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MARINE MAMMAL REPORT

by

John J. Burns

Volume VI
Annual Project Segment Report
Federal Aid in Wildlife Restoration
Project W-6-R-5,6 Work Plan G-a

The subject matter contained within these reports is often fragmentary in nature and the findings may not be conclusive; consequently, permission to publish the contents is withheld pending permission of the Department of Fish and Game.

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-5,6 TITLE: Alaska Wildlife Investigation

WORK PLAN: G-a TITLE: Marine Mammal Studies

JOB NO.: 1 TITLE: Walrus Biology and Population Studies

PERIOD COVERED: January 1, 1964 to December 31, 1964

ABSTRACT

The major spring migration of walrus through Bering Strait occurred during the last week in May and the first week of June. This was at the same time as during previous years, in spite of an unusually slow retreat of the pack ice. The small sample of 41 adult females obtained during the spring of 1964 was composed of 64% parturient, 24% pregnant, and 12% barren females, closely approximating the composition observed since 1962. Twenty-nine known-age females were found to have been pregnant 98 times; an average of 3.4 times per individual. The parturition rate was found to be one calf each 2.02 years. The number of pregnancies per individual, and calves per year, was slightly higher in the 1964 sample than in previous samples: this is attributed to the small sample size in 1964, and to selective hunting in the main migration of reproductively active females. The consistent findings regarding age composition of the harvest, and the various over-all aspects of reproduction found during the last four years give every indication of a stable population.

RECOMMENDATIONS

The present regulation of no limit on adult bulls, and five subadult or adult cows per resident hunter should remain in effect. Efforts should be made to obtain specimens which would provide information about age composition and various aspects of reproduction in the female segment of the population apart from the main migration. If possible, a system for the exchange of current information between American and Soviet biologists should be initiated.

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JOB NO: 1 TITLE: Walrus Biology and Population Studies

PERIOD COVERED: January 1,1964 to December 31, 1964

OBJECTIVES

To investigate the important facets of walrus biology with special attention directed to determining age-specific birth rates, age and social organization of active breeders, and to identify and evaluate the biological variables contributing to the biased population samples presently being obtained. Other objectives include the acquistion of information concerning herd composition and distribution in the wintering areas; assessment of current techniques and the validity of present findings concerning productivity, population size and trend; evaluation of the effects of current harvests on the existing herds; and the accumulation of information regarding natural mortality. In addition, the areas used as hauling grounds within the territorial waters of Alaska will be surveyed when the opportunities arise.

PROCEDURES

Information about the magnitude and composition of the harvest was obtained by Department employees stationed at the most productive hunting sites when the majority of walrus were taken. This field activity also provided the opportunity to obtain most of the specimen material. Hunters saved the desired specimens, which were then collected at the conclusion of each hunt. At Little Diomede Island a Department observer was able to go along on many of the hunting forays.

Assistants helping with this project included Mr. Gary Lust who was stationed at Gambell during the spring hunting season, and Mr. Rex Thomas who worked on King Island during the same period. I worked at Little Diomede Island during May and June, and at Wainwright and Barrow during August. Fall field work (during November) was attempted on

St. Lawrence Island but proved unsuccessful because of unfavorable weather and ice conditions. However, this trip did provide some valuable information about the bearded seal (Erignathus barbatus) and the spotted or harbor seal (Phoca vitulina).

Data and specimens collected included body measurements, tusk measurements, weights (all obtained at Wainwright), notation of date, female reproductive tracts, and lower canine teeth.

The age of individual walrus was determined on the basis of the number of annual rings in the cementum layer of lower canine teeth. (Brooks, 1954; Fay, 1955, 1960, 1964; Harbo, 1961; Burns, 1963, 1964b). Reproductive history of individual females was obtained through examination of ovaries for corpora lutea and corpora albicantia. Reproductive history, correlated with age, provided additional information about breeding activity in females, the period between births, and the crude rate of increase.

Due to poor hunting conditions during the 1964 spring season, hunters took very few female walrus. Reproductive tracts and teeth were obtained from 41 adult females.

FINDINGS

Little information about winter distribution and activities of walrus was obtained, as the opportunity to get to the areas they occupied did not present itself. With respect to the acquisition and exchange of harvest information with Soviet biologists, two Soviet investigators have been directly contacted. These contacts are Dr. S. M. Uspenskii of the Moscow University Zoological Museum, and Mr. L. A. Popov of the Institute of Marine Fishery Management and Oceanology. So far, there has been no actual exchange of information.

Although this investigation segment produced little additional information with respect to rates of reproduction (the result of a small female harvest), significant facts relative to migration, segregation, foetal development body size, and growth rates, were obtained.

Migration

During late winter months the majority of walrus are usually found in association with the southern edge of the pack ice. In the central Bering Sea the southern terminus is usually somewhere between St. Lawrence and St. Matthew Islands, while in the eastern part of the sea the ice extends south along the Alaskan coast to Bristol Bay.

The position reached by the ice depends primarily on current and wind conditions, and to a lesser extent upon temperature.

In the Bering Sea area, the winter of 1963-64 was characterized by frequent and strong northerly winds, and cold temperatures. According to official weather records the average temperature during February, 1964, was colder than during any comparable period since 1930 (earlier records not available), with the execption of February 1954. Spring hunting activities in northern Bering Sea were greatly hampered because of extensive shore ice and heavy, close-packed sea ice.

The ocean currents during April, May and June are predominently from the south, and the movement of ice is generally northward. The first indication of the annual spring retreat of the pack ice is its shifting, and the formation of numerous small areas of open water.

During April, 1964, small leads were numerous but the ice was not moving north very rapidly. However, the walrus were moving with the prevailing spring current, passing the island hunting sites when conditions were such that hunters could not get to them.

It is commonly assumed that the greatest segment of the female and calf population perpetually occupies the area along the southern edge of the pack ice; and that their northward spring migration results from ice movement in that direction.

Occurrences during the past spring (1964) indicated an active migration (as opposed to passive movement on the ice) of all segments of the herd, as far north as conditions would permit. The large concentrations of cows and calves passed east of Little Diomede Island at the same time as during "normal" ice years (in the last week of May and the first week of June) even though heavy ice continued to pass north for another three weeks. Few walrus were observed after June 14.

My observations at Little Diomede Island indicated that most of the walrus passed through eastern Bering Strait. This was further substantiated by the absence of walrus near western St. Lawrence Island, and their abundance east of that island and in the vicinity of King Island.

During the summer ice along the coast did not move much further north than the village of Wainwright, and hunters from that site secured the largest harvest taken during this report period.

Segregation

Segregation between the two sexes and the various age groups has previously been recorded (Brooks, 1954; Fay, 1955; Burns, 1963, 1964 a,b). In an earlier report (Burns, 1964b), I commented on the fact that parturient females are most commonly found in the large compact herds migrating through the central Bering Strait area, while most of the pregnant and barren females are more loosely grouped and often travel closer to the coast. This was further substantiated by information obtained at Wainwright during August 1964.

As a result of the proximity of ice during August, hunters from Wainwright encountered large numbers of male walrus, relatively close to shore. A few females were also present but no calves were seen. Six adult cows were taken of which one was barren and five pregnant. Hunters from this village indicated that in some years cows are fairly abundant but calves are uncommon except after prolonged periods of strong west or northwest winds.

At the present time we have only fragmentary information about the harvest of walrus in Siberian waters. On the basis of information obtained in northern Alaska by Brooks (1954), as well as this writer, I think that when the Soviet harvest information becomes available, we will find the greatest segment of their reportedly sizable summer and fall kill composed primarily of adult males.

In recent years the adult walrus harvest in Alaska has been composed of between 65 and 70 per cent males. This composition is significant in view of the polygynous breeding habits of the walrus, as more females are being left to perpetuate the species.

Reproduction

Because of Department efforts to determine the magnitude and composition of the annual walrus harvests, and to enforce regulations concerning the killing of adult females (each hunter is allowed no more than five cows), field work has, through necessity, been conducted primarily during the productive spring hunting season at the villages responsible for the largest harvests. These villages, located on St. Lawrence, King and Little Diomede Islands, are centrally situated with respect to the spring migration of most of the cows and calves. As a result, we have been rather consistantly sampling the most important segment of the walrus population.

Examination of ovaries collected in the central Bering Sea-Bering Strait area during the 1964 spring season revealed that of the 41 females taken, 26 were parturient, ten pregnant, and five barren. Table 1 shows the condition of 254 females collected since 1962 (including the 1964 sample).

The reproductive performance of 29 females from which lower canine teeth, as well as ovaries, were obtained is presented in Table 2. These 29 cows were pregnant a total of 98 times; an average of 3.4 preganancies per individual. By comparison, there were 731 recorded preganancies in a combined sample of 227 known age females, taken during the 1961 through 1963 spring seasons (all taken in the Bering Strait area), for an average of 3.2 pregnancies per individual (Burns, 1964b).

Using six years as the average age of initial calf production, and assuming that 85 per cent of the conceptions result in live calves (Fay, 1964), the 29 females included in Table 2 bore calves an average of once each 2.02 years. Earlier findings (Burns, 1964b) showed a rate of one calf each 2.3 years. The slightly higher number of pregnancies per individual, and calves per year in the 1964 sample is attributed to the fact that the sample of females was small in 1964 and was obtained from the main migration of reproductively active animals. I think that the earlier figures are more correct for this relatively young segment of the herd.

Although the occurrence of twinning is established (Nukulin, 1954; Krylov, 1962) I have never observed a cow with two foetuses or calves (nor have other American researchers, apparently). I can only assume that the occurrence of twins is not common.

The similarities in reproductive condition (Table 1), age-specific reproductive performance (Table 2, and Table 3 of the 1964b report), average reproductive performance, and age composition exibited in samples collected since 1961, are indicative of valid sampling in a major segment of the population showing consistent rates of reproduction.

The small numbers of walrus encountered during the 1964 spring hunting season permitted accurate recording of the number of cows killed that were and were not accompanied by calves (except at King Island). Several earlier writers have commented on the close maternal bond between females and new-born calves. Seldom will one leave the other if danger threatens. When individual walrus or small groups are encountered this behaviour enables the observer to ascertain, in most cases, if a female is with or without a new-born calf. Older calves (one year or more) will more readily leave the company of their dams, and it is often not possible to recognize the mother-progeny

Table 1. Reproductive condition of 254 adult female walrus taken from 1962 through 1964 in the northern Bering Strait area

Year	N	Parturient		Pregnant		Barren	
1962	104	72	(69%)	21	(20%)	11	(11%)
1963	109	74	(68%)	25	(23%)	10	(9%)
1964	41	26	(64%)	10	(24%)	5	(12%)
Totals	254	172	(67.7%)	56	(22.1%)	26	(10.2%)

Table 2. Age composition and number of pregnancies observed in 29 female walrus taken during the spring of 1964 in the Bering Strait area

Age	N	Total Number of Pregnancies	Pregnancies For Age Class
6	1	1	1.00
7	3	5	1.67
8	1	2	2.00
9	4	7	1.75
10	4	10	2.50
11	0	--	--
12	3	9	3.00
13	1	4	4.00
14	3	14	4.66
15	5	24	4.80
16	3	17	5.66
17+	1	5	5.00
Totals	29	98	x= 3.37

relationships. Records of cows accompanied by new-born calves when killed, have been correlated with the results of ovary examination. The findings shed some additional light on the controversy raised primarily by Popov (1960), who states that cows bear young as often as three years in succession.

