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THE 1976 CATCH OF BOWHEAD WHALES (BALAENA MYSTICETUS) BY ALASKAN ESKIMOS, WITH A REVIEW OF THE FISHERY, 1973 - 1976, AND A BIOLOGICAL SUMMARY OF THE SPECIES

By
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PART I

THE 1976 CATCH OF BOWHEAD WHALES (*BALAENA MYSTICETUS*) BY ALASKAN ESKIMOS.

INTRODUCTION

The bowhead whale, *Balaena mysticetus*, is found in Arctic and northern subarctic waters. Its numbers were greatly reduced over a period of about 300 years, initially in the European Arctic and then in the eastern Canadian Arctic and the Okhotsk Sea. Commercial whaling for bowheads began in the Chukchi and later in the Beaufort Seas during the mid-1800s; the last reported voyage occurred in 1916 (Bower and Aller, 1917) when the steamer *Herman* and the auxiliary whaling schooner *Belvedere* sailed north in the spring from San Francisco and Seattle, respectively, returning that autumn with some whale products. Some of the Arctic Alaskan trading companies continued to deal in whalebone for a few more years into the early 1920s. These animals have been completely protected from commercial whaling by the International Convention for the Regulation of Whaling since 1946, and subsequently, by the U.S. Marine Mammal Protection Act (MMPA) of 1972 and the U.S. Endangered Species Act (ESA) of 1973. However, aboriginal whaling is still allowed.

The bowhead whale, also known as the Greenland right whale and the polar whale, is a large cetacean that grows to about 18.3 m (60 feet) in length. It is black or dark gray in color, often marked with white on the chin and underside. Instead of teeth its mouth contains about 600 baleen plates that strain from the water the zooplankton upon which it feeds. It has a very large head approximately one-third the length of the body, and takes its name from the highly arched shape of its mouth.

The bowhead whale of the western arctic inhabits waters extending from the northern Bering Sea in the winter, to the northern Chukchi and Beaufort Seas in the summer. The animal is found along the loose edges of the ice pack and moves northward as the ice recedes in the spring and southward as it extends in the winter. The bowhead's spring migration route passes between St. Lawrence Island and the Chukchi Peninsula, through Bering Strait and along the northwest Alaskan coast, then through the Beaufort Sea to the Banks Island region and the MacKenzie River delta. In autumn, the whales migrate westward along the north coast of Alaska to the vicinity of Wrangel Island, where they turn southward along the coast of the USSR to the northern Bering Sea. During its spring migration, the bowhead is usually seen singly or in pairs, and often in the company of belukhas or white whales (Delphinapterus leucas). During its autumn migration, these animals are frequently seen in groups containing up to 50 members.

Historically, maritime Eskimos established their villages at locations where points of land provided access to the bowheads during their migrations. Several villages participate in the spring hunt, but because the whales cross the Chukchi Sea to the coast of the USSR in autumn, only a few villages along the north coast of Alaska hunt them at that time. Residents of the two St. Lawrence Island villages (Gambell and Savoonga), and the mainland villages of Wales, Kivalina, Point Hope, Wainwright, and Barrow engage in spring whaling. Ice conditions east of Barrow do not permit spring whaling by residents of Nuiqsut or Kaktovik (Barter Island), but, these people participate in the autumn hunt as do the Barrow whalers. The locations of Alaskan whaling are shown in Figure 1.

The hunting of bowhead whales for subsistence has been a vital part of Eskimo life for at least 3,500 years (Oswalt, 1967). Present day whaling is conducted by the Eskimos of St. Lawrence Island, the Siberian coast and the Arctic Alaskan coast using a combination of traditional and modern equipment and techniques.

THE PROBLEM

Because of its isolation in an arctic environment, the bowhead whale has received little biological research effort. An expanding Eskimo harvest of this species and the impending development of the oil resources of the Alaskan continental shelf, however, may be critical factors in the survival of the bowhead whale population.

Reliable information on the natural history, numbers of animals, and migratory patterns with respect to the bowhead population is not now available for proper evaluation of the biological effect of the Eskimo harvest and of the potential effect of oil spills.

RESEARCH OBJECTIVES

The objectives of current research are to obtain the information necessary for determining the status of the bowhead whale, the impact of the Eskimo fishery on population size, and the effect that oil exploration and exploitation might have upon this species.

METHODS

Observers monitor the harvest during the spring whaling season at Point Hope and Barrow from approximately 20 April to 7 June, and during the autumn whaling season at Barrow from about 15 September to 30 October. They visit the whaling camps as often as possible and gather information on the number of bowheads sighted, killed and recovered, and struck but subsequently lost. When a whale is taken, the biologists attempt to obtain measurements, collect specimen material for sex and age determination, and take photographs. In addition, they make observations of whaling methods and equipment as a first step toward determining if it is possible to reduce the number of whales struck but not recovered.

In 1976, National Marine Fisheries Service (NMFS) research was expanded with funding from the Outer Continental Shelf Environmental Assessment Program (OCSEAP), to obtain data on the abundance, distribution, and movement of bowhead whales. Aerial surveys are being conducted to obtain information on offshore distribution and migration, and ice-based observation stations have been established to obtain 24-hour counts on the numbers of whales using near-shore leads during the spring migration. Although

data collected by the OCSEAP study is contained in periodic reports published by that program, information pertinent to the harvest is included in this report.1/

SPRING WHALING

Whaling Villages

We collected information at Point Hope and Barrow and indirectly learned of whaling activities at other villages from various sources. Mr. Milstead Zahn, NMFS, Juneau, and Alaska Department of Fish and Game personnel, John J. Burns, Fairbanks, and Carl A. Grauvogel, Nome, supplied information from St. Lawrence Island. Toby Anungazuk, Alaska Department of Fish and Game, Wales, supplied information about whaling at that village. The Reverend Clinton Swan provided information on whaling at Kivalina.

St. Lawrence Island: The whaling season began on St. Lawrence Island about 1 April and ended approximately 20 May. About nineteen crews from Gambell and at least three crews from Savoonga actively whaled during the spring. The first whale harvested by St. Lawrence Island crews was taken 21 April One bowhead was taken by Gambell whalers and seven whales were reported taken by Savoonga crews (Table 1). One of the latter was a stinker, a harpooned whale that died but was not recovered until several days later. Five additional whales were reported struck but lost off St. Lawrence Island. The bowhead whaling season here ends when conditions become favorable for walrus (Odobenus rosmarus) hunting, and although whaling gear is carried in the boats, few bowheads are taken after the hunting of walrus has begun. The people of Gambell and Savoonga share their whale catch each year.

One whaling captain from Savoonga reported that during the whaling season he believed that most of the whales passed north in the morning between the hours of 0500 and 0800, and that only a few traveled north throughout the day. He also reported that an unusually large number of bowheads were observed

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1/ Fiscus, Clifford H., Howard W. Braham, and Willman M. Marquette. 1976. Distribution and abundance of bowhead and belukha whales in the Beaufort and Chukchi Seas. In: Environmental Assessment of the Alaskan Continental Shelf, Principal Investigator's Reports, April-June 1976, Volume 1, pp. 68-84.

migrating northward in the spring of 1976.

Wales: Two crews were active during the spring of 1976 at the village of Wales. No whales were taken, and none was struck and lost. The period of whaling approximated that of Point Hope, although the exact dates are not known.

Kivalina: Three crews actively whaled at Kivalina during the spring of 1976. Whales were neither taken nor struck. The period of whaling at Kivalina approximated that of Point Hope, although the exact dates are not known.

Point Hope: The whaling season was begun 10 April when four crews went out on the ice, and ended 28 May when the ice became unsafe. NMFS observers were stationed in the village from 28 April until 1 June to monitor the harvest.

Fourteen whaling crews at Point Hope took twelve whales in 1976 and biological information was collected by NMFS observers from eleven (Table 1). Eight of the whales were young animals less than 8.9 m (29 feet, 2 inches) in length, and four were older animals 10.2 m (33 feet, 6 inches) or over in length. The largest whale taken at Point Hope was 14.7 m (48 feet, 2 inches) in length.

During the 1976 season 235 bowhead whales were sighted at Point Hope (Table 2). Bowheads taken by the whalers were included in the total and every effort was made to eliminate duplicate reports of sightings. Because other whales may have been seen by crew members and not reported, the 235 sightings represent a minimum number of bowheads seen at Point Hope.

Although no whales were reported killed and lost at Point Hope, 12 were struck and lost there. However, an enforcement division patrol conducted by the Alaska Department of Fish and Game observed five dead bowhead whales in the vicinity of Point Hope in mid May. This report indicates that apparently five of the 12 animals that were struck and lost subsequently died of their wounds. The number of whales killed by Point Hope whalers therefore includes 12 that were recovered and five not recovered by the hunters, a total of 17 whales.

Wainwright: Eight whaling crews were reported to be active during the spring of 1976 at the village of Wainwright. Three whales were taken but information was not received on animals that may have been struck and lost. The whaling

Table 1.--Biological features of bowhead whales taken during spring 1976.

Area and date	Length (centimeters)	Sex	Remarks
St. Lawrence Island-Gambell			
--	--	-	One taken, no data available
Savoonga			
--	914[1/]	F	A seventh whale was taken but no
--	1067[1/]	M	-- data was available.
--	610[1/]	M	--
--	762[1/]	M	--
--	914[1/]	M	--
--	853[1/]	M	--
Kivalina	--	-	None taken
Point Hope			
23 April	792[1/]	-	--
1 May	1021	M	--
2 May	1321	F	--
2 May	1120	M	--
2 May	853	F	--
3 May	1468	M	--
3 May	846	F	--
3 May	848	F	--
6 May	825	F	Ingutuk.[3/] Stinker.[4/]
7 May	889	F	--
9 May	808	F	--
14 May	762	M	--
Wainwright			
--	--	-	One taken, no data available
4 June	--	-	--
4 June	--	-	--
Barrow			
2 May	750[2/]	M	--
5 May	1144	M	--
6 May	796	-	--
6 May	1136	-	--
6 May	750	F	--
9 May	1235	M	Stinker
11 May	980	M	Stinker
12 May	1370	M	Stinker
14 May	1070	M	Stinker
15 May	1100	M	--
15 May	685[2/]	F	--
17 May	854	F	Ingutuk
19 May	1158	F	Stinker

1/ Estimate of length in feet was provided by the Eskimos.
2/ Length based on measuring segments of butchered whale.
3/ Small whales that are especially fat are designated by the Eskimos as Ingutuk.
4/ Whales recovered several days after death are called stinkers.

Table 2.--Sightings of bowhead whales, spring 1976.

Date	Location	
	Point Hope	Barrow[1/]
10-23 April	15	0
24 April	-	0
25	-	5
26	-	0
27	-	0
28	4[2/]	0
29	0	17
30	25	17
1 May	107	20
2	7	9
3	5	2
4	0	0
5	7	20
6	13	35
7	8	9
8	0	5
9	9	2
10	0	1
11	0	0
12	0	0
13	12	28
14	5	5
15	0	14
16	3	29
17	3	35
18	0	61
19	0	1
20	0	0
21	3	4
22	3	19
23	6	0
24	0	9
25	0	1
26	0	6
27	0	0
28	0	0
29	0	0
30	0	0
31	0	1
1 June	0	1
2	-	1
Totals	235	357

1/ Data from Fiscus, Braham, and Marquette, 1976. See footnote 1/ (corrected figures provided by H. Braham, pers. comm.).

2/ Observed from aircraft on flight from Barrow to Point Hope.

period at Wainwright approximates that of Barrow.

Barrow: The whaling season began approximately 20 April, 1976 and ended 2 June when the ice became unsafe for travel. Two observers were stationed at the Naval Arctic Research Laboratory (NARL), Barrow, from 22 April to 3 June. In addition, an OCSEAP crew of four people was stationed on the ice at the edge of the lead to make observations of bowhead whales and other marine mammals throughout the whaling season.

The number of whaling crews actively engaged in whaling varied almost daily, but approximately 36 of them operated at Barrow some time during the season. Thirteen whales were taken and recovered during the spring season. Five of the thirteen whales recovered were stinkers, the highest number recorded during a single season since the NMFS began monitoring the harvest. In addition, 18 bowheads were reported struck and lost, and seven more were killed and lost. Two additional bowheads may have been killed and lost, which would bring the total to 22. These animals were sighted from the air by OCSEAP scientists (H. Braham, pers. comm.). One dead whale was sighted 24 May floating among the ice floes 46 km (25 miles) south of Barrow and about 28-37 km (15-20 miles) offshore. On 22 May, the aerial survey crew observed 34 polar bears (Ursus maritimus) on the ice feeding upon what appeared to be a whale carcass, judging from the amount of debris in the area and the size of the body.

Some data were obtained on each of the butchered whales (Table 1). Body lengths of the whales taken ranged from 6.8 to 13.7 m (22 feet, 6 inches to 45 feet). The muktuk (skin and blubber), flukes, and baleen of a stinker can be salvaged but the remainder must be discarded as inedible. Normally, the crew responsible for the death of a stinker can be identified from marks on the harpoon or from bomb particles embedded in the whale. If so, the crew that recovers the animal shares the carcass with the crew that killed it. Otherwise, a stinker belongs to the recovering crew.

Whaling Methods

The method presently used by Alaskan Eskimos to take whales has evolved from ancestral methods and the adoption of commercial whaling gear and methods introduced by Yankee whalers in the last century. Van Stone (1958) described the era of

commercial bowhead whaling in Alaskan waters. The most recent description of the development of current Eskimo whaling methods is that of Durham (1974). Van Stone (1962) describes the traditional method of marking and cutting shares from a whale carcass at Point Hope, which, with some modification, is still in use. A similar though much simplified method of marking and cutting shares from whales is used at Barrow.

A description of whaling crews and current whaling methods and equipment employed in the fishery was presented in previous reports on the Eskimo harvest of bowhead whales (Fiscus and Marquette[2/], and Marquette, 1976). The cost of maintaining and replacing whaling equipment which is becoming increasingly expensive, is borne primarily by the whaling captains. Whaling gear used by the 14 crews at Point Hope is listed in Table 3.

Four new umiaks (skin boats) were constructed during the 1975-76 winter and used for spring whaling at Point Hope in 1976. One captain stated that he paid $700 for the boat frame, and the bearded seal (Erignathus barbatus) skins used to cover it cost an additional $200. One umiak was constructed at Kotzebue and transported to Point Hope in early spring by snowmobile and sled, a 4-day trip. Although all umiaks are of the same general dimensions and appearance, slight variations in materials and construction techniques make each distinctive.

In 1976 the price of a shoulder gun at the Pt. Hope Store was $647, darting guns were $367.05 each, and a harpoon cost $33.25. In addition, a village tax of 2 percent was levied on all store items for the first time in 1976. At least three villagers own block and tackle sets capable of hauling whales out of the water onto the ice for butchering. Because the lines of one set were old and weak and broke frequently during use, much time was spent repairing them, which slowed the butchering process considerably. Each set of block and tackle is valued at about $1,000, and use of his equipment to remove a whale from the water entitles the owner to a share of that animal.

2/. Fiscus, Clifford H., and Willman M. Marquette. 1975. National Marine Fisheries Service field studies relating to the bowhead whale harvest in Alaska, 1974. Nat. Mar. Fish. Serv., Northwest and Alaska Fisheries Center, Seattle, Washington. Processed report, 23 pp.

Table 3.--Type of equipment used by whaling crews at Point Hope, Alaska, spring 1976. Each horizontal line refers to the equipment of one crew.

Boat (Umiak)	Outboard motor	Shoulder gun	Darting gun		Floats		
			With harpoon	Without harpoon	Large plastic	Small plastic	Sealskin
1	0	1	1	0	0	1	1
1	0	1	1	1	0	1	1
1	0	2	1	1	1	1	0
1	1	2	1[1/]	1[2/]	1	1	0
1	0	0	1	1	1	1	0
1	0	0	1	1	1	1	0
1	1	2	1	1	1	1	0
1	0	1	1	1	1	1	0
1	0	1	1	1	1	1	0
1	0	1	1	0	1	1	0
1	1	0	1	1	1	1	0
1	0	1	1	1	1	1	0
1	1	1	1	1	1	1	0
1	0	0	1	1	1	1	0
Total 14	4	13	14	12	12	14	2

1/. Lost taking whale on 3 May, replacement purchased.

2/. Lost taking whale on 3 May.

In Barrow, large plastic floats (38 to 51 cm; 15 to 20 inches) that are attached to the harpoon lines to impede the whale's escape were selling for $42.50, and the small floats (30 to 36 cm; 12 to 14 inches) that are attached by a line to the darting guns to keep them from sinking, were priced at $16.75 each. At least two individuals own block and tackle sets at Barrow.

Whaling Effort

More crews were engaged in bowhead whaling in 1976 than in 1975. The number increased from 13 to 14 at Point Hope, from 4 to 8 at Wainwright, and from 30 to 36 at Barrow. Although a large number of crews are outfitted with whaling gear, the number that actively engage in whaling throughout the season is significantly smaller. At Kivalina only 3 crews were reported to have whaled in the spring of 1976, 2 less than reported for 1975. Two crews were actively whaling at Wales, and 23 were reported to be on St. Lawrence Island in 1976, a figure similar to that of 1975. At least 86 crews were, therefore, engaged in whaling in the spring of 1976.

Since the number of crews hunting at the lead varies daily, we maintained a record of their activities throughout the season in an attempt to evaluate hunting effort (Tables 4 and 5). In 1976, Point Hope crews were at the lead 23 days (66 percent of the time) from 28 April to 1 June. At Barrow, crews were at the lead 31 days (72 percent of the time) from 22 April to 3 June. Weather conditions at Barrow during this period are presented in Table 6.

Whaling effort of the crews at the two villages was evaluated by examining the number of crew-days required to take a whale. Expressed as the number of crews that whaled each day, Point Hope crews whaled a total of 229 crew-days for an average of 6.5 crews per day, and Barrow crews whaled 314 crew-days, an average of 7.3 crews per day during the season. Since 12 whales were taken at Point Hope, 19.1 crew-days were required for each whale recovered. At Barrow, 24.2 crew-days were required to take each of 13 whales during the spring harvest. A comparison of crew-days required to take whales indicates that the Point Hope whalers expended slightly less effort to take whales and hence are more efficient than the whalers at Barrow. Whaling effort required to take whales during a season may indicate differential effects of the climate, ice, and ocean currents on the ability of the whalers to kill and recover bowhead whales.

Although the total number of crews engaged in whaling in the spring of 1976 at Barrow was large, the number that

Table 4. Whaling effort at Point Hope, Alaska, spring 1976.

