A Status Report
Pertaining to Management of Pacific Walrus
During Calendar Year 1978

Alaska Department of Fish and Game
Division of Game
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I. Introduction

This walrus status report covering calendar year 1978 is the third annual report submitted to the U.S. Fish and Wildlife Service, as required under terms of the "Alaska Waiver." Implementation of the waiver covering Pacific walruses (Odobenus rosmarus) and the partial return of management authority for this species to the State of Alaska was accomplished on 7 April 1976.

This report basically conforms to the guidelines and format for such reports, as published in the Federal Register, Vol. 40, No. 249, Wednesday, December 24, 1975. In addition, questions and comments of substance, resulting from federal review of the first annual status report (for 1976) have indicated the need for information additional to that included in the Federal Register notice. This additional information was forwarded in the form of supplemental submissions for 1976 and was included as an integral part of the status report for calendar year 1977. As of June 1979 the State of Alaska has received neither comment on the report for calendar year 1977, nor responses to the specific requests for information or action included in that report. Therefore, we have proceeded on the assumptions that: (1) the information requested will not be forthcoming, and (2) that the scope of the 1977 report was satisfactory.

During this reporting period, 1 January 1978 to 31 December 1978, no monies other than those provided through the Alaska Department of Fish and Game were available for our walrus research and management

programs. Available funds were limited in 1978 and were therefore devoted mainly to required management functions including harvest monitoring, sealing of raw ivory, and surveillance on Round Island (concurrent with a research effort supported by the U.S. Fish and Wildlife Service). Additionally, a great deal of time, money, and effort were devoted to administrative matters, State/Federal interactions, and interaction with the public, including the Eskimo Walrus Commission.

II. Specific Aspects of the State of Alaska's Walrus Management Program During Calendar Year 1978

This section of the annual status report is arranged to respond to specific information requirements as outlined in Federal Register (Vol. 40, No. 249, Wednesday, December 24, 1975) and as is appropriate in view of additional requests for information from individuals and agencies that reviewed the first annual Status Report for 1976 submitted by the Alaska Department of Fish and Game. In some instances in this report reference will be made to the 1976 and 1977 reports. As a matter of format, brief attachments referred to in the text are included in the body of this report. Longer attachments are appended.

(1) Any changes in the State laws or regulations

During 1978 the State of Alaska promulgated one Emergency Regulation, three Emergency Orders, and one normal change in regulations pertaining to Pacific walruses. In May 1978, Emergency regulations were enacted at the direction of the Alaska Board of Game to establish a quota of 100

permits for the recreational taking of walruses by both resident (to the State of Alaska) and nonresident hunters. In accordance with the Administrative Procedures Act and actions of the Alaska Board of Game, these regulations remained in effect to become general hunting regulations, effective 1 July 1978. This quota was additional to that established for residents dependent upon walrus for sustenance. Separating the quotas applicable to residents dependent upon walrus for sustenance or who take walruses for the manufacture of articles of Native handicraft from that applicable to all other walrus hunters ensured that each area with a harvest quota could take the entire quota to meet local needs and that any walrus taken by recreational hunters would not be part of an area quota. Recreational hunters would have their own harvest quota of 100 walruses to be taken in Game Management Units open to walrus hunting. Local guides and hunters would not be disadvantaged by area closures resulting from attainment of area quotas, so long as the required recreational hunting permit was previously obtained. Meat and other edible byproducts obtained by recreational hunters were available to local residents.

The walrus hunting season was closed by Emergency Order in Area 2 (around Savoonga) on 16 May 1978 when the maximum allowable harvest quota of 450 walrus was taken. The season was also closed in Area 4 (around Wales) on 2 June 1978 as the established quota was also attained. In both areas the season remained closed until 1 July 1978 when the new "regulatory year" began.

An unusually large number of walruses (up to 6,000) hauled out on King Island during late June 1978. The season was closed by Emergency Order in the vicinity of King Island from 9 July to 30 September 1978. This was done to encourage the continued use of King Island by walruses as a summer resting area in 1978. During this year the island supported the largest concentration of walruses utilizing a hauling ground during summer in the American sector of Bering Strait.

Area harvest quotas were developed in 1976 to distribute the annual allowable harvest of walruses, under the terms of the waiver. Consequently, more accurate methods of continuously monitoring harvest levels have become necessary. The Alaska Board of Game adopted regulations effective 1 July 1978 that required all raw walrus ivory to be sealed within 15 days of the animal being taken or the ivory being found. The Board concurrently eliminated the raw ivory permit requirement for purchasing or selling raw ivory. The permit system was found to be inadequate as a method of measuring the harvest or in regulating the commerce of raw ivory. Additionally, the conditions of the permit were not adhered to by many hunters and purchasers, and appeared to be unenforce able. Effectiveness of the new ivory sealing requirements will be known only after they have been in effect for a reasonable period of time and only if ivory from beach cast walruses will be accurately reported.

Attached documents include: (1) the findings of emergency requiring establishment of separate harvest quotas for recreational and nonrecreational hunters; (2) the Emergency Regulations that were effective in May

1978 and subsequently became the general hunting regulations effective 1 July 1978; (3) Emergency Orders closing the seasons in Areas 2, 4, and around King Island; (4) a copy of the permit hunt supplement with regulations for recreational hunters; and (5) a copy of the raw ivory sealing regulations.

(2) Any new data on the marine mammal stocks or the marine ecosystems in question

During 1978 no efforts were devoted to direct enumeration of the size of the walrus population. As a result of joint US-USSR deliberations on marine mammal research in the North Pacific Region it has been mutually agreed that the very costly and time consuming surveys required to derive minimum population estimates should be undertaken at 5-year intervals. Further, it has been recommended and tentatively agreed that a joint US-USSR walrus survey be conducted in autumn 1980. The last joint survey was conducted in autumn 1975.

Evaluation of a proposed commercial fishery for clams, mainly the surf clam (Spisula polynyma) and the Alaska tellin (Tellina lutea), in southeastern Bering Sea and Bristol Bay intensified during this reporting period. Preliminary test fishing trials showed commercial quantities of these clams in a region north of the Alaska Peninsula from the vicinity of Ugashik Bay (57°35'N, 157°42'W) in the northeast to Port Moller (55°59.5'N, 160°34.5'W) in the southwest.

Walruses depend extensively on clams, including the species targeted

BOARD OF GAME
FINDING OF EMERGENCY

The Alaska Board of Game finds than an emergency exists and that the attached regulation amendment is necessary for the immediate preservation of the public peace, health, safety or general welfare. A statement of the facts constituting the emergency is:

1. Quotas have been established by regulation for the take of walrus in various areas of Units 22, 23 and 26 to fairly allocate the resource among users from various villages.

2. A minor portion of the annual walrus harvest is taken by recreational hunters, both resident and nonresident, but this portion is very important to hunters, native guides, and general economy of the area.

3. The timing of the nonresident and recreational hunts is such that the entire quota listed for Units 22, 23 and 26 may be taken (and the season closed by emergency order) prior to the time that recreational hunters would normally hunt.

4. Establishment of a quota for recreational hunters would reduce resentment of local residents from whose quota the take by recreational hunters would other-wise be deducted.

ADOPTION

Under authority of AS 16.05.255., the amendment is therefore adopted as an emergency regulation to take effect immediately upon filing by the lieutenant governor as provided in AS 44.62.180(3).

Chapter 81. Hunting

Article 9.
Hunting Seasons and Bag Limits

5 AAC 81.350(4) is amended:

(4) WALRUS.

Unit 9	No open season	
Unit 17, except for that portion in the Walrus Islands State Game Sanctuary (including all waters within 1/2 mile of Round Island).	Resident: Oct. 20 - Dec. 1 Mar. 1 - Apr. 30 Nonresident: No open season	One walrus for food, by permit only. A total of 50 permits will be issued to applicants who appear in person at the Villages of Togiak, Manokotak, Twin Hills and Clarks Point, on a first-come, first-served basis.

(A) The following areas, seasons and bag limits apply to the taking of walrus by unit residents partially dependent upon walrus for sustenance.

Unit 18	No closed season	Residents of Unit 18 traditionally dependent upon and utilizing walrus for sustenance may take up to 5 adult cows or subadults (either sex) and adult bulls without limit; and provided further that orphaned calves may be taken for food

		without contributing to the bag limit.
Unit 22	No closed season	Residents of Unit 22 traditionally dependent upon and utilizing walrus for sustenance may take up to 10 walruses, not more than 5 of which may be adult cows or subadults (either sex); that orphaned calves may be taken for food without contributing to the bag limit; and that certain specific area quotas apply, as listed below:

Areas	Annual quota of walruses that may be taken for sustenance
1. The waters of Bering Sea near the settlement of Gambell within the area bounded by lines connecting the following positions: 64° 30' N, 171° 22' W; 64° 30' N, 171° 00' W; 63° 00' N, 171° 00' W; 63° 00' N, 174° 59' W; and the U.S.-Russian Convention Line of 1867 between 63° 00' N, 174° 59' W and 64° 30' N, 171° 22' W.	450
2. The waters of Bering Sea near the settlement of Savoonga within the area bounded by lines connecting the following positions: 64° 30' N, 171° 00' W; 64° 30' N, 168° 00' W; 63° 00' N, 168° 00' W; 63° 00' N, 171° 00' W; 64° 30'N, 171° 00' W.	450
3. The waters of Norton Sound and Bering Sea near the settlements of Nome and King Island within the area bounded by lines connecting the following positions: 65° 10' N, 168° 50' W; 65° 10' N, 166° 55' W; 64° 33' N, 163° 30' W; 63° 30' N, 163° 30' W; 63° 30' N, 168° 50' W; 65° 10' N, 168° 50' W.	250
4. The waters of the Bering and Chukchi Seas near the settlement of Wales within the area bounded by lines connecting the following positions: 66° 00' N, 167° 55' W; 66° 00' N, 167° 20' W; 65° 10' N, 167° 20' W; 65° 10' N, 167° 50' W; 65° 32' N, 168° 40' W; 65° 45' N, 168° 40' W; 66° 00' N, 167° 55' W.	150
5. Waters of the Bering and Chukchi Seas near the settlement of Diomede within the area bounded by lines connecting the following positions: 66° 20' N, 168° 59' W; 66° 20' N, 167° 30' W; 66° 00' N, 167° 30' W; 66° 00' N, 167° 55' W; 65° 52' N, 168° 20' W; 65° 10' N, 168° 20' W; 65° 10' N, 169° 45' W; 65° 30' N, 168° 59' W; 66° 20' N, 168° 59' W.	450

6. Waters of the Chukchi Sea near the settlement of Shishmaref within the area bounded by lines connecting the following positions: 67° 00' N, 167° 30' W; 67° 00' N, 164° 00' W; 66° 36' N, 164° 00' W, 66° 00' N, 167° 00' W; 66° 00' N, 167° 30' W; 67° 00' N, 167° 30' W.		150
Units 23 and 26	No closed season	Residents of Units 23 and 26 traditionally dependent upon and utilizing walrus for sustenance may take up to 5 walrus; orphaned calves may be taken for food without contributing to the bag limit. Certain specific area quotas apply as listed below:

Areas	Annual quota of walruses that may be taken for sustenance
7. Waters of the Chukchi Sea near the settlement of Wainwright within the area bounded by lines connecting the following positions: 72° 30' N, 161° 30' W; 71° 30' N, 158° 30' W; 70° 48' N, 158° 30' W; 70° 15'N, 161° 30' W; 71° 30" N, 161° 30' W.	160
8. Waters of the Chukchi and Beaufort Seas near the settlement of Barrow within the area bounded by lines connecting the following positions: 71° 10' N, 158° 30' W; 72° 10' N, 154° 00' W; 70° 50' N, 154° 00' W; 70° 48' N, 158° 30' W; 72° 10' N, 158° 30' W.	180

(B) The following areas, seasons, and bag limits apply to residents of Units 18, 22, 23 and 26 not partially dependent upon walrus for sustenance, other Alaska residents and nonresidents.

Units 18, 22, 23 and 26	No closed season	One adult bull, by permit only*. 100 permits will be available.

* By permit. Refer to 5 AAC 81.050(16)

Note: It is the intent of the State of Alaska to limit the annual take of walruses to less than 2,300 per year. If this number is exceeded, further restrictive regulations will be implemented. If the take exceeds 3,000 walruses, hunting will be closed for the remainder of the regulatory year.

Authority: AS 16.05.255(?)(4)

HUNTING-TRAPPING

Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Under Authority of AS 16.05.060

EMERGENCY ORDER NO. 5-01-78

Issued at Nome, May 15, 1978

Effective date 12:01 a.m. May 16, 1978

Expiration date June 30, 1978 unless superseded by subsequent emergency order

JUSTIFICATION:

Hunting success by Savoonga residents traditionally dependant on and utilizing walrus for sustenance during the year and in the past several days has been very good and the recommended allowable walrus harvest in the Savoonga area has been achieved. To avoid a harvest in excess of the maximum quota the walrus hunting season for residents traditionally dependant upon and utilizing walrus for sustenance will be closed effective 12:01 a.m. May 16, 1978.

REGULATION:

5 AAC 81.350 is therefore amended to read:

5 AAC 81.350 Marine Mammal Hunting (4) (Walrus)

(A) The following areas, seasons and bag limits apply to the taking of walrus by unit residents partially dependant upon walrus for sustenance.

Unit 22, Area 2.

2. The waters of the Bering Sea near the settlement of Savoonga within the area bounded by lines connecting the following positions: 64° 30'N, 171° 00' W; 64° 30' N, 168° 00' W; 63° 00' N, 168° 00' W; 63° 00' N, 171° 00' W; 64° 30' N, 171° 00' W are closed to the taking of

HUNTING-TRAPPING

Emergency Order

Under Authority of AS 16.05.060

ALASKA DEPARTMENT OF FISH AND GAME

Emergency Order No. 5-02-78 Issued at Nome, 1 June 1978

Effective Date: 12:01 AM 2 June 1978 Expiration Date: 30 June 1978 unless superceded by subsequent emergency order

Justification:

Hunting success during the past several days by Wales residents traditionally dependent upon and utilizing walrus for sustenance, has been very good and the recommended allowable walrus harvest in the Wales area has been achieved. To avoid a harvest in excess of the maximum quota, the walrus hunting season for residents of Wales traditionally dependent upon and utilizing Walrus for sustenance will be closed effective 12:01 AM, 2 June 1978.

Regulation:

5 AAC 81.350 is therefore amended to read:

5 AAC 81.350 Marine Mammal Hunting (4) (Walrus)

(A) The following areas, seasons and bag limits apply to the taking of walrus by unit residents partially dependent upon walrus for sustenance.

Unit 22 Area:

4. The waters of the Bering and Chukchi seas near the settlement of Wales within the area bounded by lines connecting the following positions:

66° 00' N. 167° 55' W. 66° 00' N. 167° 30' W. 65° 30' N. 167° 30' W.

HUNTING-TRAPPING

Emergency Order

Under Authority of AS 16.05.060

ALASKA DEPARTMENT OF FISH AND GAME

Emergency Order No. 5-03-78
Effective Date: 12:01 July 9, 1978

Issued at Nome, July 8, 1978
Expiration Date: September 30, 1978 unless superceded by subsequent emergency order

JUSTIFICATION:

During the last two weeks from 2,000 to 8,000 walrus have been hauling out on the beach at King Island to rest. This is the first major hauling out of walrus on King Island in many years. To encourage the establishment of a permanent summer resting ground in the northern Bering Sea the hunting season for walrus on King Island and the waters within one mile of the Island are closed effective 12:01 A.M. July 9, 1978.

REGULATION:

5 AAC 81.350 is therefore amended to read:

5 AAC 81.350 Marine Mammal Hunting (4) walrus

(A) The following areas, seasons, and bag limits apply to the taking of walrus by unit residents traditionally dependent upon walrus for sustenance.

Unit 22, except King Island and waters within one mile of it.	No closed season	Residents of Unit 22, traditionally dependent upon and utilizing walrus for sustenance, may take up to 10 walruses, not more than 5 of which may be adult cows or subadults (either sex); that orphaned calves may be taken for food without contributing to the bag limit; and that certain specific area quotas apply, as listed below;
Unit 22, that portion comprising King Island and the waters within one mile of the Island.	No open season	

(B) The following areas, seasons, and bag limits apply to residents of Units 18, 22, 23 and 26 not traditionally dependent upon walrus for sustenance, other Alaska residents and nonresidents.

Units 18, 22 (except King Island and the waters within one mile of the Island), 23 and 26	No closed season	One adult bull, by permit only. 100 permits will be available. Permits may be obtained by applying in person at Nome, Kotzebue, Barrow and Bethel.

Unit 22, that portion comprising King Island and the waters within one mile of the Island	No open season

Ronald O. Skoog
Commissioner

by delegation to:

Robert E. Pegau
Regional Supervisor

EXPLANATION:

walrus hauling out grounds in Alaska have been confined to the Walrus Islands State Game Sanctuary in Bristol Bay. The use of King Island in the northern Bering Sea by large numbers of walrus is unprecedented within the memory of long time residents of the Island. The ice pack with which these walrus are normally associated has receded several hundred miles north of King Island. Hunting of walrus on summer hauling out grounds will usually cause them to abandon the site, so to encourage continued use of King Island by walrus during the summer months this emergency order has been enacted.

