampling estimates (standardized by the standard error of the shearing-sampling estimates) to a Student's t distribution with 1 degree of freedom using a Kolmogorov-Smirnov statistic.

Table 6. Comparison of fraction of sheared pups from photographs and field observations. Sample sizes are numbers of photographs and numbers of 25 pup samples available for each rookery.

		Photographs			Field data	
Date	Rookery	N	Fraction of sheared pups	Approx 95% CI	N	Fraction of sheared pups
8/19/86	Polovina	17	0.158	0.128-0.194	40	0.155
8/19/86	Polo. Cl.	47	0.123	0.110-0.136	316	0.116
8/20/86	Tolstoi	52	0.120	0.107-0.132	265	0.129

Table 7. Summary of counts and duplicate shearing-sampling estimates available of numbers of fur seal pups born on St. Paul Island, Alaska, 1963-68.

			Shearing sampling estimate		Count-mean
Year	Rookery	Count	Mean	SD	SD
1963	Little Polovina	7,230	6,519	12	59.25
1964	Morjovi	17,530	17,750	320	0.69
	Little Polovina	7,180	8,385	255	4.73
	Zapadni Reef	5,700	6,515	193	4.22
1965	Little Polovina	7,314	6,118	237	5.04
	Morjovi	18,384	15,435	204	14.45
	Zapadni Reef	5,383	5,422	58	0.67
1966	Little Polovina	7,071	8,698	673	2.42
	Morjovi	17,388	19,165	817	2.18
	Zapadni Reef	5,729	4,942	9	87.44
1968	Morjovi	16,781	15,937	646	1.31
	Zapadni Reef	5,916	4,554	189	7.21

Results

The estimated fractions of sheared pups obtained from photographs and from field counts were not significantly different from each other on any rookery (Table 6). For one rookery, the fraction of sheared pups was higher than the field counts, for another somewhat lower, and for the last, the fractions were essentially the same.

The reanalysis of the duplicate total count and shearing-sampling data in Table 7, using the Kolmogorov-Smirnov statistic rejects the hypothesis ($d = 0.368$, d.f. = 12, $P < 0.05$) that the standardized differences between the counts and shearing-sampling estimates follow a Student's t distribution with 1 degree of freedom. On the other hand, if we test the hypothesis that the counts and the means are equal using a t-test, we reject the hypothesis in 3 out of 12 cases at the 0.05 level and in 4 out of 12 cases at the 0.10 level; the probability of rejection rates higher or as high as these is 0.0022 and 0.0043. In every case of rejection of the hypothesis of equality, the count is higher than the shearing-sampling estimate.

Discussion

The fractions of sheared animals from photographs and field data (shearing-sampling method) taken during 1986 are not significantly different from each other. Since counting sheared and nonsheared animals in photographs could be biased in similar directions, it is not valid to conclude that either method produces an unbiased estimate of the number of fur seal pups. We can only conclude from the study of photographs, that in 1986, the samplers saw the same fraction of sheared pups as the photographers--that is, that the two methods were consistent.

The reanalysis of the duplicate total pup counts and shearing-sampling estimates is confusing. On one hand, the sign test indicates that there is an equal probability that the count will be greater or less than the shearing-sampling estimate; but, on the other hand, analyses which take into account the standard error of the shearing-sampling estimate indicate that the estimates are significantly different more often than we would expect under the null hypothesis of no difference. Furthermore, in each case of rejection of the hypothesis of equality of the counts and shearing-sampling estimates, the count is significantly greater.

It is important to know if the shearing-sampling method is biased or not and if so, in what direction. Unfortunately, it may not be possible to answer the question, because every method proposed to study the bias potentially has its own bias problems. Counts could be positively biased if double counting were a problem, or negatively biased if large numbers of animals were somehow unavailable for counting. Most previous discussion on the bias of the shearing-sampling method has indicated that if there is bias, it is probably negative. Roppel et al. (1981) confirmed that sheared pups were significantly lighter than nonsheared pups. Thus, the selection of pups for shearing is biased toward lighter animals. If the larger, nonsheared pups are more likely to spend time in the water than the lighter, sheared pups, then the fraction of sheared animals counted during the sighting surveys would be positively biased and therefore the estimate of the population size (the number of animals that was sheared divided by the fraction of sheared animals in the sightings) would be negatively biased. Another potential source of bias in the shearing-sampling estimation procedure is the high visibility of

the sheared animals. Because the observer's eye is attracted to a marked animal, it is very difficult to count in a random manner. Circumstantial evidence that some counters are probably biased towards counting marked animals is the lack of zero counts of sheared animals among groups of 25 animals. If the sheared animals are randomly distributed on the rookery, and samples of sheared and nonsheared animals are taken at random, and if 10% of all pups were sheared, we would expect, on the average, that about 7% of the samples of 25 animals would contain no sheared animals. Some observers have only 1 or 2% zero samples out of more than 500-600 samples. Another complicating factor might be that the sheared animals are not randomly distributed on the rookery. If there is a tendency of the animals to clump, this should not bias the estimate but it would bias the estimate of the variance of the estimate.

There are also factors which would lead to a positive bias in the shearing-sampling estimate. Counters who are aware of the potential bias of lack of zero counts might inadvertently overcompensate, which may result in a positive bias because their counts have relatively fewer sheared animals. If the shearing crew is not honest and reliable and fewer animals are sheared than were prescribed, the resulting estimate is positively biased.

An important implication of potential bias in the shearing-sampling estimate is its effect on the estimate of the rate of increase or decrease of the population. If the bias is constant over time, the estimate of the rate of change in the population is not greatly affected; however, the variance of the rate of change is underestimated if we are unaware of the bias. If there is a trend in the bias, then a rate of change of the population could be

underestimated or overestimated, depending on the rate of change in the bias; in both cases, the variance of the rate of change is underestimated. At present, there is no evidence that this has ever happened; we must be aware of the problems that biased methods cause and realize the importance of monitoring our population assessment methods to avoid both bias and any change in bias.

The method of using photographs to study the bias of the shearing-sampling methods shares some of the problems of the shearing-sampling method as employed in the field. If the method of choosing animals for shearing is biased, then the photographs cannot overcome that. If the counter's eyes are attracted differentially to the sheared animals, then the photographer's eye might also be--especially if the photographer is conscientiously taking pictures along the line of sight of the counter. Other more difficult problems with counting sheared animals from photographs are the additional potential biases introduced with the photograph: molt can be mistaken for a shear mark; lighting can make an animal appear to have a shear mark; and, in general, since it is usually easier deciding that an animal is sheared rather than not sheared, relatively more sheared animals may have been uncounted. All of these factors positively bias the estimate of the number of marked animals in the population and therefore negatively bias the estimate of the total number of pups.

In spite of these problems, the preliminary results of this study indicate that the fractions of sheared animals obtained from photographs and from the field studies are not significantly different from each other. However, the inconsistency between the counts and shearing-sampling estimates is disturbing and further studies could be done. First, if total counts are

ever made on any rookery, it is strongly recommended that separate tallies of sheared and nonsheared animals be collected. This would give an additional check on the shearing-sampling estimate. The preliminary photographic work appears satisfactory, but it could be improved if, in addition to the design carried out in 1986, a technique were also developed to randomly select and photograph groups of pups. In the future, we may want to conduct investigations concerning the heterogeneity of behavior of sheared and non-sheared pups. Such studies might indicate which animals tend to be sheared and which resighted and if there are major differences in rates of resighting non-sheared vs. sheared animals. This is perhaps our best hope for understanding the processes that govern the selection of animals for shearing and resighting.

Acknowledgements

H. R. Huber generously counted animals on photographs and critically reviewed the manuscript. L. Briggs photographed samples during the shearing-sampling.

NORTHERN FUR SEAL PREDATION STUDIES NEAR THE PRIBILOF ISLANDS, ALASKA

by

Thomas R. Loughlin

Pelagic studies during 1986 were restricted to an analysis of dietary data collected near the Pribilof Islands during 1985. This analysis compares present feeding data to data collected in the past.

Comparison of past studies on fur seal feeding habits showed that the percentage of fish (60-66%) and squid (33-39%) in the fur seal diet has remained relatively constant (Table 8). Walleye pollock (Theragra chalcogramma) was the predominant food item in most years, except 1963-64 when pollock abundance may have been low. The time female fur seals spend at sea on feeding trips has declined from the early 1960's to 1985, although the diet has not changed appreciably (Table 9).

Cooperative studies by the National Marine Mammal Laboratory and Resource Ecology and Fisheries Management Division near the Pribilof Islands during 1984 and 1985 showed that fish that prey on walleye pollock and fur seals consumed walleye pollock as a major dietary component (Appendix Table B-9). During the 1985 studies, walleye pollock 38-48 cm long were abundant in the sample area, but fur seals consumed mostly 12.5-18.6 cm pollock (age 1) in terms of numbers (Fig. 6). Fur seals consumed walleye pollock in the size range of 4-40 cm during previous study years. Examination of fur seal scats and colons in 1985 yielded diet information similar to information gathered from fur seal stomachs.

Table 8.--Diet composition data of northern fur seals in the eastern Bering Sea from July to October based on frequency of occurrence data normalized to sum to 100%.

	Percent frequency of occurrence (normalized)					
	Eastern Bering Sea (area unspecified)		Study area near Pribilof Islands (55-59 `N x 170-175 `W)			
Prey species	1892[a] A	1955[b] B	1960-62[c] C	1963-64[c] D	1973-74[c] E	1985 F
FISH:						
Walleye pollock (Theragra chalcogramma)	46.47	25.53	42.92	13.01	22.00	26.99
Pacific cod (Gadus macrocephalus)	0.52	0.81	-	0.12	2.70	-
Gadidae (Unidentified)[d]	-	-	-	5.97	19.85	8.10
Pacific lamprey (Lampetra tridentata)	2.11	-	-	-	0.12	-
Pacific herring (Clupea harengus pallasi)	-	-	-	7.43	-	-
Salmonidae	3.70	0.71	2.43	2.48	0.36	-
Osmeridae (Unidentified)	-	-	0.81	-	1.09	-
Capelin (Mallotus villosus)	-	31.91	4.05	4.95	1.69	-
Eulachon (Thaleichthys pacificus)	-	-	0.81	-	-	-
Bathylagidae	12.14	-	-	4.95	1.33	4.88
Myctophidae	-	-	-	-	0.12	-
Sablefish (Anoplopoma fimbria)	-	-	-	-	0.24	-
Atka mackerel (Pleurogrammus monopterygius)	-	-	1.62	1.93	1.33	-
Lumpsuckers (Cyclopteridae)	-	-	-	1.10	0.24	-
Pacific sandfish (Trichodon trichodon)	-	-	-	0.28	-	-
Pacific sand lance (Ammodytes hexapterus)	-	1.71	-	3.03	-	-
Wolfish (Anarhichadidae)	0.53	-	-	1.10	0.24	-
Pleuronectidae (Unidentified)	-	-	-	1.93	-	-
Pacific halibut (Hippoglossus stenolepis)	-	-	0.81	-	-	-
Greenland turbot (Reinhardtius hippoglossoides)	-	-	-	8.53	9.17	-
Unidentified fish[e]	-	1.42	7.29	4.68	7.36	25.59
Subtotal (fish)	65.47	60.28	61.54	61.34	65.01	68.25
CEPHALOPODS:						
Octopus	0.70	-	-	-	-	-
Squid (Gonatidae)[f]	33.83	39.72	38.46	38.66	34.99	31.75
Subtotal (cephalopods)	34.53	39.72	38.46	38.66	34.99	31.75
Total	100.00	100.00	100.00	100.00	100.00	100.00
Number of stomachs with food	100	114	97	217	486	43

[a]Study by Alexander; data given in Lucas (1899). Collections presumably near Pribilof Islands.

[b]Collections made primarily near Unimak Pass and in transit to the Pribilof Islands from 17 June to 20 July (Wilke, and Kenyon 1957). The actual frequency of stomachs with fish was not given, and the percentage of total fish may be underestimated relative to squid.

[c]Based on reanalysis of the original data for the specified area.

[d]Gadidae (Unidentified) includes mainly specimens of walleye pollock or Pacific cod which could not be identified to species.

[e]Unidentified fish may also include some specimens of the other given prey species where the remains could not be identified to taxa, in addition to species not listed in the table.

[f]Only squids of the family Gonatidae have been identified to date in stomach contents of northern fur seals taken in the Bering Sea. Due to difficulties in identification to taxa in past years, all squid species have been pooled.

Table 9.--Mean duration (dur.) in days of the first feeding trip, all feeding trips beginning in July, and all feeding trips observed during July and August for northern fur seals from St. Paul Island, Alaska, 1951 to 1985.

		First trip			July trips			All trips			
Rookery	Year	Dur.	SD	N	Dur.[a]	SD	n[b]	Dur.	SD	N	Ref[c]
Kitovi	1951	5.9	1.5	12	7.2	1.9	30	7.2	1.9	30	1
Kitovi	1962	7.8	2.3	33	8.4	2.8	58	9.7	2.8	146	2
Kitovi	1963	6.6	1.8	26	7.4	1.9	49	8.0	2.1	85	2
Kitovi	1976	5.0	2.2	11	7.0	2.4	25	8.5	2.4	106	3
Kitovi	1977	5.7	2.1	26	6.8	2.3	77	7.1	2.1	314	3
Zapadni	1984	3.5	1.4	32	5.7	2.5	151	5.9	2.5	171	4
Kitovi	1985	3.5	1.4	20	4.5	1.6	59	--	--	--	5
ANOVA		p>0.99			p>0.99			p>0.99			

[a]Includes only feeding trips that began in July.

[b]N = number of trips.

[c]References: 1) Bartholomew and Hoel (1953); 2) Peterson (1968; used only values for females when the first at-sea trip was provided); 3) Gentry and Holt (1986), and NMML files (for July data); 4) present study; and 5) Goebel (1988).

Figure 6a.

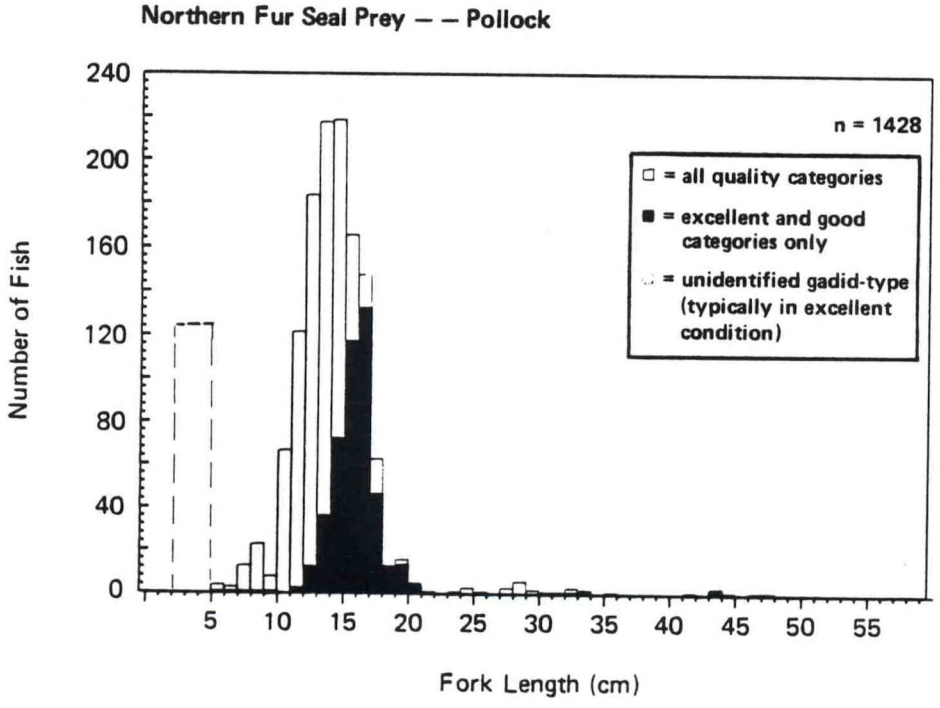

Figure 6b.

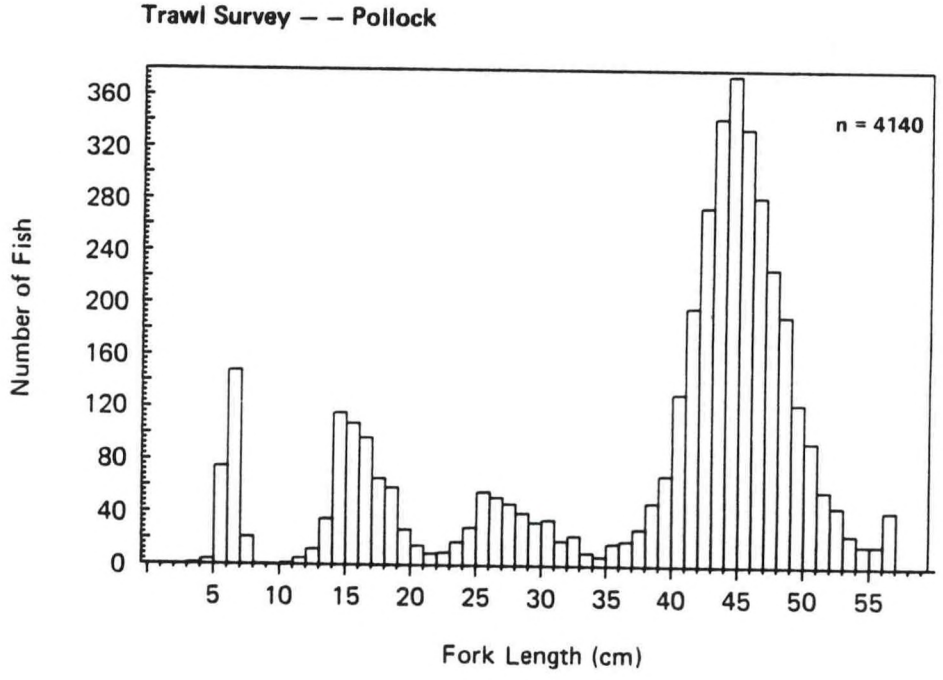

Figure 6.—Fork length frequencies (cm) for walleye pollock from fur seal stomach contents (6a) and bottom and midwater trawls (6b) (note: the y axes on each figure are scaled differently).

Fish that prey on pollock consumed all sizes of pollock, but small (age 0) pollock were the dominant size group eaten in terms of numbers. Thus, in 1985 when age-1 pollock were abundant, predatory fish and northern fur seals utilized this common food resource. These results indicate that the pollock food web of Kajimura and Fowler (1984) should also show a major flow of pollock juveniles (2-20 cm) going to the northern fur seal (Fig. 7). There was a noticeable lack of 2- to 3-year-old (22-35 cm) pollock caught during trawl surveys in 1985; it would, therefore, be informative to study the change in diet of predatory fish and fur seals in years of abundant 2- and 3-year-old pollock.

It also appears that the fishery removal of large walleye pollock did not remove food resources utilized by fur seals in 1985. Since large pollock consume 1-year-old or medium pollock, which were the major food source of fur seals sampled in 1985, the walleye pollock fishery in the fur seal feeding areas of the eastern Bering Sea may even have a beneficial effect on the abundance of appropriately sized prey for fur seals (as suggested by Swartzman and Haar 1983)). It may, however, be detrimental to other marine mammal species (Frost and Lowry 1986).

Fur seals consumed about as much pollock (132.5 x 10^3t) as walleye pollock did eating pollock (134 x 10^3t) (Loughlin and Livingston 1986). Commercial pollock fisheries operating in the sample areas removed about 104 x 10^3t of mostly large pollock during the period 1 July to 31 October. Predatory fish consuming all size groups of pollock accounted for 296 x 10^3t of pollock.

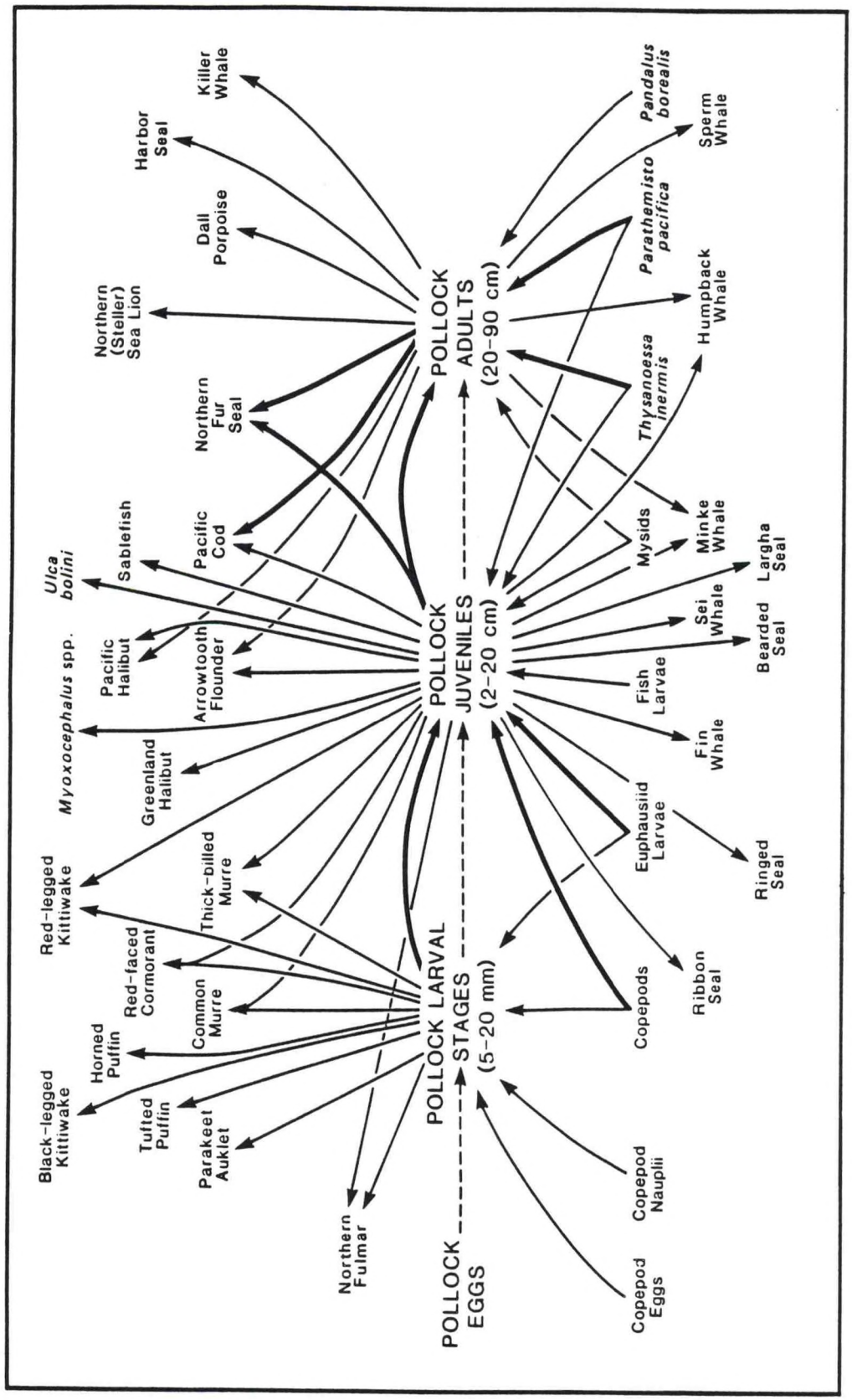

Figure 7.--Apparent food web based on walleye pollock in the eastern Bering Sea (modified from Smith 1981).

Studies of radio-tagged female fur seals (from Zapadni Reef and Northeast Point rookeries) during 1984 and 1985 (Loughlin et al. 1987) showed that feeding locations were predominantly northwest and southwest of St. Paul Island. Some had feeding trips resulting in round-trip distances of over 400 km. Further research on the feeding range of fur seals in the eastern Bering Sea and the competition for food resources with predatory fish throughout this range is important. It would provide more details about the dynamics of food chain interactions in years with differing availability of pollock age groups--the major resource for fish, mammals, seabirds, and man in this area of the eastern Bering Sea.

(This report is a summary of papers written by numerous authors in Loughlin and Livingston (1986)).

POPULATION AND BEHAVIORAL STUDIES, SAN MIGUEL ISLAND, CALIFORNIA (ADAMS COVE AND CASTLE ROCK)

by

George A. Antonelis, Jr., Robert L. DeLong, and Patrick J. Gearin

Adams Cove

The 1986 field season on San Miguel Island, California, extended from 8 June through 31 July. There were 23 adult males, 19 subadult males (bachelors), 9 adult females, and 3 live pups on the rookery when studies began on 8 June. Research activities included population monitoring and a tagging program at Adams Cove and Castle Rock.

A total of 670 pups were born at the Adams Cove colony in 1986. Maximum counts of 55 large adult[1], 11 small adult[2] and 95 bachelor males were recorded on 15 July, 29 June, and 21 July, respectively. The greatest number of adult females (422) ashore occurred on 12 July. Population information for the Adams Cove colony of northern fur seals is summarized in Table 10 for 1981-1986.

Although pup production at Adams Cove has not yet reached the number recorded in 1982 (1,029), it appears as if the colony is recovering from the 1983 El Niño event, which was associated with a 60% decline in pup production and 48% decrease in numbers of adult females. Since 1983, the

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[1]Large adult males--refers to males of similar size to those with harems on the Pribilof Islands (maximum size).

[2]Small adult males--refers to males that appear physically mature (having all secondary sex characteristics) but are smaller than other adult males.

Table 10.--Summary of observations on the northern fur seal colony in Adams Cove, San Miguel Island, California, 1981-86.

Observations	1981	1982	1983	1984	1985	1986
Season span						
Beginning date	9 June	9 June	10 June	11 June	11 June	8 June
Ending date	13 Sept.	6 Dec.	20 Aug.	4 Aug.	28 Aug.	31 July
First male	9 June[a]	9 June[b]	10 June[c]	13 June[d]	11 June[e]	8 June[f]
First female	9 June[a]	9 June[b]	10 June[c]	13 June[d]	11 June[e]	8 June[f]
First birth	9 June[a]	9 June[b]	10 June[c]	13 June[d]	11 June[e]	8 June[f]
Mean birth date	16 June	25 June[g]	2 July	25 June[g]	1 July	2 July
Median birth date	28 June	28 June	1 July	26 June	30 June	3 July
Total births	941	1,029	408	478	458	670
Total pup deaths	289	51	89	44	17	82
Total females (maximum counted & date[h])	717 1 July	628 8 July	377 15 July	333 6 July	315 1 July	422 12 July
Total large adult males	10	30	31	26[i]	28[i]	55[i]
Total small adult males	11	22[j]	30[j]	18[j]	13[j]	11[j]
Total subadult males	95[j]	88[i]	37[i]	49[i]	54[i]	95[i]

[a]Seven adult males, 86 females, and 24 pups present 9 June.
[b]Seven adult males, 28 subadult males, 20 females, and 5 pups present 9 June.
[c]Five large adult males, 1 small adult male, 11 subadult males, 4 females, and 1 pup present 10 June.
[d]Eleven large adult males, 8 small adult males, 15 subadult males, 101 females, and 55 pups present 13 June.
[e]Sixteen large adult males, 6 subadult males, 16 females, and 7 pups present 11 June.
[f]Twenty-three large males, 19 subadult males, 9 females, and 3 live pups present 8 June.
[g]Estimated from previous breeding season information.
[h]A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
[i]Maximum single count.
[j]None of these males were territorial.

size of the colony is slowly increasing and has reached values observed in the late 1970s. Presently, pup production is 65% and the maximum female count is 67% of the 1982 counts.

