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Fur Seal Investigations, 1984

Edited by
Patrick Kozloff

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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ABSTRACT

Northern fur seal (Callorhinus ursinus) research in 1984 was conducted on the Pribilof Islands and Bogoslof Island in Alaska, and on San Miguel Island and nearby Castle Rock in southern California.

Estimates made of the number of pups born in 1984 on St. Paul Island, one of the Pribilofs, show a slight but insignificant increase. Live pups have been weighed on this island in late summer from 1957 through 1971, and in 1980 and 1984. Significant differences:, exist in mean weights between sexes and between rookeries for all years. Males consistently weigh more than females and the differences between rookeries vary from year to year. There has been a general increase in the mean weight for both males and females from the 1950's to the present (1984).

An antibiotic drug, oxy-tetracycline, was adminstered by intramuscular injection to 227 fur seals in 1984. The oxy-tetracycline present in the tooth fluoresces when tooth sections are examined under ultraviolet light, thereby giving a clear benchmark of dentine layers that are being laid down. The main study included 40 radio-tagged females (19 collected), 17 pups of radio-tagged females (9 collected), 5 pups marked on day of birth to identify the neonatal line (5 collected), and 6 subadult males given various doses of oxy-tetracycline from the commercial harvest (2 collected).

Females tend to specialize in one of three types of diving strategies. These are characterized as shallow, deep, or a

combination of the two; a statistical definition of these types is needed. The seals tend to use the same dive strategies from year to year, but make' slight shifts in depth as a function of time of season. Dive type may change with age.. Deep divers. are older, larger individuals, but not all larger females become deep divers. Foraging effort increases in October, just before weaning occurs.

Transmitter-equipped female fur seals from St. Paul Island were followed at sea and were found to travel about 100 nautical miles (nmi) to feeding locations both over the continental shelf and in deep water. They. traveled at about 3.5 to 4.5 knots when swimming to the feeding locations but at about 7 knots when returning. Two of four animals went south of St. Paul Island; the other two went northwest;

Estimates of the number of pups on Bogoslof Island and in the southern California area vary. The Bogoslof Island fur seal rookery is viable although it has not increased in number since the 1983 survey. The number of pups born at Adams Cove on San Miguel Island in 1984 (478) increased by 17.0% from the number (408) born in 1983. Pup production on Castle Rock in 1984 (411) increased by 184 animals (81.0%) from 1983.

INTRODUCTION

by

Charles W. Fowler and Patrick Kozloff

The United States, Canada, Japan, and the Soviet Union cooperatively carry out research on the northern fur seal, Callorhinus ursinus, on land and at sea under the Interim Convention on the Conservation of North Pacific Fur Seals. As part of the U.S. obligations under this agreement, scientists from the National Marine Mammal Laboratory (NMML) in Seattle, Washington have conducted annual surveys and studies on U.S.-owned islands. In particular, they have studied the Pribilof Islands and Bogoslof Island in Alaska and San Miguel Island off southern California, all used by fur seals for breeding and hauling out. This report summarizes the research carried out on these islands in 1984. It served as the U.S. contribution to the 28th annual meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission in Tokyo, Japan in 1985.

The Pribilof Islands of St. Paul (Fig. l), St. George (Fig. 2), and Sea Lion Rock (Fig. 1 - Sivutch) are host to breeding populations of northern fur seals. Two additional colonies containing approximately 2,000 to 4,000 northern fur seals breed on U.S.-owned San Miguel Island and nearby Castle Rock off southern California (Fig. 3). A small colony of about 40 fur seals now breeds on Bogoslof Island. The colony began in 1980 and in 1984 included about 14 pups.

Juvenile male fur seals (primarily 3- and 4-year-olds) are currently harvested commercially each year from the hauling grounds of 14 rookeries on St. Paul Island; an upper limit of 22,000 fur seals

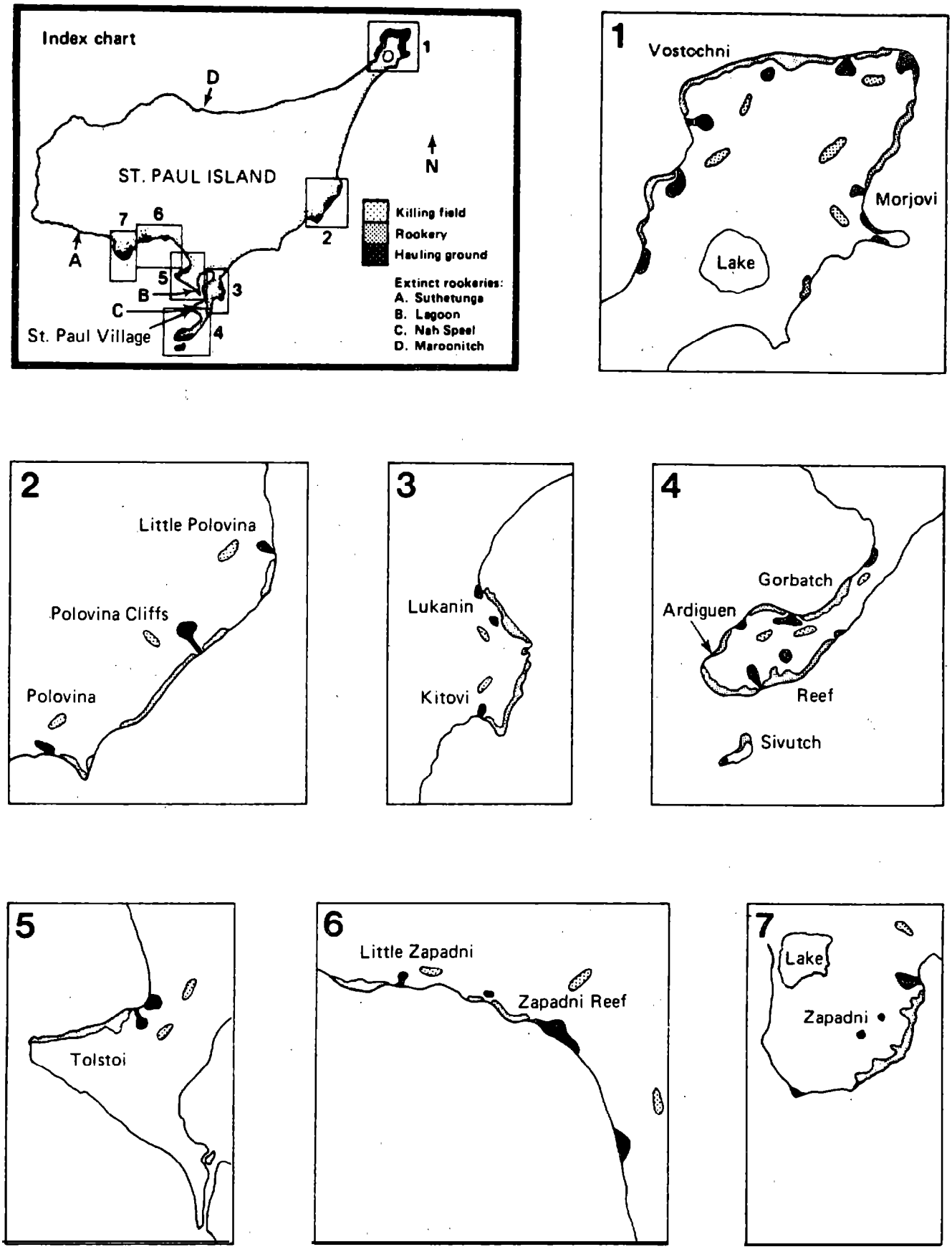

Figure 1 .--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. Paul Island, Alaska.

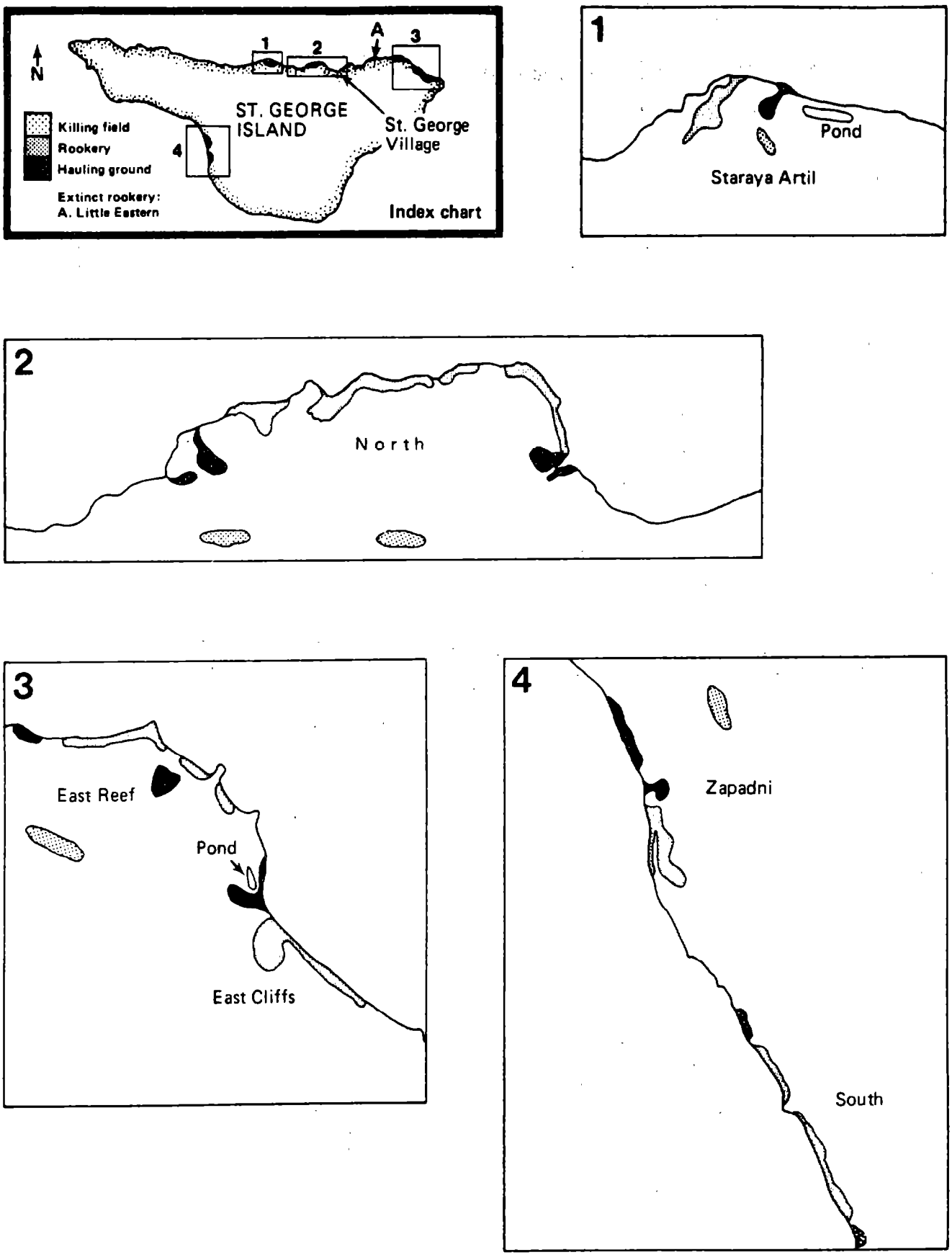

Figure 2.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. George Island, Alaska.

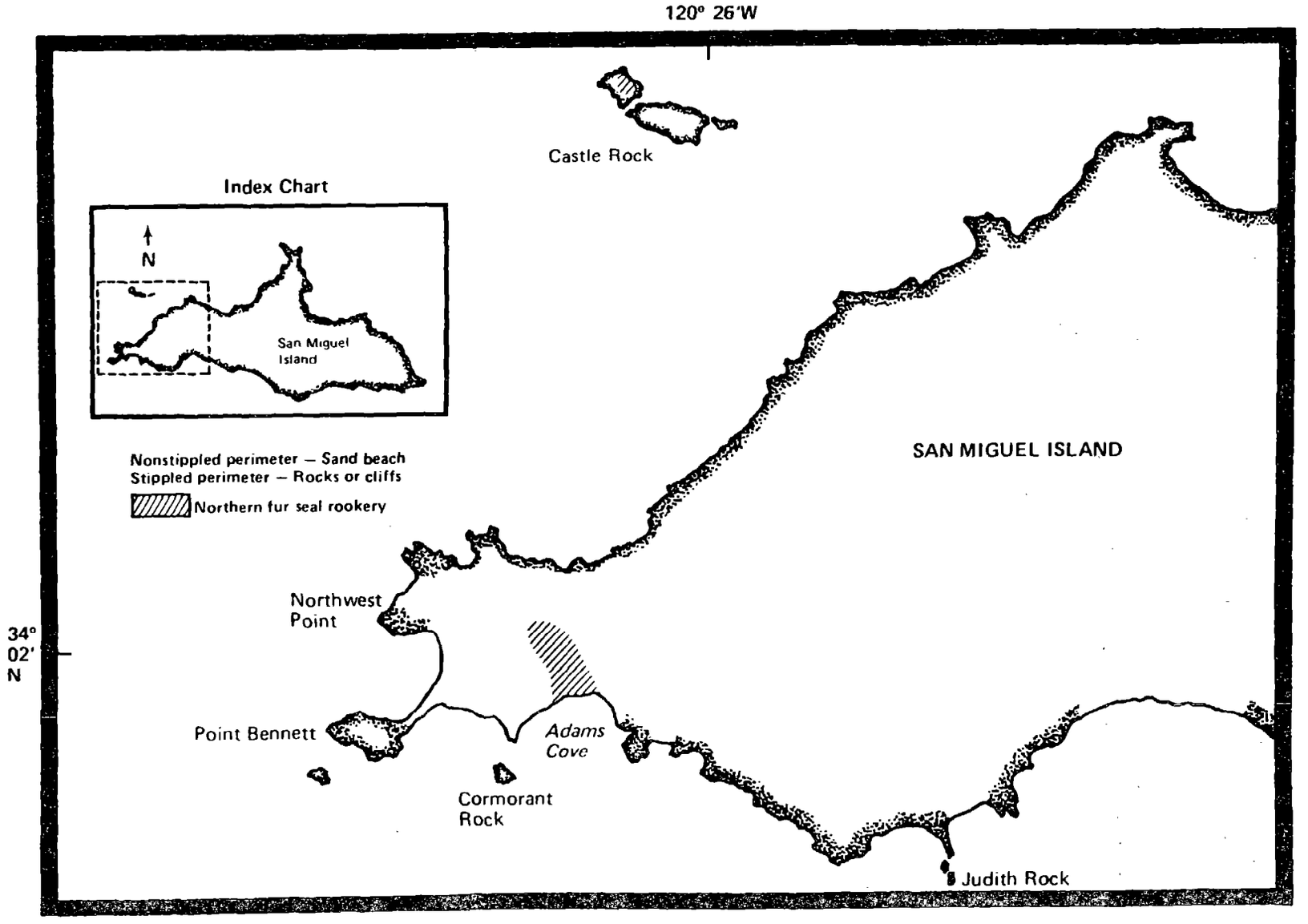

Figure 3.--Location of northern fur seal breeding colonies, San Miguel Island, California.

was imposed in the harvest during 1984. In the same year, 350 males were taken on St. George Island for local use as food. A moratorium on the commercial harvesting of seals on St. George Island was imposed beginning in 1973 to permit research on a population as it reverts to its natural state. Fur seals are also not harvested on Bogoslof Island, Castle Rock, San Miguel Island, Sea Lion Rock, or at Ardiguen hauling ground on St. Paul Island. However, some males from these rookeries may be subjected to a slight harvest mortality since young male seals occasionally haul out at some distance from their rookeries of birth. There are four extinct rookeries on St. Paul Island (Fig.. 1) and one on St. George Island (Fig. 2).

