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JUNEAU, ALASKA

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MARINE MAMMAL REPORT

By

John J. Burns

Volume XII
Project Progress Report
Federal Aid in Wildlife Restoration
W-17-2, Jobs 8.3R, 8.4R, 8.5R, 8.6R & 8.7R (2nd half) and
W-17-3, Jobs 8.6R, 8.7R & 8.8R (1st half)

(Printed April, 1972)

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Arthur Smith, Robert Pegau, Jack Lentfer, Edward Muktoyuk, and Rae Baxter (Alaska Department of Fish and Game); Vernon Slwooko, resident of Gambell; and Alexander Akeya, resident of Savoonga.

Project Nos.: W-17-2 Project Title: Marine Mammal Investigations

Job No.: 8.3R Job Title: Walrus Study

Period Covered: January 1, 1970 to June 30, 1970

SUMMARY

The 1970 harvest of walruses in Alaska was 1422 animals. Of these 881 (62%) were bulls, 427 (30%) were cows and 114 (8%) were calves of either sex. Proportional harvests by season were 4 percent during late winter, 86 percent during spring and summer and 10 percent during fall and early winter. A summary of retrieved harvest and total kill at each hunting site is included. Utilization of the 1970 harvest (proportion of usable meat saved) was poor due to the large harvests made at such villages as King Island and Diomede. Greatest potential value of the 1970 walrus harvest was estimated at $358,745. The value realized by hunters and other direct users of walruses or their by-products was estimated at $200,000.

This progress report also includes remarks on the characteristics of walruses collected during the winter months, as well as reports concerning the continuing use of recently re-established hauling grounds.

CONTENTS

BACKGROUND

The general background of the decline in Pacific walruses, and the subsequent dramatic recovery of the population was included in several previous reports (i.e. Burns, 1970).

At the present time, a monograph concerning the biology of walruses is being prepared by Dr. Francis Fay, Arctic Health Research Center, Fairbanks. This monograph will, in part, be addressed to the questions of breeding biology and productivity. Therefore, every effort has been extended to provide Dr. Fay with the material required to complete his work.

During 1970, efforts of the Alaska Department of Fish and Game were directed primarily toward: 1) enforcement of the bag limit on female walruses; 2) assessment of magnitude and composition of the annual harvest; 3) collections of biological material of specific worth to ongoing walrus research programs; and 4) documentation of the use of hauling grounds by walruses.

OBJECTIVES

Job objectives during this report period were somewhat restricted in comparison to those of previous years. During this report period they included: 1) accumulation of current harvest information necessary for effective management of the walrus resource; 2) a continuing but limited investigation of the interspecific relationships between walruses and other pagophilic pinnipeds of Bering Sea; and 3) investigation of the winter ecology of walruses.

PROCEDURES

Information concerning walrus hunting, magnitude of the harvest and utilization by Alaskan residents was obtained primarily by Department

employees working at the major walrus hunting sites during the main spring hunting season. Magnitude and composition of the walrus harvest at less productive hunting sites were determined through correspondence with and interviews of hunters, resident clergymen, teachers and village leaders. Parameters of hunting success used as relative indicators of walrus abundance and availability included total harvest, hunting loss, total kill, hunting effort and success per unit of effort. Value of the harvest and actual extent of utilization were also determined as measures of the importance of walruses to the economy of western Alaska.

Biological investigations of the walrus were limited to the acquisition of material from old-age females, and animals taken during the winter. Mr. Edward S. Muktoyuk participated, as the Department's representative, in the 1970 winter cruise of the Coast Guard Icebreaker, *Northwind*. During that cruise four walruses were collected for various scientific purposes. In addition, careful records were kept of the distribution and abundance of all pinnipeds. These data will be correlated with several factors ranging from characteristics of the sea ice to the distribution of benthic invertebrates.

RESULTS

Walrus Harvest

During 1970, the retrieved harvest of walruses in Alaska was 1422 animals. Total kill (retrieved harvest plus estimated hunting loss including orphaned calves) was estimated at about 2,840 animals. Table 1 presents a summary of the 1970 retrieved harvest, including success at various villages, composition of the harvest, estimated hunting loss and estimated total kill.

As in most years, the traditional walrus hunting villages in or near Bering Strait (Gambell, Savoonga, King Island and Little Diomede Island) took the greatest proportion of the total harvest. Hunters from these four villages harvested 1150 walruses or 81 percent of the 1970 harvest.

The chronological aspect of annual harvests is important from the standpoints of storage, preservation and utilization of meat, availability of animals and the supply of raw ivory available to carvers. Chronology and composition of the 1970 walrus harvest is presented in Table 2. Approximately 4 percent of the harvest was obtained during the period from January to April, 86 percent from April through August and 10 percent from September through December.

Utilization of the Harvest

Utilization of the meat from the important spring harvest of walruses was as follows: at Nunivak Island, the Kuskokwim area, Kivalina, Point Hope, Wainwright and Barrow, 85 to 95 percent; Gambell, Savoonga and Wales, 50 to 60 percent; and at King Island and Little Diomede Island,

Table 1. Retrieved and total kill of walrus in Alaska during 1970.

Location	Walrus Retrieved	Composition of Harvest*						Percent Hunting Loss	Estimated Total Kill
		Males		Females		Calves			
		No.	(%)	No.	(%)	No.	(%)		
Nunivak and Kuskokwim Area	45	34	(75)	8	(18)	3	(7)	40	75
Gambell	243	114	(47)	67	(28)	62	(25)	50	486
Savoonga	180	156	(87)	16	(9)	8	(4)	50	360
King Island	137	21	(15)	105	(77)	11	(8)	65***	391
Wales	77	19	(25)	47	(61)	11	(14)	50	154
Diomede	590	423	(72)	152	(26)	15	(2)	50	1,180
Kivalina and Point Hope	6	5	(83)	1	(17)	0	(0)	20	8
Wainwright	89	60	(67)	25	(28)	4	(5)	20	112
Barrow	39	37	(95)	2	(5)	0	(0)	35	60
Other Areas**	16	12	(75)	4	(25)	0	(0)	20	20
TOTALS	1,422	881	62%	427	30%	114	8%	50%	2,846

*The columns "males" and "females" include all age groups with the exception of calves of the year.
**Includes four animals taken during the research cruise of the USCGC, *Northwind*, as well as the few animals reported from the Norton Sound Area, Northeast Cape and Shishmaref.
***This high loss was due to the normal hunting loss of adults and the high proportion of calves which were orphaned.