Of the 41 females taken during the spring of 1964, 26 were parturient and showed no sign of pregnancy or approaching ovulation. Of there, 22 were observed with new calves, two without calves (calf mortality?) and two were not identified as being with or without calves. In the ten females found to be pregnant none were accompanied by new born calves, precluding the possibility of calf production two years in succession, in this small sample. Occasionally pregnancy two years in succession does occur if a calf is born before or during the early part of the breeding season, or if prenatal mortality occurs (Fay, 1964; Burns 1964b).

I have concluded in an earlier report (Burns, op. cit.) that about 80 percent of the mature cows calve every two years, 15 per cent bear calves every third year, and the remainder less frequently. The proportion of cows that calve two years in succession is insignificant. These conclusions are based on the observed parturition rate of one calf each 2.3 years.

Foetal Development

Breeding (rutting) occurs from December to May with the peak of activity during February and March (Fay, 1960). The earliest recorded date of embryo implantation is June 10 (Kenyon, 1958), and the main period of implantation has been established as occuring between 15 June and 15 July (Brooks, 1954; Fay 1955, 1960; Burns, 1964b). Additional work will probably disclose a more restricted period of implantation as is the case with most other animals in which delayed implantation occurs (Asdell, 1946). The period of delay from breeding to implantation us usually around 2 1/2 months (Fay, 1964). Birth occurs principally during late April and early May, after approximately 10 months of actual foetal growth.

During August 1964 I examined five foetuses taken at Wainwright. They were acquired between 17 and 22 August, and ranged in weight from 440 to 575 g.

DISCUSSION

Brooks (1954) recognized that a restriction on the killing of female walrus was probably the most effective means of preventing a

possible decline in walrus numbers. Although it was thought that there would be considerable opposition to any restriction of hunting privileges, a regulation establishing a limit of seven adult female walrus per resident hunter, became effective on January 1, 1960. The present limit of five females per resident hunter was promulgated by the Alaska Board of Fish and Game in 1961. In spite of some initial resistance to this regulation, particularly by hunters at Little Diomede Island, it has been strictly adhered to.

During the four years a limit has been in effect, there has been a dramatic shift in the sex composition of the annual harvests. Recent harvests have been comprised of between 25 and 30 per cent cows, in contrast to a marked predominance of females in earlier harvests. The present acceptance of this regulation resulted from the realization by Eskimo hunters at King and Little Diomede Islands that they can not attempt to destroy this resource at the expense of Eskimos utitizing them in other areas of northwestern Alaska. Walrus ivory has lost some of its value as a result of large surpluses at Savoonga, Wainwright and Barrow.

The consistent findings regarding the various aspects of reproduction and the age composition of the harvest during the last four years indicate that during that short period of time there has been every indication of a stable population.

The age composition of the male segment of the harvest has remained the same since 1953, when sizable samples were first obtained by Brooks and Fay.

As yet we have no indication of the size and composition of the harvest by Siberian hunters. Until this information is obtained, the actual magnitude of the total annual kill of Pacific walrus can only be estimated.

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-R-5,6 TITLE: Alaska Wildlife Investigations

WORK PLAN: G-a TITLE: Marine Mammal Studies

JOB NO.: 2 TITLE: Walrus Harvest and Utilization

PERIOD COVERED: January 1, 1964 to December 31, 1964

ABSTRACT

The retrieved kill of walrus during the report period was calculated to be 975 to 1,040 animals. This harvest was composed of 69 per cent bulls, 25 per cent cows, and 6 per cent calves. Total kill was computed at between 2,061 and 2,215 walrus. The 1964 spring hunt in the northern Bering Sea-Bering Strait area was poor at most locations, while the summer hunt at Wainwright was unusually successful. However, this success did not extend to Barrow, a site where very few walrus were secured. Utilization of the retrieved harvest was good, ranging from 20 to 25 per cent at King Island to over 80 per cent at the other hunting locations including Little Diomede Island. Greatest potential value of the harvest was estimated at $206,025.

RECOMMENDATIONS

If at all possible, current information concerning the Soviet harvest of Pacific walrus, and the composition of the harvest should be obtained. The present regulation imposing a limit of five cows per resident hunter, and no limit on bulls, is adequate to supply the subsistance needs of hunters, particularly in the smaller villages. The present regulations should remain in effect.

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WORK PLAN: G-a TITLE: Marine Mammal Studies

JOB NO.: 2 TITLE: Walrus Harvest and Utilization

PERIOD COVERED: January 1, 1964 to December 31, 1964

OBJECTIVES

To determine the manitude, utilization, and value of the walrus harvest in Alaska.

PROCEDURES

The magnitude and utilization of the walrus harvest in western and northwestern Alaska were determined by a combination of methods including observation, recording of data by interested hunters, by personal interview, and through correspondence.

This job was conducted concurrently with jobs G-a1 and G-a3. Information concerning the sex and age composition of the harvest was acquired along with the biological data and specimens obtained. During the reporting period, Department personnel were at Northeast Cap, on St. Lawrence Island, during the latter part of October and the first part of November; Mr. Gary Lust, Department biologist, was at the village of Gambell from April 21 to June 19; and Mr. Rex Thomas was at King Island from April 19 to June 6. I was at Little Diomede from May 7 to June 27. In addition, Department personnel contracted hunters at the walrus hunting sites of Unalakleet, Nome, Wales, Shishmaref, Kivalina, Point Hope, and Barrow.

FINDINGS

During this report period several adversities of nature occurred which greatly affected the actual harvest of walrus, or the ultimate utilization of those that were taken. Spring hunting in the northern Bering Sea-Bering Strait region was extremely poor, as the result of

Table 1. Retrieved and Total Kill of Walrus in Alaska From January 1, 1964 to December 31, 1964

Location	Walrus Retrieved	Known Composition of Harvest: Males no.	Males %	Females no.	Females %	Calves no.	Calves %	Percent Hunting Loss	Total Kill
Kuskokwim Area	25	?	?	?	?	?	?	40	42
Norton Sound	8-10	6	75	2	25	0	0	30	11-14
Cambell	108-118	43	40**	29	27**	36	33**	30	154-169
Savoonga	238-248	169	71**	36	15**	33	14**	50	566-615
Northeast Cape	25	?	?	?	?	?	?	50	50
King Island	190-195	28	16	147	84	?	?	60***	475-487
Diomede Island	69-82	54	78	13	19	2	3	60	167-205
Wales	7	7	100	0	0	0	0	50	14
Kivalina	15-20	?	?	?	?	?	?	20	18-25
Point Hope	10-15	?	?	?	?	?	?	20	13-19
Icy Cape	30-40	27	90	3	10	0	0	50	60-80
Wainwright	225	203	90	22	10	0	0	50	450
Barrow	10	10	100	0	0	0	0	50	20
Other Areas*	15-20	?	?	?	?	?	?	20	21-25
Totals	975-1,040								2,061-2,215

*Includes eight walrus known to have been taken by Sport hunters.

**Composition of spring harvest only.

***Includes orphaned calves which apparently do not survive.

an unusually late spring break-up and close-packed, heavy ice. Walrus passed the normally productive hunting sites at a time when ice conditions precluded hunting activity. Conditions did not improve until after the main migration had passed. Consequently, the harvest was insufficient to supply the necessary quantities of meat, skins and ivory required by the inhabitants of several of the villages. The hunting season at Barrow (July and August) was not successful as heavy ice remained near the shore throughout the normally productive hunting period.

During the period 1 January 1964 to 31 December 1964, the total retrieved kill of walrus was between 975 and 1040 animals (Table 1). This is below the long term average annual harvest of approximately 1,300 walrus recorded by Collins (1940), and Brooks (1954). Approximately one-fifth of the retrieved kill was taken by hunters from the village of Wainwright, a hunting site where the harvest is usually much lower.

For the purposes of this report, the walrus hunting year is separated into four seasons. During each season the animals are available to hunters at different villages.

Winter Harvest

By the first part of January, the walrus herds in American waters have usually split up into two widely scattered groups. The central group winters south of St. Lawrence Island, and the eastern group is usually south of Nunivak Island and extends into Bristol Bay. The animals are not readily available to Alaskan hunters, and only scattered small herds or individual walrus are taken. During the winter of 1964 (January 1 to March 21) approximately 30 to 40 walrus were taken, mostly by hunters from St. Lawrence Island.

According to official weather records, the average temperature during February, 1964, was colder than during any February since 1930 (earlier records not available), with the exception of 1954. It is noteworthy that in the spring of 1954, as during the past spring, walrus hunting was very poor.

At the present time, little information concerning the location of the southern terminus of winter ice, or the areas in which the walrus wintered, is available. However, it is assumed that the severe winter conditions greatly affected the spring harvest of walrus as a result of heavy ice throughout northern Bering Sea, and because of extended areas of shore ice (land-fast ice) around the islands and along the mainland.

Spring Harvest

During most years, spring hunting normally produces the major segment of the annual harvest. It is the period when the island villagers replenish their stocks of meat for human and dog consumption, obtain skins for their boats, and ivory on which they are dependent as a source of income. Unfortunately, during this spring (1964) the hunting was very poor. The retrieved kill during April, May, and June was approximately 450 animals.

Savoonga, on St. Lawrence Island, was the most successful hunting site. Hunters from that village, utilizing 16 skin boats, took 178 walrus. This harvest was composed of 71 per cent adult bulls, 15 per cent cows, and 14 per cent calves. Table 2 presents the sex and relative age composition of the harvest, as well as a comparison with previous years.

Records kept by interested hunters indicated that the most productive hunting occurred between 14 May and 12 June. The number of walrus harvested was not adequate to supply the needs of the 390 inhabitants, and 650+ dogs, present in Savoonga.

At King Island, walrus hunting was accomplished with the aid of three small skin boats. Hunting success was slightly below average, although it was more than adequate to supply the necessary quantities of meat and hides required by the 35 inhabitants of that Island. This was the only site where head hunting occurred during the past spring. The harvest, most of which was taken between 2 June and 15 June, amounted to approximately 175 animals. Of the adult walrus harvested, 16 per cent were bulls and 84 per cent cows.

Hunters at both Gambell and Diomede experienced one of the poorest hunting seasons on record. At Gambell, 13 skin boats were employed, and 58 walrus were taken. Composition of this small harvest was 36 per cent adult bulls, 24per cent adult cows, 7 per cent sub-adults (sex ratio 3 males: 1 female), and 33 per cent calves (1:1 sex ratio).