DISTRIBUTION:

Lt. Governor, Board of Game, Department of Public Safety, Bering Straits Native Corporation, King Island Native Corporation, Sitnasuak Native Corporation, radio stations KICY and KNOM, Nome newspapers: Nome Nugget and Bering Straights. Copies of this order are available from Department of Fish and Game offices in Juneau and Nome

WALRUS

Hunt Number	Season Dates	Area & Game Management Unit	Legal Walrus
1250	July 1-June 30	Units 18, 22, 23, & 26	Adult Bull

WALRUS HUNT 1250 Units 18, 22, 23, and 26, for Adult Bulls Only

Hunt Area: Units 18, 22, 23, and 26

Season Dates: July 1-June 30

Permits Available: Permits will be issued throughout the season at Department of Fish and Game offices in Anchorage, Barrow, Kotzebue, Bethel, Fairbanks, and Nome, Alaska, during regular Department working hours.

Conditions Specific to Hunt 1250:

1. Hunters shall obtain their permits by appearing in person at a Department of Fish and Game office in Anchorage, Barrow, Kotzebue, Fairbanks, Bethel, or Nome, Alaska, during regular Department working hours prior to beginning their hunt.
2. All permittees shall return their completely filled-out permit report to one of the above Department offices during regular Department working hours within the time specified on the permit.
3. Walrus may be taken legally only with a hand-held nonautomatic rifle using a centerfire cartridge larger than .264 caliber (6.4mm), except that .30-30-caliber may not be used, or with the aid of spears or harpoons that are hand-held or thrown.
4. Only surface transportation may be used; all boats engaged in walrus hunting shall be equipped with two functional harpoons, including lines and floats.
5. There is a statewide quota of 3,000 walrus assigned by geographical area (see Hunting Regulations booklet for areas and numerical quotas). When quota is taken in each area, the season will be closed by emergency announcement.
6. Hunters taking a walrus will present the tusks to a Department representative for sealing within 15 days of the time of taking.

Additional Information on Hunt 1250: Walrus hunting is not allowed in Unit 9.

5 AAC 81.195. SEALING OF RAW WALRUS IVORY. (a) No person may possess, buy, sell, trade, give or otherwise transfer any raw walrus ivory (except fossilized ivory) found and/or taken inside or outside of Alaska unless it has been sealed by an authorized representative of the department. Seals must remain on each tusk until the entire tusk has been altered by carving, cutting, grinding, etching, sanding, filing or drilling to create a cultural, functional or aesthetic product, or until an appropriate department marking is applied or exchanged for the seal; surface polishing does not constitute altering under this section.

(b) Possessing, buying, selling, trading, giving or transferring portions of raw walrus ivory tusks may be authorized if the original sealed tusk is presented prior to cutting up so that the portion to be transferred may also be sealed.

(c) Notwithstanding the provisions of (a) of this section, the person finding raw walrus ivory and/or taking a walrus may possess unsealed, raw ivory from that source for a period not to exceed 15 days from the time of taking or finding or shall be tendered immediately for sealing upon the request of an authorized representative of the department.

(d) No person may falsify any information required on the sealing form provided by the department.

for commercial exploitation. Additionally, based on data from aerial surveys in spring 1976 and count trends on Round Island, in northern Bristol Bay, numbers of walruses in the Bay have been increasing. Based in part on concerns generated in Alaska, Dr. Sam W. Stoker, University of Alaska, Fairbanks, was contracted by the U.S. Marine Mammal Commission to prepare a report on the proposed fishery. The final report entitled "Report on a Subtidal Commercial Clam Fishery Proposed for the Bering Sea" (Final Report MMC-77/01, 33pp.) became available in late 1977. Because of its unlimited availability from the Marine Mammal Commission it is not appended to this document.

In view of the potential direct competition for the clam resource between walruses and fishermen in Bristol Bay, the Game Division of the Alaska Department of Fish and Game also prepared a preliminary evaluation of the impact of this fishery on walruses. This evaluation is attached as Appendix I. Additionally, plans were formulated for a more rigorous study of walruses in the proposed fishery area.

Concurrent studies by other agencies or organizations were conducted during 1978. These included an assessment of clam distribution and biomass along the north side of the Alaska Peninsula, undertaken by the National Marine Fisheries Service, and concurrent studies of the effects of hydraulic clam dredging on sediments and benthic communities in the proposed fishery area. The latter study was undertaken by Tetra Tech Inc.

It is anticipated that further studies of walruses in the fishery area will be undertaken in 1979 or 1980, pending availability of contract monies.

From spring to early winter 1978, walrus hunters reported several unusual situations; large numbers of animals hauling out at various locations, a large proportion of walruses in poor condition (usually reported as abnormally skinny and/or lethargic), and a high incidence of natural mortality.

Due to lack of funds, no effort was made by the Alaska Department of Fish and Game to obtain data on the frequency and extent of debilitation in harvested animals. Regarding hauling areas, those reported were visited, if possible, in the course of other Department duties in the vicinity of reported hauling areas. Verified hauling areas utilized during 1978 are indicated in Table 1.

(3) Harvest Data 1978

Harvest data were collected by Department personnel and local hunters employed throughout the Game Management Units open to walrus hunting. These data for the 12-month reporting period are presented in Tables 2 and 3. The sex composition, geographical distribution, and seasonal distribution of the 1978 harvest can be further summarized as follows:

Table 1. Information on major hauling grounds in Alaska used by Pacific walrus in 1978.

Location	Dates of	Number of Walruses	Sex Composition	Comments and Information Source
Round Island	May to Oct.	Variable, up to 12,000	Males only	C. Smith, ADF&G: J. Taggart and C. Zabel, Univ. Calif. Santa Cruz.
Nunivak Island	June to Sept.	Variable, 500 to 1,500	Males only	J. Williams, resident of Mekoryuk.
St. Lawrence Island	June to Nov.	Variable up to more than 30,000	Males and	Walrus numerous in adjacent waters all summer and Autumn. Hauled out at six different sites including the Punnuk Islands. A. Okeya, resident of Savoonga; R. Nelson and R. Pegau, ADF&G, Nome; F.H. Fay, Univ. Alaska, Fairbanks; and numerous other sources.
King Island*	June to Nov.	Variable up to 6,000	Males and females	E. Muktoyuk and R. Pegau, ADF&G, Nome.
Little Diomede	July to Sept.	Variable up to 2,500	Males and females	A. Iyahuk, resident of Diomede; R. Pegau, ADF&G, Nome.
Cape Lisburne	July to ?	Up to 500	Males and females	A. Springer and D. Roseneau, L.G.L., Ltd., Fairbanks, Alaska.

* By mutual agreement between the King Island Village Council and the Alaska Department of Fish and Game, King Island was closed to walrus hunting during summer 1978. This step was taken to protect resting walruses from undue disturbance and harrassment on the island.

Table 2 Walrus harvest in Alaska during 1978.

Village	January - March			April - June			July - September			October-December			Total
	M	F	C	M	F	C	M	F	C	M	F	C	
Mekoryuk	0	0	0	32	0	0	0	0	0	-----20-----			52
Remainder - Yukon-Kuskokwim Delta	0	0	0	-------50-------			0	0	0	-----68-----			118
Stebbins	0	0	0	17	0	0	0	0	0	0	0	0	17
Unalakleet	0	0	0	-------20-------			0	0	0	1	0	0	21
Gambell	36	1	0	81	121	131	5	1	0	94	----1----		471
Savoonga	8	0	0	272	121	130	7	12	0	14	3	0	567
Nome-King Island	0	0	0	84	94	30	0	0	0	0	0	0	208
Brevig Mission	0	0	0	7	84	5	0	0	0	0	0	0	96
Wales	0	0	0	149	25	0	0	0	0	0	0	0	174
Diomede	0	0	0	203	92	23	------10-------			0	0	0	328
Shishmaref	0	0	0	73	37	10	0	0	0	0	0	0	120
Kivalina	0	0	0	0	0	0	1	0	0	0	0	0	1
Point Hope	0	0	0	0	0	0	0	1	0	0	0	0	1
Wainwright	0	0	0	0	0	0	11	9	0	0	0	0	20
Barrow	0	0	0	0	0	0	------30-------			0	0	0	30
Total (known composition)	44	1	0	918	574	329	24	23	0	109	3	0	

Grand Total		
	Males	1,095
	Females	601
	Calves (either sex)	329
	Adults (sex unknown)	199
	Total	2,224

Table 3

Village	1978 Harvest	Permitted Sport Harvest*	Portion of Total Harvest % at each village	Hunting Loss	Estimated Total Kill	Boat hours per walrus retrieved
Mekoryuk	52	9	2.34	50	104	-
Remainder of Yukon Kuskokwim	118	0	5.31	50	236	-
Stebbins	17	2	0.76	60	42	-
Unalakleet	21	0	0.94	60	53	-
Gambell	471	5	21.18	40	785	4.00
Savoonga	567	29	25.50	40	945	2.00
Nome-King Island	208	9	9.35	65	594	-
Brevig Mission	96	0	4.32	60	240	-
Wales	174	2	7.82	55	387	-
Diomede	328	1	14.75	25	437	1.40
Shishmaref	120	0	5.40	50	240	-
Kivalina	1	0	0.04	-	1	-
Point Hope	1	1	0.04	-	1	-
Point Lay	0	0	0.00	-	0	-
Wainwright	20	8	0.90	-	20	-
Barrow	30	1	1.35	-	30	-
Other Areas	0	0	0.00	-	0	-
Totals	2,224	67			4,115	

* Permitted sport harvest is included in the harvest figures for each village where such taking occurred.

Sex composition of 2,224 walrus taken in Alaska during 1978.

Sex and Relative Age	Number	Percent of Harvest
Males older than 1 year	1,095	49.2
Females older than 1 year	601	27.0
Calves of either sex	329	14.8
Sex unknown (adults)	199	9.0

Geographical distribution of the 1978 walrus harvest.

Region	Sex	Number	Percent of Harvest
Bering Sea		2,052	92.3
	Males	1,010	49.2
	Females	554	27.0
	Calves	319	15.6
	Sex unknown	169	8.2
Chukchi Sea		172	7.7
	Males	85	49.4
	Females	47	27.4
	Calves	10	5.8
	Sex unknown	30	17.4

Seasonal distribution of the 1978 harvest.

Season	Number	Percent of Harvest
January-March	45	2.0
April-June	1,891	85.0
July-September	87	3.9
October-December	201	9.1

The abundance of walruses within their range, particularly in Bristol Bay, has continued to increase. This increase, together with increased commercial fishing effort in northern Bering Sea, has undoubtedly increased the incidence of illegal and unreported taking, especially in view of the current value of raw ivory. Our best estimate of the extent of illegal taking in 1978 was 100 to 150 animals. Perhaps this could be verified on the basis of "undercover" enforcement efforts made by agents of the Fish and Wildlife Service. The Alaska Department of Fish and Game has not been provided with any information about these investigations.

(4) A summary of all research activity on the stocks or ecosystem in question.

The Alaska Department of Fish and Game is not in a position to summarize all research activity on the ecosystem in question. Range of the Pacific walrus includes the Bering, Chukchi, Beaufort, and East Siberian Seas as well as part of the Arctic Ocean. These regions are

subject to exploitation and scientific investigation by a large number of people from many nations and representing many disciplines.

Studies bearing most directly on the ecosystem of which walruses are a part were conducted under the aegis of the BLM/NOAA Outer Continental Shelf Environmental Assessment Program. Annual reports of studies conducted in 1978 are available elsewhere (U.S. Department of Commerce, NOAA. 1978. Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators. Vol. 1 to 13. Boulder, CO).

Research partly supported by the State of Alaska included studies conducted on Round Island, one of the Walrus Island group in Bristol Bay. This research involves three broad areas: (1) behavior patterns of individual walruses on the hauling grounds; (2) analysis of social interactions among walruses; and (3) assessment of the impact of man-caused disturbance on walruses using the rookeries. Mr. S. James Taggart and Ms. Cindy Zabel conducted the actual field work. The USFWS provided logistics and developmental costs and the State of Alaska provided field equipment and salaries.

Mr. Taggart was working under the direction of Dr. James Estes (USFWS) of Santa Cruz. The results of his scientific research can be obtained through the Fish and Wildlife Service.

A bibliography of reports and publications prepared by personnel of the Alaska Department of Fish and Game in 1978 is included below.

1978 Burns, J. J. The ribbon seal. In R. J. Harrison and S. H. Ridgway, eds. Handbook of Marine Mammals. London: Academic Press (in press).

1978 Burns, J. J. Ice seals of the Bering and Chukchi Seas. Pacific Search Press. Seattle, WA (in press).

1978 Burns, J. J. and A. Gavin. Recent records of hooded seals, Cystophora cristata Erxleben, from the western Beaufort Sea. (Manuscript submitted).

1978 Burns, J. J., ed. Probable impacts and consequences of oil development. Pages 288-320 in Interim Synthesis: Beaufort/ Chukchi. NOAA/OCSEAP, Boulder, CO. 362pp.

1978 Eley, T. and L. F. Lowry, eds. Marine Mammals. Pages 134-151 in Interim Synthesis: Beaufort/Chukchi. NOAA/OCSEAP, Boulder, CO. 362pp.

1978 Lowry, L. F. Status of the Pacific walrus. Alaska Dept. Fish and Game, Wildl. Inf. Leafl. No. 4. 4pp.

1978 Lowry, L. F., K. J. Frost and J. J. Burns. Foods of ringed seals and bowhead whales near Point Barrow, Alaska. Can. Field-Nat. 92(1):67-70.

The publication "Status of the Pacific Walrus" prepared by L. F. Lowry is included as Appendix 2.

This continued increase in size of the walrus population is manifest in several ways including (1) the increasing number of walruses remaining in Bristol Bay during summer, (2) the increasing use of shore haulouts in northern Bering Sea and Bering Strait, and (3) the increase in extra limital occurrences of walruses. During 1978 walrus hunters of the Bering Strait region expressed increasing concern about the poor condition of many of the walruses they harvested.

In autumn 1978 an unusually large number of walruses died on the beaches of St. Lawrence and the nearby Punuk Islands. These mass mortalities were reported to ADF&G through a field assistant who resided on St. Lawrence Island. Due to lack of program funds the Department was unable to investigate the occurrences. However, Dr. Francis H. Fay, University of Alaska, was immediately informed of the incidents and was able to investigate the circumstances. His findings relative to these 1978 events were published and are attached as Appendix 3.

The mass mortality reported by Fay is probably directly related to the large and increasing walrus population.

(5) Any changes in the information provided with the original request for return of management.

Major changes in information originally provided have already been mentioned. These include the increasing size of the walrus population, the increasing frequency of debilitated animals taken by Native hunters, the increasing number of walruses utilizing shore rookeries, and the

increased numbers of walruses occurring in Bristol Bay (also the extra-limital occurrences).

The Alaska Department of Fish and Game is currently facing strong and growing opposition from coastal residents to the restrictive overall harvest quota of 3,000 animals. These residents are empirically well aware of the general status and trend of the population and are becoming increasingly frustrated about their inability to have the quota changed. The ADF&G shares their concerns and frustrations. During 1978 the court challenge to regulation of subsistence hunting, filed on behalf of the people of Togiak in 1977, remained unresolved.

The matter of marking and accounting for raw ivory was resolved in 1978. This subject will be discussed in a subsequent section of this status report.

(6) A summary of all enforcement activity, including permits issued, skins sealed, reports under permits, investigations undertaken and their dispositions.

A. Permits and tags

Walrus sport hunting permits were again issued to hunters not dependent upon, nor utilizing, walrus for sustenance. Analysis of the data regarding hunters obtaining permits is as follows:

Residency of Hunters	#Permits Issued	Hunted	Did not Hunt	Used Guides		Successful	Unsuccessful
				yes	no		
Resident	134	80	54	22	58	37	43
Nonresident	34	29	5	27	2	25	4
Foreign	6	6	-	6	-	5	1
Totals	174	115	59	55	60	67	48

A total of 174 permits to hunt walrus were issued in 1978, of these, 59 hunters did not hunt.

The following indicates sport harvest by village and the hunter success.

Village	Resident			Nonresident			Foreign			Grand Total	
	S[1]	U[1]	T[1]	S	U	T	S	U	T	S	U
Mekoryuk	3	2	5	5	0	5	1	0	1	9	2
Stebbins	2	0	2	0	0	0	0	0	0	2	0
Gambell	4	3	7	1	0	1	0	0	0	5	3
Savoonga	16	1	17	9	3	12	4	1	5	29	5
Nome-King Island	4	12	16	5	0	5	0	0	0	9	12
Wales	1	0	1	1	0	1	0	0	0	2	0
Diomede	0	0	0	1	0	1	0	0	0	1	0
Pt. Hope	1	0	1	0	0	0	0	0	0	1	0
Wainwright	3	0	3	5	0	5	0	0	0	8	0
Barrow	1	9	10	0	0	0	0	0	0	1	9
Totals	35	27	62	27	3	30	5	1	6	67	31[2]

1/ S, U, T = Successful, Unsuccessful and Total

2/ Of the 48 unsuccessful hunters, 31 provided enough information to determine the exact location from which they hunted.

A total of 67 walrus were taken by permitted recreational hunters. The seasonal distribution of the sport harvest was as follows:

Months	Residents	Nonresidents	Foreign	Total
Jan-March	0	0	0	0
April-June	32	21	5	58
July-Sept	5	4	0	9
Oct-Dec	0	0	0	0
	37	25	5	67

Permitted recreational hunters spent between one and ten days hunting for walrus. Twenty-nine successful hunters took their walrus during the first day of the hunt.

There were 33 permits issued to visit the Walrus Island State Game Sanctuary during 1978. Most permits were for parties larger than 1 person. Three permits issued to tourists aboard the vessel Lindblad Explorer were for 216 people.