Tagging Program and Records

During the 1986 field season, increased emphasis was placed on resightings of fur seals that were tagged as pups in Adams Cove. Surveys for tags occurred about once every 3 days. Bachelor male haul-out areas and groups of females within the territories of reproductively active males were approached to within about 10-20 m and the tags read with either binoculars or a spotting scope. Usually only a quarter to a third of the rookery was surveyed per day for tag reading. A total of 114 individual fur seal tags were read during the 1986 field season. Of this total, 42 (37%) were males and 72 (63%) were females.

All resightings of fur seals that were tagged as pups on San Miguel Island are shown in Appendix Table B-10. The most conspicuous aspect of these data was the absence of 3-year-old animals that were born during the El Niño event of 1983. We believe this is a reflection of increased mortality to the 1983 cohort, and demonstrates the effect this dramatic environmental phenomenon had on a small population of northern fur seals located at the southernmost extension of the species breeding range.

Three fur seals were observed on San Miguel Island that were not tagged there. One was a 19-year-old nonparturient female from St. George Island (Monel-T-409, right). The other two were parturient females, a 7-year-old from the Kurile Islands (Monel-26951, left) and a 9-year-old from Robben Island (Monel-KT-1290, right). Other records of females and males that were tagged at unknown ages are shown in Appendix Tables B-11 thru B-14.

On 25 September, 100 fur seal pups at Adams Cove were double-tagged with pink Roto-tags (hard plastic). All tagged pups were checkmarked by removing the cartilaginous extension of the fourth digit on the right hind flipper (Appendix Table B-15).

Mortality on Land

Mortality of fur seal pups born at Adams Cove increased from 3.7% (17) in 1985 to 13.9% (82) in 1986. Twenty-nine of the 82 dead pups (35%) died during a six-day period 4 to 9 July as a result of heat prostration caused by high air and sand temperature, solar radiation, and low wind speed. The cause of pup mortality for the remaining 65% was undetermined.

Castle Rock

A summary of census information for Castle Rock from 1981 to 1986 is presented in Table 11. In 1986, a count of 576 pups (555 live and 21 dead) was obtained on 27 July; this count represents an increase in pup production of 78.3% or 253 more pups than the 1985 count of 323.

On 3 July, 48 breeding males were counted on Castle Rock from aerial photographs, representing an increase of 12 breeding males from the 1985 count. Furthermore, the presence of 53 large adult males exceeded all previously recorded counts.

Two tagged fur seals were observed on Castle Rock during the pup count on 27 July. One animal was a 10-year-old parturient female (SMI-129, left) and the other was a 6-year-old male (C-23 pink, left/right). Additionally, two males, which were tagged as pups at Castle Rock, were observed on shore at Adam's Cove (SMI-2129 6-year-old subadult male and SMI-1344 7-year-old small bull). One of these males (SMI-1344) was observed maintaining a territory of up to three females for at least 7 days in Arroyo Number 2.

Table 11.--Summary of censuses of northern fur seals, Castle Rock, California, 1981-86.

Fur seals	Numbers observed, methods, and date of observation					
	1981	1982	1983	1984	1985	1986
Females[a]	597(+) 27 July	680(+) 31 July	245(+) 3 Aug.	411(+) 8 Aug.	323(+) 4 Aug.	576(+) 27 July
Pups (total observed)[b,c]	597 27 July	680 31 July	227 3 Aug.	411 8 Aug.	323 4 Aug.	576 27 July
Pups (dead observed)[c]	29 27 July	34 31 July	18 3 Aug.	32 8 Aug.	11 4 Aug.	21 27 July
Reproductive large adult males (with females)[d]	28 2 July	27 2 July	20 1 July	33 1 July	36 1 July	42 3 July
Total large adult males[d]	29 2 July	38 2 July	40 1 July	43 1 July	43 1 July	50 3 July
Total small adult males[d]	12 2 July	7 2 July	13 1 July	3 1 July	1 1 July	4 3 July

[a]Minimum estimate from pup count.

[b]Includes dead pup count.

[c]Land-based counts.

[d]Counts were obtained through aerial photographs.

On 23 September, 100 fur seal pups were double-tagged with pink Roto-tags (hard plastic). All tagged pups were checkmarked by removing the cartilaginous extension of the fourth digit on the right hind flipper (Appendix Table B-16).

NURSING-SUCKLING LINES IN NORTHERN FUR SEAL TEETH

by

Hiroshi Kajimura

The purpose of this study was to determine if the fine growth lines present within annual layers in dentine of adult female northern fur seal teeth are related to feeding trips made by the female during lactation. The fine lines are supposedly laid down during lactation periods when the female alternately nurses its pup (fasting) and goes to sea for an extended period of time to feed (growth). Scheffer and Peterson (1967) first discovered about 11 fine growth lines in the dentine of a northern fur seal pup tooth, each line representing one period of suckling followed by a fast. In the adult female, the fast corresponds to the period when the female is ashore on the rookery nursing its pup. For the northern fur seal pup, the corresponding fast occurs during the period the female is at sea feeding for 2 to 8 days, after which she returns to nurse her pup. This cycle continues until the pup is weaned. Each nursing-suckling-fasting period corresponds to the fine dentine growth lines in both the female and the pup. Fine growth lines in dentine of adult female Antarctic fur seal (Arctocephalus gazella) teeth have also been identified as the nursing-fasting period showing that the growth layers deposited in teeth of mothers and pups were related (Bengtson 1988).

Methods

Two methods were used to examine the fine structures in the teeth of female northern fur seals. Canine teeth were cut mid-sagittally (longitudinal half sections), while others were longitudinally thin sectioned. The mid-sagittal half sections were acid-etched and examined under the scanning electron microscope (SEM). The SEM produces a three-dimensional view of the etched tooth surface, which allows for greater interpretation of the fine growth lines. The acid etching removes superficial calcium that produces the alternating ridges and grooves. In the second method, a thin tooth section was examined by polarized light microscopy (PLM). Polarized light microscopy enhances resolution of the microstructure in layered hard tissues that cannot otherwise be detected using conventional microscopes. In addition, PLM also gives color contrast to the microstructure for enhancing the layered hard tissues.

Result-Discussion

Preliminary indications are that fine growth lines are present in the dentine of female northern fur seal teeth, and these lines may be related to feeding-nursing-fasting activities by the female during the breeding season.

The teeth of older northern fur seal females with unknown reproductive condition and young multiparous females ages 5- to 8-years-old with known reproductive condition were selected for this preliminary study. Fur seals with known reproductive condition were selected based only on uterine horn condition from pelagic samples collected during 1972-74. A multiparous animal, by definition, has given birth to two or more pups. These younger seals were selected because the annual tooth growth surface area is greater in younger animals since the annual increment in growth diminishes with

increase in age. However, one uncertainty is whether the female nursed its pup to weaning or aborted its nursing cycle anytime before weaning. A nursing cycle is defined as a period when the nursing pup and lactating female remain together on land (1 to 3 days) and when the pup is left alone while the female goes to sea to feed for about 2 to 8 days. Pups generally nurse from birth (some as early as late June) to early November.

Pup suckling lines, as first reported by Scheffer and Peterson (1967), are generally visible in sagittal sections of teeth examined using both the SEM and PLM methods. The pup suckling lines are only partially visible depending on the resolution and contrasted patterns of light under polarized light. However, these pup suckling lines are clearly visible when examined under the SEM (Fig. 8).

The examination of sagittal sections of teeth from older females of unknown reproductive condition and young multiparous females of known reproductive condition indicate that fine growth lines are present. However, the fine growth lines are not readily visible throughout the sagittal section of the tooth, making interpretation difficult. The tooth of one older female seal (age 10+) of unknown reproductive condition clearly showed 13 fine growth lines in its annual growth layer (Fig. 9). These fine growth lines appeared to have been laid down during its first pregnancy or in its sixth year. The 13 fine growth lines are indicative of 13 nursing bouts with its pup until weaning. Among the teeth that were processed for this study, this is the only mid-sagittal section that shows "suckling" lines clearly in both the upper and lower corresponding sections of the adult female teeth (Fig. 10).

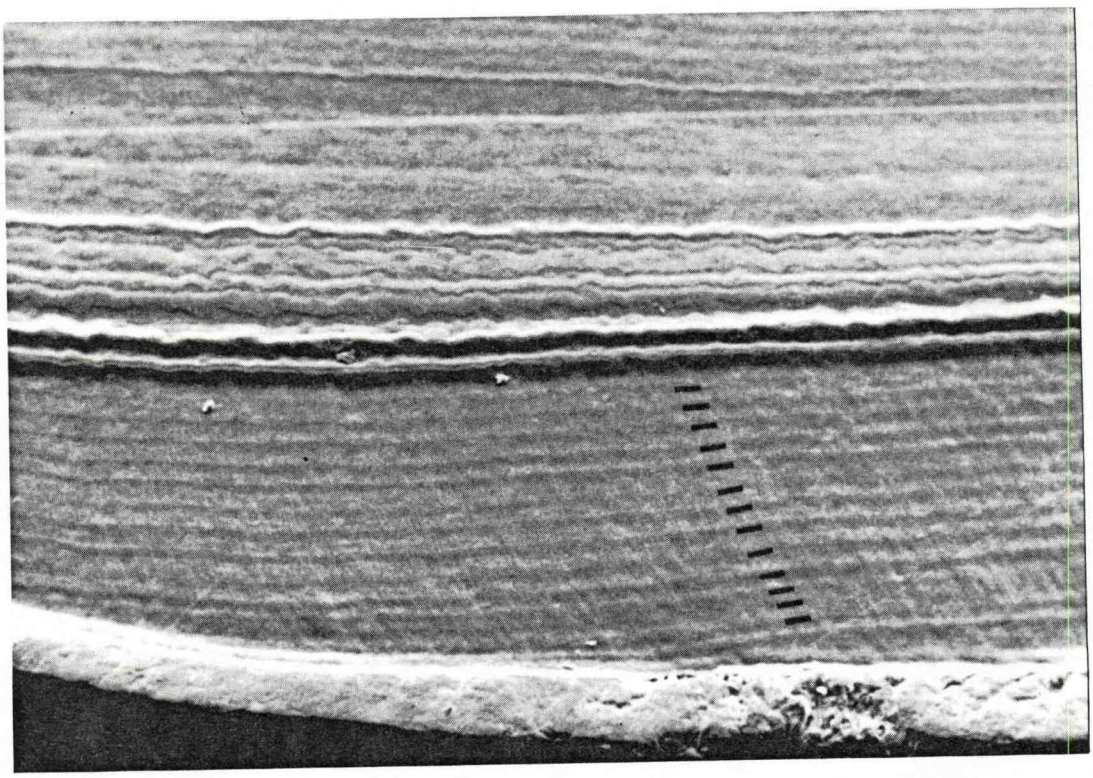

Figure 8.--Photograph from a scanning electron microscope showing northern fur seal pup nursing lines.

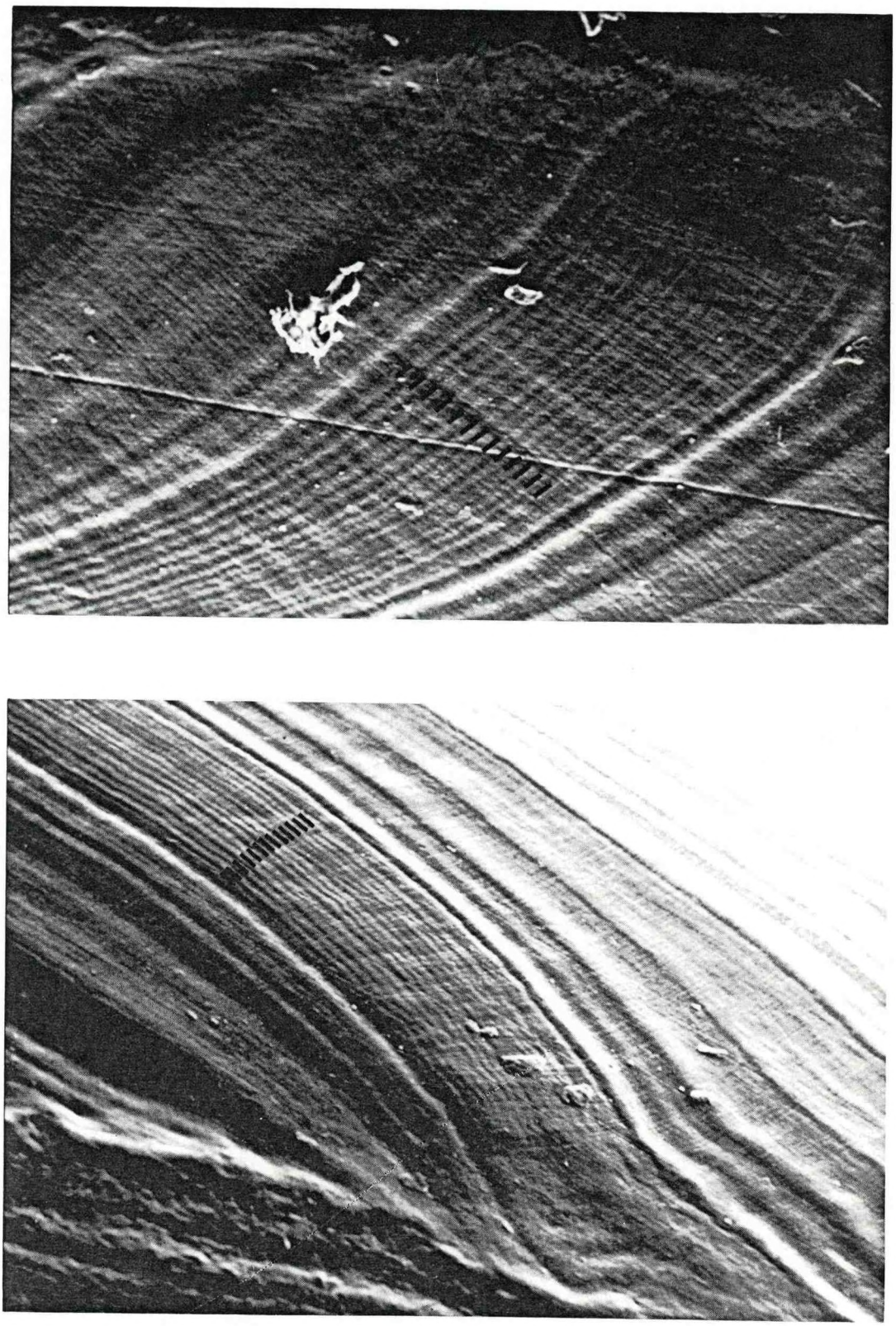

Figure 9.--Scanning electron microscope photograph showing fine growth lines in maxillary teeth of adult female northern fur seals.

The basic difficulty associated with mid-sagittal or longitudinal thin sectioning of fur seal teeth is that the teeth are not symmetrical, thereby making a desired cut difficult. A near-perfect cut is necessary to clearly define the fine nursing lines within the annual growth layer. The desired mid-sagittal cut of any fur seal canine teeth should have the annuli perpendicular to the cut surface at the tooth midpoint (at the pulp canal) throughout the tooth section. This mid-sagittal cut is difficult for two reasons. First, the canine tooth becomes smaller towards the root of the tooth. Second, it tapers toward the root; that is, continuing throughout the life of the seal, usually beginning at about age 5-6 years, each annual dentine deposition growth area becomes progressively smaller. In addition to the "perfect cut," the acid etching procedure is also critical because excessive etching may erode or dissolve the fine growth lines.

Studies needed include the study of teeth of seals with known reproductive history and of seals that have successfully completed nursing their pups through weaning. Preferably this should be done using young lactating females younger than age 10 years. This is necessary to verify that the fine lines present in the dentine are indeed related to the nursing cycle of the lactating female.

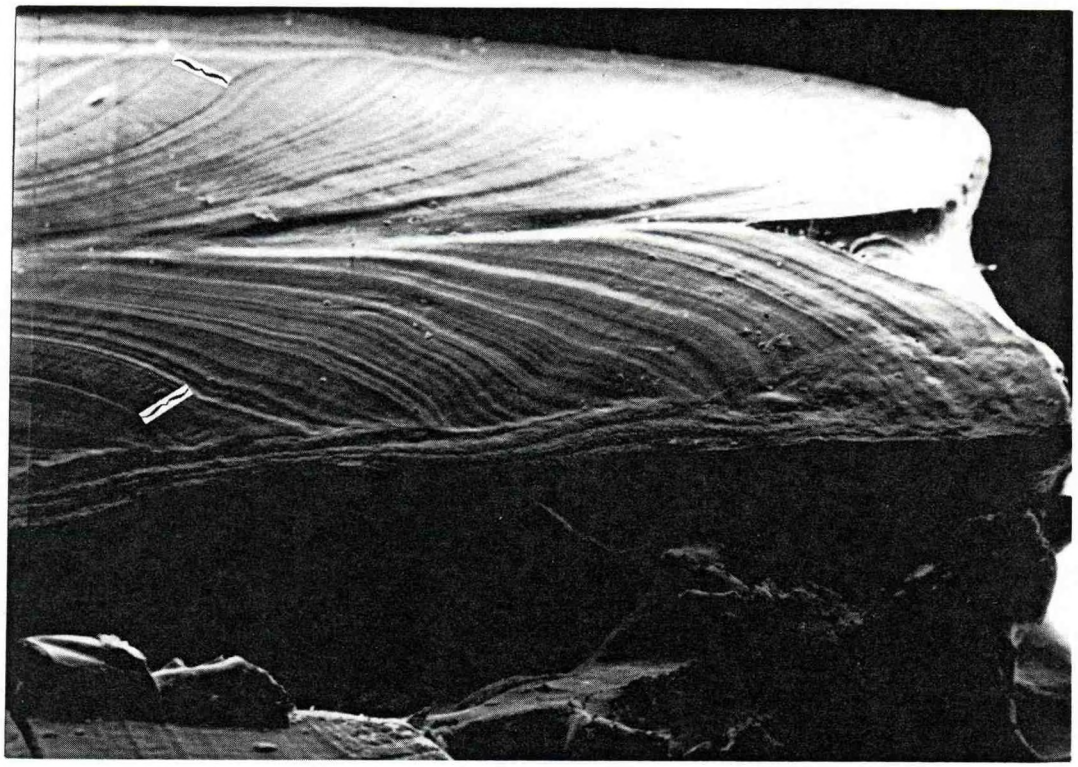

Figure 10.--The general area of tooth section shown in figure 9.

THE INFLUENCE OF ENTANGLEMENT IN MARINE DEBRIS ON THE DIVING BEHAVIOR OF SUBADULT MALE NORTHERN FUR SEALS

by

John L. Bengtson, Brent S. Stewart, Lisa M. Ferm, and Robert L. DeLong

Entanglement of northern fur seals in marine debris, especially trawl net fragments, is thought to have contributed to the decline of the Pribilof Island fur seal population (Fowler 1985, 1987). Fur seals that become entangled in large net fragments at sea may die relatively quickly by starvation if their ability to forage is impeded or by drowning if they are hindered from returning to the surface to breathe. The fate of the 0.4% to 0.5% of the juvenile male fur seals that are entangled in relatively small pieces of debris (<1 kg) is not fully understood, but recent data indicate that mortality of such males is greater than unentangled males (Griben 1979; Scordino 1985). It seems unlikely that fur seals die soon after they become entangled in small fragments of debris. Instead, the mechanism of mortality may be related to increased energy expenditure and reduced foraging efficiency, which will result in poor physical condition.

Methods

On 19 July 1986, 6 subadult male northern fur seals (approximately 3 to 4 years old) were captured, instrumented, and released at the Reef rookery haul-out area on St. Paul Island. A 300-g Mark I microprocessor time-depth recorder (MTDR) (Wildlife Computers, Woodinville, WA)[1] and a 50-g radio

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

transmitter (Advanced Telemetry Systems, Bethel, MN) were glued to the dorsal pelage of each seal using quick-setting epoxy (Devcon EK-40). The MTDRs were programmed to record depth (hydrostatic pressure) once every 15 seconds. Three of the six fur seals included in this study were selected because they were already entangled in small fragments (<1 kg) of trawl netting.

Rookeries and hauling grounds on St. Paul Island were surveyed by radio at least once each day between 20 July and 16 October to determine if radio-tagged seals were present. Radio surveys were also conducted at hauling grounds and rookeries on St. George Island between 8 August and 3 September. As each radio-tagged seal returned to land from its first foraging trip to sea, the seal was recaptured and the recorder and transmitter recovered by cutting them away from the underfur. The net fragments present on entangled seals that were recovered was removed and the weight, mesh size, and twine diameter of the debris were determined.

Results

All seals departed St. Paul Island within 5 days of MTDR deployment. Five of the six seals were recaptured when they returned to land: three of these were recaptured within 0.5 km of their initial capture site, one was recaptured 17 km from its initial capture site at Northeast Point, St. Paul Island, and another was recaptured at East Reef on St. George Island. The body weights of recaptured individuals upon their return to land are given in Appendix Table C-1.

Entangled subadult males were at sea approximately twice as long as those subadult males not entangled in debris (Appendix Table C-2) (general linear model with poisson errors, $P > 0.05$). While at sea, all males made

about 10 to 18 times more dives per hour at night (2330 to 0700 hours) than they did during the day (0700 to 2330 hours) (Appendix Table C-3, Fig. 11). There was no difference in the number of dives made by entangled and unentangled subadult males during the day or at night (2 way ANOVA, $P > 0.05$).

All males made significantly deeper dives during the day than at night (2 way ANOVA, $P > 0.05$), (Appendix Table C-4, Fig. 12). Entangled males made shallower dives both during night and day than unentangled males (Fig. 13) (2 way ANOVA, $P > 0.05$). Most dives were between 1 and 2 minutes duration (Fig. 14). Dive duration increased with depth of dive for all males. Unentangled males made slightly shorter dives at given depths than entangled males (Fig. 15) (2 way ANOVA, $P > 0.05$).

Discussion

Entanglement of subadult males in small pieces of trawl net evidently increases the amount of time that they spend foraging at sea in addition to influencing the depths and durations of dives. In comparison to unentangled subadult males, the apparent limitations on diving depth of entangled males may reduce their foraging efficiency. Extended time at sea could increase the energy expenditure of entangled males. These influences may account for a higher mortality of seals entangled in debris.

The mechanisms leading to mortality differ for fur seals entangled in large and small fragments. Large fragments may have immediate effects on fur seals by increasing energy expenditure for swimming (Feldkamp 1985), by adversely influencing overall behavior (Yoshida et al. 1985), and by decreasing foraging efficiency leading to starvation and death (or perhaps drowning) in a relatively brief period of time (i.e., within several weeks

or less). Small fragments may not have a significant immediate effect on swimming energetics or feeding efficiency, but if the animals are not freed from entangling materials, their health could be seriously impaired. Our data suggest that even relatively small net fragments (<1 kg) will influence foraging and diving behavior.

In general, some aspects of the dive patterns of subadult males were similar to those reported for parturient females (Gentry et al. 1986) in that most dives were made at night, and dives made during the day were deeper than those made at night. The average depths of dives made by subadult males in 1986 were much shallower than those reported for parturient females (Gentry at al. 1986) in earlier years. The frequency distribution of mean maximum dive depths for subadult males was unimodal compared to a bimodal frequency distribution for females.

Acknowledgments

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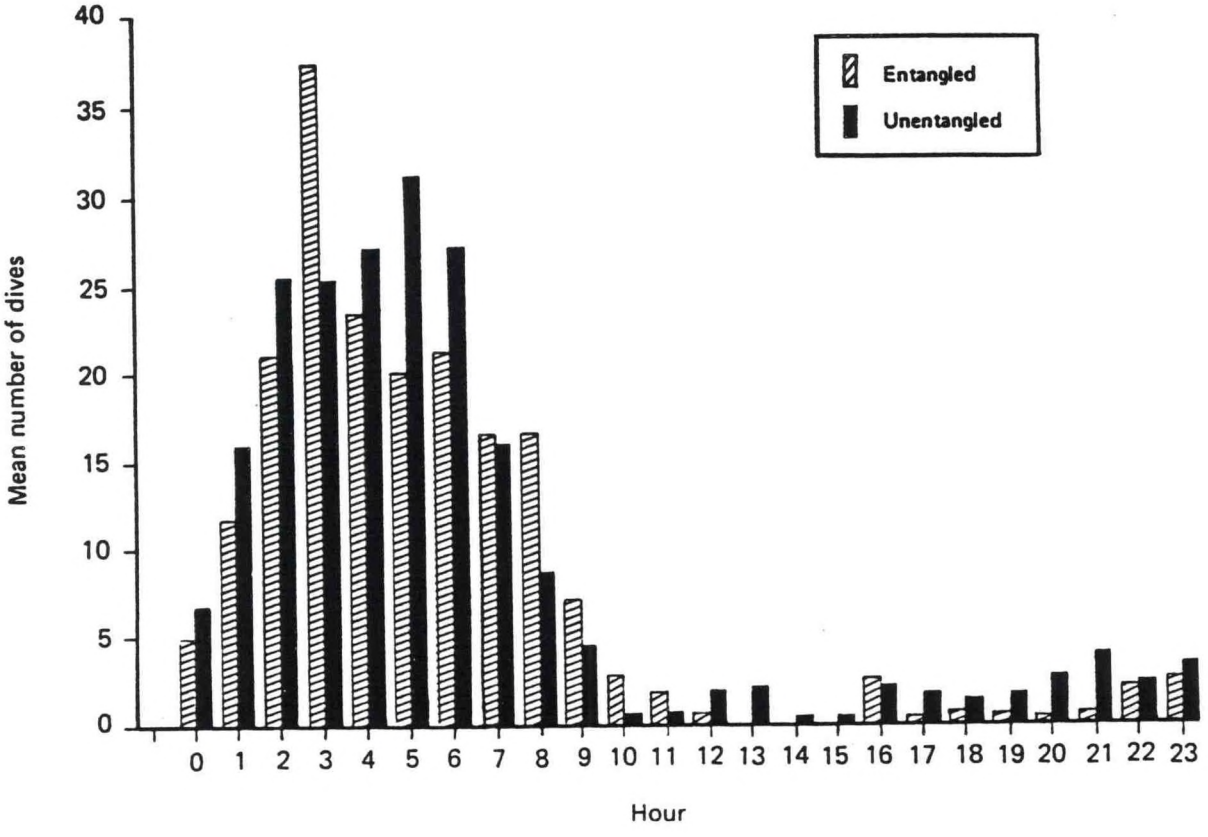

Figure 11.--Mean number of dives made by subadult male northern fur seals throughout a 24-hour period, comparing individuals entangled in marine debris and those free of debris.

