

## Surface Times

The length of time a whale was visible to the observer at each blow was recorded. Of 112 recordings for non-breaching animals, surface times ranged from 1.6 to 16.5 seconds. Mean time at the surface was  $6.1 \pm 0.5$  seconds. Of 36 breaching animals, surface times ranged from 1.9 to 10.3 seconds with a mean of  $4.1 \pm 0.6$  seconds.

## Summary

Between 2 April and 7 June, 280 bowhead whales were counted from the Cape Lisburne research site at Alokut during 691 hours of systematic observation effort; 99.3 percent of these whales were seen between 18 April and 14 May. This compares with sightings made at Point Barrow where 96.8 percent of the whales passed between 22 April and 18 May. This 4-day lag in sightings between the two observation sites compares favorably with the estimated 3.6 to 4.7 day travel time (4.1-5.3 km/hour calculated rate of travel for bowheads passing Cape Lisburne).

Using interpolations to estimate the number of whales passing during periods of poor visibility, approximately 478 bowheads passed the Cape within 15 km during the spring migration. The average offshore recorded distance was 4.5 km. Whales were seen as far as 14.8 km, the outer limit of visibil-

ity during excellent conditions. An unknown portion of the population passed beyond the viewing range. Virtually all of the bowheads were traveling in a northeasterly direction as they passed Cape Lisburne which suggests a route less dependent on coastal features than on sea ice shear zones and direct line travel toward Point Barrow. Most whales were sighted on the far side of leads and polynyas.

Fog and storms precluded watches during critical parts of the migration, further reducing the Cape Lisburne counts relative to those made at Point Barrow. The viewing area was too large to be covered adequately by one or two observers at a time, and problems with determining duplicate sightings also may have suppressed counts.

A high frequency of breaching and fluke slapping occurred in the Cape Lisburne area relative to records from other sites. Synchronous breaching and milling suggest considerable courtship and/or copulation was taking place. The mean dive time between sounding dives for nonbreaching whales was  $11.6 \pm 2.4$  seconds. The mean recorded time at the surface was 6.1 seconds with a range of 1.6 to 16.5 seconds.

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# Vessel Survey for Bowhead Whales in the Bering and Chukchi Seas, June-July 1978

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## Introduction

Prior to the advent of Yankee whaling for bowhead whales, *Balaena mysticetus*, in the Chukchi Sea in 1848, there were an estimated 6,500 bowheads in the Sea of Okhotsk population and 11,700 to 18,000 in the western Arctic population (International Whal-

ing Commission, 1978). By the turn of the 20th century bowheads in the Sea of Okhotsk had been nearly exterminated

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and those in the Bering Sea and Arctic Ocean were reduced to a level that was no longer commercially important (Bockstoce<sup>1</sup>).

Townsend (1935) reviewed several hundred logbooks of 19th century whalerships and plotted positions of 5,114 bowhead catches in the Bering Sea and Arctic Ocean from lat. 53° to 73°N, and long. 120°W to 135°E (Fig. 1a, b, c). Catches were recorded from much of the Bering Sea, the majority on the western side, and showed a clear

<sup>1</sup>Bockstoce, J. 1978. A preliminary estimate of the reduction of the western Arctic bowhead whale (*Balaena mysticetus*) population by the pelagic whaling industry: 1848-1915. Unpubl. manuscr., 32 p. Prepared for the Marine Mammal Commission, Washington, D.C.