Table 2. Chronology and composition of the 1970 walrus harvest at the various hunting sites.

Location	Seasonal Walrus Harvest - 1970												Grand Total
	Winter Jan - April			Spring & Summer April - Aug			Fall & Winter Sept - Dec			Totals			
	M	F	calves	M	F	calves	M	F	calves	M	F	calves	
Nunivak and Kuskokwim Area	12	0	0	22	8	3	0	0	0	34	8	3	45
Gambell	15	0	0	44	57	62	55	10	0	114	67	62	243
Savoonga	8	0	0	118	11	8	30	5	0	156	16	8	180
King Island	0	0	0	21	105	11	0	0	0	21	105	11	137
Wales	0	0	0	19	47	11	0	0	0	19	47	11	77
Diomede	18	3	0	375	137	15	30	12	0	423	152	15	590
Kiyalina and Point Hope	0	0	0	5	1	0	0	0	0	5	1	0	6
Wainwright	0	0	0	60	25	4	0	0	0	60	25	4	89
Barrow	0	0	0	37	2	0	0	0	0	37	2	0	39
Other areas	2	2	0	7	2	0	3	0	0	12	4	0	16
TOTALS	55	5	0	708	395	114	118	27	0	881	427	114	1422

2 to 5 percent of the utilizable meat. As usual, when the success of individual boats increased utilization of the animals taken decreased.

During the other seasons of the year, when fewer walruses were taken and conditions for preservation were good, utilization was generally high, amounting to between 80 and 90 percent.

Value of the 1970 Harvest

The potential value of the 1970 walrus harvest was calculated in the same manner as outlined in previous segment reports. It is based upon the very conservative values set forth by Fay (1958) and Harbo (1960). These values were:

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 cents per pound
Skins of females valued at $20.00 each

Also included is the value of male skins which can presently be sold for $75.00 each.

The estimated values of component parts of the 1970 harvest are presented in Table 3. Greatest potential value of the harvest was calculated to have been around $358,700. The actual income received was far less than the potential income, due to poor utilization of meat and hides from males. Only about 40 hides from males were sold and most of these came from Savoonga.

Winter Collections

Four walruses were collected during the winter months by Mr. Edward S. Muktoyuk. These represent the majority of our very limited collections obtained during the midwinter period. Reproductive tracts were turned over to Dr. Francis Fay, Arctic Health Research Center, as he is currently writing a monograph concerning biology of the Pacific walrus. Data concerning these four animals are presented in Table 4.

Miscellaneous Observations

Residents of Little Diomede Island reported that during November 1970, walruses again utilized the east side of Soviet Big Diomede Island as a hauling ground (Uglit). As has been pointed out previously, the re-establishment of regular hauling areas, after many years, is a very significant development. Many such areas were apparently abandoned during the last 90 years, probably due to harrassment of these animals by white and Eskimo hunters and also because the total population of Pacific walruses was greatly reduced.

The hauling ground on Big Diomede Island has now been used each year since 1965. Residents of Little Diomede Island, living only 2.7 miles

Table 3. Potential value of the 1970 walrus harvest in Alaska.

Location	Harvest			Value of Ivory		Bacula	Meat	Value of Skins		Greatest Potential Value
	M	F	calves	Raw	Carved			M	F	
Nunivak and Kuskokwim Area	34	8	3	$ 896	$ 5,250	$ 238	$ 3,900	$ 2,550	$ 160	$ 12,098
Gambell	114	67	62	3,406	22,625	798	15,823	8,550	1,340	49,136
Savoonga	156	16	8	3,904	21,500	1,092	16,612	11,700	320	51,224
King Island	21	105	11	1,554	15,750	147	8,472	1,575	2,100	28,044
Wales	19	47	11	926	8,250	133	4,792	1,425	940	15,540
Diomede	423	152	15	11,672	71,875	2,961	51,518	31,725	3,040	161,119
Kivalina and Point Hope	5	1	0	130	750	35	560	375	20	1,740
Wainwright	60	25	4	1,690	10,625	420	7,526	4,500	500	23,571
Barrow	37	2	0	908	4,875	259	3,820	2,775	40	11,769
Other areas	12	4	0	328	2,000	84	1,440	900	80	4,504
TOTALS	881	427	114	$25,414	$163,500	$6,167	$114,463	$66,075	$8,540	$358,745

Table 4. Measurements of four walruses collected during January and February, 1970.

Field Data Recorded	Specimen Numbers NW-1-70	NW-2-70	NW-3-70*	NW-4-70
Location of Capture	57° 58'N 164° 45'W	57° 58'N 164° 45'W	62° 20'N 165° 40'W	62° 20'N 165° 40'W
Date	1-31-70	1-31-70	2-14-70	2-14-70
Sex	Male	Male	Female	Female
Weight (lbs.)	3650	1950	1600	1875
Tusk Measurements (in.)	20 1/2 x 9 7/8	15 1/2 x 7	14 1/2 x 5 1/4	--
Length (in.)	140	110	108 1/2	114
Standard Length (in.)	120	103 1/2	101	102
Girth (in.)	119	98 1/2	95 1/4	96 1/4
Auxillary Girth (in.)	123 1/2	97	95 1/2	110
Foreflipper Length (in.)	32	30 3/4	24 1/4	26 1/8
Foreflipper Width (in.)	19 3/4	15 3/4	15 1/4	16 1/4
Hindflipper Length (in.)	31	25 1/2	23 1/2	25
Hindflipper Width (in.)	34	30	29 3/4	28 1/2
Naval to Anus (in.)	54	46 3/4	36	34 3/4
Penis to Anus (in.)	41	36 1/4	--	--
Blubber Thickness**(in.)	3	--	2	2 1/2

* This female accompanied by a 10 1/2 month old calf.
** Blubber thickness measured immediately over the sternum.

from the larger island, reported that an estimated 2,000 male walruses utilized the island during late November and December.