Raw ivory permits were required during the first six months of the report period and 205 such permits were issued.

During 1978, officers of the Division of Fish and Wildlife Protection made 272 contacts and spent 10,562 hours in enforcing marine mammal regulations. A breakdown of this effort representing that time devoted entirely to walruses is unavailable. As described in the 1977 status report several Division of Game personnel were involved in enforcing marine mammal regulations including walrus regulations.

(7) Budget and staffing level for walrus-related activities during 1978.

No one person works solely (full-time) on walrus. However, several full-time (permanent) employees, as well as seasonal employees are involved with the walrus management and research program. During the intensive periods of activity, primarily the spring hunting season, several persons are involved full-time with walrus programs. During calendar year 1978 the approximate number of man-months devoted to programs pertaining to walrus was as follows:

(A) Man-months - Permanent employees - regional operations.

Nome	-	17.5
Kotzebue	-	.5
Barrow	-	.5
Fairbanks	-	4.0
King Salmon	-	1.0
Bethel	-	.5
Anchorage	-	.5
Juneau	-	1.0

Total effort - Permanent personnel - 25.5 man-months.

(B) Man-months - Temporary employees

Walrus Islands	-	4.5
Hunting villages (Bering Sea)	-	8.5
Hunting villages (Chukchi Sea)	-	2.5
Laboratory work	-	.5
Record compilation	-	1.0
Clerical	-	1.0
Permits	-	1.0

Total effort - Temporary personnel - 19.0 man-months.

The figures above do not include any of the effort devoted to enforcement of walrus regulations by employees of the Department of Public Safety.

The estimated funding level of programs carried out by the Department of Fish and Game pertaining to walrus during 1978, including personnel services, operating funds, comodities, contractual services, and equipment was $174,000.

(8) The rate of loss associated with taking and an indication of total (retrieved and unretrieved) take.

Specific details on the estimated total kill and the rates of hunting loss can be seen in Table 3. These rates were determined for villages at which Department personnel were stationed. Based upon these figures, the overall loss rate for 1978 is placed at 50 percent. Several factors contributed to this loss rate. During the first week of June a prolonged storm forced an extensive concentration of ice close to the southern coastline of the Seward Peninsula particularly between Nome and Wales. Associated with this ice were numerous pods of walrus, principally nursery groups. Hunters from Nome, Brevig Mission and Wales, many of which are relatively inexperienced walrus hunters, had ready access to large numbers of these animals. Consequently, high loss rates and a high incidence of orphaned calves were associated with these villages.

The estimated total kill in 1978 was 4,115 walruses. This number has been derived by assuming all walruses struck by rifle fire and all calves which are orphaned will die. The assumptions are not necessarily true. This method of estimating hunting loss is used to insure that annual mortality resulting from hunting is not underestimated. It should be borne in mind that estimates of hunting loss are just that--estimates. They have been, and will continue to be, contested by the walrus hunting public.

(9) The number of animals taken for ivory alone, by sex and location.

In 1978 it was estimated that the taking solely for ivory was as follows:

Village	Males	Females	Unknown sex
Mekoryuk			14
Stebbins			10
Unalakleet			10
Gambell	55	49	
Savoonga	126	48	
Nome-King Island	40	47	
Brevig Mission	4	42	
Wales	88	12	
Diomede	101	37	
Shishmaref	44	22	

The total estimated number of walruses taken for ivory alone (i.e. for purpose of creating authentic articles of Native handicraft) during 1978 was 458 bulls, 257 cows, and 34 animals of unknown sex. This represents 34 percent of the total harvest. The actual number of walrus taken at any one village that have absolutely nothing but the head removed is less than 34 percent of the total take. However, of the walrus taken the total amount actually utilized is far less than that indicated as the percent taken only for ivory. This is because some pieces of meat are usually removed from each walrus killed. The total amount of meat actually retrieved from adult walruses is relatively low hence the high estimates of the percent taken for ivory alone.

(10) Any other actions taken to give subsistence takers preference over non-subsistence takers.

The only take allowed in Game Management Unit 17 is for food by local residents. In Units 18 22, 23, and 26 separate seasons and bag limits were established by the Alaskan Board of Game which provides for a maximum of 100 permits to be issued to Alaskan residents and all non-residents that are not partially dependent upon walrus for sustenance.

During this reporting period 2,157 walruses, which was 97 percent of the total harvest, were taken by subsistence hunters.

(11) The extent to which subsistence needs of Native and non-Native are being met under the current regulations and the extent, if any, to which they are not being met as a result of the regulations.

This point, understandably, remains one of great controversy. There are deep-seated differences of opinion. In almost every location where a quota was imposed in 1977, the hunters are dissatisfied and claim that their subsistence needs cannot be met.

Reviewers are referred to the response and attachments relative to this question, which were submitted as part of the 1976 report.

Comments and opinions of persons reviewing this report (especially this particular question) will be welcomed by the Alaska Department of Fish and Game. It is currently our opinion that the subsistance needs of walrus hunters and their dependents can, and are being met. However, the economic needs of these same people are not being met. Currently and until such time as the walrus population is reduced to a level slightly below the long-term carrying capacity of its habitat, there is a beneficial opportunity to increase the economic returns from the walrus resource. These returns (and the allowable limit of taking) would have to be significantly reduced when the walrus population reached the optimal level.

(12) Methods used, if any, for marking and/or accounting of ivory.

As part of the Decision on Waiver of the Moratorium (Federal Register,

vol. 40, no. 248, Wednesday, December 24, 1975, p. 59460) the U.S, Fish and Wildlife Service was to devise a satisfactory method of marking raw ivory. The Alaska Department of Fish and Game also worked on the problem. The FWS effort was unsuccessful and the ADF&G proceeded to implement broad scale use of the methods it found to be successful. Correspondence relative to the research efforts for developing a practical method of sealing raw ivory are attached.

The Alaska Board of Game adopted regulations requiring the sealing of all walrus raw ivory effective July 1, 1978. Several methods were used initially and two methods have been found to produce satisfactory results. On all ivory that is to be sold, metal locking tags are physically attached to the tusk by drilling a narrow slot in the base of the tusk and attaching the locking tag. On all tusks or pieces that are to be retained in their natural state for display, a serialized number is inscribed on the tusk. At the time of sealing, data regarding harvest, size, sex, location of kill or find is recorded along with name, address, and hunting license number of the owner. Sealing instructions and a copy of a sealing certificate are attached.

Since the regulations require that all raw walrus ivory be sealed, considerable amounts of ivory taken prior to enactment of the regulations was also sealed during the last half of 1978. Five thousand one hundred sixty tusks or pieces of tusks were sealed for hunters or owners from 38 towns and villages in Alaska.

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

SUBPORT BUILDING
JUNEAU 99801

September 18, 1978

Mr. Lynn Greenwalt, Director
U.S. Fish and Wildlife Service
Washington, D.C. 20240

Dear Lynn:

To insure compliance with the conditions of the waiver of moratorium regarding taking of walrus, the State of Alaska has implemented a system of maximum allowable harvest quotas in the vicinity of those villages which have the greatest potential for taking walrus. To accurately monitor the harvests and the quotas, the State of Alaska has found it necessary to attempt to develop a system for marking raw ivory. Although it is not entirely satisfactory, we have implemented a system of sealing raw ivory and are continuing to search for better techniques.

In Federal Register Vol. 40, No. 248-Wednesday, December 24, 1975, page 59460 regarding Taking of Walrus, Decision on Waiver of Moratorium, under the heading "The State Program," the following statement is made: "4. Marking of Raw Ivory (R.D. at 48). While the recommendation that raw ivory be marked is laudable and was suggested by the Fish and Wildlife Service, the service testified that at the present there is no existing satisfactory method for marking and accounting for ivory. This recommendation of the ALJ will be held in abeyance pending a study which will be undertaken by the Fish and Wildlife Service to devise a satisfactory method of marking raw ivory." (Emphasis added).

I presume the study referred to has been undertaken in the intervening two and one-half years and that you may have some preliminary or perhaps final results. In that respect, what are the results of the study, what methods of marking raw ivory have been tried and what was the success or problems with each method? We would appreciate learning about these efforts as it may save some costly duplication of effort.

Sincerely,

for Ronald O. Skoog
Commissioner

In Reply Refer To:
FWS/WA-11982

Dr. Ronald O. Skoog, Commissioner
Alaska Department of Fish and Game
Subport Building
Juneau, Alaska 99801

Dear Ron:

This is in reply to your letter of September 18, regarding a study to devise a method for marking raw ivory.

In early 1976, I requested the Division of Wildlife Research to develop a proposal relating to the development of a satisfactory method of marking and accounting for walrus ivory. The Marine Mammal Section, National Fish and Wildlife Laboratory, reviewed the situation in some detail, reviewing other tagging efforts of a similar nature, and determined that they did not have the technical expertise to address this problem. The proposal was then reviewed by the Support Services Section at Denver Wildlife Research Center. They reached the conclusion that no currently available chemical or other marking technique was available which would not also destroy the intrinsic properties of or appearance of the ivory. The known technique of marking sections of elephant ivory would not be appropriate for walrus tusks used in the handicraft trade. To address new, untried techniques on a trial and error basis, particularly with no promising candidate techniques in mind, would have been prohibitively expensive.

The conclusion was reached that some method of sealing could be used to mark the entire walrus tusk satisfactorily, provided that the seal would be impossible to reuse once removed. We made the, perhaps erroneous, assumption that such seals were available on the commercial market which could be modified for use with walrus ivory. We assume that the system which Alaska has implemented is using that principle.

We sincerely regret not having made the negative findings relative to marking walrus ivory known to you. We would be pleased to work with you in attempting to refine and improve your present system of sealing raw ivory, and if your biologists have suggestions for promising avenues of research into other marking techniques we will take the necessary steps to evaluate them.

Let me apologize again for our failure to adequately communicate in this matter.

Sincerely yours,

(Sgd.) WILLIAM K. NELSON

Associate Director

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER / SUBPORT BUILDING
JUNEAU 99801

December 28, 1978

Harvey K. Nelson
Associate Director
U.S. Fish and Wildlife Service
Washington, D.C. 20240

Dear Harvey:

Thank you for your letter of 12 December, 1978, regarding the efforts of the Service to develop a system for marking raw ivory. While it is disappointing that your National Fish and Wildlife Laboratory and your Support Service Section of the Denver Wildlife Research Center have not been able to develop an adequate marking system for ivory, I can understand the problem. We too have been wrestling with it, and finally have been able, with a little experimentation, to devise a system which seems to work rather well in our situation.

We presently heat-shrink a plastic band around the base of the tusk which encloses and attaches a metal seal to identify all ivory which is destined for the carving or commercial trade. For those tusks that are separated from the skull and for which no display purpose is planned we find it even easier to drill a small hole through the proximal rim of the tusk and insert the metal tag there. For those few specimens that are destined to be used in skull mounts or in mounted walrus specimens, we find that we can adequately mark the tusk by etching the identification number just below the gum line at the rear of the tusk and coating the etching with a fluorescent chemical.

We find the above methods of marking to be adequate and satisfactory for marking of all ivory taken in the State. If personnel from either of your two Research Centers would like more information we would be happy to provide it.

Sincerely,

Ronald O. Skoog
Commissioner

Instructions for Sealing Raw Ivory

1. Determine if the tusks are to be used as carving stock or left whole for wall or head mounts.

2. Head mounts will have a number engraved just below the gum line on the back (inner curve) side of the tusk. The engraved number will be inked with a rapdi-o-graph type ink for better visibility. Once the ink is dry, a small drop of UV lacquer is placed over the number. Be sure the UV lacquer is well mixed before applying. See # 8.

3. Those tusks or portions of tusks to be used for carving stock will be sealed by placing the metal locking tag through a hole drilled in the upper portions or root of the tusk. Use a 5/32 drill bit and drill 4 holes side by side, then slip the metal tag through the holes and lock it. The holes should be an inch or so in from the edge.

4. Portions of tusks will still be sealed using the shrinkable tubing as follows: Slide the band onto the tusk until a snug fit is achieved or choose a band that best fits the tusk, apply heat to shrink the tubing to a tight fit, then apply a few drops of glue under the band to secure it. Be careful not to overheat the band as it will tear. Do not lock the tag until you have completed the heat treatment. If the band does tear, at least you haven't lost the metal tag.

5. Bands should be placed on the middle 1/3 of the tusk.

6. Once the individual begins to carve or work a tusk, the band can be removed, but only if it interferes with the work he is doing. If the band is removed, it should be retained until the piece is finished, then it can be discarded.

7. A heat source, such as an electric heat gun or space heater with about a 4" stove pipe attached, works very well for shrinking the band. Open flame tends to be uneven and can damage the band. When applying heat, rotate tusk to apply heat evenly.

8. The number to be engraved on hea (mounts or tusks that are not going to be carved will be the sealing certificate number (upper right hand corner of the sealing book) followed by the letter a, b, c, ...J.

   Example: 2 heads to be sealed as trophies; sealing certificate number is 1502. Each tusk is measured and 1502A is engraved on the right tusk, 1502 B on the left. The second head, same owner, would be 1052 C on the right tusk and 1502 D on the left, etc. If the page is filled, then go to the next page, starting over with a, b, c, and so forth.

   There should, obviously, be only one person's ivory per sealing certificate.

INSTRUCTIONS FOR SEALING RAW IVORY

SINGLE TUSKS

There are two ways in which a single tusk may be sealed:

1) The preferred method is to cut a small notch in the upper portion of the tusk approximately 3/4" from the edge and attach a metal locking walrus seal.

2) If the hollow end of tusk has been removed or if the hollow end is of insufficient width to drill a notch, the sealing certificate number located in the upper right hand corner of the sealing certificate (see example) should be engraved on the root. The suffix A, B. C. etc., is to be added to this number depending on the number of tusks to be sealed. This number should be "inked in" with India ink to make it easier to read.

HEAD MOUNTS AND OTHER

If the owner wishes to make a head mount or does not want to split the ivory out of the head for some other reason, the head will be sealed as follows:

1) Assuming the skull has been cut through the brain cavity, a small notch should be drilled at the rear of the skull preferably where the saggital bone extends downward into the brain cavity. A metal locking tag shall then be attached. A tag placed in this position will not be noticable if the head is to be mounted. If all of the skull is intact, drill a small notch (hole) at the rear of the skull near the occipital condyle bone and attach the metal locking walrus tag through this hole.

2) The number of the tag is to be engraved into the tusk at the rear of the gum line. One tusk is to be labeled "A" and the other "B". (Example: if the number on the metal locking tag is 20468, then one tusk would be marked 20468A and the other would be marked 20468B). These numbers are also to be "inked in" with India ink.

MEASURING IVORY AND FILLING OUT THE SEALING CERTIFICATES

All measurements are to be taken to the nearest 1/2 of a centimeter. Tusk length is measured from the gum line to the tip of the tusk following the outside curvature. Tusk circumference is measured at the gum line.

The ivory sealing certificate form is basically self explanitory (see example). All blanks should be completed with the most valid information available. Probably the most important blank on this form is the date of kill, every attempt should be made to obtain this information. If a specific date is not available, indicate the month and year or the time of year (spring, fall, etc.). All ivory found on the beach should be noted in the remarks section.

If there are any questions regarding the above, contact the Nome office.

NE 0093

DEPARTMENT OF FISH & GAME

WALRUS IVORY SEALING CERTIFICATE

NAME OF HUNTER OR OWNER John Doe

Box 862 (ADDRESS) Nome (CITY) Ak (STATE)

A-64538 (HUNTING LICENCE NO.) April 18 1979 (DATE OF SEALING) Nome (SEALING LOCATION)

SEAL NO.	* √	SEX M	SEX F	SEX UNK	DATE OF KILL	TUSK CIR.	TUSK LENGTH	GMU TAKEN	NEAREST COMMUNITY TO KILL SITE
1 20468A		✓			2-12-79	36.0	71.0	22	Nome
20428						35.5	70.5		
2. 20469			✓		2/79	30.0	72.5	22	Nome
					animal only had one tusk				
3. 20470		✓			Fall	41.5	65.0	22	Nome
20471					79	41.0	64.5		
4. 20472A		✓			2-21-79	38.0	62.5	22	Nome
20473						38.0	64.5		
5.									

John Doe (SIGNATURE OF OWNER) Bob Olson (SEALED BY)

INSTRUCTIONS: Tusks should normally be sealed in pairs. If one tusk is missing, so indicate on that line and the reason; broken, etc. Tusk circumference should be taken at "gum line," and tusk length is measured from the gum line to the tip of the tusk.

*Check here only if sealing a portion of a tusk cut from a previously sealed tusk.

Remarks: 20470 - 20471 From animal found on beach 3 miles east of Cape Nome

(13) An indication of how many Natives have been involved in guiding walrus sport hunters and any information that is available concerning the economic benefit, if any, that is derived by Natives from such sport hunting.

Of the registered guides that had clients during 1978, three were Native and six were non-Native. On nearly all hunts supervised by non-Native guides at least one or two Native assistant guides or class A assistant guides are hired with four to six Native crew members. The number of Natives involved in guiding operations varies but it estimated between 15 to 20, employed as class A or assistant guides and an additional 45 to 60 Natives were employed as crewmembers. Sport hunters hunted from 10 different villages during the year.