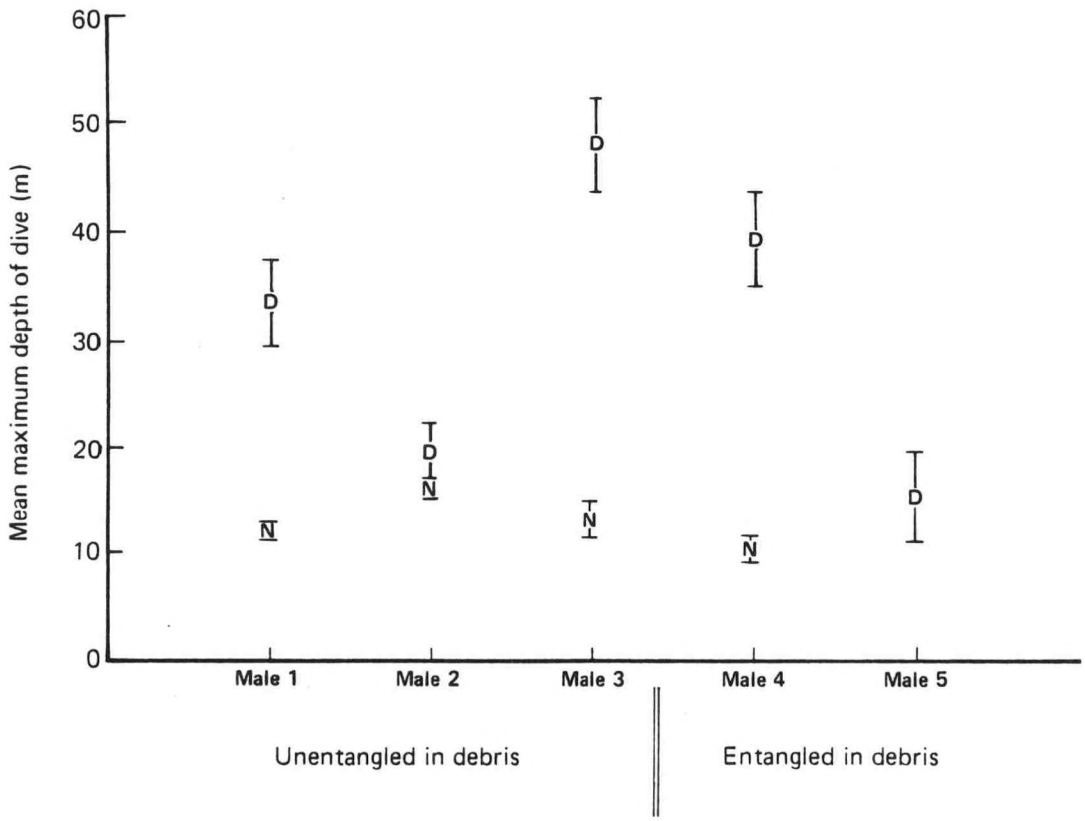

Figure 12.--Mean maximum depth of dive for subadult male northern fur seals, St. Paul Island, Alaska, July-August 1986. Day and night dives (<4m) are compared for entangled and unentangled individuals. Vertical bars indicate a 95% confidence interval.

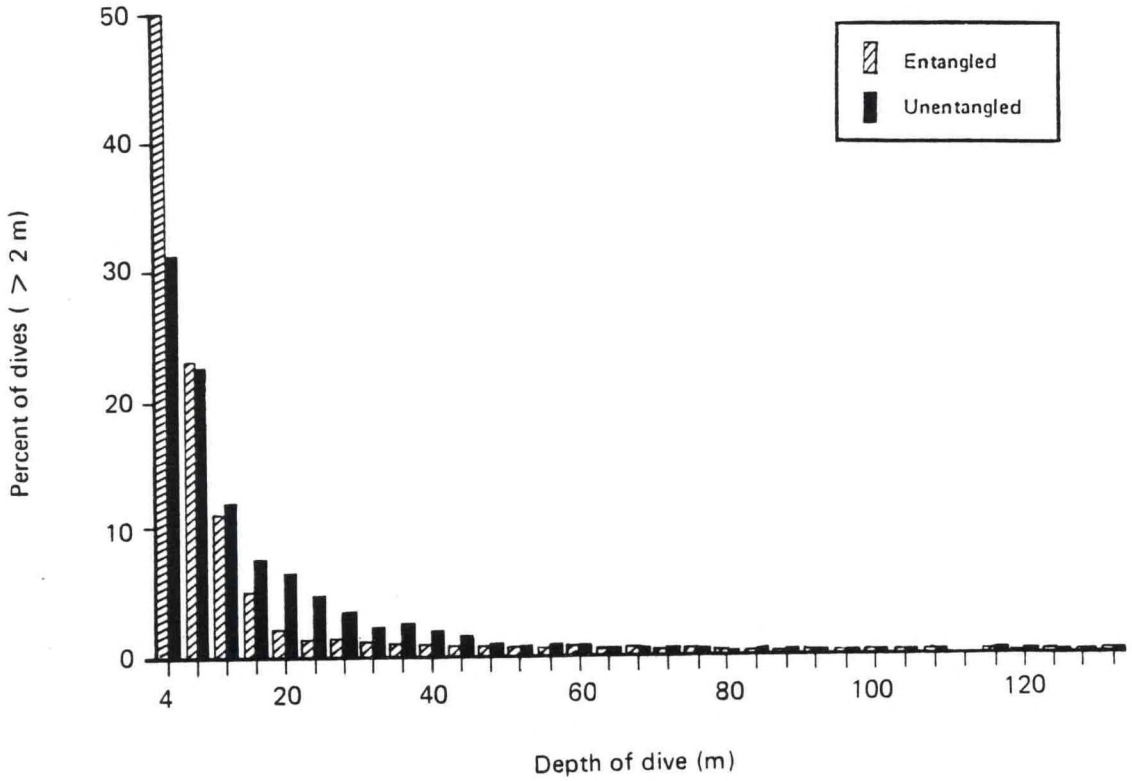

Figure 13.--Comparison of frequency distribution of maximum depth of dives made by entangled and unentangled subadult male northern fur seals, St. Paul Island, Alaska, July-August 1986.

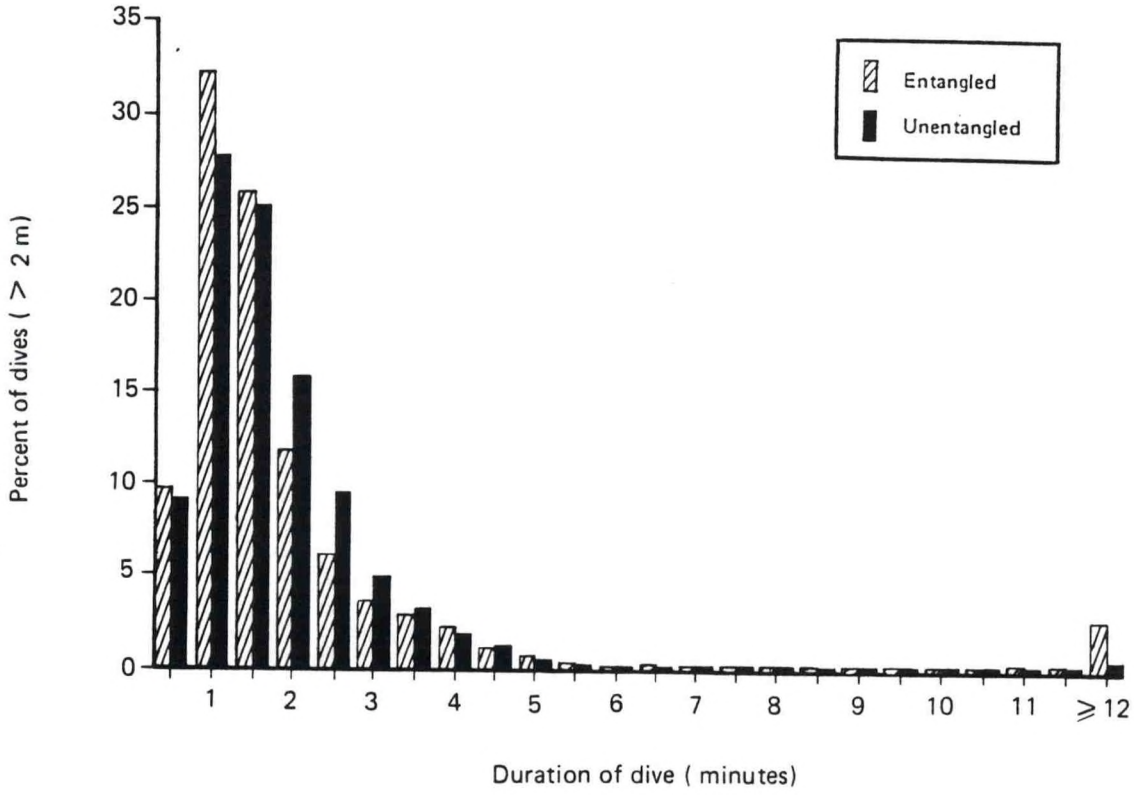

Figure 14.--Comparison of frequency distribution of dive duration by entangled and unentangled subadult male northern fur seals, St. Paul Island, Alaska, July-August 1986.

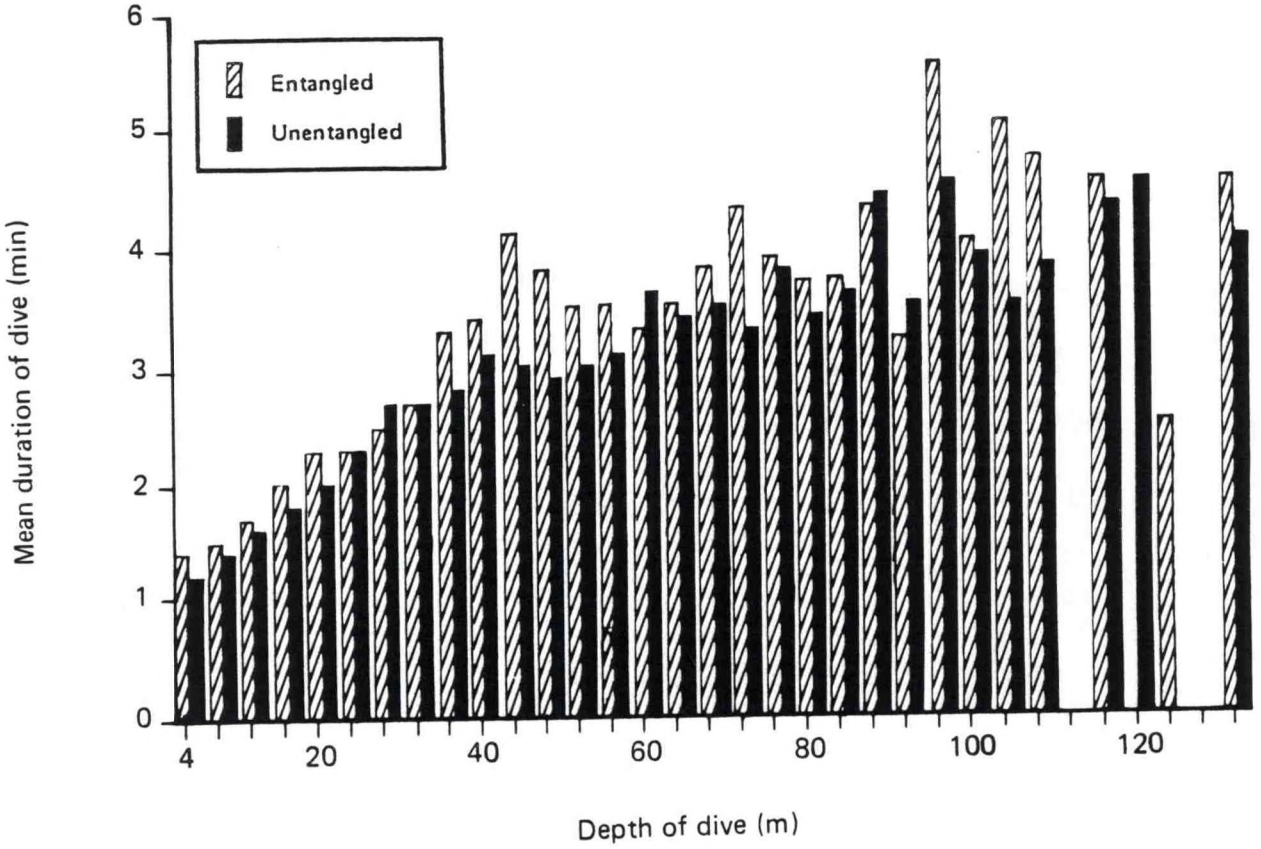

Figure 15.--Average duration of dives with respect to depth for entangled and unentangled subadult male northern fur seals, St. Paul Island, Alaska, July-August 1986.

OBSERVATIONS OF BEACH DEBRIS AND NET ENTANGLEMENT ON ST. PAUL ISLAND, ALASKA

by

Brent S. Stewart, Norihisa Baba, Patrick J. Gearin, and Jason Baker

Selected rookery sections of Polovina, Vostochni, and Kitovi rookery and nearby areas were cleaned of small debris between 19 and 21 August, of trawl and gill-net fragments, packing bands, rubber bands, etc., in which northern fur seals could potentially become entangled (Appendix Table C-5). Large fragments and entire nets were marked with flourescent spray paint for later identification, and net samples were collected to determine mesh and twine size. The average mesh size of large and small trawl net fragments (and nets or net panels) was 14.26 cm (median 13 cm, standard deviation 6.5 cm; Appendix Table C-6, Fig. 16). Approximately 68% (64) of all net fragments weighed less than 2 kg (Appendix Table C-7). The average mesh size of the smaller fragments was 13 cm (SD = 6.5 cm). Of 251 packing bands found, 17 (6.8%) were closed (Appendix Table C-8); the average circumference of closed bands was 99 cm (SD = 54 cm). These same areas were again cleaned of debris between 14 October and 17 October and we found very little debris washed ashore during the 2-month period between 19 August and 14 October (Appendix Table C-9).

Each rookery on St. Paul Island was surveyed on a regular basis between 6 September and 7 October to investigate the magnitude of entanglement of fur seals, especially pups (Appendix Table C-10). Groups of females and pups were observed visually using binoculars from catwalks or concealed locations during these surveys. Females and pups whose entire bodies were clearly visible were tallied as sampled individuals. Visual

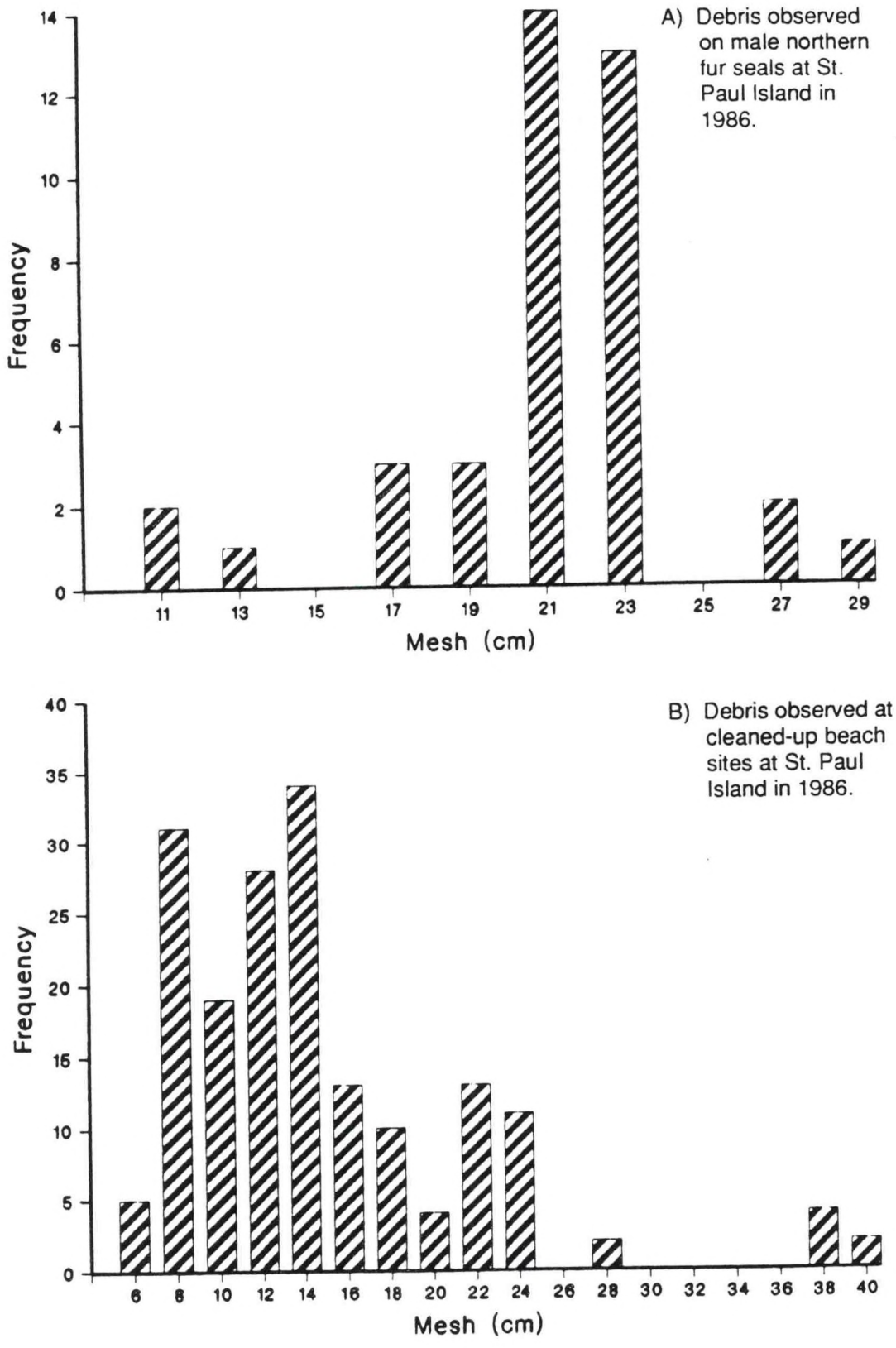

Figure 16.--Debris observed on male northern fur seals and at cleaned-up beach sites at St. Paul Island, Alaska, 1986.

surveys of females were not made after 7 October because subadult males begin hauling out with females on rookeries and are generally indistinguishable from young females. Approximately 0.05% of females and about 0.05% of pups surveyed were observed to be entangled (Appendix Table C-10). Prior to 24 August no pups, live or dead, were observed entangled at any rookery. On 25 August, one pup was observed entangled in a mass of clear plastic debris (perhaps a knotted plastic bag) at Zapadni Reef. This pup was not seen during subsequent surveys. The entangled pups observed later in the season were primarily older pups (i.e., "silver-coats") that had begun entering and playing in the water within a few hundred meters of shore (see Gearin et al. in this report for additional details on entangled pups). It appears that pups become entangled in debris in nearshore waters rather than becoming entangled in debris on shore. The proportion of pups that are entangled in debris is clearly dynamic with respect to time of season and pup maturity and it may be greater than the observed 0.05% by mid-November when most pups are weaned and spending more time in nearshore waters before departing the rookeries.

All entangled pups were observed at areas with significant amounts of beach wrack rather than at cleared beaches, but the observation may be misleading. The beaches that were cleaned were chosen because they were already comparatively free of debris and therefore could be most efficiently cleaned of all debris. The amount of debris on particular beaches may be indicative of the amount of debris that is generally just offshore and likely to wash ashore due to currents and circulation patterns in particular areas that result in greater rates of deposition. Our observations suggest

that pups become entangled in debris while they are in the water, rather than while they are ashore. The relatively few entangled pups observed at cleaned beaches is therefore more likely related to the amount of nearshore, floating debris rather than to our removal of debris from these beaches.

The magnitude of entanglement that we observed among females (0.05%) was much less than that which has been generally observed for young males (about 0.40%). However, all of the females that were observed entangled during the surveys were relatively immature animals (six black vibrissae and three mixed vibrissae) approximately the same ages as subadult males sampled in past commercial harvests and current roundup surveys from which the higher entanglement rate is derived. The sampling effort, therefore, in current and past surveys is not comparable for males and females because surveys of females sampled significantly more age groups (perhaps as many as 10 age groups) than for males (2 to 3 age groups). It may not be surprising then that entanglement rates previously reported for females were much lower than those reported for 2- to 4-year-old subadult males. Our recent observations suggest that entanglement among immature females may be similar to that generally observed among adult females (see Gearin et al. in this report for additional discussion). Further work on entanglement among immature females should concentrate on equalizing sampling methods including, perhaps, studies of tagged juvenile females.

NORTHERN FUR SEALS TAGGED AND OBSERVED DURING ENTANGLEMENT STUDIES ST. PAUL ISLAND, ALASKA

by

Brent S. Stewart, John Bengston, and Norihisa Baba

Field studies were conducted at St. Paul Island, Alaska, from 13 July through 16 October 1986 to document the magnitude and nature of entanglement of subadult male northern fur seals in marine debris. Entangled seals were captured and tagged primarily during systematic roundups at hauling grounds and captured and tagged opportunistically during beach-walk surveys of rookeries and hauling grounds. For each entangled male that was tagged, two unentangled males were tagged as controls to study the effects of small net fragments on male survival. In addition, two controls were tagged for each entangled male that was seen which had been tagged in 1985.

Between 16 July and 16 October, 128 entangled males and 279 control males were tagged (Appendix Tables C-11, C-12, and C-13). Of those, 70 entangled and 165 control males were tagged during roundup surveys (Appendix Tables C-12 and C-14). Of 22,572 harvestable size males (i.e., 2 to 4 years old) observed during roundup surveys, 0.42% (95) were entangled and another 0.14% (32) had scars around their necks from prior entanglement (Appendix Tables C-12 and C-15). No seals that were tagged as controls in 1986 had become entangled; however, one male that was entangled when tagged in 1986 was later resighted during the roundup surveys without the debris. Of 37 control males that were tagged in 1985 and resighted in 1986, none were entangled when resighted.

Eighty-four (65.6%) of the 128 entangled males were entangled in trawl net fragments, mostly gray and green (Appendix Table C-16). Of the trawl net fragments on 81 of those males, about 58% (48) were estimated to weigh less than 150 g, about 31% (26) between 150 g and 500 g, and about 11% (9) were estimated to weigh more than 500 g.

Trawl net samples were collected from 49 of the 125 entangled males that were tagged (Appendix Table C-16). The average mesh size of these small fragments was 20.5 cm (standard deviation = 3.5 cm). The stretched mesh of 14 (28.6%) of these fragments measured less than 20 cm, whereas it was greater than 20 cm for 35 (71.4%) sample fragments.

Twenty males (15.6%) were entangled in rope or twine fragments, 18 (14.1%) in packing bands, and 4 (3.1%) were entangled in other miscellaneous debris (Appendix Table C-16). Two (1.6%) males had small monofilament fragments around their necks and presumably had become entangled in actively fished gill nets and had either been cut out or, perhaps, broken out of the net.

Previously tagged northern fur seals were also observed at rookeries and hauling grounds during entanglement studies (Appendix Table C-17). Of 176 unentangled fur seals (controls) tagged in 1985, 37 (21%) were observed in 1986, and none were entangled or had scars or marks around their necks from recent entanglement (Appendix Table C-18). Thirty-one of those fur seals were observed during roundup surveys. Of 85 entangled males that were tagged in 1985, 12 (14.1%) were seen in 1986 (Appendix Table C-18 and C-19). Differences in resights of entangled and unentangled fur seals are not significantly different (P = 0.819 Chi-square). Eight of those fur seals were observed during roundup surveys, one of which had lost its debris.

LATE-SEASON SURVEYS FOR ENTANGLED NORTHERN FUR SEAL FEMALES AND PUPS ST. PAUL ISLAND, ALASKA

by

Patrick J. Gearin, Brent S. Stewart, and Robert L. DeLong

Sixty-six surveys were conducted late in the season between 21 September and 21 October 1986 to locate entangled northern fur seal females and pups at all rookery and bachelor haul-out areas. During these surveys a total of 69 entangled fur seals were observed, and of these 39 were captured and tagged (Appendix Table C-20). Tagged fur seals included 1 juvenile male, 14 pups, and 24 females. The entangled juvenile male (probably a yearling) which was tagged on 10 October is included in this total.

Pup Entanglement

A total of 25 northern fur seal pups were observed entangled during the surveys. Pups were observed entangled in a variety of debris including trawl net webbing (64%) and trawl line (20%) (Appendix Table C-21). Mesh sizes of trawl net on pups ranged from 15 to 22 cm, with a median mesh size of 18 cm (Appendix Table C-20). One pup had a plastic hot dog wrapper from a 1-pound package around its neck. This debris was in a closed loop 18 cm when stretched tight and since it was of lightweight nondurable material most likely would have fallen off within several days. Another pup had a collar of hard, durable, red plastic material around its neck. None of the pups were observed entangled in monofilament debris.

Debris was removed from four entangled pups during the surveys. One pup was first observed on 21 September entrapped in a large bundle of blue trawl net which weighed 2.5 kg and stretched over 4 m. The net was firmly

snagged between the boulders of Zapadni Reef rookery. We freed the pup from the net, and then tagged and released it. This tagged pup was recovered dead on 15 October approximately 500 m west of its tagging location at Little Zapadni rookery. Two other pups entrapped in net webbing which had become snagged between boulders were also freed from the debris, tagged, and released. One pup was found dead on Little Zapadni rookery; it had a 520 g mass of grey trawl net wound extremely tight around its neck. Wounds attributed to entanglement were noted on only 1 of 25 pups observed. One pup had a 360° deep open wound apparently from straining against the snagged net. The general appearance of other pups that were entrapped in debris seemed to be healthy and of normal size. The sex ratio of the 16 entangled pups that were sexed was equal--8 females and 8 males.

Entangled Females

A total of 44 female northern fur seals were observed entangled during surveys conducted in September and October (Appendix Table C-22). The majority (24 or 55%) were females with black vibrissae approximately 1-4 years of age. Twelve females (27%) had mixed colored (black and white) vibrissae, ages approximately 4-6 years. The remainder (8 or 18%) were females with white vibrissae, age 6 years or older (Appendix Table C-22). Females were observed entangled in a variety of debris, but most commonly (43%) in trawl web (Appendix Table C-21).