A similar occurrence was reported by Mr. Winfred James, a resident of Gambell, on the northwestern tip of St. Lawrence Island. The following comments are paraphrased from a letter written by Mr. James to this writer: For the first time in my life I have witnessed a great number of male walruses hauled up at the base of the mountain east of Gambell. They climbed very high on the hillside, even passing the old hunting blinds. Also, from the point near Gambell Village, as far as one could see east of the mountain, there were walruses in the water. I estimated that there were perhaps between 10,000 and 15,000 males in the area for nearly two weeks in early December. This occurrence of male walruses was probably because there was no ice around. We did not get ice until after Christmas.

As has been reported in previous years, the walruses which come ashore prior to the arrival or formation of sea ice are essentially all males.

RECOMMENDATIONS

It is recommended that the present bag limit of five adult female walruses per hunter, per year remain in effect. Efforts should be continued to improve hunting techniques at all villages where walruses are taken. Involvement of the various Native associations in the overall walrus hunting situation, particularly the aspects of inefficient and wasteful hunting practices, should be encouraged. Involvement of the State of Alaska with the international ad hoc. panel of scientists concerned with Bering Sea pinnipeds, should be fostered and encouraged.

LITERATURE CITED

Burns, J. J. 1970. Marine Mammal Report. Fed. Aid Progress Rpt., Alaska Dept. of Fish and Game, Juneau. p. 1-16 (mimeo.)

Fay, F. H. 1958. Pacific walrus investigations on St. Lawrence Island, Alaska. Arctic Health Res. Center. U.S. Public Health Service, Anchorage. 54 p. (mimeo.)

Harbo, S. J. Jr. 1960. Walrus harvest and utilization. In Annual Progress Report, Fed. Aid. Wildl. Restor., Proj. W-6-R-1, Job 1b. pp. 420-432. Alaska Dept. Fish and Game, Juneau.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Samuel J. Harbo, Jr., University of Alaska; Jack Lentfer, Robert Pegau, Edward Muktoyuk and Arthur Smith, Alaska Department of Fish and Game; Thomas Menadelook, resident of Teller and Michael Ehredt and Oscar Ahkinga, residents of Barrow.

Project Nos.: W-17-2 and W-17-3 Project Title: Marine Mammal Investigations

Job No.: 8.4 R Job Title: Ribbon Seal Life History

Job No.: 8.5 R Job Title: Interspecific Relationship Among Seals

Job No.: 8.6 R Job Title: Spotted Seal Life History

Job No.: 8.7 R Job Title: Marine Environment Study

Job No.: 8.8 R Job Title: Data Analysis and Reporting

Period Covered: January 1, 1970 to December 31, 1970

SUMMARY

The value of seal bounty records for recent years has continued to decline, as far as providing reliable information for estimating the total annual hair seal harvest in northern Alaska. Analysis of all data from various sources indicated a harvest of between 15,000 and 18,000 seals in 1970. This was composed of ringed, bearded, spotted and ribbon seals; the declining order of importance as indicated by the sequence in which they are listed above.

Specimens and data collected pertinent to the overall seal research program included material from 36 spotted seals, 24 ringed seals and 12 bearded seals.

Aerial surveys of ringed seals in areas of landfast ice extending along the Alaskan coast from Point Lay to Barter Island were made between 8 and 15 June 1970. Surveys of 8, 9 and 13 June were used for determining density and estimating the number of seals present within six sectors of the total area. The density of seals in sectors east of Point Barrow was low and relatively uniform (2.28, 1.06, 1.38 and 2.43 seals per square mile). Within sectors southwest of this point, density was substantially higher (5.36 and 3.70 per square mile). The minimum number of ringed seals in all sectors surveyed was 11,612. Comparison of survey results

in areas of intensive seismic exploration with undisturbed areas indicated that even with intensive disturbance associated with exploratory activities conducted within the limits imposed by state regulations, ringed seals were not appreciably displaced.

Preliminary data analyses and compilation was accomplished and rough drafts of several proposed publications were prepared.

CONTENTS

BACKGROUND

Comments concerning the broad background, or overview of marine mammal investigations in northern Alaska have been presented in previous reports and publications (Burns, 1970a). Remarks here will be restricted to statements pertinent to work conducted or completed during this report period.

Oil exploration and development activity along Alaska's north coast, and a heightened interest in international management of Bering Sea marine mammals, greatly influenced the actual work undertaken during 1970. This work, without exception, fell within the projects designated for 1970. However, in some cases the proposed schedule sequence was altered from that indicated in the project planning documents. The general approach to investigations of pinnipeds important to residents of northern Alaska has remained the same, centering around: 1) relatively short-term species investigations, 2) a moderately long-term investigation of the ecological relationships among northern pinnipeds, and 3) a long-term integrated investigation of the marine system. With respect to the latter, our studies are a small but important part of a multi-disciplinary approach to the biology of the Bering Sea.

In conjunction with the 1970 meeting of the International North Pacific Fur Seal Commission, two days of meetings were devoted specifically to discussions of Bering Sea pinnipeds. This marked the first occasion that American and Soviet investigators were able to discuss, on an informal basis, respective research and management programs directed toward pinnipeds of the Bering Sea. Future exchanges of this nature are planned, and it is hoped that investigators from Alaska will be provided with the opportunity to participate.

Other major involvements during 1970 which provided information included in this report were:

1. Observation of off-shore oil exploration activities in the Prudhoe Bay Area on 13 and 14 March and 22 and 23 April.

2. Field work, by Mr. Arthur C. Smith, on Little Diomede Island, from early May to mid June.
3. An extensive aerial survey of ringed seals, *Phoca (Pusa) hispida*, along the northern coast between Point Lay and Barter Island.

The extensive aerial survey was conducted by me, with assistance from Mr. Michael Ehredt, pilot and Mr. Jack Lentfer and Mr. Oscar Ahkinga, secondary observers on one of the survey flights.

From September through December 1970, I attended classes at the University of Alaska. This involvement was directed primarily at obtaining a better understanding of biological processes relevant to the Bering Sea system.