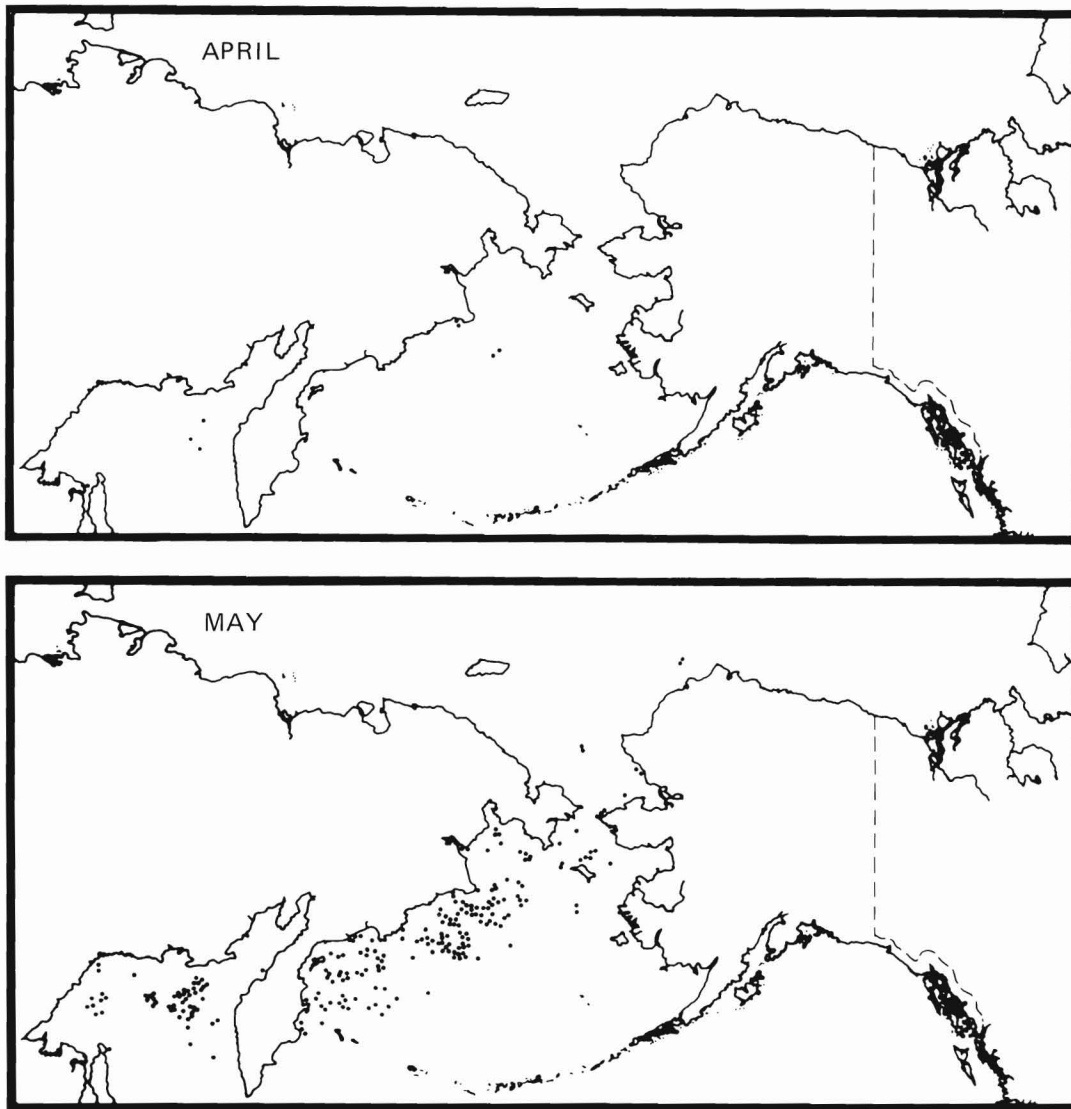


Figure 1a. —Locations where bowheads were taken by Yankee whalers in April and May 1848-1919. Each black dot represents a single harvested whale. Data points summarized from Townsend (1935).

shift northward through the season as animals moved in response to the receding ice. Townsend's (1935) harvest records for the months of June through October indicated that bowheads once ranged from west of Wrangel Island, U.S.S.R., to Amundsen Gulf, Northwest Territories, Canada, and from as far south as the Pribilof Islands west to Cape Navarin, U.S.S.R. These records have served as the major source for understanding bowhead distribution during the period of commercial exploitation, 1848-1919. Townsend's plots, when compared with current knowl-

edge of the distribution of bowheads (Braham et al., 1979; Braham and Krogman<sup>2</sup>; Braham et al.<sup>3</sup>), suggest that these whales were killed over a much wider range than they apparently occupy at present.

<sup>2</sup>Braham, H. W., and B. D. Krogman 1977. Population biology of the bowhead (*Balaena mysticetus*) and beluga (*Delphinapterus leucas*) whale in the Bering, Chukchi and Beaufort Seas. Processed rep., 29 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

<sup>3</sup>Braham, H., B. Krogman, and G. Carroll. 1979.