At Diomede, the spring hunt produced only 27 adult walrus (76 per cent were males, 33 per cent females), and two calves. As at the other villages mentioned, walrus were in the vicinity of Diomede, occasionally in large concentrations, but conditions were unfavorable for hunting.

The spring hunt at other areas was also unproductive. As of June 27, 15 to 20 walrus were taken in the Kuskokwim area, four in Norton Sound, 20 to 25 at Northeast Cape, and two at Wales.

Table 2. Comparison of Known Sex and Age Composition of Walrus Taken In Alaska During the Spring Hunting Seasons of 1962, 1963 and 1964

Village	Males		Females		Calves		Males		Females		Calves		Males		Females		Calves	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Gambell	72	19	153	40	155	41	54	22	117	47	77	31	42	55	15	20	19	25
Savoonga	241	82	133	11	19	7	94	17	55	27	53	26	127	71	26	15	25	14
L. Diomede	136	53	104	41	15	6	133	62	85	29	26	9	18	62	9	31	2	7
King Island	-	-	-	-	-	-	-	-	-	-	_	_	29	16	144	79	10	5
Wales	-	-	-	-	-	-	-	-	-	-			2	100	0	0	0	0

Summer Harvest

The major segment of the walrus population passes northward through Bering Strait by the end of June. During July, August and early September they become available to hunters at Kivalina, Point Hope, Icy Cape, Wainwright and Barrow.

Heavy shore ice conditions were responsible for the small combined harvest of between 25 and 35 walrus at Kivalina and Point Hope. During August the southeastern edge of the pack ice remained in the vicinity of Wainwright, enabling the hunters at the village to secure an unusually good catch as walrus were available near the beach. Hunters at Wainwright took 225 walrus, approximately 95 per cent of which were bulls. Hunters from the small settlement at Icy Cape also benefited from the proximity of ice during August, and took between 30 and 40 walrus. Almost all of these animals were males.

Barrow remained ice bound almost all summer and the walrus harvest was very poor, only 10 animals being secured. However, the poor walrus season was more than compensated for as 10 or 12 whales (mostly California Grey Whales) were taken.

The total harvest of walrus taken during the summer hunting season at the points mentioned above was between 290 and 310 animals.

Fall Harvest

Few walrus were taken between September and late October as they were not available to Alaskan hunters. When the heavy ice moved south to the vicinity of northern Bering Sea, during November, walrus became more numerous in that area. From mid-November until the end of December walrus were available to hunters at Diomede, King, St. Lawrence and Nunivak Islands. The reported fall harvests were as follows; Little Diomede, 40 to 55; St. Lawrence Island, 135 to 155; King Island, 15 to 20; and in the other areas including Nunivak Island, 15 to 20 walrus. This constitutes a total fall harvest of from 205 to 250 animals. For some unexplained reason, the fall harvest (as the summer harvest farther north) was composed primarily of bulls. Informants at Gambell indicated that approximately 90 per cent of the animals taken near that village were adult males.

For the walrus hunting year as a whole (the report period covered), the total harvest was composed of 69 per cent males, 25 per cent females, and 6 per cent calves.

Hunting Effort

Information concerning the hunting effort expended, is available for only those sites at which Department personnel were stationed. Table 3 presents a comparison of the hunting effort and success at certain locations, during the past four spring hunting seasons. These data reflect the fact that the hunters became concerned as the 1964 spring season progressed and hunting success remained poor. Although they hunted whenever possible, much of their effort was expended after the walrus had passed, particularly in the Bering Strait area.

It is usually thought that the greatest concentrations of walrus are found in association with the southern edge of the pack ice. This was not the case during the past hunting season, as heavy ice continued to move north through Bering Strait for almost three weeks after the large concentrations of females and calves were observed.

Utilization

Meat was the primary objective of the summer walrus hunts at Barrow and Wainwright. Consequently there was no head-hunting, and the degree of utilization of the meat was high. In most areas, as hunting success increases, the extent of utilization decreases--hunters saving only the choice parts. However, at Barrow and Wainwright utilization remained high, amounting to between 75 and 85 per cent of the usable portions.

As a result of the poor harvests in the Bering Sea-Bering Strait region, utilization at all points, with the exception of King Island, was very high. At the villages on St. Lawrence Island (Gambell, Savoonga and Northeast Cape) it approached 90 per cent. Even at Little Diomede Island, one of the areas where head-hunting is a common practice, it approached 80 per cent. At King Island, 20 to 25 per cent of the usable meat and skins were saved. At other points where walrus were taken in limited numbers, utilization apparently approached 100 per cent.

Table 3. Comparative Hunting Effort and Success During the Spring Hunting Seasons of 1961, 1962, 1963 and 1964*

		Gambell	Diomede	Savoonga	King Island
No. Hunting Days	1961	13 of 35	18 of 26	----	----
	1962	19 of 33	8 of 16	11 of 28	----
	1963	14 of 20	11 of 37	----	----
	1964	27 of 48	21 of 51	----	13 of 48
Boat Hours	1961	910	399	----	----
	1962	947	140	537	----
	1963	810	320	----	----
	1964	1,714	502	----	199
Boat Hours Per Walrus Retrieved	1961	5.10	.75	----	----
	1962	4.62	.58	1.96	----
	1963	4.74	1.20	----	----
	1964	29.55	17.31	----	1.14

*Data include only those hours expended, and walrus taken while an observer was at the respective villages.

Implications Of the Poor Spring Harvest

The village of Gambell was probably the hardest hit as a result of the unproductive spring hunting season. Mr. Gary Lust, Department biologist stationed at that village, felt that the number of dogs (used as draft animals) would be greatly reduced unless there was an abundance of summer (California Grey) whales.

The number of female walrus hides obtained for boat coverings was also inadequate. Continuous hauling of boats across extensive, rough, shore ice damaged many of the coverings. More than half of the boats were reported in need of new skins. Due to the meat shortage, hides of the 14 female walrus taken were not prepared as boat coverings, but were cut and stored for food.

It can be expected that raw ivory will be in relatively short supply, especially to carvers in the Nome and Katzebue area. However, with a little coordination and planning on the part of persons supplying raw ivory, it can be purchased from villages such as Savoonga, Wainwright and Barrow, where there are few carvers and an abundant supply of ivory.

Value

Potential value of the walrus harvest during the report period covered, was calculated in the same manner as outlined in the 1963 Segment Completion Report (Burns, 1964). It is based on the following values set forth by Fay (1958), and Harbo (1961):

Tusks of adult females valued at $10.00 per pair.

Tusks of adult males valued at $24.00 per pair.

Tusks, carved, either sex, valued at $125.00 per pair.

Bacula valued at $7.00 each.

Walrus meat valued at $.10 per pound.

Skins of female walrus valued at $20.00 each.

The estimated values of the component parts of the walrus harvest are presented in Table 4. The total potential value of the harvest is calculated to have been $206,025.

Table 4. Potential Value of the Walrus Harvest Taken in Alaska Between January 1, 1964 and December 31, 1964

Location	Harvest			Value of Ivory					Greatest
	Males	Females	Calves	Raw	Carved	Bacula	Meat*	Skins	Pot. Value
Barrow	10	0	0	$ 240	$ 1,250	$ 70	$ 1,000	$ 0	$ 2,320
Diomede	54	13	2	$ 1,426	$ 8,375	$ 378	$ 6,192	$ 260	$ 15,205
Gambell	76	19	23	$ 2,014	$11,375	$ 532	$ 8,878	$ 330	$ 21,665
King Island	28	147	10	$ 2,142	$21,875	$ 196	$11,680	$ 2,940	$ 36,691
Savoonga	200	33	25	$ 5,130	$29,125	$ 1,400	$22,130	$ 660	$ 53,315
Wainwright	203	22	0	$ 5,092	$28,125	$ 1,421	$21,620	$ 440	$ 51,606
Other Area	99	11	?	$ 2,486	$13,750	$ 693	$10,560	$ 220	$ 25,223
Totals	670	245	60	$18,530	$114,375	$ 4,690	$82,060	$ 4,900	$206,025

*Utilizable weight is calculated on the basis of 1,000 pounds for adult males, 600 pounds for adult females and 65 pounds for calves.

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ADDENDUM

Due to a change in the period covered by the segment reports, there is a lapse in coverage from July 1, 1963 to December 31, 1963. The segment ending June 30, 1963 (W-6-R-4) has been reported, and the W-6-R-6 segment constitutes the main body of this report. Harvest information presented in the following discussion so for the period July 1, 1963 to December 31, 1963 and is the report for the W-6-R-5 segment.

During the summer of 1963 (July and August) hunting was unusually good at Wainwright and Barrow, and harvests of almost unprecedented magnitude were obtained. At Wainwright, the retrieved kill was between 300 and 350 animals, of which approximately 85 per cent were adult males. The harvest at Barrow was estimated at 350 animals, 85 to 90 per cent of which were bulls (Woldstad; Hopson; and Brower, pers. Corres.).

As the early fall migration of walrus progressed, they were not generally available to Alaskan hunters, and very few were taken. It was not until the heavy ice with which the walrus were associated, reached the northern Bering Sea area (in late November) that hunters from Diomede, King and St. Lawrence Islands had successful hunting. The harvest of walrus during December amounted to between 160 and 200 animals, most of which were taken by hunters from St. Lawrence Island. The fall and early winter harvest consisted primarily of adult males.

For the period between July 1 and December 31, 1963 the total retrieved harvest of walrus was estimated to be between 810 and 900 animals. Of this harvest, 85 per cent (690-765) were adult males. The remainder were cows and sub-adults of both sexes. The hunters at Wainwright do not utilize the calves, and I have not seen one that was brought into the village.

Hunting loss approximated 50 per cent, (it may be slightly higher during the late fall when ice conditions are unfavorable) and the total kill of walrus during this period was between 1,620 and 1,800 animals.

SUBMITTED BY:

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-6-R-5,6 TITLE: Alaska Wildlife Investigations

WORK PLAN: G-a TITLE: Marine Mammal Studies

JOB NO: 3 TITLE: Seal Biology and Harvest Studies

PERIOD COVERED: January 1, 1964 to December 31,1964

ABSTRACT

Observations of, and specimens from bearded seals were taken starting in 1962. Hunting effort devoted to the harvesting of these seals during the spring is dependent upon the abundance and availability of walrus. The spring of 1964 was a poor walrus hunting season, and more bearded seals were taken than usual Specimens and data taken from these seals included body weights and measurements, notation of date and location of kill, reproductive tracts, skulls (or lower jaws), and claws. Reproductively active seals taken by Alaskan hunters average about 91 in. in zoological length (range--84 to 104 in.), and summer weights have been recorded up to 610 pounds. Large animals in winter fat condition weigh over 700 pounds. The peak period of delayed implantation is from 2 1/2 to 3 1/2 months the embryo becoming implanted around the first part of August. Birth usually takes place during the last part of April, after a gestation period of about 12 months. Lengths of term foetuses were recorded as ranging from 124.5 to 139.7 cm; and weights from 31.3 to 38.6 kg. The nursing period is short, lasting from 12 to 18 days. By the time they are weaned, pups have attained approximately 69 per cent (63 in.) of their adult length. Little or no weight increase occurs during the first several months of independent life. Migration is generally concurrent with the seasonal advance and retreat of the pack ice, although young seals are sometimes found where there is no ice. The retrieved kill of bearded seals in Alaska is approximately 3,000 animals per year, with a total kill of around 6,000.