Hunters paid an average of $2,500 for guided hunts with costs ranging between $1,500 and $3,200 for the hunt alone. Additionally all hunters had transportation costs and some also had to pay for meals and lodging. At least 55 hunters used guides so that the estimated income was $82,500 for the guiding services. Of this Native assistants received approximately 75 percent or $61,875. This does not include money they may have received for meals, lodging, sale of handicrafts, etc.

(14) An explanation of how the State has functioned in the public display and scientific research permit program relating to the taking of walrus and, if the State has functioned in this process, an indication of the State's actions and the disposition of the permit applications.

The only permit activity that the Department was involved in during this report period was during May. Sea World California had obtained a permit to capture 8 walrus calves for the purpose of display in facilities in California. Sea World's compliance with the permit and handling of

the actual capture were less than desirable. First, they gave no notice to ADF&G personnel at Nome that they were in the area. Secondly, they offered a $2,000.00 reward for live walrus calves on a first come, first purchased basis. This prompted a major rush of hunters during the first day of favorable weather and sea ice conditions. In the competitive rush, hunters did not take the time to salvage parts, except ivory, from the adult females which were taken. Rather, they captured the calves (many more than were purchased) and returned to shore as soon as possible. This situation was the inevitable result of a high cash inducement at a location (Gambell) where opportunities to obtain a cash income are limited for most people. Calves not purchased by Sea World were ultimately disposed of and used for dry meat.

Reference to the 1977 status report will further detail the State's role in the permitting process.

The State also reviewed and commented on a scientific collecting permit sought by the government of the USSR. This application was for 200 walruses and a number of seals to be taken within the U.S. 200 mile zone. It was the opinion of the U.S. Fish and Wildlife Service and the Marine Mammal Commission that such taking would be considered part of the overall quota of 3,000 walruses that could be taken by American Nationals or within the 200 mile zone. Based on these opinions, and on behalf of the Alaskan walrus hunters, the State recommended rejection of a permit for walruses and approval of the taking of seals.

WALRUS - CLAMS -

Appendix 1
1978 Rept.

AN EVALUATION OF POTENTIAL IMPACT OF THE PROPOSED BERING SEA SURF CLAM FISHERY ON THE PACIFIC WALRUS POPULATION

A report submitted to the 13th plenary session of the North Pacific Fishery Management Council, February 23, 1978, by Lloyd Lowry, Alaska Department of Fish and Game.

There has been a lot of concern expressed during the planning phases of the clam fishery regarding the possible effect of the fishery on marine mammals, particularly walrus. I would like to try to explain the reason for such concern and present the facts of the situation as we know them now. In the Marine Mammal Protection Act of 1972 Congress recognized marine mammals as functional components of marine ecosystems and mandated various Federal agencies to maintain populations of each species at levels which will insure that they remain functional ecosystem components. One of the most abundant marine mammals in the Bering Sea, the Pacific walrus, is of direct concern when considering the development of a commercial surf clam fishery.

Pacific walruses themselves have for many years been a heavily utilized resource. Subsistence utilization by Alaskan natives dates back thousands of years. During the late 19th and early 20th centuries, commercial exploitation of walruses reduced the walrus population to about one-third of its estimated original size. After the end of the commercial walrus hunting period the population increased to number at present some 200,000 animals, approximately the size of the pre-commercial exploitation population. Walruses are still a resource of major importance to coastal residents of Alaska and the Soviet Union. The 1977 walrus harvest provided 1.6 million dollars of income to Alaskan coastal residents for carved ivory alone. The average yearly value of carved ivory and oosiks at the villages of Gambell, Diomede and Savoonga over the past three years was slightly over one million dollars. This amounts to over $7000 per family per year and does not include the value of meat, skins and income from such activities as guiding of sport walrus hunters. In these villages, located on islands in the northern Bering Sea, other sources of income are very scarce.

The present walrus harvest in Alaska is closely regulated to distribute the total allowable take among the various villages on the basis of need. The total allowable harvest is designed to maintain the walrus population at the optimum sustainable level. Considerations of walrus productivity and carrying capacity of the environment are central to determination of the level of optimum sustainable population. In nearly all locations along the coast residents would like to harvest more walrus than allowed under present quotas. If harvests are to be even maintained at present levels, the carrying capacity of the walrus range must not be reduced.

Walruses are numerous, large, and benthic feeders. In all areas examined to date, clams of various species made up the bulk of the walrus diet. A recent study which compared walrus foraging with abundance

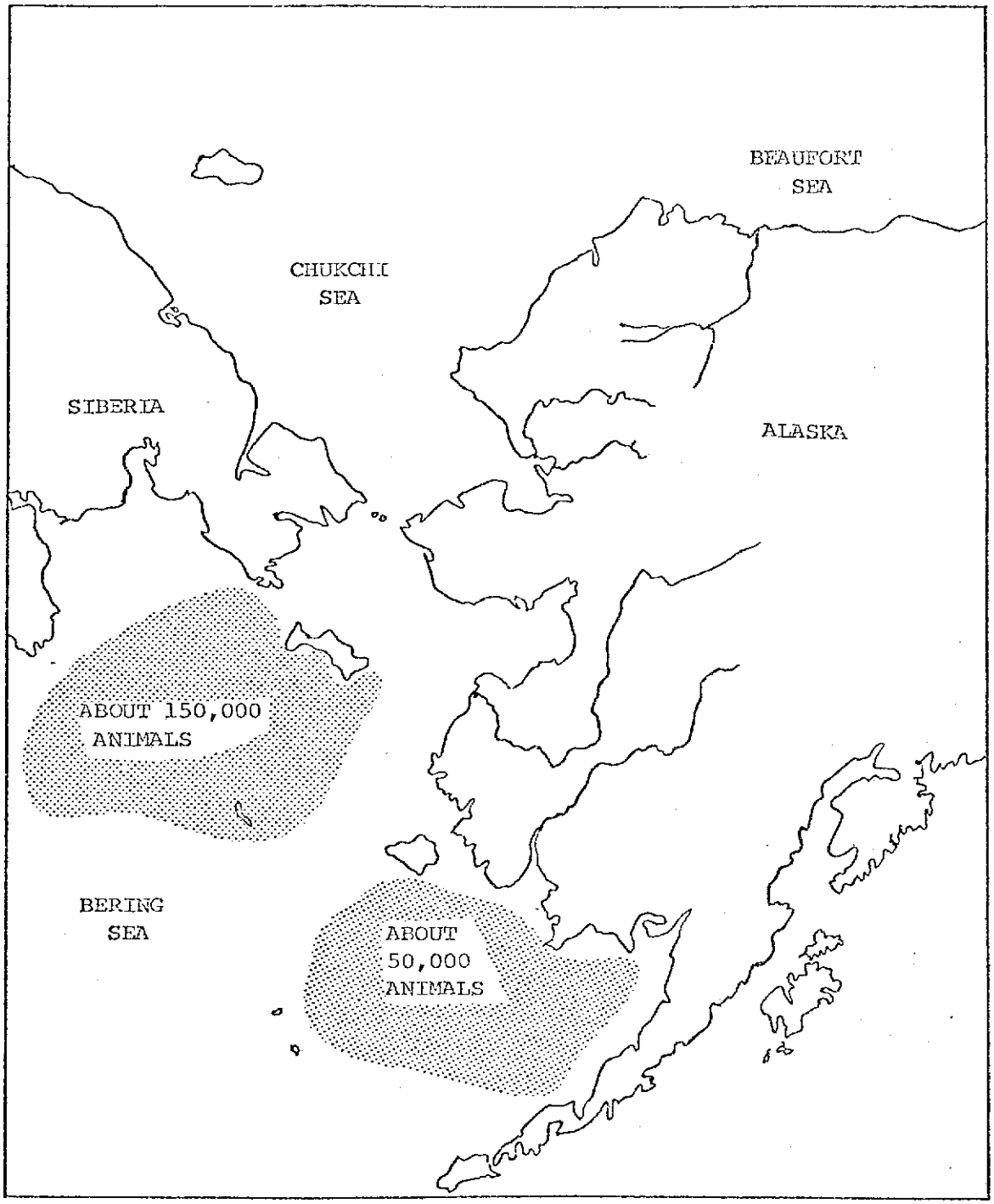
of appropriate foods as indicated by grab samples suggested that the walrus population is at or near the carrying capacity of the habitat. However, in this study the abundance of food was underestimated because the grab samples did not adequately sample large epifauna and deeply buried infauna such as surf clams.

Nonetheless it seems hardly advisable to enter into a commercial clam fishery in the walrus feeding range without some assurance that the impact on the walrus population would be negligible. Exchanges of communications during the early phases of the clam fishery planning and resource assessment strongly reflected such concerns. However, results of the 1977 resource assessment give strong indications that direct conflict between walruses and the Bering Sea clam fishery as presently envisioned will be slight if any.

Figures 1 and 2 show the general pattern of winter and summer distribution of the Pacific walrus population. With few major exceptions, such as at Round Island, most of the walrus population is found associated with sea ice on a year-round basis. Therefore the distribution of walrus is strongly influenced by the distribution of ice. Availability of food is also very important in walrus distribution. For example, in summers when the Chukchi Sea pack ice retreats north of the continental shelf many thousands of walrus use Wrangell Island off the northeast coast of Siberia as a hauling out area.

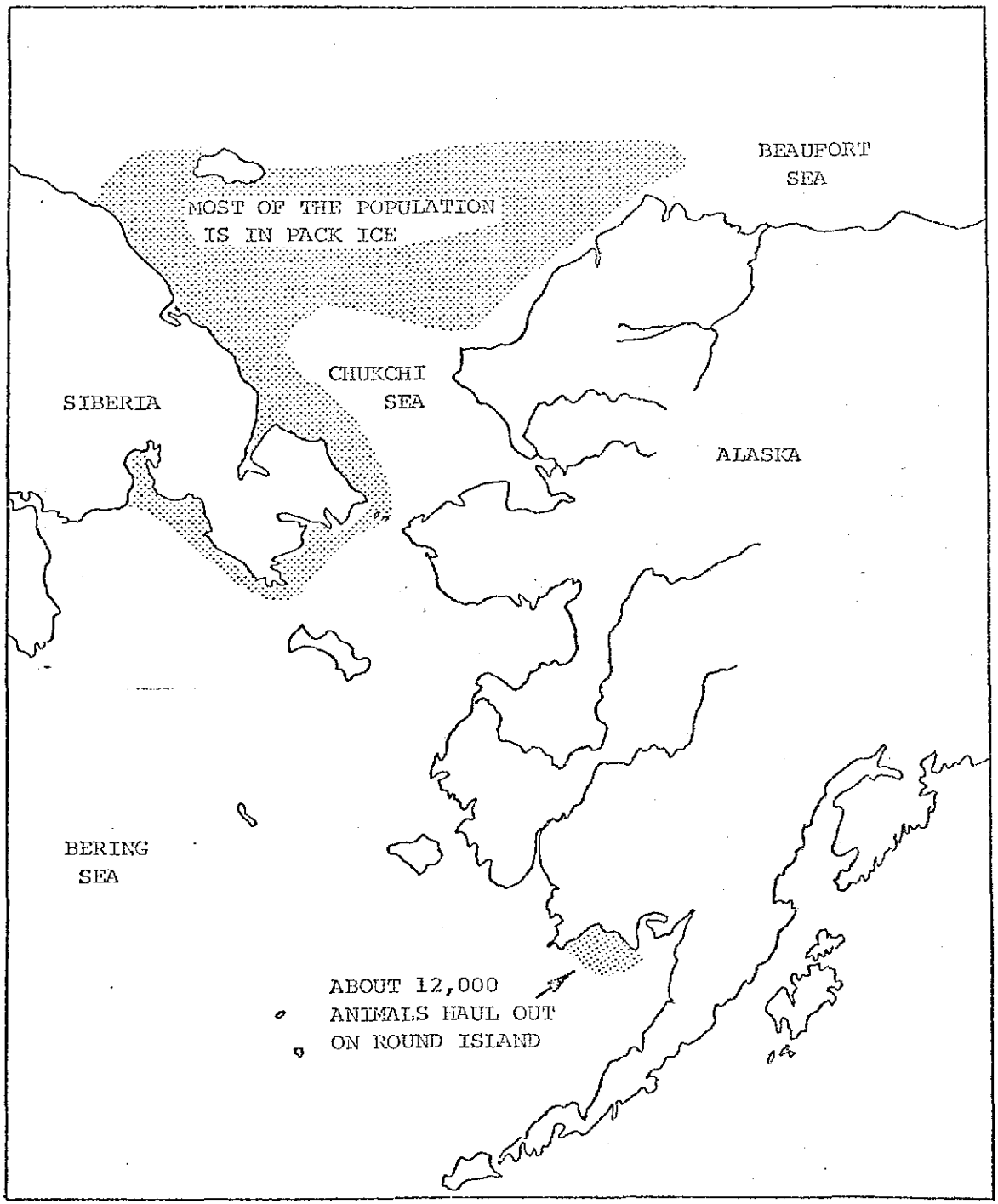
Figure 3 shows the distribution of walrus in Bristol Bay in relation to surf clam resource assessment blocks. The northern part of the area is used extensively during summer by animals which haul out at Round Island. The exact foraging range of these animals is not known but it seems unlikely that many range the 60 plus miles that would be needed to reach the area of the proposed fishery (contiguous blocks along the north side of the Alaska Peninsula). None were seen in the area during the 1977 resource assessment. Winter distribution of walrus in the area depends largely on the extent of sea ice. During light ice years walrus are concentrated in the northern portion of the area while in heavy ice years they are distributed throughout Bristol Bay. Surveys conducted to date indicate that the proposed fishery area usually contains very few walrus.

There are two main reasons why the proposed Bering Sea clam fishery can be expected to have minimal effect on the walrus population. The first is explained by the distributional features just described. The second reason is due to the different patterns of resource selection used by walruses and the clam fishery. The clam fishery will harvest one or few species of relatively large clams. Walrus feed on a number of different clam species of various sizes. To a lesser extent they also feed on other benthic organisms such as snails, sea cucumbers and worms. If the fishery does not have significant adverse effects on other components of the benthic community, the suitability of the region for walrus feeding would be reduced only slightly and probably not significantly.



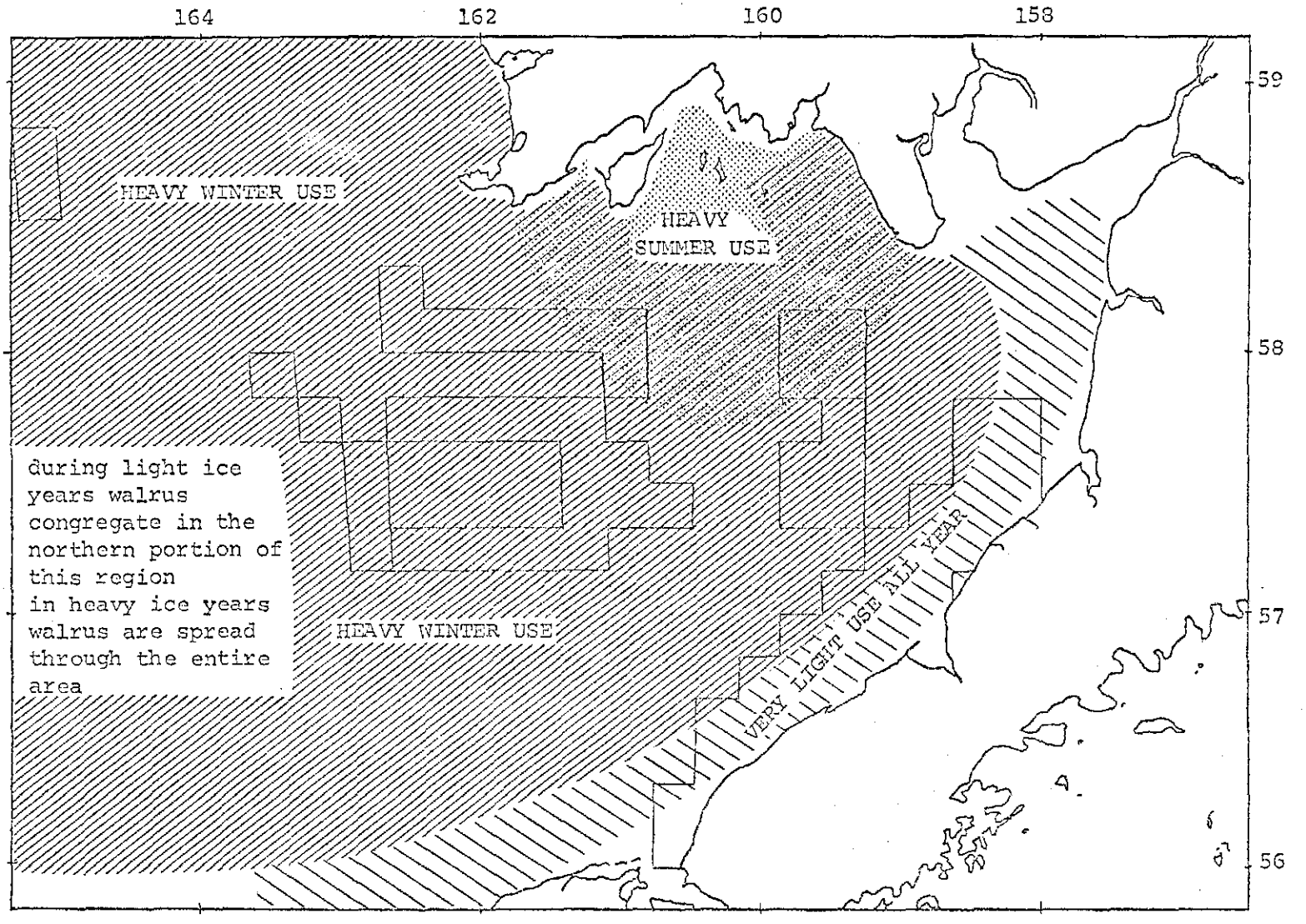
MAJOR WINTERING AREAS OF WALRUS

FIGURE 1



MAJOR SUMMERING AREAS OF WALRUS

FIGURE 2



DISTRIBUTION OF WALRUS IN BRISTOL BAY IN RELATION TO SURF CLAM RESOURCE ASSESSMENT BLOCKS

FIGURE 3

Appendix 2.