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

POPULATION ASSESSMENT, PRIBILOF ISLANDS, ALASKA

by

Patrick Kozloff, Anne E. York, and Joe Scordino

In accordance with provisions of the Interim Convention on Conservation of North Pacific Fur Seal's, the National Marine Mammal Laboratory (NMML) monitors 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. Information is also gathered on the number of seals in the commercial harvest on St. Paul Island that are entangled in fishing net fragments and in other debris.

Population Parameters

Herd characteristics monitored on the Pribilof Islands in 1984 included the 1) age and sex composition of seals harvested on St. Paul Island, 2) number and sex of seals taken for food on St. George Island, 3) number of live adult males and pups, and 4) number of dead pups and older seals.

Age and Sex Composition of Seals Harvested

Males--Drives were to be made from the hauling grounds on St. Paul Island from 2 July to 3 August or until the upper limit of 22,000 fur seals was reached. All male seals with a body length of 49 inches (124.5 cm) or less from tip of tail to tip of nose were taken. Seals were not harvested on Saturdays or Sundays, and those identified as female were rejected. The age composition of these animals was determined from a 20% sample of maxillary canine teeth collected in

each harvesting area (Appendix Tables A-l and A-2). The sizes of the year classes of male seals harvested since 1970 are listed in Table 1. The age composition of males harvested on St. Paul Island since 1975 is shown in Table 2.

On St. George Island, 350 subadult male seals of approximate ages 2-5 years were taken for food from 13 July to 3 August on the east hauling ground of North Rookery.

Females--A few young females through 4 years of age were inadvertently taken during the commercial harvest of males on St. Paul Island and during the harvest for food on St. George Island because of their similarities in size and in whisker (vibrissae) color with 3-year-old males. In 1984, a total of 32 females on St. Paul Island were harvested. 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 1984, 4,803 harem and 3,977 idle adult male fur seals (bulls) were counted on St. Paul Island from 9 to 16 July (Appendix Tables A-3, A-4, and A-5). On St. George Island, 1,473 harem and 1,369 idle bulls were counted on 12 and 13 July (Appendix Tables A-4 and A-5). Figure 4 illustrates the relative location of the different classes of adult males on a typical fur seal rookery-hauling ground complex on the Pribilof Islands.

Dead Seals Older Than Pups Counted

The rookeries and adjacent beaches of St. Paul Island were surveyed for dead seals older than pups from 12 to 16 September and the count totaled 72 females and 66 males. Canine teeth of the animals were collected wherever possible for studies of age at death.

Table 1 .--Harvest of male northern fur seals, by age group, St. Paul Island, Alaska, 1970-82 year classes.[a]

Year class	Age group 2	3	4	5	Total harvested
	----------Number of seals----------				
1970	916	16,337	15,533	1,402	34,188
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[b]	2,065	15,587	4,601	-	22,253
1981[b]	3,047	13,976	-	-	17,023
1982[b]	3,133	-	-	-	3,133
Total	23,075	177,112	93,803	6,504	300,494
Mean	1,775	14,759	8,528	650	25,809[c]

[a] Includes only 2- to 5-year-olds taken during the harvest of male seals.

[b] Incomplete returns.

[c] 1980, 1981, and 1982 year classes not included.

Table 2.--Age classification of male northern fur seals harvested, St. Paul Island, Alaska, 1975-84.

Year of harvest	Age group 1	2	3	4	5	6	Total harvested
	----------Number of seals----------						
1975	0	1,642	15,186	10,768	1,402	95	29,093
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

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

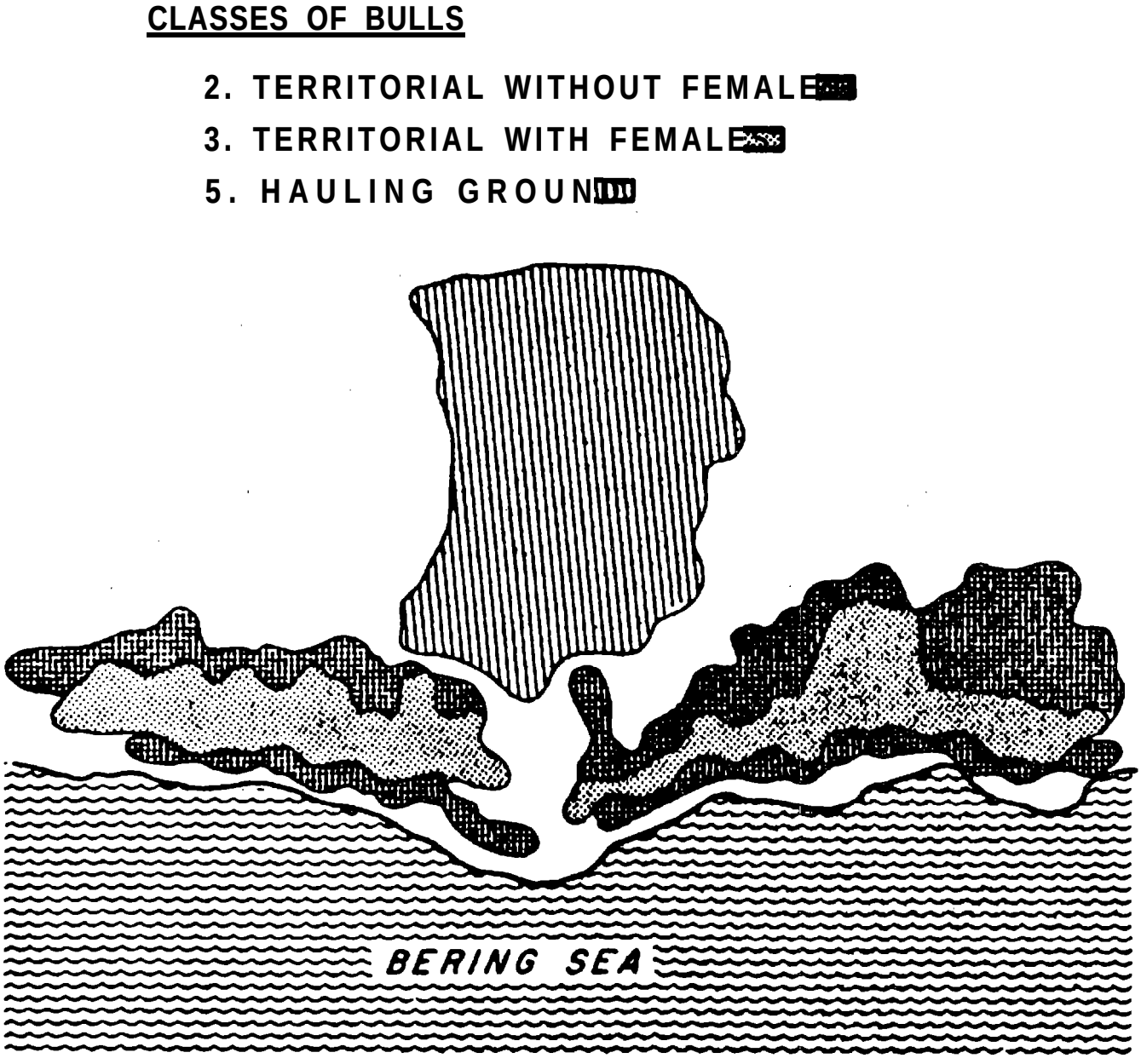

Figure 4. --General composition of a typical fur seal rookery.

Table 3 lists the number of these seals' counted on the Pribilof Islands since 1965.

Dead Pups Counted

In. 1984, 6,115 dead fur seal pups were counted on all rookeries of St. Paul Island from 21 to 30 August (Appendix Table A-6). Dead pup counts on St. Paul and St. George Islands since 1975 are given in Appendix Table A-7.

Number of Pups Born in 1984

St. Paul Island--Estimations of the total number of pups alive at the time of shearing have been made and standard errors calculated since 1980. The ratio of live pups to bulls on the sample rookeries is computed from the mean pup estimate of two sampling periods (Table 4) and the mid-July count of harem males (Appendix Table A-4). Following the procedures described in the 1980 report of Fur Seal Investigations (Kozloff 1981)) the total number of pups born is estimated by multiplying the estimated ratio of pups to bulls by the total number 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	$\bar{r}$	r*
Vostochni	28,771	811	35.48	33.60	37.33
Tolstoi	23,113	614	37.64	32.93	40.03
Gorbatch	11,782	358	32.91	34.65	33.12
Zapadni Reef	5,552	210	26.44	35.26	30.72
Little Polovina	818	46	17.78	34.73	32.82
Total	70,036	2,039	34.35		

Table 3.--Number of dead northern fur seals counted that were older than pups, Pribilof Islands, Alaska, 1965-84. 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	-[a]	-[a]	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

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

Table 4.--Estimated number of northern fur. seal pups in 1984 at times of shearing and birth on five rookeries of St. Paul Island, Alaska. Pups were sheared 6-14 August; sampling periods 1 and 2 were 17-18 and 21-22 August, respectively.

Item	Rookery					
	Vostochni	Little Polovina	Tolstoi	Gorbatch	Zapadni Reef	Total
No. pups sheared	3,680	176	2,662	1,633	931	9,082
No. 25-pup samples						
Period 1	159	7	132	84	57	-
Period 2	152	5	125	68	50	-
No. sheared pups counted						
Period 1	471	39	396	262	270	-
Period 2	528	26	346	265	188	-
Total no. pups counted[a]						
Period 1	3,975	175	3,300	2,100	1,425	-
Period 2	3,800	125	3,125	1,700	1,250	-
Estimated no. pups alive[b]						
Period 1 sampling	31,057	790	22,183	13,089	4,914	72,033
Period 2 sampling	26,485	846	24,043	10,476	6,190	68,040
Mean, both periods	28,771	818	23,113	11,782	5,552	70,036
No. dead pups counted	973	14	1,367	522	301	3,177
Estimated no. pups born[c]	29,744	832	24,480	12,304	5,853	73,213

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

[b] Estimated from $\hat{N} = MC/R$. (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

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

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

$$r^* = 5r - 4\bar{r} \text{ where } r = \frac{70,036}{2,039} = 34.35.$$

The estimate of the ratio of pups to bulls ($\hat{R}$) is

$$\hat{R} = 1/5 \sum_{j=1}^{5} r^*(j) = 34.803,$$

$$\text{and } \hat{Var}(\hat{R}) = \Sigma \frac{r^*(j)^2 - 5\hat{R}^2}{20} = 2.857 \text{ and } SE(\hat{R}) = 1.690.$$

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

34.803 t (2.776) (1.690) or

34.803 + 4.691.

The total number of harem males counted on all rookeries of St,. Paul Island is 4,803 (Appendix Table A-4)

The total numbers of pups at shearing = 167,159 + 22,531 (with 95% confidence interval); counted number of dead pups = 6,115; and total number of pups born (with an approximate 95% confidence interval) = 173,274 + 22,531.

Mark Recoveries

During the commercial harvest of male northern fur seals on St. Paul Island, 11 males marked by the Soviet Union as pups were recovered. Appendix Table A-8 lists the number of Soviet tags recovered by the United States in 1984.

Seals Entangled in Net Fragments and Other Materials

The number of entangled northern fur seals appearing in the harvest on St. Paul Island since 1967 is given in Appendix Table A-9.

LIVE PUP WEIGHTS, ST. PAUL ISLAND, ALASKA

by

Patrick Kozloff and Laurie J. Briggs

Untagged living pups were weighed on St. Paul Island from 3-5 September in 1984 for continued research efforts to determine if body weight is related to survival and if body weights have changed with the reduced population size. Pup weight data had been previously collected on St. Paul Island in the years 1957 through 1971 and in 1980. Living pups were not weighed during the years 1972 through 1979 and 1981 through 1983.

Pups weighed in past years were both tagged and untagged, and it was determined that tagging caused an immediate weight loss. The mean weight of tagged pups was less than that of untagged pups for both males and females (Marine Mammal Biological Laboratory 1969). In 1962, the weighing program was modified to include three weighings, each a month apart, in order to determine if the differences in weights of tagged and untagged animals changed by the time pups left the island. Analytical results showed that weight loss caused by tagging was partially overcome after two months.

In 1980, a preliminary study was conducted to determine if pups selected for shearing weighed less than those not selected. It was determined that sheared pups generally weighed less than unsheared pups (Kozloff 1981).

Table 5 presents the sample size, mean, and variance for each rookery for pup weights determined in early September for the years

Table 5.--Sample size, mean, and variance of weights of untagged live male and female pups during 1957-71, and in 1984. A dash indicates no data.

Rookery and year	Male			Female		
	Sample size	Mean weight (kg)	Variance	Sample size	Mean weight (kg)	Variance
1957						
Zapadni Reef	53	8.26	3.50	50	7.48	4.59
Polovina	79	8.37	4.94	82	7.51	4.00
NE Point[a]	145	8.92	2.89	111	7.84	2.25
Reef	114	8.92	4.06	108	7.65	3.15
All rookeries	391	8.72	-	351	7.65	-
1958						
NE Point[a]	127	11.40	1.93	121	9.50	1.84
1959						
Zapadni Reef	127	9.31	4.13	118	8.05	2.68
Polovina	113	9.29	2.90	96	8.10	3.07
NE Point[a]	96	8.94	3.19	102	7.83	2.34
Reef	107	10.00	2.72	71	8.62	2.37
All rookeries	443	9.39	-	386	8.10	-
1960						
Zapadni Reef	52	8.94	6.24	41	8.29	4.00
Polovina	81	9.81	4.17	89	9.11	2.61
NE Point[a]	146	9.63	3.66	128	9.18	3.62
Reef	95	10.42	3.46	106	9.44	2.19
All rookeries	374	9.77	-	364	9.14	-
1961						
Zapadni Reef	48	8.38	2.53	77	7.08	2.49
Polovina	141	8.69	2.84	158	7.99	2.11
NE Point[a]	138	8.52	2.65	149	7.30	2.40
Reef	54	8.06	2.95	82	7.71	2.84
All rookeries	381	8.50	-	466	7.57	-
1962						
Zapadni Reef	75	8.84	3.74	75	8.47	2.30
Polovina	75	8.70	3.17	75	8.06	2.58
NE Point[a]	75	9.64	3.18	75	8.18	3.53
Reef	75	9.53	2.99	75	7.97	3.19
All rookeries	300	9.17	-	300	8.17	-

Table 5. --Continued.