Date	Number of crews on lead	Remarks
28 April	0	Lead closed.
29	0	Lead closed.
30	14	Lead opened at 1200 hours.
1 May	14	Lead open.
2	14	Lead open.
3	14	Lead open.
4	14	Lead open.
5	14	Lead open.
6	10	Lead open, several miles wide.
7	12	Lead open, several miles wide.
8	13	Lead open, several miles wide.
9	14	Lead open,; all crews off ice 2400 hours, windy.
10	0	Lead open, windy and rough.
11	8	Lead open, windy and rough.
12	10	Lead open.
13	14	Lead open.
14	12	Lead open.
15	6	Most of lead closed, open on East end.
16	3	Most of lead closed, open on East end, raining.
17	4	Most of lead closed, open on East end, raining.
18	0	Lead open, windy and rough, ice dangerous.
19	0	Lead open, windy and rough, ice dangerous.
20	0	Lead open, windy and rough, ice dangerous.
21	7	Lead open.
22	13	Lead open.
23	13	Lead open.
24	1	Lead open, windy and rough.
25	0	Lead open, windy and rough.
26	0	Lead closed.
27	3	Scattered openings.
28	2	Lead open, windy and rough.
29	0	Lead open, windy, strong current, ice dangerous.
30	0	Lead open, windy, strong current, ice dangerous.
31	0	Lead open, windy, strong current, ice dangerous.
1 June	0	End of season.

Table 5.--Whaling effort at Barrow, Alaska, spring 1976.

Date	Number of crews in lead	Remarks
April		
22	3	Lead opening and closing
23	6	Lead closed
24	0	Lead closed
25	0	Lead closed
26	10	Lead closed
27	0	Lead closed
28	0	Lead closed
29	7	Lead open
30	13	Lead open
May		
1	15	South lead closed, north lead open
2	10	North lead open, windy and rough
3	13	All crews off ice by evening
4	0	Strong offshore wind
5	20	Lead open
6	22	Lead open, windy and rough
7	0	Lead open, windy and rough
8	20	Lead freezing over
9	0	Lead closed
10	0	Lead closed
11	0	Lead closed
12	0	Lead closed
13	10	Variable openings
14	15	Variable openings
15	28	Lead open
16	27	Lead open
17	27	Lead open
18	20	Lead closing
19	10	Scattered openings
20	5	Scattered openings
21	5	Scattered openings
22	5	Scattered openings
23	5	Scattered openings
24	5	Scattered openings
25	2	Scattered openings
26	2	Lead closing
27	2	Lead closed
28	2	Lead closed
29	0	Lead closed
30	1	Ice breaking up
31	1	Ice breaking up
June		
1	2	Ice dangerous
2	1	Ice dangerous
3	0	Season ended

Table 6.--Weather data at Barrow, Alaska, spring 1976.

Date	Temperature (F°)			Average wind velocity (Mph)	Wind direction (degrees)
	Max.	Min.	Ave.		
April					
22	10	-9	1	6.8	090
23	11	5	8	5.3	340
24	10	6	8	8.2	090
25	16	5	10	9.0	100
26	18	4	11	8.2	090
27	15	-1	7	6.1	250
28	14	-12	1	9.6	140
29	19	-6	7	14.3	100
30	23	10	17	12.5	090
May					
1	23	9	16	11.6	080
2	25	15	20	13.2	060
3	28	15	22	18.7	070
4	30	22	26	16.5	070
5	30	16	23	6.3	200
6	27	14	21	13.6	060
7	16	9	13	15.8	060
8	14	6	10	8.6	020
9	13	2	8	8.2	060
10	10	1	6	7.2	060
11	9	3	6	5.7	060
12	14	9	12	11.3	070
13	15	4	10	14.0	070
14	13	4	9	12.5	060
15	15	10	13	12.9	090
16	21	13	17	15.2	080
17	16	9	13	15.6	070
18	11	8	10	12.5	080
19	11	7	9	7.6	290
20	17	10	14	5.4	090
21	15	11	13	10.2	090
22	20	11	16	14.6	080
23	23	19	21	12.1	080
24	27	23	25	12.3	030
25	30	23	27	11.2	020
26	29	19	24	12.4	230
27	25	13	19	9.3	220
28	30	22	26	11.2	020
29	30	25	28	14.0	010
30	35	28	32	11.6	070
31	34	26	30	11.9	110
June					
1	34	23	28	10.0	080

participated at every opportunity throughout the season averaged close to eleven. A daily count of active crews was not obtained because camps were scattered along 25 miles of lead and not all could be reached during a single day. The whaling season lasted about a month and a half at Point Hope and Barrow with the most productive hunting occurring during May.

Utilization

The whales were pulled from the water when possible by means of a block and tackle and then butchered. Thin ice required partial butchering of the animal before it could be hauled from the water, a situation that greatly increased the time spent on this aspect of whaling. Accordingly, the butchering process required from as few as 3 to as many as 30 hours. Parts removed from the animal were taken ashore as soon as possible to prevent loss when the ice shifted.

Most of the meat, muktuk, and blubber were removed from the butchering site immediately after the whale was cut up. Occasionally, however, several days elapsed before all parties hauled off their shares. Remains of the backbone, some ribs and internal organs, and the skull (at Barrow) were generally left on the site. Usually, fewer parts of the whale were left on the ice at Point Hope than at Barrow. At Point Hope, the skull was returned to the sea after the tympanic bullae and lower jawbones were removed, and the latter were taken to the village. At Barrow, the skull (tympanic bullae removed), including jawbones, was usually left at the butchering site. At some butchering sites, mostly at Barrow, blubber was left on the ice. Before the snowmobile era, surplus blubber was used for dog feed. The Eskimo utilizes most of the whale, including the meat, muktuk, baleen, gum tissue (mamaak), flukes, flippers, brains, tongue, intestines, heart, kidneys, epithelium of the liver, the tympanic bullae, and frequently the stomachs (Carroll, 1976).

Other Mammals

In addition to bowhead whales the following species of mammals were observed or reported in 1976 at Point Hope during the spring whaling season.

Belukha	*Delphinapterus leucas*
Bearded seal	*Erignathus barbatus*
Largha seal	*Phoca largha*

Ringed seal	Phoca hispida
Polar bear	Ursus maritimus
Walrus	Odobenus rosmarus

Belukha were observed from 28 April to 22 May at Point Hope. At least two noticeable waves of these animals migrated past the whaling camps. The first occurred from late April to 5 May and the second from 8 to 16 May. A third wave may have occurred in late May. Belukha sighted and taken at Point Hope are given in Table 7.

The whalers do not actively pursue belukha during the bowhead whaling season because they frequently sink quickly and require considerable effort to recover, although they are prized for food. A belukha harvest at this time is incidental to the bowhead whale fishery. Rifles are normally used to kill the animals. It is difficult to obtain data on the belukha because these animals are butchered immediately after they are killed, a process that requires but a few minutes to complete after the animal is hauled onto the ice. Crew members at times eat some of the meat at the whaling camp, but usually take their shares directly home. Measurements were obtained of a fetus that had been abandoned on the ice after whalers had butchered a pregnant female.

Other species killed at Point Hope during the spring whaling season (Table 8) included 77 ringed seals and one largha seal. Two bearded seals were sighted but not killed. A dead floating walrus was found drifting in the lead by the whalers but was not taken. Two polar bears were sighted from an aircraft on a flight from Barrow to Point Hope.

At Barrow, other species killed included two belukha (Table 7) one of which sank and was lost, and four polar bears (Table 9). A total of 328 belukha were sighted: 19 on 16 May, 101 on 18 May, and 208 on 22 May (Table 7). Sightings of belukha at Barrow varied considerably, perhaps due to weather and ice conditions that made observations difficult. Belukha may utilize leads that are farther out than the near-shore leads frequented by whalers, as indicated by OCSEAP surveys[17]. In addition to 34 polar bears counted feeding upon a large carcass frozen in the ice north of Barrow, other marine mammals observed during aerial surveys of the northeastern Chukchi and western Beaufort Seas by OCSEAP observers from 30 April to 20 June are reported by Fiscus, Braham, and Marquette[17].

At Wales, three belukha were reported taken by two crews that whaled there during the spring season (Table 7).

Narwhals (Monodon monoceros) have been reported as occasional visitors to Alaskan waters (Geist, Buckley and

Table 7.--Belukha taken or observed at whaling villages in Alaska during spring, 1976.

Location and date	Number sighted	Killed and recovered	Killed but lost	Remarks
Point Hope				
28 April	321	0	0	Observed from aircraft on flight from Barrow to Pt. Hope
1 May	26	0	0	
2	1	1	0	
3	150	1	0	
5	10	0	0	
6	1	0	0	
7	1	1	0	
8	15	0	0	
9	4	4	0	
11	100	0	0	
13	250	0	0	
14	1	1	0	Male 423 cm long, skull taken for MMD collection
16	12	0	0	
17	1	0	0	
22	35	0	0	
Totals	928	8	0	
Barrow[1/]				
16 May	19	0	0	
18	101	0	1	Sank
22	208	1	0	
Totals	328	1	1	
Wales				
--	3	3	-	
Totals	3	3	-	

1/ Data combined for harvest and OCSEAP crews.

Table 8.--Mammals other than whales taken or observed at Point Hope, Alaska, spring 1976.

Species	Date	Number sighted	Number killed	Sex	Length
Ringed seal	24 Feb.-7 March		1	M	--
	24 Feb.-7 March		1	M	--
	24 Feb.-7 March		1	-	--
	7-19 March		1	M	118.6
	12-19 April		1	-	--
	12-19 April		1	M	--
	12-19 April		1	M	--
	12-19 April		1	M	--
	16-21 April		1	F	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	-	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-21 April		1	M	--
	16-23 April		1	M	--
	16-23 April		1	M	--
	16-27 April		1	M	--
	18 Apr.-2 May		7	-	--
	24-27 April		2	M	--
	24-30 April		1	M	--
	25 April		1	M	--
	30 April		1	M	--
	1 May		1	M	126.9
	1 May		10	-	--
	6 May		10	-	--
	13 May		1	M	123.7
	13 May		1	M	126.0
	16 May		1	M	117.4
	17 May		3	-	--
	27 May		5	M	--
	27 May		1	F	--
	27 May		1	F	126.6
	27 May		1	M	106.6
	27 May		1	F	106.1
	27 May		1	F	102.6
	27 May		1	M	120.8
	27 May		1	M	108.3
	27 May		1	F	101.2
	27 May		1	F	107.0
	27 May		1	M	112.2
	27 May		1	M	112.5

Table 8.--Mammals other than whales killed or observed at Point Hope, Alaska, spring 1976--continued.

Species	Date	Number sighted	Number killed	Sex	Length	Remarks
Bearded seal	1 May	1	0	-	-	
	31 May	1	0	-	-	
Largha seal	1 May	1	1	-	-	
Polar bear	28 April	2	0	-	-	Observed from aircraft on flight from Barrow to Point Hope
Walrus	12 May	1 (dead)	0	-	-	Found floating in lead, not taken

Table 9.--Mammals other than whales killed or observed at Barrow, Alaska, spring 1976.

Species	Date	Number sighted	Number taken	Remarks
Polar bear	14 May	1	0	
	31 May	1	1	
	31 May	1	1	
	31 May	1	1	
	31 May	1	1	
		5	4	

Manville, 1960). An experienced whaling captain at Barrow reported that he sighted a single narwhal in a pod of belukha on 15 May, west of the village. In another unconfirmed report, NMFS observers at Point Hope during the spring of 1974 were informed of a narwhal that had been found dead on the beach north of the village at Pingu Bluff in October or November of 1973. The animal was described as being about the same size as a belukha, with a tusk that protruded from the body approximately 51 cm (20 inches). The tusk had been traded to a non-resident of the village and was not available for examination.

A resident of Barrow stated that he sighted killer (Orcinus orca) and gray (Eschrichtius robustus) whales while travelling to Wainwright by boat during the first week of September. Killer whales apparently appear occasionally in Alaskan arctic waters. Bee and Hall (1956) noted three records (one near Icy Cape, and two near Barrow) of these whales in the area. Banfield (1974) states that they are rare visitors to the Beaufort Sea.

Two incidents of killer whales attacking other cetaceans were reported by Eskimos in 1976. In August 1975, four Point Hope residents on a boat a short distance south of the village observed seven killer whales attacking a young gray whale. They reported that the largest killer whale held the gray by the tail while the others attacked various areas of the gray's body. After a short time the killer whales appeared to abandon the gray, which was almost motionless and bleeding profusely. After remaining almost lifeless for several minutes, the gray began to feebly swim away when the killer whales suddenly reappeared and attacked it again. The gray soon sank from sight and, presumably, died. At Barrow, three residents witnessed three or four killer whales attacking an unidentified cetacean off the coast of that village during this past summer.

AUTUMN WHALING

Barrow: The beginning of the autumn whaling season coincides with the westward migration of bowheads past Barrow to wintering grounds in the northern Bering Sea. In 1976 the whaling season began 26 August, which was unusually early for Barrow, and ended 8 October when the formation of new ice prevented further travel by boat. Weather data for Barrow during this period is given in Table 10. The pack ice remained approximately 104.6 km (65 miles) off the north coast of Alaska during the autumn whaling season. An NMFS observer was

Table 10.--Weather data at Barrow, Alaska, during autumn whaling season.

Date	Temperature (F°) maximum	minimum	average	Average wind velocity (Mph)	Wind direction (degrees)
August					
26	46	34	40	14.2	090
27	41	33	37	10.6	080
28	42	33	38	6.0	100
29	48	33	41	5.8	120
30	43	36	40	6.0	150
31	51	35	43	6.5	100
September					
1	37	34	36	4.4	330
2	37	31	34	4.2	310
3	33	30	32	7.8	300
4	36	28	32	8.6	260
5	35	26	31	6.7	190
6	37	31	34	8.9	160
7	44	33	39	11.1	180
8	34	31	33	9.3	020
9	36	33	35	5.4	070
10	38	32	35	8.7	120
11	48	33	41	13.5	120
12	34	30	32	11.8	100
13	33	31	32	11.4	080
14	36	32	34	17.3	070
15	35	33	34	13.9	060
16	35	32	34	6.9	060
17	35	31	33	10.4	100
18	35	30	33	12.4	100
19	33	29	31	8.3	080
20	31	23	27	9.2	080
21	46	31	39	15.2	190
22	39	32	36	10.4	230
23	34	29	32	14.9	060
24	31	27	29	14.6	070
25	30	27	29	14.9	070
26	33	30	32	7.8	050
27	32	28	30	9.3	080
28	31	27	29	18.5	040
29	29	22	26	19.9	050
30	22	18	20	19.5	070
October					
1	24	19	22	18.1	080
2	27	18	23	15.2	090
3	26	23	25	15.2	040
4	25	23	24	16.4	040
5	27	23	25	18.4	070
6	28	22	25	15.1	070
7	28	21	25	7.7	070
8	26	21	24	14.6	230
9	24	4	14	16.6	240
10	19	0	10	15.5	220

stationed at NARL from 11 September to 14 October.

Autumn whaling differs in several ways from spring whaling. Wood or aluminum boats 5.49 to 7.62 m (18 to 25 feet) in length are used instead of skin covered boats. The crews often must venture several miles out to sea to locate the whales. The boats are powered by large outboard or inboard motors; noise made by these motors apparently does not frighten the animals in the autumn as it does during the spring hunt. As in the spring, darting and shoulder guns are used in the autumn to kill the whales. However, since the migrating whales are usually hunted in the open sea during the autumn, they are unable to escape easily by swimming under nearby ice floes as they frequently do in the spring. The whalers are therefore able to pursue them for a longer time, continuing to fire bombs into them until they die. For example, one captain reported that after firing all the bombs that he had with him (17) at one whale, he finally killed it with a lance.

Twelve crews engaged in autumn whaling at Barrow killed and recovered ten whales. An eleventh whale was killed but abandoned because of rough seas and an insufficient number of boats to assist in safely towing the carcass to shore some 46 km (25 miles). The whalers reported that most of the whales were taken about 37 km (20 miles) north of Point Barrow. Fifteen to thirty-two hours were required to tow the whales to shore near the village. Data obtained on whales that were killed and recovered is presented in Table 11. Although the whalers prefer to kill the small whales that are reported to follow the earlier migrating large animals, the ten whales taken this autumn were all large and measured from 13.20 to 17.30 m (43 feet, 4 inches to 56 feet, 9 inches) in length. This year is the first in which bowheads have been reported taken in August at Barrow.

Nuiqsut: Three crews actively whaled during the autumn of 1976 at the village of Nuiqsut. A fourth crew could not join the hunt because of a malfunctioning motor. Whales were not taken, and information was not received on animals that may have been struck but lost.

Kaktovik: Seven whaling crews were active during the autumn of 1976 at the village of Kaktovik on Barter Island. Two bowheads were killed by Kaktovik crews, but information was not received on whales that were struck and lost.

Table 11.--Biological features of bowhead whales taken during autumn 1976.

Area and date	Length (centimeters)	Sex	Remarks
Barrow			
28 August	1650 1/	M	--
30 August	1630 1/	M	--
3 September	1620 1/	M	--
3 September	1650 1/	M	--
3 September	1730 1/	F	--131 cm fetus collected.
10 September	1600	F	--Ingutuvak 2/
20 September	1430	F	--
20 September	1408	M	--
20 September	1525	M	--
21 September	--	-	Lost due to high seas.
7 October	1320	M	--
Kaktovik			
20 September	1371 1/	M	--
27 September	914 1/	-	--
Nuiqsut	--	-	None taken

1/. Length estimated by natives.
2/. Whales that are especially fat are designated by the Eskimos as Ingutuk if small and Ingutuvak if large.

SUMMARY

Details concerning the bowhead hunt in 1976 were:

Location	Season	Butchered No.	Killed and lost no.	Struck and lost no.
Gambell	Spring	1	0	0
Savoonga	Spring	7	0	5
Wales	Spring	0	0	0
Kivalina	Spring	0	0	0
Point Hope	Spring	12	0	12
Wainwright	Spring	3	0	3
Barrow	Spring	13	7	18
Barrow	Autumn	10	1	0
Nuiqsut	Autumn	0	0	0
Kaktovik	Autumn	2	0	0
Total		48	8	35

The fact that a whale is struck and lost does not necessarily mean that it has been fatally injured. Some whales harpooned with the darting gun escape when the line breaks, and others hit with a missile from the shoulder gun escape if the bomb fails to explode. Some of these animals may die and some may recover.

In 1976, 35 whales were reported struck and lost and 8 were reported killed and lost for a total of 43 struck and lost. It should be noted, however, that since these data are obtained from statements made by the whalers, or rarely from the observations of investigators, they represent a minimum known number of animals struck and lost.