In 1978 an estimated 1,783-2,865 bowheads migrated past the National Marine Fisheries Service (NMFS) ice camp census stations near Point Barrow, Alaska (Braham et al., 1979). This estimate was based on counts made in

Population biology of bowhead whale (*Balaena mysticetus*) II: Migration, distribution, and abundance in the Bering, Chukchi, and Beaufort Seas, with notes on the distribution and life history of white whales (*Delphinapterus leucas*). Unpubl. final rep., OCSEAP Contract R7120807, 118 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

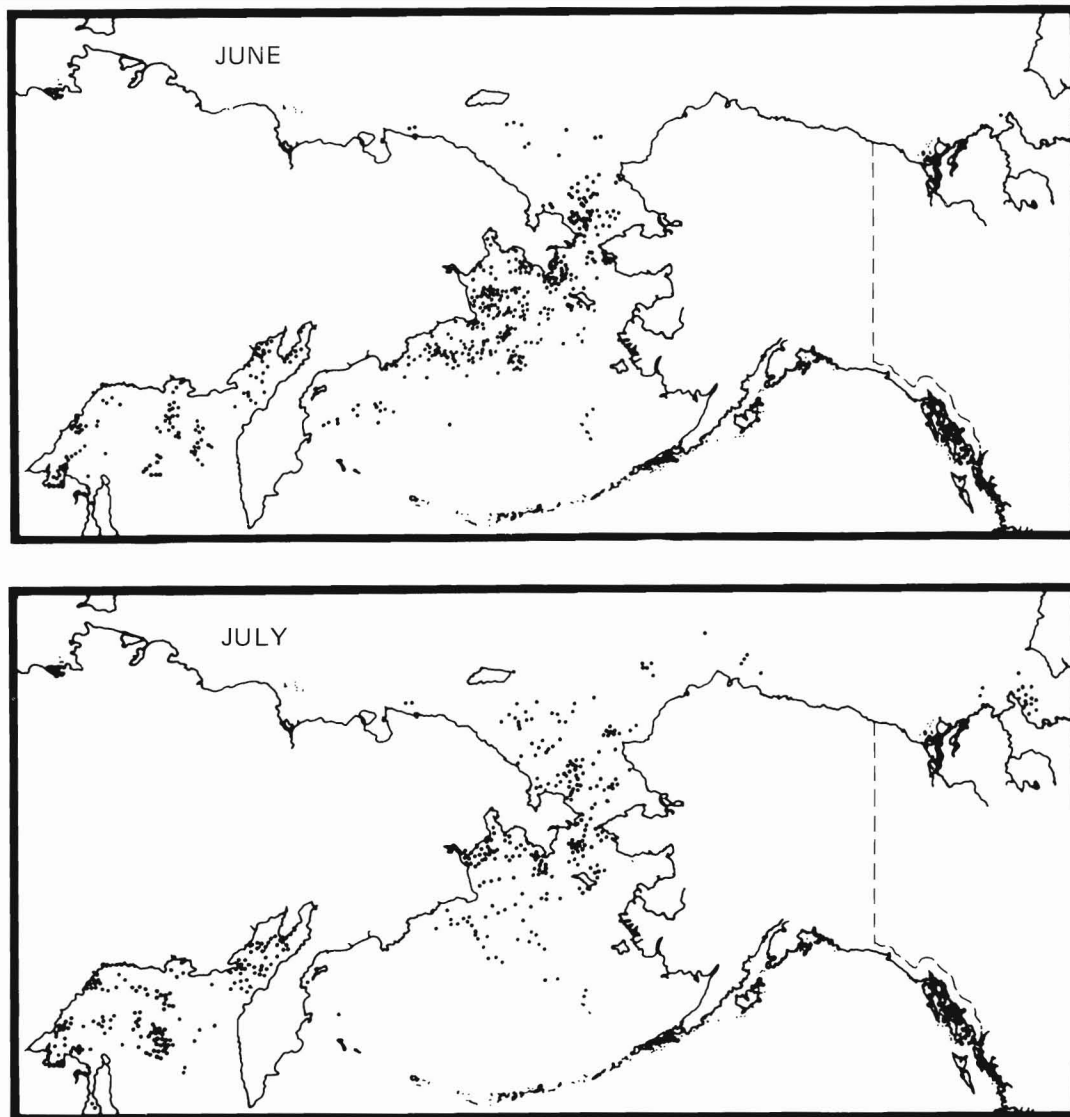


Figure 1b. —Locations where bowheads were harvested by Yankee whalers in June and July 1848-1919 (from Townsend, 1935).

the nearshore lead near Point Barrow from 15 April through 30 May. To evaluate the accuracy of this estimate, it was necessary to determine whether additional whales: 1) Migrated eastward past the ice camps after they closed in June, 2) migrated directly into the western Chukchi Sea in the spring without passing the Point Barrow ice camp, and/or 3) slowly migrated north from the Bering Sea to the central Chukchi Sea with the retreating ice in June and July.