OBJECTIVES

Objectives of work conducted during this report period included: 1) continuation of the life-history study of ribbon seals *Phoca (Histriophoca) fasciata* including data analysis; 2) as far as possible, preparation of a comprehensive report about the interspecific relationships among Bering Sea phocids and the marine environment essential to them; and 3) accumulation of sufficient data and specimen material from Bering Sea harbor seals, *Phoca vitulina largha*, on which to base a comprehensive life-history study of this species. In addition, information from ringed seals, *Phoca (Pusa) hispida* was also collected in order to investigate various aspects of this species spatial distribution and ecology. For the purposes of marine mammal management, assessment of magnitude and characteristics of the seal harvest in northern Alaska was also continued.

PROCEDURES

Seal Harvest Assessment, 1970

As in past years, assessment of magnitude of the annual seal harvest in northern Alaska was determined by a combination of procedures including analysis of bounty records, reports from hunters, and observations recorded by Department biologists at various villages during different periods of the year.

Life History, Interspecific and Ecological Investigations

Ringed, spotted and ribbon seals killed by Eskimo hunters were weighed, measured, and autopsied when possible. Specimens necessary for determining various aspects of the species life-histories were collected for laboratory analysis. These included reproductive organs and fetuses, skulls, jaws, claws, stomachs, various soft tissues, parasites, eyes, skin samples, etc. Samples of some soft tissues were subdivided for various purposes including an analysis of heavy metals and pesticide residues. Factors influencing seal distribution were determined by field observation of seals at different times of the year.

Survey of Ringed Seals Along the North Coast

The total area censused extended from Point Lay to Barter Island. This region was subdivided into six sectors as follows: I) Point Lay to Wainwright; II) Wainwright to Barrow; III) Barrow to Lonely; IV) Lonely to Oliktok; V) Oliktok to Flaxman Island; and VI) Flaxman Island to Barter Island. Sectors III and IV were particularly important due to the number of replicate counts and statistical comparisons employed. These six sectors were delineated primarily because of the presence of readily visible landmarks (buildings and transmitting antennas) at each settlement and secondarily, because each settlement possessed the navigational equipment needed to establish the position of our aircraft during the census. Each was also able to provide weather reports necessary for planning the daily census flights and for subsequent comparison of conditions during surveys. These settlements also are situated on headlands which, in some cases, mark the boundaries of areas with different oceanographic conditions. Point Barrow delineates sectors showing major differences in characteristics of currents and shore ice. Lonely and Oliktok delineate that portion of the north coast directly influenced by the Colville River.

There are major differences in extent, thickness and conformation of landfast ice between those sectors southwest of Barrow (I and II) and those to the east (III through VI). This apparently results from the direction of coastal exposure to storms, ocean currents and the influence of drifting sea ice.

Timing of the actual surveys was based on previous experience in the Bering Sea and along the north coast. The first two weeks of June were judged as the optimum survey period in that we assumed the maximum number of resident seals present in the area would be hauled out; the sea ice between Barrow and Barter Island (the area of major interest) had not yet begun to break up; an influx of ringed seals into the area east of Barrow, resulting from seasonal migration, had not yet occurred; adverse effects of extensive water on top of the fast ice, from melt and overflow of major rivers, was not yet a problem; and conditions for observing seals were very good due to the relatively clean ice and snow background.

Surveys were conducted mainly between the hours of 1000 and 1600 when, based on previous general observations of ringed seals, the maximum number were expected to be hauled out. The aircraft used for the surveys were a Cessna 185 equipped with wheels (average true ground speed of 130 m.p.h.) or a Cessna 180 equipped with skis (average true ground speed of 115 m.p.h.). Survey transects were one-half mile on either side of the aircraft. Therefore, each mile traveled equaled one square mile surveyed. Transect width was maintained with the use of fixed reference points on both the windows and wing struts of the aircraft. These reference points were checked each day by flying over landing fields of known length, at different altitudes. Optimum survey altitude was 500 feet. This altitude was maintained on all flights except for brief periods when fog or low cloud cover necessitated a lower flying altitude. During these periods

surveys were continued at an altitude of 300 feet. Seals were counted along continuous transects, some in excess of 200 miles long, whenever possible. Censusing was discontinued when conditions were judged as unfavorable for seals to bask (i.e. moderate to high winds and/or precipitation).

During favorable survey days conditions were excellent for counting seals in sectors III through VI. The extensive landfast ice was flat and bright, providing good contrast. Ringed seals were generally scattered. Landfast ice extended a minimum of six miles off Point Barrow and three miles off Barter Island (both of which are prominent extensions of land) to a maximum of 48 miles off shore from the head of Harrison Bay. Mean seaward extent of landfast ice in sectors III through VI was 12 to 14 miles.

Ice conditions in sectors I and II were very different than those in sectors III through VI. Landfast ice was rough, with open water occasionally extending to the beach. Conditions varied from no fast ice at Point Lay, to a maximum extent of 12 miles in the area northeast of Point Franklin. Average extent of fast ice was approximately two miles from shore. Ringed seals were concentrated into larger aggregations than were observed in sectors III through VI. However, conditions of favorable contrast and this seal's propensity for avoiding rough ice and hauling out in the smooth areas facilitated the census efforts.

All counts were made by two observers (the pilot and an observer [J. B.] sitting in the adjacent front seat). On two surveys, additional experienced observers were also present. The purpose of the additional observer on one flight was to make a replicate count within the transect on the same side of the aircraft as one of the principal observers; on the second flight, the purpose of the additional observer was to count all seals to the limit of visibility. These counts were compared with those obtained by principal observers within limits of the one-mile transect. Secondary observers were hindered by their inability to see directly in front of and directly below the aircraft.

The reaction of ringed seals to the approach of the survey aircraft was quite variable, apparently depending on proximity to cliffs or high headlands, position of the aircraft in relation to the seals and weather conditions. In the vicinity of high cliffs, seals were apparently alarmed by noise from the aircraft itself and by the sounds echoing from the cliff face. When transects were within about two miles of a rock cliff, most seals went into the water as the plane came directly over or abreast of them. This did not interfere with most of the surveys as there were only a few high cliffs in sectors I and II and none in sectors III to VI.