There was an apparent difference in the types of debris, mesh size, and severity of open wounds observed on females of different age groups. Fifty percent of females with black and mixed vibrissae were entangled in trawl web, whereas only 12.5% of females with white vibrissae were entangled. The percent occurrence of monofilament gillnet on females with

black, mixed, and white vibrissae was 16.7, 8.3, and 0, respectively. This may indicate that older females are less susceptible to monofilament entanglement (Appendix Table C-21). Five females (11.3%) were entangled in monofilament gillnet. Open wounds were observed on 28 (64%) of the 44 entangled females.

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REFERENCES

Bartholomew, G. A., Jr., and P. G. Hoel. 1953. Reproductive behavior of the Alaskan fur seal, Callorhinus ursinus. J. Mammal. 34:417-436.

Bengtson, J. 1988. Long-term trends in the foraging patterns of female Antarctic fur seals at South Georgia. In D. Sahrhage (editor), Antarctic Ocean and resources variability, p. 286-291. Springer-Verlag, Berlin, Heidelberg.

Chapman, D. G., and A. M. Johnson. 1968. Estimation of fur seal pup populations by randomized sampling. Trans. Am. Fish. Soc. 97:264-270.

Feldcamp, S. 1985. The effects of net entanglement on the drag and power output of a California sea lion, Zalophus californianus. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 83:692-695.

Fowler, C. W. 1985. An evaluation of the role of entanglement in the popultion dynamics of northern fur seals on the Pribilof Islands. In R. S. Shomura and H. O. Yoshida (editors), Proceedings of the workshop on the fate and impact of marine debris, 27-29 November 1984, Honolulu, Hawaii, p. 291-307. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFC-54.

Fowler, C. W. 1987. Marine debris and northern fur seals: a case study. Mar. Pollut. Bull. 18(6B):326-335

Frost, K. J., and L. F. Lowry. 1986. Sizes of walleye pollock, Theragra chalcogramma, consumed by marine mammals in the Bering Sea. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 84:192-197.

Gentry, R. L., and J. R. Holt. 1986. Attendance behavior of northern fur seals. In R. L. Gentry and G. L. Kooyman (editors), Fur seals: maternal strategies on land and at sea, p. 41-60. Princeton Univ. Press, NJ.

Gentry, R. L., G. L. Kooyman, and M. E. Goebel. 1986. Feeding and diving behavior of northern fur seals. In R. L. Gentry and G. L. Kooyman (editors), Fur seals: maternal strategies on land and at sea, p. 61-78. Princeton Univ. Press, NJ.

Goebel, M. E. 1988. Duration of feeding trips and age related reproductive success of lactating females. In P. Kozloff and H. Kajimura (editors), Fur seal investigations, 1985, p. 28-33. U.S. Dep. Commer., NOAA Tech. Memo. NOAA NMFS F-146.

Griben, M. 1979. A study of intermixture of subadult male fur seals, Callorhinus ursinus (Linnaeus 1758), between the Pribilof Islands of St. George and St. Paul, Alaska. M.S. Thesis, Univ. of Washington, Seattle, WA. 191 p.

Kajimura, H., and C. W. Fowler. 1984. Apex predators in the walleye pollock ecosystem in the eastern Bering Sea and Aleutian Islands regions. In D. H. Ito (editor), Proceedings of the workshop on walleye pollock and its ecosystem in the eastern Bering Sea, p. 193-233. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-62.

Kozloff, Patrick (editor), 1982. Fur seal investigations, 1981. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-37, 88 p.

Loughlin, T. R., and P. A. Livingston (editors). 1986. Summary of joint research on the diets of northern fur seal and fish in the Bering Sea during 1985. NWAFC Processed Rep. 86-19, 92 p. Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

Loughlin, T. R., J. L. Bengtson, and R. L. Merrick. 1987. Characteristics of feeding trips of female northern fur seals. Can. J. Zool. 65(8):2079-2084.

Lucas, F. A. 1899. The food of northern fur seals. In D. S. Jordan (editor). The fur seals and fur seal islands of the North Pacific Ocean, Part 3. p. 59-68. U.S. Gov. Print. Off., Washington, D.C.

Nelder, J. A. and R. W. M. Wedderburn. 1972. Generalized Linear Models. J.R. Statistic Soc., A. 135:370-384.

Peterson, R. S. 1968. Social behavior of pinnipeds with particular reference to the northern fur seal. In R. J. Harrison, R. C. Hubbard, R. S. Peterson, C. E. Rice, and R. J. Schusterman (editors), The behavior and physiology of pinnipeds, p. 3-53. Appleton-Century-Crofts, New York.

Roppel, A. Y., P. Kozloff, and A. E. York. 1981. Pup weighing. In P. Kozloff (editor), Fur seal investigations, 1980. NWAFC Processed Rep. 81-2. p. 16-21. Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

Scheffer, V. B., and R. S. Peterson. 1967. Growth layers in teeth of suckling fur seals. Growth 17(3):129-145.

Scordino, J. 1985. Studies on fur seal entanglement, 1981-1984, St. Paul Island, Alaska. In R. S. Shomura and H. O. Yoshida (editors), Proceedings of the workshop on the fate and impact of marine debris, 27-29 November 1984, Honolulu, Hawaii, p. 278-290. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFC-54.

Smith, G. B. 1981. The biology of walleye pollock. In D. W. Hood and J. A. Calder (editors), The eastern Bering Sea Shelf: oceanography and resources, Vol. 1, p. 527-551. U.S. Dep. Commer., Off. Mar. Pollut. Assessment, NOAA, Rockville, MD.

Swartzman, G. L., and R. T. Haar. 1983. Interactions between fur seal populations and fisheries in the Bering Sea. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 81:121-132.

Wilke, F., and K. W. Kenyon. 1957. The food of fur seals in the eastern Bering Sea. J. Wildl. Manage. 21:237-238.

York, A. E., and P. Kozloff. 1987. On the estimation of numbers of fur seal pups born on St. Paul Island, 1980-1986. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 85(2):367-375.

Yoshida, K., N. Baba, M. Nakajima, Y. Fujimaki, A. Furuta, S. Nomura, and K. Takahashi. 1985. Fur seal entanglement survey report test study at a breeding facility, 1983. Unpubl. manuscr., 20 p. (Document submitted to 28th Meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, Tokyo, Japan, April 4-12, 1985). Far Seas Fish. Res. Lab., Jpn. Fish. Agency, 1000 Orido, Shimizu 424, Japan.

APPENDICES

APPENDIX A

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 seals 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 if the animal should lose its tag.

Classifications of adult male fur seals

Class 1 (shoreline)	Full-grown males apparently attached to "territories" spaced along the water's edge at intervals of 10-15 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 1 males should not be confused with Class 2 animals, which have definite 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, some are between 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 into 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 may be found here. 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 conformation of an adult. Males included in this count are approximately 7 years of age and older. Prior to 1966, Class 3 males were called harem bulls, and Classes 1, 2, 4, and 5 were collectively called idle bulls. From 1966 through 1974, the adult male seals were classified into 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.
Drive	The act of surrounding and moving groups of seals from one location to another.
Hauling ground	An area, usually near a rookery, on which nonbreeding seals congregate. See Rookery.
Haulout	The act of seals moving 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, by attaching an inscribed metal or plastic tag to one or more of its flippers, by hair-clipping, or by bleaching.
Mark recoveries	Recovery of a seal that has been marked by one of several methods. See Marked.
Rookery	An area on which breeding seals congregate. See Hauling ground.
Roundup	Biologists surround and herd juvenile male fur seals that are close to the location they haul out, usually on the hauling ground itself.

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.

APPENDIX B

Tabulations of northern fur seal data collected on the Pribilof Islands, Alaska, and on San Miguel Island and nearby Castle Rock, California, in 1986.

APPENDIX B (continued)

Table B-1.--Daily age classification of male northern fur seals taken in the subsistence harvest, St. Paul Island, Alaska, 14 July to 27 September 1986.

Date	Rookery*	Males harvested	Tooth sample	Percent in each age group of sample					Estimated no. harvested by age group				
				1	2	3	4	5	1	2	3	4	5
July 14	REEF	50	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
15	ZAP	19	17	0.0	10.5	84.2	5.3	0.0	0	2	16	1	0
16	L. ZAP	51	51	0.0	12.0	72.0	16.0	0.0	0	6	37	8	0
17	POL	51	50	0.0	22.0	68.0	10.0	0.0	0	11	35	5	0
18	NEP	64	41	0.0	32.0	68.0	0.0	0.0	0	20	44	0	0
21	REEF	49	39	0.0	31.0	56.0	13.0	0.0	0	16	27	6	0
22	LUK	96	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
23	L. ZAP	31	21	0.0	14.0	67.0	19.0	0.0	0	4	21	6	0
24	POL	54	41	0.0	27.0	63.0	10.0	0.0	0	15	34	5	0
25	NEP	102	66	0.0	52.0	42.0	6.0	0.0	0	53	43	6	0
28	REEF	60	11	0.0	45.0	45.0	10.0	0.0	0	27	27	6	0
29	LUK	59	28	0.0	68.0	25.0	7.0	0.0	0	40	15	4	0
30	L. ZAP	27	25	0.0	24.0	68.0	8.0	0.0	0	7	18	2	0
31	POL	33	26	0.0	42.0	54.0	0.0	4.0	0	14	18	0	1
Aug. 1	NEP	56	11	0.0	36.0	64.0	0.0	0.0	0	20	36	0	0
5	REEF	83	56	0.0	64.0	36.0	0.0	0.0	0	53	30	0	0
6	ZAP	82	17	0.0	76.0	24.0	0.0	0.0	0	62	20	0	0
7	L. POL	80	23	0.0	61.0	31.0	4.0	4.0	0	49	25	3	3
8	NEP	181	82	0.0	36.0	48.0	16.0	0.0	0	65	86	29	1
Sept.27	L. ZAP	71	51	6.0	80.0	14.0	0.0	0.0	4	57	10	0	0

*REEF = Reef and Gorbatch
ZAP = Zapadni
L. ZAP = Little Zapadni
POL = Polovina
NEP = Northeast Point
LUK = Lukanin
L. POL = Little Polovina

Table B-2.--Cumulative age classification of male northern fur seals taken in the subsistence harvest, St. Paul Island, Alaska, 14 July to 27 September 1986.

Date	Rookery*	Estimated no. harvested by age group					Total harvest to date	Percent harvested by age group				
		1	2	3	4	5		1	2	3	4	5
July 14	RWWF	0	0	0	0	0	50	0	0	0	0	0
15	ZAP	0	2	16	1	0	69	0	3	23	1	0
16	L. ZAP	0	8	53	9	0	120	0	7	44	8	0
17	POL	0	19	88	14	0	171	0	11	51	8	0
18	NEP	0	39	132	14	0	235	0	17	56	6	0
21	REEF	0	55	159	20	0	284	0	20	56	8	0
22	LUK	0	55	159	20	0	380	0	14	42	5	0
23	L. Zap	0	59	180	26	0	411	0	14	44	6	0
24	POL	0	74	214	31	0	465	0	16	46	7	0
25	NEP	0	127	257	37	0	567	0	22	45	7	0
28	REEF	0	154	284	43	0	627	0	25	45	7	0
29	LUK	0	194	299	47	0	686	0	28	44	7	0
30	L. ZAP	0	201	317	49	0	713	0	28	44	7	0
31	POL	0	215	235	49	1	746	0	29	45	7	0
Aug. 1	NEP	0	235	371	49	1	802	0	29	46	6	0
5	REEF	0	288	401	49	1	885	0	33	45	6	0
6	ZAP	0	350	421	49	1	967	0	36	44	5	0
7	L. POL	0	399	446	52	4	1,047	0	38	43	5	0
8	NEP	0	464	532	81	5	1,228	0	38	43	7	0
Sept.27	L. ZAP	4	521	542	81	5	1,229	0	42	44	7	0

*REEF = Reef and Gorbatch
ZAP = Zapadni
L. ZAP = Little Zapadni
POL = Polovina
NEP = Northeast Point
LUK = Lukanin
L. POL = Little Polovina

Table B-3.--Number of adult male northern fur seals counted, by class[a] and rookery section, St. Paul Island, Alaska, 11-21 July 1986. 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	12	15	-	-	-	-	-	-	-	-	-	-	-	-	27
3	42	43	-	-	-	-	-	-	-	-	-	-	-	-	87
5	18	5	-	-	-	-	-	-	-	-	-	-	-	-	23
Kitovi[b]															
2	6(7)	0	1	7	3	-	-	-	-	-	-	-	-	-	24
3	35(18)	17	57	79	51	-	-	-	-	-	-	-	-	-	257
5	0(1)	0	0	2	44	-	-	-	-	-	-	-	-	-	47
Reef															
2	10	18	29	13	2	8	7	13	15	4	2	-	-	-	121
3	62	95	74	47	48	53	26	49	42	33	8	-	-	-	537
5	0	0	3	0	75	0	10	20	0	10	3	-	-	-	121
Gorbatch															
2	11	6	14	11	7	4	-	-	-	-	-	-	-	-	56
3	98	67	53	13	32	54	-	-	-	-	-	-	-	-	317
5	64	0	0	104	6	1	-	-	-	-	-	-	-	-	175
Ardiguen															
2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
3	66	-	-	-	-	-	-	-	-	-	-	-	-	-	66
5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Morjovi[c]															
2	5(2)	14	5	4	16	14	-	-	-	-	-	-	-	-	60
3	37(32)	37	59	36	68	46	-	-	-	-	-	-	-	-	315
5	42(3)	0	32	0	0	39	-	-	-	-	-	-	-	-	116
Vostochni															
2	7	2	7	5	1	17	11	4	2	1	9	3	9	9	87
3	39	20	47	31	28	82	60	75	47	20	68	39	120	60	736
5	0	0	0	22	68	0	2	0	20	1	0	34	13	17	177
Little Polovina															
2	0	2	-	-	-	-	-	-	-	-	-	-	-	-	2
3	9	19	-	-	-	-	-	-	-	-	-	-	-	-	28
5	1	51	-	-	-	-	-	-	-	-	-	-	-	-	52
Polovina															
2	5	2	-	-	-	-	-	-	-	-	-	-	-	-	7
3	41	17	-	-	-	-	-	-	-	-	-	-	-	-	58
5	66	36	-	-	-	-	-	-	-	-	-	-	-	-	102

Table B-3--Continued.

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Polovina Cliffs															
2	3	6	3	9	5	16	18	-	-	-	-	-	-	-	60
3	32	31	26	60	58	74	110	-	-	-	-	-	-	-	391
5	6	6	1	6	5	10	6	-	-	-	-	-	-	-	40
Tolstoi															
2	2	5	3	3	11	7	11	5	-	-	-	-	-	-	60
3	51	58	62	53	87	90	104	76	-	-	-	-	-	-	581
5	0	0	0	0	3	0	3	136	-	-	-	-	-	-	142
Zapadni Reef															
2	15	1	-	-	-	-	-	-	-	-	-	-	-	-	16
3	142	40	-	-	-	-	-	-	-	-	-	-	-	-	182
5	25	24	-	-	-	-	-	-	-	-	-	-	-	-	49
Little Zapadni															
2	1	2	12	7	5	7	-	-	-	-	-	-	-	-	34
3	16	50	94	100	54	93	-	-	-	-	-	-	-	-	407
5	5	2	4	0	0	58	-	-	-	-	-	-	-	-	69
Zapadni[d]															
2	9(0)	11	13	12	7	15	12	8	-	-	-	-	-	-	87
3	65(0)	93	113	85	102	83	83	17	-	-	-	-	-	-	641
5	34(28)	4	0	25	0	0	0	13	-	-	-	-	-	-	104

[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]Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table B-4.--Number of adult male northern fur seals counted, by rookery, Pribilof Islands, Alaska, July 1986.

Island and rookery	Date (July)	Class of adult male* 2	3	5	Total
St Paul Island					
Lukanin	11	27	87	23	137
Kitovi	18	24	257	47	328
Reef	17	121	537	121	779
Gorbatch	16	56	317	175	548
Ardiguin	21	3	66	6	75
Morjovi	19	60	315	116	491
Vostochni	19/20	87	736	177	1,000
Little Polovina	21	2	28	52	82
Polovina	18	7	58	102	167
Polovina Cliffs	18	60	391	40	491
Tolstoi	19	58	581	142	781
Zapadni Reef	19	16	182	49	247
Little Zapadni	21	34	407	69	510
Zapadni	20	87	641	104	832
Island total		642	4,603	1,223	6,468
St. George Island					
Zapadni	14	36	140	257	433
South	13	36	200	104	340
North	14	127	599	320	1,046
East Reef	13	47	92	53	192
East Cliffs	13	75	282	127	484
Staraya Artil	13	47	81	113	241
Island total		368	1,394	974	2,736

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

Table B-5.--Number of harem and idle male northern fur seals counted in mid-July, Pribilof Island, Alaska, 1977-86. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Harem	Idle	Harem	Idle	Harem	Idle
1977	6,457	3,845	1,610	899	8,067	4,744
1988	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	-	-	-	-
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
1986	4,603	1,865	1,394	1,342	5,997	3,207

TABLE B-6.--Number of dead northern fur seal pups counted, by rookery section, Pribilof Islands, Alaska, August 1986.

Island and Rookery	Date	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
St. Paul Island	August															
Polovina Cliffs	15	43	50	59	88	91	120	140	-	-	-	-	-	-	-	591
Little Polovina	15	4	15	-	-	-	-	-	-	-	-	-	-	-	-	19
Polovina	15	55	12	-	-	-	-	-	-	-	-	-	-	-	-	67
Tolstoi	15	72	89	112	93	138	187	177	194	-	-	-	-	-	-	1,062
Vostochni	16	32	14	68	48	27	118	100	109	54	8	32	56	159	66	891
Morjovi	16	62[a]	55	98	68	106	52	-	-	-	-	-	-	-	-	441
Gorbatch	17	183	96	134	2	65	98	-	-	-	-	-	-	-	-	578
Ardiguen[b]	17	79	-	-	-	-	-	-	-	-	-	-	-	-	-	79
Reef	17	75	132	84	69	84	65	47	72	100	42	8	-	-	-	778
Lukanin	21	99	115	-	-	-	-	-	-	-	-	-	-	-	-	214
Kitovi	21	58[c]	154	117	73	27	-	-	-	-	-	-	-	-	-	429
Zapadni	18	74	169	207	285	213	217	235	17	-	-	-	-	-	-	1,417
Little Zapadni	18	11	106	170	183	164	181	-	-	-	-	-	-	-	-	815
Zapadni Reef	18	257	133	-	-	-	-	-	-	-	-	-	-	-	-	390
																7,771

St. George Island: No counts of dead pups made during 1986.

[a]Does not include dead pups counted on second point south of Sea Lion Neck.

[b]No numbered sections.

[c]Includes 16 dead pups counted in Kitovi Amphitheater.

Table A-7.--Number of dead northern fur seal pups counted, by rookery, Pribilof Islands, Alaska, 1977-86.[a]
A dash indicates no data.

Island and rookery	Year									
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
St. Paul Island										
Morjovi	870	606	269	508	346	348	274	336	247	441
Vostochni	2,021	1,041	573	932	889	837	747	973	604	891
Little Polovina	103	90	28	77	41	49	46	14	29	19
Polovina Cliffs	733	761	433	627	463	570	438	397	367	591
Polovina	160	151	85	127	89	97	79	75	56	67
Ardiguen	112	15	31	76	38	49	33	46	6	75
Gorbatch	860	475	260	699	379	399	414	522	371	578
Reef	1,233	593	651	790	623	654	649	411	624	778
Kitovi	331	203	171	256	187	269	223	142	211	429
Lukanin	250	197	132	206	102	139	171	104	149	214
Tolstoi	3,291	1,488	1,645	1,488	1,547	1,332	1,178	1,407	919	1,062
Little Zapadni	1,133	674	637	645	377	779	562	580	485	815
Zapadni Reef	427	129	161	243	266	276	258	301	197	390
Zapadni	2,559	1,650	1,368	1,185	1,451	1,503	925	807	1,001	1,417
Counted total	14,083	8,073	6,444	7,859	6,798	7,301	5,997	6,115	5,266	7,767
Estimated oversight 5%[b]	704	404	322	393	340	365	300	306	263	388
Total	14,787	8,477	6,766	8,252	7,138	7,666	6,297	6,421	5,529	8,155
St. George Island										
North	408	1,068	774	949	810	649	367	-	317	-
Zapadni	92	179	277	350	186	190	124	-	134	-
South	98	225	186	197	177	110	111	-	128	-
East Reef	60	164	104	121	74	56	25	-	22	-
East Cliffs	140	292	285	284	402	340	128	-	106	-
Staraya Artil	410	590	565	484	376	315	148	-	99	-
Counted total	1,208	2,518	2,191	2,385	2,025	1,660	903	-	806	-
Estimated oversight 5%[b]	60	126	110	119	101	83	45	-	40	-
Total	1,268	2,644	2,301	2,504	2,126	1,743	948	-	846	-

Table B-7.--Continued.

Island and rookery	Year									
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Pribilof Islands										
counted total	15,291	10,591	8,635	10,244	8,823	8,961	6,900	6,115	6,072	-
Estimated oversight 5%[b]	764	530	432	512	441	448	345	306	303	-
Total	16,055	11,121	9,067	10,756	9,264	9,409	7,245	6,421	6,421	-

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

[b]As established by 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. Mmmal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N. E., Seattle, WA 98115.

Table B-8.--Sightings of northern fur seals with Soviet tags, St. Paul Island, Alaska, and San Miguel Island, California, 1986.

Date	Rookery of sighting	Tag number	Island of tagging
St. Paul Island			
July 18	Vostochni	MD 671	Medny
19	Zapadni Reef	XM 9453	Medny
22	Zolotoi Sands	MC 1488	Medny
25	Zapadni	TC 1064	Medny
27	Zapadni Reef	MC 2631	Medny
27	Zapadni Reef	YM 3957	Medny
29	Tolstoi	bA 462	Bering
29	Tolstoi	mc 2832	Medny
29	Tolstoi	mc 2999	Medny
Aug. 1	Reef	YM 562	Medny
1	Zapadni	bC 17	Bering
3	Polovina	bC 2667	Bering
3	Polovina	TM 9771	Medny
4	Morjovi	MD 1312	Medny
4	Polovina	TM 8165	Medny
4	Lukanin	TM 9240	Medny
5	Reef	TM 9880	Medny
6	Gorbatch	TM 9171	Medny
17	Zapadni	MC 3214	Medny
19	Polovina	bD 1830	Bering
20	Vostochni	YM 4849	Medny
20	Vostochni	MD 1462	Medny
22	Reef	ba 223	Bering
Sept. 23	Tolstoi	MD 3316	Medny
25	Zapadni Reef	XM 9453	Medny
28	Tolstoi	BM 288	Medny
29	Ardiguen	XM 402	Medny
Oct. 1	Polovina	M? 1700	Medny
10	Tolstoi	BD 2120	Bering
12	Tolstoi	bd 2120	Bering
15	Zapadni Reef	HM 7915	Medny
15	Little Zapadni	TM 9259	Medny
15	Kitovi	ME 2613	Medny
15	Kitovi	BD 1130	Bering
San Miguel Island			
July 7	Adams Cove	26951	Kurile
11	Adams Cove	KT 1290	Robben

Table B-9.--Gastrointestinal contents of northern fur seals collected, St. Paul Island, Alaska, 6-16 August 1985.

Prey	Number[a]	% Occurrence	Seal specimen number
Fish total	1,936	100.0	1-43
Bathylagidae			
Leuroglossus stilbius	279	9.3	3, 13, 14, 15
Gadidae			
Gadus macrocephalus (t)[b]	3	7.0	12, 28, 31
Theragra chalcogramma	1,499	67.4	1, 4, 5, 6, 8-12, 17, 21, 22, 25, 27-41, 43
T. chalcogramma (t)[b]	2	4.7	10, 42
unidentified Gadidae	18	20.9	5, 6, 10, 13, 28, 32, 33, 35, 40
unidentified fishes	135	48.8	2, 7, 10, 15, 16, 18-24, 26-28, 30, 35, 36, 38, 41,43
Cephalopod total	253	46.5	1, 2, 4, 13-17, 20, 22-24, 27, 28, 30-33, 37, 38
Gonatidae			
Gonatus berryi	1	2.3	14
G. pyros	1	2.3	2
G. tinro	1	2.3	14
G. tinro (t)[b]	3	2.3	13
G. madokai or *G. middendorffi*	104	34.9	1, 13, 15, 17, 20, 22, 24, 27, 28, 30, 35, 36, 38
Gonatus sp.	1	2.3	14
Gonatopsis borealis or *Berryteuthis magister*	139	20.9	1, 2, 4, 13-17, 23
unidentified Gonatidae	3	7.0	1, 2, 16

[a]Number of individuals.

[b]Tentative identification.

Table B-10.--Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California and the date first observed at Adams Cove in 1986.

Tag number/color[a]				
Left flipper	Right flipper	Sex	Year tagged	Date of first sighting
SMI-328-Monel	NTR	F[b]	1976	24 June
SMI-334-Monel	NTR	F[b]	1976	14 July
SMI-908-Monel	0008-red	F[b]	1977	4 July
SMI-937-Monel	NTR	F	1977	18 July
SMI-946-Monel	NTR	M	1977	7 July
SMI-1183-Monel	NTR	F[b]	1978	6 July
SMI-1211-Monel	466-white	M	1978	21 June
NTL	SMI-1331-Monel	M	1979	27 July
NTL	SMI-1577-Monel	M	1979	21 July
SMI-1977-Monel	469-pink	F[b]	1980	21 July
SMI-2008-Monel	NTR	F	1980	14 July
SMI-2073-Monel	NTR	F	1980	25 July
SMI-2096-Monel	457-pink	M	1980	25 June
NTL	SMI-2129-Monel	M	1980	24 June
SMI-2130-Monel	NTR	F[b]	1980	11 July
SMI-2144-Monel	427-pink	F	1980	18 July
NTL	427-pink	F	1980	20 July
NTL	434-pink	F	1980	29 July
NTL	435-pink	F	1980	20 July
441-pink	NTR	M	1980	8 July
NTL	457-pink	F	1980	7 July
NTL	461-pink	F[b]	1980	18 July
NTL	486-pink	F	1980	21 July
NTL	487-pink	F[b]	1980	25 July
NTL	488-pink	F	1980	21 July
491-pink	NTR	M	1980	20 June
NTL	495-pink	F[b]	1980	12 July
NTL	498-pink	F	1980	12 July
651-pink	NTR	M	1980	4 July
NSL	SMI-2273-Monel	F	1980	29 June
SMI-2296-Monel	SMI-2297	F[b]	1980	6 July
SMI-2330-Monel	SMI-2331	F[b]	1980	4 July
NTL	SMI-2341-Monel	M	1980	6 July
NTL	SMI-2343-Monel	M	1980	19 July
NTL	SMI-2367-Monel	M	1980	26 July
SMI-2376-Monel	SMI-2377-Monel	F	1980	11 July
SMI-2402-Monel	SMI=2403-Monel	M	1980	14 July
NTL	SMI-2413-Monel	M	1980	21 July
NSL	SMI-2417-Monel	F	1980	25 June
NTC	SMI-2419-Monel	M	1980	10 July
A-2	A-2-pink	M	1980	22 June
A-8-pink	NTR	F[b]	1980	21 July
A-9-pink	A-9-pink	M	1980	10 July

Table B-10.--Continued.