At the two villages (Point Hope and Barrow) where NMFS observers were stationed in the spring of 1976, 25 whales were killed and recovered compared to 30 struck and lost. At Barrow 25 whales were struck and lost, of which 7 were reported killed and lost. Since 13 whales were killed and recovered, almost 2 of the animals were struck and lost for each one recovered. At Point Hope 24 whales were struck, of which 12 were killed and recovered and 12 were struck and lost. The Point Hope data are considered reasonably complete, whereas those for Barrow are incomplete due to the greater geographic dispersion of whalers in that locality.

PART II

A REVIEW OF THE HARVEST, 1973 - 1976

AND A BIOLOGICAL SUMMARY OF THE SPECIES.

INTRODUCTION

The current investigation of the subsistence harvest for bowhead whales conducted by Alaskan Eskimos was begun by the NMFS in 1973. The principal objective of the research is to obtain population and biological data necessary to determine the status of the bowhead in the Bering, Chukchi, and Beaufort Seas, and to evaluate the effect of the harvest on these whales. A secondary objective is to evaluate the effect that oil exploration and exploitation might have upon this species. Knowledge obtained from this research will provide the basis for determining whether protective measures are needed for this endangered whale as provided for by the MMPA of 1972 and the ESA of 1973.

Maritime Eskimos of arctic Alaska have conducted a subsistence hunt for bowhead whales since before 1800 B.C. (Oswalt, 1967). Little is known about past harvests of bowheads by these people because they normally do not keep records of their catch. Whaling has been the economic and social basis of Eskimo culture for centuries.

Commercial whaling for bowheads began in the Arctic Ocean in 1848 when the vessel Superior, commanded by Captain Roys, became the first whaler to pass through the Bering Strait in search of these animals (Harmer, 1928). Others followed Roys and in 1870, 487 whales were taken (estimated on the basis of whalebone production by Rice, 1974). Although 309 whales were reported taken in 1893 (Allen, 1942), the fishery declined rapidly after that and commercial whaling ended early in the 20th century.

Following severe depletion of the bowhead whale population in the western Arctic Ocean by commercial whalers, it received complete protection from further exploitation by the International Conventions for the Regulation of Whaling of 1931, 1937, and 1946. Aborigines, however, have been allowed to continue taking the whales for subsistence.

Paragraphs 1, 6, and 7 of the Schedule to the International Whaling Convention of 1946, revised in 1975, are applicable to the harvest of bowhead whales by aborigines. Paragraph 1 includes Balaena mysticetus, the bowhead, in the definition of "right whale." Paragraph 6(c) classifies right whales as a Protection Stock which is defined as follows: "A Protection Stock is a stock which is below 10 percent of MSY stock level. There shall be no commercial whaling on species or stocks whilst they are classified as Protection Stocks." However, paragraph 7 specifies that "...the taking of gray or right whales by aborigines or a Contracting Government on behalf of aborigines is permitted but only when the meat and products of such whales are to be used exclusively for local consumption by the aborigines."

The MMPA (Sec. 101b) provides that any Indian, Aleut, or Eskimo "who dwells on the coast of the North Pacific Ocean or the Arctic Ocean" may take bowhead whales for subsistence or for the purpose of creating authentic articles of handicraft, if not accomplished in a wasteful manner. The MMPA further allows the Secretary (of Commerce) to prescribe protective regulations if a species subject to such aboriginal taking is determined to be depleted. The ESA (Sec. 10e) allows Alaskan Indians, Aleuts, and Eskimos the same privileges as does the

MMPA. If, however, the taking of an endangered species affects it "materially and negatively," the ESA allows the Secretary (of Commerce) to prescribe protective regulation for that species.

The first studies on bowhead whales by the Marine Mammal Division (MMD), then the Marine Mammal Biological Laboratory, were carried out by Dale W. Rice3/ in 1961 and 1962. In 1973, through a contract with the University of Southern California, the MMD of the Northwest and Alaska Fisheries Center (NWAFC) supported Dr. Floyd Durham's studies of the bowhead whale, which he had begun in 1961. Since 1974 the MMD has stationed scientists at the two most important whaling villages (Point Hope and Barrow) to monitor the hunt and gather catch statistics and biological data, except in 1975 when the Barrow studies were contracted to the University of Alaska. Beginning in September 1975, the MMD has also participated in the OCSEAP study to evaluate the possible effects of oil development related activities on bowhead whales. Information obtained by monitoring the harvest, together with base-line data collected as a result of the OCSEAP studies, will provide the data necessary to provide a continuing evaluation of the population status of these whales.

METHODS

Information on the Eskimo harvest of bowhead whales is collected by biologists stationed at Point Hope and Barrow, the two major whaling villages, during the whaling seasons. They visit the whaling camps as often as possible and gather information on the number of bowheads sighted, killed and recovered, and struck but subsequently lost. Every effort is made to obtain morphological measurements, biological specimens for sex and age determinations, and photographs of each whale taken by the Eskimos. In addition, the biologists observe whaling methods and equipment as a first step toward determining if it is possible to reduce the number of whales wounded but not recovered.

The collection of biological data and specimen samples by NMFS observers is largely subject to voluntary cooperative

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3/ Rice, Dale W. 1964. Eskimo whaling in Arctic Alaska. U.S. Fish and Wildlife Service, Marine Mammal Biological Laboratory, Bureau of Commercial Fisheries, Seattle, WA. Typewritten report, 23 pp.

efforts by the whalers. In addition, since recovered animals must be cut up and taken ashore as soon as possible because of the constant danger of shifting ice, the whalers do not tolerate any significant delay of their activities. For this reason, the observers attempt to arrive at the scene of a kill before the carcass has been removed from the water. If the investigators are present for the entire butchering process it is often possible to obtain much of the desired biological information.

In 1975, research on bowhead whales was expanded with funding from the OCSEAP. Aerial surveys and an ice-based station were employed to obtain data on the distribution, migration, and abundance of bowheads.[1/] Aerial surveys were conducted from the Naval Arctic Research Laboratory, Barrow, Alaska. Depending upon the cloud ceiling, surveys were flown at altitudes of 200 to 2,000 feet, with near and offshore leads surveyed. Visual estimates were made, and photographs were taken to verify species and numbers of animals sighted. The ice-based station was established on shorefast ice approximately eight miles northwest of Barrow. A 24-hour watch was maintained, when ice conditions permitted, and the number of bowhead whales sighted was recorded. Sightings by Eskimos were also obtained; these sightings were screened to ensure that they were not duplicates of the ice station crew sightings. Data thus obtained will provide information on the distribution, migration, and abundance of the bowhead population in the Bering, Chukchi, and Beaufort Seas.

DISTRIBUTION AND MIGRATION

The bowhead whale inhabits arctic and subarctic waters in four principal areas: (1) from Spitzbergen west to east Greenland, (2) in Davis Strait, Baffin Bay, James Bay, and adjacent waters; (3) in the Bering, Chukchi, Beaufort, and East Siberian Seas; and (4) in the Okhotsk Sea. They inhabit the loose edge of the ice pack and migrate with ice movements. At peak population the bowhead whale was considered circumpolar in distribution (Tomlin, 1957), retreating to the north Atlantic and Bering Seas only in winter.

During the spring migration northward the bowheads follow extensive leads in the ice that are oriented in a southwest to northeast direction (Fay, 1974). The leads pass close to prominent land points such as Wales, Point Hope, and Barrow (Shapiro and Burns, 1974). Timing of the migration is no doubt

related to ice conditions, and movements northward in the spring and southward in the autumn are fairly regular through the years. Bailey and Hendee (1926) reported that the first bowheads were seen at Wales in the latter part of April. According to Foote4/, the earliest known date for the arrival of whales at Point Hope within the past few decades was 19 March, but during the 1950's they were sighted usually during the first two weeks of April. Johnson, et al. (1966) reported that the first bowheads arrived at Point Hope on 11 April in 1960 and on 13 April in 1961. The earliest known date that bowheads have appeared at Barrow was reported by Brower (1954) to be 29 March. Durham5/ states that the first run usually arrives at Barrow during the latter part of April. The spring harvest generally ends late in May, although bowheads have been observed passing Barrow during June when the ice is unsafe for hunting.

The Eskimos of Point Hope and Barrow generally recognize three distinct runs of whales past their villages during the spring migration (Brower6/, Foote4/, and Nelson, 1969). According to Durham5/ as many as four runs (or waves) of bowheads occur. The first run passes Point Hope in early April and Barrow in late April, which in some years may not be noticed due to ice conditions which prevent the whalers from going out. Our observers have also noted three distinct runs past Point Hope and Barrow and possibly a fourth. Whales making up the first two runs are usually small animals of both sexes, and many of them are the size that Durham5/ would call yearlings, ranging in length from 6.7 to 7.9 m (22 to 26 feet). Whales making up the third run include large males and females with calves. Since observations are affected by weather and ice conditions, more information must be gathered on migration waves before definite conclusions can be drawn.

4/ Foote, Don Charles. 1964. Observations of the bowhead whale at Point Hope, Alaska. McGill University, Montreal, P.Q., Canada. Unpublished manuscript. January. pp. 1-78.

5/ Durham, Floyd E. 1972. Biology of the bowhead whale (Balaena mysticetus L.) in the western Arctic, University of Southern California, Los Angeles. Unpublished manuscript.

6/ Brower, Charles D. 1920-26. The Northernmost American-an Autobiography, 2 Vols. Copy in Naval Arctic Research Laboratory Library, Barrow, Alaska.

Based upon sightings (Table 2), three fairly distinct groups or runs of bowhead whales migrated past Point Hope and Barrow during the spring of 1976. At Point Hope, an early run apparently occurred during mid-April, a second from 28 April to 9 May, and a third from 13 to 23 May. Observations were limited during the last ten days of May because of inclement weather and the water currents that created dangerous ice conditions. Three runs of whales also passed by Barrow, the first of which occurred from 25 April to 3 May, the second 5-10 May, and the third from 13 to 31 May. The third group that passed Barrow may actually have been two separate runs (13-19 and 21-26 May), but adverse weather and ice conditions restricted observations during this period.

The above data are weak and more information must be gathered on migrations before definite conclusions can be drawn. Certainly, the bowhead whale is dependent on leads or recently fractured ice containing thin spots through which it can surface for air. Leads far offshore might allow whales to migrate unobserved, and poor visibility on windy days would also limit sightings.

Many species of animals and birds migrate in a series of waves from wintering to summering grounds. Rice and Wolman (1971) describe the seasonal migratory cycle of the gray whale, which exhibits temporal segregation by age, sex, and reproductive status. Similar segregation has been reported in the humpback whale, Megaptera novaeangliae, by Dawbin (1966).

THE HARVEST

The method presently used by Alaskan Eskimos to take whales has evolved from traditional methods and the adoption of gear and techniques introduced by commercial whalers in the last century. Whales were traditionally taken with harpoons and lances fashioned from stone, ivory, and bone. During the era of commercial whaling, Eskimos were often employed by vessels and shore-based stations to assist in taking whales. As a result, these people gained experience in the use of darting guns and shoulder guns and eventually acquired these weapons for personal use. After commercial whaling ceased, the Eskimos continued to use these weapons, which have not changed substantially in design since then.

Catch and Mortality Statistics

Data on the numbers of whales killed and recovered, known killed but lost, and struck and lost during each whaling

season from 1973 to 1976 have been recorded by NMFS observers (Table 12). Bowheads killed by the Soviets from 1972 to 1976 are presented in Table 13 to complete the known kill for subsistence during recent years. Bowheads are not hunted in the eastern Beaufort Sea by Canadian Eskimos (Sergeant and Hoek, 1974). In addition, an on-going literature search is being conducted by the author to obtain data on the historical subsistence kill by Eskimos to provide a comparison with the kill of recent years. These data are given in Table 14 along with recent data for numbers killed and recovered, the statistics judged to be most comparable to historical catch data.

Little information is available on the kill of bowheads by Soviet Eskimos. Zenkovich (1938) reports that Eskimos of the Chukchi Peninsula in particular hunt bowhead whales, though they catch no more than 10 tons each year. Geller (1957) claims that Soviet Eskimos catch mostly young whales weighing 4-5 tons. Tomilin (1957) writes "In the best years, up to 10 whales (including rorquals) are still" (exact year not known--assumed to be at least 1955, the date of the most recent literature citation used by him) "killed at the Chukchi Peninsula, mainly in the villages of Sireniki, Chaplino, Intuk, Naukan, and Uellen." In that area, the autumn rather than the Spring hunt is more rewarding, according to Tomilin. Zimushko (1969) states that bowhead are taken rarely by Eskimos of the Chukchi Peninsula. Mineev (pers. comm.), provided data showing that in recent years the Soviet Eskimo take has been about two whales per year (Table 13). Since 1964 the subsistence hunt has been conducted by USSR commercial-type whaling vessels that are employed primarily to obtain gray whales that are delivered to the villages on the basis of need.

Data on the numbers of whales killed and recovered, known killed but lost, and known struck and lost during each whaling season from 1973 to 1976 have been recorded to provide an evaluation of total mortality due to hunting. The number killed and recovered annually by Alaskan Eskimos since 1946 has varied from a low of one in 1959 to 48 in 1976 (Table 14). Prior to 1970, this annual take varied considerably but did not exceed 23 and averaged 10 bowhead whales. However, in the seven years since 1970, this annual take has exceeded 23 bowheads five times and averaged 29. A harvest of this size represents a sudden and significant increase in the annual take of these whales by Alaskan Eskimos.

Table 12.--Numbers of bowheads taken, known killed but lost, and known struck but lost for the whaling seasons 1973, 1974, 1975, and 1976

Season and location	Killed and recovered				Known killed but lost				Known struck but lost			
	73	74	75	76	73	74	75	76	73	74	75	76
SPRING												
St. Lawrence Is.	6	2	1	8	0	0	1	0	3	2	3	5
Kivalina	0	0	0	0	0	0	0	0	0	1	0	0
Point Hope	7	6	4	12	0	1	0	0	0	5	13	12
Wainwright	3	1	0	3	0	0	0	-	0	0	0	-
Barrow	15	6	10	13	0	1	1	7	7	19	10	18
TOTALS	31	15	15	36	0	2	2	7	10	27	26	35
AUTUMN												
Barrow	2	3	0	10	0	1	0	1	0	1	0	0
Nuiqsut	1	0	0	0	0	0	0	0	0	0	0	0
Kaktovik	3	2	0	2	0	0	0	0	0	0	0	0
TOTALS	6	5	0	12	0	1	0	1	0	1	0	0
GRAND TOTAL	37	20	15	48	0	3	2	8	10	28	26	35

Table 13.--Bowhead whales taken by USSR natives in recent years.

Year	Chukchi Sea	Bering Sea	Total
1972	0	1	1
1973	0	2	2
1974	1	2	3
1975	~~2~~	2	~~4~~ 2
1976	0	0	0

Source: Personal communication from Dr. V.N. Mineev.

Table 14 .-- Bowhead whales taken by Alaskan Eskimos and Shore-based Stations in the western Arctic Ocean.

Year	Barrow	Pt. Hope	Wainwright	Nuigsut	Icy Cape	Kaktovik	Gambell	Savoonga	Kivalina	Misc.	Total
1852	17										17
1853	7										7
1854-79											-
1880		5									5
1881	18										18
1882	1										1
1883	2										2
1884	10										10
1885	28	12									40
1886											-
1887	6										6
1888	2										2
1889	4										4
1890	1	1									2
1891	18										18
1892	8	0									8
1893											-
1894	10										10
1895	4										4
1896	6	33									39
1897	5										5
1898	42[1/]	1									43
1899											-
1900	19										19
1901		1									1
1902		2									2
1903	4	0									4
1904	2	0									2
1905	5										5
1906	1										1
1907	9	0									9
1908	23	13			10-12						46-48
1909	11	13			1						25
1910	2+										2
1911	1	3									4

Table 14 . (continued)

Year	Barrow	Pt. Hope	Wainwright	Nuigsut	Icy Cape	Kaktovik	Gambell	Savoonga	Kivalina	Misc.	Total
1912	2	1									3
1913	4	1									5
1914	1	2			1						4
1915		3									3
1916	5	7	1							1	14
1917		3			3					2	8
1918	1	7									8
1919	1	2									3
1920		3									3
1921		2									2
1922	1	13	3								17
1923										2	2
1924		16								9	25
1925	19	10	2								31
1926	4	13									17
1927	2	3									5
1928	11										11
1929	15										15
1930	7										7
1931	11	1									12
1932	7										7
1933	5										5
1934	4										4
1935	6										6
1936	4	4									8
1937	9										9
1938	4										4
1939	6										6
1940	0	5									5
1941	2	8	1								11
1942	10		1								11
1943	6										6
1944	0		2								2
1945	3	3									6
1946	9	2									11

Table 14. (continued)

Year	Barrow	Pt. Hope	Wainwright	Nuigsut	Icy Cape	Kaktovik	Gambell	Savoonga	Kivalina	Misc.	Total
1947	4	6									10
1948	5	0									5
1949	0	4	1								5
1950	4	2	2							1 (Cape	9
1951	9	4								Lisburne)	13
1952	0	2+									2
1953	17	4					2				23
1954	1	3									4
1955	19	1	1				2				23
1956	2	2					1				5
1957	0	3					0				3
1958	0	2					0				2
1959	0	1									1
1960	15	4	0								19
1961	6	2	1				1				10
1962	5	6	1								12
1963	5	3	2								10
1964	11	1	1			2			1		16
1965	4	2	0								6
1966	7	5	1								13
1967	3	1	0								4
1968	10	3	2				1				16
1969	11	3	3							1 (Wales)	18
1970	15	8	0						1		24
1971	13	6	2				1		1	1 (Wales)	24
1972	19	14	2				2		1		38
1973	17	7	3	1		3	2	4			37
1974	9	6	1			2	2		0		20
1975	10	4	0				1		0		15
1976	23	12	3			2	1	7	0	0 (Wales)	48

1/. Combined catch of Eskimos and two vessels.

The Eskimos attempt to take only small whales because of their superior palatability. From 1973 to 1976 measurements or estimates of body length were obtained for 45 males, 34 females, and 13 whales of unknown sex, a total of 92 whales (Tables 1, 11, and 15-17). Of these animals, 20 ranged in length from 460 to 796 cm (15 feet, 1 inch to 26 feet, 1 inch). Durham5/, believes that those individuals 670 to 792 cm (22 to 26 feet) in length are yearlings, perhaps 12 months of age. Rice and Wolman (1971) indicate that after the first year of growth, the body length of immature gray whales increases about 10 percent yearly. Assuming a similar growth rate for bowheads, immature individuals (less than 4 years of age according to Durham5/, might range from 810 to 975 cm (26.5 to 32 feet) in body length. The Eskimos captured 53 individuals less than 975 cm (32 feet) in length, therefore, 58 percent of all whales taken possibly were 3 years old or less when killed. Thus research indicates that a majority of the whales harvested by the Eskimos are small, a finding also noted by Bee and Hall (1956), Geller (1957), Maher and Wilimovsky (1963), and Durham5/.