During periods of marginal weather for basking, seals seemed less tolerant of the aircraft noise and were more apt to go into the water as the airplane approached. Additionally, the aircraft altitude was sometimes lower during surveys undertaken in poor weather, and this contributed to disturbance of the seals. Although several replicate counts were made on days of poor to marginal weather, the data obtained were regarded as unsatisfactory for census.

Maximal counts along the transects were obtained on 8, 9 and 13 June. On these days the reaction of seals to the aircraft was that some directly under the plane dove into the water but most merely shifted position on the ice and looked directly up at the aircraft. Those fleeing into the water were easily counted, as they did not dive until the plane was immediately overhead. The reactions of seals during the maximal counts were markedly different from those reported by Johnson, et al. (1966) and McLaren (1966). We assume that the conditions on 8, 9 and 13 June were optimal for basking and perhaps our surveys over large expanses of landfast ice (as opposed to drifting pack ice or restricted bays and fjords) contributed to the relatively mild reaction of ringed seals toward the aircraft. During previous surveys, mainly in the northern Bering Sea area, from March through April (i.e. prior to the occurrence of optimal basking conditions), most of the ringed seals sighted had gone into the water as the survey aircraft approached.

In addition to the ringed seal, the bearded seal *Erignathus barbatus* (Erxleben) is the only other phocid which normally occurs in the survey area during early June. This seal was commonly seen on the moving pack ice, but infrequently encountered on the landfast ice. Only seven were counted in sectors I and II, and none were seen in sectors III through VI, where extensive landfast ice was present.

Replicate counts were made in several sectors during subsequent days, some during optimal conditions for basking and others, as previously mentioned, during suboptimal conditions. The number of times counts were made during optimal conditions in each sector were as follows: I, once; II, once; III, three times; IV, twice; V, twice; VI, once. Replicate counts made during suboptimal or poor conditions were as follows: II, twice; III, three times; I, IV, V and VI, no replicate counts.

Most transects were more or less parallel to the coastline, but a few extended from the coast to the limit of landfast ice. The latter were made for the purpose of determining ringed seal density in relation to distance from shore, or conversely, from the edge of fast ice.

The count tallies were mainly recorded as seals observed during one-minute intervals. Distinction was made between individuals and groups and between dispersed seals and those occurring along cracks. Other recorded information included periodic navigation checks, ice and weather conditions, survey altitude, visibility, reaction of seals, and the presence of seal holes in the ice.

Using this procedure it was possible to plot exact tracks, subdivide them into distance or time intervals, plot the exact location and extent of cracks (based on parallel replicate tracks) and to statistically treat counts of dispersed and total seals. True ground speed of the survey aircraft was determined after each survey, and again at the time of data analysis. The seaward margin of landfast ice was plotted on a map, and the area of landfast ice, beyond any near-shore barrier islands, in each sector was determined by use of a planimenter.

Statistical procedures, accomplished by Mr. Harbo, included analysis of variance for: 1) comparison of day-to-day variation among replicate surveys in sector III; 2) comparison of variation in seal densities at different times of the day in sector III; and 3) comparison of seal densities with respect to distance from the seaward ice edge, based on all tracts within zones 0-8 miles from the edge, 8-16 miles, 16-24 miles and 24-32 miles in sector IV.

Comparison of disturbed (intensive seismic exploration) and undisturbed areas (no seismic exploration) was complicated by the general restriction of this exploration to near shore, shallow water areas of sectors IV and V, where seals normally occur at very low densities. Comparisons were possible between parts of sector V, which encompassed the area immediately offshore of the Prudhoe Bay oil fields. Analysis of surveys on two different days, within this sector, indicated conflicting results. These are discussed as comparisons of mean densities.

An additional comparison of seal densities with respect to distance from shore, based on three generally north-south tracts in sector IV, was made using linear regression techniques.

Density of ringed seals in sectors III, V and VI was calculated as that of a) dispersed seals, and b) total seals, within survey tracks. This distinction was not made for sector IV as no cracks were observed in that area. Seal distribution and ice conditions did not permit such a distinction in sectors I and II.

The general population estimate of ringed seals in areas of landfast ice is basically an expansion of the total seal densities per square mile as determined by flights on the three optimum survey days, to the total area of fast ice occurring in each sector.

RESULTS

Seal Harvest Assessment, 1970

As indicated in the procedures, several approaches have been used to assess magnitude of the annual seal harvest. In past years, analysis of bounty records provided the basis for estimating this annual harvest. In addition to the harvest as indicated by these records, data obtained by field personnel and from various associated studies (i.e. anthropological investigations in specific villages) have been compiled to estimate the total annual harvest of seals in northwest Alaska.

The annual progress report for 1969 (Burns, 1970a) includes an extensive review of the human population in the 44 villages extending from Platinum to Kaktovik. The total human population in 1969, based on village census data from the Bureau of Indian Affairs, Directories of Village Councils, Nome, Fairbanks, and Bethel districts, was 15,680 people. With the exceptions of the settlements of Nome, Kotzebue and Barrow, a great majority of these people are dependent to a considerable extent upon marine mammal resources.

Since about 1966, bounty records have proven unreliable as far as providing any real indication of the annual hair seal harvest. This stems basically from the fact that many seal hunters do not consider the $3.00 bounty as sufficient incentive for them to bother saving, preparing and submitting seal scalps for bounty. Additionally, the seal bounty was removed throughout southeast and southcentral Alaska, and many Eskimo hunters had assumed that it was also removed in northern Alaska. As a result, the number of seal scalps submitted for bounty during 1970 was far below the actual number of seals taken.

The actual seal harvest in northern Alaska during 1970 was estimated at between 15,000 and 18,000. This is based on the known seasonal harvest of some villages, and comparisons with information from previous years in others.

In spite of the major shortcoming of bounty records for 1970, they do provide a general indication of seasonal seal harvest, based on records of the 5,184 scalps submitted for bounty.

Table 1 is a resume of the number of seals bountied, and the estimated seal harvest in northern Alaska during 1970.

