ANNUAL HARVEST, SPECIES COMPOSITION, AND AGE STRUCTURE OF THE PHOCID SEALS OF THE BERING AND CHUKCHI SEAS

Project Title: Annual Harvest, Species Composition, and Age Structure of the Phocid Seals of the Bering and Chukchi Seas.

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ABSTRACT

This proposal is for a two year study to determine the magnitude of the seal harvest in north and western Alaska, age composition, and population size of the three principal species of seals (Phoca vitulina, Pusa hispida, and Erignathus barbatus).

An estimate of the annual harvest will be determined by setting up a sampling system incorporating eight Eskimo villages along the coast. The harvest will be intensely monitored at these sites throughout the year to access the seasonal distribution of kill by species and sex, and will provide information on the importance of regional utilization. Specimen material will be collected during the study period from four major hunting sites to ascertain the age structure of each population of seals. Age will be resolved from a combination of growth lines on front claws and annual layering in the dentine or cementum of the canine tooth. Mortality rates calculated from catch curves will be used to estimate the size of the various populations.

OBJECTIVES

To determine the annual harvest of seals and species composition along the northwest coast of Alaska encompassing the native villages from the Kuskokwim delta 60 degrees north latitude along the coast to the vicinity of Wainwright 71 degrees north latitude. To collect ample specimen material for

a comprehensive study of the age composition and to provide data for estimating the age specific mortality rate and the population size for each seal species. To provide essential information for understanding the rational utilization of marine mammal stocks taken by native Alaskans.

INTRODUCTION

Eskimos dwelling on the coast of Alaska traditionally depend on the use of marine mammals as a major source of food, and these facts are easily documented by an extensive volume of anthropological literature. Smith (1959) spent most of his life studying the culture of the Alaskan and Greenland Eskimo and in the following account adequately sums up the Eskimo's dependence on marine mammals. "It is the sea rather than the land that on the whole conditions the life of the Eskimos. The large aquatic mammals - seal, walrus, and whale provide them with their most important food, blubber for lamps, skin for clothing, boat coverings, harpoon floats and thongs, and to some extent sinews for sewing thread as well as bones and ivory for implements.

The foregoing statement certainly reflects the life style of the Eskimos at a period before the advent of the caucasian influence, but with the passage of time, the dependence on marine mammals has lessened, especially as the Eskimo adopted aspects of a cash monetary economy rather than relying solely on a hunting subsistence. Nevertheless, today Eskimos still rely on marine mammals for part of their livelihood. Kenyon (1962) reported that 21 families on Little Diomede Island took 9,000 to 14,000 pounds of bearded seal meat (Erignathus barbatus) between May 16 and June 14. A comprehensive study by the Federal Field Committee for Development Planning in Alaska (1968) provides in depth detail as to the importance of marine mammals in the diet of the village people along the coast of Alaska. In Shishmaref, for instance, a

good hunter may obtain from 12 to 14 bearded seal and many smaller seals in the course of a hunting season. Burgess (unpublished data) kept a record of the harvest of marine mammals in the village of Gambell (St. Lawrence Island) from October through May of 1971-72, and found the residents harvested 427 ring seals, (Pusa hispida); 316 spotted seals, (Phoca vitulina), 63 bearded seals, (Eringnathus barbatus); and 49 walrus, (Odobenus rosmarus).

When Congress passed the Marine Mammal Protection Act of 1972 (Public Law 92-522), they recognized the current need for Alaskan Eskimos to continue using marine mammals as they have done in the past, and they made special provisions to allow for legalized harvests outside the imposed moratorium.

A knowledge of population size and age structure is of utmost importance in the rational exploitation of any animal. The Alaska Department of Fish and Game has been engaged in a continuing biological study of the walrus since the early 1960's, and much is known about its population size, age structure, other facets of its life history (Burns, 1965; Burns 62-72, Alaska Department of Fish and Game Segment Reports). In addition there has been limited biological research on the phocids seals of the Bering and Chukchi Seas, but other than the bounty harvest records (Burns, 63-71, Alaska Department of Fish and Game Segment Reports), there are no recent quantitative studies of the yearly harvest of seals by hunters in north and western Alaska.