Tag number/color[a]				
Left flipper	Right flipper	Sex	Year tagged	Date of first sighting
A-19-pink	A-19-pink	F	1980	4 July
A-20-pink	A-20-pink	F	1980	12 July
A-22	A-22-pink	M	1980	9 July
A-26-pink	NTR	M	1980	8 July
A-44-pink	A-44-pink	F[b]	1980	4 July
A-52-pink	A-52-pink	F[b]	1980	11 July
A-58-pink	A-58-pink	M	1981	16 July
A-60-pink	A-60-pink	F	1981	7 July
A-67-pink	A-67-pink	M	1981	25 June
A-82-pink	A-82-pink	M	1981	12 June
A-83-pink	NTR	F	1981	14 July
A-90-pink	A-90-pink	M	1981	9 July
A-91-pink	NTR	M	1981	1 July
NTL	A-95-pink	M	1981	15 June
A-99-pink	NTR	M	1981	21 July
A-14-green	A-14-green	M	1981	21 July
A-16-green	A-16-green	M	1981	26 July
A-24-green	A-24-green	F[b]	1981	2 July
A-38-green	A-38-green	F	1981	21 July
A-55-green	A-55-green	F[b]	1981	4 July
A-76-green	A-76-green	F[b]	1981	4 July
NTL	A-97-green	F[b]	1981	11 July
SMI-2673	SMI-2672-Monel	F[b]	1982	16 July
SMI-2677-Monel	NSR	F	1982	29 June
SMI-2819-Monel	NTR	F[b]	1982	14 July
SMI-2845-Monel	SMI-2844-Monel	M	1982	21 July
SMI-2847-Monel	SMI-2846-Monel	M	1982	22 July
A-158-pink	A-158-pink	M	1982	21 July
A-125-green	A-125-green	M	1982	12 June
NTL	A-126-green	M	1982	15 July
A-303-pink	A-303-pink	M	1984	25 July
A-308-pink	A-308-pink	M	1984	14 July
A-320-pink	A-320-pink	M	1984	11 July
A-348-pink	A-348-pink	M	1984	21 July
A-365-pink	A-365-pink	F	1984	25 July
A-387-pink	A-387-pink	M	1984	12 July

[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 B-11.--Adult female northern fur seals double-tagged with consecutively numbered monel cattle ear tags in Adams Cove, San Miguel Island, California, on 9 October 1975, and the dates first resighted, 1981-86. A dash indicates no observation.[a]

Tag number	Date first resighted					
	1981	1982	1983	1984	1985	1986
SMI-201/202	17 July	26 Oct	-	-	-	-
203/204	-	-	-	-	-	-
205/206	-	-	-	-	-	-
207/208	-	-	-	-	-	-
209/210	-	-	-	-	-	-
211/212	-	-	-	-	-	-
213/214	-	-	-	-	-	-
215/216	-	-	-	-	-	-
217/218	-	-	-	-	-	-
219/220	-	-	-	-	-	-
221/222	-	-	-	-	-	-
223/224	-	22 Oct.	-	-	-	-
225		b				
226/227	17 July	24 June	-	-	-	6 July
228/229	13 Aug.	14 July	-	-	-	-
230/231	-	-	-	-	-	26 June
232/233	-	-	-	-	-	-
234/235	-	-	-	-	-	-
236/237	-	-	-	-	-	-
238/239	-	25 July	-	-	-	-
240/241	-	-	-	-	-	-
242/243	-	-	-	-	-	-
244/245	-	-	-	-	-	-
246/247	-	-	-	-	-	-
248/249	-	-	-	-	-	-
250/251	-	-	-	-	-	-
252/253	-	-	-	-	-	-
254/255	1 July	-	-	-	-	-
256/257	-	-	-	-	-	-
258/259	-	-	-	-	-	-
260/261	13 July	-	-	-	-	-
262/263	-	-	-	-	-	-
264/265	-	-	-	-	-	-
266/267	-	-	-	-	-	6 July
268/269	-	-	-	-	-	-
270/271	-	-	-	-	-	-
272/273	-	-	-	-	-	-
274/275	-	-	-	-	-	-
276/277	-	-	-	-	-	-

Table B-11.--Continued.

Tag number	Data first resighted					
	1981	1982	1983	1984	1985	1986
SMI-279/280	-	-	-	-	-	-
281/282	-	-	-	-	-	-
283/284	-	-	-	-	-	-
285/286	-	-	-	-	-	5 July
287/288	-	-	-	-	-	-
289/290	-	-	-	-	-	-
291/292	-	-	-	-	-	-
293/294	-	-	-	-	-	-
295/296	-	-	-	-	-	-
297/298	-	-	-	-	-	-
299/300	-	-	-	-	-	-
301/302	-	-	-	-	-	-

[a]Fifty adult females were tagged.

[b]Tag lost.

Table B-12.--Northern fur seal females double-tagged with white plastic Roto tags in Adams Cove, San Miguel Island, California, on 18 November 1979, and dates first resighted, 1981-86. A dash indicates no observations.

Tag number[a]			Date resighted[b]					
Right flipper	Left flipper	Vibrissae color[c]	1981	1982	1983	1984	1985	1986
401	402	white	6 July*	-	-	-	-	-
404	403	mixed	5 July*	19 Nov	-	-	-	-
405	406	white	5 July	3 Nov*	-	-	-	-
407	408	white (tag lost, right side)	-	-	-	-	-	
410	409	white	18 June	17 Sept	-	-	25 June	22 June*
411	412	white	-	18 Oct*	-	-	-	-
413	414	mixed	15 July	1 Sept	-	-	18 July*	-
416	415	white	11 July	17 June*	-	-	-	-
417	419	white	23 July*	29 Sept	-	-	25 June*	-
420	421	white	9 July	4 Nov*	-	-	23 June	-
422	423	white	15 July	2 Sept	15 July	14 July	-	26 June*
424	425	white	19 July	3 Sept	-	-	-	-
426	427	white	6 July*	11 July*	19 June	14 July	5 July*	28 June*
428	430	white	6 July*	29 June*	-	-	25 June	19 June*
431	432	white	12 Aug	10 Sept*	-	-	-	-
433	434	white	13 Aug*	17 July	-	-	-	23 June*
435	437	white	18 June	-	-	-	25 June*	24 June*
438	439	white	20 June	2 Sept	-	-	-	-
440	441	white	15 July	2 Oct	-	-	19 July*	-
442	443	mixed	23 July	22 Aug*	-	-	-	-
445	444	mixed	-	22 Aug	-	-	-	-
447	446	white	29 June**	9 Sept*	-	-	-	-
448	449	white	16 Aug[d]	-	-	-	-	-
450	451	white	24 June	23 June*	-	13 July	23 June	29 June*

Table B-12.--Continued.

Tag number[a]			Date resighted[b]					
Right flipper	Left flipper	Vibrissae color[c]	1981	1982	1983	1984	1985	1986
452	45	white	-	-	-	-	-	-
454	455	white	-	-	-	-	-	-
456	457	white	-	25 July*	-	-	-	-
458	459	white	23 Sept[e]	-	23 July	-	-	-
460	461	white	-	-	-	-	-	-

[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.

[d]Died due to cliff collapse; right-side tag lost.

[e]Resighted on Castle Rock.

Table B-13.--Subadult male northern fur seals double tagged at Adams Cove, San Miguel Island, California (24 May 1980), and date first observed in 1986. A dash indicates no data.

Tag numbers			
Plastic (pink) Roto tags tags applied to left foreflipper*	Monel steel tags applied to right foreflipper*	Estimated fur seal weight when tagged (Kg)	Date 1986
420	SMI 651	45-60	-
421	SMI 653	45-60	-
423	SMI 655	25-35	-
424	SMI 657	25-35	-
425	SMI 658	25-35	-
426	SMI 659	25-35	-
427	SMI 661	25-35	-
428	SMI 664	25-35	20 June
492	SMI 665	25-35	-

*Tags destroyed: Plastic pink No. 422; Monel steel Nos. SMI 652, 654, 656, 660, 662, and 663.

Table B-14.-- Northern fur seal females double-tagged with plastic yellow Riese tags on 29 June 1985 in Adams Cove, San Miguel Island, California, and the dates first resighted in 1986. A dash indicates no observation.

Tag number		
Right flipper	Left flipper	1986
F-049	F-049	24 June[a]
F-050	F-050	18 July[a]
F-051	F-051	26 June[a]
F-052	F-052	20 June[a]
F-053	F-053	-
F-054	F-054	27 June[a]
F-055	F-055	-
F-056	F-056	-
F-057	F-057	07 July[a]
F-058	F-058	-
F-059	F-059	26 June[a]
F-060	F-060	26 June
F-061	F-061	07 July[a]
F-062	F-062	10 July
F-063	F-063	27 June
F-064	F-064	23 June[a]
F-065	F-065	-
Lost tag	F-066	13 July
F-067	F-067	07 July
Lost tag	F-068	07 July[b]
F-069	F-069	23 June
F-070	F-070	-

[a]The female was known parturient.

[b]The pup was stillborn or died shortly after birth.

Table B-15.--One hundred northern fur seal pups double-tagged with pink Roto tags at Adams Cove, San Miguel Island, California, on 25 September 1986. All animals were checkmarked by removal of the cartilaginous extension of the fourth digit on the right hind flipper.

Tag number	Sex	Weight (kg)
A401	F	12.00
402	M	11.50
403	M	13.00
404	M	14.50
405	M	13.00
406	M	18.50
407	M	15.50
408	F	14.00
409	M	12.75
410	F	11.00
411	F	14.25
412	F	13.50
413	M	13.50
414	M	15.25
415	M	17.00
416	F	13.50
417	F	5.00
418	F	12.50
419	M	12.00
420	F	11.50
421	M	11.25
422	M	14.00
423	M	14.25
424	M	15.00
425[a]	F	15.00
426	F	11.00
427	M	20.00
428	M	12.50
429	M	9.50
430	M	15.50
431	F	11.00
432	F	15.50
433	M	15.00
434	M	15.00
435	F	13.00
436	M	12.00
437	M	12.00
438	M	14.50
439	F	17.00
440	M	16.00

Table B-15.--Continued.

Tag number	Sex	Weight (kg)
A441	M	14.25
442	F	13.00
443	M	13.00
444	F	11.10
445	F	13.50
446	M	14.50
447	F	11.50
448	M	15.50
449	M	14.50
450	F	12.25
451	F	13.50
452	F	12.00
453	F	10.00
454	M	13.50
455	F	12.00
456	F	11.50
457	M	11.50
458	F	14.00
459	F	11.25
460	F	7.50
461	F	12.00
462	F	9.00
463	M	11.50
464	F	7.50
465	F	11.25
466	F	9.50
467	F	15.00
468	F	12.75
469	M	13.50
470	M	13.25
471	M	12.00
472	F	13.00
473	F	13.75
474	F	12.00
475	M	12.15
476	F	9.50
477	M	11.25
478	M	15.00
479	F	12.00
480	F	11.00
481	F	11.50
482	F	12.50
483	M	17.50
484	F	10.50
485	F	11.50

Table B-15.--Continued.

Tag number	Sex	Weight (kg)	
A486	M	16.00	
487b	M	11.50	Eroded vesicles
488	F	12.00	
489	M	11.00	
490	M	15.00	
491[b]	F	12.75	Eroded vesicles
492	F	11.00	
493	F	13.75	
494	F	13.25	
495b	M	14.50	Eroded vesicles
496	M	13.75	
497	M	14.00	
498	M	11.00	
499	M	16.50	
500	F	11.25	

[a]Female portion of tag turned inside out.
[b]Eroded vesicles on flippers.

Table B-16.--One hundred northern fur seal pups double-tagged with pink Roto tags at Castle Rock, San Miguel Island, California, on 23 September 1986. All animals were checkmarked by removal of the cartilaginous extension of the fourth digit on the right hind flipper (tag number 260 destroyed).

Tag number	Sex	Weight (kg)	Remarks*
C221	M	9.00	S, B
222	F	10.00	S, B
223	M	5.50	S, B
224	F	7.00	S, B
225	F	9.00	S, B
226	M	14.50	S, B
227	F	8.00	S, B
228	F	9.25	S, B, V, EV, VS
229	M	13.50	S, B
230	M	11.75	S, B
231	M	10.50	S, B
232	F	10.50	S, B
233	F	13.00	S, B
234	M	11.50	S, B
235	F	9.00	S, B
236	M	12.00	S, B
237	F	8.25	S, B
238	F	11.75	S, B
239	F	11.50	S, B
240	F	10.50	S, B
241	M	11.50	S, B
242	M	12.50	S, B
243	F	10.00	S, B
244	M	13.00	S, B
245	F	14.00	S, B
246	M	9.00	S, B
247	M	11.00	S, B, EV
248	M	12.75	S, B
249	M	13.00	S, B
250	F	8.00	S, B
251	F	9.50	S, B
252	M	13.50	
253	M	11.00	
254	F	10.00	
255	F	10.50	
256	F	7.75	
257	M	12.25	
258	M	12.50	
259	F	10.50	

Table B-16.--Continued.

Tag number	Sex	Weight (kg)	Remarks*
C261	M	11.50	
262	F	9.50	
263	M	11.00	
264	M	15.00	
265	F	10.50	
266	F	4.00	
267	F	5.00	
268	M	12.00	
269	M	12.25	
270	F	9.00	
271	F	10.00	
272	M	12.00	
273	M	13.00	
274	M	8.00	
275	M	12.00	
276	M	13.00	
277	F	10.50	
278	M	10.75	
279	M	15.00	
280	F	13.00	
281	F	11.25	
282	F	10.00	
283	M	11.50	
284	F	9.50	
285	F	7.75	
286	F	11.00	
287	M	14.00	EV
288	F	10.25	
289	M	9.50	
290	F	9.75	EV
291	F	11.50	
292	F	9.50	
293	F	10.00	EV
294	F	8.75	
295	F	12.00	
296	M	12.00	
297	F	11.00	
298	M	12.25	
299	F	10.50	
300	M	11.50	
301	M	6.00	
302	F	8.00	
303	M	12.50	
304	M	12.50	
305	F	9.50	

Table B-16.--Continued.

Tag number	Sex	Weight (kg)	Remarks*
C306	M	11.75	
307	M	11.25	
308	F	11.75	
309	M	13.00	
310	M	13.00	
311	F	11.25	
312	M	10.50	
313	F	11.00	
314	M	17.25	
315	M	14.50	
316	F	11.75	
317	M	16.25	
318	F	12.75	
319	M	9.50	
320	M	13.50	
321	F	9.50	

*B = Blood sample collected.
S = Rectal swabs collected for virology.
V = Vesicles present on flippers.
VS = Vesicles sampled for virology.
EV = Eroded vesicles present on flippers.
HV = Healed vesicles present on flippers.

APPENDIX C

Tabulations of northern fur seal entanglement data.

APPENDIX C (Continued)

Table C-1.--Body weight of subadult male northern fur seals upon returning from feeding trip to sea. Weight of the marine debris is given for two individuals; the debris was removed at the end of this study. Male No. 0119 acquired the piece of poly line during the feeding trip described. A dash indicates no data.

Seal tag number	Individual number	Weight of debris (g)	Body weight (kg)
0119	4	875[a] 200[b]	44
0326	5	51[a]	42
0328	1	N/A	-
0329	2	N/A	43
0330	3	N/A	44

[a]trawl webbing

[b]poly line

Table C-2.--Comparison of duration of feeding trips to sea for subadult male northern fur seals at St. Paul Island, Alaska, July-August, 1986. Entangled individuals spent significantly more time at sea ($p > 0.95$) than unentangled individuals (general linear model with Poisson errors).

	Specimen number	Days at sea	Mean days at sea
Unentangled Males	0328	20	
	0329	18	17.3
	0330	14	
Entangled Males	0326	34	37.0
	0119	40	

Table C-3.--The number of dives made by subadult male northern fur seals St. Paul Island, Alaska, July-August, 1986. The number of dives (≥4m) made at night was significantly higher than the number made during the day ($p > 0.95$). There was no significant difference between the number of dives made by entangled and unentangled individuals ($p > 0.95$). These comparisons were tested using a two way analysis of variance.

	Entangled males (n=2)		Unentangled males (n=3)	
	Per period	Per hour	Per period	Per hour
Day (16.5 hours)	32.5 (n=509)	2.0	21.0 (n=451)	1.3
Night (7.5 hours)	148.6 (n=2486)	19.8	171.0 (n=3613)	22.8
Combined (24 hours)	181.1 (n=2995)	21.8	191.9 (n=4064)	24.1

Table C-4.--Mean maximum depth of dives (m) for subadult male northern fur seals St. Paul Island, Alaska, July-August 1986. The mean maximum depth of dives (>4m) at night was deeper than dives during the day. Unentangled individuals dove significantly deeper than entangled individuals. A two-way analysis of variance demonstrated significant differences between the depths of dive at different times of day and for entangled and unentangled seals ($p > 0.95$).

Time of day	Entangled males (n=2)	Unentangled males (n=3)	All males (n=5)
Day	26.5 (n=509)	32.8 (n=451)	29.7 (n=960)
Night	9.4 (n=2,486)	13.8 (n=3,613)	11.6 (n=6,099)
Combined	18.8 (n=2,995)	23.3 (n=4,064)	20.6 (n=7,059)

Table C-5.--Beach cleanup sites at St. Paul Island, Alaska, 1986.

Date	Location of beach cleanup site
19 Aug.	Polovina rookery sections 1 and 2 and adjacent beach to south of section 1.
20 Aug.	Vostochni rookery sections 13 and 14, cobble beach between sections 12 and 13, and approximately 300 m of sand beach south of section 14.
21 Aug.	Kitovi rookery sections 1 and 2 and adjacent cobble beach south of section 1.

Table C-6.--Stretched mesh (cm) of trawl debris found at beach cleanup sites, St. Paul Island, Alaska, 1986.

Mesh size	Frequency distribution for mesh			
	Frequency	Cumulative frequency	Percent	Cumulative percent
5.0	1	1	0.57	0.57
5.5	1	2	0.57	1.14
6.0	2	4	1.14	2.29
6.5	1	5	0.57	2.86
7.0	5	10	2.86	5.71
7.5	11	21	6.29	12.00
8.0	10	31	5.71	17.71
8.5	5	36	2.86	20.57
9.0	4	40	2.29	22.86
9.5	1	41	0.57	23.43
10.0	10	51	5.71	29.14
10.5	4	55	2.29	31.43
11.0	8	63	4.57	36.00
11.5	8	71	4.57	40.57
12.0	5	76	2.86	43.43
12.5	7	83	4.00	47.43
13.0	8	91	4.57	52.00
13.5	4	95	2.29	54.29
14.0	15	110	8.57	62.86
14.5	7	117	4.00	66.86
15.0	4	121	2.29	69.14
15.5	3	124	1.71	70.86
16.0	3	127	1.71	72.57
16.5	3	130	1.71	74.29
17.0	5	135	2.86	77.14
17.5	5	140	2.86	80.00
19.0	1	141	0.57	80.57
19.5	1	142	0.57	81.14
20.0	2	144	1.14	82.29
21.0	2	146	1.14	83.43
21.5	4	150	2.29	85.71
22.0	4	154	2.29	88.00
22.5	3	157	1.71	89.71
23.0	7	164	4.00	93.71
23.5	2	166	1.14	94.86
24.0	1	167	0.57	95.43
24.5	1	168	0.57	96.00
27.0	1	169	0.57	96.57
27.5	1	170	0.57	97.14
37.0	1	171	0.57	97.71
38.5	2	173	1.14	98.86
39.0	2	175	1.14	100.00

Table C-7.--Trawl debris observed on rookeries and hauling grounds, St. Paul Island, Alaska, 19-21 August 1986. A dash indicates no data.

Rookery	Net color	Mesh size (cm)	Twine diam. (mm)	Weight (kg)
Polovina	Green	7.5	6	0.03
	-	7.5	5	0.45
	-	7.5	5	0.91
	-	7.5	6	2.70
	-	8.0	8	0.05
	-	8.0	6	0.91
	-	8.0	8	1.40
	-	8.5	7	3.20
	-	10.0	7	0.45
	-	10.0	3	5.00
	-	10.5	5	11.40
	-	11.0	5	1.80
	-	11.5	6	1.80
	-	11.5	2	2.70
	-	12.5	5	0.05
	-	12.5	3	0.68
	-	13.0	5	0.23
	-	13.5	3	14.50
	-	14.0	2	0.20
	-	14.5	3	0.05
	-	20.0	3	-
	-	27.0	3	1.60
	-	38.5	4	2.30
	-	39.0	4	0.05
	-	39.0	4	0.05
	gray	6.0	6	0.68
	-	6.5	5	6.40
	-	7.0	6	22.70
	-	7.0	6	1.80
	-	7.0	5	1.80
	-	7.5	5	0.05
	-	7.5	7	0.22
	-	7.5	5	1.80
	-	7.5	5	4.10
	-	7.5	4	5.00
	-	7.5	5	7.30
	-	8.0	5	0.45
	-	8.5	7	2.70
	-	9.0	6	0.91
	-	9.0	5	0.91
	-	9.0	7	7.30
	-	11.5	7	2.70
	-	12.0	7	7.30
	-	13.0	6	0.45
	-	13.0	5	4.10

Table C-7.--Continued.

Rookery	Net color	Mesh size (cm)	Twine diam. (mm)	Weight (kg)
Polovina	-	13.5	4	0.05
	-	14.0	3	0.05
	-	15.0	2	0.10
	-	16.5	3	0.91
	-	27.5	5	6.80
	blue	8.5	4	0.02
	-	8.5	6	0.22
	-	8.5	6	4.10
	-	11.0	5	-
	-	13.5	5	14.50
	-	14.5	3	0.90
	orange	10.0	1	4.50
	-	12.5	4	5.90
	-	13.0	5	0.91
	white	14.0	5	0.45
	black	10.0	8	0.22
	green	8.0	4	-
	green	10.0	2	-
	-	11.5	3	-
	-	12.0	5	-
	-	13.0	6	-
	-	14.5	5	-
	-	15.5	5	-
	-	15.5	3	-
	-	17.5	3	-
	-	17.5	4	-
	-	21.0	5	-
	blue	5.0	13	-
	-	10.5	2	-
	-	13.5	6	-
	-	14.0	3	-
	-	17.5	4	-
	-	23.0	4	-
	gray	6.0	2	-
	-	7.0	6	-
	-	7.0	6	-
	-	7.5	3	-
	-	10.0	4	-
	-	10.5	4	-
	-	11.0	2	-
	-	11.0	3	-
	-	12.5	5	-
	-	12.5	5	-
	-	14.0	4	-
	-	14.0	5	-
	-	14.5	3	-
	-	14.5	5	-

Table C-7.--Continued.

Rookery	Net color	Mesh size (cm)	Twine diam. (mm)	Weight (kg)
Polovina	-	17.5	3	-
	-	20.0	4	-
	-	22.0	8	-
	-	23.0	3	-
	black	5.5	3	-
Vostochni	green	8.0	6	-
	-	10.0	7	1.80
	-	10.0	8	0.90
	-	11.0	2	-
	-	11.0	3	-
	-	11.5	3	3.20
	-	12.0	3	0.90
	-	13.0	7	1.00
	-	14.0	6	1.40
	-	14.0	3	2.30
	-	14.0	3	-
	-	14.0	5	-
	-	14.5	5	-
	-	15.0	5	1.40
	-	16.5	4	-
	-	17.0	4	0.45
	-	19.5	4	0.70
	-	21.0	3	-
	-	21.5	5	-
	-	21.5	2	-
	-	22.0	2	-
	-	22.5	2	-
	-	23.0	7	-
	-	23.0	3	-
	-	23.5	2	-
	blue	14.0	2	-
	-	14.0	4	-
	-	16.0	5	0.05
	-	17.0	2	1.40
	-	17.0	3	-
	-	17.5	4	-
	-	17.0	5	-
	-	21.5	3	-
	-	21.5	3	-
	-	22.5	1	2.20
	-	23.0	4	0.90
	-	23.0	4	-
	-	24.5	6	-
	gray	8.0	3	0.90
	-	8.0	7	0.90
	-	8.0	6	1.10

Table C-7.--Continued.

Rookery	Net color	Mesh size (cm)	Twine diam. (mm)	Weight (kg)
Vostochni	-	8.0	6	6.40
	-	9.0	5	-
	-	10.0	4	0.40
	-	10.5	6	9.50
	-	11.0	4	-
	-	11.5	2	-
	-	11.5	2	0.40
	-	12.0	2	-
	-	12.0	4	-
	-	13.0	6	1.80
	-	14.0	4	-
	-	14.0	4	-
	-	14.5	3	-
	-	15.0	3	-
	-	15.5	3	0.05
	-	16.0	3	-
	-	16.0	3	-
	-	19.0	3	-
	-	22.0	3	-
	-	23.0	3	1.80
	-	24.0	4	-
	-	37.0	4	-
	white	12.5	3	-
Kitovi	green	10.0	7	0.05
	-	11.0	2	-
	-	11.5	2	0.22
	-	12.5	3	0.90
	-	15.0	3	-
	-	17.0	3	1.40
	-	22.0	5	4.50
	-	22.5	2	0.45
	-	38.5	3	-
	gray	9.5	2	0.05
	-	13.0	7	0.05
	-	14.0	7	2.30
	-	16.5	3	-
	-	23.5	3	0.90

Table C-8.--Packing bands and other miscellaneous synthetic debris observed at beach cleanup sites, St. Paul Island, Alaska, 1986. A dash indicates no data.

Date	Rookery	Packing band: Open Color	Closed (No.)	Circumference (cm)	Other debris
19 Aug.	Polovina	Green	4	0	-	Two red plastic rings.
		Yellow	20	0	-	10 cm inside diam.
		Clear	-	-	-	One blue plastic
		White	17	2	88, 136	ring. 10 cm inside
		Blue	25	2	146, 178	diam.
		Black	23	3	92, 140, 152	
20 Aug.	Vostochni					
		Green	3	0	-	One red plastic ring.
		Yellow	36	1	130	10 cm inside diam.
		Clear	1	1	50	One yellow plastic
		White	19	1	18	ring. 10 cm inside
		Red	2	0	-	diam. One green
		Blue	43	0	-	monofilament;
		Black	29	5	19, 46,46, 47, 90	gillnet monofilament diam. = < 1mm; mesh size (stretched) = 12cm
21 Aug.	Kitovi					
		Green	1	0	-	
		Yellow	12	1	168	
		Clear	1	0	-	
		White	1	0	-	
		Blue	8	0	-	
		Black	6	1	148	

Table C-9.--Debris observed at beach cleanup sites, St. Paul Island, Alaska, 4-17 October 1986.