Of the 120 whales killed and recovered by Eskimos from 1973 through 1976, sex was determined for 81 (Table 18). Of that number, 47 (58 percent) were males and 34 (42 percent) were females. The Eskimos may take smaller animals, not only because they prefer them over larger (and older) bowheads for food, but because young individuals predominate among whales migrating north early in the season. The large whales, including females with calves, appear later when the ice conditions generally become unsafe for the whalers. Such temporal segregation would also account for the greater proportion of males in the catch.

An example of inadvertant selection by sex may have occurred during the autumn hunt of 1976 at Barrow where unusually successful whalers caught a total of ten large bowheads. Since seven of the ten whales were males, a segration process may be occurring that might result from males leaving sooner than females, i.e., a temporal segregation by sex and reproductive state as noted for bowheads by Frazer (1976), Tomilin (1957), and Vinogradov (1949), for gray whales by Rice and Wolman (1971), and for humpbacks by Dawbin (1966).

Whales taken from 1973 through 1976 are presented by date, in Tables 19 and 20. The earliest date on which a whale was taken during this period was 21 April, and the latest during the spring season was 6 June. For the total of 80 whales for which the date is known, 39 animals (56 percent) were killed 1-15 May, which may indicate that this period is normally the peak of the spring migration. According to Maher and Wilimovsky (1963), 72 percent of the whales taken at Barrow

Table 15.--Biological features of bowhead whales taken during the 1973 whaling season.

Area	Date	Body length (centimeters)	Sex	Remarks
		SPRING		
Barrow	7 May	823	M	
	7 May	670	M	
	7 May	915	F	
	12 May	915	F	
	12 May	910	M	
	13 May	820	M	
	23 May	855	F	
	24 May	884	F	
	24 May	610	M	
	24 May	--	M	
	25 May	975	F	
	27 May	823	F	
	28 May	762	M	
	6 June	1525	F	
	6 June	460	M	
Wainwright	19 May	1036	F	
	20 May	825	F	
	23 May	--	-	
Point Hope	5 May	--	-	
	5 May	--	-	
	17 May	--	-	
	18 May	--	-	
	19 May	--	-	
	23 May	--	-	
	25 May	--	-	
St. Lawrence Island	-	--	-	
	-	--	-	
	-	--	-	
	-	--	-	
	-	--	-	
	-	--	-	
		AUTUMN		
Nuiqsut	-	--	-	
Kaktovik	-	--	-	
	-	--	-	
	-	--	-	
Barrow	-	--	-	
	-	--	-	

Table 16.--Biological features of bowhead whales taken during the 1974 whaling season.

Area	Date	Body length (centimeters)	Sex	Remarks
	SPRING			
Point Hope	21 April	1219	-	
	21 April	914	-	
	20 April	813	M	
	2 May	869	M	
	11 May	757	F	
	23 May	1524	M	
	25 May	1550	M	
St. Lawrence Island				
Gambell	29 April - 1 May	1219	-	
	2 May	1219	-	
Wainwright	31 May	--	-	
Barrow	30 April	975	-	
	4 May	671	M	
	12 May	813	M	
	16 May	1135	F	Ingutuvak
	29 May	1385	M	Stinker
	29 May	--	-	Not recovered
	29 May	724	F	Ingutuk
	AUTUMN			
Barrow	29 Sept.	975	M	
	29 Sept.	--	M	Lost in heavy seas
	3 Oct.	1067	M	
	8 Oct.	823	F	
Kaktovik	10 Sept.	--	-	
	before 24 Sept.	--	-	

Table 17.--Biological features of bowhead whales taken during the 1975 whaling seasons.

Area	Date	Length (in centimeters)	Sex	Remarks
		SPRING		
St. Lawrence Island				
Gambell	23 April	--	-	Sank, line broke
	7 May	1280	M	
Point Hope	24 April	1097 1/	-	Ingutuvak
	26 April	610 1/	-	
	10 May	846	F	Ingutuk
	15 May	1158 1/	M	
Barrow	5 May	795	F	
	9 May	691	M	
	13 May	927	F	
	14 May	800 1/	-	
	15 May	854	M	
	15 May	--	-	Sank
	16 May	1620	F	Lactating
	20 May	784	F	Ingutuk
	21 May	1111	F	
	23 May	715	-	
	31 May	1402	M	Stinker
		AUTUMN		
Barrow	None			
Nuiqsut	None			
Kaktovik	None			

1/ Length estimated by natives.

Table 18.--Number of male and female bowhead whales taken by Eskimos in Alaska, 1973 - 1976, for which sex is known

Year	Males	Females	Totals
1973	8	9	17
1974	10	4	14
1975	5	6	11
1976	24	15	39
Totals	47	34	81
Percent	.58	.42	

Table 19.--Dates bowhead whales taken by Eskimos during the spring seasons 1973 - 1976.

Date	Number	Date	Number
21 April	2	21 May	1
22	0	22	0
23	1	23	4
24	1	24	3
25	0	25	1
26	1	26	1
27	0	27	1
28	0	28	1
29	0	29	2
30	2	30	0
		31	1
1 May	1		
2	5	1 June	0
3	3	2	0
4	1	3	0
5	2	4	0
6	4	5	0
7	4	6	2
8	0		
9	3		
10	1		
11	2		
12	4		
13	2		
14	3		
15	4		
16	2		
17	1		
18	0		
19	2		
20	2		

Table 20.--Dates bowhead whales taken by Eskimos during the Autumn seasons 1973 - 1976.

Date	Number	Date	Number
28 August	1	21 September	0
29	0	22	0
30	1	23	0
31	0	24	0
		25	0
1 September	0	26	0
2	0	27	1
3	3	28	0
4	0	29	0
5	0	30	0
6	0		
7	0	1 October	0
8	0	2	0
9	0	3	0
10	1	4	0
11	0	5	0
12	0	6	0
13	0	7	1
14	0		
15	0		
16	0		
17	0		
18	0		
19	0		
20	4		

from 1954 to 1960 were killed 4-18 May; then concluded that the migration peak may occur within this period. During the autumn hunt, the earliest date on which a whale was killed from 1973 to 1976 was 28 August, and the latest 7 October. Of only 23 whales taken in autumn from 1973 to 1976, 12 were harvested in 1976. Consequently, it is difficult to conclude much about timing of the autumn migration. However, a majority of the whales were taken by 20 September, possibly indicating that the peak of the autumn migration past Barrow occurs about mid-September.

Killed but Lost

Bowhead whales known to have been killed and lost must be added to those killed and recovered to derive the total annual known kill. Most of the information on whales killed and lost is, at best, sketchy and unverified because it is based upon statements made by whalers, or rarely from observations of investigators. Data obtained by NMFS observers shows that the number killed and lost varied from none in 1973 to eight in 1976 (Table 12).

The only information available on whales found dead near the whaling villages is that obtained in 1976. Five dead bowhead whales were seen in the ice in mid-May near Point Hope (E. Valentine, pers. comm.). A first assumption may be that these whales were wounded by whalers from that village and that they died nearby from their injuries. Tomilin (1957) reported, however, that some Soviet Eskimos have in the past sought the carcasses of bowheads that occasionally become trapped in shifting ice and evidently perish of natural causes. Although he admits that this phenomenon is rare (the bowhead is well adapted to and therefore capable of surviving in the ice), it occurs frequently enough to justify its consideration as a hunting technique. Although insufficient information is available for the evaluation of this occurrence near Point Hope, it should not be assumed that all five whales died from injuries inflicted by Point Hope whalers. The results of OCSEAP aerial surveys list one dead whale in the ice far offshore from Barrow 24 May, and another frozen in the ice north of Barrow that was being fed upon by a large number of polar bears. Identification of these carcasses was not verified but, assuming that they were all bowheads, the kill in 1976 includes 48 recovered and 15 killed but lost, a total of 63 whales. This number of bowheads is the largest known to have been killed by the Eskimos in a single year.

Struck and Lost

The evaluation of data on wounded and lost whales is difficult because it is not known how many of these animals may have died. Various estimates of the number of whales struck and lost compared to the number killed and recovered have been made. Johnson et al (1966) wrote that even when struck the whales are only secured about 25 percent of the time. Durham (1974) states that only about one in four or five whales struck is recovered. However, statistics gathered by Foote (Pers. comm.) from various sources show that 37 bowheads were struck and lost compared to 36 killed and recovered at Point Hope (Table 21), indicating that 50 percent of all whales struck were lost. Scott (1951) reported that up to 50 percent of all whales hit are not recovered, primarily because of poor equipment. NMFS observations since 1973 yield similar findings. A total of 112 whales (48 percent) was known to have been lost (99 struck and lost and 13 killed and lost) compared to 120 that were killed and recovered. It is difficult to obtain exact figures on this subject because most are obtained from statements made by the whalers, which may account for the wide range of figures reported for whales that have been struck and lost.

Our finding that 50 percent of all whales struck are lost by Eskimo whalers (admittedly a minimum figure) may approximate reality. Early commercial whalers perfected their technique to where they recovered an average 67 percent or greater of all whales struck, according to Bodfish (1936), who on one occasion harpooned 16 whales, losing only four. Scammon (1874) stated that only 20 percent of all whales struck are lost. Although it is doubtful that the rate at which the Eskimos strike and lose whales approaches that of early professional whalers, a 50 percent loss rate may be assumed to be reasonable because of the subsistence value and prestige gained by taking a whale.

Fragments of bombs or harpoons have not been found in whales taken by the Eskimos since the NMFS has been monitoring the harvest, but Durham[7/] found an old bullet in the blubber of one animal. A few whalers have stated that they occasionally find an old harpoon or fragments of harpoons or bombs in whales that they have taken. The fact that harpoons may remain embedded in whales for many years has been established in at least four instances (Clark, 1887; Dall, 1899; and Colby, 1936). The discovery of old whaling equipment in bowheads provides evidence that bowheads can survive abortive hunting attempts.

7/ Durham, Floyd E. 1973. Census and Spring Migration Studies on the Bowhead Whale in the Western Arctic in 1973. Univ. So. Calif. Los Angeles, contract No. 03-3-208-200 with NMFS, Seattle, Wash., Unpublished report, 15 November 1973.

Table 21.--Data collected by Foote[1/] on numbers of bowhead whales that were struck and lost compared to those killed and recovered for various years from 1915 to 1962, at Point Hope, Alaska.

Date	Killed and Recovered	Struck and lost
1915	3	3
1916	7	1
1917	3	2
1940	5	8
1951	4	8-10[2/]
1956	2	3
1960	4	10
1961	2	2
1962	6	1
Totals	36	39

1/ Personal communication, D.C. Foote to D.W. Rice, 2 November 1964.

2/ The larger number (10) was used to obtain total of 39.

Strandings

Strandings of bowhead whales on arctic shores apparently are infrequent. Durham[7] reported the only stranding that he knew about occurred in September, 1964, near Barter Island. Sergeant and Hoek (1974) state that strandings rarely occur along Canadian shores and that those they know of are the cumulative results of many years.

Biological samples

Material may be collected freely by anyone from the remains of whales abandoned by the Eskimos, but material from a newly taken whale may be collected only with the permission of the captain of the crew that took the animal. An ancient custom of returning the skull to the sea after removal of desirable portions from the head is observed by many Eskimos at Barrow and by all at Point Hope. The whalers must butcher the whales as rapidly as possible to avoid loss of the carcass due to shifting ice. For this reason they do not tolerate interference with the butchering process, which may take 3 to 30 or more hours. Thus, it is seldom possible to obtain all of the desired measurements and samples from each whale, which is usually available for this purpose only on an opportunistic basis. Measurements of the morphological features of bowhead whales taken by the Eskimos from 1973 to 1976 are presented in the appendix.

Some biological samples have been obtained from most whales taken by the Eskimos since 1973. Every effort has been made to obtain ovaries, testes, and baleen for age and reproduction studies. Other samples frequently collected included tissues from the skin, blubber, muscles, heart, lungs, liver, and intestines. Various organs and bones have also been collected, including eyes, small ear bones, and the entire reproductive tract of one young female. Although Durham[5] states that the wax ear plugs cannot be used to estimate the age of bowheads, several ear plugs were collected but a satisfactory method for keeping them intact has not been discovered. A bowhead fetus 131 cm (4 feet, 4.5 inches) in length was removed from a 1730 cm (56 feet, 9 inch) female taken during the autumn of 1976, and sent to the U.S. National Museum at Washington, D.C. This fetus is the only one found since the NMFS began to monitor the Eskimo harvest of bowhead whales in 1973.

Bowheads do not appear to feed during the spring migration and few stomachs containing food have been found at that time of year. The only stomach content noted during our study was a black liquid. During his 13-year study Durham[5] found some food in seven of ten stomachs examined during the spring,

which he identified as being green matter like bile or digested phytoplankton, copepods, euphausiids, mysids, amphipods, gammarids, and two 12.7 cm (5 inch) long cottids. Johnson et al. (1966) examined three whales taken during the spring. The stomachs of a young male and a lactating female were empty and the stomach of a young female contained a few items of food (Table 22). Scoresby (1820) reported finding only squillae or shrimps in the mouth of one individual and in the few stomachs he was able to examine. Mitchell (1974a) states that bowheads feed on mysids and various other small to medium sized zooplankton and notes various sources that indicate it is sometimes a bottom-feeder and eats amphipods.

Some food has been found in the stomachs of whales taken during the autumn hunt. The stomachs of two whales taken during the autumn at Barrow in 1976 contained food (Table 22). Durham5/ examined the stomachs of 7 whales, of which six contained mysids, gammarids, green matter, amphipods, some bone fragments of small fish, mud dwelling tunicates, vegetation silt, and a few small pebbles. Durham5/ believed that bowheads feed sporadically and lightly during their migrations in spring and autumn, and Johnson, et al. (1966) concluded that bowheads do little feeding while migrating.

As mentioned above, the bowhead feeds by straining marine organisms through its many baleen plates. Scoresby (1820) reported that "each side of bone consists of upwards of 300; in a small whale the number was 316 or 320." Eschricht and Reinhardt (1866) reported counts of 308 distinct blades for a newborn and 310 for an individual 670 cm (22 feet) in length. Scammon (1874) wrote that 330 on each side was a fair average, and 370 was the highest count obtained. Cook (1926) stated that the total number of baleen plates varies from 550 to 650. These figures suggest that the total number of baleen plates in the bowhead can vary considerably. We obtained counts of baleen plates on one side of the mouth for 12 females, 10 males, and one animal of unknown sex. For females the count varied from 274 to 329 (average - 302). For males the number ranged from 237 to 346 (average - 305). Our data indicates that the females have a smaller range (274 to 329), with a higher minimum (274) and a lower maximum (329) than do the males with a greater range (237 to 346) and a lower minimum (237) and higher maximum (346). Our data sample is relatively small, however; future counts may provide more insight into the significance of baleen counts.

NMFS observers attempt to obtain one piece of the longest baleen from each whale taken by the Eskimos for determining age. Occasionally, when some or all of the baleen had been removed from the butchering site, the homes of the whalers were subsequently visited to obtain measurements and samples of what we were informed was the longest baleen from specific whales.

Table 22.--Stomach contents of bowhead whales.

Specimen number	Date	Species	Volume (ml)	Comments
76B6F[1/]	10 Sept. 1976	Thysanoessa raschii	17.0	Contents badly digested and broken up.
		Rozinante fragilis	0.1	
		Parathemisto libellula	0.4	
		Small pebble	<0.1	
76B7F[1/]	20 Sept. 1976	Thysanoessa raschii	28.6	All specimens for which species could be determined were of this species.
		Gammarus zaddachi	0.5	3 individuals
		Acanthostepheia behringiensis	1.8	10 individuals
		Monoculoides zernovi	0.6	8 individuals
		Rozinante fragilis	0.5	6 individuals
		Parathemisto libellula	1.0	10 individuals
		Shrimp	<0.1	partial carapace only, perhaps family Hippolytidae
M1527[2/]	13 May 1961	Polychaeta		Stomach nearly empty, fragmentary remains only.
		Reptantia		
		Gastropods		
		Crustacea		
		Echinoidea		
		Sand and gravel		

1/ Identified by L. Lowry, Alaska Department of Fish and Game.
2/ Johnson, et al., 1966.

All whales examined were inspected for parasites. Ectoparasites (Cyamid sp.) were collected from three whales, and were reported for but not collected from two other animals. No endoparasites were observed. Our observations confirm previous reports, one in 1874 by Scammon, that bowheads are remarkably free from parasites.

Because NMFS observers cannot always be present before the whales are cut up, body length can be obtained for only a few of the animals harvested. As a result, the relationship of certain other body measurements (i.e., fluke width at insertion (juncture of fluke and body), and length of the mandible to total length has been examined to determine if they can be used to estimate the total length of cut up whales (Tables 23 and 24). The relationship of total fluke span to body length has also been examined as an aid in determining the length of whales taken by early whalers, who measured and reported fluke width, especially those for extraordinarily large whales (Table 24). Such information may make possible conversion of all early measurements of bowheads to a standard length, i.e., total length from the tip of the rostrum to the notch of the flukes, in a straight line parallel to the body axis.

Cooperative research on biological specimen material from bowhead whales is being conducted with several interested scientists. Included are studies of the integument, biology and morphology, genetic karyotyping, sight, hearing, parasites, nerves innervating the body skin, chemical pollution, physiology involved with diving, and food. A study on hearing has been partially completed and reported on by Fleischer (1976), and food from the stomachs of two whales has been identified (L. Lowry, pers. comm.).

Table 23.--Comparison of measurements of bowhead whale mandible to total length of whale (in centimeters).