Rookery and year	Male Sample size	Male Mean weight (kg)	Male Variance	Female Sample size	Female Mean weight (kg)	Female Variance
1963						
Zapadni Reef	75	8.94	3.52	75	7.60	2.44
Polovina	75	8.17	2.62	75	7.60	2.72
NE Point[a]	75	9.14	3.34	75	8.38	2.69
Reef	75	9.42	4.95	75	8.29	3.50
All rookeries	300	8.92	-	300	7.97	-
1964						
Zapadni Reef	75	7.80	-	75	6.93	-
Polovina	75	10.26	-	75	8.86	-
NE Point[a]	75	9.68	-	75	7.76	-
Reef	75	8.69	-	75	7.36	-
All rookeries	300	9.10	-	300	7.70	-
1965						
All rookeries	300	9.50	-	300	8.20	-
1966						
Zapadni Reef	175	9.90	-	175	8.80	-
Morjovi	175	9.50	-	175	8.00	-
All rookeries	300	9.60	-	300	8.40	-
1967						
Zapadni Reef	100	10.22	4.48	100	8.94	2.62
Polovina	100	9.30	3.81	100	8.94	3.12
Morjovi	100	10.44	2.60	100	9.23	2.38
Reef	100	10.32	2.63	100	8.96	1.63
All rookeries	400	10.20	-	400	9.00	-
1968						
Zapadni Reef	100	9.45	3.38	100	8.28	2.70
Polovina	100	9.48	3.48	100	8.20	2.89
Morjovi	100	9.73	3.55	100	7.92	2.50
Reef	100	9.60	2.99	100	8.74	2.19
All rookeries	400	9.56	-	400	8.28	-
1969						
Zapadni Reef	100	9.20	2.62	100	7.90	1.74
Polovina	100	9.90	3.94	100	9.00	2.40
Morjovi	100	10.10	3.32	100	8.90	2.46
Reef	100	10.00	2.00	100	8.80	2.08
All rookeries	400	9.80	-	400	8.60	-

Table 5.--Continued.

Rookery and year	Male			Female		
	Sample size	Mean weight (kg)	Variance	Sample size	Mean weight (kg)	Variance
1970						
Zapadni Reef	100	9.50	4.00	100	8.30	2.94
Polovina	100	10.10	3.09	100	9.20	1.99
Morjovi	100	10.70	3.26	100	9.20	2.52
Reef	100	10.60	3.09	100	9.40	2.08
All rookeries	400	10.20	-	400	9.00	-
1971						
Zapadni Reef	100	9.30	3.41	100	8.20	2.76
Polovina	100	10.00	4.17	100	8.40	4.80
Morjovi	100	8.70	2.87	100	7.70	2.73
Reef	100	9.50	3.06	100	8.00	2.63
All rookeries	400	9.40	-	400	8.10	-
1984						
Zapadni Reef	100	10.62	4.69	100	9.14	3.64
Morjovi	100	10.72	5.17	100	9.20	4.56
Reef	100	11.66	4.40	100	9.92	2.53
All rookeries	300	11.00	-	300	9.42	-

[a] NE Point = Northeast Point.

1957 through 1971 and 1984. Figures 5 and 6 show the trend of mean annual pup weights over time. Significant differences exist in mean weights between sexes and rookeries for all years. The differences between rookeries vary from year to year, and in some years there were no significant differences between some of the rookeries. For example, in 1957, 1959 and 1962, the mean weights of males were similar between Zapadni Reef and Polovina and between Reef and Northeast Point; in 1963, the weights of females were also similar for the same rookeries. Female pup weights taken on Polovina, Reef, and Northeast Point were similar in 1957, 1960 and 1962. In general, pup weights taken on Reef Rookery have been higher than other rookeries.

The data presented in Figures 5 and 6 suggest a general increase in mean pup weights for both males and females. When considering this trend, it should'be noted that in 1958 pup weights were taken on Northeast Point Rookery only, whereas all other mean weights were averaged over three or more rookeries. It is also of interest to note that the mean weights for both males and females taken on Northeast Point Rookery in 1958 were significantly greater than any other average weight taken on a specific rookery.

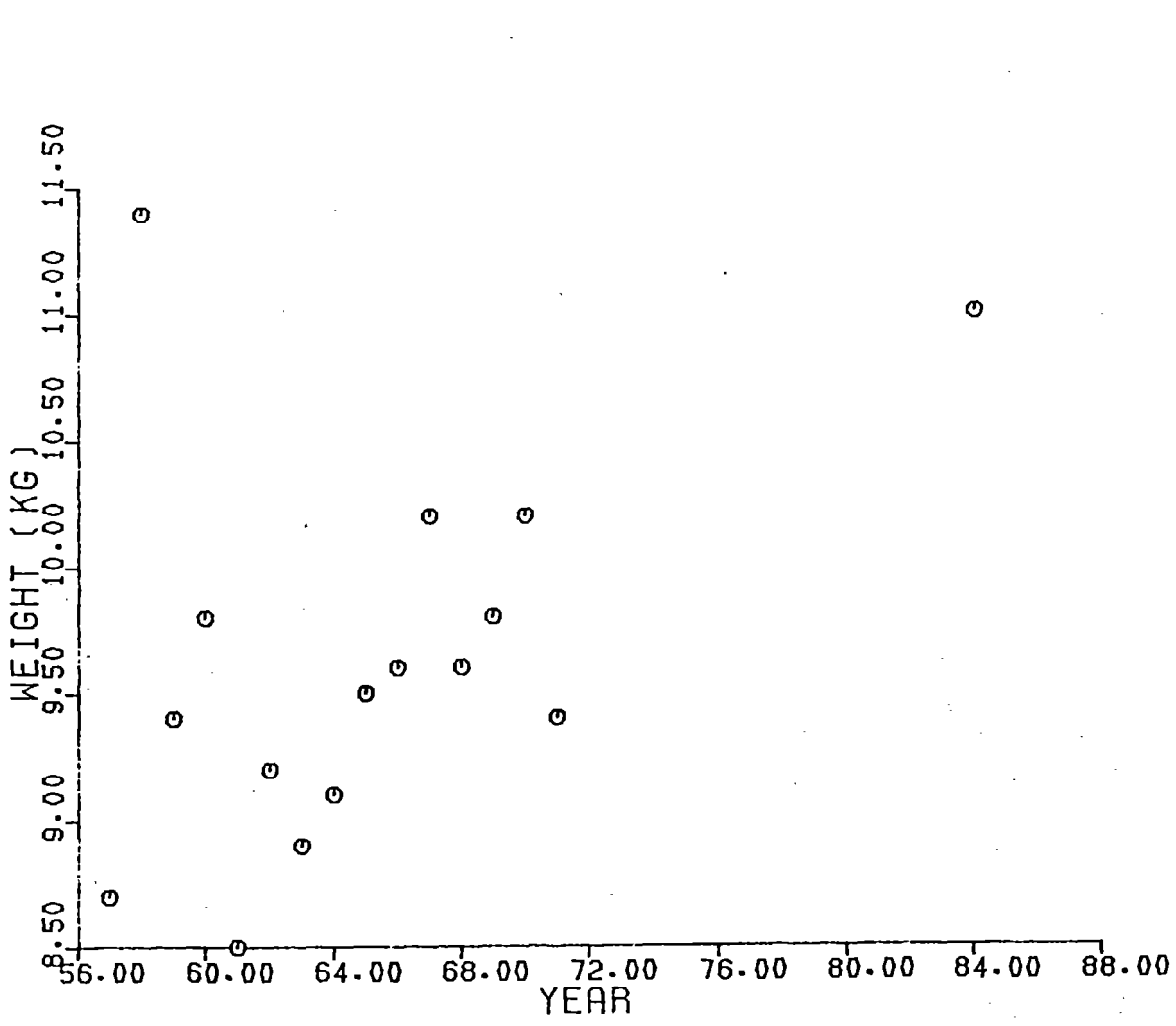

Figure 5.--A plot of the mean weights of male fur seal pups as measured in early September for St. Paul Island, Alaska from 1957 through 1984.

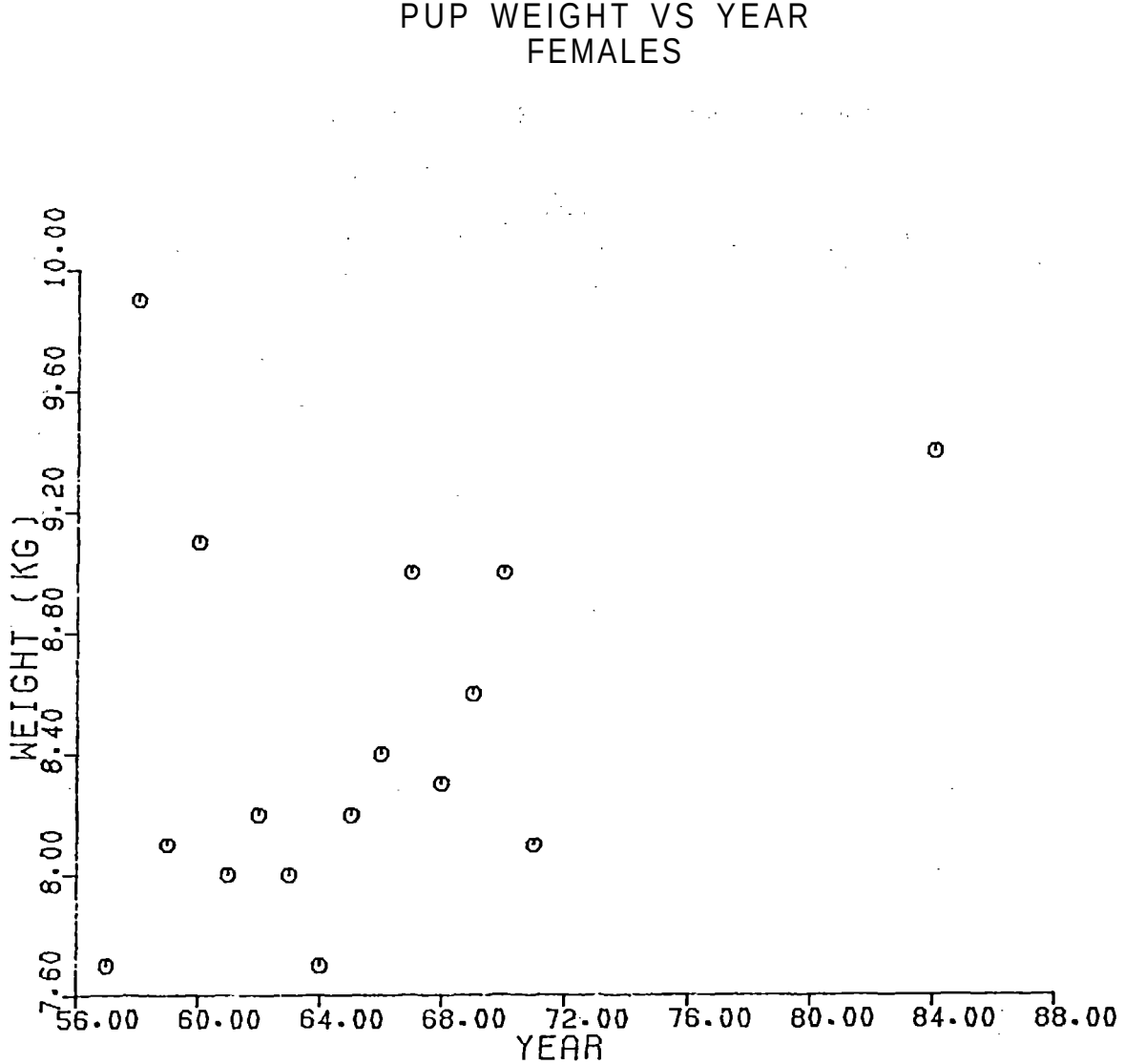

Figure 6.--A plot of the mean weights of female fur seal pups as measured in early September for St. Paul Island, Alaska from 1957 through 1984.

TETRACYCLINE MARKING OF NORTHERN FUR SEALS, ST. PAUL ISLAND, ALASKA

by

Hiroshi Kajimura and John-L. Bengtson

Studies were conducted in 1984 with the objective of placing known marks in teeth of northern fur seals so that the fine dental structures (layers) could be related definitely to life history parameters. To provide reference points at known intervals (layers) within teeth, an antibiotic drug, oxy-tetracycline, was administered by intramuscular injection. Upon injection, the drug is incorporated into hard tissues, principally the teeth and bones, within a short time. The tetracycline present in the tooth fluoresces when sections are examined under ultraviolet light, thereby giving a clear benchmark of dentine layers that are being laid down. Some of the females and pups in our study were given a second dose of tetracycline to provide a second reference point in the dentine. These known marks will provide a check in evaluating how some behavioral events (e.g., feeding trips, nursing/fasting cycles) may be related to fine structures in teeth.

Study Area

Zapadni Reef Rookery was chosen as the study area because earlier studies conducted at this site showed that it was easy to observe and capture seals there, its proximity to the village made it readily accessible, and seals on this rookery were accessible for capture from the water's edge. These features proved beneficial when the seals were to be captured for administering the second injection of tetracycline.

Capture and Internal Marking of Fur Seals

Fur seals other than pups were captured with a noose pole or choker and placed on a restraint board similar to that described by Gentry and Holt (1982). The restraint board was used to immobilize adult female fur seals while we attached telemetry devices (radio transmitters) to their heads. This restraint board was also used when we examined subadult males entangled in net fragments or other debris. When the restraint board was not used, the seals were held down by two people while a third administered the tetracycline. Pups were captured by using a hoop net or bare hands and were held on the ground by one person while the other administered the tetracycline. All seals marked with tetracycline were also given two identical tags, one on each flipper, for future identification (Table 6).

Radio transmitters were attached to the heads of the adult females with a quick drying epoxy glue before they left the rookery on their first feeding trip. The telemetry devices were used to monitor the females' presence on or absence from the rookery 24 hours a day, and for tracking them at sea (see section on Northern Fur Seal Tracking).

Chart recorders and scanning receivers were placed near the rookery of radio tagging to monitor the presence of the females while ashore on the rookery. The recorders scanned all frequencies (each transmitter had a separate frequency) and, therefore, provided complete records of the females while ashore. Information on the females presence or absence from land was recorded for later use in delineating several aspects of feeding trip/nursing cycles, including the number and duration of trips made during the study. This information, in addition to the known marks

Table 6.--Northern fur seals marked with an identical tag on each front flipper and with intramuscular tetracycline injection, St. Paul Island, Alaska, 1984.

Tag type and color	Tag number	Number marked	Remarks
Blue Roto-tag	501-520	20	Radio-tagged females
	522-524	3	Lice study (females)
	526-586[a]	61	Subadult male net entanglement study
	587-600	14	Females (long-term studies)
White Riese-tag	1213-1220	8	Pups of radio-tagged females
	1221-1225	5	Subadult males (various doses)
	2701-2720	20	Radio-tagged females
	2721	1	Pup of radio-tagged female
Green Roto-tag	801-807	7	Pups of radio-tagged females
	826-862[b]	36	Females (long-term studies)
	863-900	38	Pups (long-term studies)
Pink Roto-tag	801/802[c]	1	Subadult male (various doses)
	803-824	22	Subadult male net entanglement study
	825-848[d]	23	Pups (long-term studies)
		259	

[a] Seals tagged with numbers 526-541 were not internally marked with tetracycline.

[b] Tag number 848 was not used.

[c] Tagged with consecutive numbers.

[d] One pup tagged with consecutive numbers (825/826).

put in teeth via tetracycline injection, will be correlated to events that occurred during the summer breeding season.