RECOMMENDATIONS

The present regulations of no closed season and no limit should be continued with respect to bearded seals. The bounty paid for seals, as a welfare program, should be re-evaluated in light of the commercial value of these animals.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-6-R-5,6 TITLE: Alaska Wildlife Investigations

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JOB NO: 3 TITLE: Seal Biology and Harvest Studies

PERIOD COVERED: January 1, 1964 to December 31, 1964

OBJECTIVES

The objectives of the present study were to determine the magnitude, characteristics and value of the harvest of hair seals in Alaska; determine the factors affecting seasonal movements, abundance and distribution of the bearded seal (Erignathus barbatus), and the age and sex composition of the harvest; obtain information concerning reproduction in the bearded and ribbon seal (Histriophoca fascita); and to obtain specimen material from ringed (Pusa hispida) and spotted (Phoca vitulina) seals, the investigations of which are being conducted by other personnel.

Data presented in this report are primarily about the bearded seal; and the aspects of life-history presented are those from which meaningful conclusions can be drawn without requiring the acquisition of too much additional information. A more complete report will be forthcoming when the specimen analysis is completed, and additional necessary information is obtained.

INTRODUCTION

The bearded seal (Erignathus barbatus) is an "earless seal" belonging to the family Phocidae. It is an almost completely aquatic seal which rarely frequents land, and only seasonally hauls out on the ice. These seals are usually sparcely distributed throughout their circumpolar range, although large concentrations are occasionally observed. Scheffer (1958) indicates that they are "...more or less resident, moving casually and not in regular migration." However, the majority of bearded seals in the Bering and Chukchi Seas move with the seasonally advancing and retreating ice, thus migrating north each spring and south each fall. Some animals apparently do not migrate.

These include a few juveniles which remain along the coast after the ice is gone, occasionally frequenting bays, brackish water estuaries and river mouths. Also, seals remaining in the northern Chukchi Sea and Arctic Ocean do not have to move very far to remain near ice.

There are two subspecies of bearded seals recognized in the literature. These are E. b. barbatus (occuring in the eastern Arctic and sub-arctic), whose range is considered to include the suitable habitat from the Laptev Sea westward to the central Canadian Arctic Archipelago; and E. b. nauticus (occuring in the western Arctic and sub-arctic), which occurs from the central Canadian-Arctic Archipelago westward to the Laptev Sea (Scheffer, 1958). The eastern and western limits of distribution for the two subspecies are very uncertain, and in actuality probably do not exist. At the presently recognized western limit (Laptev Sea) there is no barrier to the movement of bearded seals in either direction. As Scheffer (loc. cit.) indicates, in spite of the close relationship between the two forms it is probably desirable at this time to retain the separate names because of their firm establishment in systematic literature.

The bearded seal (Eskimo terms--mukluk, or oogruk) is the largest of the phocid seals inhabiting the northern Bering-Chukchi Sea area. These seals have always been inportant in the subsistence economy of the coastal dwelling Eskimos, and continue to play an important role in the comparatively new subsistence-wage earning economy of the present day. In addition to supplying food and raw material for the home manufacture of such items as rope, boot soles, boat coverings and harnesses, the raw pelts now have a commercial value. In Alaska the commercial value of seal skins has greatly increased, especially since 1962. Skins of young bearded seals which had little or no commercial value prior to 1962 are now worth as much as $25.00. The number of seal scalps submitted to the State of Alaska for bounty has greatly increased, indicating increased hunting effort by Alaskans. Soviet hunters from eastern Siberia are also taking advantage of the presently high prices, and have increased their hunting effort on this commonly shared resource.

At present there is little information available concerning the various aspects of bearded seal life history, and nothing which would indicate the possible effects of increased exploitation. Rational exploitation of these seals for commercial purposes, and to feed a rapidly increasing human population, demands that particular aspects of the biology of these seals be clearly understood.

Starting in 1962, the Alaska Department of Fish and Game initiated a study of bearded seals with the objectives of finding out the magnitude of the harvest, determining the factors affecting abundance, distrubution

and seasonal movements, and to add to the present body of knowledge concerning rates and physiology of reproduction. Where applicable, comparisons were made with the findings of studies from other areas.

The field work was conducted concurrently with investigations of other marine mammals, particularly of the Pacific walrus. The most productive hunting period for both walrus and bearded seals is during the spring and summer (April through August) when boats can be employed. The productive hunting period is progressively later at the more northerly hunting sites. The number of bearded seals taken by hunters is directly affected by the abundance and availability of walrus. When walrus are not available, or the harvest is insufficient to supply the needs of hunters, more effort is devoted to the taking of bearded seals. If walrus are available, little effort is made to take the seals.

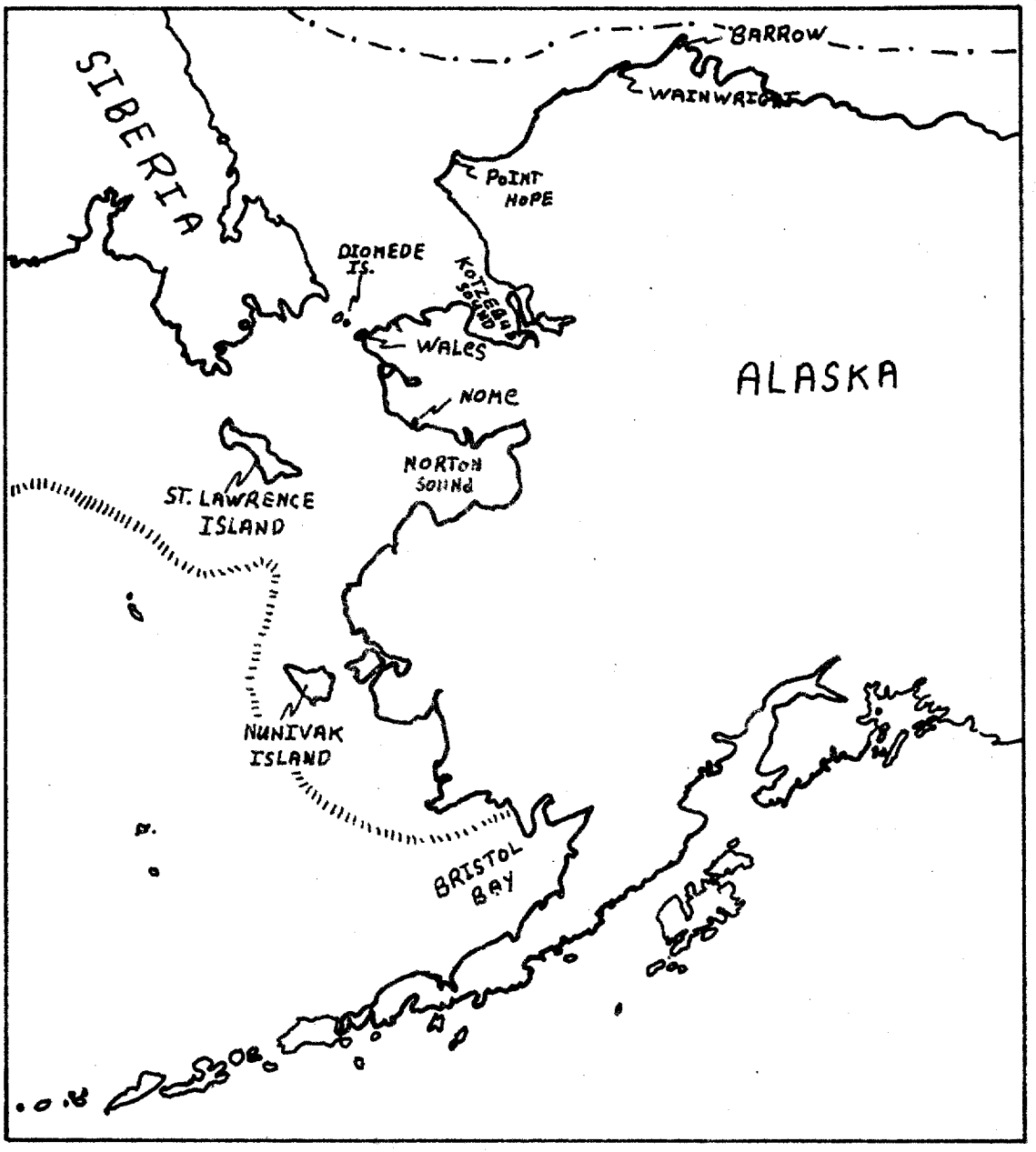
During the spring hunting seasons of 1962 and 1963, walrus were sufficiently available to hunters, and they did not take bearded seals in any large numbers. However, the 1964 spring season was very poor as far as walrus hunting was concerned. In an attempt to fulfill their requirements for seal skins, food, and oil, the hunters at several villages turned to the hunting of bearded seals. It was during the spring and summer of 1964 that much of the material for this report was obtained.

Methods and Materials

During the spring and early summer, field work was carried out at several widely scattered villages, most of which are in the northern Bering Sea-Bering Strait area. These villages include Gambell, Savoonga and Northeast Cape, all of which are on St. Lawrence Island; King Island, Little Diomede Island, Wales and Nome. During August 1964, work was conducted in northern Alaska at the villages of Wainwright and Barrow. Fig. 1 shows the location of sites where field work was conducted, as well as the distribution of bearded seals.

Temporary field assistants were employed during the brief spring hunting seasons. Although their primary function was to aid in walrus investigations, the field assistants collected as much material from bearded seals as time and conditions allowed. Temporary personnel that substantially contributed to these studies include: Mr. Richard Bishop who worked at Gambell in 1962; Mr. Stuart Marks who worked at Savoonga during that same year; Messrs. Peter Dzikiewicz and Jude Henzler, both of whom worked at Gambell during 1963; Mr. Gary Lust who was at Gambell during 1964, and Mr. Rex Thomas who worked at King Island during the same year.

Fig. 1. Location map showing position of some of major hunting sites, the southern limit of the effective winter range of bearded seals (IIIIIII), and the limit of effective summer range (—·—).



Spring and summer field work at Northeast Cape, Nome, Wales, Little Diomede Island, Wainwright and Barrow was done by the writer. Field work during the fall and winter, primarily accomplished at St. Lawrence Island and in the vicinity of Nome, was also done by this writer.

The Eskimo hunters at all of the villages mentioned, also played a mojor role by supplying specimens as well as time and effort.

As far as possible, field work was done throughout the year. Unfortunately, a suitable series of specimens from late fall and winter caught seals has yet to be obtained.