Specimen number	Male			Female		
	Total length	Length of mandible	Percent of total length	Total length	Length of mandible	Percent of total length
4472	610	250	.4098	--	--	--
4462	670	287	.4284	--	--	--
74B6	671[1/]	217	.3234	--	--	--
75B2	691	218	.3155	--	--	--
76B1	750	315	.4200	--	--	--
76B5	--	--	--	750	292	.3893
74H3	--	--	--	757	230	.3038
4476	762	272	.3570	--	--	--
76H12	762	250	.3281	--	--	--
75B7	--	--	--	784	243	.3100
75B1	--	--	--	795	295	.3711
76H11	--	--	--	808	262	.3243
74H1	813	254	.3124	--	--	--
74H2	813	264	.3247	--	--	--
4461	823	274	.3329	--	--	--
76H9	--	--	--	825	267	.3236
75H3	--	--	--	846	255	.3014
76H8	--	--	--	848	285	.3361
75B5	854	271	.3173	--	--	--
76B12	--	--	--	854	245	.2869
74H2	869	283	.3257	--	--	--
4471	--	--	--	884	267	.3020
75B3	--	--	--	927	333	.3592
4474	--	--	--	975	285	.2923
76B7	980	328	.3347	--	--	--
75B8	--	--	--	1111	421	.4164
76H2	1021	350	.3428	--	--	--
76B10	1100	380	.3454	--	--	--
76H4	1120	384	.3429	--	--	--
74B3	--	--	--	1135	263	.2317
76B2	1144	419	.3663	--	--	--
76B6	1235	437	.3538	--	--	--
76H3	--	--	--	1321	445	.3369
75B10	1402	464	.3510	--	--	--
76H6	1468	430	.2929	--	--	--
76B6F	--	--	--	1600	580	.3625
75B6	--	--	--	1620	562	.3469
Average			.3452			.3291
Sex unknown						
75B9	715	226	.3161			
76B3	796	275	.3455			
75B4	927	276	.2977			
74B1	975	314	.3220			
Average			.3203			

1/ Length estimated by natives.

Table 24.--Percentage of total length of whale represented by the span of the flukes and fluke width at insertion (measurements in centimeters).

Specimen		Fluke span				Fluke width at insertion			
number	Length	Female	Percent	Male	Percent	Female	Percent	Male	Percent
4478	460	--	--	137	.2978	--	--	38	.0826
4472	610	--	--	250	.4098	--	--	--	--
76B11	685	280	.4088	--	--	72	.1052	--	--
75B2	691	--	--	220	.3184	--	--	60	.0868
74H3	757	--	--	--	--	70	.0925	--	--
76H12	762	--	--	--	--	--	--	75	.0984
75B7	784	228	.2908	--	--	58	.0740	--	--
75B1	795	263	.3308	--	--	62	.0800	--	--
4461	823	--	--	245	.2977	--	--	--	--
4475	825	254	.3079	--	--	64	.0776	--	--
75B5	854	--	--	254	.2974	--	--	68	.0796
76B12	854	245	.2869	--	--	60	.0703	--	--
4470	855	264	.3088	--	--	--	--	--	--
74H2	869	--	--	--	--	--	--	70	.0806
4471	884	254	.2873	--	--	66	.0747	--	--
4466	910	--	--	307	.3374	--	--	65	.0714
4474	975	280	.2872	--	--	72	.0738	--	--
76B7	980	--	--	289	.2949	--	--	74	.0755
76H2	1021	--	--	--	--	--	--	83	.0813
76B9	1070	--	--	--	--	--	--	84	.0785
76B10	1100	--	--	371	.3373	--	--	90	.0818
75B8	1111	390	.3510	--	--	84	.0831	--	--
74B3	1135	305	.2687	--	--	70	.0617	--	--
76B2	1144	--	--	323	.2824	--	--	74	.0647
75H4	1158	--	--	--	--	--	--	73	.0630
76B13	1158	318	.2746	--	--	86	.0743	--	--
76B6	1235	--	--	362	.2931	--	--	82	.0664
76B8	1370	--	--	435	.3175	--	--	100	.0730
75B10	1402	--	--	498	.3552	--	--	123	.0878
76H6	1468	--	--	--	--	--	--	122	.0831
76H9F	1525	--	--	--	--	--	--	123	.0807
76B6F	1600	575	.3594	--	--	140	.0875	--	--
75B6	1620	551	.3401	--	--	139	.0828	--	--
Average			.3156		.3199		.0798		.0785
Sex Unknown									
76B3	796					63	.0792		
76B4	1136	366	.3222			86	.0757		
					Average		.0774		

REPRODUCTION AND GROWTH

Little is known about the reproduction and growth of bowhead whales. The harsh habitat occupied by this species has not been conducive to studies of their behavior and other natural history aspects. What little data that have been recorded in the literature were obtained by a few of the early whalers. Scoresby (1820, 1823) has given some accounts, as have Eschricht and Reinhardt (1866), and Scammon (1874).

In recent years a major contribution to the biology of bowhead whales was made by Durham[5/] in his study from 1961 to 1973. The NMFS has conducted research on these whales in 1961 and 1962 and from 1973 to the present. Because so little information on the biology of these animals is available, we have combined the results of our research with information from the literature into a summary of available data on the reproduction and growth of bowhead whales.

The mating season for bowheads is not well defined. Scoresby (1820) reported that the whales had often been observed to mate during the latter part of summer. According to Eschricht and Reinhardt (1866), mating occurred in Greenland waters during January and February. Foote[4/] observed behavior among the adults in May which suggested that copulation occurs during the spring migration. One instance of copulation apparently in progress within a pod of six adults was photographed during an OCSEAP aerial survey on 8 May 1976, near Point Barrow (H. Braham, pers. comm.). More observations are needed, however, before the range in time over which copulation occurs can be defined, but it appears to occur during the spring migration and in summer.

The gestation and calving periods, like the mating period, also are not well defined for this species. Information concerning fetuses and newborn calves of bowheads has been rarely recorded in the literature. Scoresby (1820) believed that gestation lasted 9-10 months and presumed that birth occurred in February or March, although he reported that a young calf with the umbilical cord still attached was taken by a Hull whaler in the latter part of April, 1811. Eschricht and Reinhardt (1866) disagreed with Scoresby, stating that gestation is 13-14 months and that birth occurs between late March and early May. They agreed that the female produces only one young, and Scoresby stated that two calves with a female were rarely seen. Scammon (1874) concluded that the calves apparently are born along the way during the spring migration. Gray (1886) did not believe that the young were born at a definite time, stating he had seen females with very young calves early in May and late in July. Maher and

Wilimovsky (1963) state that adult females with calves are seen from about mid-May to mid-June at Barrow; in 1955 the first female with a calf was seen on 15 May.

Durham[5/] infers from indirect evidence that breeding and calving occur in early April, just before the whales reach Point Hope during their migration northward in the spring. He states that pregnant females taken in autumn by the Cape Smythe Whaling Company at Barrow contained fetuses that were 183 to 244 cm (6 to 8 ft) in length. Durham concludes from the available evidence that gestation is 12 months and, because pregnant cows taken at Barrow were not lactating, that the female normally bears a calf every second year, or less often.

Observations made by NMFS observers since 1973 indicate that cows with calves pass by Point Hope and Barrow in late May. These sightings and those obtained from the literature are contained in Table 25. Data on embryonic and newborn lengths are presented in Figure 2. The available information suggests that most mating and calving probably occurs during April and May, and that the gestation period is about 12 months. Each activity can be expected to occur over some range in time, and therefore to overlap.

Length of the calves at birth is reported by Eschricht and Reinhardt (1866) to be from 396 to 427 cm (13 to 14 feet), Bodfish (1936) states it is 305 to 366 cm (10 to 12 feet), and Scoresby (1820) places it at 305 to 427 cm (10 to 14 feet). Bodfish (1936) reported seeing many calves, the smallest from 305 to 366 cm (10 to 12 feet) in length, but that a Captain Tilton, whom he had sailed with, told him of once finding a cow with a newborn calf that was only 152 or 183 cm (five or six feet) long. These lengths agree with that of a recently born calf taken at Barrow on 20 May 1954, which was estimated by the Eskimos to be 305 to 366 cm (10 to 12 feet) in length and one to two weeks old.

We do not know how long the lactation period is nor how long calves remain with their mothers. Scoresby (1823) observed sucklings in the waters of Spitzbergen and Greenland from April through July. Scammon (1874) wrote, "It has been a mystery among the most experienced whalemen, as to where the bowheads resorted to bring forth their young, or where the young remained until grown to a considerable degree of maturity; but within a few years, whales have been seen around Point Barrow with young calves...", and he speculated "that that area of the Beaufort Sea from Point Barrow to Banks Island doubtless affords ample herding and breeding places for the whales indigenous to the region." Gray (1886) states "There is a great deal still to be

Table 25.--Dates female bowhead whales and calves have been observed.

Date	Remarks	Source
18 March 1807	Female with newborn, newborn killed	Eschricht & Reinhardt (1866)
14 April 1961	Female with very small calf sighted	Foote[4]
20 April 1962	Female with yearling calf sighted	Foote[4]
April 1811	Newborn, umbilical attached	Scoresby (1820)
29 April 1956	Newborn, killed	Maher & Wilimovsky (1963)
6 May	Newborn 396 cm (13 ft) umbilical attached	Eschricht & Reinhardt (1866)
May	Newborn	Durham[5]
13 May 1961	Female with calf sighted	Foote[4]
13 May 1961	Female with calf sighted	Foote[4]
13 May 1962	Small calf sighted	Foote[4]
15 May 1962	Female with calf sighted	Foote[4]
16 May 1975	Lactating female 1620 cm killed	Marquette (1976)
16 May 1976	Female and calf sighted	Fiscus, Braham and Marquette[1]
20 May 1954	Newborn 305-366 cm (10-12 ft) killed, estimated 1-2 weeks old	Maher & Wilimovsky, (1963)
22 May 1976	Female and calf sighted	Fiscus, Braham, and Marquette[1]
24 May 1961	Calf killed, sank	Foote[4]
24 May 1961	Lactating female killed, 1417 cm (46 ft 6 in)	Johnson, et al. (1966)
27 May	Female 1371 cm (45 ft) and calf killed	Durham[5]
28 May	Female with calf killed	Bodfish (1936)
28 May 1971	Newborn 447 cm (14 ft 8 in) killed	NARL Staff (1972)
28 May 1971	Female 1560 cm (51 ft 2 in) killed, mother of newborn killed	NARL Staff (1972)
28 May 1975	Female and calf sighted	Marquette (1976)
3 June 1971	Small calf killed	Pedersen, pers comm.
6 June 1973	Newborn, 460 cm (15 ft 1 in) killed	Durham[8]
June 1811	Nursing calf harpooned	Scoresby (1820)
June 1851	Calf sighted	Allen (1973)
15 July 1821	Nursing calf 579 cm (19 ft) killed	Scoresby (1823)
30 Sept. 1736	Newborn, 549 cm (18 ft) killed prior to this date, preserved and arrived in port on this date.	Slijper (1962)
2 Oct	Calf 549 cm (18 ft), estimate of length from skull measurements	Durham[8]

found out as to where the old cows disappear to after calving; for after 40 years whaling experience in the Greenland Sea I have not seen more than a dozen accompanied by calves." Evidence that cows with nursing calves can be very secretive and successfully evade observation is demonstrated by the gray whale (Rice and Wolman, 1971). Slijper (1962) recorded a 12-month lactation period. Tomilin (1957) states "The functional leap in baleen growth, when the calf begins to consume adult food, usually takes place upon attaining a length of 7 to 8.5 m (23 to 27 feet, 11 inches) in Greenland right whales. This size marks the end of lactation." Durham[5/] considers whales within this length range to be yearlings.

Allen (1973) writes that a Soviet officer told him that he had seen the beach covered with dead calves in the winter, about the entrance of the Bay of Petropavlovski (on Kamchatka Peninsula), but he does not say whether the officer advanced a reason for their deaths. The dead calves may have been associated with the birth process as described for the gray whale by Gilmore (1958), or they may have been a pod of yearlings described as calves that were trapped by the ice and suffocated.

Adult females accompanied by calves have been observed from 18 March to 2 October (Table 25). Early observations made by commercial whalers were limited to time periods when they could safely navigate their vessels in the ice-filled waters of the arctic. Sightings reported in recent years have been made primarily from the edge of the lead during the spring whaling season, and from small boats during the autumn hunt by the whalers of Barrow. A small calf taken at Barrow 2 October was believed by Durham[8/] to have been weaned. From measurements of the skull he estimated the length of the calf at 549 cm (18 feet) and its age at about 6 months. Since lactating females have not been taken by whalers in the autumn it may indicate early weaning, perhaps at age 5 or 6 months.

Sexual maturity in bowhead whales is reached at a length of 1158 cm (38 feet) for males and at 1220 cm (40 feet) for females at age 4 years according to Durham[5/]. He recorded a 1371 cm (45 foot) long female with a calf taken on 27 May, the remains of a pregnant female estimated to be 1310 cm (43 feet) long with a 152 cm (5 foot) long fetus taken near Barrow on 10 May, and a pregnant female 1570 cm (51 feet, 6 inches) in length containing a 25 cm (10 inch) embryo taken on 2 June near Barrow. A newborn calf, a fetus, and their mother were taken and measured during the present study. A female 1525 cm (50 feet) and its 460 cm (15 feet, 1 inch) newborn calf were taken on 6 June 1973 at Barrow. In the autumn of 1976, a 131 cm (4 feet, 3.5 inch) fetus was removed from a female that was 1730 cm (56 feet, 6 inches) long as measured by the whaling captain from Barrow

that killed it. Because most of the whales taken by the Eskimos are immature, data obtained during the present NMFS study is not sufficient to make conclusions regarding sexual maturity.

Some data were obtained indicating the approximate length at which bowheads attain physical maturity. Examination of the degree of fusion of the vertebral epiphyses with the centra showed that for one male 1120 cm (36 feet, 9 inches) in length, fusion was in the early stages and was perhaps 10 to 25 percent completed; for a male 1158 cm (38 feet) in length, fusion was about 25 percent completed; but for a male 1468 cm (48 feet, 2 inches) in length, fusion was complete. Eschricht and Reinhardt (1866) found that fusion was complete for a male 1402 cm (46 feet) in length, but incomplete in a male 1490 cm (48 feet, 10.5 inches) in length. Attainment of physical maturity for males is therefore apparently reached between 1402 cm (46 feet) and 1468 cm (48 feet, 2 inches), or possibly 1524 cm (50 feet) in length. Females apparently become physically mature at a length slightly greater than the males. Some variation can be expected in the length at which individuals attain physical maturity, as shown by the 1676 cm (55 foot) long but physically immature female reported by Durham, a finding also reported by Eschricht and Reinhardt (1866).

Baleen has been examined by many investigators in efforts to determine the ages of whales. Although some disagreement exists, it is thought that the growth ridges on baleen plates represent true growth rings or marks (Scoresby, 1820; Eschricht and Reinhardt, 1866; Wheeler, 1930; Ruud, 1940, 1945; Tomilin, 1945; Ruud, Jonsgard, and Ottestad, 1950; Nishiwaki, 1950, 1951; Robins, 1960; and Utrecht and Utrecht-Cock, 1968). Lengths of the longest plates from several bowhead whales are compared to their body lengths in Table 26, and except for a few deviations, length of the baleen generally increases with length and, possibly, age of the animal. Disparities may result from erroneous measurements or in recording of data, or because some baleen was incorrectly identified for our observers as being the longest plates from specific whales. All baleen samples will be examined to determine whether the ages of whales can be told using this technique, and the results will be reported in the future.

ABUNDANCE

Estimates of Original Population

The size of the original population of bowhead whales in the western Arctic is not known. Determination of the historical annual catch of bowheads can, however, provide a basis for estimating the size of the former population before whaling

Table 26. Total number of baleen on one side of mouth and length of longest baleen compared to total length of the whale.

Sex	Specimen number	Length (cm)	Number baleen	Longest baleen (cm)
FEMALE	74B5	724	---	60
	76B5	750	281	137
	74H3	757	280	66
	75B7	784	274	70
	76H11	808	304	123
	4475	825	---	69
	75H3	846	275	90
	76H5	853	320	--
	76B12	854	303	79
	76H10	889	307	145
	4464	915	---	154
	4463	915	---	160
	75B3	927	323	155
	4474	975	---	140
	75B8	1111	324	221
	74B3	1135	298	57
	76H3	1321	329	212
	76B7F	1430	---	280
	75B6	1620	---	313
			Average 302	
MALE	4472	610	---	69
	4462	670	---	156
	75B2	691	---	45
	4476	762	---	127
	76H12	762	294	--
	74H1	813	--	85
	74B2	813	321	97
	4461	823	---	155
	75B5	854	335	126
	74H2	869	288	118
	4466	910	---	183
	76H2	1021	346	138
	76B10	1100	342	--
	76H4	1120	285	200
	76B2	1144	315	226
	76B6	1235	237	--
	76B10F	1320	---	242
	75B10	1402	---	287
	76B8F	1408	---	230
	76H6	1468	283	256
	76B9F	1525	---	245
	76B2F	1630	---	290
			Average 305	
UNKNOWN	76B3	796	270	133
	74B1	975	---	129
	75H1	1097	---	95

seriously depleted the stock, and aid in determining an acceptable annual yield for the subsistence hunt conducted by the Eskimos. Knowledge of catch data for the shore-based aboriginal hunt and the early pelagic fishery by whaling vessels is needed to provide a basis for estimating the size of the original population of bowhead whales.

Size of the original population of bowhead whales in the western Arctic can only be estimated crudely. The commercial catch in 1880, 1885, and 1886 was 265, 220, and 153 whales (Clark, 1887), for an average harvest of about 200 animals a year. Utilizing information on annual average whalebone production, Rice[3/] (1974) estimated the population as around 4,000 or 5,000 during the period 1868-1884.

Historical Catch of Bowhead Whales

Little is known about the historical aboriginal harvest of bowhead whales because the Eskimos normally do not keep records of their whaling activities. Data on annual catches in the past can only be obtained, therefore, from the literature and by talking with individuals possessing such information. Narrative reports by residents of Point Hope relate the taking of 15 to 18 whales annually during the spring hunt years ago before the arrival of the commercial whalers (Rainey, 1947). An excellent record of successful whaling captains and the dates on which they took whales has been compiled since 1949 by a resident of Point Hope, Mr. Herbert Kinneeveauk. Mr. David Brower of Barrow compiled data on whales taken there during 1928 to 1954 from family records. Durham[8/], the late D.C. Foote (pers. comm.), Maher and Wilimovsky (1963), Sonnefeld (1960), and the staff of the Naval Arctic Research Laboratory at Barrow[9/] have compiled data on the harvest from various sources.

8/ Durham, Floyd E. In press. The catch of bowhead whales (Balaena mysticetus) by Eskimos in the western arctic. Part I. Catch statistics. Contr. Sci., Los Angeles County Mus. Nat. Hist.

9/ Naval Arctic Research Laboratory Staff. 1972. Eskimo Whaling at Barrow, Alaska. Naval Arctic Res. Lab., Barrow, Alaska. Unpublished Report compiled by the staff, 12 December 1972. 24 pp.

The author is now searching the literature for data on the historical catch of bowhead whales by the aborigines of Alaska and the USSR (Tables 13 and 14) to augment information previously collected. A search of whaling vessel logbooks has also been initiated (J. Bockstoce, pers. comm.) to obtain data on the pelagic catch. When combined, these data will provide a means for estimating the size of the initial population of bowheads and, together with abundance information now being collected, provide a basis for determining the present status of the stock and for measuring the effects of the subsistence harvest on that stock.