Due to the biological importance of marine mammals in the marine ecosystem, their esthetic value to Alaska, and the fact that Alaskan natives are the only people who can legally kill marine mammals, it is paramount that the magnitude of the harvest and the age composition of each seal population be monitored from year to year. Only with such information will it be possible to develop a management plan for the sensible utilization of marine mammal stocks by

Alaskan natives which will insure the continued welfare of each species.

BACKGROUND STUDIES

The collection and analysis of seal harvest data and specimen material has been undertaken by the Alaska Department of Fish and Game over the last 10 years, and has yielded a considerable volume of information directly applicable to this study, (Burns, 1967; Burns, 1962-1972, Alaska Department of Fish and Game Segment Reports). Probably the most significant of these studies is the report of the annual seal harvest by resident hunters of the Bering and Chukchi Seas. Data for compilation of these records was obtained primarily from the analysis of bounty forms.

During the decade of the 1960's and until June 1972 the State of Alaska offered a bounty on seal taken north of 58 degrees north latitude and west of 159 degrees west longitude (bounties were removed south of 58 degrees north latitude in 1966). Essentially, this area included most of the coast and inland waters of northwestern Alaska, and encompasses the proposed study area. Hunters received bounty payments by submitting seal scalps which were counted and tallied on an appropriate form. Although such scalps did not include every seal killed in the annual harvest, the information could be used for estimating the total yearly seal kill in northwestern Alaska.

A considerable quantity of data and biological material has been assimilated in a study of the ice breeding harbor seal of the Bering Sea (Phoca vitulina), (Burns, unpublished). Specimen material has been aged, and can be used for a comparison of age composition, mortality rates, and other parameters of the population (Burns, personal communication).

As part of the continuing program in gathering harvest data and developing a management program for marine mammals, the Alaska Department of Fish

and Game is currently engaged in a project very similar to the proposed study. However, due to the financial burden, there is question as to how long it can be maintained.

METHODS

Collection of Specimen Material and Harvest Data

Along the coast in the study area there are 29 villages that hunt seal and have an Eskimo population over 100. To determine the absolute annual harvest in each of these villages would seem to be prohibitive due to the manpower and economic resources required to station a biological recorder at each hunting site. The most realistic approach to meet the objectives is to establish a samplying system using certain select villages along the coast. Based on data from bounty records, it appears eight villages will provide adequate specimen material and a representative sample of the harvest of sufficient magnitude to determine the total harvest.

Bounty records were most reliable between 1963 and 1966 when they represented approximately 80 percent of the total seal kill (Burns, personal communication). The annual harvest by village during this period is depicted in Tables 1, 2, and 3 (data in 1964 not available), and provides insight as to relative importance of each village as a hunting site. As would be expected, variables such as resident population size, regional animal availability, and individual hunter efficiency, combine to distribute the harvest unequally among the villages.

Since some hunting sites are substantially more productive than others, four villages will provide adequate specimen material for age analysis. The four are Hooper Bay, Point Hope, Shishmaref, and Savoonga. During the years when harvest statistics were most reliable these sites took an average of

49.6 percent of the annual seal kill (Table 4).

Specimen material will be obtained from these four sites by hiring a resident of the village to do the collecting throughout the entire year. Experience under similar situations in past years has shown that it is impractical to expect the collector to obtain material from every seal killed, but it is likely that the sample at each site will approach 80 percent of the village kill. The village collector will be responsible for recording the sex, date of kill, and species for every seal for which a specimen was not obtained.

Throughout the course of the year additional material will be collected from Nome and other sites in conjunction with related studies. It is anticipated that there will be a minimum of 1500 specimens for age analysis.

The collectors in the four villages of Hooper Bay, Point Hope, Shishmaref, and Savoonga will provide data for estimating the total native seal kill by virtue of the records maintained during the collection of specimen material. These villages will represent the harvest in the best hunting sites, but to provide insight into the relative hunter efficiency in villages situated in less desirable locations, a resident will be hired to record harvest information in four other villages. These four will be Wainwright, Wales, Stebbins, and Quinhagak. The recorder's only responsibility will be to tabulate the total kill by species, sex, and date. Harvest data from eight villages within the study area should exceed 60 percent of the annual kill in north and western Alaska. These statistics will provide data for determining the total yearly kill with some degree of accuracy, (see analysis of data).