Data collected from aerial surveys flown in 1976 and 1978, corroborated

by data from a land-based study in 1978, strongly suggest that few, if any, whales migrated through leads past Point Barrow after the closure of the ice camps (Rugh and Cabbage, 1980; Braham et al.<sup>3</sup>, 1980). Two questions remained to be answered before it could be determined what, if any, correction should be applied to the NMFS population estimate: Did any bowheads migrate directly into Soviet waters during the spring of 1978? Did any whales migrate into the central Chukchi Sea with the retreating ice during the summer of 1978 and, therefore, remain un-

accounted for in the spring census at Barrow? To address the first question, ice conditions in the northwest Chukchi Sea were examined (see Discussion). To address the second, a survey was conducted in the Bering and Chukchi Seas in June and July 1978. Results of the survey are reported in this paper.

Also summarized here are survey results from three other vessels on cruises in the Bering Sea and Arctic Ocean during 1978: NOAA research vessel *Surveyor*, Soviet sealing vessel *Zubarevo*, and U.S. Coast Guard icebreaker *Northwind*.

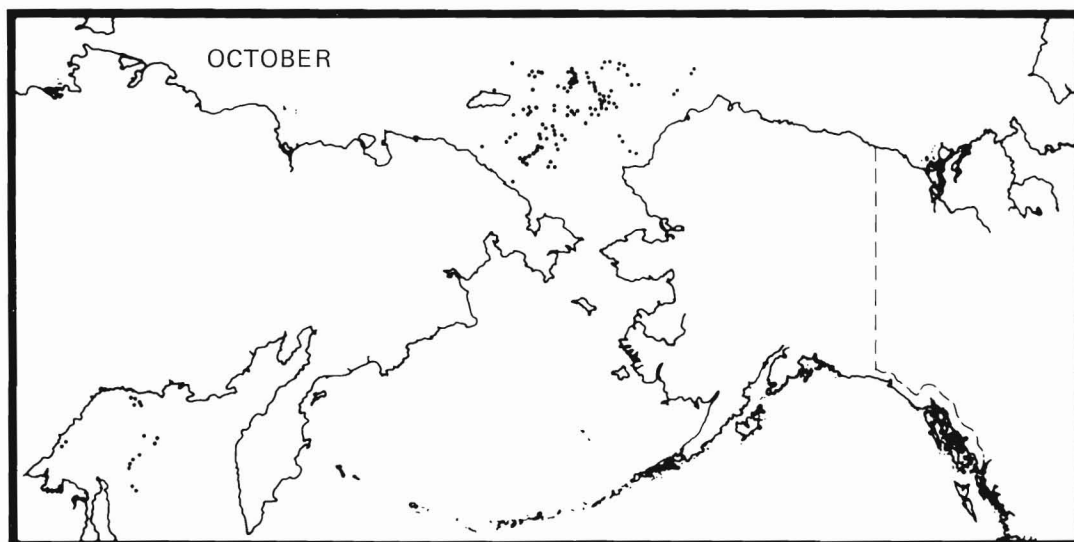
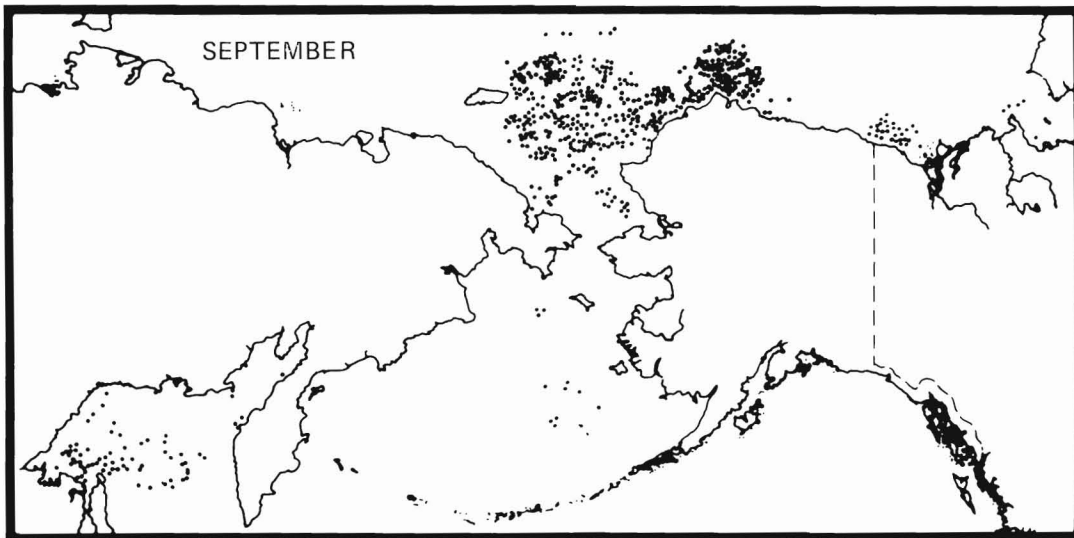
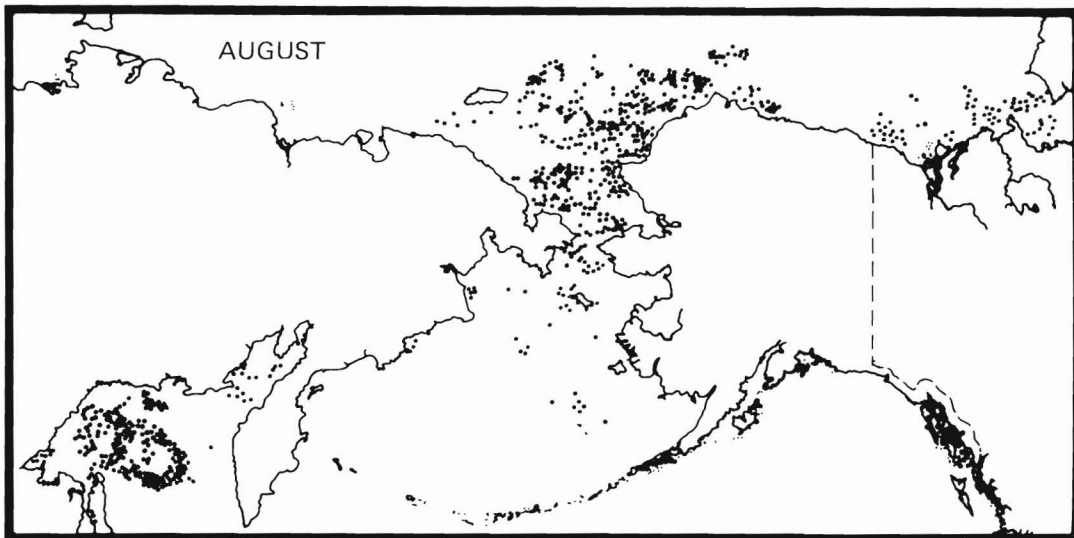