Bowhead Whale Sightings

Some indication of the relative abundance of bowhead whales may be discerned by examining reports of the numbers of animals passing by the whaling villages during the spring migration. Bailey and Hendee (1926) wrote that Jim Allen, a Wainwright trader who had hunted whales for 25 years, said that more whales were observed there in 1922 than he had ever seen before. They concluded that the data available at that time indicated that the stock had increased substantially by the 1920's. Rainey (1947) concluded from his observations that they seemed to be increasing in numbers. Mansfield (1971) also believed that the bowhead population of the Bering, Chukchi, and East Siberian Seas appeared to be increasing. Burns (pers. comm.) stated that "In recent years continued slow increase was most noticeable in the numbers passing traditional hunting sites, and the increase was also indicated by the slowly increasing annual catches at these same sites, hunting as usual in the traditional manner." An Eskimo of Savoonga, on St. Lawrence Island, reported that an unusually large number of bowheads were observed migrating past the island during the spring of 1976. All of these observations apparently indicate that the bowhead population has been slowly increasing through the years.

Counts of Bowhead Whales

Past counts of bowheads passing whaling villages provide some indiation of the relative abundance of the whales in earlier years. Rainey (1940) reported scores of bowheads were seen passing Point Hope, and that he had seen at least 20 whales daily during the week of 12-19 April 1940. Foote[4/] made counts of bowheads passing Point Hope and recorded 127 in 1960, 49 (poor ice conditions) in 1961, and 177 in 1962. Rice (1974) commented

that the highest rate of migration that he had observed was at Barrow when 25 whales passed by during a 23 hour period on 11 May 1962, and added that over 100 whales were observed passing that village each year. Harry[10] stated that in 1971, 500 bowheads were reported to have passed Wainwright during the first period of the whaling season. At Point Hope 28 bowheads were counted during one 24-hour period in April of 1971 (J. Bockstoce, pers. comm.).

More recent counts of bowheads passing Point Hope and Barrow have been made since the NMFS began monitoring the harvest. Although no systematic counts were made at Point Hope, whaling crews observed 59, 132, and 235 whales passing the village during the springs of 1974, 1975, and 1976, respectively. Seventy-five whales were observed passing Point Hope during one 24-hour period on 1 May 1976 (J. Bockstoce, pers. comm.). Durham[8] states that in 1973 two Eskimo whalers at Barrow reported counts of 380 and 261 bowheads that passed that village during the spring migration, for which a conservative average may be 320 animals.

The OCSEAP crews made one autumn (1975) and one spring (1976) aerial survey, and a systematic count of bowheads was made at an ice-based station in the spring of 1976. A total of 357 whales was counted migrating up the lead past the ice-based station at Barrow (Table 27). Results of the aerial surveys conducted in the spring of 1976 are summarized in Table 28. Unusually severe conditions kept the pack ice next to shore all summer in 1975, and only two whales were sighted during the September October flights.

Fewer bowhead whales were counted in near-shore leads from the air than from the ice-based station, probably because less effective observational effort was achieved while flying than while on the ice. Thus it appears that counts from shore stations will be superior to counts from the air for delineating animal abundance in the near-shore leads. Aerial survey results west of Barrow indicate that bowheads migrate in the spring through near-shore leads, while east of Pt. Barrow they were seen in leads further offshore[11].

10/ Harry, George Y., Jr. 1973. Arctic Whales and the Eskimos. U.S. Dept. Comm., NOAA, NMFS report submitted to Scientific Committee, International Whaling Commission, Document No. 23, 25th Meeting. 26 pp.

11/ Braham, H.W., and B.D. Krogman, 1977. Population biology of the bowhead (Balaena mysticetus) and beluga (Delphinapterus leucas) whales in the Bering, Chukchi, and Beaufort Seas. Northwest and Alaska Fisheries Center Processed Report.

Table 27.--Numbers of bowhead whales, Balaena mysticetus, counted per day in open leads by the ice station counting crew and by Eskimos near Barrow, Alaska, from 25 April to 2 June 1976. Twenty-four hour watches were not maintained for all dates. Ice crew and Eskimo counts were not duplicates. No Eskimo counts were available after 20 May[1/]

Date	Number of animals seen		
	Ice crew	Eskimos	Total
25 April	3	2	5
29 April	11	6	17
30 April	7	10	17
1 May	17	3	20
2 May	3	6	9
3 May	1	1	2
5 May	11	9	20
6 May	16	19	35
7 May	8	1	9
8 May	4	1	5
9 May	2	0	2
10 May	0	1	1
11 May	0	0	0
12 May	0	0	0
13 May	21	7	28
14 May	5	0	5
15 May	11	3	14
16 May	18	11	29
17 May	26	9	35
18 May	52	9	61
19 May	1	0	1
21 May	4	-	4
22 May	19	-	19
23 May	0	-	0
24 May	9	-	9
25 May	1	-	1
26 May	6	-	6
31 May	1	-	1
1 June	1	-	1
2 June	1	-	1
Total	259	98	357

1/ Source: see Footnote 11.

Table 28.--Numbers of bowhead whales, Balaena mysticetus observed and miles of trackline flown by date during aerial surveys of the northeastern Chukchi and western Beaufort Seas, 30 April to 20 June, 1976. All flights were made from the Naval Arctic Research Laboratory, Barrow, Alaska 1/

Dates	Location of survey; Barrow to	Number of animals	Miles of trackline*
30 April	Pt. Hope	4	595
1 May	Wainwright and offshore leads	6	419
3 May	Icy Cape	3	250
8 May	Wainwright and east of Cape Simpson	34	260
9 May	Offshore leads east	5	161
12 May	Barter Island	2	600
14 May	Northeast of Barrow	0	60
15 May	Wainwright	18	225
19 May	Pt. Hope	3	270
20 May	Northeast of Barrow (offshore leads)	0	70
22 May	Wainwright (offshore leads); east to Lonely	4	352
24 May	Wainwright	3	150
28 May	Peard Bay	1	110
31 May	Wainwright	4	250
1 June	Pt. Hope	3	600
4 June	Northeast of Barrow	15	201
5 June	Wainwright	2	231
18 June	West of Barrow	0	602
19 June	Cape Lisburne	1	404
20 June	Barter Island	0	600
Totals		108	6,410

1/ Source: see Footnote 1.

* Trackline miles are for all miles flown, whether over open lead or shore fast ice; values are for nautical miles.

Estimates of Present Population

Rice[3] estimated a population size in 1964 of roughly 1,000 whales. On the basis of catch statistics for Point Hope from 1890 to 1964 (compiled by Foote, pers. comm.), and for Barrow from 1928 to 1960 (compiled by Maher and Wilimovsky, 1963), Rice (1974) concluded that although the Eskimos continued to hunt bowheads, there was no indication of change in the population size during this century. Fay (1975) states that the present population is believed to be about 1,000 and is thought to be increasing steadily. Durham[7] considered 2,500 a reasonable estimate of the population, and Harry [10] estimated the population to be between 1,000 and 3,000 animals in 1973. Mitchell (1974b) concluded that on the basis of the observed sustained kill and sightings by hunters and others, the western Arctic stock appears to be recovering well and must be counted in the high hundreds or low thousands. Sergeant and Hoek (1974) concluded that many of the whales migrating past Barrow spend their summers in the eastern Beaufort Sea north of the MacKenzie River delta and west of Banks Island, and estimated the population in this sector to number in the low hundreds. In a recent report Scheffer (1976) places the population of bowheads at around 2,000 whales.

A preliminary analysis of data obtained by OCSEAP surveys in 1976 suggests that as many as 800 bowhead whales may have migrated past Barrow during the spring survey period (25 April-2 June); given the protracted migration period (March through July) and the evidence of sightings and past catches of bowheads in the Chukchi Sea during the summer, it is unlikely that this number totally accounts for the current stock size.[11] Further examination of survey methodology will be required before any conclusions can be made regarding the statistical reliability and accuracy of abundance estimates obtained from these data. Preliminary evidence suggests that the number of sightings will vary from year to year depending on ice and other environmental conditions. Thus, repeated surveys in subsequent years and in other areas will be required before questions concerning precision and accuracy of estimates of total bowhead abundance might be answered.

DISCUSSION OF THE HARVEST

Several factors are probably responsible for the increased kill of bowhead whales by Alaskan Eskimos in recent years. From 1946 to 1969 the kill averaged about 10 whales annually. Since 1970 the annual take has averaged 29. Reasons for this increasing catch since 1970 are not obvious but several factors may be contributory.

The number of whaling crews has generally increased during recent years (Table 29). This trend would account for the observed increase in the catch of bowhead whales and might be correlated to the economic impacts of the Alaska Land Claims Settlement Act (authorized payments extinguishing all land claims of Alaskan natives) and the exploitation of north slope petroleum. Traditionally, the prestigeous status of whaling captain was attained by a combination of skill, intelligence, energy, and astute business ability (Rainey, 1947). Although some captains inherited their equipment, the qualities listed were necessary for them to establish and maintain whaling crews. This situation when Eskimos had little income, resulted in a fairly stable number of experienced captains and crews. However, the rising economy of the Eskimos in recent years has provided capital for new whaling captains, often inexperienced young men, to establish crews and to buy equipment and bombs. An abundance of bombs, when combined with inexperience, can encourage careless aiming, and long, possibly, unnecessary shots. All of these factors can be expected to result in an increasingly larger annual kill and in loss of struck whales.

It might be argued that the growing annual kill reflects an increased abundance of bowhead whales. Although OCSEAP data collected during the first year of surveys are insufficient to be indicative, other investigators previously cited in this report have concluded that the population is increasing at an unknown rate. Several Eskimos remarked about the large numbers of whales sighted during 1976, and correctly predicted that they were going to take many whales this year. Additionally, the prevalence of young animals in the catch might indicate a healthy, increasing population. It follows that an increase in the number of whales would result in an increased kill, especially when accompanied by an increase in whaling effort.

Weather also affects the number of whales taken. Whaling is conducted under severe Arctic environmental conditions important in their effect on hunter success. If leads open further out than that near shore, a majority of the whales may follow a route inaccessible to the whalers. An ideal near-shore lead would be 91.4 to 183 m (100 to 200 yards) wide and remain open during most of the season. However, constantly moving ice often closes the lead and presents considerable danger to the crews. Camps and equipment must frequently and quickly be moved to shore to prevent their loss to crushing ice. Strong offshore winds sometimes cause the shorefast ice on which the whaling crews are camped to, break off and drift seaward, and strong winds reduce the whalers ability to see whales and make the water rough and dangerous for their small boats. Occasional fog and snowstorms reduce observations and present considerable risk to crews in pursuit of whales. These conditions are primarily responsible for a variable number of crews actually engaged in whaling from day to day. That environmental conditions

Table 29.--Number of Alaskan Eskimo crews participating in spring whaling in recent years

Location	Date	Number
Barrow	1971	25
	1972	27
	1973	28
	1974	21
	1975	30
	1976	36
Point Hope	1973	11
	1974	10
	1975	13
	1976	14
Wainwright	1973	6
	1974	2
	1975	4
	1976	8
St. Lawrence Island	1974	8
	1975	23
	1976	-
Kivalina	1974	5
	1975	5
	1976	3
Wales	1974	-
	1975	-
	1976	2

can therefore significantly influence the success of Eskimo whalers from year to year was shown by the reduced kill in 1975 (Table 12), when the most severe sea-ice conditions of the past 23 years occurred (Barnett, 1976), and by a record high kill in 1976 during favorable weather, particularly in the autumn.

An observed change in whaling methodology, particularly at Barrow, may have resulted in an increase in the number of whales being struck but lost. Traditionally a whale is first struck by a darting gun which fires a bomb into the animal and implants a harpoon with attached float. If a second bomb is necessary, it is usually fired almost immediately from another darting gun, but without attached harpoon. If more bombs are needed to kill the whale, or if it is not safe for the boat to approach the wounded animal, then a shoulder gun is used. Considerable skill and courage are required to employ the darting gun, and recent observations indicate that whales are now often struck first with bombs fired from shoulder guns. Although the whale is usually injured, it can frequently elude its pursuers unimpeded by a harpoon with attached line and float. This practice no doubt results in numerous whales being struck and lost.

Reports by other authors on the numbers of whales that have been struck and lost vary considerably. Our investigation has shown that from 1973 through 1976, 99 whales were struck and lost and 13 were killed but not recovered. Thus, 112 were lost, compared to 120 killed and recovered. Our data show that approximately one-half (48 percent) of all whales struck were wounded and lost, a figure considerably less than that reported by others.

The number of struck and lost whales that die from their wounds can only be estimated. Some bombs fired into whales fail to explode, and others pass clear through and explode in the water. Judging from the relatively small size of the bombs used by the Eskimo whalers, which are about the size of Discovery tags used in whale marking studies, and the small amount of powder used in them (100 grams), some of these injuries may not be fatal (shoulder gun bombs are 46 cm (18 inches) and darting gun bombs are 38 cm (15 inches) in length; and both types are 2 cm (0.75 inch) in diameter).

Several factors contribute to the problem of striking but not recovering whales, of which the most important may be failure of the bomb to explode after it enters the whale. The

weak points of bombs are the fuse and the keeper (Figure 6). The keeper, a small piece of wood is designed to break when the bomb is fired, allowing the firing pin to fall and strike the cap, thereby igniting the fuse, which in turn burns into the lower part of the bomb and ignites the powder. Keepers supplied with the bombs are made of balsa wood. Substitute keepers, however, are fashioned from wooden matches when, for various reasons, the bombs are reloaded. These new keepers frequently do not break when the missile is fired and the bomb therefore fails to explode as intended. Bombs may also fail to explode should the fuse fail to ignite or if the powder becomes damp. Redesigning of the bomb and its component parts with ease and safety in assembly under rigorous field conditions in mind, may prevent loss of some struck whales.

Improvements in the weaponery presently used in the fishery might be effective in reducing the number of whales that are struck and lost. Guns and bombs used by the whalers in taking bowheads are manufactured by the Naval Gun Company, Doylestown, Pennsylvania[12/], under contract to the Alaska Native Industries Cooperative Association (ANICA), the only authorized source of such equipment. The guns and bombs have continued in use almost unchanged since their introduction by commercial whalers in the late 19th century. Numerous malfunctions of the bombs certainly contribute to the problem of whales struck and lost.

In summary, many factors are responsible for the increasing numbers of whales taken and those wounded and lost. Although the annual take of bowheads varied erratically in past years, it remained generally stable at a level which apparently allowed the population to increase. However, in the 1970's a considerable increase occurred in the harvest. Because the size of the bowhead population is as yet undetermined, the increase in the annual kill cannot be readily evaluated but is of great concern.

12/ Reference to trade name(s) in this report does not imply endorsement of commercial product(s) by the National Marine Fisheries Service, NOAA.

FUTURE RESEARCH

The Scientific Committee of the International Whaling Commission (IWC) recommended at the June 1976 meeting (1) that a thorough examination of early whaling history, including inspection of logbooks, be made to provide information on past population levels; (2) that marking studies be done to help assess mortality rates of struck but lost whales; (3) that an assessment of current population status be made; and (4) that a collection or compilation of better information on sex, length, maturity, and age of captured whales be assembled. In addition, the Scientific Committee strongly recommended that necessary steps be taken to limit expansion of the fishery and to reduce the loss rate of struck whales. The IWC concurred with the recommendation of its Scientific Committee, and, in a resolution to the contracting governments, urged them to implement those recommendations as soon as possible.

In 1977 biologists will again be stationed for the spring hunt at the two major whaling villages, Point Hope and Barrow, and at Barrow in the fall to gather information on bowhead whales taken. In addition, an observer will visit St. Lawrence Island during the spring whaling season to obtain information on the hunt at the villages of Gambell and Savoonga. In the past we have had to depend on visitors to the island to provide us with information o n whaling activities there.

We will establish an ice-based counting station at Point Hope in 1977, as well as at Barrow, in order to make better estimates of the numbers of bowhead whales migrating northward. Because some whales migrating past Point Hope may travel to the north Chukchi Sea by a route other than past Barrow, a count obtained at Point Hope may detect those animals and permit a more accurate enumeration of the population.

Future aerial surveys should enable us to determine how bowheads arrange themselves in time and space as they move into and out of the Arctic Ocean. Whereas ice-based surveys give more complete whale counts, aerial surveys have been invaluable for delineating migratory patterns and behavior, thus allowing better interpretation of counts from the ice. Continued collection of data in the future from ice-based counting stations and from the air will significantly contribute towards our understanding of bowhead whale distribution and abundance.

During the spring of 1978 we plan to expand our observations of the Eskimo harvest of bowheads to all villages actively engaged in whaling. In that year, two observers will for the first time be stationed on St. Lawrence Island throughout the whaling season because the potential take of these

animals is great in that area, and whaling methods employed by the Eskimos there are unique among all the whaling villages of Arctic Alaska. The crew at Barrow will be augmented to provide sufficient people to monitor the 36 whaling crews active at that village. One biologist will also visit villages during the whaling season where observers have never been stationed to obtain all information possible relating to the harvest and biology of bowhead whales. With these data we can improve our estimates of whales killed and lost and those struck but lost, as well as increase our collection of data on age and sex composition of the catch.

Beginning in 1978, we also plan to start a project of examining the logbooks of early whaling vessels to determine the pelagic catch of bowhead whales by commercial whalers. In addition, a search of the literature will provide an estimate of the annual catch by Eskimos in the past. These data will provide a statistical basis for estimating the original size of this population.

Plans are now being made for conducting a bowhead whale marking program as soon as a tag suitable for the rigorous conditions of the Arctic can be developed. The ice-filled waters inhabitated by these whales require a tag that can survive the harsh physical conditions of this environment. Frequent physical contact by these animals with floating ice dictates that the tags will have to be well anchored in the body of the whale, with a minimum projection from the body to reduce damage from the ice. Information produced by a marking program will augment known information on the abundance and distribution of bowhead whales.

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Thanks are due the whaling captains and crew members at Point Hope and Barrow who provided much information and answered our numerous questions concerning whaling. I especially wish to thank Mr. Herbert Kinnieveuk, who was kind enough to permit me to use his records of successful whaling captains and dates on which they took whales from 1949 to the present. The Reverend Clinton Swan has been most helpful in providing information annually on whaling activities at Kivalina.