Oxy-tetracycline (20 to 30 mg/kg body weight) was administered by intramuscular injection to the females, pups, and subadult males to provide reference points at known intervals (layers) within their teeth. Two hundred and twenty-seven fur seals were internally marked with tetracycl-ine on St. Paul Island in 1984. The marked animals included 94 females, 71 pups, and 62 subadult males. Of this group, our principal study animals included 40 radio-tagged females, 17 pups of the radio-tagged females, 5 pups marked on the day of birth to identify the neonatal line in their teeth, and 6 subadult males (given various doses of tetracycline) captured alive during the commercial harvest operations. Other seals internally marked with tetracycline for long-term studies included 51 females, 50 pups, 3 females used in a lice study, and 56 net-entangled subadult males from the commercial harvest.

A second dose of tetracycline was also administered to 17 radio-tagged adult females and to 10 of their pups to provide a second known mark.

Collection of Study Animals and Samples

Seals collected for this study included 19 radio-tagged adult females, 9 pups born to these radio-tagged females, 5 pups marked for neonatal line study, and 2 subadult males (Table 7). From this group, 8 radio-tagged seals and 5 pups had received a second dose of tetracycline, including 2 mother/pup pairs. Six tetracycline-marked mother/pup pairs were collected for our study (Table 8). The teeth from each of these animals were collected for microscopic study of the fine dentine layers.

Table 7.--Tetracycline-marked fur seals collected, St. Paul Island, Alaska, 1984.

Animal type	Tag no.	Date of injection 1st	Date of injection 2nd	Date collected
Adult female	501	6/30	-	9/24
"	502	6/30	-	9/30
"	503	6/30	-	8/13
"	506	7/1	-	10/27
"	509	7/1	8/5	9/18
"	510	7/1	-	9/28
"	511	7/1	8/10	9/24
"	512	7/1	8/11	9/25
"	514	7/1	7/17	8/14
"	515	7/1	8/11	9/25
"	517	7/1	8/6	9/27
"	519	7/1	-	9/19
"	2701	6/29	-	8/13
"	2704	6/29	-	9/25
"	2709	6/29	7/22	9/19
"	2716	6/30	-	9/18
"	2717	6/30	-	9/28
"	2718	6/30	8/3	9/20
"	2720	6/30	-	9/21
Pup	1215	7/22	8/14	9/24
"	1216	7/23	-	8/14
"	1218	7/24	-	8/13
"	1219	7/24	8/14	9/30
"	802	7/30	8/14	9/23
"	803	8/4	8/14	9/22
"	804	8/4	-	9/18
"	805	8/5	8/14	9/21
"	806	8/8	-	9/19
"	1	7/14	-	[a]
"	2	7/16	-	a
"	3	7/16	-	a
"	4	7/16	-	a
"	5	7/16	-	a
Male	1221	7/23	-	7/30
"	801-802	7/23	-	7/30

[a] One pup collected on 8/5 and four pups taken on 8/8.

Table 8.--Tetracycline-marked mother/pup pairs collected, St. Paul Island, Alaska 1984.

Mother tag no.	Date of injection 1st	Date of injection 2nd	Date collected	Pup tag no.	Date of injection 1st	Date of injection 2nd	Date collected
2701	6/29	-	8/13	1216	7/23	-	8/14
2705	6/29	-	-	2721	7/16	8/14	-
2706	6/29	8/11	-	1213	7/22	8/14	-
2707	6/29	8/1	-	1217	7/24	8/14	-
2708	6/29	7/16	-	1219	7/24	8/14	-
2709	6/29	7/22	9/19	806	8/8	-	9/19
2714	6/30	8/3	-	1220	7/25	8/14	-
2717	6/30	-	9/28	(not tagged)	-	-	9/28
2718	6/30	8/3	9/20	803	8/4	8/14	9/22
2720	6/30	8/6	9/21	805	8/5	8/14	9/21
503	6/30	-	8/13	1218	7/24	-	8/13
506	7/1	-	10/27	801	7/25	8/14	-
508	7/1	-	-	807	8/8	-	-
509	7/1	8/5	9/18	802	7/30	8/14	9/23
510	7/1	-	9/28	1214	7/22	8/14	-
515	7/1	8/11	9/25	804	8/4	-	9/18
518	7/1	8/10	-	1215	7/22	8/14	9/24

BEHAVIOR AND BIOLOGY, PRIBILOF ISLANDS, ALASKA

by

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

Work Plan

The 1984 field season on St. George Island comprised four major research projects. Two workers recorded behavioral data at East Reef and Zapadni Rookeries for comparison against the 1974-76 baseline data. Data categories that were recorded are listed in the 1983 Report of Fur Seal Investigations (Kozloff 1985). Another observer collected data on the behavior and structure of the peripheral male population at Staraya Artil Rookery. One worker collected data on gregariousness and aggression among females held in an enclosure-at East Reef Rookery. Finally, three workers deployed time-depth recorders (TDRs) on females at East Reef Rookery. Other activities during the 1984 field season on St. George Island included tagging adult females and pups at East Reef, East Cliffs, and Staraya Artil Rookeries (Table 9), photographing the flippers of pups for G. A. Nesterov of the U.S.S.R., studying interactions between adult males and pups, surveying the entire island for entangled adult females, and censusing juvenile males on hauling grounds once weekly. In addition, the rookerieson St. Paul Island were surveyed to determine the size of the peripheral male population.

Diving Behavior of Adult Female Fur Seals

Diving and foraging behavior of female fur seals has been studied for 9 years (Kooyman et al. 1976). The purpose of this study is to obtain

Table 9.--Tags applied to northern fur seals for studies of behavior, St. George Island, Alaska, 1984.

Type and color of tag	Tag number	Age-sex class	Number of seals tagged	Rookery
White Riese	2088, 2754, 2755, 2761-64 2770[a], 2775[b]	Adult females	9	East Reef
	2089-2090 2601-2661 2751-2753 2756-2760 2765-2767	Female pups	73	East Reef
Yellow Riese	5228, 5234-5238 5240 5801-5848	Male pups	54	East Reef
	5239	Female pup	1	East Reef
	5701-5723	Juvenile males	23	East Reef/ East Cliffs
	5721-5722	Adult males	2	Staraya Artil
Green Riese	2011	Female pup	1	East Reef hauling grounds
	2014-2121	Adult females	107	East Reef

[a] Female was formerly tagged 207 White Riese.

[b] Female was formerly tagged 765 White Riese.

an index of the amount of food available to fur seals in the Bering Sea by measuring the effort mothers expend foraging. This index will be valuable in the event that changes occur in the Bering Sea ecosystem. The major trends in fur seal diving are being published (Gentry et al. in press), along with the questions that these trends, generated. In the present report, these secondary questions will be addressed.

Research on attendance behavior prior to 1983 showed that females suckle their pups for about 125 days, during which time they make trips to sea for feeding. These foraging trips increase in duration throughout the season, culminating in trips of about 9 days each before weaning occurs. The previous results showed that three dive patterns exist in this species. Shallow divers forage mostly just before dawn and just after dusk. They do not dive deeper than about 75 m, and the depth of dives within a dive bout changes with time, suggesting that the prey move vertically while seals forage. Deep divers forage between 125 and 200 m, and dive at all hours of the day. The depths do not change within a bout, suggesting that the prey are not moving vertically. Deep divers usually make one-third as many dives as shallow divers; nevertheless they gain comparable mass on a trip to sea (Costa and Gentry in press), suggesting a greater efficiency in weight gained per dive. Mixed divers use the deep and the shallow patterns just described, but not usually on the same day. Usually, these seals have more shallow than deep dives. All three dive types are shown in Figure 7. About 40% of all seals instrumented were mixed divers; the other 60% comprised equal proportions of shallow and deep divers.

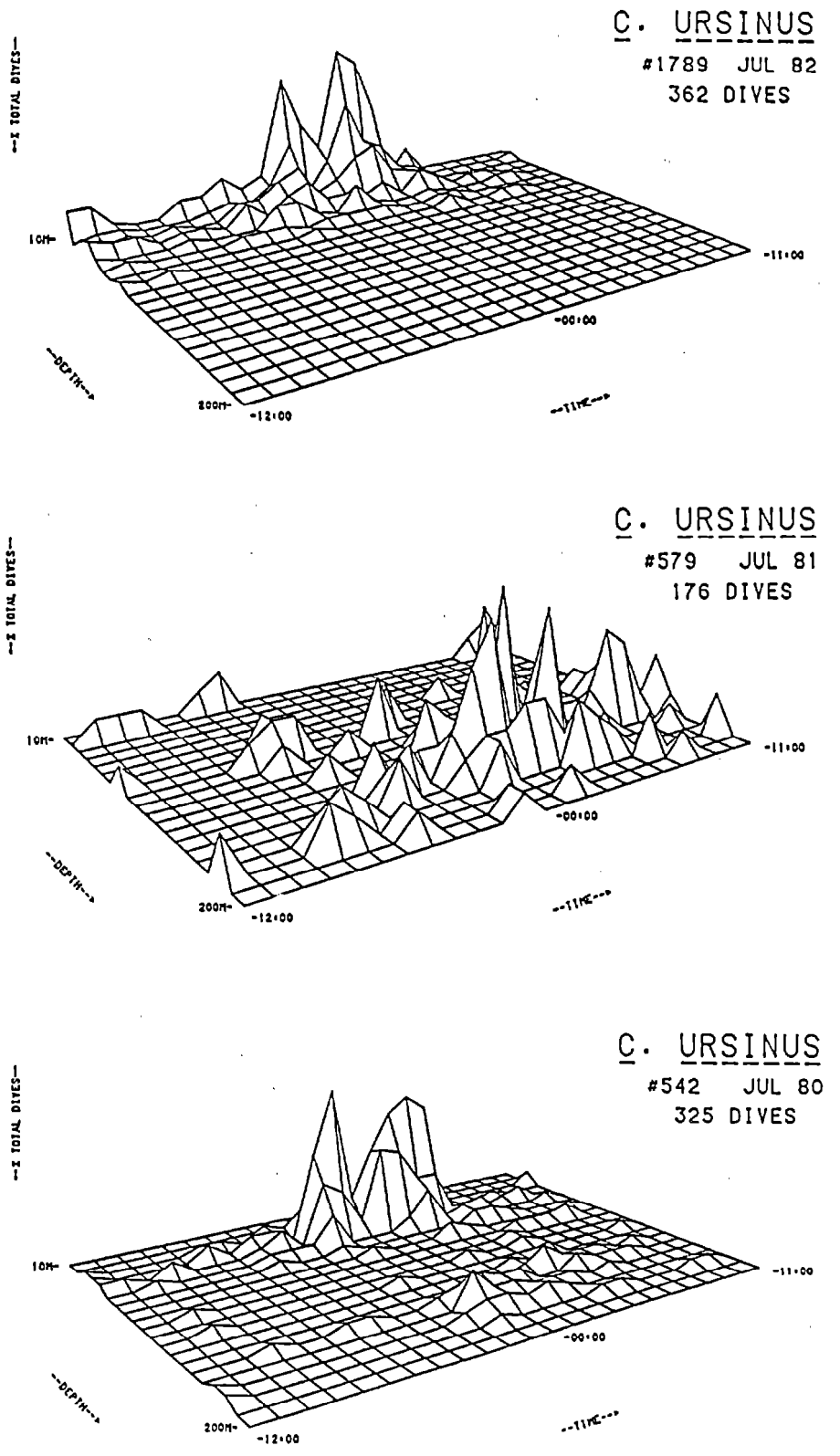

Figure 7. --Plots of depth, time of day, and frequency of dive for shallow, deep, and mixed diving patterns of northern fur seals.

The specific questions that arose from the previous effort are: 1) Are the three dive patterns discrete and valid categories, 2) are individual seals specialists in using these. patterns in different years, and in different parts of a given season, 3) 'does dive effort, as measured by dives made per hour at sea, increase seasonally as foraging trips increases, and 4) is the difference between shallow and deep diving determined by size of the seal? (Larger seals should be able to reach greater depths than smaller seals because oxygen storage capacity and- power output increase with size.)

To address these questions, investigators attached TDRs to three females in July of two successive years between 1982 and 1984. Three other females were fitted with instruments in July 1983 and again in October 1983. Weights were obtained for the instrumented females and were compared according to dive type. Instruments were attached only to females that were suckling pups. The data were collected and analyzed (Gentry in press).

Validity of Dive Types

The three dive types described previously appear to be valid, but they are not as discrete as formerly concluded. The shallow and mixed dive types that were identified in the 1982 and earlier data were seen again in the 1983-84 data (Figs. 8 and 9). No deep divers were recorded, but sample sizes were small. Intergrades occurred between types, especially when seasonal differences were involved (compare Female 1208 in October, Fig. 9, to the mixed dive pattern of Fig. 7). Two variations on dive types were seen. One mixed diver, Female P9, had a preponderance of deep rather than shallow dives (Fig. 9); one shallow diver (Female 207)

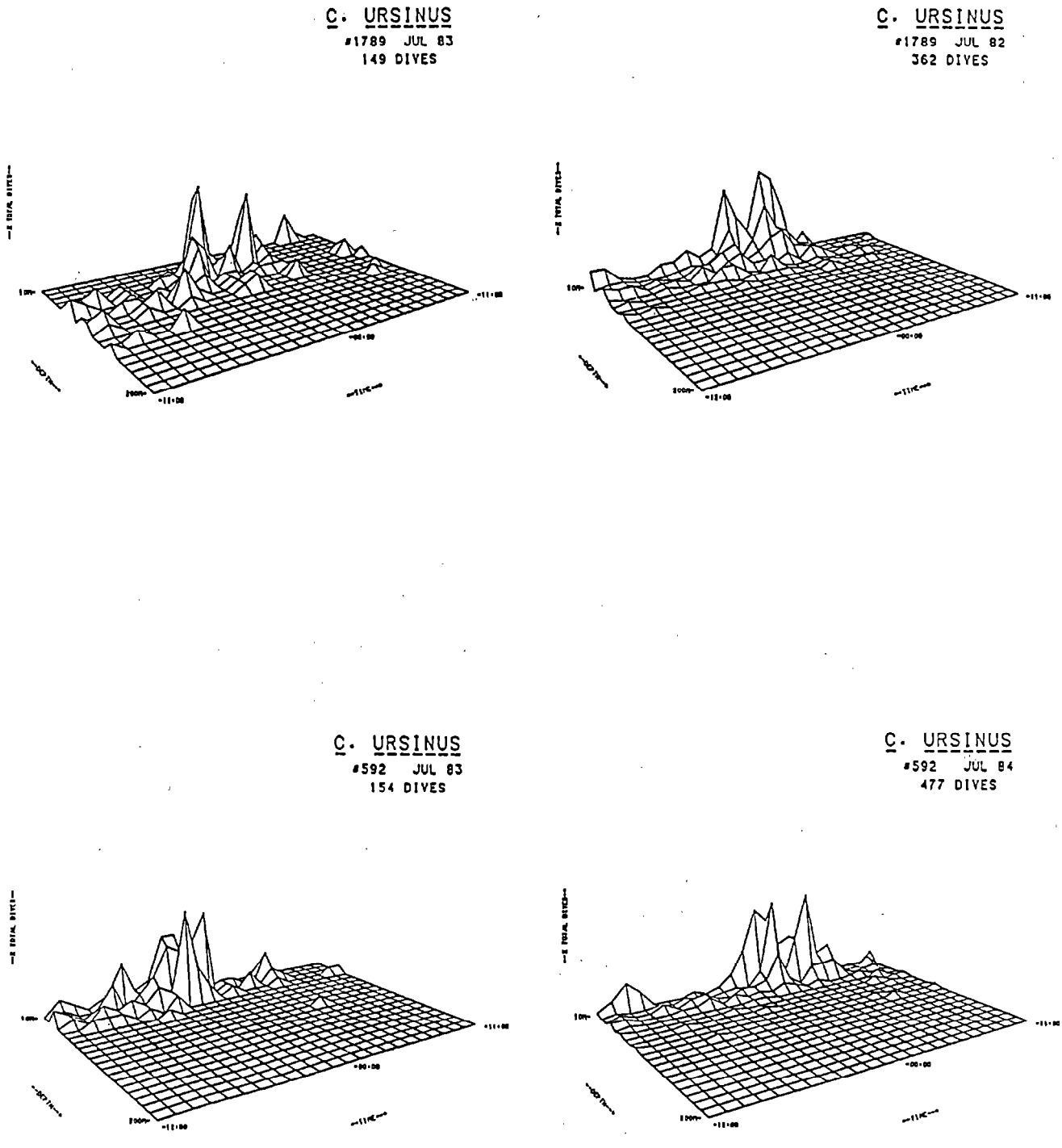

Figure 8. -,-Comparisons of diving patterns in July of different years. A third female (1208) showed no apparent difference in dive depths between 1982 and 1983, although for technical reasons the record could not be analyzed.