Life History, Interspecific and Ecological Investigations

During 1970, these investigations continued at a reduced level of effort. This was a result of time constraints imposed by other job responsibilities and because I was on leave during the fall months. Nonetheless, some very important specimen material and data were obtained thanks to the very good cooperation of Mr. Robert Pegau (Nome) and Mr. Jack Lentfer (Barrow).

Data and specimens were obtained from a total of 72 seals, of which 36 were spotted seals, 24 were ringed seals and 12 were bearded seals. Most of the spotted seal specimens were collected during the period September through October, and provided some much sought after information concerning the time of fetal implantation in this species.

The level of effort with respect to investigations of seal biology will be greatly increased, starting in January 1972, and the material collected to date will be an important part of this effort.

In conjunction with an overall analysis of pesticide and heavy metal contamination of the northern marine environment, fat samples from 22 marine mammals were submitted for analysis of these contaminants. As of this writing, results are not available. Samples of subcutaneous (depot) fat were also obtained for analysis of fatty acid composition. These analyses are being made at the Institute of Arctic Biology, University of Alaska. The purposes are to: 1) compare the fatty acid composition among pinnipeds from Bering Sea, in light of their respective food habits and phylogenetic relationships, and 2) to analyze, over a 12-month period, changes in fatty acid composition within a single species, the ringed seal. It is anticipated that this work will be completed during 1972.

Table 1. The 1970 harvest of hair seals in northern Alaska as indicated by a) bounty records and b) estimated harvests made by hunters from each hunting site.

Village	Seal Harvest Indicated by 1970 Bounty Records						Estimates of Actual Harvests*
	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Season Unknown	Total Bountied	
Platinum	0	0	0	0	0	0	35
Goodnews Bay	0	0	0	0	0	0	180
Quinhagak	0	29	0	0	0	29	205
Eek	0	0	0	0	0	0	250
Tuntutuliak	0	0	0	0	0	0	105
Kwigillingok	0	0	0	0	0	0	200
Kipnuk	0	0	0	0	0	0	185
Chefornak	0	0	0	0	0	0	125
Nightmute	0	0	0	0	0	0	80
Mekoryuk	0	197	0	0	0	197	900
Tununak	0	0	0	0	0	0	450
Hooper Bay	154	200	34	25	0	413	1,800
Chevak	0	0	22	0	0	22	550
Scammon Bay	0	0	0	0	0	0	300
Alukanuk	0	0	0	0	0	0	70
Kwiguk (Emonak)	0	0	0	0	0	0	15
Stebbins	0	0	0	0	0	0	350
St. Michael	0	0	0	0	0	0	70
Unalakleet	0	0	0	0	0	0	225
Shaktoolik	0	0	0	0	0	0	285
Koyuk	0	20	0	0	0	20	100
Elim	0	0	0	0	0	0	90
Golovin	0	14	0	35	0	49	25
White Mountain	0	0	36	0	0	36	15
Solomon	0	0	0	0	0	0	20
Nome	0	29	5	0	0	34	185
Gambell	0	64	0	329	148	541	750
Savoonga	272	145	60	349	95	921	1,200
Northeast Cape	0	0	0	0	0	0	15
Teller	0	37	45	98	64	244	350
Brevig Mission	19	59	106	33	148	365	410
Wales	0	61	0	0	32	93	200

Table 1. (continued)

Village	Seal Harvest Indicated by 1970 Bounty Records						Estimates of Actual Harvests*
	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Season Unknown	Total Bountied	
Little Diomede	0	130	0	0	17	147	170
Shishmaref	54	227	288	213	136	918	2,100
Deering	0	0	0	0	0	0	45
Buckland	0	0	0	0	0	0	45
Kotzebue	53	41	0	0	0	94	250
Noatak	0	35	0	0	0	35	90
Kivalina	156	91	0	0	36	283	650
Point Hope	207	106	0	44	242	599	1,900
Wainwright	0	75	69	0	0	144	480
Barrow	0	0	0	0	0	0	2,000
Kakotvik	0	0	0	0	0	0	120
TOTAL	915	1,560	665	1,126	918	5,184	17,590

* Estimates based on known seasonal harvests at some villages, reports of interested residents, and estimates by investigators residing in or visiting various villages.

Survey of Ringed Seals Along the North Coast

The first aspect of the survey results considered was the day-to-day variation in number of seals counted in relation to weather conditions. A resume of weather conditions in each sector for the days on which survey flights were made is presented in Table 2.

The comparison of observed density between three optimum survey days (8, 9 and 13 June) and the three poor survey days (10, 11 and 15 June) showed obvious recognizable differences in means. Additional sophisticated statistical analysis of these differences was not necessary.

Subsequent counts were made in sectors III and IV by Mr. Jack Lentfer, Alaska Department of Fish and Game, Barrow, on 6 July. Lentfer reported that the landfast ice still extended for 13 miles off Lonely at that time, but had decreased slightly from 23 miles to approximately 21 miles in the vicinity of Oliktok. The condition of the landfast ice had greatly deteriorated, with the formation of many small ponds, such that 10 to 50 percent of the ice was covered by water and its general coloration had changed from white to dirty brown. The total count in both sectors, on that date, was only three seals. Weather conditions during this survey were as follows: wind, 8 knots at Barrow, 5 knots at Lonely and 5 knots at Oliktok; sky, high overcast; temperature in the low 40's (F); visibility 10+ miles.

The survey flights of 8, 9 and 13 June were chosen as the basis for estimation of seal populations in each sector. Comparison of counts made on these days, within sector III, indicated no significant difference at the 5 percent significance level for either dispersed or total seals ($F<1.0$). Mean densities of total seals were 1.68, 1.83 and 2.15.

The test of effectiveness of the primary observers by addition of secondary observers indicated that the former were adequate. On 9 June a secondary observer (Lentfer), scanning within the transect, sighted no seals which had not also been counted by the principal observers. On 13 June the secondary observer (Oscar Ahkinga), counting all seals to the limit of visibility, recorded fewer animals than the principal observers did within the transects (1043 versus 1158, on a flight from Barrow to Barter Island and return).