I am grateful to the following for providing information on the whaling activities on St. Lawrence Island: Mr. Edward Wightman, NMFS, Anchorage, Alaska; Dr. Francis H. Fay, University of Alaska, Fairbanks; Dr. James A. Estes, U.S. Fish and Wildlife Serivce, Anchorage; and Mr. Thomas J. Eley, Jr., Alaska Department of Fish and Game, Fairbanks.

The support of the Naval Arctic Research Laboratory (NARL) at Barrow, Alaska is also gratefully acknowledged. The use of the NARL cabin at Point Hope and logistic support made it possible for us to observe and collect information on whaling in that area. The use of NARL facilities and the expertise of the staff at Barrow were essential for our studies there.

Weather data for Barrow was provided by the NOAA Weather Service facility located at that village.

The following people participated in the field work and collection of the data: Michael F. Busby, Geoffry M. Carroll, Dr. Floyd E. Durham, Clifford H. Fiscus, Peter Frankson, Gordon H. Jarrell, John R. Patee, and Glenn A. Seaman.

Finally, I wish to express my gratitude to the many scientists whose interest and cooperative research involves ongoing studies that will enrich our knowledge of the biology of the bowhead whale. To date, one study on hearing has been partially completed by Dr. G. Fleischer (1976), Tuebinger University, Tuebinger, West Germany. Mr. Lloyd Lowry, Alaska Department of Fish and Game, Fairbanks, identified food items found in stomach contents of bowhead whales. When the various cooperative studies are completed, the findings will be included in future NMFS reports on the bowhead.

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FIGURES

1. Map of bowhead whale study area.

2. Growth rate for bowhead whale fetuses and newborn calves.

3. Each whaling crew has a seal-skin covered boat (umiak) and tent. Snowmobiles have largely replaced the dog team for transportation.

4. Two darting guns in position in the bow of the skin boat are ready for instant use. One gun has a harpoon attached that is secured to a float by a line about 61m (200 feet) in length.

5. Two shoulder guns have been placed so that they can be easily picked up. The bomb has been removed from the gun in the foregroundto show its size.

6. Exploded view of bomb used in shoulder guns. Bomb fired from darting guns (bottom) is identical except it is about 8 cm (3 inches) shorter because flight-vanes are not needed.

7. Harpoon with toggle-head in position for thrusting into whale.

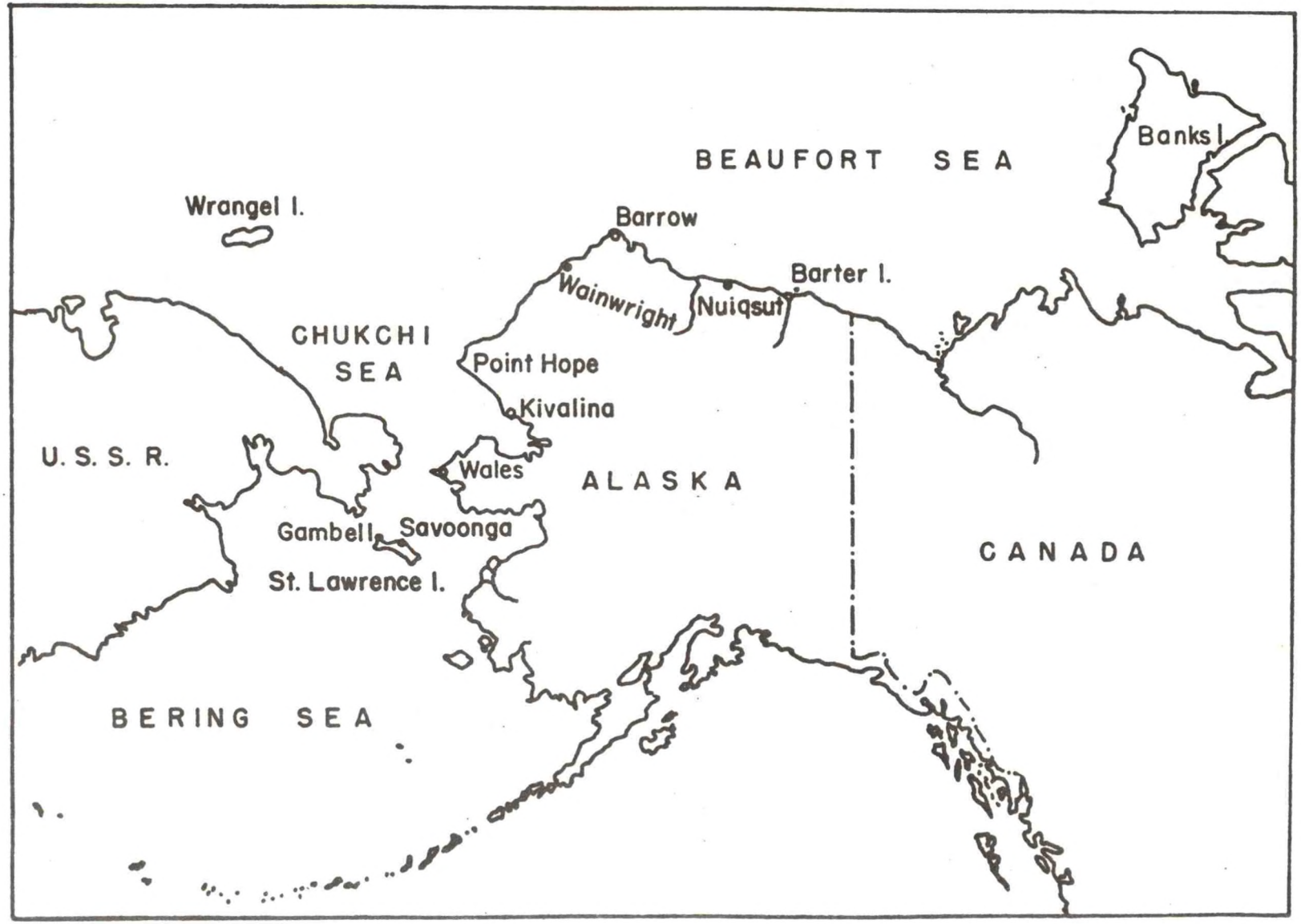
8. Harpoon head rotates to position illustrated as result of tension caused by attached line and float, after harpoon has entered body of the whale. The toggle-head greatly reduces chance that the harpoon may be pulled out, perhaps resulting in loss of the whale.

9. Skin-deep cuts are made by a skilled flensor before whale is removed from the water to indicate how specific sections of the whale are to be cut and removed.

10. Most of the bowhead whales taken by the Eskimos are pulled up onto the ice for butchering by means of block and tackle anchored to an ice bridge.

11. Two large whales pulled onto the ice for butchering.

12. Butchering of the whale has been completed, except for the side of baleen that is about to be removed.



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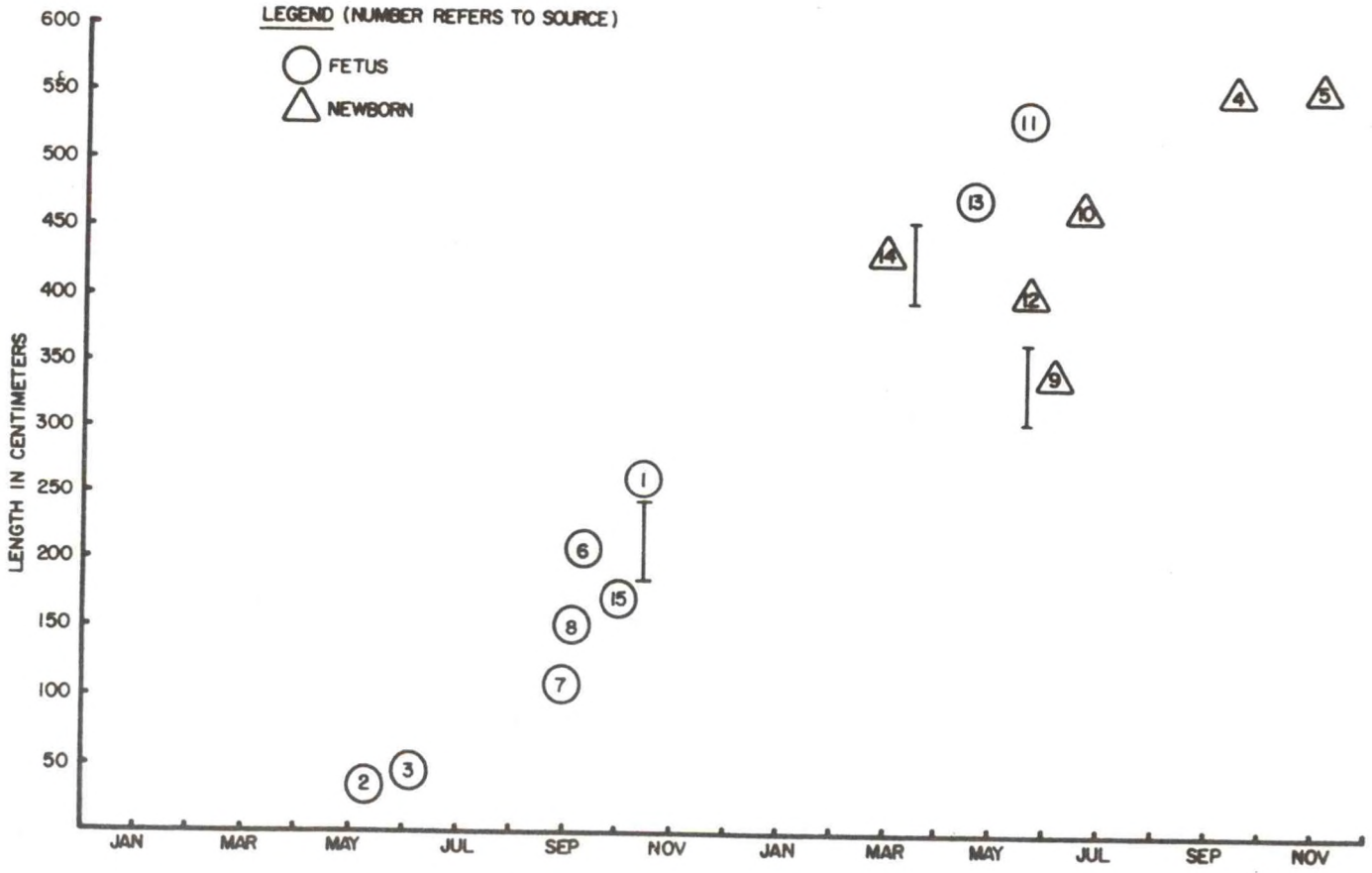


FIGURE 2. GROWTH RATE FOR BOWHEAD WHALE FETUSES AND NEWBORN CALVES.

Figure 2. Continued: sources of data on growth for fetuses and newborn of the bowhead whale.

Number	Date	Age	Length (cm)	Source
1.	Autumn	Fetus	183-244	Durham, F., Unpub. Rept. 5/
2.	10 May	Fetus	13	Durham, F., Unpub. Rept. 5/
3.	2 June	Fetus	25	Durham, F., Unpub. Rept. 5/
4.	Autumn	Est. 6 mo.	549	Durham, F., Unpub. Rept. 5/
5.	30 Sept.	Newborn	549	Slijper, 1962.
6.	12 Sept. 1852	Fetus	190	Allen, 1973.
7.	1 Sept. 1882	Fetus	91	Murdoch, 1885.
8.	3 Sept. 1976	Fetus	131	Marquette, (this report).
9.	20 May 1954	Est. 1-2 wks	305-366	Maher & Wilimovsky, 1963.
10.	6 June 1973	Newborn	460	Durham, F., Unpub. Rept. 7/
11.	22 May 1925	Fetus	518	Richards, E.A., 1949.
12.	6 May 1843	Newborn, umbilical still attached	396	Eschricht & Reinhardt, 1866.
13.	20 Apr. 1801	Fetus	457	Eschricht & Reinhardt, 1866.
14.	18 Mar. 1807	Newborn	396-457	Eschricht & Reinhardt, 1866.
15.	Autumn 1916	Fetus	152	Brower, C.D., Unpub. rept. 6/

Figure 3. Each whaling crew has a seal-skin covered boat (umiak) and tent. Snowmobiles have largely replaced the dog team for transportation.

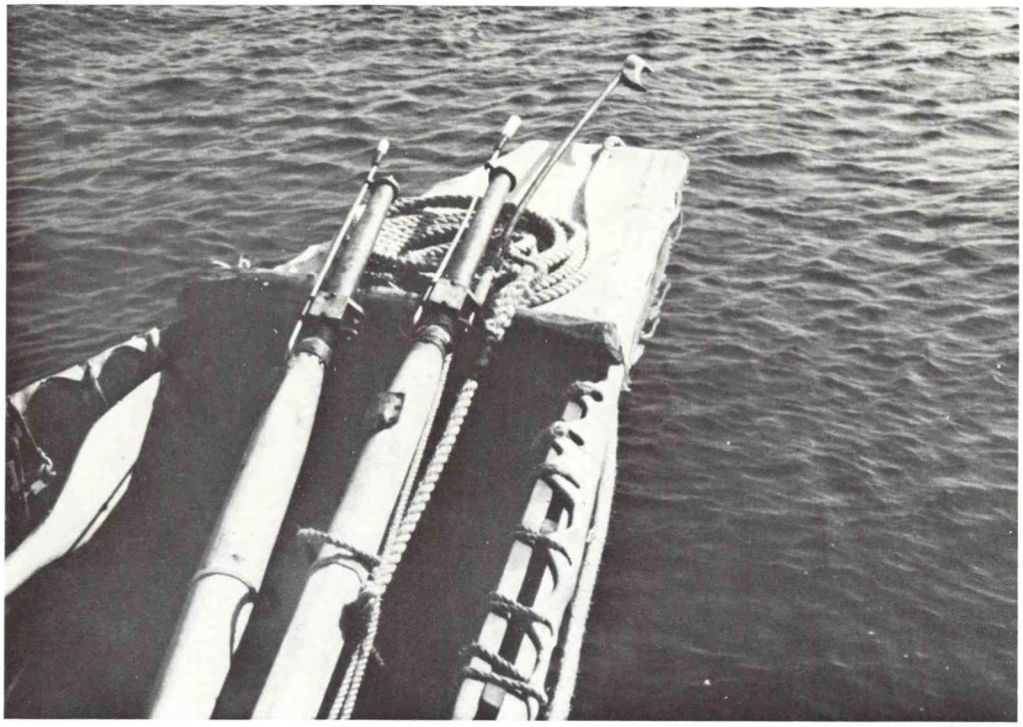
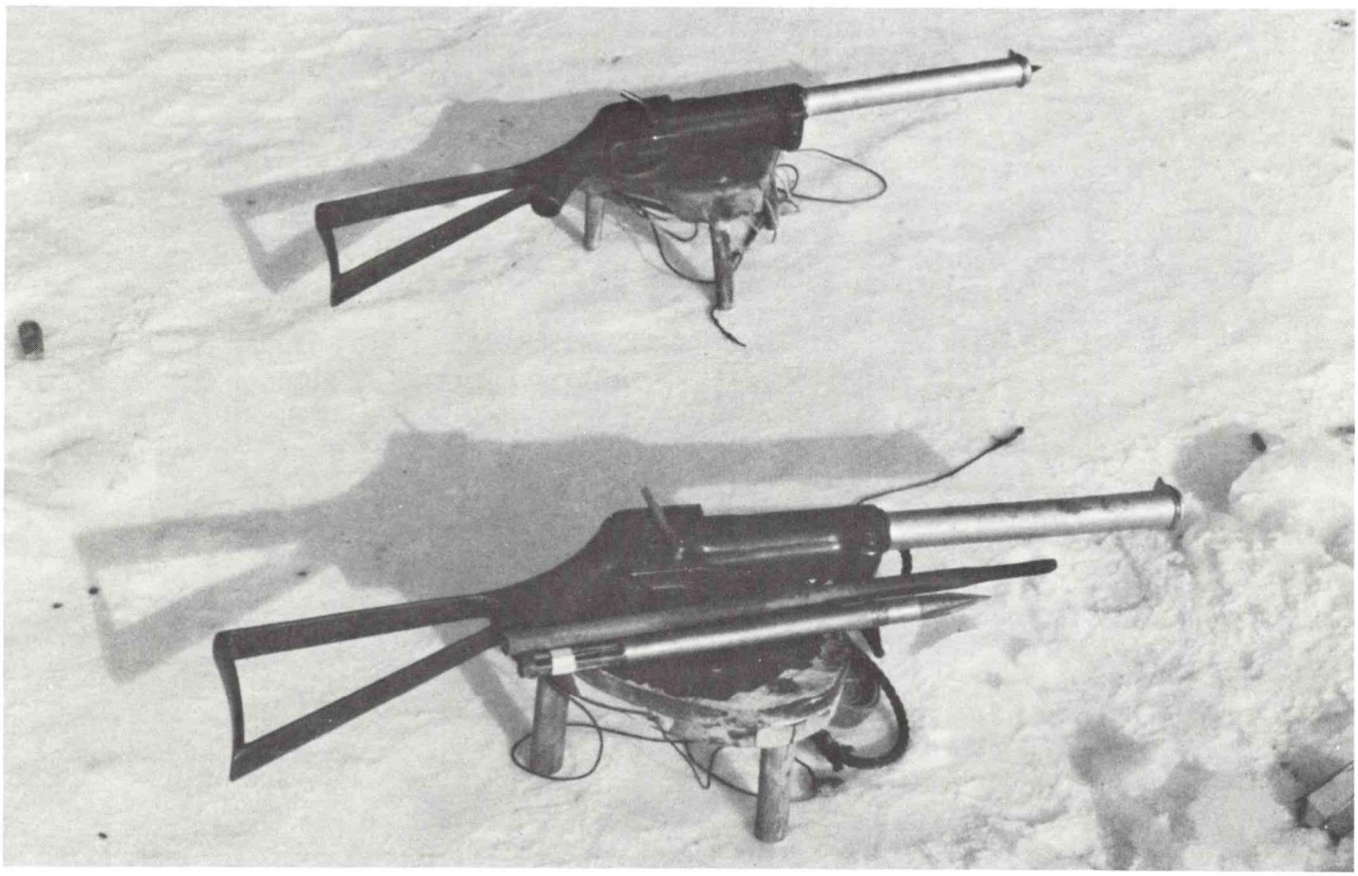


Figure 4. Two darting guns in position in the bow of the skin boat are ready for instant use. One gun has a harpoon attached that is secured to a float by a line about 61m (200 feet) in length.