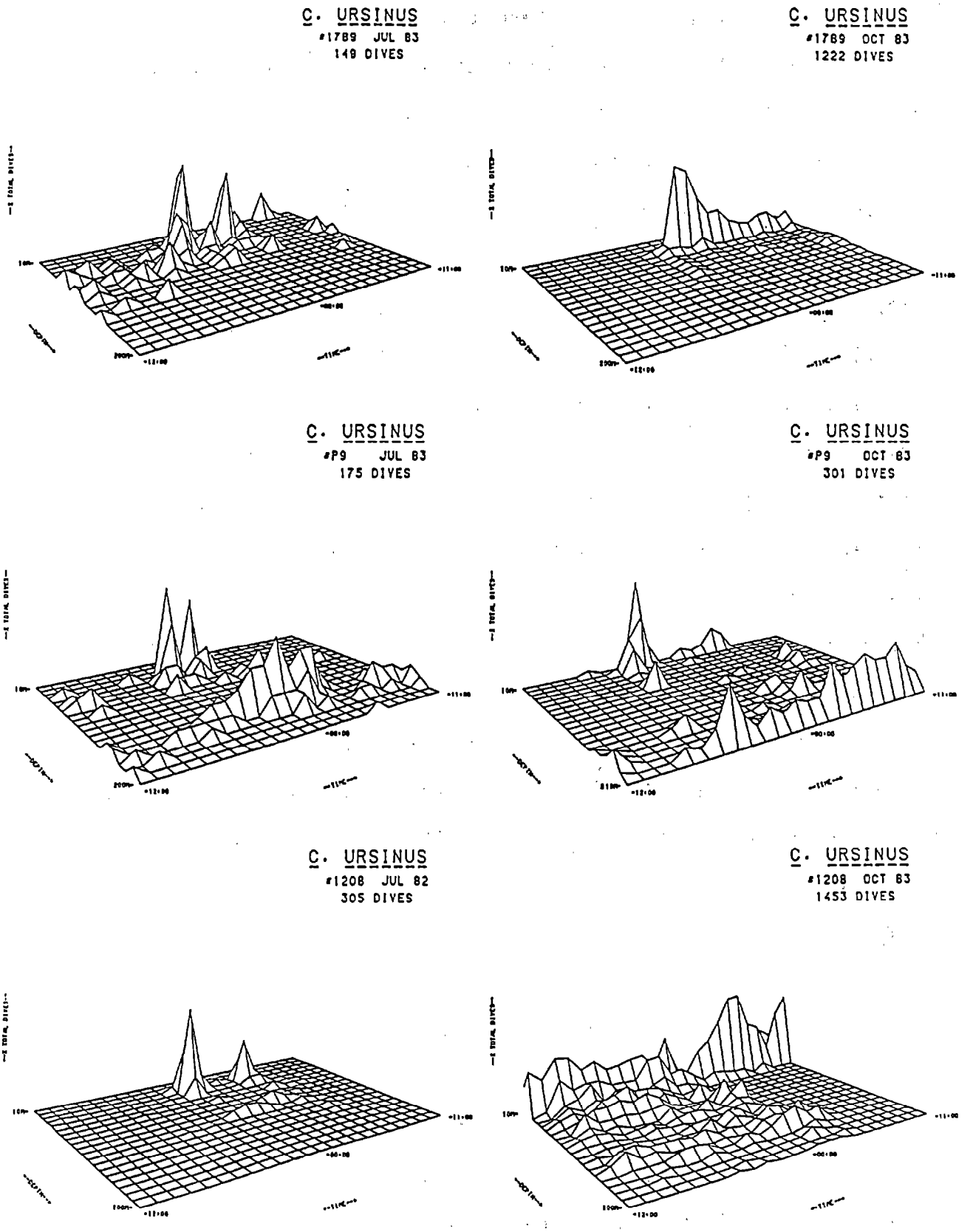

Figure 9. --Comparisons of dive records early (July) and late (October) in the breeding season. Note that female 1208's July record is from 1982.

dove at all hours, not just around dawn and dusk (Fig. 10). These results show that a statistical definition of dive types is now necessary.

Individual Specialization

Individual seals seen to specialize in the use of one or another of the three dive types, at least to the extent that these categories are valid. Neither animal in Figure 10 made substantial shifts in dive type between years. A third animal (1208) had a typical shallow dive pattern in July 1982, and although its record could not be digitized due to technical problems, no deep dives were recorded in July 1983. One female (1789) had deeper dives in 1983 than in 1982. Such changes in depth of diving were also seen in comparing data from July and October (Fig. 9). One seal (1789) dove slightly shallwer, and two (P9 and 1208) dove deeper in October than in July. However, only one of these shifts was substantial enough to be considered a change in dive type (1208 changed from shallow to mixed). In summary, most animals (5/6 pairwise comparisons) retained the same dive pattern over years and seasons. Although the sample size is small, we conclude that females specialize in being shallow, mixed or deep divers, but that slight shifts in the depths attained may occur with changes of age or season. These shifts may reflect changes in prey type or in vertical movement of prey.

Seasonal Changes in Dive Effort

Dive effort, as measured by the number of dives performed per hour spent at sea, increased from July to October for all three females (Table 10). The average rate of diving within bouts for seven females in July 1980-82 (Gentry et al. in press) was 1.5 dives per hour, compared to almost 4.0 in October 1983 (Table 10). The increase seemed to be greater

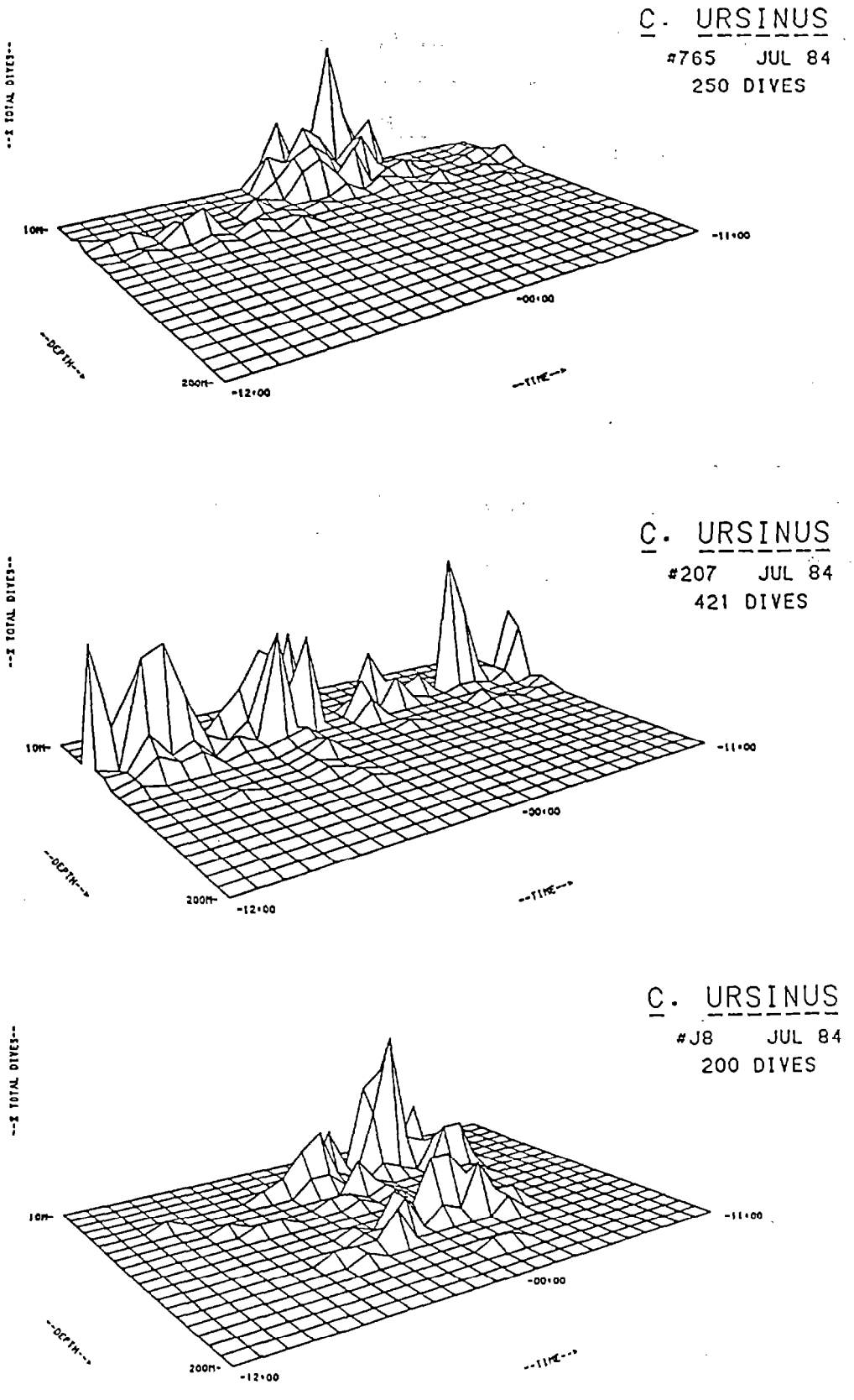

Figure 10. --Comparison of dive pattern in older (38 and 207) 12 years) and younger (female 765, a known 5-year-old) seals. Female P9 (Fig. 9) is also) 12 years.

Table 10.--Comparative dive rate of female fur seals in July and October.

Female number	Dives per hour spent at sea	
	July	October
P9	1.30	1.90
1208	1.30[a]	5.50
1789	1.10	4.50
Mean (SD)	1.23 (0.12)	3.97 (1.86)

[a] Record from July 1982; others from July 1983. The average rate of diving for seven females recorded in July of other years was 1.5 dives per hour spent at sea.

for shallow or mixed divers than for pyedominantly deep divers (such as P9). Therefore, not only did foraging trips become longer, but dive effort increased late in the season. These increases may be related to. increased pup needs or to impending migration for the female..

Size and the Dive Pattern

Apparently not all larger females become deep divers, but deep divers tend to be larger than other females.

Deep divers (P9 and others in past research) averaged 45.0 kg in weight, whereas mixed and shallow divers averaged 38.7 kg and 36.9 kg, respectively. The sample sizes are small, but the trend suggests that larger females have the flexibility to perform any dive type, while smaller females are obligated to be shallow divers. Size varies with age in fur seals.

The results of the past 2 years suggest that the fur seal herd is composed of individuals that, within a season or between two seasons, maintain the same or a closely similar diving pattern. Some specialize in feeding at the surface at night. Some specialize in feeding between 125 and 200 m throughout day and night. Other individuals alternate between these two dive patterns. The dive type may change with age. Deep divers are always larger females, but mixed or shallow divers may be of any size. Because of the flexible behavior of older females, and perhaps seasonal changes in behavior of prey, the three dive types are not entirely discrete. However, the division of diving behavior into three broad categories is valid. Foraging effort increases substantially prior to weaning and migration.

Future research will attempt to increase the sample size for cross year comparisons. In 1985, we will measure the swim speeds that these animals maintain at sea. Swim speeds are important for estimating the energy expended at sea and the foraging range. They will also show whether the hunting tactics of seals involve taking prey by pursuit (by burst swimming).

NORTHERN FUR SEAL TRACKING STUDY, BERING SEA

by

Thomas R. Loughlin and John L. Bengtson

Operational Plan

The NOAA ship Surveyor was used to follow northern fur seals at sea to determine their feeding locations and movement patterns during July 1984. Prior to the ship's 15 July arrival at St. Paul Island, an advance field party attached radio transmitters to 40 female northern fur seals from Zapadni Reef Rookery (see section on Tetracycline Marking of Northern Fur Seals). Each transmitter had a unique frequency within the 164 to 165 MHz range to allow identification of specific females by the frequency of the transmitter. The transmitters were attached to the females using Devcon epoxy-resin and placed on the top of the head to. allow exposure when the animal surfaced to breathe. Radio frequencies at the 164-165 MHz range are highly attenuated in sea water, allowing monitoring of transmitted signals only when the transmitter's antenna is out of water.

We recorded the location of specific animals and tracked their movements. at sea by selectively using four 4-element Yagi antennae placed 29 m above the water on the aft mast of the ship. Each antenna was positioned to point toward a different quadrant: port, astern, starboard, and ahead. By choosing the antenna(e) with the strongest signal, we determined the position and relative distance of the fur seal to the ship. The radio receivers were monitored 24 hours each day by

groups of two people on 4-hour watches. The general area for searching for seals at sea was determined by the field party using two tracking stations at Reef Rookery and Ridge Wall on St. Paul Island. Radio communications between the ship and the field party were conducted daily to determine which animals were on the beach or were likely to depart and be candidates for tracking at sea.

Results

The study lasted 408 hours (17 days) of which 285 hours (70%) were spent tracking northern fur seals; the remaining 123 hours were spent searching for animals (107 hours or 26%) or remaining inactive near St. Paul Island (16 hours or 4%). The total distance covered was 1,728.4 nautical miles (nmi).

Of the 40 animals equipped with radio transmitters, we located 11 (28%) and spent a substantial amount of time following 4 of them (Table 11). Animals 323 and 304 had tracks that were to the south of St. Paul Island, resulting in round-trip distances of about 200 nmi; animals 144 and 845 had tracks to the north and covered similar distances (Fig. 11). The other animals were followed for only short distances, were encountered during transit, or were encountered while tracking other animals and their tracklines were not determined.

Our most complete record was for animal 304. We followed it as it left St. Paul Island until its return to the island 5 days later. This animal and 323 left St. Paul Island in a southwest direction to approximately 16 km offshore, then headed south, stopping infrequently to

Table 11. --Number of hours spent and mileage covered searching for and tracking radio-equipped northern fur seals, July 1984.