Age Determination of Specimen Material

With few exceptions, specimen material obtained from each seal will include the lower jaw and two claws from one of the front flippers.

The age of a ring seal may be determined from claws up to 7-8 years, and in some instances up to 12 years (Feedseev, 1966). Claws will be used for initial age determination since they require only a minimal of laboratory preparation before examination. When an animal is judged to be seven years or older, final determinations of age will be ascertained from calcified cross sections of the canine tooth by examining the annual laminations in the dentine. This method has been used by other investigators (Laws, 1953; Fisher and MacKenzie, 1954), but has been further refined for processing specimens in large quantities, Mansfield (personal communication).

Initially, spotted seals will be aged by examination of the claws, and using the same criteria as ring seals, a canine tooth will be examined for animals found to be over seven years of age. Canine sections will be decalcified and prepared histologically similar to a procedure outlined by Stoneberg (1966) for black bears. Age will be determined from the annual layering in the cementum. Burns (personal communication) has used this method and it has proved quite successful.

The method of aging seals from sections of their canine teeth is not always applicable in bearded seals due to the rapid deterioration of the teeth (McLaren, 1958). Most teeth are worn beyond use or missing by nine years of age (Burns, 1967). The claw can be used for age determination from 9 to 16 years at which time wear at the tip eliminates the first year's growth (McLaren, 1958). A combination of claws and wear of teeth in the jaw will be used in determining age in bearded seals.

Analysis of Data

A reliable estimate of the total yearly native harvest can be obtained indirectly by using two methods.

1. Harvest statistics from the eight villages will provide a coefficient of relative harvest for each hunter during the year. By applying the coefficient to the number of active hunters an estimate of the total harvest can be derived for those villages not censused. This figure together with the known harvest data from the eight villages will approximate the yearly harvest.

2. Kill data from the bounty records was most accurate during the period 1963 to 1966 when it approached 80 percent of the retrieved kill. Harvest data from the eight villages can be compared with their statistics from the 1963 to 1966 period and a "proportionate relative kill figure" established. For example, if the 1973 harvest among the censused villages is 75 percent of the take during the early bounty period, (1963-1966), it is likely that the harvest in the uncensused villages approaches the same percentage. Thus, the yearly native harvest in the uncensused villages can be determined by a direct proportion.

It is self-evident fact that if the seals of a region are to support Eskimo needs indefinitely, then the total mortality from hunting and natural causes cannot exceed the annual recruitment into the population.

Where a population is sampled at random the age composition of the catch may be used to determine the age specific rate of total mortality, (McLaren, 1962). Due to the segregated distribution of age classes at different hunting sites, the native harvest is unlikely to represent a random sample, particularly during the winter months. However, after a seal attains adult status, or in some cases an age of 15, they are probably equally accessible and samples of these older age classes can be used to derive mortality curves, (Mansfield, 1970).

Likewise, older age classes of immature seals and young adults are equally represented when they are taken in open water areas during the summer.

Using these segments of the population, a catch curve can be drawn and an accurate estimate of age specific mortality obtained.

If the annual mortality rate is known, together with the total annual kill it is possible to estimate the population size for each species of seal, (McLaren, 1962). The resident coastal Siberians, as well as Russian commercial sealing vessels, take a considerable number of seals every year, and it is likely that some (or all) these animals are members of the same population from which Alaskan seals are killed. Fortunately, current Russian harvest data is available for most of these animals (see Table 5 for harvest data from 1968 through 1971) and, therefore, it will be possible to determine the total Bering and Chukchi Sea yearly harvest with some degree of accuracy.