Rookery	Debris	Weight (kg)	Mesh (cm)	Twine diam. (mm)
Kitovi	Gray trawl	0.211	11.0	3
	Green trawl	0.106	19.5	4
	Blue trawl	0.056	13.0	3
	2 open yellow bands			
Vostochni	Gray trawl	3.016	12.5	4
	Green trawl	0.942	14.0	4
	1 closed yellow band; circumference = 164 cm			
Polovina	Gray trawl	2.100	8.5	5
	1 closed black band; circumference = 160 cm			
	1 closed blue band; circumference = 102 cm			
	1 closed yellow band; circumference = 128 cm			
	2 open yellow bands			

Table C-10.--Visual surveys for entangled northern fur seal females and pups, St. Paul Island, Alaska, 1986. (S=sampled, EN=entangled, SC=scarred)

Rookery	Date	Females			Pups	
		S	EN	SC	S	EN
Reef	6 Sept.	327	0	0	741	0
	11 Sept.	349	0	0	294	0
	17 Sept.	296	0	0	311	0
	29 Sept.	1,600	2[a]	1	1,450	0
	5 Oct.	685	1[b]	0	1,310	0
	Total	3,257	3	1	4,106	0
Gorbatch	6 Sept.	169	0	0	246	0
	11 Sept.	285	0	0	315	0
	17 Sept.	224	0	0	285	0
	30 Sept.	850	2[b]	0	600	0
	Total	1,528	2	0	1,446	0
Tolstoi	6 Sept.	215	0	0	326	0
	11 Sept.	286	0	0	286	0
	17 Sept.	210	0	0	265	0
	Total	711	0	0	896	0
Zapadni Reef	10 Sept.	245	0	0	215	0
	17 Sept.	186	0	0	276	0
	22 Sept.	0			436	1
	25 Sept.	0			216	0
	26 Sept.	0			235	0
	28 Sept.	355	0	0	436	1
	1 Oct.	0			316	1
	Total	786			1,941	2
Little Zapadni	10 Sept.	421	0	0	488	0
	17 Sept.	231	0	0	213	0
	28 Sept.	316	0	0	265	0
	2 Oct.	2,106	1[b]	1	2,658	1
	Total	3,074	1	1	3,624	1
Zapadni	10 Sept.	425	0	0	396	0
	17 Sept.	310	0	0	357	0
	28 Sept.	297	0	0	318	0
	Total	1,032	0	0	1,071	0
Vostochni (beach area cleaned of debris)	5 Sept.	189	0	0	156	0
	13 Sept.	146	0	0	110	0
	18 Sept.	168	0	0	134	0
	28 Sept.	153	0	0	149	0
	7 Oct.	113	0	0	168	0
	Total	769	0	0	717	0

Table C-10.--Continued.

Rookery	Date	Females			Pups	
		S	EN	SC	S	EN
Vostochni						
(beach area not	5 Sept.	95	0	0	91	1
cleaned of debris)	13 Sept.	18	0	0	52	0
		63	0	0	106	0
		103	0	0	128	0
	18 Sept.	128	0	0	113	0
		111	0	0	83	0
	28 Sept.	428	0	0	394	0
		118	0	0	123	0
	7 Oct.	486	0	1	413	0
	Total	1,550	0	1	1,961	2
Morjovi	7 Sept.	321	1[c]	0	368	3
	18 Sept.	239	0	0	291	1
	26 Sept.	216	0	0	325	1
	7 Oct.	264	0	0	311	0
	Total	1,040	1	0	1,295	5
Polovina Cliffs	9 Sept.	543	0	0	610	0
	18 Sept.	508	0	0	455	0
	21 Sept.	0			327	0
	27 Sept.	0			306	0
	30 Sept.	434	1[b]	0	571	0
	Total	1,485	1	0	2,269	0
Polovina	8 Sept.	116	0	0	125	0
	18 Sept.	155	0	0	116	0
	21 Sept.	0			148	1
	26 Sept.	0			344	0
	27 Sept.	0			316	0
	1 Oct.	265	1[c]	0	289	1
	Total	536	1	0	1,338	2
Lukanin	9 Sept.	96	0	0	105	0
	15 Sept.	115	0	0	109	0
	21 Sept.	0			166	0
	28 Sept.	145	0	0	124	0
	3 Oct.	0			687	0
	Total	356	0	0	1,191	0
Kitovi	9 Sept.	215	0	0	241	0
(beach area not	15 Sept.	228	0	0	230	0
cleaned of debris)	28 Sept.	416	0	0	453	0
	Total	859	0	0	924	0

Table C-10.--Continued.

Rookery	Date	Females			Pups	
		S	EN	SC	S	EN
Kitovi	9 Sept.	185	0	0	162	0
(beach area cleaned	15 Sept.	194	0	0	196	0
of debris)	28 Sept.	110	0	0	101	0
	3 Oct.				121	0
	Total	489	0	0	580	0
Little Polovina	8 Sept.	8	0	0	30	0
	14 Oct.				57	0
	Total	8	0	0	87	0
Tolstoi	21 Sept.	0			412	0
	30 Sept.	0			830	0
	Total	0			1,242	0
Grand Total		17,472	9	3	24,230	12

[a]One black vibrissae female and one mixed vibrissae female.

[b]Black vibrissae female.

[c]Mixed vibrissae female.

Table C-11.--Summary of male northern fur seals tagged (entangled and control), St. Paul Island, Alaska, 16 July through 16 October 1986.

Rookery	Number of seals tagged			Total
	Entangled	Control	Net marked	
Zapadni	26	51	0	77
Little Zapadni	4	14	0	18
Zapadni Reef	4	4	0	8
Tolstoi	14	34	0	48
Zolotoi Sands	4	10	0	14
Gorbatch	9	18	0	27
Reef	13	37	0	50
Kitovi	5	11	0	16
Lukanin	5	8	0	13
Polovina	15	31	0	46
Polovina Cliffs	1	1	0	2
Morjovi	9	20	0	29
Vostochni	15	35	1	51
English Bay	4	5	0	9
Total	128	279	1	408

Table C-12.--Roundup surveys and tagging of northern fur seals at St. Paul Island, Alaska, 1986. A dash indicates no data.

Date	Rookery	Effort	Harvest size males	Entangled males			Net marked seals	Controls		Males tagged in 1985 and resighted in 1986		
				Observed	Tagged	Resighted		Tagged	Resighted	Controls	Entangled	Not entangled
19 July	Reef	off	-	-	2	-	-	3	-	-	-	-
20 July	Vostochni	off	-	-	1	-			-	-	-	-
21 July	Gorbatch	off	-	-	2	-	-	-	-	-	-	-
16 July	Zapadni Reef	on	67	0	0	0	0	0	0	0	0	0
22 July	Polovina	on	366	2	2	0	0	4	0	2	0	0
22 July	Polovina	on	55	1	1	0	0	2	0	0	0	0
22 July	Polovina	on	183	1	1	0	0	2	0	0	0	0
22 July	Kitovi	on	276	1	1	0	0	3	0	2	0	0
22 July	Zolotoi Sands	on	310	4	2	0	0	6	0	1	0	0
23 July	Tolstoi	on	310	1	1	0	0	2	0	0	0	0
23 July	Tolstoi	on	707	3	3	0	1	6	0	1	0	0
23 July	Gorbatch	on	611	5	4	0	0	12	0	0	1	0
25 July	Zapadni	on	1,979	7	6	0	1	14	9	3	1	1
26 July	Reef	on	193	0	0	0	0	0	0	0	0	0
26 July	Reef	on	350	1	0	0	1	2	0	0	0	0
26 July	Reef	on	177	0	0	0	0	0	2	0	0	0
26 July	Reef	on	722	2	1	1	3	2	2	2	0	0
27 July	Little Zapadni	on	680	4	2	1	3	6	3	1	1	1
27 July	Zapadni Reef	on	280	1	0	0	0	2	2	1	1	0
27 July	Zapadni Reef	on	167	0	0	0	0	0	2	0	0	0
29 July	Tolstoi	on	339	0	0	0	1	0	0	1	0	0
29 July	Tolstoi	on	985	5	2	2	1	4	6	3	0	2
29 July	Zolotoi Sands	on	350	0	0	0	4	0	0	0	0	0
30 July	Vostochni	on	505	0	0	0	0	0	0	1	0	0
30 July	Morjovi	on	89	1	1	0	0	2	0	0	0	0
30 July	Morjovi	on	391	2	2	0	1	4	0	1	0	0
30 July	Morjovi	on	206	0	0	0	1	0	0	0	0	0
31 July	Vostochni	on	120	2	2	0	0	8	0	0	0	0
31 July	Vostochni	on	190	1	1	0	1	2	0	0	0	0
31 July	Vostochni	on	79	0	0	0	1	0	0	0	0	0
31 July	Vostochni	on	110	1	1	0	0	2	0	0	0	0
31 July	Vostochni	on	350	1	0	0	0	2	0	2	0	0
31 July	Lukanin	on	77	2	2	0	1	4	0	0	0	0
31 July	Kitovi	on	429	2	2	0	0	4	0	1	0	0

Table B-12.--Continued.

Date	Rookery	Effort	Harvest size males	Entangled males			Net marked seals	Controls		Males tagged in 1985 and resighted in 1986		
				Observed	Tagged	Resighted		Tagged	Resighted	Controls	Entangled	Not entangled
1 Aug.	Gorbatch	on	535	3	2	1	0	6	1	0	0	0
1 Aug.	Reef	on	251	1	0	0	0	2	0	1	0	0
1 Aug.	Reef	on	20	0	0	0	0	0	1	0	0	0
1 Aug.	Reef	on	377	2	2	0	0	2	0	0	0	0
1 Aug.	Zapadni	on	1,836	6	6	0	1	12	3	0	0	0
2 Aug.	Little Zapadni	on	140	0	0	0	2	0	0	0	0	0
2 Aug.	Zapadni Reef	on	36	1	1	0	0	2	0	1	0	0
3 Aug.	Polovina	on	368	4	3	1	0	6	1	0	0	0
3 Aug.	Polovina	on	429	1	1	0	2	2	0	0	0	0
3 Aug.	Little Polo	on	96	0	0	0	0	0	0	0	0	0
3 Aug.	Tolstoi	on	244	4	3	1	0	6	0	0	0	0
3 Aug.	Tolstoi	on	894	4	3	1	2	6	4	2	0	0
4 Aug.	Vostochni	on	521	0	0	0	1	0	1	1	0	1
4 Aug.	Vostochni	on	115	0	0	0	0	0	0	0	0	0
4 Aug.	Vostochni	on	313	0	0	0	0	0	2	0	0	0
4 Aug.	Morjovi	on	128	2	0	1	0	2	0	0	1	0
4 Aug.	Lukanin	on	633	3	2	1	1	4	0	1	0	0
4 Aug.	Kitovi	on	298	0	0	0	0	0	2	0	0	0
5 Aug.	Vostochni	on	180	0	0	0	0	0	0	0	0	0
5 Aug.	Vostochni	on	305	1	0	1	0	0	2	1	0	0
5 Aug.	Vostochni	on	112	1	1	0	0	2	1	0	0	0
5 Aug.	Vostochni	on	67	0	0	0	0	0	1	0	0	0
5 Aug.	Reef	on	281	0	0	0	0	0	1	0	0	0
5 Aug.	Reef	on	152	0	0	0	0	0	1	0	0	0
5 Aug.	Reef	on	375	5	4	1	2	8	1	0	0	0
5 Aug.	Zolotoi Sands	on	163	0	0	0	0	0	3	0	0	0
6 Aug.	Gorbatch	on	350	0	0	0	0	0	1	0	0	0
7 Aug.	Tolstoi	on	194	0	0	0	0	0	0	1	0	0
7 Aug.	Tolstoi	on	632	3	1	0	0	2	4	1	0	0
8 Aug.	Zapadni	on	874	4	4	0	1	8	3	5	0	0
17 Aug.	Reef	off	-	-	0	1	-	-	-	-	-	-
17 Aug.	Zapadni	off	-	-	0	-	5	-	-	-	-	-
18 Aug.	Vostochni	off	-	-	0	-	6	-	-	-	-	-

Table C-12.--Continued.

Date	Rookery	Effort	Harvest size males	Entangled males			Net marked seals	Controls		Males tagged in 1985 and resighted in 1986		
				Observed	Tagged	Resighted		Tagged	Resighted	Controls	Entangled	Not entangled
18 Aug.	Morjovi	off	-	-	0	-	3	-	-	-	-	-
19 Aug.	Polovina	off	-	-	0	-	6	-	-	-	-	-
22 Aug.	Vostochni	off	-	-	0	-	3	-	-	-	-	-
24 Aug.	Vostochni	off	-	-	19	-	0	-	-	-	-	-
24 Aug.	Kitovi	off	-	-	2	-	0	-	-	-	-	-
24 Aug.	Reef	off	-	-	6	-	0	-	-	-	-	-
24 Aug.	Zapadni	off	-	-	10	-	1	-	-	-	-	-
25 Aug.	Morjovi	off	-	-	8	-	0	-	-	-	-	-
25 Aug.	Polovina	off	-	-	12	-	0	-	-	-	-	-
25 Aug.	Zolotoi Sands	off	-	-	4	-	2	-	-	-	-	-
24 Sept.	Reef	off	-	-	2	-	2	-	-	-	-	-
25 Sept.	Polovina	off	-	-	2	-	0	-	-	-	-	-
21 Sept.	Polovina	off	-	-	0	-	1	-	-	-	-	-
25 Sept.	Zapadni Reef	off	-	-	0	-	1	-	-	-	-	-
27 Sept.	Zapadni Reef	off	-	-	0	-	2	-	-	-	-	-
28 Sept.	Reef	off	-	-	2	-	1	-	-	-	-	-
29 Sept.	Gorbatch	off	-	-	0	-	1	-	-	-	-	-
2 Oct.	Little Zapadni	off	-	-	6	-	1	-	-	-	-	-
3 Oct.	Zapadni	off	-	-	0	-	4	-	-	-	-	-
3 Oct.	English Bay	off	-	-	0	-	3	-		-	-	-
6 Oct.	Tolstoi	off	-	-	8	-	1	-	-	-	-	-
7 Oct.	Kitovi	off	-	-	0	-	2	-	-	-	-	-
7 Oct.	Lukanin	off	-	-	0	-	1	-	-	-	-	-
8 Oct.	Morjovi	off	-	-	4	-	2	-	-	-	-	-
10 Oct.	Vostochni	off	-	-	1	-	-	0	-	-	-	-
11 Oct.	Zapadni	off	-	-	7	-	0	-	-	-	-	-
12 Oct.	Reef	off	-	-	4	-	0	-	-	-	-	-
12 Oct.	English Bay	off	-	-	5		1	-	-	-	-	-
14 Oct.	Polo Cliffs	off	-	-	1	-	1	-	-	-	-	-
15 Oct.	Little Zapadni	off	-	-	2	-	1	-	-	-	-	-
15 Oct.	Kitovi	off	-	-	2	-	0	-	-	-	-	-
16 Oct.	Polovina	off	-	-	0	-	1	-	-	-	-	-
16 Oct.	Reef	off	-	-	0	-	4	-	-	-	-	-

Table C-13.--Northern fur seals tagged with Allflex tags for entanglement studies, St. Paul Island, Alaska, 1986. Numbers up to 1,000 are orange; those over 5,000 are white. Tag numbers 0658/59, 0660, 0714/0715, 0790/0791 = females, others = males. A dash indicates no data.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0326	0326	19 July	Reef	d	trawl	s	gray	t	180°	23.0	-
0327	0327	19 July	Reef	d	trawl	m	gray	t	180°	-	-
0328	0328	19 July	Reef	c							
0329	0329	19 July	Reef	c							
0330	0330	19 July	Reef	c							
0331	0331	20 July	Vostochni	n					360°		
0332	0332	20 July	Vostochni	d	trawl	s	green	vt	0	-	-
0333	0333	21 July	Gorbatch	d	packing band		blue	tnb	0		
0334	0334	21 July	Gorbatch	d	skin ring	s		t	0		
0335	0335	22 July	Polovina	d	packing band	s	yellow	t	220°		
0336	0336	22 July	Polovina	c							
0337	0337	22 July	Polovina	c							
0338	0338	22 July	Polovina	c							
0339	0339	22 July	Polovina	c							
0340	0340	22 July	Polovina	d	trawl	m	green	t	0	22.0	4.0
0341	0341	22 July	Polovina	d	trawl	m	gray	t	0	21.5	3.0
0342	0342	22 July	Polovina	c							
0343	0343	22 July	Polovina	c							
0344	0344	22 July	Polovina	d	twine	s	gray	vt	360°		6.0
0345	0345	22 July	Polovina	c							
0346	0346	22 July	Polovina	c							
0347	0347	22 July	Kitovi	d	rope	s	white	vt	180°		13.0
0348	0348	22 July	Kitovi	c							
0349	0349	22 July	Kitovi	c							
0350	0350	22 July	Kitovi	c							
0351	0351	22 July	Zolotoi Sands	d	trawl	l	gray	t	0	22.0	4.0
0352	0352	22 July	Zolotoi Sands	d	trawl	s	gray	vt	220°	23.0	-
0353	0353	22 July	Zolotoi Sands	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0354	0354	22 July	Zolotoi Sands	c							
0355	0355	22 July	Zolotoi Sands	c							
0356	0356	22 July	Zolotoi Sands	c							
0357	0357	22 July	Zolotoi Sands	c							
0358	0358	22 July	Zolotoi Sands	c							
0359	0359	23 July	Tolstoi	d	trawl	l	green	t	0	18.0	4.0
0360	0360	23 July	Tolstoi	c							
0361	0361	23 July	Tolstoi	c							
0363	0363	23 July	Tolstoi	c							
0365	0365	23 July	Tolstoi	c							
0366	0366	23 July	Tolstoi	c							
0367	0367	23 July	Tolstoi	c							
0369	0369	23 July	Tolstoi	c							
0370	0370	23 July	Tolstoi	c							
0371	0371	23 July	Tolstoi	c							
0372	0372	23 July	Gorbatch	d	trawl	s	white	tnb	0	21.0	4.0
0373	0373	23 July	Gorbatch	d	trawl	s	green	vt	360°	-	-
0374	0374	23 July	Gorbatch	d	packing band	s	green	vt	360°	-	-
0375	0375	23 July	Gorbatch	c							
0376	0376	23 July	Gorbatch	c							
0377	0377	23 July	Gorbatch	c							
0378	0378	23 July	Gorbatch	c							
0379	0379	23 July	Gorbatch	c							
0380	0380	23 July	Gorbatch	c							
0381	0381	23 July	Gorbatch	d	packing band	s	yellow	tnb	0		
0382	0382	23 July	Gorbatch	c							
0383	0383	23 July	Gorbatch	c							
0384	0384	23 July	Gorbatch	c							
0385	0385	23 July	Gorbatch	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0386	0386	23 July	Gorbatch	c							
0387	0387	23 July	Gorbatch	c							
0388	0388	25 July	Zapadni	d	trawl	s	blue	vt	360°	21.0	-
0389	0389	25 July	Zapadni	d	trawl	s	gray	vt	360°	-	-
0390	0390	25 July	Zapadni	d	trawl	s	gray	vt	360°	21.5	3.0
0391	0391	25 July	Zapadni	d	cottonline	s		tnb	180°		3.0
0392	0392	25 July	Zapadni	d	trawl	l	green	tnb	0	21.5	7.0
0393	0393	25 July	Zapadni	c							
0394	0394	25 July	Zapadni	d	sheetplastic	s	clear	l	0		
0395	0395	25 July	Zapadni	c							
0396	0396	25 July	Zapadni	c							
0397	0397	25 July	Zapadni	c							
0398	0398	25 July	Zapadni	c							
0399	0399	25 July	Zapadni	c							
0400	0400	25 July	Zapadni	c							
0401	0401	25 July	Zapadni	c							
0402	0402	25 July	Zapadni	c							
0403	0403	25 July	Zapadni	c							
0404	0404	25 July	Zapadni	c							
0405	0405	25 July	Zapadni	c							
0406	0406	25 July	Zapadni	c							
0407	0407	25 July	Zapadni	c							
0408	0408	26 July	Reef	c							
0409	0409	26 July	Reef	c							
0410	0410	26 July	Reef	d	trawl	m	orange	t	180°	18.0	5.0
0411	0411	26 July	Reef	c							
0412	0412	26 July	Reef	c							
0413	0413	27 July	Little Zapadni	d	trawl	l	green	s	0	-	3.0
0414	0414	27 July	Little Zapadni	d	trawl	m	green	t	0	21.5	2.0

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0415	0415	27 July	Little Zapadni	c							
0416	0416	27 July	Little Zapadni	c							
0417	0417	27 July	Little Zapadni	c							
0418	0418	27 July	Little Zapadni	c							
0419	0419	27 July	Little Zapadni	c							
0420	0420	27 July	Little Zapadni	c							
0421	0421	27 July	Zapadni Reef	c							
0422	0422	27 July	Zapadni Reef	c							
0423	0423	29 July	Tolstoi	d	rope	l	tan	tnb	0		13.0
0424	0424	23 July	Tolstoi	d	trawl	m	green	t	180°	-	-
0425	0425	29 July	Tolstoi	d	trawl	m	gray	tnb	0	21.0	3.0
0426	0426	23 July	Tolstoi	d	trawl	s	gray	vt	360°	-	-
0427	0427	29 July	Tolstoi	c							
0428	0428	29 July	Tolstoi	c							
0429	0429	29 July	Tolstoi	c							
0430	0430	29 July	Tolstoi	c							
0431	0431	30 July	Morjovi	d	trawl	l	gray	tnb	0	22.0	3.0
0432	0432	30 July	Morjovi	c							
0433	0433	30 July	Morjovi	c							
0434	0434	30 July	Morjovi	d	trawl	s	green	tnb	0	21.0	4.0
0435	0435	30 July	Morjovi	d	poly-line	s		t	0		-
0436	0436	30 July	Morjovi	c							
0437	0437	30 July	Morjovi	c							
0438	0438	30 July	Morjovi	c							
0439	0439	30 July	Morjovi	c							
0440	0440	31 July	Vostochni	d	trawl	s	white	t	0	-	4.0
0441	0441	31 July	Vostochni	d	packing band	s	white	vt	0		
0442	0442	31 July	Vostochni	c							
0443	0443	31 July	Vostochni	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0444	0444	31 July	Vostochni	c							
0445	0445	31 July	Vostochni	c							
0446	0446	31 July	Vostochni	c							
0447	0447	31 July	Vostochni	c							
0448	0448	31 July	Vostochni	c							
0449	0449	31 July	Vostochni	c							
0450	0450	31 July	Vostochni	d	webbing	m	brown	vt	180°	-	8.0
0452	0451	24 Aug.	Reef	c							
0454	0455	24 Aug.	Reef	c							
0456	0457	24 Aug.	Reef	c							
0458	0459	24 Aug.	Reef	c							
0460	0461	24 Aug.	Zapadni	c							
0462	0463	24 Aug.	Zapadni	c							
0464	0465	24 Aug.	Zapadni	c							
0466	0467	24 Aug.	Zapadni	c							
0468	0469	24 Aug.	Zapadni	c							
0470	0471	24 Aug.	Zapadni	c							
0472	0473	24 Aug.	Zapadni	c							
0474	0475	24 Aug.	Zapadni	c							
0476	0477	24 Aug.	Zapadni	d	trawl	s	green	t	0	-	-
0478	0479	24 Aug.	Zapadni	c							
0480	0481	24 Aug.	Zapadni	c							
0482	0483	25 Aug.	Morjovi	c							
0484	0485	25 Aug.	Morjovi	c							
0486	0487	25 Aug.	Morjovi	c							
0488	0489	25 Aug.	Morjovi	c							
0490	0491	24 Aug.	Morjovi	c							
0492	0493	25 Aug.	Morjovi	c							
0494	0495	25 Aug.	Morjovi	c							

Table C-13.--Continued.