Activity		Hours	
"In place" searching near St. Paul Island		52.5	
Transit searching		54.5	
	Subtotal nontracking	107.0	
Identification nos. of seals tracked			
144		32.0	
164		8.0	
183		9.0	
304		121.5	
323		61.5	
564		7.0	
665		3.0	
685		7.0	
845		36.0	
444 and 906	heard in transit only, not tracked	0.0	
	Subtotal tracking	285.0	
	Total active	392.0	
	Inactive (anchored St. Paul)	16.0	
	Total all	408.0	(17 days)
	Mileage	1,728.4	nautical miles

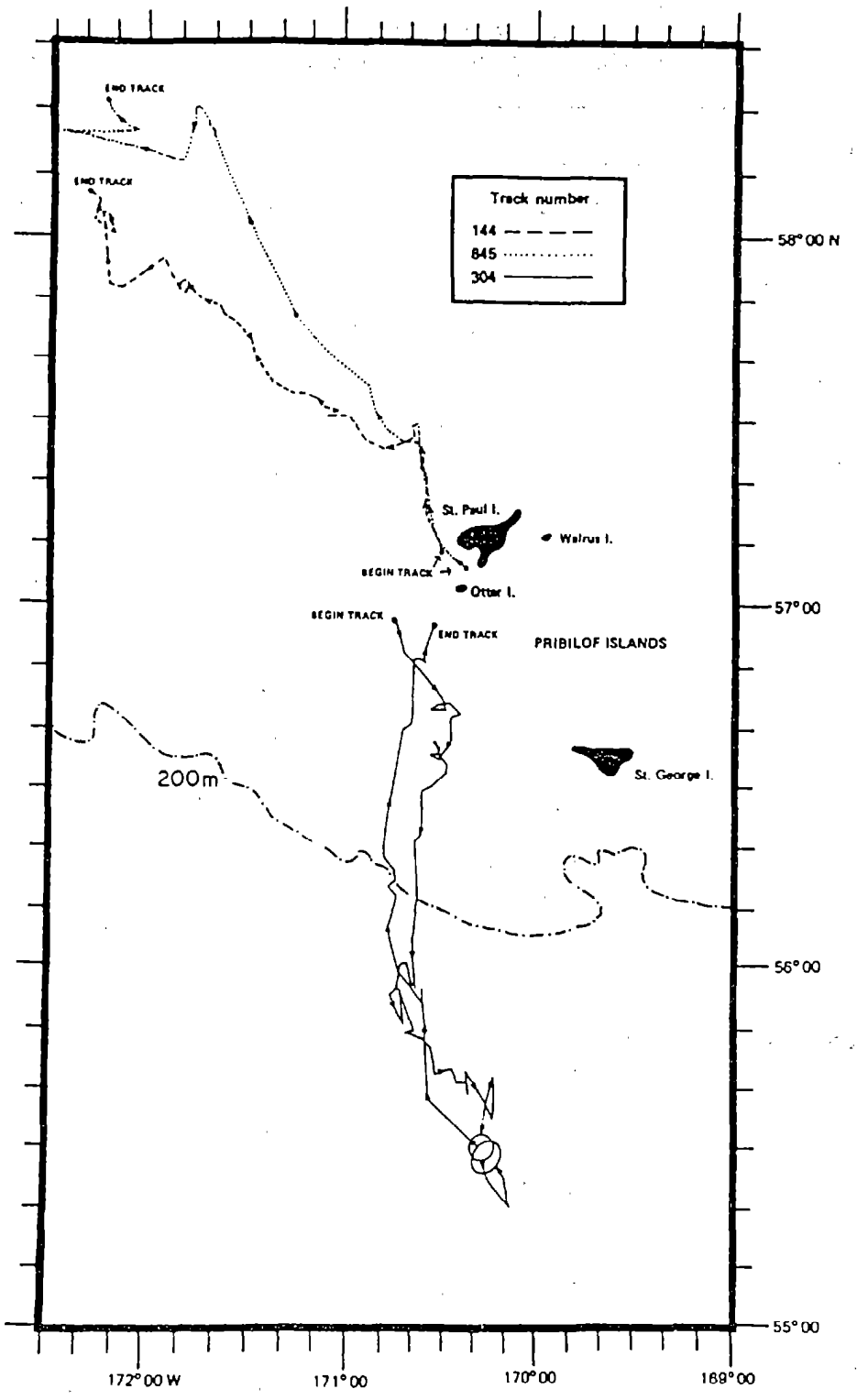

Figure 11.--Movements of three transmitter-equipped northern fur seals from St. Paul Island during July 1984. Circled areas for seal 304 indicate presumed feeding areas. Track lines represent approximately 161 km (100 miles) travel distance from St. Paul Island.

feed and rest. Both animals continued in this way until they were past the continental shelf break and in water over 1,800 fathoms in depth. Their trip to the shelf break took about 2 days; they spent 1.5 days feeding in deep water, then progressed back to St. Paul Island in about 1.5 days along the same approximate course line used earlier.

Animals 144 and 865 moved north and west of the island on similar track lines. Both were followed from St. Paul Island but their tracklines were either lost or discontinued and were not followed back. Neither animal went as far as the shelf break, which is significantly farther west from the north of St. Paul Island than from the south, but both animals remained on the shelf in water ranging from 35 to 56 fathoms in depth.

During travel, the animals generally progressed at between 3.5 and 4.5 knots when swimming to the feeding location and at about 7.0 knots when returning. They swam in relatively straight lines, rarely altering their course. There was often a rest period between 5:00 and 7:00 a.m. and between 5:00 and 7:00 p.m. and most feeding seemed to occur at night and late afternoon, although substantial variation to this pattern occurred. It is difficult to correlate behavioral patterns to strength and consistency of the received signal, but the behavior we presumed to occur as based on these signals corresponds to similar patterns discerned in other studies.

Conclusions

The most interesting result of this study was finding that it was relatively easy to track animals in the open sea. We are confident that

subsequent studies can be completed with good chances of success.

The study was also important in showing that the northern fur seals from Zapadni Reef Rookery on St. Paul Island feed in areas of actual and potential conflict with commercial fisheries (particularly Bering Sea groundfish fisheries) and with commercial and exploratory oil and gas operations in the St. George Basin and areas to the north. Further work should be conducted to demonstrate the extent to which these areas are used by fur seals from both St. Paul and St. George Islands.

The study was also important in showing that animals from the same rookery do not necessarily feed in the same location.

NORTHERN FUR SEAL SURVEY, BOGOSLOF ISLAND, ALASKA

by

Thomas R. Loughlin, Robert V. Miller,

Michael A. Perez, and Michael E. Goebel

Objective

The NOAA ship Surveyor was used to transport researchers to census northern fur seals on Bogoslof Island. Plans also called for attaching two identical Riese-tags, one on each front flipper, to females and pups.

Results

Inclement weather and time restrictions allowed only one landing of three individuals to count animals and record fur seal distribution. Northern fur seals were seen at the northwest end of the island in the large rocks south of Kenyon Dome. Fur seals have been seen in the same area in previous years. A total of 40 animals were counted, including 7 adult males, 7 subadult males, 12 adult females and 14 pups, for which sexes were not determined.

Unfortunately, it was not possible to capture and tag any animals in 1984, but five animals were seen from tagging efforts in 1983 when 39 animals were tagged. We resighted four females and one subadult male, including one male with a monel tag indicating an origin on one of the Soviet rookeries. We were not able to identify the tag number of the seal from the U.S.S.R. nor those of three seals from the United States. One subadult male tagged by the United States in 1983 on Bogoslof Island was seen during July 1984 on St. George Island.

Conclusion

The results from this survey indicate that the northern fur seal rookery on Bogoslof Island is viable although it has not increased in number since the 1983 survey. Dead pups were not seen and all the live pups observed appeared to be healthy and well fed. We are optimistic that this small rookery will continue to exist and expand in coming years.

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

by

George A. Antonelis, Jr. and Robert L. DeLong

Adams Cove

The 1984 field season extended from 10 June through 8 August. Research activities included population monitoring through daily censuses, a pup tagging program, and a female nursing and at-sea feeding cycle study.

Population Information

Population information for the Adams Cove colony is summarized in Table 12. On 10 June, when studies began, there were 11 large adult males, 8 small adult males, 15 subadult males (bachelors), 101 adult females, and 55 live pups on the rookery. A total of 478 pups were born, representing a 17% increase from the 1983 count of 408.

Maximal counts of 26 territorial males on 5 July and 49 bachelors on 4 July were recorded at the Adams Cove rookery. The greatest number of adult females on land occurred on 6 July when 330 were counted.

During the El Nino event of 1983, northern fur seal pup production in Adams Cove decreased by 60% from the 1982 level (1,029 to 408). The maximal number of adult females on land, as an index of abundance, was 377 in 1983, representing a decrease of 48% from 1982 when 628 females were counted. Since pup production (478

Table 12.--Summary of some observations of the northern fur seal colony in Adams Cove, San Miguel Island, California, 1979-83.

Observation	1979	1980	1981	1982	1983	1984
Season span[a]						
Beginning date	15 May	17 May	9 June	9 June	10 June	13 June
Ending date	15 Sept.	23 Sept.	13 Sept.	6 Dec.	20 Aug.	4 Aug.
First male	21 May	17 May[b]	9 June[c]	9 June[d]	10 June[e]	13 June[f]
First female	16 May[g]	23 May	9 June[c]	9 June[d]	10 June[e]	13 June[f]
First birth	28 May	24 May	9 June[c]	9 June[d]	10 June	13 June[f]
Mean birth date	29 June	29 June	26 June	25 June[h]	1 July	25 June[h]
Median birth date	26 June	30 June	28 June	28 June	1 July	26 June
Total births	834	896	941	1,029	408	478
Total pup deaths	72	103	289	51	89	44
Total females (maximum counted and date)[i]	702 25 Aug.	665 31 Aug.	717 1 July	628 8 July	377 15 July	333 6 July
Total large adult males	11	9	10	30	31	26[j]
Total small adult males	13[k]	10	11	22[l]	30[l]	18[l]
Total bachelors[m]	50	68	95	88	37	49

[a] Beginning and ending dates of continuous observations.
[b] Two adult males present 17 May--arrived prior to 17 May.
[c] Seven adult males, 86 females, and 24 pups present 9 June--arrived prior to 9 June.
[d] Seven adult males, 28 subadult males, 20 females, and 5 pups present.
[e] Five large adult males, 1 small adult male, 11 subadult males, 4 females, and 1 pup present 10 June--arrived prior to 10 June.
[f] Eleven large adult males, 8 small adult males, 15 subadult males, 101 females and 55 pups present 13 June--arrived prior to 13 June.
[g] Four females present 16 May--arrived prior to 16 May.
[h] Estimated from previous breeding season information.
[i] A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.
[j] Maximum count.
[k] Includes six small adult males that were not territorial.
[l] None of these males were territorial.
[m] Subadult males about 104-127 cm in body length, tip of nose to tip of tail.

total births) and female abundance (maximal count 333) in 1984 did not recover to 1982 level, it appears that the El Nino event might have a long-term effect on pup production, resulting from either a relocation of females to other areas (e.g., Pribilof Islands) or an increased adult female mortality.

Tagging Program and Records

The 1984 field season's resightings of fur seals that were tagged as pups on San Miguel Island in 1980 and 1981 are shown in Appendix Table A-10. Tag resightings are also obtained when dead or emaciated pups of the year are found on beaches or at sea. Most of these tag recoveries have been recorded north of Pt. Conception, California, and along the coasts of Oregon, Washington, and British Columbia. A 3-year-old male, double-tagged as a pup at Adams Cove (monel tag nos. SMI 2434-left and SMI 2437-right), was taken in the commercial harvest on St. Paul Island on 31 July 1984.

On San Miguel Island in 1984, there were no sightings of tagged fur seals from other islands. Other records of tag resightings have been kept for adult females and juvenile males that had been tagged on San Miguel Island (Appendix Tables A-11 and A-12).

On 21 September, 100 fur seal pups were double-tagged with pink Roto-tags (hard plastic). Roto-tags were used exclusively in 1984 because their numbers can be read at greater distances than those on monel tags. All tagged pups were checkmarked by removing the cartilaginous extension of the third digit on the right hind flipper (Appendix Table A-13).

Mortality on Land

The mortality of the fur seal pups born in Adams Cove decreased from 22% (89) in 1983 to 9% (44) in 1984. Heat prostration from warm environmental conditions[1] and drowning from high tides appeared to be the most common cause of mortality. On 20, 24 and 30 July, a total of 9 pup deaths resulted from heat prostration. High tides which flooded the rookery on 25-28 June and 8-10 July appeared to be responsible for the drowning deaths of 16 pups. The cause of death for the other 19 pups in 1984 was undetermined.

Castle Rock

A summary of census information for Castle Rock is presented in Table 13 for 1979-84. In 1984, a count of 411 pups (379 live and 32 dead) was obtained on 8 August, representing an increase in pup production of 184 animals (81%) from 1983.

On 1 July, 33 breeding males were counted on Castle Rock from aerial photographs, representing an increase of 13 breeding males from the 1983 count.

Fur seal pups were not tagged on Castle Rock in 1984 because large waves made it impossible to go ashore there.

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[1] High air and sand temperature, solar radiation, and low wind speed combine to raise a fur seal's body temperature and cause heat prostration.

Table 13.--Summary of censuses of northern fur seals, Castle Rock, California, 1979-84.

Fur seals	Numbers observed, methods and date of observation					
	1979	1980	1981	1982	1983	1984
Females	653(+)[a] 1 Aug.	563(+)[a] 1 Aug.	597(+)[a] 27 July	680(+)[a] 31 July	245(+)[a] 3 Aug.	411[a] 8 Aug.
Pups (total observed)[b]	653[c] 1 Aug.	563[c] 1 Aug.	597[c] 27 July	680[c] 31 July	227[c] 3 Aug.	411[c] 8 Aug.
Pups (dead observed)	27[c] 1 Aug.	38[c] 1 Aug.	29[c] 27 July	34[c] 31 July	18[c] 3 Aug.	32[c] 8 Aug.
Reproductive large adult males[d]	27[e] 3 July	27[e] 1 July	28[e] 2 July	27[e] 2 July	20[e] 1 July	33[e] 1 July
Total large adult males	32[e] 3 July	32[e] 1 July	29[e] 2 July	38[e] 2 July	40[e] 1 July	43[e] 1 July
Total small adult males	7[e] 3 July	2[e] 1 July	12[e] 2 July	7[e] 2 July	13[e] 1 July	3[e] 1 July

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

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GLOSSARY

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

Bachelor--Young male seals of ages 2-5 -years.

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

Drive--The act of surrounding and forcing groups of seals to move on land from one location to another.

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

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

Haul out--The act of 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-*--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 freeze marking, by hair-clipping, or by bleaching.

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

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

Round--The sequence in which hauling grounds are visited for the drive to harvest seals. A circuit, or round of the hauling grounds is completed in 5 days, and the procedure is repeated throughout the harvest of males.

Classifications of adult male fur seals

Class 1 (shoreline)--Full-grin 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. The latter definitely have territories; whereas the shoreline males appear to be attached to such sites but may not be in all cases.

Class 2 (territorial without females)--Full-grown males that have no females, but are actively defending territories. Most of these animals are located on the inland fringe of a rookery, 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.

Table 14 lists English translations of Russian names given to some of the rookeries or hauling grounds by Russian fur hunters in the late 1700s.