Figure 1c. —Locations where bowheads were harvested by Yankee whalers in August, September, and October 1848-1919 (from Townsend, 1935).

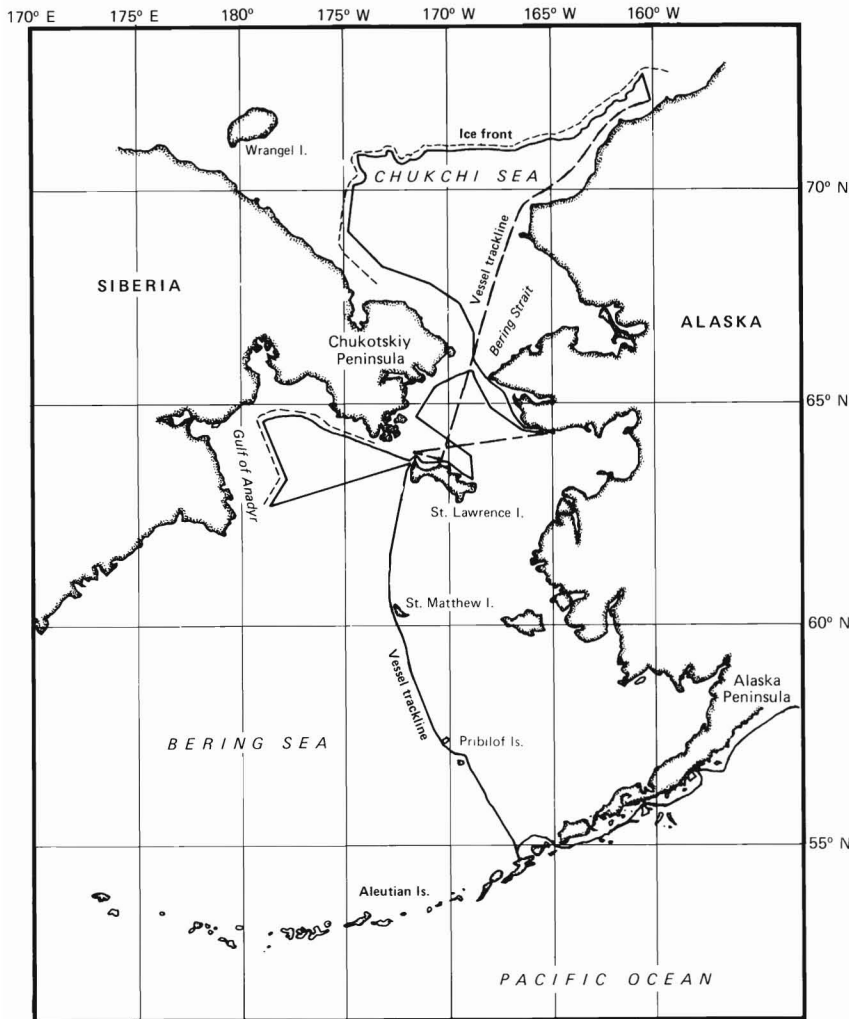


Figure 2.—NMFS bowhead whale study area and vessel survey tracklines north (—) and south (—) during the fishing vessel *Western Viking* survey, 14 June-15 July 1978. Short dashed lines (---) represent the ice front.

### Materials and Methods

The survey was conducted from the *Western Viking*, a 33 m fishing vessel based in Dutch Harbor, Alaska. The cruise began in Seward, Alaska, on 13 June and ended in Nome, Alaska, on 15 July 1978 after completion of the transect shown in Figure 2. Permission was obtained from the Soviet government to extend the cruise track to within 19.3 km (12 miles) of the Soviet coast from the Gulf of Anadyr to the north side of the Chukotskiy Peninsula.

From 11 to 15 observers were on-board at various times during the cruise—eight NMFS personnel, four students, and one staff observer from

the Ocean Research and Education Society (ORES), and two representatives of the Alaska Eskimo Whaling Commission. Watches were maintained along the entire survey route, weather permitting. Initially, 4-hour watches were kept by teams of three observers. The southern portion of the survey track was in darkness 3 hours/day, from 0200 to 0500 hours; the northern section had 24-hour daylight. Beginning 26 June, watches were reduced to two observers for 2-hour periods on a 24-hour schedule.

Daily records were maintained of the vessel's position, heading and speed, observers' hours and position on the vessel, weather and sea surface condi-

tions affecting visibility, and an appraisal of visibility. When marine mammals were sighted, the following information was recorded: Sighting cue (i.e., what caught the observer's eye); estimated horizontal angle of the sighting relative to the vessel's heading; estimated distance to the sighting and, whenever possible, perpendicular angle and estimated distance of the animal(s) passing abeam; the number of individuals and their heading and behavior. Once the basic data were recorded, the vessel diverted from its course to approach the animal(s) for closer behavioral observations and for photographs.

When species of special interest were encountered, underwater recordings were made. Signals were transmitted on a VHF carrier back to the vessel where they were received by a Defense Electronics Instrumentation (DEI)<sup>4</sup> recorder (sonobuoy receiver) and recorded on a Nagra recorder.

### Results

#### Fishing Vessel *Western Viking*

The 31-day survey covered approximately 10,186 km and resulted in observations of an estimated 1,238 cetaceans; 51 sea otters, *Enhydra lutris*; and 4,643 pinnipeds. No bowhead whales were observed, despite nearly ideal observation conditions over much of the survey route, particularly in the northern Bering and southern Chukchi Seas and along the ice edge where bowhead whales were expected.

Analyses of the acoustic recordings from the *Western Viking* cruise are not complete; however, we do not believe bowhead vocalizations were recorded. Recordings were made in the presence of other marine mammals, including Dall's porpoise, *Phocoenoides dalli*; killer whales, *Orcinus orca*; and walrus, *Odobenus rosmarus*; these have been reviewed and do not appear to contain sounds recognizable as bowhead whale vocalizations.<sup>5</sup>

#### NOAA Research Vessel *Surveyor*

During the period 25 April-15 June 1978 (Cruise 1, legs 5 and 6), scientists

<sup>4</sup>Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

<sup>5</sup>D. K. Ljungblad, Naval Ocean Systems Center, San Diego, CA 92152, pers. commun. 1980.

aboard the NOAA ship *Surveyor* surveyed the area from the southern edge of the pack ice in the Bering Sea, including St. Lawrence Island, southerly along the Alaska coast, through Unimak Pass and on to Kodiak, Alaska. Weather was variable; good viewing conditions were prevalent along the ice edge. Throughout the cruise a marine mammal watch was maintained, consisting of one or two deck officers, quartermaster, helmsman, and lookout.