Tag number[a]				c = control d = debris n = net mark	Description of net fragment						
Left	Right	Date	Rookery		Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0496	0497	25 Aug.	Morjovi	c							
0498	0499	25 Aug.	Polovina	c							
0501	0501	31 Aug.	Vostochni	c							
0502	0502	31 Aug.	Vostochni	c							
0503	0503	31 Aug.	Vostochni	d	packing band	s	black	vt	360°		
0504	0504	31 Aug.	Vostochni	c							
0505	0505	31 July	Vostochni	c							
0506	0506	31 July	Vostochni	c							
0507	0507	31 July	Vostochni	c							
0508	0508	31 July	Lukanin	d	trawl	s	orange	t	0	17.0	6.0
0509	0509	31 July	Lukanin	c							
0510	0510	31 July	Lukanin	d	trawl	l	green	t	0	17.0	4.0
0511	0511	31 July	Lukanin	c							
0512	0512	31 July	Lukanin	c							
0513	0513	31 July	Lukanin	c							
0514	0514	31 July	Kitovi	d	packing band	s	yellow	tnb	0		
0515	0515	31 July	Kitovi	c							
0516	0516	31 July	Kitovi	c							
0517	0517	31 July	Kitovi	c							
0518	0518	31 July	Kitovi	c							
0519	0519	31 July	Kitovi	d	trawl	s	gray	tnb	0	-	3.0
0520	0520	1 Aug.	Gorbatch	d	line	s	white	t	360°		3.0
0521	0521	1 Aug.	Gorbatch	d	line	s	gray	tnb	0		6.0
0522	0522	1 Aug.	Gorbatch	c							
0523	0523	1 Aug.	Gorbatch	c							
0524	0524	1 Aug.	Gorbatch	c							
0525	0525	1 Aug.	Gorbatch	c							
0576	0577	5 Aug.	Reef	c							
0578	0579	5 Aug.	Reef	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0580	0581	5 Aug.	Reef	c							
0582	0583	5 Aug.	Reef	c							
0584	0585	5 Aug.	Reef	c							
0586	0587	5 Aug.	Reef	c							
0588	0589	5 Aug.	Reef	c							
0590	0591	5 Aug.	Tolstoi	d	packing band		gray	-	-		
0592	0593	7 Aug.	Tolstoi	c							
0594	0595	7 Aug.	Tolstoi	c							
0596	0597	8 Aug.	Zapadni	d	trawl	m	green	tnb	0	23.0	4.0
0598	0599	8 Aug.	Zapadni	d	trawl	s	blue	t	0	-	4.0
0600	0601	8 Aug.	Zapadni	d	trawl	m	gray	t	0	21.5	3.0
0602	0603	8 Aug.	Zapadni	c							
0604	0605	8 Aug.	Zapadni	c							
0606	0607	8 Aug.	Zapadni	d	twine	s	blue	l	0		-
0608	0609	8 Aug.	Zapadni	c							
0610	0611	8 Aug.	Zapadni	c							
0612	0613	8 Aug.	Zapadni	c							
0614	0615	8 Aug.	Zapadni	c							
0616	0617	8 Aug.	Zapadni	c							
0618	0619	8 Aug.	Zapadni	c							
0620	0621	17 Aug.	Reef	d	trawl	s	black	vt	360°	-	-
0622	0623	23 Aug.	Tolstoi	d	trawl		green	-	-	-	-
0624	0625	17 Aug.	Zapadni	d	trawl	m	gray	t	0	23.0	4.0
0652	0653	17 Aug.	Zapadni	d	packing band	s	white	t	200°		
0654	0655	17 Aug.	Zapadni	d	monofilament	s	green	t	360°	9.0	0.5
0656	0657	17 Aug.	Zapadni	d	trawl	s	green	t	360°	22.5	3.0
0658	0659	17 Aug.	Zapadni	d	twine	s	white	t	30°		-
0660	0661	17 Aug.	Zapadni	d	plastic ring	s	black	tnb	20°		
0662	0663	17 Aug.	Zapadni	d	twine	s	white	t	360°		0.3

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control D = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0664	0665	18 Aug.	Vostochni	d	packing band	s	white	tnb	0		
0666	0667	18 Aug.	Vostochni	d	trawl	m	blue	tnb	0	17.5	6.0
0668	0669	18 Aug.	Vostochni	d	trawl	m	green	t	0	22.0	3.0
0670	0671	18 Aug.	Vostochni	d	trawl	s	white	tnb	0	-	-
0672	0673	18 Aug.	Vostochni	d	trawl	s	gray	t	0	21.0	5.0
0674	0675	18 Aug.	Vostochni	d	trawl	s	gray	t	0	23.0	3.0
0676	0677	18 Aug.	Morjovi	d	fiber band	s	black	l	30°		
0678	0679	18 Aug.	Morjovi	d	trawl	m	gray	t	0	21.0	3.0
0680	0681	18 Aug.	Morjovi	d	trawl	s	green	t	0	-	4.0
0682	0683	19 Aug.	Polovina	d	trawl	s	white	t	180°	-	-
0684	0685	19 Aug.	Polovina	d	trawl	s	green	t	360°	-	-
0686	0687	19 Aug.	Polovina	d	trawl	m	gray	t	0	-	-
0688	0689	19 Aug.	Polovina	d	rubber band	s	tan	l	0		
0690	0691	19 Aug.	Polovina	d	rope	s	tan	vt	360°		-
0692	0693	19 Aug.	Polovina	d	trawl	l	orange	vt	0	12.5	5.0
0694	0695	22 Aug.	Vostochni	d	trawl	s	green	tnb	0	20.5	6.0
0696	0697	22 Aug.	Vostochni	d	trawl	s	blue	tnb	0	-	-
0698	0699	22 Aug.	Vostochni	d	trawl	s	green	tnb	0	29.0	3.0
0702	0703	24 Aug.	Reef	c							
0704	0705	24 Aug.	Vostochni	c							
0706	0707	24 Aug.	Vostochni	c							
0708	0709	24 Aug.	Vostochni	c							
0710	0711	24 Aug.	Vostochni	c							
0712	0713	24 Aug.	Vostochni	c							
0714	0715	24 Aug.	Vostochni	c							
0716	0716	24 Aug.	Vostochni	c							
0718	0719	24 Aug.	Vostochni	c							
0720	0721	24 Aug.	Vostochni	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0722	0723	24 Aug.	Vostochni	c							
0724	0725	24 Aug.	Vostochni	c							
0726	0727	24 Aug.	Vostochni	c							
0728	0729	24 Aug.	Vostochni	c							
0730	0731	24 Aug.	Vostochni	c							
0732	0733	24 Aug.	Vostochni	c							
0734	0735	24 Aug.	Vostochni	c							
0736	0737	24 Aug.	Vostochni	c							
0738	0739	24 Aug.	Vostochni	c							
0740	0741	24 Aug.	Vostochni	c							
0742	0743	24 Aug.	Vostochni	c							
0744	0745	24 Aug.	Kitovi	c							
0746	0747	24 Aug.	Kitovi	c							
0748	0749	24 Aug.	Reef	c							
0750	0751	25 Aug.	Polovina	c							
0752	0753	25 Aug.	Polovina	c							
0754	0755	25 Aug.	Polovina	c							
0756	0757	25 Aug.	Polovina	c							
0758	0759	25 Aug.	Polovina	c							
0760	0761	25 Aug.	Polovina	c							
0762	0763	25 Aug.	Polovina	c							
0764	0765	24 Aug.	Polovina	c							
0766	0767	25 Aug.	Polovina	c							
0768	0769	25 Aug.	Polovina	c							
0770	0771	25 Aug.	Polovina	c							
0772	0773	25 Aug.	Zolotoi Sands	d	trawl	s	white	tnb	0	-	-
0774	0775	25 Aug.	Zolotoi Sands	c							
0776	0777	25 Aug.	Zolotoi Sands	c							
0778	0779	25 Aug.	Zolotoi Sands	d	trawl	m	green	t	0	10.5	3.0

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0780	0781	25 Aug.	Zolotoi Sands	c							
0782	0783	25 July	Zolotoi Sands	c							
0789	0788	21 Sept.	Polovina	d	trawl	s	green	t	180°	-	-
0790	0791	21 Sept.	Polovina	d	trawl	-	-	-	-	-	-
0792	0793	24 Sept.	Reef	d	trawl	s	gray	l	30°	-	-
0794	0795	24 Sept.	Reef	d	rope	s	tan	tnb	330°		-
0796	0797	24 Sept.	Reef	c							
0798	0799	24 Sept.	Reef	c							
0800	0801	25 Sept.	Zapadni Reef	d	twine	s	red	l	0		-
0802	0803	24 Aug.	Polovina	c							
0804	0805	24 Sept.	Polovina	c							
0806	0807	27 Sept.	Zapadni Reef	d	trawl	s	green	tnb	0	19.5	3.0
0808	0809	28 Sept.	Zapadni Reef	d	trawl	s	gray	tnb	0	21.0	3.0
0810	0811	28 Sept.	Reef	d	trawl	m	green	t	0	20.0	2.0
0812	0813	28 Sept.	Reef	c							
0814	0815	28 Sept.	Reef	c							
0816	0817	29 Sept.	Gorbatch	d	band	s	yellow	t	0		
0818	0819	2 Oct.	Little Zapadni	c							
0820	0821	2 Oct.	Little Zapadni	c							
0822	0823	2 Oct.	Little Zapadni	c							
0824	0825	2 Oct.	Little Zapadni	c							
0852	0853	2 Oct.	Little Zapadni	c							
0854	0855	2 Oct.	Little Zapadni	c							
0856	0857	2 Oct.	Little Zapadni	d	monofilament	s	clear	t	50°	11.5	0.5
0858	0859	3 Oct.	Zapadni	d	packing band	s	black	tnb	15°		
0860	0861	3 Oct.	Zapadni	d	trawl	s	yellow	t	0	-	1.0
0862	0863	3 Oct.	Zapadni	d	line	s	white	l	360°		
0864	0865	3 Oct.	Zapadni	d	trawl	s	gray	l	0	11.5	4.0
0868	0867	5 Oct.	English Bay	d	trawl	s	green	t	0	23.0	3.0

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0870	0871	5 Oct.	English Bay	d	trawl	m	gray	t	0	21.5	3.0
0872	0873	5 Oct.	English Bay	d	TV cable	s	black	l	0		
0874	0875	7 Oct.	Kitovi	d	trawl	s	green	t	360°	-	-
0902	0903	6 Oct.	Tolstoi	c							
0904	0905	6 Oct.	Tolstoi	c							
0906	0907	6 Oct.	Tolstoi	c							
0908	0909	6 Oct.	Tolstoi	c							
0910	0911	6 Oct.	Tolstoi	c							
0912	0913	6 Oct.	Tolstoi	c							
0914	0915	6 Oct.	Tolstoi	d	trawl		green	t	0	-	-
0916	0917	6 Oct.	Tolstoi	c							
0918	0919	6 Oct.	Tolstoi	c							
0920	0921	7 Oct.	Kitovi	d	twine	s	gray	t	260°		-
0922	0923	7 Oct.	Lukanin	d	trawl	s	green	t	0	25.0	3.0
0925	0924	8 Oct.	Morjovi	d	twine	s	tan	l	180°		-
0952	0953	8 Oct.	Morjovi	d	trawl	m	gray	t	0	19.0	8.0
0954	0955	8 Oct.	Morjovi	c							
0956	0957	8 Oct.	Morjovi	c							
0958	0959	8 Oct.	Morjovi	c							
0960	0961	8 Oct.	Morjovi	c							
0964	0965	11 Oct.	Zapadni	c							
0966	0967	11 Oct.	Zapadni	c							
0968	0969	11 Oct.	Zapadni	c							
0970	0971	11 Oct.	Zapadni	c							
0972	0973	11 Oct.	Zapadni	c							
0974	0975	11 Oct.	Zapadni	c							
0976	0977	12 Oct.	Reef	c							
0978	0979	12 Oct.	Reef	c							
0980	0981	12 Oct.	Reef	c							

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
0982	0983	12 Oct.	Reef	c							
0984	0985	12 Oct.	English Bay	c							
0986	0987	12 Oct.	English Bay	c							
0988	0989	12 Oct.	English Bay	c							
0990	0991	12 Oct.	English Bay	d	trawl	m	blue	t	0	19.5	3.0
0992	0993	12 Oct.	English Bay	c							
0994	0995	12 Oct.	English Bay	c							
0996	0997	14 Oct.	Polovina Cliff	d	trawl	m	green	t	0	21.5	3.5
0998	0999	14 Oct.	Polovina Cliff	c							
5110	5110	15 Oct.	Little Zapadni	d	trawl	l	blue	t	0	20.5	3.0
5111	5111	15 Oct.	Little Zapadni	c							
5112	5112	15 Oct.	Little Zapadni	c							
5113	5113	15 Oct.	Kitovi	c							
5114	5114	15 Oct.	Kitovi	c							
5115	5115	16 Oct.	Polovina	c							
5116	5116	16 Oct.	Reef	c							
5117	5117	16 Oct.	Reef	c							
5118	5118	16 Oct.	Reef	c							
5119	5119	16 Oct.	Reef	c							
5126	5126	1 Aug.	Gorbatch	c							
5127	5127	1 Aug.	Gorbatch	c							
5128	5128	1 Aug.	Reef	c							
5129	5129	1 Aug.	Reef	c							
5130	5130	1 Aug.	Reef	d	trawl	m	green	tnb	0	17.0	4.0
5131	5131	1 Aug.	Reef	c							
5132	5132	1 Aug.	Reef	c							
5133	5133	1 Aug.	Reef	d	trawl	s	blue	tnb	0	-	-
5134	5134	1 Aug.	Zapadni	d	trawl	m	green	vt	0	19.5	3.0
5135	5135	1 Aug.	Zapadni	d	trawl	s	green	t	0	-	4.0

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
5136	5136	1 Aug.	Zapadni	d	trawl	s	gray	vt	360°	-	-
5137	5137	1 Aug.	Zapadni	d	poly-line	s	white	vt	360°		8.5
5138	5138	1 Aug.	Zapadni	c							
5139	5139	1 Aug.	Zapadni	c							
5140	5140	1 Aug.	Zapadni	c							
5141	5141	1 Aug.	Zapadni	c							
5142	5142	1 Aug.	Zapadni	c							
5143	5143	1 Aug.	Zapadni	c							
5144	5144	1 Aug.	Zapadni	c							
5145	5145	1 Aug.	Zapadni	c							
5146	5146	1 Aug.	Zapadni	d	trawl	s	gray	tnb	0	-	-
5147	5147	1 Aug.	Zapadni	c							
5148	5148	1 Aug.	Zapadni	c							
5149	5149	1 Aug.	Zapadni	c							
5150	5150	1 Aug.	Zapadni	c							
5151	5151	1 Aug.	Zapadni	d	packing band	s	blue	t	0		
5152	5152	2 Aug.	Zapadni Reef	d	trawl	s	green	tnb	0	23.0	3.0
5153	5153	2 Aug.	Zapadni Reef	c							
5154	5154	2 Aug.	Zapadni Reef	c							
5155	5155	3 Aug.	Polovina	d	trawl	s	gray	t	0	21.0	7.0
5156	5156	3 Aug.	Polovina	d	trawl	s	gray	vt	180°	-	4.0
5157	5157	3 Aug.	Polovina	d	rope	s	gray	t	0		-
5158	5158	3 Aug.	Polovina	c							
5159	5159	3 Aug.	Polovina	c							
5160	5160	3 Aug.	Polovina	c							
5161	5161	3 Aug.	Polovina	c							
5162	5162	3 Aug.	Polovina	c							
5163	5163	3 Aug.	Polovina	c							
5164	5164	3 Aug.	Polovina	d	trawl/net	s	green	t	0	-	5.0

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
5165	5165	3 Aug.	Polovina	c							
5166	5166	3 Aug.	Polovina	c							
5167	5167	3 Aug.	Tolstoi	d	trawl	s	gray	t	0	-	7.0
5168	5168	3 Aug.	Tolstoi	c							
5169	5169	3 Aug.	Tolstoi	c							
5170	5170	3 Aug.	Tolstoi	d	trawl	m	green	t	0	21	3
5171	5171	3 Aug.	Tolstoi	c							
5172	5172	3 Aug.	Tolstoi	c							
5173	5173	3 Aug.	Tolstoi	d	line	s	gray	tnb	0		
5174	5174	3 Aug.	Tolstoi	c							
5175	5175	3 Aug.	Tolstoi	c							
5176	5176	3 Aug.	Tolstoi	d	line	s	white	t	100°		3.0
5177	5177	3 Aug.	Tolstoi	d	trawl	m	green	vt	330°	11.0	3.0
5178	5178	3 Aug.	Tolstoi	c							
5179	5179	3 Aug.	Tolstoi	c							
5180	5180	3 Aug.	Tolstoi	c							
5181	5181	3 Aug.	Tolstoi	c							
5182	5182	3 Aug.	Tolstoi	d	trawl	m	gray	t	0	22.0	3.0
5183	5183	3 Aug.	Tolstoi	c							
5184	5184	3 Aug.	Tolstoi	c							
5185	5185	4 Aug.	Vostochni	c							
5186	5186	4 Aug.	Vostochni	c							
5187	5187	4 Aug.	Lukanin	d	packing band	s	white	tnb	0		
5188	5188	4 Aug.	Lukanin	d	line	s	green	tnb	360°		5.0
5189	5189	4 Aug.	Lukanin	c							
5190	5190	4 Aug.	Lukanin	c							
5191	5191	4 Aug.	Lukanin	c							
5192	5192	4 Aug.	Lukanin	c							
5193	5193	5 Aug.	Vostochni	d	tie wrap	s	clear	t	30°		

Table C-13.--Continued.

Tag number[a]					Description of net fragment						
Left	Right	Date	Rookery	c = control d = debris n = net mark	Type	Mass[b]	Color	Tight or loose[c]	Degree of wound	Mesh size (cm)	Twine size (mm)
5194	5194	5 Aug.	Vostochni	c							
5195	5195	5 Aug.	Vostochni	c							
5196	5196	5 Aug.	Reef	d	trawl	s	gray	t	0	22.5	3.0
5197	5197	5 Aug.	Reef	d	trawl	s	gray	t	0	26.5	4.0
5198	5198	5 Aug.	Reef	d	trawl	m	gray	t	0	21.5	3.0
5199	5199	5 Aug.	Reef	d	packing band	s	blue	t	0		
5200	5200	5 Aug.	Reef	c							
5552	5553	10 Oct.	Vostochni	d	packing band	s	white	t	330°		

[a]The following Allflex tag numbers were not used. Orange: 0362, 0364, 0368, 0453, 0500, 0526-0575, 0626-0651, 0700, 0701, 0717, 0784-0787, 0826-0851, 0866, 0876-0901, 0926-0951, 0962, 0963. White: 5120-5125.

[b]Mass of debris; s = small; m = medium; l = large.

[c]Tightness of debris around neck; t=tight; vt=very tight; tnb=tight but not binding; l=loose.

Table C-14.--Summary of northern fur seal males tagged during roundup surveys St.Paul Island, Alaska, 1986.

Location	Survey date		Tagged	
			Entangled	Control
Reef	26 July		1	4
	1 August		2	4
	5 August		4	8
		Total	7	16
Kitovi	22 July		1	3
	31 July		3	3
	4 August		0	0
		Total	4	6
Lukanin	31 July		2	4
	4 August		2	4
		Total		
Polovina	22 July		4	8
	4 August		4	8
		Total	8	16
Little Polovina				
	3 August		0	0
Morjovi	30 July		3	5
	4 August		0	2
		Total	3	7
Vostochni	30 July		0	2
	31 July		3	14
	4 August		0	0
	5 August		1	2
		Total	4	18
Zapadni	25 July		6	14
	1 August		6	12
	8 August		4	8
		Total	16	34
Little Zapadni				
	27 July		2	6
	2 August		0	0
		Total	2	6

Table C-14.--Continued.

Location	Survey date		Tagged: Entangled	Tagged: Control
Zapadni Reef				
	16 July		0	0
	27 July		0	2
	2 August		1	2
		Total	1	4
Tolstoi	23 July		4	8
	29 July		2	4
	3 August		6	12
	7 August		1	2
		Total	13	26
Zolotoi Sands				
	22 July		2	6
	29 July		0	0
	5 August		0	0
		Total	2	6
Gorbatch	23 July		4	12
	1 August		2	6
	6 August		0	0
		Total	6	18
Grand Total			70	165

Table C-15.--Percent of harvestable size male northern fur seals that were observed entangled or scarred from previous entanglement during roundup surveys, St. Paul Island, Alaska, 1986.

Rookery	Number of males		
	Sampled	Entangled (%)	With scars (%)
Reef	2,898	11 (0.38)	6 (0.21)
Kitovi	1,003	3 (0.30)	0 (0.00)
Lukanin	710	5 (0.70)	2 (0.28)
Polovina	1,401	9 (0.64)	2 (0.14)
Little Polovina	96	0 (0.00)	0 (0.00)
Morjovi	814	5 (0.61)	2 (0.25)
Vostochni	2,967	7 (0.24)	3 (0.10)
Zapadni	4,689	17 (0.36)	3 (0.06)
Little Zapadni	820	4 (0.49)	5 (0.61)
Zapadni Reef	550	2 (0.36)	0 (0.00)
Tolstoi	4,305	20 (0.46)	5 (0.12)
Zolotoi Sands	823	4 (0.49)	4 (0.49)
Gorbatch	1,496	8 (0.53)	0 (0.00)
Total	22,572	95 (0.42)	32 (0.14)

Table C-16--Summary of material observed entangled on male northern fur seals, St. Paul Island, Alaska, 1986. A dash indicates no data.

Type of material	Number of males entangled (% of total)	Average stretch mesh (standard deviation)
Gray trawl net	34 (26.6)	22.0 cm (3.0 cm)
Green trawl net	33 (25.8)	20.0 cm (4.0 cm)
Blue trawl net	7 (5.5)	19.5 cm (1.5 cm)
White trawl net	5 (3.9)	-
Orange trawl net	3 (2.3)	16.0 cm (3.0 cm)
Black trawl net	1 (0.8)	-
Yellow trawl net	1 (0.8)	-
Rope or twine	20 (15.6)	
Packing bands	18 (14.1)	
Monofilament gillnet	2 (1.6)	10.0 cm (2.0 cm)
Other	4[a] (3.1)	

[a]1 ring of pup skin, 1 piece of clear sheet plastic, 1 piece of brown webbing, 1 piece of black TV cable.

Table C-17.--Sightings of tagged northern fur seals, St. Paul Island, Alaska, 1986. A dash indicates no data.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
-	blue	549	23 Sept.	Reef		-
none	orange	0060	1 Aug.	Zapadni Reef	n	m
-	green	865	12 Oct.	English Bay		-
182	yellow	not seen	5 Aug.	Zapadni Reef		-
302	pink	not seen	23 Sept.	Tolstoi		f
405	pink	not seen	15 Oct.	Kitovi		f
441	blue	441	22 July	Zolotoi Sands		m
448	orange	present	15 Oct.	Kitovi		m
481	blue	481	1 Aug.	Reef		m
481	blue	-	26 July	Reef		m
532	blue	532	23 July	Gorbatch		m
534	blue	-	26 July	Reef		m
534	blue	-	22 July	Zolotoi Sands		m
555	blue	-	31 July	Vostochni		m
559	blue	-	1 Aug.	Gorbatch		m
564	blue	-	22 July	Zolotoi Sands		m
573	blue	none	25 July	Zapadni		m
579	blue	-	1 Aug.	Zapadni		m
589	blue	589	15 Oct.	Zapadni Reef		f
591	blue	not seen	29 Aug.	Zapadni Reef		f
592	blue	592	26 Aug.	Zapadni Reef		f
592	blue	592	27 Aug.	Zapadni Reef		f
592	blue	592	28 Aug.	Zapadni Reef		f
592	blue	not seen	17 Aug.	Zapadni Reef		f
593	blue	not seen	7 Aug.	Zapadni Reef		-
593	blue	593	24 Sept.	Zapadni Reef		f
595	blue	not seen	12 Aug.	Zapadni Reef		f
595	blue	595	22 Sept.	Zapadni Reef		m
599	blue	not seen	9 Aug.	Zapadni Reef		-
599	blue	not seen	11 Aug.	Zapadni Reef		-
742	orange	742	25 Sept.	Zapadni Reef		m
788	orange	748	23 Sept.	Polovina Cliffs		m
812	pink	811	29 July	Tolstoi		m
813	pink	814	23 Sept.	Tolstoi Cliffs		-
826	green	826	5 Aug.	Zapadni Reef		f
826	green	-	18 July	Zapadni Reef		f
826	green	826	28 Sept.	Zapadni Reef		f
827	green	827	20 Aug.	Vostochni		-
830	green	not seen	17 Aug.	Zapadni Reef		f
831	pink	832	4 Aug.	Lukanin		m
831	green	not seen	26 Aug.	Zapadni Reef		f
831	pink	832	3 Aug.	Polovina		m
832	green	-	19 July	Zapadni Reef		-
832	green	832	25 Sept.	Zapadni Reef		f
834	green	not seen	7 Aug.	Zapadni Reef		-

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
835	green	-	25 July	Zapadni Reef		f
835	green	not seen	17 Aug.	Zapadni Reef		f
835	green	not seen	25 Aug.	Zapadni Reef		f
835	green	-	21 July	Zapadni Reef		-
835	green	835	25 Sept.	Zapadni Reef		f
836	green	-	18 July	Zapadni Reef		f
836	green	836	21 Sept.	Zapadni Reef		f
837	green	837	22 Sept.	Zapadni Reef		f
837	green	not seen	27 Aug.	Zapadni Reef		f
838	green	not seen	19 Aug.	Zapadni Reef		f
839	green	-	25 July	Zapadni Reef		-
840	green	not seen	17 Aug.	Zapadni Reef		f
840	green	-	18 July	Zapadni Reef		f
840	green	840	29 Sept.	Zapadni Reef		f
843	green	not seen	11 Aug.	Zapadni Reef		-
845	blue	none	27 July	Zapadni Reef		m
846	green	not seen	11 Aug.	Zapadni Reef		-
846	green	not seen	11 Aug.	Zapadni Reef		f
846	green	846	5 Oct.	Zapadni Reef		f
854	green	not seen	21 Aug.	Zapadni Reef		f
854	green	not seen	23 Aug.	Zapadni Reef		f
854	green	not seen	12 Aug.	Zapadni Reef		f
854	green	854	29 Sept.	Zapadni Reef		f
855	green	not seen	12 Aug.	Zapadni Reef		f
855	green	present	22 Sept.	Zapadni Reef		f
861	green	not seen	23 Aug.	Zapadni Reef		f
861	green	861	25 Aug.	Zapadni Reef		f
861	green	not seen	26 Aug.	Zapadni Reef		f
861	green	not seen	21 Aug.	Zapadni Reef		f
861	green	not seen	19 Aug.	Zapadni Reef		f
861	green	861	24 Sept.	Zapadni Reef		f
862	green	-	25 July	Zapadni Reef		-
865	green	865	15 Oct.	Zapadni Reef		f
875	green	not seen	21 Sept.	Polvina		-
896	green	896	22 Sept.	Zapadni Reef		f
0001	orange	0001	5 Oct.	English Bay	d	m
0001	orange	0001	29 July	Tolstoi	d	m
0007	orange	0007	21 Sept.	Polovina	n	m
0019	orange	0019	25 July	Zapadni	d	m
0025	orange	not seen	12 Aug.	Zapadni Reef	n	m
0027	orange	0027	23 Sept.	Tolstoi Cliffs	n	m
0031	orange	0031	24 Sept.	Reef	n	m
0042	orange	0042	4 Aug.	Vostochni	n	m
0043	orange	0043	27 July	Zapadni Reef	n	m
0043	orange	not seen	5 Aug.	Zapadni Reef	n	m
0046	orange	0046	8 Aug.	Zapadni	n	m

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
0047	orange	0047	23 July	Gorbatch	d	m
0058	orange	0058	29 July	Tolstoi	d	m
0058	orange	0058	25 July	Zapadni	d	m
0058	orange	0058	27 July	Little Zapadni	d	m
0065	orange	0065	27 July	Zapadni Reef	d	m
0070	orange	0070	27 July	Little Zapadni	n	m
0075	orange	-	18 July	Vostochni	d	m
0094	orange	0094	31 July	Kitovi	n	m
0094	orange	0094	22 July	Kitovi	n	m
0096	orange	0096	6 Oct.	Tolstoi	d	-
0096	orange	0096	3 Oct.	Zapadni	d	m
0098	orange	0098	29 July	Tolstoi	n	m
0098	orange	0098	7 Aug.	Tolstoi	n	m
0099	orange	0099	27 July	Little Zapadni	d	m
0106	orange	0106	22 July	Polovina	n	m
0116	orange	0116	26 July	Reef	n	m
0119	orange	0119	19 July	Reef	d	m
0121	orange	0121	8 Aug.	Zapadni	n	m
0123	orange	0123	22 July	Polovina	n	m
0124	orange	0124	8 Aug.	Zapadni	n	m
0142	orange	0142	17 Aug.	Zapadni	n	m
0157	orange	-	25 Aug.	Zapadni Reef	n	m
0160	orange	0160	25 July	Zapadni	n	m
0163	orange	0163	22 July	Kitovi	n	m
0168	orange	-	11 July	Polovina	n	m
0169	orange	none	29 July	Tolstoi	n	m
0176	orange	0176	19 Aug.	Polovina	n	m
0184	orange	0184	31 July	Vostochni	n	m
0187	orange	0187	4 Aug.	Vostochni	n	m
0191	orange	0191	29 July	Tolstoi	n	m
0195	orange	0195	4 Aug.	Vostochni	n	m
0202	orange	0202	4 Aug.	Morjovi	d	m
0207	orange	0207	16 Aug.	Vostochni	d	m
0211	orange	0211	22 July	Zolotoi Sands	d	m
0212	orange	0212	30 July	Vostochni	n	m
0212	orange	0212	4 Aug.	Vostochni	n	m
0213	orange	0213	6 Oct.	Tolstoi	d	m
0213	orange	0213	31 July	Vostochni	n	m
0219	orange	0219	7 Aug.	Tolstoi	n	m
0219	orange	not seen	19 Aug.	Zapadni Reef	n	m
0227	orange	0227	4 Aug.	Lukanin	n	m
0231	orange	0231	26 July	Reef	n	m
0231	orange	0231	1 Aug.	Reef	n	m
0232	orange	0232	17 Aug.	Zapadni	n	m
0234	orange	0234	8 Aug.	Zapadni	n	m
0236	orange	0236	23 July	Tolstoi	d	m