Weather and ice conditions, as well as differences in the way seals are handled by hunters from the various villages, determine how much information can be obtained from the seals that are killed. Hunters in the Bering Strait area usually butcher the bearded seals at or near the place where they are killed, making it impossible to obtain weights and measurements. When working at the hunting sites in this area, we supplied members of each boat crew with lables and plastic bags. While butchering animals, one of the crew members would save the specimens we desired. These specimens included reproductive tracts, skulls, claws and notation of date and sex. This procedure proved very successful, and a large sample of reproductive tracts was obtained.

At Little Diomede Island, the hunting crews are larger than at the other hunting sites (larger boats are employed), and the total number of boat crews is much smaller. During the past several years only three large skin boats have been used during the spring hunts. During 1963 and 1964, one member of each crew volunteered to take measurements as well as collect specimens from the bearded seals.

Most of the body measurements taken were those outlined by McLaren (1958b). However, there were some additions, and a few minor changes. The measurements used in this study are as follows:

Zoological length-measured over curvature of body from tip of nose to end of tail, with head and neck in a natural position.

Standard length-measured along a straight line on a flat surface, from tip of nose to end of tail with head and neck in a natural position.

Tail length-measured from the externally visible base of the tail to the end of the tail.

Girth-taken around the body immediately behind the foreflippers.

Auxiliary Girth-the largest circumference around the abdomen. This measurement usually exceeded girth.

Navel to anus-the distance along the curvature of the body from the center of the umbilical scar to the anterior notch of the anus in males, and to the vestibule of the female.

Penis to anus-measured along body contour from the center of the penile orifice to the anterior notch of the anus.

Foreflipper length-the distance along the anterior border of the forelimb, from axilla to tip of longest digit (not claw).

Foreflipper width- the straight line distance from the tips of the first and last digits (not claws) of the spread flipper.

Hindflipper length-measured from the level of the astragalus bone, along the inner edge of the extended flipper, to the level of the longest digit.

Hindflipper width-the straight line distance from the tips of the first and last digits (not claws) of the spread flipper.

Weight-taken with a 500 or a 2,000 lb. capacity scale.

Measurements of the same animal, taken by different persons often varied widely. For this reason, hunters were requested to furnish only the zollogical length and girth of the seals they killed. These measurements did not vary appreciably when several people measured the same animal. Tables showing the complete series of measurements are composed solely of the author's data.

The acquistion of a series of body weights and measurements has proven hard to obtain at most hunting sites. At one village (Wainright) circumstances were such that it was possible to obtain the data desired. At Wainwright, the most productive hunting period is during July and August. The extensive shore ice has usually moved off, allowing the hunters to bring the large seals (and walrus) to the beach with little trouble. These animals were weighed using a tractor equipped with a hydraulic lift, or a small Caterpillar crane.

Field numbers used by this writer are a combination of letters and numerals indicating the location, number of the animal and year of capture. Thus, W-10-64 would designate specimen number 10, collected at Wainwright in 1964. Vital information including the date of capture was recorded on field data forms. This method proved very satisfactory as work was conducted at only a few sites, during successive years.

Examples of field numbers used are as follows:

N-00-62, Nome

G-00-62, Gambell

S-00-62, Savoonga

NC-00-62, Northeast Cape

KI-00-62, King Island

D-00-62, Diomede

WL-00-62, Wales

W-00-64, Wainwright

B-00-64, Barrow

The digits of the foreflippers were allowed to rot, and the claws extracted (as suggested by McLaren, 1958b). Reproductive materials, except bacula, were preserved in 10 per cent formalin. Skulls and lower jaws were cleaned by Dermestes beetles.

To date, the specimen material collected has been only partially processed in that the more exacting examinations of such things as embryological development, histological examination of ovarian and testicular changes, and a morphometric analysis of skulls has yet to be completed.

The analyses discussed in this segment report consist of weights and measurements (length and width) of testicles, weights and lengths of bacula, weights of ovaries and body measurements. After being weighed, ovaries were sectioned, using a scalpel, into sections 1-2mm in thickness. The size, position and number of corpora lutea, and or Corpora albicantia were recorded and diagramed on individual cards.

Age correlations are not included as some of the specimen material (claws) has yet to be examined, and the remainder has been sent to Dr. Ian McLaren of McGill University in an attempt to check the validity of my findings. This information will be included in the next segment report.

FINDINGS

As mentioned in the previous section, the kind and amounts of data which can be acquired from seals taken at the various hunting sites depends upon several factors including shore ice conditions and traditional hunting procedures. The productivity of field work is also dependent upon the season of the year. Climatic conditions are most severe during winter and early fall, often curtailing the Eskimos' hunting activity. Coupled with this is the fact that bearded seals are more sparsely distributed, and harder to obtain during this period. Often the hunters (and biologists) are reluctant and sometimes unable to record data, and to save the heavier specimens which often have to be carried long distances over moving ice. The great inconvenience imposed by low temperatures (often below-20°F) and high wind also tends to discourage the efficient processing of material from the larger seals. As a result, data and specimens acquired during the winter and early spring are limited. However, more effort is presently being devoted to the acquisition of material during this period in order to insure more accurate and complete knowledge of the ecology and life history of these animals.

Some of the results of previous investigations, particularly those of Soviet biologists, were not found to be in agreement with my findings. This is particularly true with respect to certain aspects of reproduction. These diversities of opinion will be discussed in their proper context.

To date, the most complete review of growth and reproduction of the bearded seal was presented by McLaren (1958a).

Body Size

The length which adult bearded seals attain is fairly well known at a result of studies by McLaren (op. cit.), Johnson, et. al.(1962), and Kenyon (1962). McLaren (op. cit., p. 220) graphically presents the lengths of 59 seals, and states that the average length of 25 full grown adults is about 235 cm. (92.5 in.). My studies indicate that length (from nose to tail along a straight line) is approximatly 8 to 10 per cent less than zoological length. This would mean that the average zoological length of adult seals in the eastern Canadian Arctic is approximately 101 in.

Both Johnson, et. al. (op. cit.) and Kenyon (op. cit.) worked with small samples of seals which were from Alaska. Johnson stated that the average length of an unspecified number of seals was 87.6 in. The data of Kenyon (Table 5, p. 383) shows the average length of four adults to be 211.1 cm (83.1 in.). Converted to zoological length these would be

be 95.5 in. and 90.6 in., respectively.

The average zoological length of 85 reproductively active seals which I measured was 91 in. (range--84-104 in.). The indicated difference in size between Canadian and Alaskan seals probably does not really exist. McLaren's (op. cit.) findings were based upon recorded lengths of full-grown seals (9+ years of age), whereas bearded seals often begin reproducing before completing their growth.

Information concerning the weights of bearded seals is almost non-existent in the scientific literature. Kenyon (op. cit.) recorded the weights of six adult seals taken during late May. Four of these were weighed intact; the weights ranging from 460 to 527 pounds (X=486).

During August 1964, I was able to obtain weights of 24 seals. Of these, 11 were adults the weights of which ranged from 435 to 610 pounds (X-503). During August, as in late May, the seals are still in a relatively lean conditions due to the thin layer of blubber. Observation of the condition of large seals during January and February indicates that some of them most certainly weigh in excess of 700 pounds.

Figure 2 shows the correlation between zoological length and weight of 31 seals taken during late spring and summer.

The morphometric analysis of skulls acquired during this study has not yet been completed, and will be reported upon at a latter date.

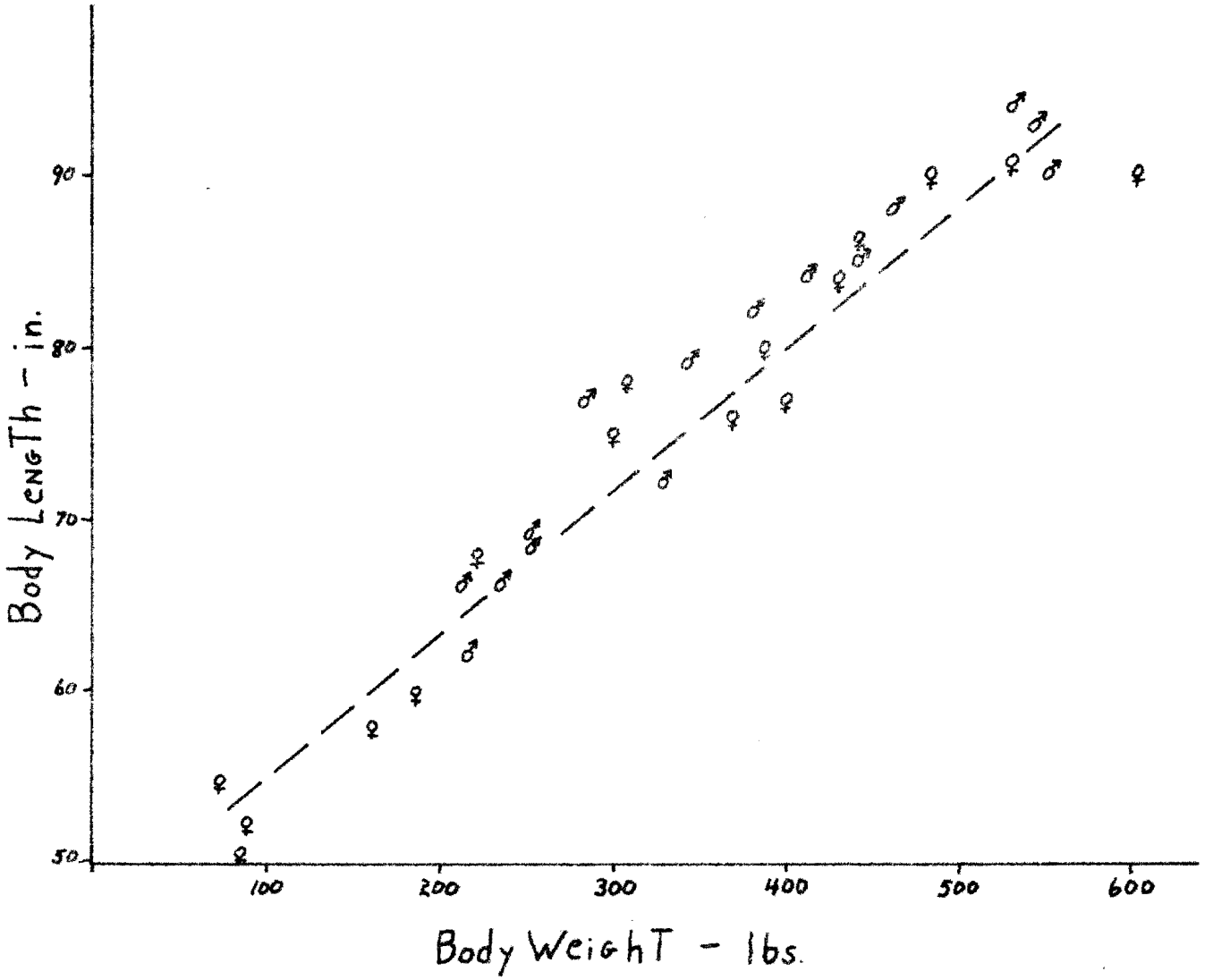
Reproduction

To begin a discussion of reproduction it is probably most desirable to confirm the period during which the breeding or rutting season occurs. There has been some difference of opinion regarding this point, particularly among the Soviet investigators. Thus, although Chapsky (1938) acknowledged the occurrence of delayed implantation in bearded seals, Sleptsov (1949) indicated that a period of latent or arrested embryonic growth did not actually occur. As a result his conclusions concerning the breeding and gestation periods are in error.