McLaren (1962) found that a safe annual sustainable kill for ring seals in Baffin Island was 8 percent of the total population. Since the figure was computed from a population experiencing maximum hunting mortality, it can probably be used as a safe indicator for the maximum hunting mortality for seal species with similar reproductive potential. In the Bering and Chukchi Seas this would include not only the ring seal, but the spotted seal as well, (Mansfield, 1967). Burns (1967) determined that age at sexual maturity for a bearded seal (female) is five to six years and the yearly pregnancy rate is approximately 80 percent in mature females. Since bearded seals have a lower reproductive potential, McLaren (1962) suggested a maximum sustainable yield of 5 percent as a safe first approximation of the harvest.

For initial analysis of the effect of native hunting on the various seal populations, it is probably safe to assume that 8 percent mortality is not an excessive level of exploitation for any species of seal. However, a more complete sampling of the harvest will provide answers with a greater degree of confidence.

It is doubtful that any of the three principal seal species (ring, spotted and bearded) along the northwest coast of Alaska are presently over-harvested or are even approaching these conditions, (Burns, 1967; personal communication). However, it is unrealistic to assume that these conditions would never occur and, therefore, it is essential to have a program which closely monitors the seal harvest from year to year. Only then can there be some assurance for the continued rational utilization of the resource.

ESTIMATED COSTS

		FY 1974	FY 1975
100	Principal investigator (Grauvogel)	None	None
	Assistant (Muktoyuk)	None	None
	Village specimen collectors (4 men at $150/mo.	7,200	7,200
	Village data recorders (4 men @ $75/mo.	3,600	3,600
	Laboratory tech. (for sectioning and reading large samples of teeth; 7 mo. @ $1,000/mo.	7,000	7,000
200	Field travel in Alaska (to collecting sites on a routine basis)	1,500	1,500
	Per diem in Alaska	1,200	1,200
300	Aircraft charter - 4 place; 10 hrs. @ $65/hr.	650	650
400	Purchase of specimens (minimum 3,000 sets at $.50 per set)	1,500	1,500
	Laboratory supplies	300	300
	Field and collecting supplies	600	600
		$23,550	$23,550

Table 1. Harvest of Hair Seals in Western and Northern Alaska From August 1, 1962 to July 31, 1963

Village	No. of Seals Taken	Village	No. of Seals Taken
Barrow	412	Noatak	106
Buckland	94	Nome	1,019
Candle	30	Platinum	19
Chevak	555	Point Hope	2,752
Deering	188	Point Lay	148
Eek	26	Savoonga	685
Elim	179	Scammon Bay	300
Gambell	605	Shaktoolik	195
Golovin	88	Shishmaref	4,537
Goodnews Bay	126	St. Michael	64
Hooper Bay	869	Stebbins	307
King Island	24	Teller	1,046
Kivalina	998	Unalakleet	38
Kotzebue	1,465	Wainwright	573
Little Diomede	427	Wales	617
Mekoryuk	656	White Mountain	2
N. E. Cape	19		
TOTALS			19,169

Table 2.--Seals bountied in the Second and Fourth Judicial Districts (western and northwestern Alaska) during 1965, and the species composition as indicated by examination of seal scalps and observation at some of the hunting sites

Village	Village Identification No.	Seal Harvest			
		All Seals	Ringed	Bearded	Harbor
Miscallaneous	0	826	516	150	160
Mekoryuk	1	1,332	532	300	500
Chevak	2	629	329	100	200
Hooper Bay	3	1,046	646	200	200
Scammon Bay	4	319	129	90	100
Stebbins	5	401	181	100	120
Unalakleet	6	173	93	40	40
Shaktoolik	7	321	171	70	80
Koyuk	8	172	82	40	50
Golovin	9	230	120	60	50
Nome	10	815	705	50	60
Savoonga	11	621	321	150	150
Gambell	12	893	543	200	150
Teller	13	320	135	35	150
Brevig Mission	14	729	559	70	100
Wales	15	761	636	75	50
Diomede	16	210	130	70	100
Shishmaref	17	6,604	4,404	1,000	1,200
Deering	18	180	100	40	40
Kotzebue	19	1,131	731	100	300
Kivalina	20	827	652	100	75
Point Hope	21	2,016	1,616	250	150
Wainwright	22	345	205	100	40
Barrow	23	114	54	40	20
TOTALS		21,015	13,590	3,430	3,995