The variation in numbers of seals in relation to a) distance from shore, and b) distance from the edge of landfast ice was tested, using survey results from sector IV, in which the landfast ice was most extensive. Results of linear regression analysis of the three longest tracks from the ice edge to shore in that sector on 9 June were inconclusive. However, a slight increase in density seemed to exist as the distance from shore increased. The positive relationship between seal density and distance from shore was significant at the 13 percent level for two-minute segments of the survey tracks and 20 percent for four-minute segments.

In view of these results, the fast ice area of sector IV was subdivided into four zones as follows: 0-8, 8-16, 16-24 and 24-32 miles from the seaward edge of landfast ice. Unfortunately, sample size within

Table 2. Weather conditions during survey periods recorded at each settlement.

Date	Location	Time	Sky	Visibility	Wind		Temp. (F.)	Chill Factor
					Direction	Velocity		
8-VI	Barrow	0800	Overcast	10 mi.	260°	8 Knots	25°	17
	Wainwright	0800	Overcast	7 mi.	340°	3 Knots	30°	27
	Lonely	0800	Overcast	3 mi. fog	260°	10 Knots	33°	23
	Point Lay	1200	Partly Cloudy	30 mi.	060°	4 Knots	35°	31
	Barrow	1700	Overcast	--	330°	9 Knots	26°	17
9-VI	Barrow	0800	Overcast	15 mi.	010°	6 Knots	22°	16
	Lonely	0800	Overcast	10 mi.	120°	5 Knots	30°	25
	Oliktok	0800	Overcast	10 mi.	330°	6 Knots	30°	24
	Barrow	1000	Overcast	--	030°	6 Knots	22°	16
	Oliktok	1300	Partly Cloudy	7 mi.	330°	6 Knots	34°	28
	Flaxman Is.	1300	Partly Cloudy	7 mi.	--	Calm	29°	29
	Barrow	1500	Overcast	--	030°	8 Knots	23°	15
10-VI	Barrow	0800	Overcast	15 mi.	010°	14 Knots	22°	8
	Lonely	0800	Overcast (Snow)	10 mi.	060°	8 Knots	28°	20
	Barrow	1100	Overcast (Snow)	--	350°	14 Knots	25°	11
11-VI	Barrow	0800	Overcast	15 mi.	040°	10 Knots	27°	17
	Barter Is.	0800	Partly Cloudy	2 mi. fog	090°	10 Knots	33°	23
	Barrow	1200	Overcast (Snow)	--	350°	7 Knots	--	--
13-VI	Barrow	0800	Overcast	15 mi.	120°	4 Knots	26°	22
	Lonely	0800	Overcast	10 mi.	--	Calm	32°	32
	Oliktok	0800	Overcast	10 mi.	--	Calm	30°	30
	Flaxman Is.	0800	Overcast	10 mi.	030°	8 Knots	30°	22
	Barter Is.	0800	Overcast	20 mi.	100°	7 Knots	27°	20
	Barrow	1000	Overcast	15 mi.	130°	3 Knots	29°	26
	Lonely	1030	Overcast	--	090°	5 Knots	31°	26
	Oliktok	1107	Overcast	--	010°	8 Knots	32°	24
15-VI	Barrow	0800	Clear	20+mi.	240°	5 Knots	36°	31
	Wainwright	0800	Clear	20+mi.	090°	1 Knot	50°	49
	Lonely	0800	Clear	20+mi.	--	Calm	48°	48
	Wainwright	1220	Clear	20+mi.	200°	3 Knots	60°	57
	Barrow	1340	Clear	20+mi.	130°	9 Knots	46°	37

the latter zone did not warrant its inclusion in the analysis. Using data from the first three zones of the combined surveys of 9 and 13 June, and on the basis of both two and four minute time segments, no significant relationship between seal density and distance from the seaward edge of landfast ice existed ($F<1$) for both time segments.

An additional test was made to determine if the density of ringed seals changed within the three different, 8-mile-wide zones. Regression analysis indicated that a slight decrease in seal density occurred in both the intermediate zone of 8 to 16 miles, and in the near-shore zone of 16 to 24 miles as distance from the seaward ice edge increased in each. Differences in both of these zones were significant at the 5 percent level within the zone bordering the seaward ice edge (0 to 8 miles); no relationship of seal density and distribution to distance from the ice edge existed. Results of these comparisons are presented in Table 3.

The minimum size of the resident ringed seal population in areas of landfast ice between Point Lay and Barter Island was estimated from the survey data. A minimum population of about 11,600 ringed seals was indicated (Table 4). The density of ringed seals, by sectors, showed a close similarity in sectors III through VI, east of Barrow (especially the density of dispersed seals), and a considerably lower density than that in sectors I and II, southwest of Barrow. It may be argued that restricted fast ice in sectors I and II resulted in an increased concentration of ringed seals during the survey period. However, a trend of higher seal density to the south, during the period when ice is present in the southern Chukchi and Bering seas, has been indicated also by previous surveys at the same time year in such areas as the northwestern coast of the Seward Peninsula and Kotzebue Sound (Burns, unpublished).

Differences are also apparent in the biological and oceanographic aspects of these two areas. Sectors between Point Lay and Point Barrow border the Chukchi Sea which is entirely underlain by the biologically rich Bering-Chukchi Platform. Those sectors to the east of Point Barrow are in the less productive Beaufort Sea (Nansen, 1902; Johnson, 1956). Zooplankton of the Beaufort Sea are mainly holoplanktonic forms; whereas in the Chukchi Sea, these forms are augmented by an increase in the meroplankton, "showing the more neritic character of the water" (Johnson, 1956).

Historically, the relative abundance of ringed seals in areas east of Point Barrow has always been low, as reflected by the small number of prehistoric Eskimo village sites. Comments by contemporary hunters, pilots and other residents also point out this marked difference in abundance (and availability) of ringed seals.

In view of the intensive offshore seismic exploration along the northwest coast, it was desirable to determine whether any adverse effects of this activity on ringed seal distribution could be detected in the survey data. Seismic profiling, using shorefast ice as a working platform, is accomplished by drilling through the ice and down into the bottom sediments. According to regulations of the State of Alaska, the "shot" hole must be

Table 3. Results of statistical comparison of ringed seal density in relation to distance from the seaward edge of fast ice within sector IV.