ALASKA DEPARTMENT
OF FISH & GAME

STATUS OF THE PACIFIC WALRUS

WILDLIFE INFORMATION
LEAFLET NO. 4
AUGUST 1978

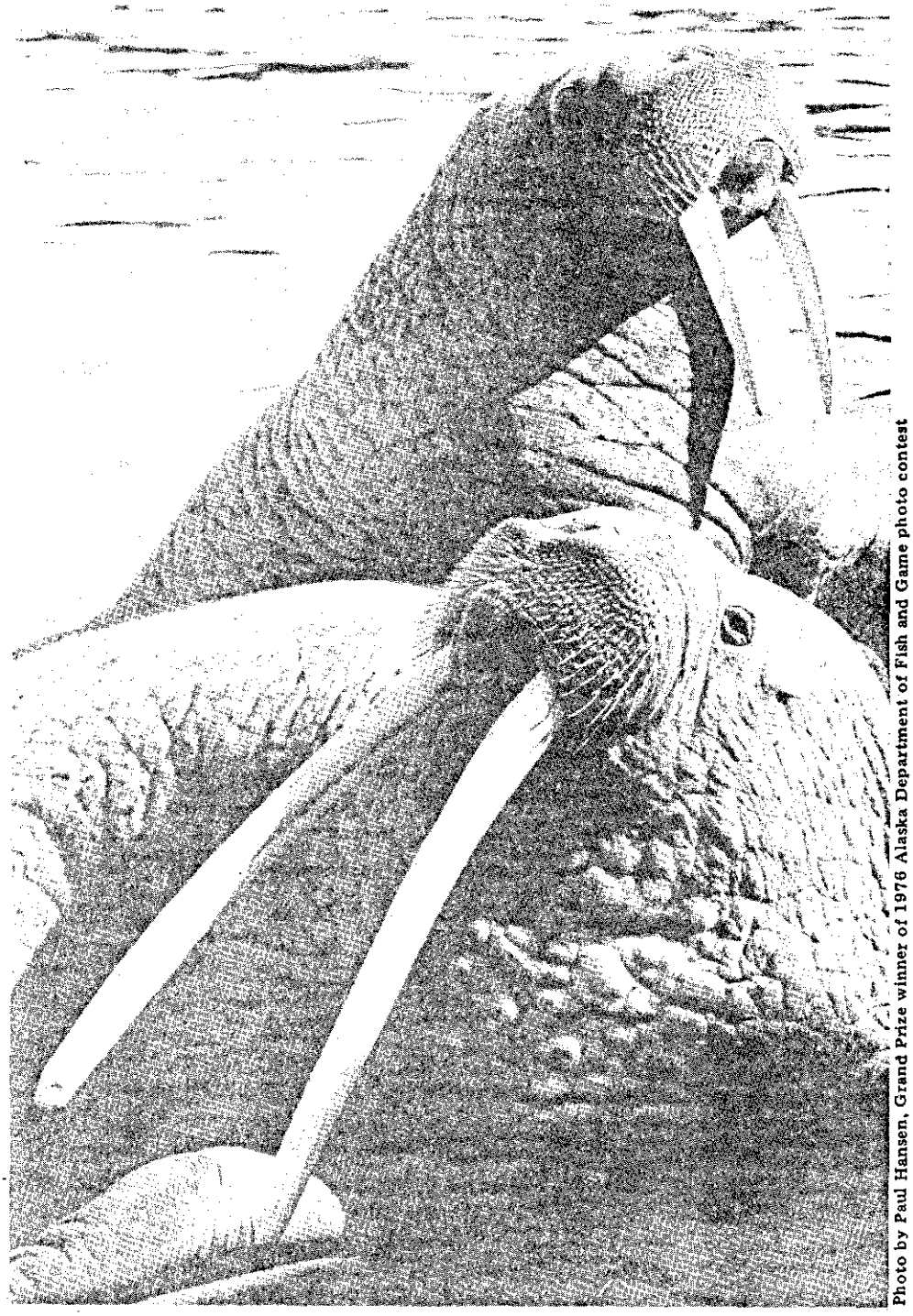


Photo by Paul Hansen, Grand Prize winner of 1976 Alaska Department of Fish and Game photo contest

Of the many species of marine mammals found in Alaskan waters, the walrus is perhaps one of the most unusual, economically important, and controversial.

They are studied and hunted in the icy waters of the Bering and Chukchi seas, and their tusks are carved into items of art which are marketed from Barrow to New York. The status and fate of the walrus are discussed in courtrooms from Nome to Washington, D. C.

Although many of the facts and opinions regarding walruses vary with time and the individual expressing them, one fact is clear to all. Walruses are now, and have been for many years, a very important resource to residents of the Bering and Chukchi sea coasts. Recognizing this importance, the Alaska Department of Fish and Game has, since Statehood, maintained an active program of walrus management and research. In fact, the walrus was one of the first species to be selected by the State for intensive study. Concern for the protection of the walrus population has resulted in the passage of laws such as the one which established the Walrus Islands State Game Sanctuary in 1960.

With the modernization of outlying areas during recent years, the nature of traditional dependence on walrus is changing. The purpose of this status report is to examine past trends in walrus numbers and utilization and consider the present status of the population with regard to ecological, sociological and economic factors.

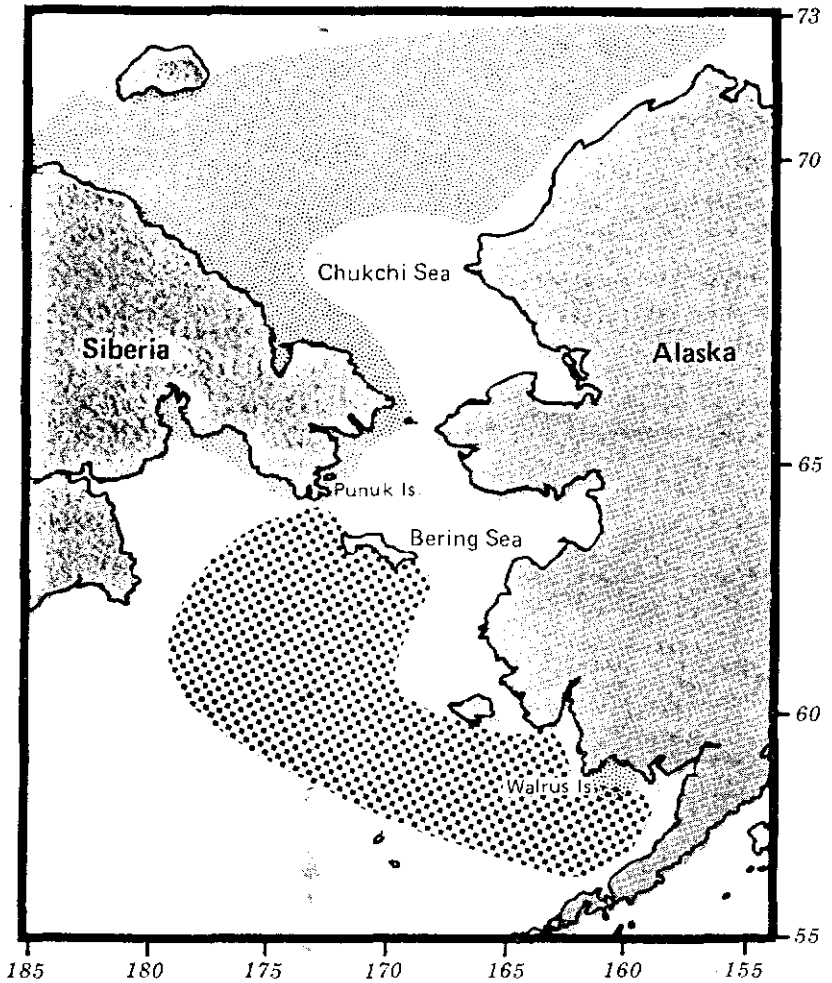


Figure 1. Approximate summer and winter distribution of the major portion of the Pacific walrus population.

Basic Biology and Distribution

Walruses are widely distributed in arctic and subarctic waters, and are usually found in association with sea ice. Two forms or subspecies are recognized: the Atlantic walrus *(Odobenus rosmarus rosmarus)* and the Pacific walrus *(Odobenus rosmarus divergens)*, which is far larger. The Atlantic walrus numbers less than 10,000 animals presently and is classified as an endangered species. The Pacific walrus, discussed here, has never been classified as endangered although the size of the population has at times been much smaller than it is today.

Pacific walruses are migratory animals. Their movements closely follow the advance and retreat of seasonal sea ice on which they haul out to rest, sun themselves and socialize. In the absence of sea ice, beaches are sometimes used as haul-out areas. The most notable of these areas in Alaska are the Walrus Islands in Bristol Bay and the Punuk Islands in the northern Bering Sea. Wrangell Island off the northeast Siberian coast and several sites along the northern and eastern shore of the Chukchi Peninsula are also utilized. The general winter and summer distribution of walruses is shown in Figure 1.

Most female walruses begin to breed at five or six years of age. Mating occurs in winter and the young are born about 15 months later, generally in early May. The single calf born is dependent on its mother for at least 18 to 24 months, and the social bond between them is very strong during that period. Females usually breed at two-year intervals when in their prime and at somewhat longer intervals in later years. Calves weigh 85 to 140 pounds (39 to 64 kilograms) at birth and grow rapidly to reach about 750 pounds (340 kilograms) by two years of age. Females reach their maximum weight of about a ton when nine or ten years old, while males continue to grow until at least 14 or 15 years of age and may reach a weight of two tons. Walruses sometimes attain an age of over 40 years, but due to selective hunting pressure and other mortality factors few ever do.

The diet of walruses in the northern Bering Sea consists primarily of clams. Snails, amphipods, crabs, shrimps, several kinds of worms, sea cucumbers and even seals are occasionally eaten. Food items in other areas are less well known but apparently similar.

Walruses are gregarious and have a complex social system. Vocalizations and motions of the head and tusks are important social signals, and large animals with large tusks are dominant over smaller animals. Both males and females will care for and protect calves and wounded animals. Walruses are not particularly wary and are quite easily approached. Though their vision seems to be poor, their senses of hearing and smell are apparently quite keen.

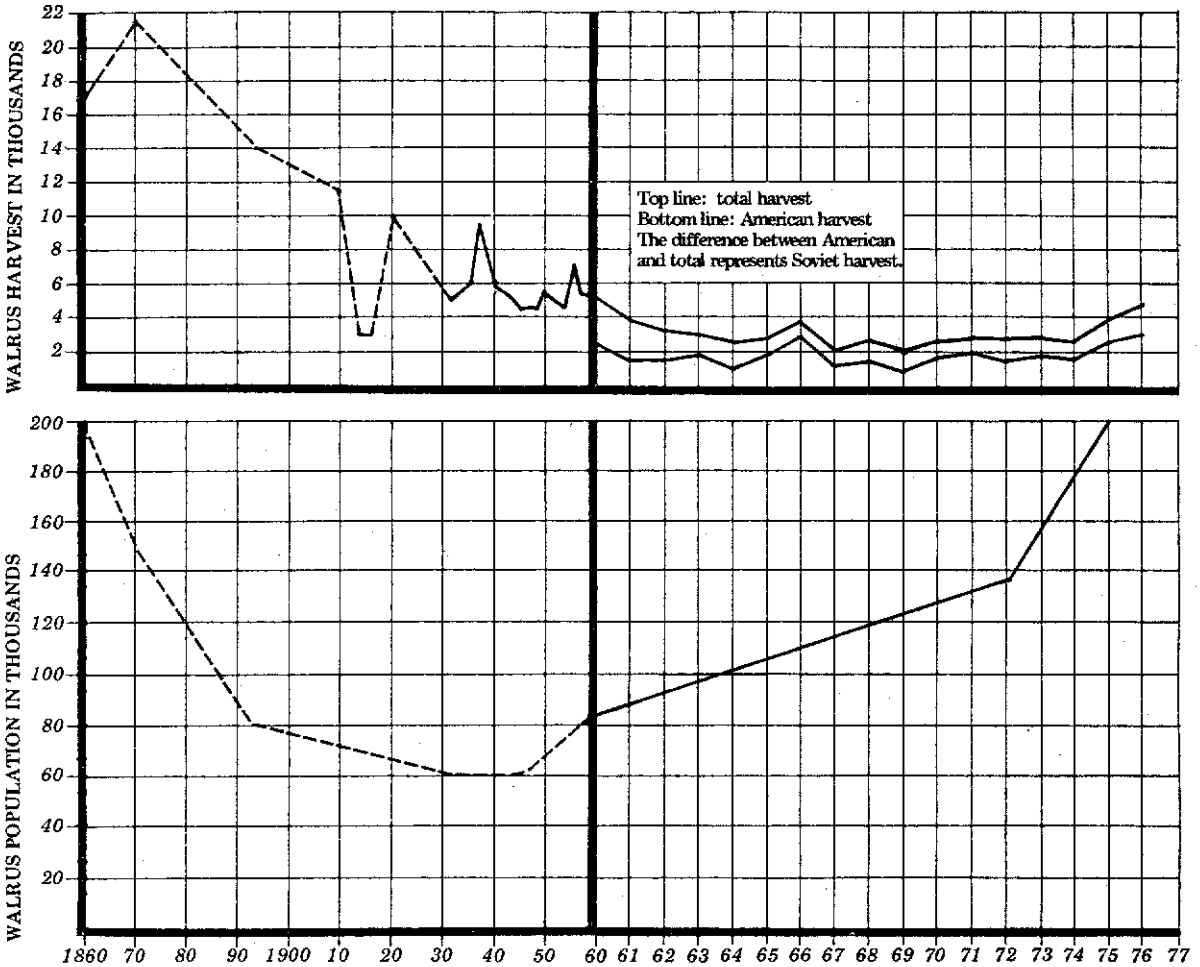


Figure 2. Estimated trends in walrus harvest and population levels. Dashed lines indicate approximate data.

Historical Population Size, Harvest and Regulations

Walruses have been hunted for thousands of years by Eskimos living along the Alaskan coast. For most of those years the small number of hunters, the rigorous nature of the hunt and the relatively primitive weapons and equipment used kept the harvest small. Skin boats powered by sail and paddle did not range far but were seaworthy and could carry tons of meat. A hunting season was considered successful when all the meat storage areas were full. When whaling ships began to pursue bowhead whales in the Bering Sea and north through the Bering Strait, the situation changed drastically. The whalers found the gregarious and unwary walruses to be easy targets. Starting in the 1860's, tens of thousands of walruses were taken annually for oil and ivory. Estimates of population size during this period of overexploitation and the harvest levels on which they are based are shown in Figure 2. By 1880 the population was so severely reduced that walruses in commercial quantities were difficult to obtain and such harvests occurred incidental to other pursuits. During and after World War I harvesting was generally by coastal residents who took walruses mostly for food for themselves and their dog teams, and hides for lines and boat coverings. Commercial take by the Soviets intensified in the 1930's and 1940's. Commercial hunting in Alaska ended in 1941 with the passage of the Walrus Act which prohibited exportation of raw ivory. The walrus population may have reached its lowest level of fewer than 60,000 animals in the 1930's or early 1940's.

Throughout this period there were no legal restrictions on the native harvest of walrus. The size of the annual harvest by Alaskan natives was limited largely by weather, hunt technology and the need for meat and other parts of the animals.

Recent Population Size, Harvest and Regulations

In 1960 the newly created Alaska Department of Fish and Game took steps to encourage a recovery of the walrus population. A bag limit of seven females or subadults and unlimited bulls per resident hunter was set. Nonresidents were limited to one bull walrus per year. In 1961 the limit on cows and immatures was reduced to five per hunter. Up to 1956 the Soviet government was still conducting commercial harvests of walruses though in decreasing amounts, and in the early 1960's the allowable catch for subsistence use was sharply reduced. In 1963 the Soviets imposed a yearly quota of 1,100 animals. Throughout the 1960's and early 1970's the total harvest ranged

between two and five thousand animals per year, well below the harvest levels of previous decades (Fig. 2).

A major change in the technique used to estimate the size of the walrus population occurred in 1960. For the first time, extensive aerial surveys were flown over the Bering and Chukchi seas and the walruses observed in the survey area were counted. Extrapolations of the numbers seen in the area surveyed to the total area of walrus habitat resulted in population estimates of about 50,000 by the Soviets and 90,000 by the Americans. A subsequent aerial survey conducted in 1972 indicated a population of 101,000 to 135,000 walruses. In that year the Soviets increased the quota for their subsistence harvesting operation to 2,000 per year. A joint Soviet and American aerial survey in 1975 resulted in an estimate of 200,000 walruses after the spring harvest.