On 7 May 1978 at 0710, a tentative observation of a bowhead whale was made at lat. 61°15'N, long. 172°41'W. At 0835 on the same date, one bowhead was sighted along the ice edge at lat. 61°16'N, long. 172°13'W. Both sightings occurred during the middle portion of the spring migration past the whaling villages. These whales might not have reached the Arctic Ocean until after the spring hunt or closure of the NMFS ice camps.

#### Sealing Vessel *Zubarevo* (U.S.S.R.)

From March through July 1978 the crew of the Soviet sealing vessel *Zubarevo* hunted pinnipeds from Karaginski Bay (lat. 59°30'N, long. 155°E) north with the receding ice to Wrangel Island. During this 5-month cruise no bowhead whales were seen. On 4 August 1978, Geoff Carroll, NMFS, Seattle, Wash., boarded the *Zubarevo* at Barrow, Alaska. The vessel departed Barrow and proceeded southwest along the ice edge to 37 km northwest of Wainwright, Alaska, where it remained until 13 August, then gradually worked west, to Herald Island. The vessel proceeded south through the Bering Strait to Arakamchechen Island, and on to Gambell, St. Lawrence Island. During this cruise no bowheads were observed though coverage was thorough along the ice front (lat. 70°55'N, long. 160°32'W to lat. 71°57'N, long. 160°59'W).

#### USCG Icebreaker *Northwind*

The U.S. Coast Guard icebreaker *Northwind* worked in the Beaufort Sea from 15 August to 15 September 1978. Although detailed records on marine mammal sightings were not main-

tained, no bowhead whales were seen during the first 2 weeks of the cruise.<sup>6</sup>

#### Discussion

Results of the research conducted on four separate cruises in 1978 lead us to conclude that few, if any, bowheads remained in the area south of the ice front in the Bering and Chukchi Seas during the summer months. In addition to these cruises, several factors support this conclusion.

No bowheads were observed along the ice edge or in the waters between Point Barrow and St. Lawrence Island covered by aerial surveys of 8-11 June 1978 (Braham et al. 1980).

Members of the Eskimo communities have commented on bowhead whale modern distribution. The mayor of Savoonga, Alaska,<sup>7</sup> reported that bowheads were not observed around St. Lawrence Island between late April and early December 1978. Whalers from St. Lawrence Island<sup>8</sup> reported that no bowheads were seen around the island between early May and the first part of November 1978. Donald Harry<sup>9</sup>, in cooperation with local Eskimos hunting for marine mammals, maintained a shore count for NMFS from May to December 1978. His records noted the absence of bowheads from June to September, though 11 bowheads were seen between 26 September and 21 December 1978 (Braham et al. 1980). The mayor of Little Diomedé, Alaska<sup>10</sup>, reported that bowheads had been sighted around the island only in spring and autumn during his lifetime. All Eskimos interviewed stated that bowheads did not occur in the northern Bering Sea during the summer months, except for an occasional animal (Braham et al., footnote 3).

<sup>6</sup>K. J. Frost, Alaska Dep. Fish Game, 1300 College Rd., Fairbanks, AK 99701, pers. commun. October 1978.

<sup>7</sup>J. Wongitillin, Mayor, Savoonga, AK 99759, pers. commun. to Steven Leatherwood, June 1978.

<sup>8</sup>V. Slwooko, and C. Oozeva, Gambell, AK 99742, pers. commun. to Howard Braham, Summer 1978.

<sup>9</sup>D. Harry, Gambell, AK 99742, pers. commun. to Howard Braham, December 1978.

<sup>10</sup>P. Omiak, Mayor, Little Diomedé, AK 99790, pers. commun. to Stephen Leatherwood, 1 July 1978

Although considerable survey effort was expended in the southern portion of the historical range of the bowhead whale, no bowheads were found. The cumulative 1978 sighting data from aerial surveys, four research cruises, and interviews with local Eskimos, indicated that this species was not present in the ice-free waters of the southern Chukchi or Bering Seas during the summer of 1978. It appears, then, that bowheads are not present in substantial numbers during the summer months in the areas south of the ice front and may not occupy as great a range as they did prior to commercial exploitation.

Results from the spring and summer bowhead whale research effort suggest that the bowhead population spends the summer months in the Beaufort Sea prior to migrating into the Chukchi and Bering Seas in late autumn and early winter months. Observations of bowhead whales along the northeast coast of the Chukotskiy Peninsula in September 1974 and 1975 suggest that the migration pattern into the Chukchi Sea from the Beaufort Sea may be by way of Herald Island.<sup>11</sup> This seems to corroborate Townsend's (1935) data.