Table 14.--English translations of Russian names for Pribilof Island rookeries and hauling grounds.

Island and Russian name	English translation	Comments and derivation of name
St. Paul Island		
Vostochni	---	From "Novoctoshni" meaning "place of recent growth"; applied to Northeast Point which was apparently at one time an island that has since been connected to St. Paul Island by drifting sand.
Morjovi	Walrus	Historically, walruses hauled out here in summer.
Polovina	Halfway	Halfway to Northeast Point from the village.
Kitovi	Of "kit" or whale	When whaling fleets were active in the Bering Sea between 1849 and 1856, a large right whale killed by some ship's crew drifted ashore here.
Gorbatch	Humpback	Apparently refers to the "hump like" nature of the scoria slope above the rookery.
Tolstoi	Thick	In this case, thick headland on which the rookery is located.
Zapadni	West	Western part of the island.
Lukanin	---	So named after a Russian pioneer sailor who was said to have taken over 5,000 sea otters from St. Paul Island in 1787.
Zoltoi (hauling ground)	Golden	
St. George Island		
Staraya Artil	---	Old settlement or village. There was once a settlement or village adjacent to the rookery.

Table 14.--Continued

Island and Russian name	English translation	Comments and derivation of name
Zapadni	West	Western part of the island.
Sea Lion Rock		
Sivutch	Sea lion	These animals haul out but do not breed here.

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APPENDIX A

Tabulations of northern fur seal data collected on the Pribilof Islands, Alaska, and on San Miguel Island and nearby Castle Rock, California, in 1984.

APPENDIX A (Continued)

Page

Table A-1.--Daily age classification of male northern fur seals harvested, St. Paul Island, Alaska, 2 July to 3 August 1984.[a]

Date	Rookery[b]	Males harvested	Tooth sample	Percent in each age group of sample					Estimated number harvested by age group				
				2	3	4	5	6	2	3	4	5	6
July 2	NEP (e)	346	76	2.6	51.3	42.1	4.0	0.0	9	177	146	14	0
2	NEP (w)	446	89	1.1	43.8	51.7	3.4	0.0	5	195	231	15	0
3	POL	378	72	1.4	58.3	37.5	1.4	1.4	5	221	142	5	5
3	L-K	251	43	4.7	51.1	39.5	4.7	0.0	12	128	99	12	0
5	TZR	611	119	2.5	54.6	42.0	0.9	0.0	15	334	257	5	0
5	ZAP	402	80	6.3	50.0	42.5	1.2	0.0	25	201	171	5	0
6	REEF	898	179	4.5	63.7	31.8	0.0	0.0	40	572	286	0	0
9	NEP (e)	609	106	11.3	62.2	25.5	1.0	0.0	69	379	155	6	0
9	NEP (w)	132	26	3.8	53.9	38.5	3.8	0.0	5	71	51	5	0
10	POL	518	82	7.3	57.3	34.2	1.2	0.0	38	297	177	6	0
10	L-K	238	38	5.3	68.4	23.7	2.6	0.0	13	163	56	6	0
11	ZAP	958	146	4.8	66.4	28.1	0.7	0.0	46	636	269	7	0
12	TZR	210	35	0.0	62.9	37.1	0.0	0.0	0	132	78	0	0
13	REEF	1,059	154	8.5	66.2	24.7	0.6	0.0	90	701	262	6	0
16	NEP (e)	626	45	8.9	73.3	13.3	4.5	0.0	56	459	83	28	0
16	NEP (w)	77	12	0.0	66.7	33.3	0.0	0.0	0	51	26	0	0
17	POL	734	110	14.5	66.4	19.1	0.0	0.0	107	487	140	0	0
17	L-K	500	84	9.5	76.2	11.9	2.4	0.0	48	381	59	12	0
18	ZAP	1,123	154	13.0	72.1	14.9	0.0	0.0	146	810	167	0	0
19	TZR	588	83	13.3	62.6	24.1	0.0	0.0	78	368	142	0	0
20	REEF	992	144	20.8	68.1	10.4	0.0	0.7	206	676	103	0	7
23	NEP (e)	623	80	12.5	77.5	10.0	0.0	0.0	78	483	62	0	0
23	NEP (w)	189	23	4.4	65.2	30.4	0.0	0.0	8	123	58	0	0
24	POL	612	80	21.3	70.0	7.5	1.2	0.0	130	429	46	7	0
24	L-K	426	61	19.7	63.9	16.4	0.0	0.0	84	272	70	0	0
25	ZAP	802	121	20.7	66.1	13.2	0.0	0.0	166	530	106	0	0

Table A-1 .--Continued.

Date	Rookery[b]	Males harvested	Tooth sample	Percent in each age group of sample					Estimated number harvested by age group				
				2	3	4	5	6	2	3	4	5	6
July 26	TZR	433	69	7.2	62.4	23.2	7.2	0.0	31	270	101	31	0
27	REEF	1,413	165	17.6	64.3	13.9	3.6	0.6	249	909	196	51	8
30	NEP (e)	1,109	126	11.9	59.5	27.8	0.8	0.0	132	660	308	9	0
30	NEP (w)	232	35	8.6	71.4	20.0	0.0	0.0	20	166	46	0	0
31	POL	660	99	16.2	61.6	20.2	2.0	0.0	107	407	133	13	0
31	L-K	675	106	38.7	55.6	3.8	1.9	0.0	261	375	26	13	0
Aug. 1	ZAP	1,554	226	35.8	54.0	9.3	0.9	0.0	556	839	145	14	0
2	TZR	456	56	10.7	64.3	21.4	3.6	0.0	49	293	98	16	0
3	REEF	1,154	130	21.6	67.7	9.2	1.5	0.0	249	781	106	18	0

[a] An upper limit of 22,000 male fur seals was imposed in the harvest during 1984.
[b] NEP (e) = East side of Northeast Point (Morjovi);
NEP (w) = West side of Northeast Point (Vostochni);
TZR = Tolstoi, Zapadni Reef, and Little Zapadni;
POL = Polovina , Polovina Cliffs, and Little Polovina;
ZAP = Zapadni;
REEF = Reef, Gorbatch, and Ardiquen;
L-K = Lukanin and Kitovi.

Table A-2 .--Cumulative age classification of male northern fur seals harvested, St. Paul Island, Alaska, 2 July to 3 August 1984.a

Date	Rookery[b]	Estimated number harvested by age group					Total harvest to date	Percent harvested by age group				
		2	3	4	5	6		2	3	4	5	6
July 2	NEP (e)	9	177	146	14	0	346	3	51	42	4	0
2	NEP (w)	14	372	377	29	0	792	2	47	47	4	0
3	POL	19	593	519	34	5	1,170	2	51	44	3	0
3	L-K	31	721	618	46	5	1,421	2	51	44	3	0
5	TZR	46	1,055	875	51	5	2,032	2	52	43	3	0
5	ZAP	71	1,256	1,046	56	5	2,434	3	52	43	2	0
6	REEF	111	1,828	1,332	56	5	3,332	3	55	40	2	0
9	NEP (e)	180	2,207	1,487	62	5	3,941	4	56	38	2	0
9	NEP (w)	185	2,278	1,538	67	5	4,073	4	56	38	2	0
10	POL	223	2,575	1,715	73	5	4,591	5	56	37	2	0
10	L-K	236	2,738	1,771	79	5	4,829	5	57	37	1	0
11	ZAP	282	3,374	2,040	86	5	5,787	5	58	35	2	0
12	TZR	282	3,506	2,118	86	5	5,997	5	59	35	1	0
13	REEF	372	4,207	2,380	92	5	7,056	5	60	34	1	0
16	NEP (e)	428	4,666	2,463	120	5	7,682	6	61	32	1	0
16	NEP (w)	428	4,717	2,489	120	5	7,759	5	61	32	2	0
17	POL	535	5,204	2,629	120	5	8,493	6	61	31	2	0
17	L-K	583	5,585	2,688	132	5	8,993	7	62	30	1	0
18	ZAP	729	6,395	2,855	132	5	10,116	7	63	28	2	0
19	TZR	807	6,763	2,997	132	5	10,704	8	63	28	1	0
20	REEF	1,013	7,439	3,100	132	12	11,696	9	64	26	1	0
23	NEP (e)	1,091	7,922	3,162	132	12	12,319	9	64	26	1	0
23	NEP (w)	1,099	8,045	3,220	132	12	12,508	9	64	26	1	0
24	POL	1,229	8,474	3,266	139	12	13,120	9	65	25	1	0
24	L-K	1,313	8,746	3,336	139	12	13,546	10	64	25	1	0
25	ZAP	1,479	9,276	3,442	139	12	14,348	10	65	24	1	0

Table A-2.--Continued.

Date	Rookery[b]	Estimated number harvested by age group					Total harvest to date	Percent harvested by age group				
		2	3	4	5	6		2	3	4	5	6
July 26	TZR	1,510	9,546	3,543	170	12	14,781	10	65	24	1	0
27	REEF	1,759	10,455	3,739	221	20	16,194	11	63	23	1	0
30	NEP (e)	1,891	11,115	4,047	230	20	17,303	11	64	24	1	0
30	NEP (w)	1,911	11,281	4,093	230	20	17,535	11	64	24	1	0
31	POL	2,018	11,688	4,226	243	20	18,195	11	64	23	2	0
31	L-K	2,279	12,063	4,252	256	20	18,870	12	64	23	1	0
Aug. 1	ZAP	2,835	12,902	4,397	270	20	20,424	14	63	22	1	0
2	TZR	2,884	13,195	4,495	286	20	20,880	14	63	22	1	0
3	REEF	3,133	13,976	4,601	304	20	22,034	14	64	21	1	0

[a] An upper limit of 22,000 male fur seals was imposed in the harvest during 1984.
[b] NEP (e) = East side of Northeast Point (Morjovi);
NEP (w) = West side of Northeast Point (Vostochni);
TZR = Tolstoi, Zapadni Reef, and Little Zapadni;
POL = Polovina , Polovina Cliffs, and Little Polovina;
ZAP = Zapadni;
REEF = Reef, Gorbatch, and Ardiquen;
L-K = Lukanin and Kitovi.

Table A-3.--Number of adult male northern fur seals counted, by, classa and rookery section, St. Paul Island. Alaska, 9-16 July 1984. 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	14	14	-	-	-	-	-	-	-	-	-	-	-	-	28
3	56	63	-	-	-	-	-	-	-	-	-	-	-	-	119
5	48	0	-	-	-	-	-	-	-	-	-	-	-	-	48
Kitovi[b]															
2	9(12)	4	22	16	8	-	-	-	-	-	-	-	-	-	71
3	48(18)	9	54	61	46	-	-	-	-	-	-	-	-	-	236
5	0(0)	6	0	0	82	-	-	-	-	-	-	-	-	-	88
Reef															
2	11	20	31	14	14	20	9	4	6	7	5	-	-	-	141
3	49	90	76	39	46	63	31	48	39	34	11	-	-	-	526
5	4	16	0	0	155	0	62	52	0	0	0	-	-	-	289
Gorbatch															
2	17	14	8	1	2	12	-	-	-	-	-	-	-	-	54
3	95	54	78	15	38	78	-	-	-	-	-	-	-	-	358
5	73	0	0	125	0	4	-	-	-	-	-	-	-	-	202
Ardiguen															
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Morjovi[c]															
2	26(10)	25	14	22	17	19	-	-	-	-	-	-	-	-	133
3	44(27)	57	44	73	56	60	-	-	-	-	-	-	-	-	361
5	72(6)	0	19	0	9	2	-	-	-	-	-	-	-	-	108
Vostochni															
2	15	10	14	10	9	51	34	45	13	14	7	22	37	15	296
3	53	17	41	42	33	86	54	108	51	37	38	59	123	69	811
5	124	10	2	61	0	133	16	0	4	50	6	53	46	47	552
Little Polovina															
2	14	6	-	-	-	-	-	-	-	-	-	-	-	-	20
3	29	17	-	-	-	-	-	-	-	-	-	-	-	-	46
5	103	8	-	-	-	-	-	-	-	-	-	-	-	-	111
Polovina															
2	8	17	-	-	-	-	-	-	-	-	-	-	-	-	25
3	40	30	-	-	-	-	-	-	-	-	-	-	-	-	70
5	165	2	-	-	-	-	-	-	-	-	-	-	-	-	167
Polovina Cliffs															
2	6	8	9	9	27	16	29	-	-	-	-	-	-	-	104
3	31	33	33	57	57	75	118	-	-	-	-	-	-	-	404
5	0	3	1	0	0	0	8	-	-	-	-	-	-	-	12
Tolstoi[d]															
2	-	14	11	7	8	28	33	25	-	-	-	-	-	-	126
3	-	121	69	46	104	112	76	86	-	-	-	-	-	-	614
5	-	0	3	0	8	0	0	171	-	-	-	-	-	-	182
Zapadni Reef															
2	17	47	-	-	-	-	-	-	-	-	-	-	-	-	64
3	45	165	-	-	-	-	-	-	-	-	-	-	-	-	210
5	68	84	-	-	-	-	-	-	-	-	-	-	-	-	152
Little Zapadni															
2	10	19	25	36	31	32	-	-	-	-	-	-	-	-	153
3	17	37	83	84	59	87	-	-	-	-	-	-	-	-	367
5	2	0	8	7	0	58	-	-	-	-	-	-	-	-	75
Zapadni[e]															
2	34(0)	73	51	67	29	39	33	6	-	-	-	-	-	-	332
3	70(0)	82	94	117	73	106	74	10	-	-	-	-	-	-	626
5	0(124)	0	0	0	131	4	9	170	-	-	-	-	-	-	438

[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.

Table A-4.--Number of adult male northern fur seals counted, by rookery, Pribilof Islands, Alaska, July 1984.

Island and rookery	Date (July)	Class of adult male [a] 2	3	5	Total
St. Paul Island					
Lukanin	11	28	119	48	195
Kitovi	11	71	236	88	395
Reef	16	141	526	289	956
Gorbatch	16	54	358	202	614
Ardiguen	16	5	55	1	61
Morjovi	9	133	361	108	602
Vostochni	9	296	811	552	1,659
Little Polovina	11	20	46	111	177
Polovina	11	25	70	167	262
Polovina Cliffs	11	104	404	12	520
Tolstoi	13	126	614	182	922
Zapadni Reef	13	64	210	152	426
Little Zapadni	12	153	367	75	595
Zapadni	12	332	626	438	1,396
Island total		1,552	4,803	2,425	8,780
St. George Island					
Zapadni	12	152	157	166	475
South	12	62	247	51	360
North	13	236	593	197	1,026
East Reef	12	46	96	47	189
East Cliffs	12	101	279	62	442
Staraya Artil	12	112	101	220	433
Island total		709	1,473	743	2,925

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

Table A-5.--Number of harem and idle male northern fur seals counted in mid-July, Pribilof Islands, Alaska, 1975-84. A dash indicates no data.