McLaren (1958a) reviewed Sleptsov's conclusions in light of his own findings, and determine that, "The males are going out of rut in June, and are probably most potent in Mid-May." Unfortunately he had no material from adult male seals taken during April or early May.

Specimens collected from the Bering Strait region during April and May indicate that the peak period of breeding activity occurs from

Fig. 2. Correlation between length and weight in 31 bearded seals of both sexes, taken during June, July and August.



mid-April to mid-May with animals of both sexes occasionally remaining potent until at least late June. Female seals ovulating for the first time, often do so long after the normal breeding period. This was also found to be true in the ringed seal, (McLaren, 1958b), and the northern fur seal (Craig, 1964).

My conclusions regarding time of the normal breeding period are based on the occurrence of recently impregnated females as early as 13 April, and of animals which has previously been pregnant, and contained mature follicles as late as 23 May. Two such females taken on the latter date contained follicles which in one case was 27 x 18 mm and in the other, 18 x 13 mm. It was only in the ovaries of young females, ovulating for the first time, that follicles larger than 11 mm occurred after 23 May. Ovaries of one such female contained an 11 x 7 mm follicle when taken on 20 June. My sample consisted of 69 reproductively active females.

Ovarian Development

For the purposes of this report, ovarian development and breeding activity are correlated with body length. At a later date this information will be correlated with the age of seals. The sample under discussion consists of 102 animals from which the ovaries were obtained. Two of these were term foetuses. Zoological length was recorded from 31 of these seals.

Harrison and Matthews (1949) have commented on the observed activity in the genitalia of late foetal and new-born female seals; partially attributing this activity to the production of progesterone and estrogen by the placenta after the corpus luteum ceases its secretory function. Craig (1964) noted similiar actvity in late foetal female fur seals. Ovaries of the two term foetuses in my sample also demonstrated a high degree of activity, as did those of several new-born pups. Weights of the foetal ovaries were in one case the same, and in another much greater than those observed in mature females. Ovary weight decreases rapidly after birth.

The ovary weights (both ovaries combined) of sexually immature seals, excluding foetal and new-born animals, remain more or less constant until just prior to the onset of breeding activity. Ovary weights of these animals are usually between 4 and 4 g. This rapidly increases to between 6 and 10 grams at the time of first ovulation. Zoological length of the smallest female which was pregnant for the first time was 213.4 cm (84 in.). Hence it can be concluded that females begin breeding after attaining at least 92 per cent of the average length at physical maturity. This closely coincides with the findings of McLaren (op. cit.).

Ovary weight continues to increase throughout the reproductive life of the animal. The increase is caused by continued follicular activity and formation of Corpora lutea and Corpora albicantia with each successive pregnancy. Bearded seals apparently remain reproductively active throughout their life span (judged to be about 18 to 20 years), as no "senile" ovaries, containing neither a Corpus lutem nor maturing follicles, are included in my sample.

Implantation and Foetal Development

Specimens acquired at Wainwright during August 1964 show that in Alaska, most bearded seal embryos are implanted over a relatively short period of time, extending from about 28 July to 10 August. This indicates a delay in development of from 2 1/2 to 3 1/2 months.

Delayed implantation occurs in other groups of animals, particularly the Mustelidae. Photoperiod directly effects the duration of the dormant period, suggesting that activation of the pituitary gland is involved (Asdell, 1946). Variation in the gestation period, within the same species of animal, is the result of differences in the duration of arrested development. Thus, despite variation in the time of breeding, date of implantation, and whelping are more closely grouped.

Occasionally in young seals pregnant for the first time, implantation occurs later than normal. This was the situation I observed in two cases. McLaren (1958a) recards an estreme case of a foetus 2.5 mm long, taken on September 17. He gives no information regarding age of the female from which it was recovered.

There is no way of foretelling the fate of these tardy foetuses, but it is likely that they are at a disadvantage from the standpoint of natural selection. If these late foetuses survive and are born during the usual birth period, they would be decidedly smaller than normally developing pups. On the other hand, if the duration of foetal development were normal the pups would be born much later, possible at a time when conditions were less favorable for survival.

Six foetuses recovered from females taken between 5 and 18 August 1964, ranged in size from 0.35 to 2.40 cm (see Table 1). A newly implanted foetus was collected on 8 August. In addition, a female which had recently lost its foetus (abortion or resorption) was taken on 22 August. In this animal, the still-ovious zone of former uterine attachment was slightly larger than in the female taken on 18 August. The uterine horn that had supported the foetus contained much dark congealed blood.

Table 1. Zoological Length of Bearded Seal Foetuses Collected From July Through May

Date	Location	Length (cm)	Weight (kg)
29 July	Northern Foxe Basin, Canada[1].	new implanted	-
5 Aug.	Wainwright, Alaska	0.35	-
5 Aug.	Wainwright, Alaska	1.0	-
6 Aug.	Wainwright, Alaska	2.1	-
8 Aug.	Wainwright, Alaska	1.6	-
8 Aug.	Wainwright, Alaska	Newly implanted	-
10 Aug.	Wainwright, Alaska	2.4	-
22 Aug.	Southwest Baffin Is., Canada[1].	1.45	-
28 Aug.	Northern Foxe Basin, Canada[1].	12.0	-
29 Aug.	Southampton Is., Canada[1].	10.9	-
2 Sept.	Ungava Bay, Canada[1].	11.4	-
17 Sept.	Northern Foxe Basin, Canada[1].	0.25	-
20 Sept.	Southampton Is., Canada[1].	22.2	-
21 Sept.	Northern Foxe Basin, Canada[1].	8.6	-
28 Oct.	Nome, Alaska	51.5	1.92
29 Oct.	Northern Foxe Basin, Canada[1].	24.0	-
24 Nov.	Wainwright, Alaska	37.3	1.28
25 Nov.	Nome, Alaska	53.4	2.16
28 Nov.	Nome, Alaska	54.0	3.57
8 Dec.	Nome, Alaska	65.4	4.99
20 April	Gambell, Alaska	134.7	38.6
20 April	Gambell, Alaska	125.8*	36.3
24 April	Gambell, Alaska	139.7	34.0
24 April	Gambell, Alaska	124.5	31.3
4 May	Point Hope, Alaska[2].	127.5*	30.4
6 May	Gambell, Alaska	138.4	33.1
6 May	Gambell, Alaska	135.9*	-
6 May	Gambell, Alaska	142.3*	-

[1]Data from McLaren, 1958a, p. 225.
[2]Data from Johnson, et. al., 1962.
*Indicates new-born calves. Data included for comparison.

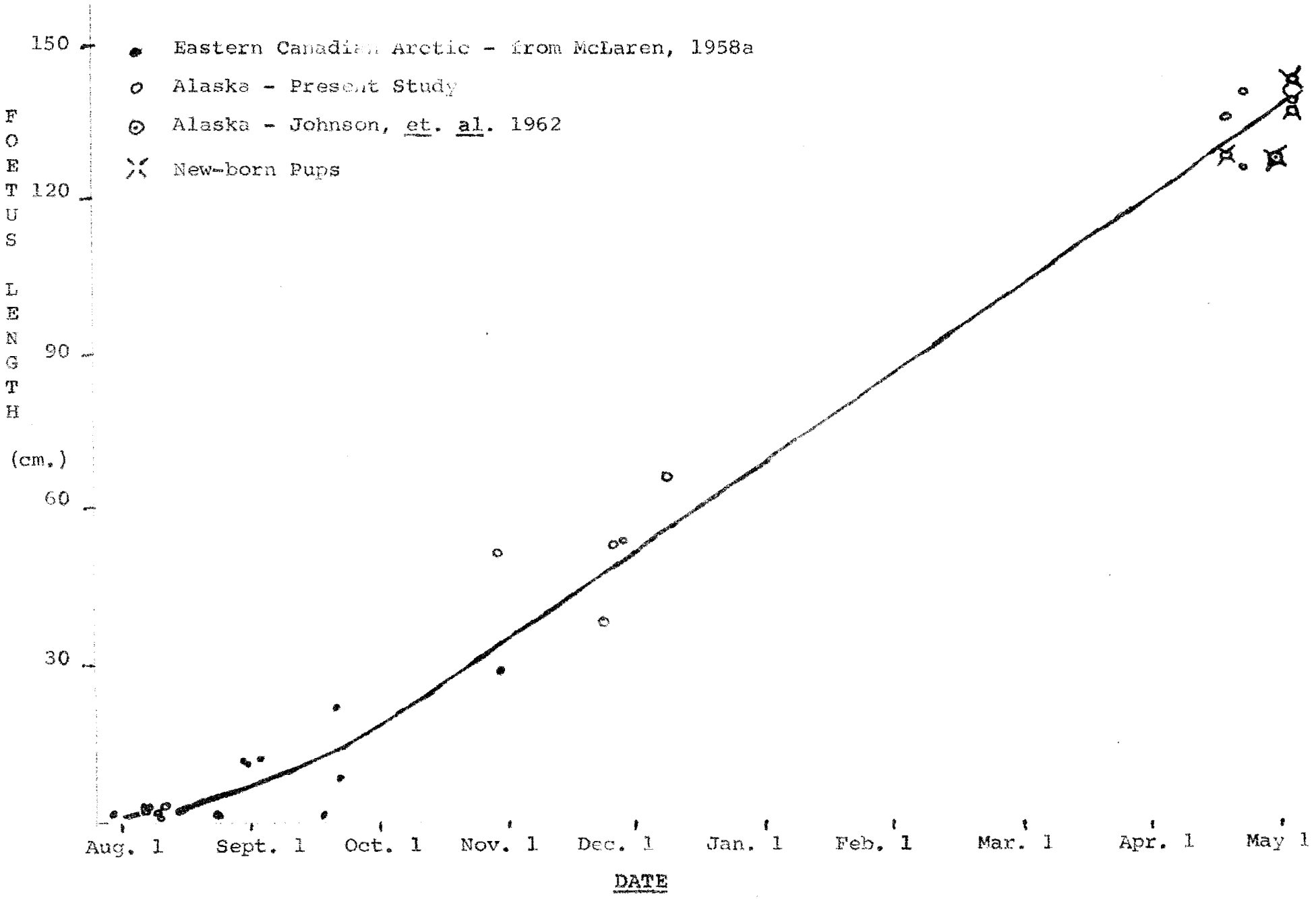


Fig. 3. Growth of bearded seal foetuses.