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
0239	orange	0239	29 July	Tolstoi	d	m
0239	orange	0239	7 Aug.	Tolstoi	n	m
0245	orange	0245	25 July	Zapadni	n	m
0326	orange	0326	28 Aug.	Sea Lion Rock	d	m
0326	orange	0326	29 Aug.	Reef	d	m
0330	orange	0330	16 Aug.	Reef	n	-
0330	orange	0330	23 Sept.	Reef		-
0330	orange	0330	17 Aug.	Reef		-
0333	orange	0333	22 Aug.	Reef	d	-
0337	orange	0337	27 July	Zapadni Reef		m
0342	orange	0342	1 Aug.	Reef		m
0343	orange	0343	1 Aug.	Reef		m
0345	orange	0345	26 July	Reef		m
0346	orange	0346	26 July	Reef		m
0348	orange	0348	1 Aug.	Gorbatch		m
0352	orange	0352	23 July	Gorbatch		-
0353	orange	0353	17 Aug.	Reef		-
0357	orange	0357	25 July	Zapadni		m
0360	orange	0360	25 July	Zapadni		m
0360	orange	none	29 July	Tolstoi		m
0360	orange	0360	27 July	Little Zapadni		m
0361	orange	0361	25 July	Zapadni		m
0362	orange	0362	29 July	Tolstoi		m
0364	orange	0364	29 July	Tolstoi		m
0367	orange	0367	25 July	Zapadni		m
0368	orange	0368	25 July	Zapadni		-
0368	orange	-	17 Aug.	Zapadni		-
0368	orange	none	27 July	Little Zapadni		m
0369	orange	0369	29 July	Tolstoi		m
0370	orange	0370	25 July	Zapadni		m
0372	orange	0372	23 July	Gorbatch		m
0374	orange	none	26 July	Reef		m
0375	orange	none	25 July	Zapadni		m
0375	orange	none	27 July	Little Zapadni		m
0376	orange	0376	25 July	Zapadni		m
0376	orange	none	27 July	Zapadni Reef		m
0376	orange	0376	17 Aug.	Gorbatch		-
0377	orange	0377	25 July	Zapadni		m
0377	orange	0377	29 July	Tolstoi		m
0382	orange	0382	22 Aug.	Reef		-
0389	orange	0389	22 Aug.	Vostochni	d	-
0390	orange	none	29 July	Tolstoi		m
0395	orange	0395	27 July	Zapadni Reef		m
0397	orange	0397	1 Aug.	Zapadni		m
0400	orange	0400	1 Aug.	Zapadni		m
0401	orange	0401	17 Aug.	Zapadni		-

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
0403	orange	0403	27 July	Little Zapadni		m
0404	orange	0404	1 Aug.	Zapadni Reef		-
0405	orange	0405	17 Aug.	Reef		-
0405	orange	0405	27 July	Zapadni Reef		m
0406	orange	0406	29 July	Tolstoi		m
0406	orange	0406	7 Aug.	Tolstoi		m
0411	orange	0411	16 Oct.	Reef		-
0412	orange	0412	22 Aug.	Reef		-
0414	orange	0414	4 Aug.	Lukanin		m
0416	orange	0416	17 Aug.	Zapadni		-
0419	orange	0419	29 July	Tolstoi		m
0435	orange	0435	17 Aug.	Reef		-
0440	orange	0440	4 Aug.	Vostochni		m
0442	orange	0442	5 Aug.	Morjovi		m
0443	orange	not seen	14 Oct.	Polovina Cliff		-
0445	orange	0445	4 Aug.	Vostochni		m
0446	orange	0446	3 Aug.	Polovina		m
0448	orange	0448	15 Oct.	Kitovi		-
0449	orange	0449	5 Aug.	Vostochni		m
0450	orange	0450	5 Aug.	Vostochni		m
0458	orange	0459	12 Oct.	Reef		-
0482	orange	0483	4 Aug.	Vostochni		m
0487	orange	0487	6 Oct.	Tolstoi		-
0503	orange	0503	4 Aug.	Vostochni		m
0504	orange	0504	16 Oct.	Reef		-
0506	orange	0506	5 Aug.	Vostochni		m
0507	orange	0507	5 Aug.	Vostochni		m
0508	orange	0508	1 Aug.	Zapadni		m
0509	orange	0509	4 Aug.	Lukanin		m
0514	orange	0514	4 Aug.	Lukanin		m
0514	orange	0514	3 Aug.	Polovina		m
0515	orange	0515	28 Sept.	Kitovi		-
0516	orange	0516	4 Aug.	Kitovi		m
0517	orange	0517	4 Aug.	Kitovi		m
0520	orange	present	29 Sept.	Gorbatch	d	-
0590	orange	0591	17 Aug.	Zapadni		-
0592	orange	0593	6 Aug.	Tolstoi		-
0596	orange	0597	17 Aug.	Zapadni Reef	d	-
0604	orange	0605	17 Aug.	Zapadni		-
0608	orange	0609	17 Aug.	Zapadni		-
0620	orange	0621	24 Sept.	Reef		-
0666	orange	0667	24 Aug.	Vostochni	d	-
0682	orange	0683	22 Aug.	Vostochni	d	-
0690	orange	0691	25 Aug.	Polovina	d	-
0698	orange	0699	24 Aug.	Vostochni	d	-
0718	orange	0719	22 Sept.	Lukanin		-

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
0736	orange	0737	28 Sept.	Reef		-
0738	orange	0739	28 Sept.	Reef		-
0742	orange	0743	27 Sept.	Zapadni Reef		-
0742	orange	present	25 Sept.	Zapadni Reef		-
0789	orange	0788	23 Sept.	Polovina Cliff	d	-
0794	orange	0795	28 Sept.	Reef	d	-
0800	orange	0801	29 Sept.	Gorbatch	d	-
0808	orange	0809	29 Sept.	Gorbatch	d	-
0914	orange	0915	12 Oct.	Tolstoi Sands		-
0960	orange	0961	17 Oct.	Vostochni		-
0990	orange	0991	15 Oct.	Zapadni Reef	d	-
0996	orange	0997	16 Oct.	Polovina		m
1592	yellow	-	4 Aug.	Vostochni		m
2041	green	2041	5 Aug.	Reef		m
2041	blue	-	1 Aug.	Reef		m
2054	blue	-	22 July	Polovina		m
2061	blue	2061	31 July	Vostochni		m
2061	green	2061	4 Aug.	Vostochni		m
2712	yellow	2712	29 Aug.	Zapadni Reef		f
2712	yellow	2712	8 Oct.	Zapadni Reef		f
2806	white	2806	23 July	Kitovi		f
2813	white	2813	23 July	Kitovi		f
2813	yellow	2813	15 Oct.	Kitovi		f
not seen	yellow	2818	30 Sept.	Tolstoi		f
5002	white	5002	24 Sept.	Zapadni Reef		f
5004	white	-	25 July	Zapadni Reef		-
5004	white	5004	26 Aug.	Zapadni Reef		f
5004	white	5004	21 Sept.	Zapadni Reef		f
5006	white	-	29 July	Zapadni Reef		f
5010	white	not seen	7 Aug.	Zapadni Reef		-
5010	white	-	18 July	Zapadni Reef		f
5010	white	5010	2 Oct.	Zapadni Reef		-
5019	white	5019	22 Sept.	Zapadni Reef		f
5019	white	5019	7 Aug.	Zapadni Reef		f
5019	white	5019	17 Aug.	Zapadni Reef		f
5019	white	5019	26 Aug.	Zapadni Reef		f
5019	white	5019	27 Aug.	Zapadni Reef		f
5019	white	5019	28 July	Zapadni Reef		f
5020	white	5020	2 Oct.	Zapadni Reef		f
5021	white	5021	19 July	Zapadni Reef		-
5021	white	5021	28 Aug.	Zapadni Reef		f
5021	white	5021	29 Sept.	Zapadni Reef		f
5021	white	5021	28 Sept.	Zapadni Reef		f
5021	white	5021	17 Aug.	Zapadni Reef		f
5025	white	5025	28 July	Zapadni Reef		f
5034	white	5034	7 Aug.	Zapadni Reef		f

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
5035	white	5035	27 Aug.	Zapadni Reef		f
5036	white	5036	19 July	Zapadni Reef		-
5039	white	5039	1 Aug.	Zapadni Reef		-
5040	white	not seen	23 Aug.	Zapadni Reef		f
5040	white	not seen	27 Aug.	Zapadni Reef		f
5040	white	not seen	7 Aug.	Zapadni Reef		-
5046	white	5046	8 Oct.	Zapadni Reef		-
5047	white	not seen	21 Aug.	Zapadni Reef		f
5050	white	not seen	10 Aug.	Zapadni Reef		-
5050	white	-	25 July	Zapadni Reef		-
5050	white	5050	26 Aug.	Zapadni Reef		f
5077	white	5077	6 Aug.	Zapadni Reef		-
5078	white	5078	28 July	Zapadni Reef		f
5080	white	-	22 July	Zapadni Reef		-
5104	white	5104	29 Aug.	Reef		-
5109	white	5109	29 Aug.	Reef		-
5128	white	5128	5 Aug.	Reef		m
5132	white	5132	5 Aug.	Reef		m
5133	white	5133	29 Aug.	Reef		-
5148	white	5148	21 Sept.	Zapadni Reef		-
5149	white	5149	29 Aug.	Reef		-
5154	white	5154	2 Oct.	Little Zapadni		-
5154	white	not seen	12 Aug.	Zapadni Reef		m
5159	white	5159	5 Aug.	Zolotoi Sands		m
5161	white	5161	4 Aug.	Lukanin		m
5161	white	5161	17 Aug.	Gorbatch		-
5161	white	5161	5 Aug.	Zolotoi Sands		m
5164	white	5164	5 Aug.	Reef		m
5165	white	5165	4 Aug.	Lukanin		m
5171	white	5171	5 Aug.	Zolotoi Sands		m
5171	white	5171	6 Aug.	Gorbatch		m
5172	white	5172	7 Aug.	Tolstoi		m
5174	white	5174	5 Aug.	Reef		m
5176	white	5176	7 Aug.	Tolstoi		m
5178	white	5178	5 Oct.	Tolstoi Sands		-
5179	white	5179	23 Oct.	Polovina Cliff		-
5179	white	5179	7 Aug.	Tolstoi		m
5181	white	5181	21 Sept.	Polovina Cliff		-
5182	white	5182	7 Aug.	Tolstoi		m
5184	white	5184	7 Aug.	Tolstoi		m
5201	white	5201	24 July	Kitovi		f
5202	white	5202	18 July	Kitovi		f
5202	white	5202	7 Oct.	Kitovi		f
5203	white	5203	3 Oct.	Kitovi		f
5204	white	5204	19 July	Kitovi		f
5204	white	5204	15 Oct.	Little Zapadni		-

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
5208	white	5208	11 July	Kitovi		f
5208	white	5208	22 Sept.	Kitovi		f
5218	white	-	15 July	Kitovi		f
5223	white	5223	7 Oct.	Kitovi		f
5232	white	5232	19 July	Kitovi		f
5235	white	5235	19 July	Kitovi		f
5809	yellow	5809	23 July	Tolstoi		m
5840	yellow	5840	31 July	Vostochni		m
-	white	405	19 July	Kitovi		f
-	white	5020	22 July	Zapadni Reef		-
-	pink	788	17 July	Reef		m
MC1488	monel	none	22 July	Zolotoi Sands		m
MC2631	monel	none	27 July	Zapadni Reef		m
MC3214	monel	MC3214	17 Aug.	Zapadni		-
MD1312	monel	none	4 Aug.	Morjovi		m
MD1462	monel	MD1462	20 Aug.	Vostochni		-
MD671	monel	-	18 July	Vostochni		m
TC1064	monel	none	25 July	Zapadni		m
TM8165	monel	TM8165	4 Aug.	Polovina		m
TM9171	monel	TM9171	6 Aug.	Gorbatch		m
TM9240	monel	none	4 Aug.	Lukanin		m
XM9453	monel	-	19 July	Zapadni Reef		f
YM4849	monel	YM4849	20 Aug.	Vostochni		-
YM562	monel		1 Aug.	Reef		m
bA223	monel	bA223	22 Aug.	Reef		-
bA462	monel	none	29 July	Tolstoi		m
bC17	monel	none	1 Aug.	Zapadni		m
bC2667	monel	none	3 Aug.	Polovina		m
bD1830	monel	bD1830	19 Aug.	Polovina		-
bd2120	monel	present	12 Oct.	Tolstoi Sands		m
mc2832	monel	none	29 July	Tolstoi		m
mc2999	monel	-	29 July	Tolstoi		m
not seen	white	5010	29 Aug.	Zapadni Reef		f
not seen	white	5223	7 Oct.	Kitovi		f
not seen	white	5015	9 Aug.	Zapadni Reef		-
not seen	green	879	26 Aug.	Zapadni Reef		f
not seen	white	5077	26 Aug.	Zapadni Reef		f
not seen	pink	405	15 Oct.	Kitovi		f
none	orange	0157	27 Sept.	Zapadni Reef	n	m
none	monel	021564	6 Oct.	Tolstoi		f
none	blue	present	23 July	Tolstoi		m
none	yellow	2442	3 Aug.	Polovina		m
none	monel	TM9771	3 Aug.	Polovina		m
none	orange	0060	2 Aug.	Zapadni Reef	n	m

Table C-17.--Continued.

Left tag no.	Tag color	Right tag no.	Date	Location	Debris resight status	Sex
tag	white	5148	21 Sept.	Zapadni Reef		-
tag	monel	TM9880	5 Aug.	Reef		m
ym3957	monel	-	27 July	Zapadni Reef		m
S-1074	monel	none	30 Sept.	Tolstoi		f

Table C-18.--Summary of 1986 resightings of male northern fur seals that were tagged with orange Allflex tags in 1985, St. Paul Island, Alaska.[a]

	1985-tagged controls resighted in 1986			1985-tagged entangled seals resighted in 1986		
	No debris	With debris	Total	No debris	With debris	Total
On effort[b]	31	0	31	1	7	8
Off effort[c]	6	0	6	0	4	4

Tag numbers:

No debris	With debris	No debris	With debris
0007,0025		0195	0001,0019
0027,0031			0047,0058
0042,0043			0065,0075
0046,0060			0096,0099
0070,0094			0119,0202
0098,0106			0207
0116,0121			
0123,0124			
0157,0160			
0163,0168			
0169,0176			
0184,0187			
0191,0211			
0212,0213			
0219,0227			
0231,0232			
0234,0236			
0239,0245			
0142			

[a]In 1985, 85 entangled and 176 control subadult males were tagged.

[b]Systematic surveys (roundups) conducted specifically for observing tagged seals.

[c]Surveys conducted opportunistically during beach-walk surveys of rookeries and handing grounds.

Table C-19.--Characteristics of entangled subadult male northern fur seals tagged with orange Allflex tags in 1985 and resighted in 1986, St. Paul Island, Alaska.

	When tagged in 1985				When resighted in 1986			
Tag No.	Debris type	Debris size[a]	Tightness[b]	Wound degree[c]	Debris type	Debris size	Tightness	Wound degree
0001	White band	s	t	360°	No debris			
0019	poly-line/gill net	s	t	180°	Same	Same	vt	360°
0047	white line	s	t	360°	Same			
0058	green trawl	s	tnb	0	No debris			
0065	white band	s	vt	360°	Same			
0075	blue trawl	m	t	0	Debris present			
0096	green band	s	l	0	Debris present			
0099	gray line	s	t	180°	Same			
0119	green trawl	m	t	0	Debris present			
0195	orange line	s	tnb	0	No debris present			
0202	green trawl	m	tnb	0	Same	Same	vt	200°
0207	gray trawl	s	tnb	0	Debris present			

[a] s = <150 grams of debris; m = 150-500 grams of debris

[b] t = debris attached tightly; tnb = debris tight but not binding. vt = debris attached very tightly.

[c] open wound along point of entanglement expressed as degree of a circle.

Table C-20.--Entangled northern fur seal females and pups tagged with white Allflex[a] tags, St. Paul Island, Alaska, 21 September-18 October 1986. A dash indicates no data.

Date	Location	Tag Number Left	Tag Number Right	Vibrissae color[b]	Sex	Debris Type	Debris Color	Debris Stretched mesh (cm)	Debris Diam. (mm)
15 Sept.	Morjovi	0787	0786	Pup	F	Trawl	White	19.0	3.0
21 Sept.	Polovina	5501	5502	Black	F	Trawl	Blue	-	-
25 Sept.	Zapadni Reef	5504	5503	Pup	F	Trawl	Blue	15.0	5.0
28 Sept.	Reef	5505	5506	White	F	Twine	Yellow		-
28 Sept.	Reef	5507	5508	Black	F	Monofilament		-	0.5
28 Sept.	Ree	5509	5510	Mixed	F	Line	Red		
28 Sept.	Reef	5511	5512	Black	F	Line	Green/Yellow		
29 Sept.	Gorbatch	5513	5514	White	F	Band	Yellow		
29 Sept.	Gorbatch	5515	5516	Black	F	Monofilament		5.5	0.5
2 Oct.	Little Zapadni	5517	5518	White	F	Trawl	Orange	-	-
2 Oct.	Little Zapadni	5519	5520	Pup	F	Band	Yellow		
2 Oct.	Little Zapadni	5521	5522	Mixed	F	Trawl	Grey	27.0	2.5
3 Oct.	Zapadni	5523	5524	Pup	M	Trawl	Orange	18.0	4.0
3 Oct.	Zapadni	5525	5526	Pup	F	Trawl	Green	21.0	3.0
3 Oct.	Zapadni	5527	5528	Black	F	Twine	White		-
4 Oct.	Zapadni Reef	5529	5530	Pup	M	Trawl	Grey	-	-
5 Oct.	Zapadni Reef	5531	5532	Black	F	Trawl	White	18.0	3.5
5 Oct.	Zapadni Reef	5533	5534	Pup	F	Line	White		-
5 Oct	Zapadni Reef	5535	5536	Pup	F	Trawl	Grey	-	-
5 Oct.	English Bay	5537	5538	Black	F	Trawl	Green	23.0	3.0
6 Oct.	Tolstoi	5539	5540	Pup	M	Cloth	White		
6 Oct.	Tolstoi	5541	5542	Pup	F	Trawl	Green	16.0	3.0
6 Oct.	Tolstoi	5543	5544	Black	F	Trawl	Green	-	3.5
7 Oct.	Kitovi	5545	5546	Mixed	F	Trawl	Grey	22.0	3.0
7 Oct.	Kitovi	5547	5548	Pup	M	Trawl	Blue	16.0	5.0
8 Oct.	Morjovi	5549	5550	Black	F	Unknown		-	-
10 Oct.	Vostochni	5551	5552	Mixed	F	Monofilament		11.0	0.5
10 Oct.	Vostochni	5553	5554	Black	M	Line	White		-
10 Oct.	Polovina Cliffs	5555	5556	Black	F	Trawl	Blue	20.4	4.0
14 Oct.	Polovina Cliffs	5557	5558	Mixed	F	Trawl	Grey	22.0	2.5
14 Oct.	Polovina Cliffs	5559	5560	Black	F	Line	Grey		-
14 Oct.	Polovin	5561	5562	Mixed	F	Line	Green		3.5
14 Oct.	Polovina	5563	5564	Pup	M	Trawl	Orange	17.0	3.5
14 Oct.	Polovina	5565	5566	Black	F	Band	Yellow		
14 Oct.	Polovina	5567	5568	Pup	M	Trawl	Green	22.0	3.0
15 Oct.	Little Zapadni	5569	5570	Black	F	Trawl	Green	21.0	3.0
15 Oct.	Little Zapadni	5571	5572	Black	F	Trawl	Grey	-	3.0
15 Oct.	Zapadni Reef	5573	5574	White	F	Band	Yellow		
18 Oct.	Ardiguen	5575	5576	Pup	M	Trawl	White	16.0	3.0

[a]Pup Nos. 0787-0786 was tagged prior to beginning of survey with orange Allflex tag.

[b]Pup vibrissae color is black.

Table C-21.--Entangling debris on northern fur seal pups and females based on vibrissae color, St. Paul Island, Alaska, September-October 1986.

	Female vibrissae color									
Debris type	Black	Percent	Mixed	Percent	White	Percent	Total	Percent	Pup	Percent
Trawl web	12	50.0	6	50.0	1	12.5	19	43.2	16	64.0
Trawl line	2	8.3	2	16.7	1	12.5	5	11.3	5	20.0
Twine	1	4.2	2	16.7	1	12.5	4	9.1	0	0.0
Monofilament	4	16.7	1	8.3	0	0.0	5	11.3	0	0.0
Packing bands	2	8.3	0	0.0	2	25.0	4	9.1	1	4.0
Plastic	0	0.0	0	0.0	0	0.0	0	0.0	2	8.0
Cloth	0	0.0	0	0.0	0	0.0	0	0.0	1	4.0
Unknown	3	12.5	1	8.3	3	37.5	7	16.0	0	0.0
	24		12		8		44		25	

Table C-22.--Entangled northern fur seal females observed and tagged, St. Paul Island, Alaska, September - October 1986.*

Rookery	Tag number Left	Tag number Right	Vibrissae color	Debris type and color	Debris mass	Wound
Lukanin	-		white	Not evident	-	360° deep
Polovina Cliffs	-		white	Not evident	-	180° deep
Polovina Cliffs	-		white	Gray trawl	Medium	360° deep
Reef	5505	5506	white	Yellow twine	Small	360° deep
Gorbatch	5513	5514	white	Yellow band	Small	180° depp
Little Zapadni	5517	5518	white	Orange line	Small	360° deep
Zapadni Reef	-		white	Not evident	-	360° deep
Zapadni Reef	5573	5574	white	Yellow band	Small	360° deep
Tolstoi	-		mixed	Green trawl	Medium	180° deep
Tolstoi	-		mixed	Olive trawl	Medium	360° deep
Reef	5509	5510	mixed	Red twine	Small	300° open
Reef	5511	5512	mixed	Green/yellow twine	Small	220° open
Reef	-		mixed	Gray trawl	-	none
Polovina Cliffs	5561	5562	mixed	Green line	Small	none
Little Zapadni	5521	5522	mixed	Gray trawl	Medium	none
Kitovi	5545	5546	mixed	Gray trawl	Small	360° open
Vostochni	5551	5552	mixed	Monofilament	Small	300° open
Polovina Cliffs	5557	5558	mixed	Gray trawl	Large	none
Zapadni Reef	-		mixed	Not evident	-	360° deep
Gorbatch	-		mixed	Yellow line	Small	360° open
Polovina	5501	5502	black	Blue line	Small	360° deep
Zapadni Reef	-		black	Gray trawl	Medium	none
Tolstoi	-		black	Blue trawl	Medium	10°
Polovina Cliffs	-		black	Gray trawl	Medium	none
Polovina	-		black	Gray trawl	Medium	none
Zapadni Reef	-		black	Monofilament	Small	100°
Tolstoi	-		black	Monofilament	Small	none
Tolstoi	-		black	Yellow band	Small	none
Reef	5507	5508	black	Monofilament	Small	10°
Gorbatch	5515	5516	black	Monofilament	Small	10°

Table C-22.--Continued.

Rookery	Tag number Left	Tag number Right	Vibrissae color	Debris type and color	Debris mass	Wound
Tolstoi	-		black	Not evident	Small	180°
Zapadni	5527	5528	black	White twine	Small	none
Zapadni Reef	5531	5532	black	White trawl	Medium	none
English Bay	5537	5538	black	Green trawl	Small	0°
Tolstoi	5542	5544	black	Green trawl	Small	none
Pt. South	-		black	Green trawl	Small	none
Morjovi	5549	5550	black	Not evident	Small	350°
Vostochni	5555	5556	black	Blue trawl	Large	none
Polovina CLiffs	5559	5560	black	Grey line	Small	360°
Polovina	5565	5566	black	Yellow band	Small	none
Zapadni Reef	-		black	Not evident	Small	360°
Little Zapadni	5569	5570	black	Green trawl	Medium	none
Little Zapadni	5571	5572	black	Gray trawl	Medium	180°
Ardiguen	-		black	Blue trawl	Small	360°

*Tagged with white Allflex tags.

APPENDIX D

Scientific staff engaged in northern fur seal research in 1986.

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		
John L. Bengtson	NMML	Population Assessment
Laurie L. Briggs	NMML	Population Assessment
Hiroshi Kajimura	NMML	Population Assessment
Patrick Kozloff	NMML (resigned)	Population Assessment
Roger L. Gentry	NMML	Behavior and Biology
Michael E. Goebel	NMML	Behavior and Biology
Robert L. DeLong	NMML	Entanglement & Feeding Behavior
George A. Antonelis, Jr.	NMML	Foraging Behavior & 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		
Jason Baker	NMML	Tooth Studies
Wendy E. Roberts	NMML	Behavior and Biology
Richard L. Merrick	NMML	Pelagic Studies and Biology
Steve Osmek	NMML	Population Assessment
Sharon Melin	NMML	Population Assessment
Alton Roppel	NMML	Population Assessment
Pat Gearin	NMML	Behavior and Entanglement
Cooperators[a]		
Brent Stewart	Hubbs Marine Research Inst., San Diego, CA	Entanglement Studies
Gene Berry	Oregon State University	Pup Tagging Project
Doug Skilling	Oregon State University	Pup Tagging Project
Robin Brown	Oregon State Dept. of Game	Pup Tagging Project
Steve Jeffries	Washington State Dept. of Game	Pup Tagging Project
Leigh Cox	Natl. Park Service, Channel Islands National Park	Pup Tagging Project

APPENDIX D (Continued)

Name	Affiliation	Assignment
Tom Cox	Natl. Park Service, Channel Islands National Park	Pup Tagging Project
Roger Hill	Wildlife Computers	Entanglement Studies
Sue Hill	Wildlife Computers	Entanglement Studies
Terry Spraker	Colorado State University	Mortality Studies
Darlene Deghetto	Colorado State University	Mortality Studies
Norihisa Baba	Far Seas Fish. Res. Lab, Japan	Entanglement Studies
Kazuhiro Mizue	University of Nagasaki, Japan	Heavy Metals Study

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