Year	St. Paul Island		St. George Island		Total	
	Harem	Idle	Harem	Idle	Harem	Idle
1975	5,018	3,535	877	1,427	5,895	4,962
1976	5,324	4,041	1,093	996	6,417	5,037
1977	6,457	3,845	1,610	899	8,067	4,744
1978	6,496	3,908	1,590	1,220	8,086	5,128
1979	6,242	4,457	1,716	1,942	7,958	6,399
1980	5,490	4,248	1,563	1,795	7,053	6,043
1981	5,120	4,003	1,472	1,646	6,592	5,649
1982	5,767	4,009	1,410	1,319	7,177	5,328
1983	4,827	4,242	-	-	4,827	4,242
1984	4,803	3,977	1,473	1,452	6,276	5,429

Table A-6.--Number of dead northern fur seal pups counted, by rookery section, St. Paul Island, Alaska, 1984.

Island and rookery	Date (Aug.)	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
St. Paul Island																
Morjovi	21	86[a]	50	56	54	40	50	-	-	-	-	-	-	-	-	336
Vostochni	21	27	14	53	34	46	195	96	59	55	13	29	44	232	76	973
Little Polovina	23	11	3	-	-	-	-	-	-	-	-	-	-	-	-	14
Polovina Cliffs	23	30	27	29	35	52	63	161	-	-	-	-	-	-	-	397
Polovina	23	57	18	-	-	-	-	-	-	-	-	-	-	-	-	75
Ardiguen[b]	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46
Gorbatch	27	180	114	146	16	39	27	-	-	-	-	-	-	-	-	522
Reef	29	50	71	62	56	31	49	33	25	23	7	4	-	-	-	411
Kitovi	28	32[c]	4	45	30	31	-	-	-	-	-	-	-	-	-	142
Lukanin	28	46	58	-	-	-	-	-	-	-	-	-	-	-	-	104
Tolstoi	30	71	89	93	61	228	219	326	320	-	-	-	-	-	-	1,407
Little Zapadni	27	10	51	152	142	86	139	-	-	-	-	-	-	-	-	580
Zapadni Reef	27	135	166	-	-	-	-	-	-	-	-	-	-	-	-	301
Zapadni	22	30	97	126	214	146	80	77	37	-	-	-	-	-	-	807
															Total	6,115

[a] Includes 40 dead pups counted on second point south of Sea Lion Neck.
[b] No numbered sections.
[c] Includes 10 dead pups counted in Kitovi Amphitheater.

Table A-7.--Number of dead northern fur seal pups counted, by rookery, Pribilof Islands, 1975-84. A dash indicates no data[a].

Island and rookery	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
St. Paul Island										
Morjovi	1,765	1,829	870	606	269	508	346	348	274	336
Vostochni	3,259	3,826	2,021	1,041	573	932	889	837	747	973
Little Polovina	252	316	103	90	28	77	41	49	46	14
Polovina Cliffs	1,529	1,862	733	761	433	627	463	570	438	397
Polovina	419	378	160	151	85	127	89	97	79	75
Ardiguen	142	212	112	15	31	76	38	49	33	46
Gorbatch	1,025	1,341	860	475	260	699	379	399	414	522
Reef	1,837	2,055	1,233	593	651	790	623	654	649	411
Kitovi	787	846	331	203	171	256	187	269	223	142
Lukanin	505	385	250	197	132	206	102	139	171	104
Tolstoi	4,141	4,241	3,291	1,488	1,645	1,488	1,547	1,332	1,178	1,407
Little Zapadni	1,204	1,977	1,133	674	637	645	377	779	562	580
Zapadni Reef	508	638	427	129	161	243	266	276	258	301
Zapadni	3,252	3,770	2,559	1,650	1,368	1,185	1,451	1,503	925	807
Counted total	20,625	23,676	14,083	8,073	6,444	7,859	6,798	7,301	5,997	6,115
Estimated oversight 5%[b]	1,031	1,184	704	404	322	393	340	365	300	306
Total	21,656	24,860	14,787	8,477	6,766	8,252	7,138	7,666	6,297	6,421
St. George Island										
North	1,230	791	408	1,068	774	949	810	649	367	-
Zapadni	470	373	92	179	277	350	186	190	124	-
South	344	280	98	225	186	197	177	110	111	-
East Reef	102	37	60	164	104	121	74	56	25	-
East Cliffs	434	354	140	292	285	284	402	340	128	-
Staraya Artil	709	454	410	590	565	484	376	315	148	-
Counted total	3,289	2,289	1,208	2,518	2,191	2,385	2,025	1,660	903	-
Estimated oversight 5%[b]	165	114	60	126	110	119	101	83	45	-
Total	3,454	2,403	1,268	2,644	2,301	2,504	2,126	1,743	948	-

Table A-7. --Continued.

Island and rookery	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Pribilof Islands counted total	23,914	25,965	15,291	10,591	8,635	10,244	8,823	8,961	6,900	6,115
Estimated oversight 5%[b]	1,196	1,298	764	530	432	512	441	448	345	306
Total	25,110	27,263	16,055	11,121	9,067	10,756	9,264	9,409	7,245	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. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N. E., Seattle, WA 98115.

Table A-8.--Soviet tags recovered in the U.S. harvest of male northern fur seals, St. Paul Island, Alaska, 2 July to 3 August 1984.

Date	Tag number	Sex	Rookery of recovery
30 July	YM-616	F	Northeast Point
11 July	YM-2583	M	Zapadni
20 July	YM-3698	M	Reef
25 July	YM-4486	M	Zapadni
13 July	YM-8568	M	Reef
27 July	YB-1072	M	Reef
13 July	TB-9651	M	Reef
23 July	3M-3730	M	Northeast Point
27 July	TM-8154	M	Reef
31 July	30041	M	Kitovi
1 Aug.	MA-2522	M	Zapadni

Table A-9.--Northern fur seals entangled in fishing debris and other materials, U.S. commercial harvest of northern fur seals, St. Paul Island, Alaska, 1967-84.[a]

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

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

b Includes both sexes.

Table A-10.--Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, and the date first observed at Adams Cove in 1984.

Tag number[a]	Tag number/color	Sex	Year tagged	Date of first resighting
441 (L)	Roto/pink	M	1980	13 July
442 (L)	" "	M	"	16 June
451 (R)	" "	F	"	27 July
457 (D)	" "	M	"	26 June
462 (R)	" "	F[b]	"	14 July
473 (R)	" "	F	"	27 July
481 (L)	" "	M	"	15 July
487 (R)	" "	F	"	23 July
491 (L)	" "	M	"	29 June
651 (D)	" "	M	"	27 June
2007 (R)	Monel/silver	M	"	16 June
2020 (R)	" "	M	"	10 July
2129 (R)	" "	M	"	17 July
2174 (R)	" "	M	1981	24 July
A 2 (D)	Roto/pink	M	"	15 June
A 22 (R)	" "	M	"	26 June
A 26 (L)	" "	F	"	23 July
A 44 (D)	" "	F	"	27 July
A 67 (D)	" "	M	"	1 July
A 82 (L)	" "	M	"	25 June
A 95 (R)	" "	M	"	10 July
A 7 (R)	Riese/green	M	"	8 July

[a] L = Left flipper.
R = Right flipper.
D = Both flippers.

[b] Observed with pup of the year.

Table A-11 .--Northern fur seal females double-tagged with white plastic Roto-tags in Adams Cove, San Miguel Island,, California, on 18 November 1979, and date first resighted, 1980-84.

Tag number[a]			Date resighted[b]				
Right flipper	Left flipper	Vibrissae color[c]	1980	1981	1982	1983	1984
401	402	white	23 July*	6 July*	-	-	-
404	403	mixed	10 Aug.*	5 July*	19 Nov.	-	-
405	406	white	5 July*	5 July	3 Nov.*	-	-
407	408	white (tag lost, right side)	-	-	-	-	-
410	409	white	1 July*	18 June	17 Sept.	-	-
411	412	white	6 July**	-	18 Oct.*	-	-
413	414	mixed	5 July	15 July	1 Sept.	-	-
416	415	white	21 June**	11 July	17 June*	-	-
417	419	white	5 July*	23 July*	29 Sept.	-	-
420	421	white	4 July	9 July	4 Nov.*	-	-
422	423	white	18 July*	15 July	2 Sept.	15 July	14 July
424	425	white	15 Aug.	19 July	3 Sept.	-	-
426	427	white	27 June*	6 July*	11 July*	19 June	14 July
428	430	white	21 June*	6 July*	29 June*	-	-
431	432	white	29 July	12 Aug.	10 Sept.*	-	-
433	434	white	29 July	13 Aug.*	17 July	-	-
435	437	white	2 June	18 June	-	-	-
438	439	white	5 July	20 June	2 Sept.	-	-
440	441	white	5 July*	15 July	2 Oct.	-	-
442	443	mixed	18 June*	23 July	22 Aug.*	-	-
445	444	mixed	23 July**	-	22 Aug.	-	-
447	446	white	6 Sept.	29 June**	9 Sept.*	-	-
448	449	white	Died 16 Aug., due to cliff collapse, right-side tag lost.			-	-
450	451	white	28 June*	24 June	23 June*	-	13 July
452	453	white	-	-	-	-	-
454	455	white	-	-	-	-	-
456	457	white	-	-	25 July*	-	-
458	459	white	21 June	23 Sept.[d]	-	23 July	-
460	461	white	13 Aug.*	-	-	-	-

[a] Tags destroyed: 418, 429 and 436.
[b] Symbol "*" indicates the female was known parturient that year and "**" indicates the pup was stillborn or died shortly after birth.
[c] Mixed = combination of black and white.
[d] Resighted on Castle Rock.

Table A-12.--Northern fur seal males double-tagged at Adams Cove, San Miguel Island, California, with pink (P) Roto, monel (M) on 24 May 1981 or with white (W) Roto-tags on 1 May 1981, and date first resighted, 1982-84.[a]

Tag number		Age[b] (years)	Date resighted		
Right flipper	Left flipper		1982	1983	1984
SMI-659(M)	426(P)	3-4 (e)	-	25 July	-
465(W)	464(W)	3-4 (e)	6 July	-	-
466(W)	SMI-1211(M)	3 (a)	4 August	20 June	4 July
468(W)	467(W)	3-4 (e)	-	-	-
470(W)	469(W)	3-4 (e)	17 June	-	4 July

[a] Some fur seals had been tagged previously as pups with different tag types and number series.

[b] (e) = estimated age;
(a) = actual age.

Table A-13. --One hundred northern fur seal pups double-tagged with pink Roto-tags at Adams Cove, San Miguel Island, California, on 18 and 21 September 1984. All animals were checkmarked by removal of the cartilagenous extension of the third digit on the right hind flipper.

Tag number	Sex	Weight (kg)	Remarks
A-301	M	10.5	
302	F	10.0	
303	M	10.0	
304	F	10.0	
305	M	11.5	
306	F	9.5	
307	M	9.0	Healed vesicles
308	M	9.0	
309	F	8.5	
310	M	7.5	
311	M	13.0	
312	F	8.5	
313	M	8.5	
314	F	9.0	
315	M	8.0	
316	M	7.0	
317	F	9.0	
318	F	8.0	
319	M	12.0	
320	M	12.0	
321	F	10.0	
322	M	11.0	
323	M	9.0	
324	F	16.5	
325	F	11.0	
326	F	6.5	
327	F	6.5	
328	F	6.0	
329	F	7.5	
330	M	6.5	
331	F	5.0	
332	F	9.0	
333	M	14.5	
334	F	7.0	
335	M	11.5	
336	M	8.0	
337	M	10.0	
338	F	10.0	
339	M	12.5	
340	M	8.5	
341	M	11.0	
342	M	10.0	

Table A-13. --continued.

Tag number	Sex	Weight (kg)	Remarks
A-343	F	8.0	
344	M	6.0	
345	F	7.5	
346	M	9.0	
347	F	8.5	
348	M	11.5	
349	F	7.5	
350	M	12.0	
351	F	8.0	
352	F	9.5	
353	M	9.0	
354	F	12.0	
355	M	11.5	
356	F	10.5	
357	F	8.0	
358	F	11.0	
359	M	12.0	
360	F	8.5	
361	F	11.0	
362	F	11.5	
363	M	9.0	
364	M	9.0	
365	F	10.0	
366	F	8.0	
367	F	9.5	
368	M	10.0	
369	F	9.0	
370	F	9.0	Swabs and blood sample
371	F	9.0	Swabs and blood sample
373	M	9.0	Swabs and blood sample
374	F	11.0	Swabs and blood sample
375	F	9.0	Swabs and blood sample
376	M	6.5	Swabs and blood sample
377	F	9.5	Swabs and blood sample
378	M	9.0	Swabs and blood sample
379	M	11.0	Swabs and blood sample
380	F	8.0	Swabs and blood sample
381	F	8.5	Swabs and blood sample
382	F	9.0	Swabs and blood sample
383	M	13.0	
384	[a]	8.0	
385	M	10.0	
386	M	11.0	
387	M	9.0	
388	F	9.0	
389	M	8.5	

Table A-13. --continued.

Tag number	Sex	Weight (kg)	Remarks
A-390	F	10.0	
391	M	8.5	
392	M	10.5	
393	M	11.0	
394	M	9.5	
395	F	7.0	21 September
396	M	8.0	"
397	F	6.0	"
398	M	10.0	"
399	F	11.5	"
400	F	7.5	"

[a] Sex unknown.

APPENDIX B

Scientific staff engaged in northern fur seal research in 1984

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

Name	Affiliation	Assignment
Permanent		
Patrick Kozloff	NMML	Population Assessment
Hiroshi Kajimura	NMML	Population Assessment
Laurie L. Briggs	NMML	Population Assessment
Roger L. Gentry	NMML	Behavior and Biology
Michael E. Goebel	NMML	Behavior and Biology
Robert L. DeLong	NMML	Behavior and Biology
George A. Antonelis, Jr.	NMML	Behavior and Biology
Mark C. Keyes	NMML	Veterinary Medical Services
Thomas R. Loughlin	NMML	Pelagic Studies and Biology
Michael A. Perez	NMML	Pelagic Studies and Biology
Anne E. York	NMML	Population Dynamics
Temporary		
Wendy E. Roberts	NMML	Behavior and Biology
Susan Steinacher	NMML	Behavior and Biology
Leslie Slater	NMML	Behavior and Biology
John L. Bengtson	NMML	Population Assessment
Gerald G. Joyce	NMML	Population Assessment

APPENDIX B (Continued)

Name	Affiliation	Assignment
George Zacharof	NMML	Population Assessment
M. Robert Kochergin	NMML	Population Assessment
Alfey L. Hanson	NMML	Population Assessment
John Fratis	NMML	Population Assessment
Perfenia Pletnikoff, Jr.	NMML	Population Assessment
Charles A. Melovidov	NMML	Population Assessment
Anthony Philemonff	NMML	Population Assessment
John Borenin	NMML	Population Assessment
Lavrenty Stepetin	Tanadgusix Corp.	Population Assessment
Cooperators[a]		
Tom Cox	Natl. Park Serv.	Pup Tagging Project
Steven Jeffries	Wash. Dept. Game	Pup Tagging Project
Robin Brown	Oreg. Dept. Game	Pup Tagging Project
Douglas Skilling	Oreg. St. Univ., Corvallis	Pup Tagging Project
Gene Berry	Oreg. St. Univ., Corvallis	Pup Tagging Project
Jeff Barlow	Oreg. St. Univ., Corvallis	Pup Tagging Project
Norihisa Baba	Far Seas Fish. Res. Lab., Japan	Fur Seal Entanglement
Akira Furuta	Izu-Mito Sea Paradise, Japan	Fur Seal Entanglement

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