Passage of the federal Marine Mammal Protection Act in 1972 had major and varied consequences for all species of marine mammals in U. S. waters. The primary effect on the Pacific walrus was elimination of all restrictions on Native harvests. The State of Alaska immediately requested return of management authority for walruses and several other species of major importance to residents of the State. Walrus harvests in 1973 and 1974 were similar to previous years but the 1975 harvest was one of the highest on record. On April 7, 1976, after lengthy judicial and administrative proceedings, management authority for walruses was returned to the State. Emergency regulations published April 16 were similar to those instituted in 1960 and were intended to keep the total American harvest of walruses below 2,300 animals. If the harvest exceeded 3,000 animals, the hunting season would be closed. Due largely to favorable hunting conditions, the total American harvest for 1976 was 2,989 animals. In order to avoid excessive harvest and to insure that all people had an opportunity to harvest walruses before the limit was reached, quotas were established for the major hunting areas for the 1977 season. Though the absolute harvest limit is based on biological parameters of the walrus population, the area quotas were based largely on sociological and economic factors. Needless to say, the quotas which were established for each area were and still are the subject of much controversy.

Cultural and Economic Aspects

Major cultural changes began for Alaskan Eskimos many years ago. With the arrival of non-Native explorers, settlers, whalers and missionaries came the whole complex of Western culture and values. But until fairly recently modern commodities and conveniences were difficult to obtain and the seas provided most of the raw materials necessary for existence. At villages in the favorable locations, particularly near the Bering Strait, the annual migration of walruses provided the bulk of annual needs for food and raw materials. The meat, skin, organs, bones, and ivory were all used for a variety of purposes. Ivory carvings were initially traded for useful commodities such as flour, tea, knives, guns and ammunition. But as the availability of outside goods increased so did the need for ivory with which to purchase desirable items. Manufactured items replaced traditional ones and the use of many parts of the walruses decreased. Replacement of dog teams with snowmachines decreased the need for meat considerably while the need for ivory to provide cash increased drastically. Many hunters felt that it was no longer necessary or desirable to bring all parts of the walruses back to the villages. The money that could be derived from ivory carvings became a necessity to support a cash-based economy.

The results of these continual and irreversible changes are a considerably altered walrus hunting technology and ethic. High-powered rifles have increased both killing efficiency and the potential for wounding and not retrieving animals. Binoculars and outboard motors have increased hunting range and "walkie-talkies" have allowed coordination of many boats. All this has resulted in an ever-increasing demand for ivory and a surplus of walrus meat. The replacement of skin-covered umiaks with aluminum and wooden speedboats perhaps best exemplifies these changes. Speedboats and the motors to power them cost a considerable amount of money, they can range far and fast and they can carry very little meat.

A number of factors were considered when the first area quotas were established for the 1977 walrus hunting season. Among these were area population size, traditional dependence on walrus and availability of other sources of income. With the exception of one area, in the vicinity of Little Diomede Island, the established quotas were above the average yearly harvest over the previous 10-year period. The value of raw ivory has increased from $4 to $6 a pound in 1970 to as much as $25 a pound in 1977. Costs of commodities in the coastal and island communities have also increased during this period, as have the number and kinds of available and desirable items.

The economic success of these communities is precariously dependent on the health and stability of the walrus population. How much of the cash income of a village can or should be expected to be provided by walrus ivory is still an open question. Regardless of the answer to this question, the harvest cannot be allowed to adversely affect the walrus population, or people and animals alike will suffer. The present regulations on walrus hunting are designed to apportion the harvest among residents of the State on the basis of need while maintaining the walrus population at its presently high level.

by Lloyd F. Lowry
Division of Game

Appendix 3.

John J. Burns

ARCTIC
VOL. 33, NO. 2 (JUNE 1980), P. 226-245

Mass Natural Mortality of Walruses (*Odobenus rosmarus*) at St. Lawrence Island, Bering Sea, Autumn 1978

FRANCIS H. FAY[1] and BRENDAN P. KELLY[2]

ABSTRACT. In October-November 1978, several thousand living walruses came ashore in at least four localities on St. Lawrence Island where they had not been present before in this century. They hauled out also at two other sites which they have occupied annually but in much smaller numbers. At least 537 animals died on the haulout areas at that time, and approximately 400 other carcasses washed ashore from various sources. This was by far the greatest mortality of walruses ever recorded in an event of this kind. At least 15% of the carcasses on the haulouts were aborted fetuses, 24% were 5-6-month-old calves; the others were older animals ranging in age from 1 to 37 years old. About three-fourths of the latter on the haulouts were females; in the non-haulouts areas, the sex ratio was about 1:1. Forty of the best preserved carcasses were examined by necropsy. The principal cause of death was identified as extreme torsion of the cervical spine, with resultant cerebrospinal hemorrhage, apparently due to traumatization by other walruses. Nearly all of the dead were extremely lean, having less than half as much subcutaneous fat as healthy animals examined in previous years.

RÉSUMÉ. En Octobre-Novembre 1978, quelques milliers de morses vivants echouaient dans au moins quatre localités de l'ile St. Laurent, qu'ils ne frequentaient jamais avant, depuis le début du siècle. Ils se trainaient aussi jusqu'à deux autres sites qu'ils frequentaient chaque année mais en nombre bien moins important. Au moins 537 animaux mourraient sur les plages d'échouage, à cette epoque et approximativement 400 autres carcasses etaient rejetées sur le rivage provenant de sources variées. C'était de loin la plus grande héecatombe de morses jamais enregistrée dans un événement de ce genre. Au moins 15% des carcasses sur ces aires d'échouage etaient des foetus avortés, 24% étaient des jeunes de 5 à 6 mois; les autres étaient des animaux plus agés dont l'age allait de 1 à 37 ans. Environ les ¾ de ces derniers étaient des femelles. En dehors de ces points d'échouage, le rapport des sexes était environ de 1 à 1. Quarante des carcasses les mieux conservées, étaient examinées avec autopsie. Celle-ci revelait qu'une extrême torsion de l'épine cervicale etait la principale cause de mortalité, avec comme consequence une hemorragie cerebrospinale, apparamment due à une traumatisation par d'autres morses. Presque tous les morts étaient tres penchés car ils avaient moins de la moitie du gras souscutanné qu'ont les animaux en bonne santé, examinés les années prècedantes.

Traduit par Alain de Vendegies, Aquitaine Company of Canada Ltd.

INTRODUCTION

In November 1978, residents of the Eskimo village of Savoonga, Alaska reported that unusually large numbers of walruses were hauling out on St. Lawrence Island in four locations where they had not been known to occur for at least the past 40 to 50 years. At the same time, herds were hauling out on the Punuk Islands, off the eastern end of St. Lawrence Island (Fig. 1), as

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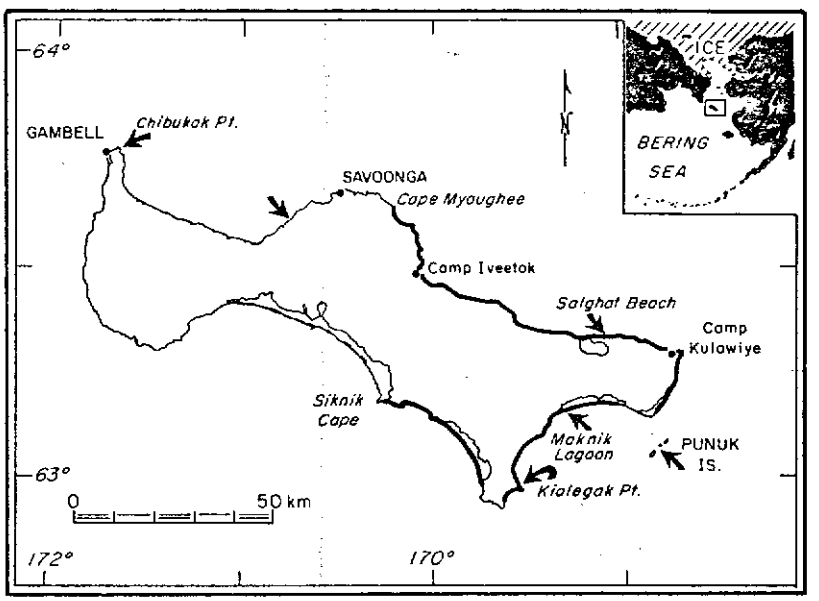

FIG. 1. Chart of St. Lawrence Island, showing localities mentioned in the text and (inset) the position of the island relative to the continents and the edge of the pack ice in late October to early November 1978. Arrows indicate areas where walrus herds hauled out at that time. The parts of the coastline that were aerially surveyed on 19 June 1979 are indicated by the heavy lines.

they usually do in autumn, as well as on Chibukak Point, near Gambell, where they have occurred irregularly in the past 17 years. Eyewitness accounts at some of the haulouts indicated that many animals were dying, apparently of natural causes, and that many fetuses had been aborted prematurely. Numerous other carcasses of animals that died at sea were washing ashore in many areas. The animals coming ashore were said to be mostly very lean, whereas walruses in autumn have tended to be very fat in previous years. The poor condition of the animals, together with the abundance of natural deaths and abortions, led to some speculation that a disease or toxic agent was striking the walrus population in epizootic proportions. Because the St. Lawrence Islanders rely on walruses for much of their food and cash income, they were understandably alarmed and concerned.

At the time when these events occurred, the weather was very stormy, with high winds and heavy seas from the south. The walruses, mainly adult females and young, were arriving from the northwest, presumably having swum from the edge of the pack ice which was then just north of Bering Strait, some 300 km away. The Eskimos remarked that the animals coming ashore appeared to be weak and physically exhausted, sleeping so soundly that it was possible to walk up and touch them without waking them. Observers on the Punuk Islands in early November estimated that there were at least 6000 walruses on the beach at one time. Hunters camped at Kialegak

Point stated that the animals covered about 2.5 km of beach and, in some places, extended inland onto the tundra.

According to the reports from Eskimos camped on Punuk, a few adult bulls were present among the females. These bulls were extremely belligerent, rushing through the resting herd to engage other bulls in battle. On one occasion, two bulls fought with such vigor that one appeared to have mortally wounded the other. In their rushes through the herd, the bulls trampled and struck at other animals with their tusks, and some calves (about 6 months old) were believed to have been killed by them. One night, an entire herd stampeded off the beach into the sea, leaving behind about 25 dead and disabled animals at the water's edge, below a wave-cut terrace.

On receiving the report of this mortality, Fay went to Savoonga in late November 1978 to investigate the matter further. Regrettably, by that time most of the carcasses were drifted over by snow and were no longer visible or accessible. We returned to the scene in June 1979, after the snow had receded enough to expose most of the bodies, to obtain documentation of their numbers, sex and age composition, and causes of death.

METHODS

We surveyed the beaches of St. Lawrence Island via chartered aircraft on 19 June 1979, some seven months after the unusual events had occurred.The objective of that survey was to obtain some measure of the distribution and abundance of carcasses and to locate the major concentrations for further study. The aircraft was flown at an altitude of about 100 m and speed of 275 km/hr. Numbers and locations of carcasses were recorded on a chart of the island.

On 20 June, we began work on the carcasses at Salghat Beach, where one of the known haulouts had occured. Two days later, we moved eastward to Camp Kulowiye to examine a series of carcasses that apparently had been cast ashore. Six days were spent on the Punuk Islands, and on 30 June we returned westward to Camp Iveetok to examine another series of beachcast carcasses.

Examination methods consisted of walking the shoreline, counting, mapping, and determining the sex and relative age of the carcasses. Postcanine teeth were retrieved for age determination where possible. Haulout areas whose limits were distinguishable by tracks, feces, and general disruption of surface features were paced off, and estimates made of numbers of animals that could have been accommodated. Those estimates were based on the findings of Krylov (1966) that, in herds of mainly adult females and young, the amount of space occupied by each individual ranged from 1.2 to 5 m^2, and of Tomilin and Kibal'chich (1975) that the mean area per individual was between 1.6 and 1.8 m^2. The former was regarded as the maximal and the latter as the most probable range of variation.

All carcasses that were relatively well preserved were necropsied in the following manner:

1. External examination for wounds and other lesions.
2. Measurement of blubber thickness over the sternum or, alternatively, over the shoulder.
3. Removal of the skin from the head and body, examining for subcutaneous hemorrhages, holes, or other lesions.
4. Removal of the blubber; examination of any lesions in it or in the superficial musculature.
5. Dissection of the superficial muscles; examination of the deeper musculature and bones for fractures, hemorrhages, or other lesions.
6. Thoracic and abdominal cavities opened; external and internal examination of all organs for any gross signs of pathological conditions.
7. Observation of any unusual amounts of fluids in body cavities, and estimations of their volume.
8. Separation of the head from the body and inspection of the brain and spinal cord at the junction.

The ages of animals, other than calves and fetuses, were determined by counts of cementum layers visible with 10X magnification in thin sagittal sections of the teeth.

All names of places on St. Lawrence Island are from the U. S. Geological Survey chart of that area (Alaska Topographic Series N6252-w16830/ 60x210) and do not necessarily correspond to local Eskimo vernacular for the same locations.

MAGNITUDE OF MORTALITY

St. Lawrence Island

Complete aerial coverage of the coast of St. Lawrence Island and the Punuk Islands on 19 June was prevented by inclement weather. Only 196 of the approximately 480 km of shoreline was surveyed, and this was entirely on the northeastern and southeastern parts of St. Lawrence Island alone (Fig. 1). We sighted 132 carcasses during that survey, including two major concentrations, 24 on the eastern part of Salghat Beach and 31 on the western part of the barrier beach of Maknik Lagoon. Only 9 carcasses were sighted in the vicinity of Kialegak Point.

The Salghat and Kialegak areas had been identified earlier as haulouts used by large herds in autumn 1978. The consensus of hunters who had been to the Maknik site more recently was that it too had been a haulout, as indicated by walrus tracks and feces on the beach.

TABLE 1. Comparison of numbers of walrus carcasses counted from the survey aircraft with actual numbers counted on the ground along portions of the coast of St. Lawrence Island, June 1979

Locality	Shoreline (km)	Carcasses counted		Aerial/ground counts (%)
		Aerial	Ground	
Haulout areas				
Salghat Beach	1.1	24	30	80
Kialegak Point	2.5	9	10	90
Non-haulout areas				
Myaughee-Iveetok	24	9	57	16
East of Salghat	7	2	4	50
Camp Kulowiye	5	1	13	8
Totals				
Haulout areas	3.6	33	40	82.5
Non-haulouts	36	12	74	16.2

TABLE 2. Estimated numbers of walrus carcasses present on the coast of St. Lawrence Island, June 1979

Locality	Shoreline (km)	Number of carcasses		
		Aerially counted	Estimated[1]	
			Range	Mean
Aerially surveyed				
Haulout areas	6.6	64	71 - 80	78
Non-haulouts	189.4	68	136 - 850	420
Total surveyed	196	132	207 - 930	498
Not surveyed	284	-	204	-
Totals	480		411 - 1134	712

[1] In surveyed areas, based on aerial counts amounting to 80-90% (mean 82.5%) of ground counts on haulouts and 8-50% (mean 16.2%) on non-haulouts. In areas not surveyed, based on estimated minimal rate of occurrence (0.72/km) in surveyed non-haulout areas.

We counted carcasses via small boat and on foot along 37.1 km of the northern coast that had been aerially surveyed. A count in the Kialegak area (2.5 km) was done by one of the Savoonga residents. Those counts disclosed that 114 carcasses actually were present where only 45 had been counted from the aircraft (Table 1). Many of those not sighted from the air were partly buried in the beach, often with only part of the torso exposed. Most of the others were in rock outcrops, under masses of kelp, or in windrows of driftwood. All but one of the carcasses were at or above the autumn 1978 storm tide level; the one exception (at Camp Iveetok) had washed ashore just prior to our arrival. Carcasses that had lain in place for a year or more were scarce and easily distinguished from the others by their dry, hard tissues and exposed bones. We did not include these in the counts.

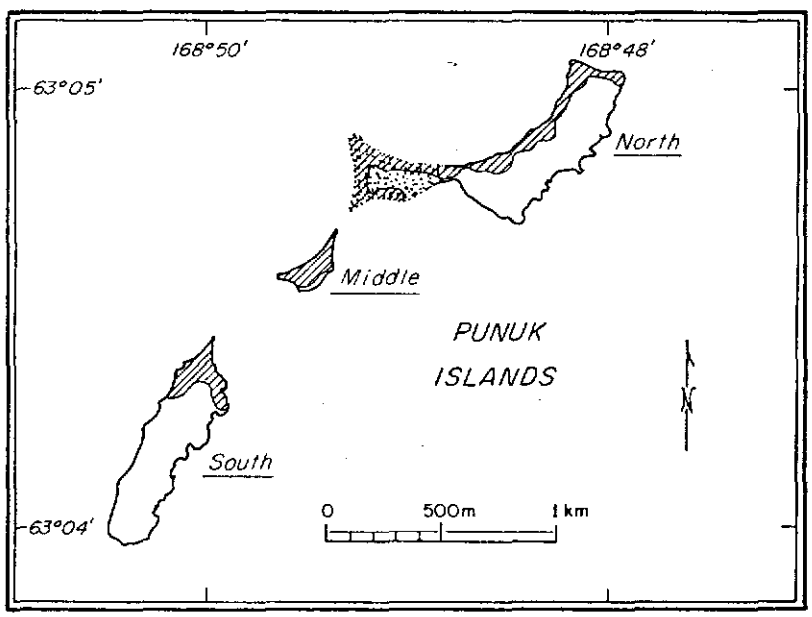

FIG. 2. Chart of the Punuk Islands, showing the areas occupied by walruses (cross-hatched) in the autumn of 1978 (Adapted from Army Map Service series Q801, sheet 1347 III NW).