Comparison of data concerning the period of implantation, foetal development, birth dates, and size of new-born pups, from both Alaska and the eastern Canadian Arctic (the latter information reported by McLaren op. cit.) indicates that development is similar in both E. b. nauticus, and E. b. barbatus. Table 1 shows the size of foetuses at different times during the gestation period (subsequent to implantation), and incorporates data from Alaska and the eastern Canadian Arctic. Figure 3 graphically illustrates the progressive development of foetuses.

Four full-term foetuses taken by hunters at Gambell ranged in length from 124.5 cm to 139.7 cm, and in weight from 31.3 to 38.6 kg. A term foetus recovered from a seal taken at Point Hope was reported by Johnson et. al. (1962) to be 131.0 cm long, and to weigh 74 pounds (33.6kg). The date this specimen was collected was not given. Two pups, taken with their mothers on 6 May, at Gambell, had lengths of 135.9 and 142.3 cm. The weights of these young seals were not recorded. McLaren (1958a) records the straight line length of a new-born pup as being 119.5 cm. This would be about 138 when converted to zoological length.

The normal birth period is relatively short, occuring during late April and early May (see Table 1, and Fig. 4). The average birth date is probably around April 26. The pacific walrus also calves most commonly during late April and May.

At the present time we have little factual information upon which to base conclusions concerning advantages of the late April-early May birth period. However, there are some rather obvious environmental conditions which I feel are selectively advantageous.

By late April, the seasonal retreat of the pack ice is well under way. Although the ice may not be moving rapidly, it is usually broken up and areas of open water are numerous. Seals with young are not forced to swim long distances under closely packed ice. The ice still affords protection from high winds by preventing the sea from becoming rough.

Bearded seal pups nurse for a short period of time (refer to following section). During the first few months after they gain independence, weather conditions are comparatively good. Seals of all ages can be seen basking on the ice. Little is known as to whether this basking is a physiologically required actvity, but May, June and usually July are the months when the seals (including the other species of phocids found in Alaska) spend considerable periods of time on top of the ice.

The Pup

New-born pups are similar in color to term foetuses. Three new born pups which I saw swimming with their mothers, appeared to be a chocolate brown. The partially dried hair of a dead pup was lighter, approaching a brownish-grey. By the time pups are weaned the pelage becomes considerable lighter in color. The sides and underparts of weaned pups are usually silver-grey, while the back is a darker bluish-grey. The hairs are 10-15 mm long, softer and more dense than those of adults. It is the hides of these first-year pups that are in commercial demand.

Pups are able to swim as soon as they are born, and the Eskimo hunters indicate that they are even born in the water. I have no observations of pups being born.

No recorded information is available concerning the length of time during which the pup is dependent upon its mother. The latest date on which a pup was observed in association with an adult female, at either Gambell, Savoonga, King Island or Little Diomede Island, since 1962, was on May 10. Dr. Francis Fay (pers, corres.) states that he has observed a pup and mother on 17 May. I think that the nursing period in bearded seals is relatively short, probably between 12 and 18 days. This conclusion is supported by several facts. The birth period occurs mainly between about 20 April and 5 May (average 26 April). Independent pups of the year are observed as early as 30 April, and are common after the first week of May. Another phocid, the harp seal (Pagophilus groenlandicus), has a relatively brief nursing period of 10-12 days (Sivertsen, 1941).

A further indication of a contracted period of dependence is the relatively large size of pups, at birth. This, in combination with the rapid growth rate common in seals (verified in bearded seal pups by their size during late April and Early May), enables them to become quite large in a very short period of time. By the time they are weaned, pups have attained approximately 69 per cent of their adult length.

It appears from examination of Table 2, that the size of seal pups at the time of birth (percentage of adult weight) may be loosely correlated with the length of the nursing period. Most of the pinnipeds have a nursing period of rather devinite duration (i.e. Weddell seal--Mansfield, 1958; elephant seal--Laws, 1953; harp seal--Sivertsen, 1941; monk seal--Kenyon and Rice, 1959; walrus--Brooks, 1953, Fay, 1955, Burns 1964). The nursing period in the ringed seal varies, usually ending when the birth lair is destroyed (except at very high latitudes: McLaren, 1958b). In the vicinity of Nome, the nursing period of the ringed seal is from 4 to 6 weeks.

Table. 2. Comparison of Birth Weights, Weights When Weaned, Adult Weights, Duration of Nursing Period, and Growth Increment of the Pups of Several Pinnipeds.

Species	Weight at Birth (lbs)	Wt. When Weaned lbs	Adult Wt. Female lbs	Comparative Weight of Pup (%) At Birth	When Weaned	Nursing Period	Increase During Nursing Period
Walrus	85 (73-150)	750#	1,600-2,000	4.3-5.3	41.9	18 Mos.	8.8x
Weddell Seal[1]	64	250#	600-650[2]	9.8	41.6	5-6 wks.	3.9x
Elephant Seal[3]	100	375#	1,600	6.3	23.4	3-4 wks.	3.8x
Ringed Seal	10	27#	150	6.7	18.0	4-6 wks.	2.7x
Harp Seal[4]	26	73#	246	10.6	29.7	10-12 days	2.8x
Monk Seal[4]	37.5	133#	575	6.5	23.1	5 wks.	3.5x
Bearded Seal	73	200#	575-600	12.7-13.3	35.0	12-18 days	2.7x

[1]Data (except for adult weight) taken from Mansfield (1958)
[2]Estimated by this writer on the basis of body measurements presented by Mansfield (op. cit.).
[3]Data from Laws (1953a)
[4]Data from Sivertsen (1941)
[5]Data from Kenyon and Rice (1959)

Table 3. Size of Bearded Seal Pups of the Year, from 20 April to 4 November

Date	Spec. No.	Sex	Weight (Kg)	Length (cm)	Girth (cm)	Index of Condition
20 April	G-11-63	Female	36.3	128.5	57.2	44.7
30 April	G-20-63	Female	72.6	148.6	99.1	66.7
2 May	G-17-64	Female	95.3	154.9	124.5	80.4
4 May	? [1]	Male	30.4	127.5	---	---
6 May	G-19-64	Female	---	135.9	71.1	52.3
6 May	G-20-64	Male	---	142.3	71.1	50.0
17 May	D-1-64	Female	---	154.9	99.1	64.0
17 May	D-2-64	Male	---	147.3	106.7	72.4
27 May	D-106-63	Male	---	157.5	101.6	64.5
4 June	G-56-64	Male	---	157.6	119.4	75.8
12 June	G-119-64	Female	---	170.2	108.0	63.5
14 June	58-88[2]	Female	69.4	134.7	---	---
14 June	58-89[2]	Female	62.6	102.9	---	---
16 June	D-26-64	Male	---	175.3	119.4	68.1
6 Aug.	W-6-64	Male	97.5	157.5	100.3	63.7
8 Aug.	W-8-64	Male	115.6	175.3	104.1	59.4
9 Aug.	W-23-64	Female	86.2	154.9	94.0	60.7
4 Nov.	SL-2-64	Male	97.5	167.6	106.7	63.7
4 Nov.	SL-3-64	Male	106.6	170.2	110.5	64.9

[1]Data from Johnson, et. al., 1962

[2]Data from Kenyon, 1962, p. 383. Lengths are not directly comparable because of differences in measuring procedure.

The large size of new-born bearded seal pups, and their rapid growth during the nursing period are indicative of a heavy physical drain on the lactating females. From this viewpoint, it would also seem that a short nursing period is advantageous.

For the first several months after weaning, the pups do not gain weight, although there is a slight increase in length. The length increase is not associated with a corresponding increase in girth as can be seen in Table 3. An index of seal condition (girth/length x 100) is also presented. Sivertsen (1941, p. 117) refers to Smirnov (1927, p. 23) who used the formula (maximum girth x 100 / total length) as an index of condition. Smirnov points out that as the length is exclusively dependent on the size of the animal, the girth is dependent upon both the size and the degree of fatness. Size enters into both the numerator and denominator, and therefore introduces an automatic correction for the size of the animal.

I have used girth (distance around the body immediately behind the foreflippers) rather than auxiliary girth (greatest distance around the body), taken by different people, do not vary as much as do measurements of auxiliary girth. This is because the girth measurements are always taken at the same level around the seals' body. Also, girth indicates only size and degree of fatness, whereas, auxiliary girth is affected by such factors as bloating, especially in warm weather (they begin to bloat shortly after death and it is often several hours before the seal can be processed), stage of pregnancy, etc.

Growth of first year pups, from April to November, is shown in Fig. 4.

Distribution and Migration

Davies (1958) pointed out a useful distinction between the total range and effective range of groups or species of animals. The total range includes the areas far from an animals normal habitat where it has occasionally been found. The effective range is the area in which most of the animals usually occur (their usual habitat). The difference between the two is sometimes rather extensive in pinnipeds as they can move great distances from their effective range to a degree not equalled in land mammals. In the present discussion, we are considering only the effective range.

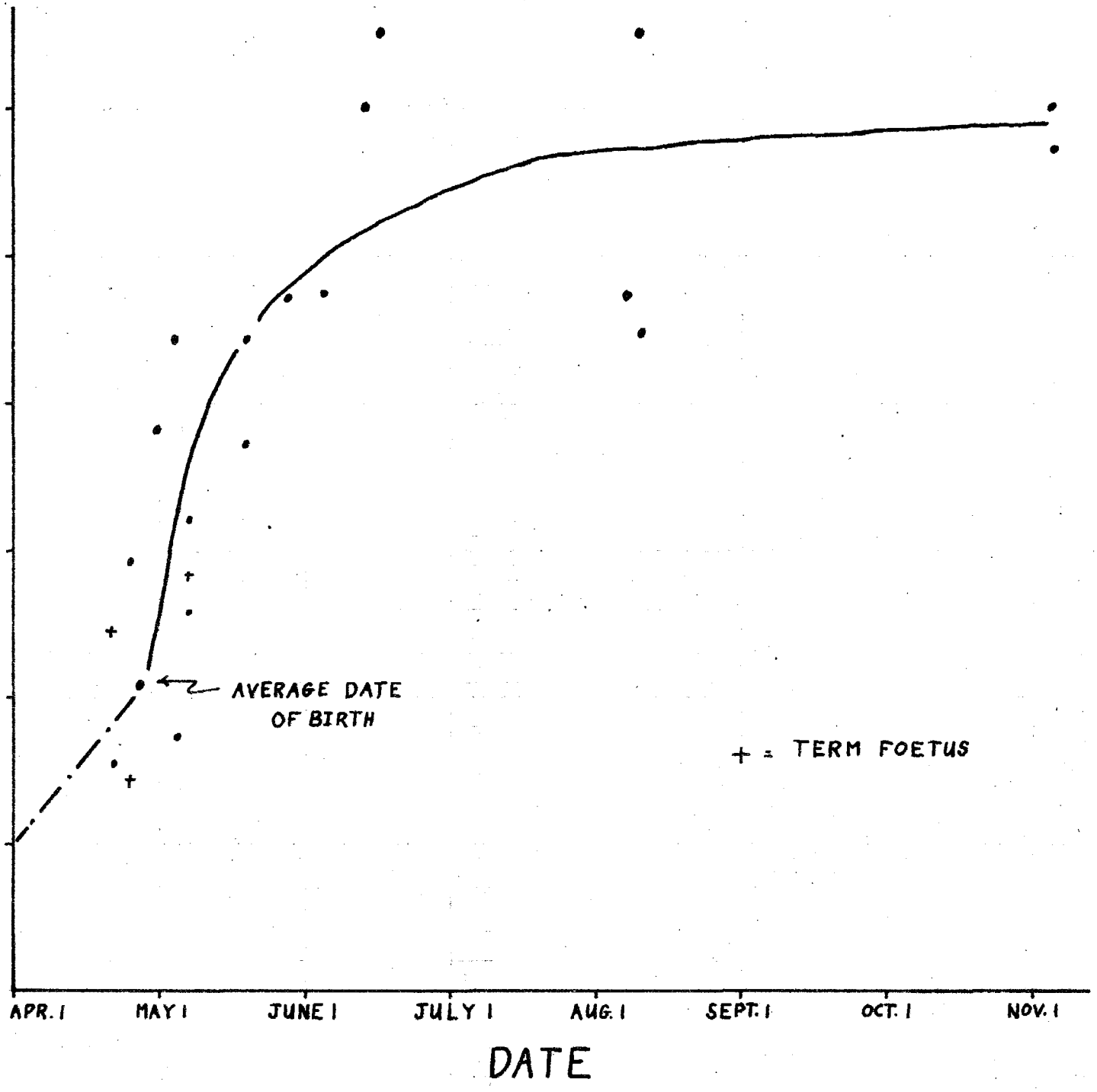


Fig. 4. Growth of Bearded Seal pups during the first six months.