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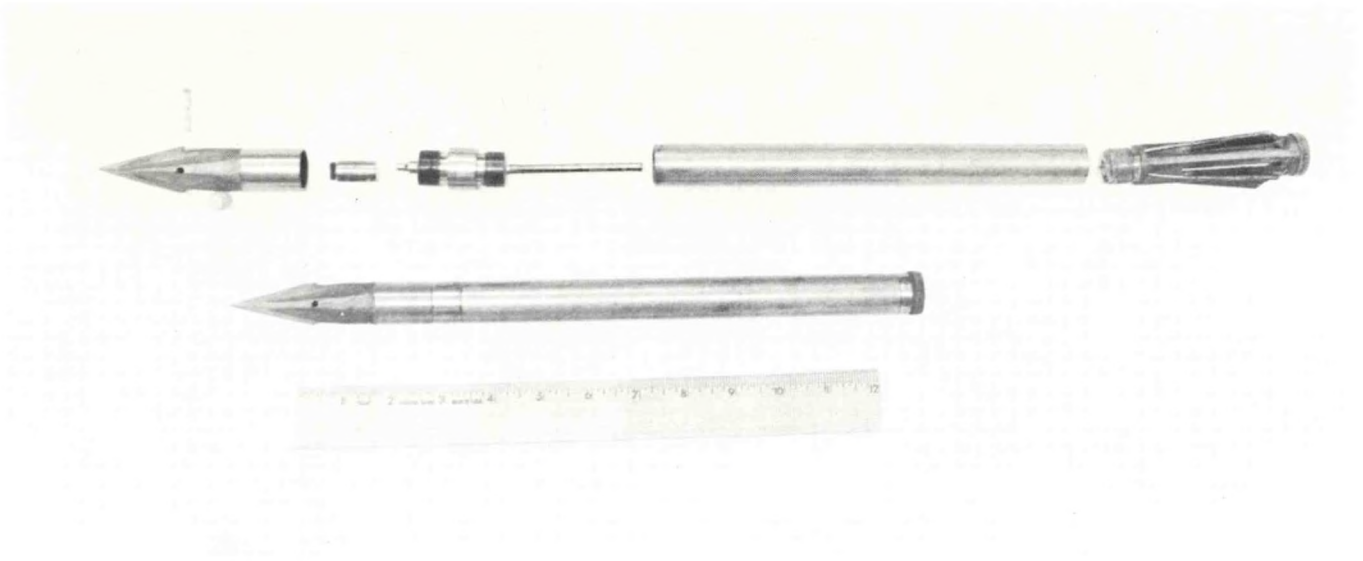

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Figure 11. Two large whales pulled onto the ice for butchering.

Figure 12. Butchering of the whale has been completed, except for the side of baleen that is about to be removed.

APPENDIX TABLE

Measurements of body proportions (in centimeters) of bowhead whales harvested by Alaskan natives, 1973-1976.

Specimen No.	4461	4462	4463	4464	4465	4466	4467
1. Sex	M	M	F	F	M	M	F
2. Snout to notch of flukes	823	670	915	915	820	910	1036
3. Snout to center of blowhole	168	--	--	--	--	240	--
4. Snout to center of eye	254	--	--	--	--	280	--
5. Snout to gape	--	--	--	--	--	--	--
6. Snout to ear	--	--	--	--	--	--	--
7. Snout to flipper insertion	315	--	--	--	--	--	--
8. Notch of flukes to center of anus	223	--	--	--	--	--	--
9. Notch of flukes to genital aperature	279	--	--	--	--	--	--
10. Notch of flukes to genital aper. (ant.)	--	--	--	--	--	--	--
11. Mammary slits, distance between	--	--	--	--	--	--	--
12. Notch of flukes to umbilicus	--	--	--	--	--	--	--
13. Flukes, total span	245	--	--	--	--	307	--
14. Fluke length, tip to notch	--	--	--	--	--	--	--
15. Fluke width at insertion	--	--	--	--	--	65	--
16. Girth behind flippers	508	--	--	--	--	--	--
17. Girth, maximum	--	--	--	--	--	--	--
18. Girth, anterior of flukes	--	--	--	--	--	--	--
19. Flipper, anterior length	122	122	122	124	--	127	--
20. Flipper, posterior length	94	99	94	100	--	94	--
21. Flipper, maximum width	53	61	63	60	--	63	--
22. Blowhole length	--	--	--	--	--	--	--
23. Blowhole dist. apart ant.	--	--	--	--	--	--	--
24. Blowhole dist. apart post.	--	--	--	--	--	--	--
25. Baleen, total right side	--	--	--	--	--	--	--
26. Baleen, total left side	--	--	--	--	--	--	--
27. Baleen, maximum length	155	156	160	154	--	183	--
28. Skin thickness	--	--	--	--	--	--	--
29. Blubber thickness	15	--	--	--	--	15	--
30. Skull length	277	292	310	318	--	310	--
31. Skull width	150	150	160	145	--	155	--
32. Mandible length (straight)	274	287	314	310	--	314	--

	4468	4469	4470	4471	4472	4473	4474	4475	4476	4477	4478	74H1
1.	F	-	F	F	M	M	F	F	M	F	M	M
2.	823	--	855	884	610	--	975	825	762	1525	460	813
3.	--	--	165	172	--	--	--	178	--	264	74	--
4.	--	--	210	242	--	--	--	220	--	372	102	--
5.	--	--	217	247	--	--	--	218	--	385	104	--
6.	--	--	--	267	--	--	--	--	--	414	120	--
7.	--	--	--	278	--	--	--	247	--	427	133	--
8.	--	--	233	240	--	--	--	275	--	405	118	--
9.	--	--	259	--	--	--	--	--	--	--	142	--
10.	--	--	--	--	--	--	--	--	--	--	195	--
11.	--	--	--	--	--	--	--	--	--	--	--	--
12.	--	--	--	--	--	--	--	--	--	730	215	--
13.	--	--	264	254	250	--	280	254	--	--	137	--
14.	--	--	--	--	--	--	--	--	--	--	--	--
15.	--	--	--	66	--	--	72	64	--	--	38	--
16.	--	--	--	--	--	--	--	520	--	--	--	--
17.	--	--	--	--	--	--	--	--	--	--	--	--
18.	--	--	--	--	--	--	--	--	--	--	--	--
19.	--	--	117	127	--	137	127	115	--	234	75	126
20.	--	--	92	104	--	115	97	85	--	206	56	104
21.	--	--	56	60	--	74	58	52	--	127	32	60
22.	--	--	--	--	--	--	--	--	--	--	--	--
23.	--	--	--	--	--	--	--	--	--	--	--	--
24.	--	--	--	--	--	--	--	--	--	--	--	--
25.	--	--	--	--	--	--	--	--	--	--	--	--
26.	--	--	--	--	--	--	--	--	--	--	--	--
27.	--	--	--	--	69	175	140	69	127	--	--	85
28.	--	--	--	--	--	--	--	--	--	--	--	2.6
29.	--	--	26	30.5	--	--	25	--	--	30	5.3	18
30.	--	--	--	268	248	355	280	260	265	414	134	--
31.	--	--	--	156	125	170	150	150	140	--	71	--
32.	--	--	--	267	250	346	285	--	272	--	--	254

	74H2	74H3	74H4	74H5	74H6	74H7	74B1	74B2	74B3	74B4	74B5	74B6
1.	M	F	M	M	-	-	-	M	F	M	F	M
2.	869	757	1524	1550	1219[1/]	914[1/]	975	813	1135	1385	724	671[1]
3.	--	169	--	--	--	--	--	--	--	--	--	--
4.	263	222	--	--	--	--	--	--	--	--	--	--
5.	--	--	--	--	--	--	--	--	--	--	--	--
6.	--	--	--	--	--	--	--	255	--	--	--	--
7.	--	--	--	--	--	--	--	--	--	--	--	--
8.	240	--	--	--	--	--	--	--	--	--	--	--
9.	--	--	--	--	--	--	--	--	--	338	--	--
10.	--	--	--	--	--	--	--	--	--	505	--	--
11.	--	25	--	--	--	--	--	--	--	--	--	--
12.	405	--	--	--	--	--	--	--	--	--	--	--
13.	--	--	--	--	--	--	--	--	305	--	--	--
14.	--	--	--	--	--	--	--	--	152.5	--	--	--
15.	70	70	--	--	--	--	--	--	70	--	--	--
16.	--	--	--	--	--	--	--	--	--	--	--	--
17.	--	--	--	--	--	--	--	--	--	--	--	--
18.	--	--	--	--	--	--	--	--	--	--	--	--
19.	126	113	--	--	--	--	--	123	117	254	--	--
20.	92	81	--	--	--	--	--	104	99	191	--	--
21.	58	57	--	--	--	--	--	62	60	137	--	--
22.	--	--	--	--	--	--	--	14	--	--	--	--
23.	--	--	--	--	--	--	--	--	--	--	--	--
24.	--	--	--	--	--	--	--	--	--	--	--	--
25.	279	280	--	--	--	--	--	321	298	--	--	--
26.	288	--	--	--	--	--	--	--	--	--	--	--
27.	118	66	--	--	--	--	129	97	57	--	60	--
28.	2	2.5	--	--	--	--	--	2	2	--	2	--
29.	15	19	--	--	--	--	--	22	24	--	17	--
30.	--	--	--	--	--	--	320	247	268	--	--	221
31.	--	--	--	--	--	--	180	149	155	--	--	115
32.	283	230	--	--	--	--	314	264	263	--	--	217

	75H1	75H2	75H3	75H4	75B1	75B2	75B3	75B4	75B5	75B6	75B7	75B8
1.	-	-	F	M	F	M	F	-	M	F	F	F
2.	1097[1/]	610[1/]	846	1158	795	691	927	800[1/]	854	1620	784	1111
3.	--	--	207	--	210	163	--	--	220	423	173	333
4.	--	--	242	--	--	202	--	--	260	532	233	392
5.	--	--	--	--	--	212	--	--	270	--	242	397
6.	--	--	--	--	--	183	--	--	290	541	--	432
7.	--	--	--	--	--	232	--	--	310	--	--	526
8.	--	--	--	--	--	186	--	--	236	397	215	--
9.	--	--	215	--	--	249	--	--	321	473	224	--
10.	--	--	--	--	--	--	--	--	--	--	--	--
11.	--	--	--	--	--	--	--	--	--	--	--	--
12.	--	--	--	--	--	--	--	--	431	--	274	--
13.	--	--	--	--	263	220	--	--	254	551	228	390
14.	--	--	--	--	--	--	--	--	--	--	--	--
15.	--	--	--	73	62	60	--	--	68	139	58	84
16.	--	--	--	--	--	535	--	--	508	--	--	700
17.	--	--	--	--	--	535	--	--	514	--	--	--
18.	--	--	--	113	--	--	--	--	98	190	106	--
19.	--	--	126	100	108	107	138	--	130	256	120	177
20.	--	--	--	92	78	78	98	--	100	202	92	125
21.	--	--	53	64	52	52	66.5	--	56	138	51	86
22.	--	--	--	--	--	--	--	--	--	--	--	--
23.	--	--	--	--	--	--	--	--	--	--	--	--
24.	--	--	--	--	--	--	--	--	--	--	--	--
25.	--	--	--	--	--	--	323	--	335	--	274	324
26.	--	--	275	--	--	--	--	--	--	--	--	--
27.	95	--	90	--	--	45	155	--	126	313	70	221
28.	--	--	2.5	2.2	--	--	--	--	2.3	2.2	2.5	2.5
29.	--	--	20	18	15	16	16	--	15.5	32	17.5	17.2
30.	--	--	--	--	293	219	333	289	276	598	276	415
31.	--	--	--	--	136	117	184	140	153	214	153	212
32.	--	--	255	--	295	218	333	276	271	562	243	421

	75B9	75B10	76H1	76H2	76H3	76H4	76H5	76H6	76H7	76H8	76H9	76H10
1.	-	M	-	M	F	M	F	M	F	F	F	F
2.	715	1402	792[1/]	1021	1321	1120	853	1468	846	848	825	889
3.	--	350	--	253	334	--	--	--	--	213	--	212
4.	--	442	--	314	418	367	--	--	--	273	--	262
5.	--	448	--	--	--	--	--	--	--	--	--	--
6.	--	--	--	--	--	--	--	--	--	--	--	--
7.	--	--	--	--	475	--	--	--	--	--	--	--
8.	--	334	--	255	--	294	343	256	--	242	--	240
9.	--	450	--	353	--	380	363	472	--	249	--	248
10.	--	--	--	421	--	511	--	--	--	--	--	277
11.	--	--	--	--	--	--	24	--	--	16	--	20
12.	--	--	--	--	505	525	--	--	--	394	--	400
13.	--	498	--	--	--	--	--	--	--	--	--	--
14.	--	--	--	--	--	--	--	--	--	--	--	--
15.	--	123	--	83	--	--	--	122	--	--	--	--
16.	--	--	--	--	674	--	--	--	--	360	--	--
17.	--	--	--	--	--	572	--	--	--	384	--	--
18.	--	--	--	--	--	--	--	--	--	--	--	--
19.	--	238	--	150	--	--	--	223	130	118	--	124.5
20.	--	188	--	116	--	--	--	175	115	95	--	96
21.	--	120	--	63	--	--	--	111	63	53	--	60
22.	--	--	--	20	23	--	--	--	--	--	14	--
23.	--	--	--	5	5.5	--	--	--	--	--	4	--
24.	--	--	--	17	22	--	--	--	--	--	12.5	--
25.	--	--	--	--	--	285	--	--	--	--	--	307
26.	--	--	--	346	329	--	320	283	--	--	--	--
27.	--	287	--	138	212	200	--	256	--	--	--	145
28.	--	--	--	2	2	--	--	2	2.5	--	--	2
29.	--	--	--	16	22	--	--	21.5	22	--	--	15
30.	233	465	--	--	--	--	--	--	--	--	--	--
31.	123	250	--	--	--	--	--	--	--	--	--	--
32.	226	464	--	350	445	384	--	430	--	285	267	--

	76H11	76H12	76B1	76B2	76B3	76B4	76B5	76B6	76B7	76B8	76B9	76B10
1.	F	M	M	M	-	-	F	M	M	M	M	M
2.	808	762	750	1144	796	1136	750	1235	980	1370	1070	1100
3.	190	225	--	320	--	265	--	330	235	--	--	295
4.	250	242	--	389	226	347	--	400	303	--	--	355
5.	--	--	--	360	256	350	--	--	310	--	--	366
6.	--	--	--	480	286	--	--	--	343	--	--	403
7.	--	--	--	420	--	342	--	--	--	--	--	--
8.	216	198	--	265	210	295	--	337	243	360	294	308
9.	220	247	--	350	--	371	--	454	310	490	364	370
10.	--	324	--	--	--	--	--	--	--	--	--	--
11.	--	--	--	--	--	--	--	--	--	--	--	--
12.	--	341	--	455	--	508	--	--	--	--	--	518
13.	--	--	--	323	274	366	--	362	289	435	--	371
14.	--	--	--	--	--	--	--	--	--	--	--	--
15.	--	75	--	74	63	86	--	82	74	100	84	90
16.	--	420	--	736	380	452	--	--	--	--	--	--
17.	--	--	--	--	--	--	--	--	--	--	--	--
18.	--	--	--	130	--	--	--	--	--	--	--	--
19.	--	111	--	164	108	162	--	204	134	218	150	189
20.	--	83	--	120	84	126	--	147	--	163	123	140
21.	--	51	--	82	49	75	--	98	74	115	79	92
22.	--	14	--	--	--	--	--	--	--	--	--	--
23.	--	3.5	--	--	--	--	--	--	--	--	--	--
24.	--	12.5	--	--	--	--	--	--	--	--	--	--
25.	304	294	--	--	270	--	281	--	--	--	--	342
26.	--	--	--	315	--	--	280	--	--	--	--	--
27.	123	--	--	226	133	--	137	237	--	--	--	--
28.	2	2.5	2	2	--	--	--	--	2	2	2	3
29.	17	12	19	20	--	--	--	--	19.5	25	21	21
30.	--	--	328	--	278	290	287	447	--	--	--	390
31.	--	--	164	--	--	--	140	--	--	--	--	--
32.	262	250	315	419	275	--	292	437	328	--	--	380

	76B11	76B12	76B13	76B1F	76B2F	76B3F	76B4F	76B5F	76B6F	76B7F	76B8F
1.	F	F	F	M	M	M	M	F	F	F	M
2.	685[1/]	854	1158	1650[1/]	1630[1/]	1620[1/]	1650[1/]	1730	1600	1430	1408
3.	--	197	--	--	--	--	--	--	--	390	410
4.	--	235	--	--	--	--	--	--	--	495	480
5.	--	240	--	--	--	--	--	--	--	--	--
6.	--	260	--	--	--	--	--	--	--	--	530
7.	--	310	--	--	--	--	--	--	--	--	--
8.	--	220	306	--	--	--	--	--	--	--	--
9.	--	230	316	--	--	--	--	--	--	--	--
10.	--	--	--	--	--	--	--	--	--	--	--
11.	--	--	--	--	--	--	--	--	--	--	--
12.	--	410	527	--	--	--	--	--	--	--	--
13.	280	245	318	--	--	--	--	--	575	--	--
14.	--	--	--	--	--	--	--	--	--	--	--
15.	72	60	86	--	--	--	--	--	140	--	--
16.	--	650	--	--	--	--	--	--	--	--	--
17.	--	690	--	--	--	--	--	--	--	--	--
18.	--	--	--	--	--	--	--	--	--	--	--
19.	121	109	154	--	--	--	--	--	255	240	280
20.	87	91	109	--	--	--	--	--	210	180	200
21.	57	52	87	--	--	--	--	--	135	115	130
22.	--	--	--	--	--	--	--	--	--	--	--
23.	--	--	--	--	--	--	--	--	--	--	--
24.	--	--	--	--	--	--	--	--	--	--	--
25.	--	--	--	--	--	--	--	--	--	--	--
26.	--	303	--	--	--	--	--	--	--	--	--
27.	--	79	--	--	290	?	--	--	--	280	230
28.	--	2.5	--	--	--	--	--	--	--	--	--
29.	--	21.5	13.5	--	--	--	--	--	--	--	--
30.	270	255	--	--	--	--	--	--	--	--	--
31.	--	--	--	--	--	--	--	--	270	--	--
32.	--	245	--	--	--	--	--	--	580	--	--

	76B9F	76B10F
1.	M	M
2.	1525	1320
3.	--	410
4.	480	470
5.	--	--
6.	--	--
7.	560	--
8.	400	--
9.	540	--
10.	--	--
11.	--	--
12.	710	--
13.	--	--
14.	--	--
15.	123	--
16.	--	--
17.	--	--
18.	--	--
19.	270	235
20.	190	190
21.	150	120
22.	--	--
23.	--	--
24.	--	--
25.	--	--
26.	--	--
27.	245	242
28.	--	--
29.	--	--
30.	--	--
31.	--	--
32.	--	--

1/. Estimate of length provided by the Eskimos.