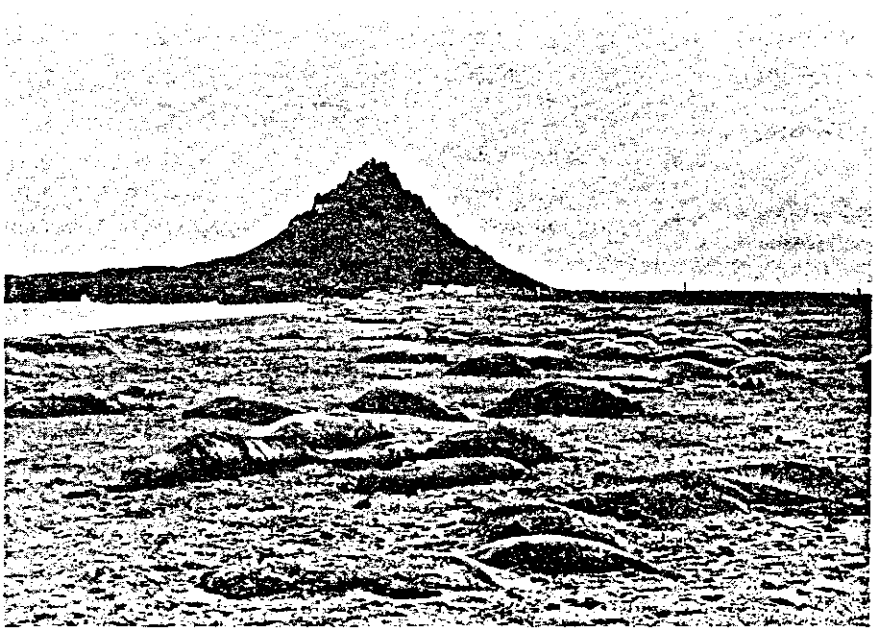

FIG. 3. Walrus carcasses on and partly buried in the beach of the western sandspit of North Punuk Island, June 1979.

The comparison of aerial and ground counts indicated that the success rates of aerial sightings in the known haulout areas were between 80 and 90% (mean 82.5%), and in the other areas only 8 to 50% (mean 16.2%). Applying these rates to the 196 km of shoreline that were aerially surveyed, we estimate that the total number of carcasses was at least 207 but not more than 930, with a mean estimate of 498 (Table 2).

We were unable to count carcasses on the 284 km of shoreline of the western part of St. Lawrence Island but received reports that they were numerous along the northern coast between Savoonga and Gambell, and that a few were present also along the western and southern coasts. It may be assumed that the number of carcasses per kilometer of beach was comparable at least to the minimum in non-haulout areas on the eastern part of the island (0.72/km), that is at least 204 carcasses.

Thus, for St. Lawrence Island as a whole, the total number of carcasses remaining in June 1979 of animals that died in autumn 1978 probably was not less than 411 nor more than 1134. The most probable estimate is about 712, to which should be added about 50 aborted fetuses reported by the Eskimos.

Punuk Islands

The three Punuk Islands were surveyed in their entirety on foot during 24 to 30 June; a total of 466 carcasses was counted. All of these were on the haulout areas that had been occupied in autumn 1978 (Fig. 2).

On the North Island, there were some additional carcasses buried in the beach (Fig. 3) that were not counted, since time did not permit their excavation for sex and age determination. There apparently had been others that had died there and been washed away by the surf, for we were unable to find the group of about 25 that the Eskimos reported to have died at the water's edge.

These counts and estimates indicate that the combined total of carcasses on St. Lawrence and the Punuk Islands, from mortality that occurred in autumn of 1978, was between about 900 and 1600; a most probable estimate is approximately 1200 carcasses.

SEX AND AGE COMPOSITION OF THE DEAD ANIMALS

St. Lawrence Island

Incoastal areas that were surveyed, the carcasses were distributed almost linearly along the beach, most of them at the autumn 1978 high water level. In the vicinity of Camp Iveetok and Camp Kulowiye, they were scattered at random, whereas at Salghat Beach they were clumped in three groups along 1.1 km of the shore. The composition of each of those groups was similar, with a ratio of three calves to two older animals in each of them. The ratio of males to females in the carcasses of the older animals at both the Iveetok and Kulowiye sites was about 1:1; at the Salghat site, it was 1:3 (Table 3).

TABLE 3. Sex ratios of walrus fetuses, calves, and older animals in the carcasses examined on St. Lawrence and the Punuk Islands, Bering Sea, June 1979

Locality	Sex composition per age class									Total
	Fetuses			Calves			Older			
	M	F	Unk.	M	F	Unk.	M	F	Unk.	
St. Lawrence Island										
Camp Iveetok	0	0	0	0	0	0	4	3	0	7
Camp Kulowiye	0	0	0	1	1	3	4	4	0	13
Salghat Beach[1]	0	0	0	9	8	1	3	9	0	30
Punuk Islands										
North I. spit (N)	8	15	19	20	25	7	26	155	1	276
North I. spit (W&S)	1	2	3	15	13	1	45	43	3	126
North I. northern part	1	2	4	2	1	5	1	3	0	19
Middle Island	0	0	7	0	0	11	0	0	11	29
South Island	5	4	5	0	0	2	0	0	0	16
Totals	15	23	38	47	48	30	83	217	15	516

[1] Eskimos reported the presence of about 50 fetuses on Salghat Beach in November 1978, but none remained at the time of our investigation in June 1979.

FIG. 4. Distribution of walrus carcasses on the northern beach of the spit, North Punuk Island, June 1979. Dotted line indicates the autumn 1978 high water level.

Punuk Islands

On the Punuk Islands, nearly all of the carcasses were well above the high water level (Fig.4). They were very unevenly distributed, more than 90% of

TABLE 4. Standard lengths (cm) of walrus carcasses measured on St. Lawrence and the Punuk Islands in June 1979

Age class	Males			Females			Sex unknown		
	N	Range	Mean	N	Range	Mean	N	Range	Mean
Fetuses	7	59- 78	66.1	13	44- 86	65.7	3	54-79	67.3
Calves	24	119-162	144.0	15	124-159	138.3	0	-	-
Juveniles & subadults (♂ 3-8 yrs; ♀ 2-5 yrs)	5	175-265	235	7	192-254	221	0	-	-
Subadults & young adults (♂ 9-13 yrs; ♀ 7-9 yrs)	3	282-340	304	6	246-295	268	0	-	-
Mature adults (♂ >14 yrs; ♀ >10 yrs)	7	300-342	320	30	252-296	279	0	-	-

them being on the North Island, 6% on the Middle Island, and 3% on the South Island (Table 3). About 95% of those on the North Island were situated on the sand spit that makes up the western third of the island (Fig. 2), which has been the traditional haulout area for at least the past 100 years. On the spit the ratio of calves to older animals was approximately 1:3, whereas on the Middle Island it was about 1:1; there were no carcasses of older animals on the South Island.

Nearly all of the fetuses were slightly smaller than those obtained previously by Fay in late November and December, indicating that they had been aborted somewhat earlier (i.e. October-November). Their sex ratio tended to be uneven (1:1.5) but did not differ significantly from that of the calves ($\chi^2_{(1)} = 1.09$). They ranged in standard length from 44 to 86 cm, with a mean of about 66 cm (Table 4).

The carcasses of calves corresponded in size and dental development to animals 5 to 6 months old, indicating that they had died in autumn, like the fetuses. Standard lengths ranged from 119 to 162 cm, with means of 144 and 138 cm for males and females respectively. Their sex ratio on the Punuk Islands, as elsewhere, was about 1:1.

The age/sex composition of the carcasses was non-uniform over the different parts of the Punuk Island haulouts (Tables 3 & 5). On the North Island, the sex ratio of those older than calves was 26 males:155 females (1:6) on the northern beach of the spit; on the western and southern beaches it was 45:43 (1:1). This difference was highly significant ($\chi^2_{(1)} = 41.2$). General observation indicated that most of the carcasses on the Middle Island were of males. On the South Island, only the carcasses of fetuses and calves remained.

There was a significantly higher proportion of physically mature adults (♂ > (or males) 15 years old; ♀ (or females) > 10 years old) on the western and southern parts of the spit than on the northern part ($\chi^2_{(1)}$ = ♂ 4.34; ♀ 6.62). In addition, there was a tendency for a greater proportion of fetuses per sexually mature female (> 5 yrs old) on the northern than on the western and southern parts of the spit, whereas the reverse was true of the calf:female ratio. However, only the latter was significant ($\chi^2_{(1)} = 5.96$).

TABLE 5. Comparative age-compositions of carcasses on the northern (N) versus western and southern (W&S) beaches of the spit on the North Island of the Punuk Islands, June 1979

Sex and location	N	Age class (years) 1-5	6-10	11-15	16-20	21-25	>25
Males							
Spit, N side	26	8	6	3	3	2	4
Spit, W & S sides	34	3	4	6	6	6	9
Females							
Spit, N side	153	11	34	47	33	16	12
Spit, W & S sides	41	1	3	17	10	5	5

PATHOLOGY

St. Lawrence Island

A total of 15 carcasses was necropsied on St. Lawrence Island. These were chosen at random from those that were best preserved, most of them having been recently covered by snow. Some bias may have been introduced by this choice, since these were the carcasses that were nearest the seaward edge of the beach.

It was determined that 11 of the 15 animals had died from traumatic injuries, 5 of which were identified with certainty as gunshot wounds (Table 6). An old gunshot wound probably had contributed to the death of another (♂ (or male 35a). The latter had a broken left scapula, necrosis of the adjacent muscles, and bacterial invasion (color and odor suggested *Escherichia coli)* of the wound. A conical mass of necrotic material extended outward from the broken shoulder to the skin, where at the apex of the cone, there was a 5 mm circular scar that appeared to be the entry point of a bullet. However, no bullet remains were evident in the wound. This animal had been secondarily traumatized more recently by another agent, as indicated by extensive deep intramuscular hemorrhages in the thoracic and pelvic regions, as well as adjacent to the old wound. These new injuries, and extensive lacerations of the hind flippers with one fractured phalanx, suggest that the agent was a killer whale, *Orcinus orca*.

The death of male 381 also was attributed to killer whale predation. In this animal there were fractures of both scapulae, all of the ribs, the pelvis, and three parts of the spinal column; the lungs and heart had been punctured in several places by the broken ribs. Massive intramuscular hemorrhage was associated with each of the fractures, and there were several litres of free blood in the thoracic cavity. The hind flippers of this animal also showed multiple lacerations with some phalanges exposed but not broken. Female 383, which had bled to death internally from a ruptured spleen, also may have been injured by killer whales.

The three calves (27, 28, 31) also had died from trauma but of a rather different type than that in the older animals. Whereas the latter appeared to

TABLE 6. Principal pathological findings in walrus carcasses necropsied on St. Lawrence Island and the Punuk Islands, June 1979

Place	Field no.	Sex	Age (yrs) or age class	Pathological findings[1]									
				Spinal torsion	Intra-cerebral hemorrh.	Lung congestion	Free blood in b.c.	Broken bones	Uterine prolapse	Umbil. hernia	Biliary stasis	Gunshot	Other
Salghat													
	27	♂	calf	+++	+++	+++	+++	-	-	-	-	-	-
	28	♀	calf	+++	+++	+	+	-	-	-	-	-	-
	23	♂	adult	-	+++	-	-	+	-	-	-	+++	-
	29	♂	adult	-	+++	-	-	+	-	-	-	+++	-
	20	♀	adult	-	+++	-	+++	+	-	-	-	+++	-
	30	♀	8	-	-	-	-	-	-	-	-	-	+?
Kulowiye													
	31	♀	calf	+++	+++	+++	+	-	-	-	-	-	-
	35a	♂	subadult	-	-	-	-	+++	-	-	-	+?	+
	32	♀	4	-	+++	-	-	+	-	-	-	+++	-
	33	♀	v. old	-	-	-	-	-	-	-	+++	-	+?
Ivootok													
	381	♂	adult	-	?	+++	+++	+++	-	-	-	-	-
	386	♂	adult	-	-	-	-	-	-	-	-	-	+?
	387	♂	adult	-	-	-	-	-	-	-	-	-	+?
	382	♀	4	-	+++	-	+++	+	-	-	-	+++	-
	383	♀	adult	-	-	-	+++	-	-	-	-	-	-
Punuk													
	40	♂	calf	+++	+++	-	-	++	-	-	-	-	-
	41	♂	calf	+++	+++	-	-	-	-	-	-	-	-
	45	♂	calf	+++	+++	-	-	-	-	-	-	-	-
	46	♂	calf	+++	+++	+++	+++	-	-	-	-	-	-
	59	♂	calf	+++	++	-	+	-	-	-	-	-	-
	263b	♂	calf	+++	+++	+++	++	-	-	-	-	-	-
	319	♂	calf	+++	+++	-	++	-	-	-	-	-	-
	322	♂	calf	+++	+++	-	-	-	-	-	-	-	-
	35b	♀	calf	+++	+++	++	-	-	-	-	-	-	-
	41	♀	calf	+++	+++	-	-	-	-	-	-	-	-
	42	♀	calf	+++	+++	-	-	-	-	-	-	-	-
	49	♀	calf	+++	+++	-	+++	-	-	-	-	-	-
	263a	♀	calf	?	?	?	?	?	-	+++	?	-	?
	315	♀	calf	+++	+++	-	++	-	-	-	-	-	-
	321	♀	calf	+++	+++	++	++	-	-	-	-	-	-
	47	♂	26	+	++	+++	+++	-	-	-	-	-	-
	158	♂	13	+++	?	-	-	-	-	-	-	-	-
	374	♂	24	++	+++	-	+++	-	-	-	-	-	-
	376	♂	23	+	-	-	+++	-	-	-	-	-	-
	48	♀	16	+++	+++	-	-	-	-	-	-	-	-
Punuk													
	51	♀	14	++	?	-	-	-	-	-	-	-	-
	135	♀	11	+++	-	++	++	-	-	-	-	-	-
	169	♀	14	?	?	?	?	?	+++	-	?	-	?
	220	♀	23	+	-	-	-	-	-	-	-	-	++
	271	♀	11	++	++	-	-	-	+++	-	-	-	-

[1] Degree of severity: +++ most severe, ++ less severe, + least severe, - not present, ? not examined, +? uncertain diagnosis or cause of death unknown

have been struck severe blows by large, blunt objects, the calves had died mainly as a result of extreme torsion of the spine, principally in the cervical region. In addition to tearing and extravasation of the spinal musculature, this torsion and vertebral dislocation produced contusions and hemorrhage of the spinal cord and brain. In each case there was moderate to massive hemorrhagic congestion of the lungs, associated with free blood in the thoracic cavity and bleeding through the nose. In no case were there any broken bones or lacerations of the extremities. The nature of the injuries

indicates that these animals died as a result of being trampled by other, larger walruses on the Salghat haulout.

Female 33 showed some intramuscular hemorrhage in the sternal, intercostal and pelvic regions but no broken bones, no internal bleeding, and no detectable cerebro-spinal damage. She was extremely jaundiced, her blubber being bright yellow, suggesting some dysfunction of the biliary drainage of the liver. Since all of the bile ducts were greatly distended, we presume (but could not demonstrate) that there was blockage of the main ducts proximal to the gall bladder, which was not exceptionally large.

No indications of the cause of death were evident in the remaining three animals.

Punuk Islands

On the North Island of the Punuk Islands, we examined 15 calves and 10 older animals (Table 6). At least 14 of the calves appeared to have died primarily from cerebro-spinal damage due to spinal torsion, as had the three examined on St. Lawrence Island. The fifteenth calf (♀ (or female) 263a), which was not examined internally, showed umbilical hernia through which some of the viscera were extruded.

The pathological conditions in most of the older animals were remarkably similar to those in the calves. Torsion of the cervical spine, cerebro-spinal hemorrhage, and internal bleeding were the most common findings associated with death, followed by two cases of intestinal prolapse, and one case (♀ (or female) 220) of collapsed lungs, due to severe compression.

In none of the cases that we examined in detail on the Punuk Islands was there any evidence of gunshot wounds. Also, there were no outward signs of gunshot in any of the other 441 carcasses there. All of the deaths appeared to have been due to natural causes, which were identified as trauma, trampling, and suffocation. This suggests that the only "causative agents" were the living walruses that hauled out there.

PHYSICAL CONDITION

The thickness of the subcutaneous blubber layer was measured on 17 of the calves and 21 of the older animals, with the objectives of assessing their general physical condition and testing the Eskimos' reports that the animals seen by them in autumn 1978 were mostly very lean. Regrettably, no comparative data were available from animals harvested in previous years during autumn, but comparison was possible with data from harvested animals taken in late winter to summer, 1958 to 1973. The animals that died on St. Lawrence and the Punuk Islands in autumn 1978 had less blubber than their counterparts in previous years (Fig. 5). A G-test for goodness of fit (Sokal and Rohlf, 1969: 575) indicated that the difference was very highly significant ($G = 31.9$, $v = 2$, $p < .005$). The difference was least extreme in the calves, but it must be recognized that those from the 1958-73 harvest samples were about 5 months younger and 20% smaller in length than the autumn 1978 dead calves.