Bearded seals occur most commonly in association with certain types of ice conditions. In winter they are usually found where there is unstable or moving ice, with areas of open water or of thin young ice. These conditions occur beyond the limits of land fast ice, and to a much greater extent below Bering Strait. For this reason, although the seals occur in the Arctic Ocean and Chukchi Sea, during winter they are located primarily in the Bering Sea. At present, the little information is available to this writer about ice conditions in the southwestern Bering and Okhotsk Seas but bearded seals occur there (Allen, 1880). Fig. 1 shows the area occupied by these seals during the winter months.

During the basking period, primarily from April to June, seals (mainly sub-adults) move in close to the coast and utilize the land fast ice as a resting place on which to sun themselves. During these periods they are numerous in the bays and sounds along the northwestern Alaskan Coast.

To maintain their association with ice, the seals must move with it. Thus, they travel south in the fall, and north in the spring much the same as the walrus. The extent of movement varies as those animals remaining north during the winter can remain in the vicinity of ice throughout the year, while animals wintering near the southern terminus of ice must travel as much as 900 miles to remain with it.

The tendency to remain near the ice is apparently more fixed in adult seals than in the juveniles. Young bearded seals are occasionally taken during the summer months in the ice-free bays, and have been observed several miles up some of the rivers. The periodical occurrence of relatively large numbers of sub-adult seals in Kotzebue Sound, during the ice free period has apparently given rise to the belief that a race of dwarf seals inhabits that area. All of the "dwarfs'" that I have examined from that area have proven to be sexually immature animals.

Circumstantial evidence indicates that the immature seals that enter the bays and sounds to bask, remain as long as the ice does. By the time the ice rots <u>in situ</u>, during late June or early July, the pack ice has receded to the vicinity of northern Alaska and many of the young seals remain where they are.

Young seals also migrate south ahead of the pack ice. At Little Diomede, King and St. Lawrence Islands the immature seals begin to appear in late September but it is not until the ice moves down that the hunters begin to take adults.

Harvest

Seasonal movement (migration) of seals is the most important single factor affecting hunting success. The productive hunting period is primarily in the spring when the young seals appear near the shore to bask, and when the seals moving with the ice pass the hunting sites. During the southward fall migration hunting is also productive, but weather conditions at this time of year often prelude hunting activity.

During the months when heavy ice occupies the areas adjacent to the coast, bearded seals are not commonly taken by hunters. These seals, when taken, are usually killed by hunters in quest of the ringed seal.

From the standpoint of utilization, these seals are highly desired because of their hides and meat, which have qualities more desirable than those of the other seals inhabitating the area. The palatibility of the flesh of males is not affected by the rut as is that of the ringed seal, which becomes almost inedible.

The number of bearded seals taken by Alaskan hunters in not accurately known. However, harvest information accumlated during the course of this study indicates that the harvest is around 3,000 animals. Table 4 presents a breakdown of the harvest by area or village.

Hunting loss is extremely high with bearded seals as many of the animals sink when killed. Sinking loss occurs in both sexes throughout the year but is less frequent in juveniles and pregnant females. Observation of hunting procedures shows that at least half of all the seals killed are lost. This means that the total kill of bearded seals by Alaskan hunters is somewhere around 6,000 animals.

I do not think that the overall composition of the harvest is a true representation of the size or age composition of the population. Segregation of animals results in a much higher availability of juveniles especially during the spring near the coastal hunting sites contains a more representative cross-section of the population. Fig. 5 depicts the frequency of occurrence of the various sized seals taken at St. Lawrence, King and Little Diomede Island.

FUTURE RESEARCH NEEDS

Much work remains to be done with the bearded seal before we will arrive at a point where valid conclusions concerning size and dynamice of the population can be drawn. The most immediate need is for a technique to determine the age of animals beyond what can be determined by examination of claws. Our knowledge of foetal growth and development (dentition, organ development, growth rates) is

Fig. 5. Length frequency of 92 bearded seals taken at St. Lawrence, King and Little Diomede Islands.

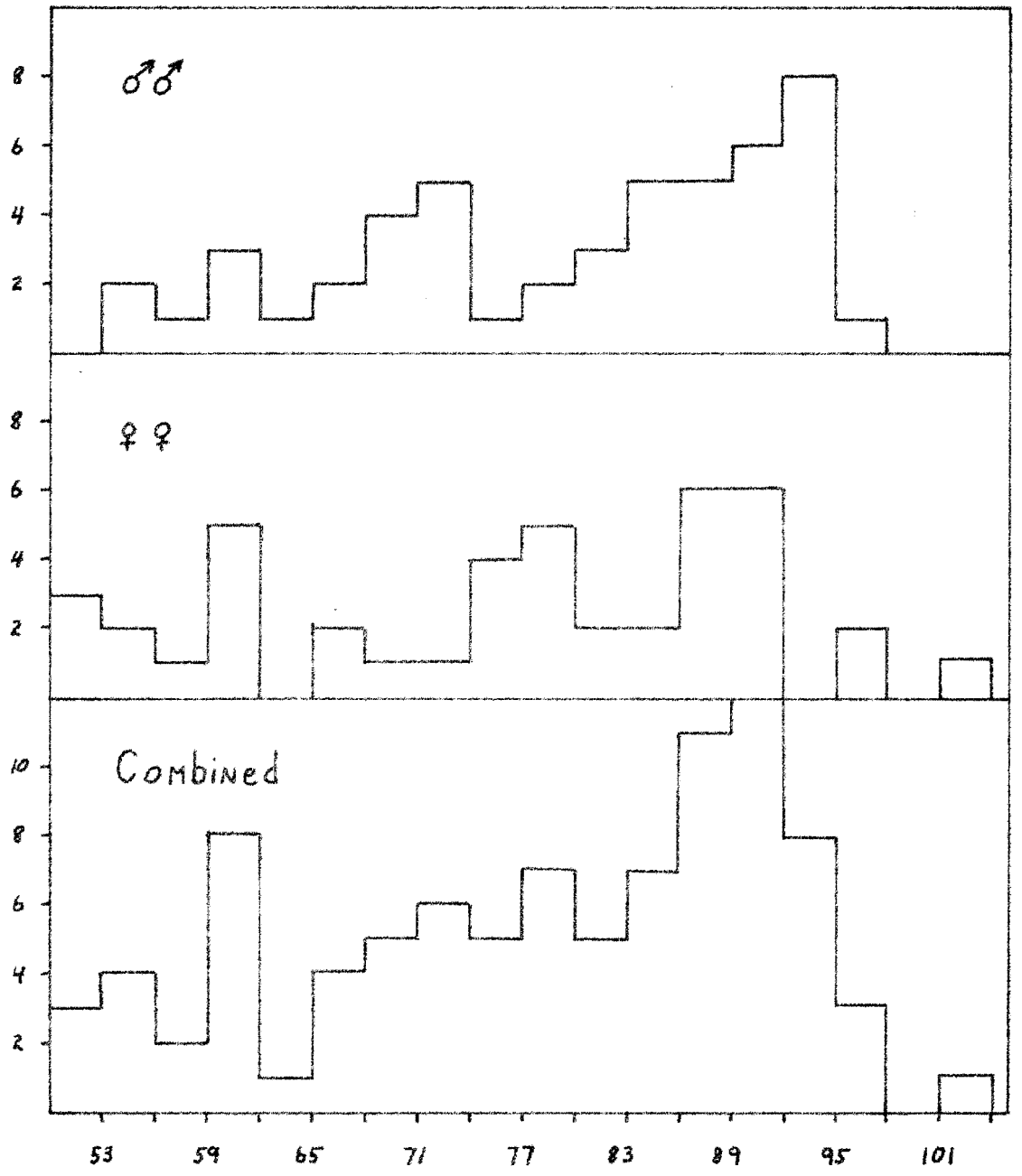


Table 4. Average Annual Harvest of Bearded Seals at Hunting Sites in Western and Northern Alaska

Village or Area	Bearded Seals	Village or Area	Bearded Seals
Bristol Bay Area	100	Savoonga	200
Kuskokwim Bay Area	225	King Island	75
Mekoryuk	50	Teller	200
Tununak	25	Brevig Mission	200
Hooper Bay	250	Wales	150
Chevak	20	Little Diomede	75
Scammon Ba	15	Shishmaref	300
Stebbins	75	Deering	20
St. Michael	15	Buckland	10
Unalakleet	40	Kotzebue	50
Shaktoolik	45	Noatak	10
Koyuk	50	Kivalina	40
Elim	50	Pt. Hope	200
Golovin	40	Pt. Lay	40
White Moutain	10	Wainwright	100
Nome	60	Barrow	150
Gambell	200		
TOTALS			3,090

fragmentary at best; and almost nothing is known about mortality, both intra-and extra-uterine. Limited food habit studies have been undertaken, mostly during the spring. This line of investigation should be pursued at points throughout the effective range of the animal, and during the fall, winter, and early spring. The factors effecting distribution are not well known, and deserve additional inquiry. Little is known about the weights attained by adult seals during the winter months, nor about the practical facets of utilization, such as the yield in the form of pounds of meat, animal fat, skin, etc. Additional information about the magnitude of the harvest by both Alaskan and Siberian hunters is also necessary.

These are only a few aspects of bearded seal biology which deserve attention. It is hoped that in the near future, many of the aspects of biology covered in this report can be correlated with age in order to arrive at more meaningful conclusions, especially in regard to rates of reproduction.

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