Table 1. The Reported Harvest of Hair Seals in Northwest Alaska during 1966, as Indicated by Bounty Records.[1]

Village	I.D. Number	Number of Hunters	Harvest of Seals by Season[2] Jan - Mar	April - June	July - Sept	Oct - Dec	Exact Season Unknown	Total Harvest
Quinhagak	1	10	12	145	0	0	0	157
Eek	2	3	0	58	2	0	0	60
Mekoryuk	3	32	20	691	257	119	0	1,087
Chevak	4	20	60	268	4	0	0	332
Hooper Bay	5	33	80	483	55	26	42	686
Scammon Bay	6	5	6	27	49	58	0	140
Stebbins	7	7	12	67	0	0	0	79
St. Michael	8	1	0	6	0	0	0	6
Unalakleet	9	1	11	0	0	0	0	11
Shaktoolik	10	7	110	18	0	0	0	128
Koyuk	11	1	0	10	0	0	0	10
Elim	12	6	14	32	5	5	77	133
Golovin	13	1	19	0	0	0	0	19
Savoonga	14	33	168	149	113	115	191	736
Gambell	15	35	159	109	136	120	296	820
Nome	16	19	25	60	6	7	202	300
Teller	17	8	0	11	70	43	48	172
Brevig Mission	18	5	73	52	0	0	58	183
Wales	19	9	22	127	0	0	85	234
Diomede	20	11	67	87	0	0	7	161
Shismaref	21	33	572	1,153	807	607	152	3,291
Deering	22	5	0	18	0	0	102	120
Kotzebue	23	5	10	125	0	0	120	255
Noatak	24	2	0	75	0	0	75	150
Kivalina	25	12	177	170	2	0	96	445
Point Hope	26	42	1,125	996	229	0	221	2,571
Wainwright	27	3	27	27	15	0	0	69
Barrow	28	3	32	10	21	0	0	63
TOTALS		352	2,801	4,974	1,771	1,100	1,772	12,418

[1] The total harvest of seals in northwest Alaska approximated 15,000 animals. The discrepancy results from failure of hunters to submit scalps for bounty--especially bearded seals. As examples, the reported harvests from Barrow, Wainwright, Kotzebue, Koyuk, Unalakleet, St. Michael, Tununak and Eek are far below the actual harvests.

[2] The term "seals" applies to all species of hair seals found in this region.

Table 4. Seal harvest and percentage of catch in Western Alaska from 1963 through 1967.*

	1963	Percent of Harvest	1965	Percent of Harvest	1966	Percent of Harvest	1967	Percent of Harvest	Total	Percent Harvest
Hooper Bay	869		1046		686		683		3,284	5.1
Shishmaref	4537		6064		3291		2651		16,543	26.0
Savoonga	685		621		736		1436		3,478	5.4
Pt. Hope	2752		2016		2571		980		8,319	13.1
TOTAL	8843	46.1%	9747	46.4%	7284	58.7%	5750	51.7%	31,624	49.6
Other Villages	10,326	53.9%	11,268	53.6%	5,134	41.3%	5,375	48.3%	32,103	50.4
TOTAL HARVEST	19,169	100%	21,015	100%	12,418	100%	11,125	100%	63,727	100%

* Data for 1964 not available

Table 5. Russia seal harvest by Commercial vessels, resident Siberians from 1968-1971.*

	1968**	1969***	1970***	1971**
Commercial Vessel				
1. Ring	362	134	200	No data
2. Spotted	2,412	1,406	3,000	5,000
3. Bearded	2,096	642	No data	No data
4. Ribbon	6,388	2,775	3,500	3,001
Total	11,258	4,957	6,700	8,001
Resident Siberians				
1. Ring	1,982	1,055	2,078	1,521
2. Spotted				
3. Bearded	768	151	368	226
Total	2,750	1,206	2,446	1,747
GRAND TOTAL	14,008	6,163	9,146	9,748

* Data from 1972 International North Pacific Fur Seal meeting (Not published)

** Two Russia commercial vessels

*** One Russia commercial vessel