Distance from ice edge	2-minute time segments of survey tracts				4-minute time segments of survey tracks			
	N*	Y (Seals)	Regress. Coeff.	F. Test	N*	Y (Seals)	Regress. Coeff.	F. Test
0 - 8 Miles	37	1.297	-0.038	<1	18	1.238	-0.062	<1
8 - 16 Miles	18	0.947	0.172	7.81	9	0.884	0.089	2.20
16 - 24 Miles	19	1.092	0.196	4.77	9	1.153	0.224	5.65

* The number of track segments of the indicated time interval.

Table 4. Results of an aerial census of ringed seals between Point Lay and Barter Island, Alaska. Data are from survey flights of 8, 9 and 13 June 1970.

Sector	Calculated Area of fast ice (sq. mi.)	Percent of fast ice surveyed	Density of seals/sq. mi.		Estimated population	Standard deviation
			Dispersed	Total*		
I	207	69.92	---	5.356	1,109	323.64
II	483	36.97	---	3.697	1,786	298.81
III	1,088	41.19	1.445	2.278	2,479	424.07
IV	2,601	15.64	1.0582	1.0582**	2,752	237.24
V	1,165	26.19	0.934	1.378	1,607	292.96
VI	773	19.90	1.049	2.430	1,879	525.85
TOTAL					11,612	

* This total includes dispersed seals and those occurring in large groups and/or along extensive cracks.
** No extensive cracks in the fast ice occurred within sector IV.

drilled a minimum of 20 feet into the sea floor for a charge of up to 20 pounds of dynamite. Where a larger charge is desired, additional drilling at the rate of one foot per additional pound of explosive is required, with a maximum allowable total charge of 50 pounds. Seismic exploration conducted in this manner, over water deeper than three fathoms, must be terminated by March 15 of each year according to regulation.

The exploration companies working in this area were contracted by the larger oil companies and were in competition with each other. As a result, successive series of shot lines (as many as five in the area under consideration) were laid out and detonated within the span of a few months while favorable ice conditions prevailed. Many of these lines paralleled or intersected one another extensively.

For the purposes of this comparison, all seismic lines detonated between 1 January and 15 March 1970, were plotted on a map. The areas of intensive exploratory activity were delineated, and comparisons of seal densities within and outside of these areas were made. Sector V provided the most suitable basis for comparison due to the greater extent and intensity of seismic exploration than in the other sectors. Comparisons were based on survey flights of 9 and 13 June, in which 76 square miles of disturbed area and 83 square miles of undisturbed area were surveyed. The calculated mean density of seals in the combined total area of disturbed and undisturbed zones was 1.05 seals per square mile on 9 June, and 0.95 on 13 June. On 9 June the density of ringed seals was slightly greater in the disturbed area (1.25 seals per square mile) than in the undisturbed area (0.91 seals per square mile). On 13 June the reverse was true, with 0.81 and 1.18 seals per square mile, respectively. Only dispersed seals were included in this comparison, as no cracks with the associated concentrations of seals were present in the zones of seismic exploratory activity. These results indicate that even in areas of intensive seismic disturbance, within the limits imposed by state regulations, ringed seals were not appreciably displaced. Furthermore, most of the dispersed seals within the seismic areas were near individual exit holes in ice ranging from 1.4 to 2.3 meters thick. The presence of these holes prior to deterioration of the ice and snow cover, indicates that they were enlarged breathing holes that had been maintained by the seals throughout the winter.

Although we think our population estimates are reasonable reflections of both density and total numbers of ringed seals within the indicated areas of landfast ice, they may be only a general indication of the total ringed seal population off the coast of northern Alaska. Additional surveys, including flights over landfast ice, the adjacent drifting seasonal ice pack, and the polar ice will be necessary to determine relative ringed seal abundance in each of these different ice zones. In the southern areas of its range, the ringed seal occurs mainly along the coast (Burns, 1970b). However, due to the increased thickness and stability of drifting ice in the northern areas, a higher proportion of ringed seals may occur farther offshore.

Several papers slated for publication, including one on the results of the ringed seal survey, were drafted and are undergoing final editing.

RECOMMENDATIONS

It is recommended that: 1) whenever possible, accurate information concerning seal hunting effort and success be obtained by Department personnel in a position to do so; 2) participation of the State of Alaska, through its Department of Fish and Game, in an international exchange of data and research procedures concerning Bering Sea pinnipeds be encouraged; 3) an additional limited census of ringed seals along the northern coast of Alaska be undertaken to provide information for comparison with the census completed during this report period; and 4) the seal bounty (primarily a means of subsidizing seal hunters in northwest Alaska) be critically re-evaluated with appropriate committees of the state legislature. If the intended purpose of the bounty is not being realized due to lack of interest by hunters, the bounty should be discontinued.

LITERATURE CITED

Burns, J. J. 1970a. Marine mammal report. Annual Proj. Seg. Rpt., Fed. Aid in Wildl. Restoration, Alaska Dept. Fish and Game, Juneau. 10:1-11. (mimeo.)

_____. 1970b. Remarks on the distribution and natural history of pagophilic pinnipeds in the Bering and Chukchi Seas. J. Mammal. 51(3):445-454.

Johnson, M. W. 1956. The plankton of the Beaufort and Chukchi Sea areas of the Arctic and its relation to hydrography. Arctic Inst. N. Am. Tech. Paper No. 1. 32 p.

Johnson, M. L., C. F. Fiscus, B. T. Ostenson and M. L. Barbour. 1966. Marine mammals, p. 877-924. In. N. J. Wilimovsky and J. N. Wolfe (ed.) Environment of the Cape Thompson Region, Alaska. U. S. Atomic Energy Comm., Div. of Tech. Info.

McLaren, I. A. 1966. Analysis of an aerial census of ringed seals. J. Fish. Res. Bd., Canada. 25(5):769-773.

Nansen, F. 1902. The oceanography of the North Polar Basin. Norw. North Polar Exped. 1893-1896. Sci. Res. 3(9):427 p. (Not seen; cited by Johnson, M. W., 1956).

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