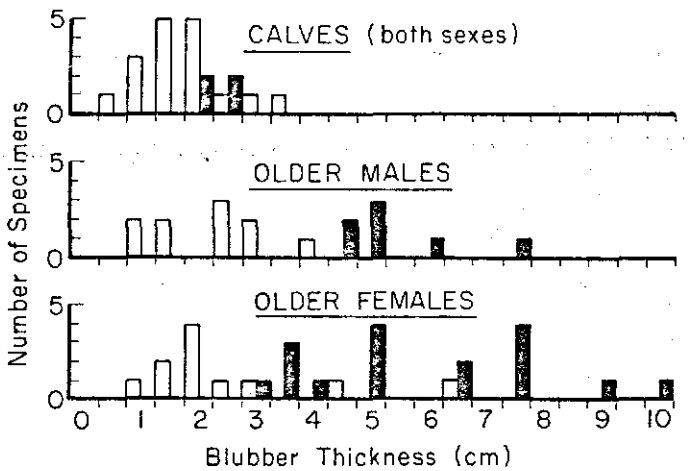

FIG. 5. Frequency of occurrence of blubber thicknesses in carcasses of walruses that died on St. Lawrence and the Punuk Islands in autumn 1978 (open bars), in comparison with that in walruses harvested in late winter to mid-summer, 1958-73 (solid bars).

The greatest differences were seen in the older males and females, which had less than half as much blubber as their 1958-73 counterparts. According to the Eskimos, this is extremely unusual, as they have previously recognized that the walruses (especially the males) are much fatter in the fall than during any other season, with blubber thicknesses of 12 cm or more.

The possibility that the carcasses we examined were not representative of the population as a whole cannot be discounted. That is, it is possible that the animals that died were in exceptionally poor condition and as a result were predisposed to being mortally injured. If they were already weakened, they may have been less able than the others to avoid such injury. However, it is unlikely that the adults that were shot would have been affected by such selection, yet they too had very thin blubber (2-3 cm).

ESTIMATED NUMBERS OF WALRUSES THAT HAULED OUT

St. Lawrence Island

At the time of our visit, the carcasses of animals that had died at Salghat Beach in the autumn of 1978 were situated along 1.1 km of the shore. This was apparently the full extent of the haulout, as there were no signs of their having used a larger area. In late October, when the animals hauled out on this shore, the beach was about 25 to 30 m wide. They had not advanced onto the tundra above the beach, but some probably were in the intertidal zone below. We have estimated that the total area occupied by the living animals had been at least 1100 by 30 m or about 33 000 m^2, and that this could have accommodated about 19 000 (± 1000) walruses (Table 7).

TABLE 7. Estimated means and extremes of numbers of walruses that hauled out on shore in six locations on St. Lawrence and the Punuk Islands, Bering Sea, in autumn 1978

	Approx. area of haulout (10^3 m^2)	Estimated thousands of walruses/haulout area occupied		
		Minimum - maximum @ 5 - 1.2 m^2/walrus[1]	Mean range @ 1.8 - 1.6 m^2/walrus[2]	Rounded mean
St. Lawrence I.				
Salghat	33.0	6.6 - 27.5	18.3 - 20.6	19±1
Maknik	60.0	12.0 - 50.0	33.3 - 37.5	35±2
Kialegak	62.5	12.5 - 52.1	34.7 - 39.0	37±2
Punuk Islands				
North Island	53.8	10.8 - 44.8	29.9 - 33.6	32±2
Middle Island	23.0	4.6 - 19.2	13.8 - 14.4	14±0.3
South Island	18.1	3.6 - 15.1	10.0 - 11.3	11±0.3

[1] Based on Krylov (1966)

[2] Based on Tomilin and Kibal'chich (1975)

It was not possible to determine the dimensions of the Maknik Lagoon haulout, because unfavorable sea conditions prevented a boat landing. The carcasses there were distributed over about 3 km of beach, which was at least as wide as that at the Salghat site, but it is probable that some re-distribution of the bodies had taken place as a result of heavy surf. A conservative estimate of the area covered by the animals is at least 2 km (i.e., about 60 000 which suggests the possibility that about 35 000 (± 2000) walruses had hauled out there. This area is not known to have been used previously as a haulout in autumn. The Eskimos believe that it was used in this case as an alternative to the Punuk Islands, which may have been fully occupied at the time.

Eyewitness accounts by Eskimos who were camped at Kialegak Point in November, when a major walrus haulout occurred, indicated that the animals had occupied about 2.5 km of the shoreline. In one area at the eastern end of the haulout, the walruses were said to have advanced at least 50 m inland, onto the tundra. This was evident during our aerial survey of the shoreline. A conservative estimate of the average overall depth of the haulout is 25 m or more, suggesting that the total area occupied was not less than 62 500 m^2. The number of animals that could have been accommodated in that area was about 37 000 ± 2000. The abundance of very old walrus bones and teeth found by us in this area in the past suggests that it is an ancient hauling-out site. However, it is not known to have been used as such in the present century prior to 1978.

Punuk Islands

The haulouts on the Punuk Islands were examined in greater detail than those elsewhere, and it is clear that the total area occupied by walruses was at least three times greater in 1978 than at any time in the past 30 years. Prior to 1978, the animals had utilized only the sandspit at the western end of the North Island, which has a low, sloping beach along most of its perimeter. No

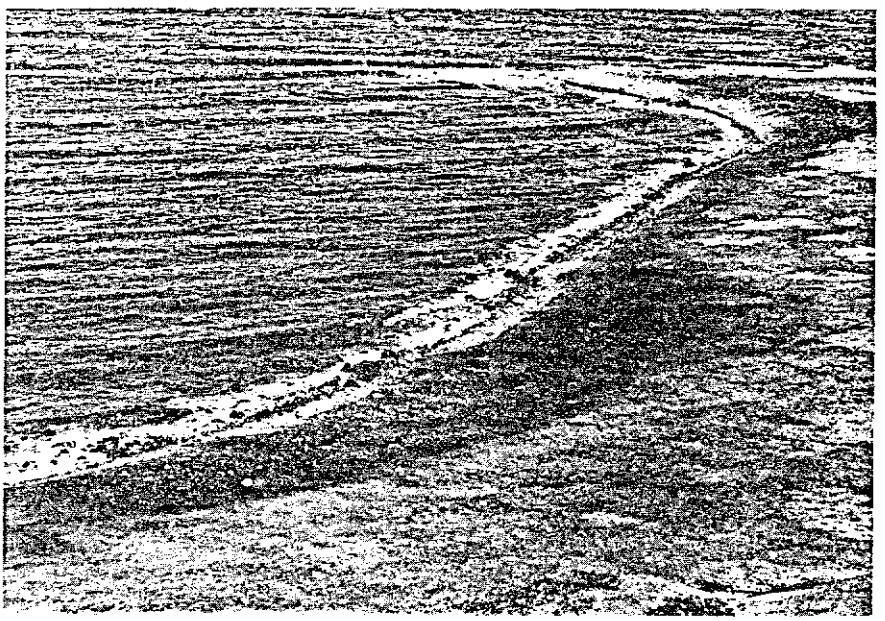

FIG. 6. Walrus haulout area on rocky shore and upland tundra of the northwestern part of North Punuk Island, June 1979. The abundance of exposed rocks in the dark, mucky area occupied by the walruses contrasted sharply with the apparently smoother carpet of vegetation above the haulout.

FIG. 7. Walrus haulout area (foreground and left, above) on the upland tundra of South Punuk Island, June 1979. The impression in the muck made by the body of one animal is evident (center, foreground). At upper right is undisturbed tundra.

part of this spit is elevated more than 3 m above mean sea level, though the remainder of the island, east of the spit, rises much higher and has a steep, rocky shoreline. The higher elevations above the wave-swept shoreline support tundra vegetation, typical of that in well-drained areas on St. Lawrence Island.

In the autumn of 1978, the walruses had occupied nearly all of the sandy beaches of the spit on the North Island, as they had in 1976 and 1977. But they had advanced also onto the tundra along the entire northwestern and northern coasts of the island, as well as over most of the Middle Island and the northern part of the South Island. Where they had invaded the tundra, nearly all of the extant vegetation had been trampled into the mud thawed by the heat of their bodies (Figs. 6, 7), and numerous rocks and old walrus bones were exposed that had not been apparent previously. The abundance of these very old, earth-stained bones in each of the tundra haulouts on the North, Middle, and South Islands suggests that these were ancient hauling grounds that had been used sometime in the distant past.

The total area that had been utilized by the walruses on the North Island in 1978 was about 33 500 m^2 on the sandspit and 20 000 m^2 on the northwestern and northern coasts. If all of it was occupied at one time, as the Eskimos' observations suggested, it probably accommodated about 32 000 (± 2000) walruses.

The animals had hauled out over the entire Middle Island with the exception of a narrow strip along the southeastern side, and had destroyed nearly all of the tundra vegetation. The area occupied there was about 23 000 m^2, which could have accommodated some 14 000 (± 300) individuals. On the South Island, they had advanced about 50 m onto the tundra and up to 20 m in elevation, covering an area of about 18 100 m^2. Approximately 11 000 (± 300) walruses could have hauled out in this area.

The greater abundance of dead walruses on the western spit of the North Island than elsewhere implies that this area was utilized either more frequently or more intensively than any of the others. Since it has been the traditional haulout site, we presume that the other areas were utilized only when the spit was fully occupied. If all of the areas had been occupied at one time, it is conceivable that some 50 000 to 60 000 walruses were on shore on the Punuk Islands sometime during the late autumn of 1978.

DISCUSSION

The occurrence of large numbers of walruses in autumn at St. Lawrence Island and the nearby Punuk Islands is not in itself unusual. These islands lie directly in the path of the walrus population during its southward migration from summering grounds in the Chukchi Sea to wintering areas in the Bering Sea. The unusual aspects of the 1978 event were (a) the large numbers that came ashore, both in the traditional locations (Punuk Islands and Chibukak Point) and in four other locations on St. Lawrence Island where they had not been present in the memory of the Eskimos living there, and (b) the large

numbers of carcasses that drifted ashore or were found dead on the haulouts, including numerous aborted fetuses. In previous years, a few individual walruses had hauled out on the northern coast of St. Lawrence Island during the autumn migration, but at no regular location other than Chibukak Point, where they first began to do so in 1962 (Fay, unpublished). They were present annually on the Punuk Islands in autumn, at least since the past century (Elliott, 1886), but usually not in numbers great enough to cover more than the sandy beaches of the peninsula on the North Island. In most years, a few carcasses drifted ashore on the northern coast of St. Lawrence Island. A few more were present in most years on the Punuk haulout, including a few calves but no fetuses, according to the Eskimos' reports and confirmed by our observations in the summers of 1962, 1977 and 1978.

The late Lawrence Kulukhon, who resided from 1916 to 1942 at Salghat Beach and who frequented the eastern end of St. Lawrence and the outlying Punuk Islands, reported that between 1930 and 1932 an unusually large number of walruses hauled out in autumn on the Punuk Islands. These were sufficient to cover the southwestern peninsula of the North Island and most of the Middle Island as well. In the following spring, he found about 100 carcasses there, mainly adult females, and several more that had drifted ashore on eastern St. Lawrence Island. A similar congregation occurred in the following autumn, leaving about the same number of carcasses. However, they did not occur there again in such numbers at any time during his residence.

Murie (1936) described the finding by natives of "a number" of walrus carcasses on the Punuk Islands and "near a hunter's camp at East Cape" [Camp Kulowiye?] in the spring of 1935, based on field notes provided by the late Otto William Geist, who spent several years in that area in archeological studies (Geist and Rainey, 1936). Presumably, this was one of the same incidents reported by Kulukhon, for Murie noted (p. 341) that " . . . this had not been observed probably for the last fifteen years." He reported further that " . . . practically all of the carcasses were badly crushed" and that their hair had been worn off, apparently as a result of the living animals having crawled over them repeatedly. Most of these were females, but there were some "smaller to medium-sized males" among them. Cahalane (1947), evidently describing the same event, attributed the death of the animals to their being "smothered and crushed" by other walruses, when a herd was driven ashore by killer whales. Schiller (1954) cited the finding by a Savoonga resident of 54 carcasses, mostly females, on the Punuk Islands in June 1949 and indicated that they " . . . were believed to have been killed [by other walruses] during breeding activities" (p. 208) in the previous autumn. He investigated another case of mass mortality of 52 walruses that occurred near the northeastern end of St. Lawrence Island in October 1951. From his examinations of 14 of these (5♂ : 9♀), Schiller concluded that the occurrence of, " . . . intestinal prolapse, . . . free blood in the body cavity, severe mutilation, and other observations" (pp. 208-209) indicated that the cause of death was "an explosive force."

In late October 1955, about 35 walrus carcasses drifted ashore on the northwestern coast of St. Lawrence Island, during a period of strong northerly winds (W. Caldwell, *in litt.*, 1956). These were mostly bulls, at least one of which had a gunshot wound (from a Soviet bullet, according to the Eskimos). Several others showed broken bones and severe lacerations, regarded as typical of killer whale predation and apparently similar to those examined by Schiller (1954).

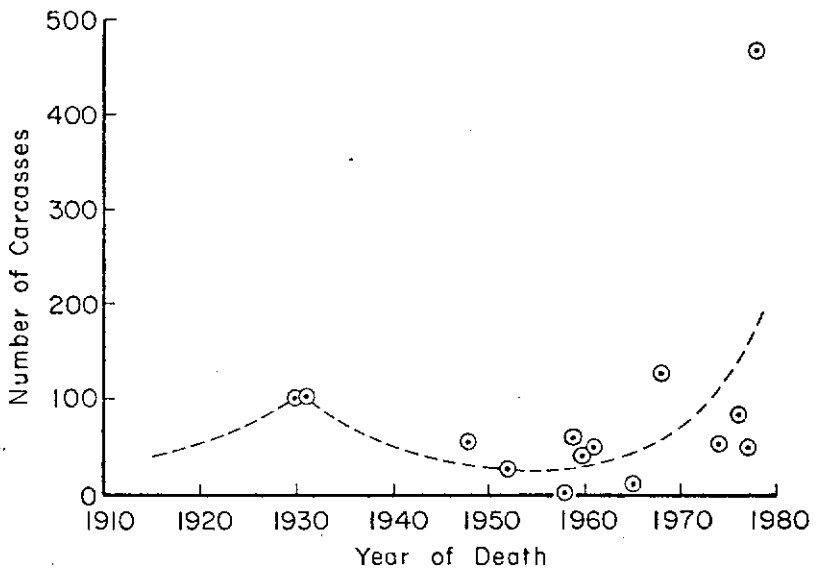

FIG. 8. Numbers of carcasses counted on the Punuk Islands in relation to the year in which the animals died. Dashed line is the suggested trend.

Since 1952, we have attempted to obtain by personal observation and by interview with the St. Lawrence Islanders a continuous record of the number of carcasses found each year on the Punuk Islands. Although we have not succeeded in this, the data obtained, when combined with those of Marks (*In* Burns, 1965: 30-31) as well as the accounts of Kulukhon and Schiller, indicate that the annual numbers have been highly variable, and suggest they they tended to be lowest between the late 1940's and early 1960's and have risen dramatically since that time (Fig. 8). This probably has been partly a reflection of increase in size of the walrus population, which is believed to have more than doubled during that period (Estes and Gol'tsev, 1980). We suspect also that it is partly reflective of the changing distribution of the population, which has been especially evident in recent years in the Bering Strait region. There, thousands of walruses have been frequenting the Diomede Islands, King Island, and Arakamchechen Island throughout the summer since the late 1960's, whereas they formerly were scarce to absent in that area in summer (Gol'tsev, 1968; J. J. Burns and F. H. Fay, unpublished).

The amount of mortality on the haulouts at other localities in the Bering and Chukchi Seas also appears to be highly variable and, at times, very

significant. At Cape Blossom, Wrangell Island, Gol'tsev (1968) observed that about 50 carcasses were left on the haulout after some 5000 animals had utilized it in 1958. In the same location in 1964 he found about 500 carcasses that had accumulated in the interim, and he accounted for an additional 250 to 300 that died in that year when 33 000-35 000 animals hauled out there. Tomilin and Kibal'chich (1975) found about 2000 carcasses on the Cape Blossom haulout in August 1972, these having accumulated from previous years. At that time, they observed that 21 calves were trampled and two fetuses aborted during a brief stampede of part of the herd that was utilizing the area. In addition, there were 149 new carcasses on the haulout when a congregation of about 36 000 females and young departed there in September of that year.

This kind of mortality seems to occur only on haulouts occupied by large herds of females and young, and not on those utilized by males alone. For example, in October 1962, when about 10 000 male walruses occupied the Inchoun haulout of northeastern Chukotka, Gol'tsev (1968) found only eight carcasses, none of which showed any signs of "violent death." Similarly, at Round Island in Bristol Bay, Alaska, where some 10 000-12 000 bulls haul out annually during the ice-free season, the number of carcasses on shore of animals dying from natural causes seldom exceeds 20, and few of those show any sign of trauma comparable to that seen in carcasses at Punuk and Cape Blossom (J. Taggert, C. Zabel, B. P. Kelly, and F. H. Fay, unpublished).

In general, our findings have confirmed the Eskimos' allegations that the greater part of the autumn 1978 mortality of walruses in the St. Lawrence Island-Punuk Islands area was due to traumatization by other walruses. Only 5 of 15 carcasses necropsied on St. Lawrence Island were certainly identified as victims of gunshot wounds, and none of 466 on the Punuk Islands had been shot. We did not rule out the possibility that the numerous abortions were caused by an infectious or toxic agent, but the probability of this seems to us less compelling that that of trauma alone. We also confirmed that the dead animals, at least, were in very poor physical condition, as alleged by the Eskimos, but cannot dismiss the possibility that the sample was biased by the weaker animals having been predisposed to this kind of mortality.

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