Although we feel confident that our survey coverage was as thorough as could be achieved under the limitations of time, personnel, funding, and clearance into Soviet waters, some bowheads may have escaped our detection, moving into Soviet waters between April and June. However, landfast ice is generally extensive and pack ice heavy along the northern Siberian coast of the Chukotskiy Peninsula northwest of the Bering Strait during spring, as wind is generally from the northeast. It seems unlikely that any persistent leads develop along the Soviet northern coast, and thus few bowheads would be present. This is substantiated by the fact that there are at present no whaling villages along this portion of the Soviet coast, yet in the past there were several along the southern and eastern coasts of the

<sup>11</sup>A. A. Berzin, Pacific Scientific Research Institute of Fisheries and Oceanography [TINRO], Tupik Shevchenko, 4, Vladivostok, 690600, U.S.S.R., pers. commun. 16 January 1977.



Chukotskiy Peninsula (footnote 11).

The objectives of the *Western Viking* survey were essentially met. Since no bowheads were sighted, it does not appear that a major correction factor is needed for the spring 1978 population estimate.

### Acknowledgments

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(*Northwind*), and Lloyd Lowry (*Surveyor*) from the Alaska Department of Fish and Game, Fairbanks, and Francis Fay (*Surveyor*) of the University of Alaska, Fairbanks, also provided valuable information. Donald Ljungblad (Naval Ocean Systems Center, San Diego, Calif.) skillfully conducted the acoustics research during the *Western Viking* cruise. We are grateful also to Susan Farnham, Victoria Moran, George Nichols, Arthur Seavey, and Gale Ward (ORES), and to the captain and crew of the *Western Viking* for their assistance in maintaining marine mammal watches. Data were also supplied by scientists and crew members of the *Surveyor*. Special appreciation is extended to Conrad Oozeva and Vernon Slwooko (Gambell), Jerry

Wongittilin (Savoonga), and Patrick Omiak (Little Diomedé).

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## Summer Distribution of Bowhead Whales in the Eastern Beaufort Sea

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### Introduction

Nearly all bowhead whales, *Balaena mysticetus*, of the western Arctic stock migrate each spring from wintering grounds in the Bering Sea to summering grounds in the eastern Beaufort Sea and Amundsen Gulf where they stay for up to 4 months (Fraker et al., 1978; Fraker, 1979). The whales begin their spring journey soon after ice conditions permit (late April) and they remain on the summering grounds nearly until freeze-up. Although the summering area must be of major significance in the ecology of these animals, little is

known about its geographical extent or the reason for its importance.

Our purpose is to describe the geographical area used by the bowheads during the July-September period (based on the locations of sightings and kills made by commercial whalers near the turn of the century and on recent observations) and to suggest an explanation of the significance of this area to these animals.

### Methods

#### Whaling Ship Observations (1891-1906)

Because there are few recent sightings of bowheads from the eastern Beaufort Sea and Amundsen Gulf, the best information about bowhead distribution comes from logbooks kept by

commercial whalers who operated extensively in this region from 1890 to about 1910 (Bockstoce, 1977). The locations and dates of sightings and captures have been extracted from original logbooks (held by the Whaling Museum, Old Dartmouth Historical Society, New Bedford, Mass.; the Providence [Rhode Island] Public Library; and Harvard University) of vessels operating in the eastern Beaufort Sea from 1891 to 1906 (Table 1). The only logbooks selected were those of cruises which took place entirely in the eastern Beaufort Sea region, and thus were preceded and followed by overwintering in the Arctic. We selected these records to

Table 1.—Vessel, logbook keeper, year, and wintering location prior to cruise of the eastern Beaufort Sea whaling grounds.

Vessel	Logbook keeper	Year	Wintering location
<i>Mary D. Hume</i>	H. H. Bodfish	1891	Herschel Island
<i>Mary D. Hume</i>	H. H. Bodfish	1892	Herschel Island
<i>Newport</i>	H. H. Bodfish	1894	Herschel Island
<i>Newport</i>	H. H. Bodfish	1895	Herschel Island
<i>Mary D. Hume</i>	G. B. Leavitt	1896	Herschel Island
<i>Beluga</i>	H. H. Bodfish	1898	Langton Bay
<i>Beluga</i>	H. H. Bodfish	1899	Baillie Islands
<i>Narwhal</i>	G. B. Leavitt	1903	Herschel Island
<i>Kariuk</i>	Unknown	1905	Herschel Island
<i>Alexander</i>	J. A. Tilton	1906	Herschel Island

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