



Acoustic and visual surveys for bowhead whales in the western Beaufort and far northeastern Chukchi seas

Sue E. Moore^{a,*}, Kathleen M. Stafford^b, Lisa M. Munger^c

^a NOAA/Fisheries S&T, Seattle, WA 98115, USA

^b APL-University of Washington, Seattle, WA 98105, USA

^c Scripps Institution of Oceanography, UCSD, San Diego, CA 92037, USA

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ABSTRACT

Two types of passive-acoustic survey were conducted to investigate the seasonal occurrence of bowhead whales (*Balaena mysticetus*) in the western Beaufort and far northeastern Chukchi seas: (1) an over-winter (2003–04) survey using autonomous recorders deployed northeast of Barrow, Alaska, and (2) a summertime dipping-hydrophone survey along the 2005 NOAA Ocean Exploration (OE) cruise track northwest of Barrow. The longest continuous sampling period from the over-winter survey was 3 October 2003 to 12 May 2004. During that period, bowhead whale calls were recorded from 3 to 23 October, intermittently on 6–7 and 22–23 November, then not again until 25 March 2004. Bowhead calls were recorded almost every hour from 19 April to 12 May 2004, with a call rate peak on 30 April (ca. 9400 calls) and a few instances of patterned calling (or, “song”) detected in early May. Bowhead whale calls were never detected during the NOAA OE cruise, but calls of beluga whales (*Delphinapterus leucas*) were recorded at 3 of 16 acoustic stations. Opportunistic visual surveys for marine mammals were also conducted during the NOAA OE cruise from the ship (65 h) and helicopter (7.8 h), resulting in single sightings of bowhead whales (3–5 whales), beluga (16–20 whales), walrus (1), polar bear (2 = sow/cub), and 17 sightings of 87 ringed seals from the ship and 15 sightings of 67 ringed seals from the helicopter.

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1. Introduction

The Bering-Chukchi-Beaufort (BCB) population of bowhead whales migrates annually between wintering areas in the northern Bering Sea and summering areas in Canadian Beaufort Sea. Although there have been occasional opportunistic summertime sightings of bowhead whales near Barrow, Alaska, since the late 1970s (Moore, 1992), the bulk of the herd is thought to feed in Canadian waters from July through early September (Moore and Reeves, 1993; Rugh et al., 2003). Still, Alaskan Native hunters routinely report seeing bowheads near Barrow in July and August, ca. 5–15 whales were noted during opportunistic aerial surveys flown northeast and southwest of Barrow in July 1999 and July 2003, respectively (Moore unpublished data), and 30 bowheads were seen in the Chukchi Sea roughly 150 km southwest of Wainwright Alaska in early August 2007 (Sekiguchi, 2007). These summertime sightings could be the result of an expanding BCB bowhead population (George et al., 2004), climate-induced changes in habitat that influence whale distribution (e.g., Moore

and Laidre, 2006), more effort directed toward documenting local knowledge of bowhead whales (e.g., Noongwook, 2007), increased summertime survey effort, or all of the above. No matter the cause, the persistent reports of bowhead whales summering outside the Canadian Beaufort Sea are of keen interest to members of the International Whaling Commission-Scientific Committee (IWC-SC), the Alaska Eskimo Whaling Commission (AEWC), and the National Oceanic and Atmospheric Administration (NOAA), organizations responsible for their conservation and management.

Acoustic detection of whale calls has become a routine and comparatively cost-effective survey method for cetaceans, especially in remote habitats offshore Alaska (Moore et al., 2006). Thus, opportunities were sought to include passive-acoustic surveys on two on-going science programs in the western Arctic: (1) the National Science Foundation Western Arctic Shelf-Basin Interactions (NSF-SBI) project (Grebmeier and Harvey, 2005), and (2) the NOAA Ocean Exploration (OE) cruise. Sampling along the track of the NOAA OE cruise was of particular interest because it included waters near the Northwind Ridge and Chukchi Plateau (hereafter, Chukchi Borderland), an area suggested by Russian scientists as possible summering habitat for bowhead whales (Bogoslovskaya, 2003; Melnikov et al., 1998). Extant literature indicates the Chukchi Borderland may contain adequate prey to

* Corresponding author.

E-mail addresses: moore@apl.washington.edu, Sue.Moore@noaa.gov (S.E. Moore).

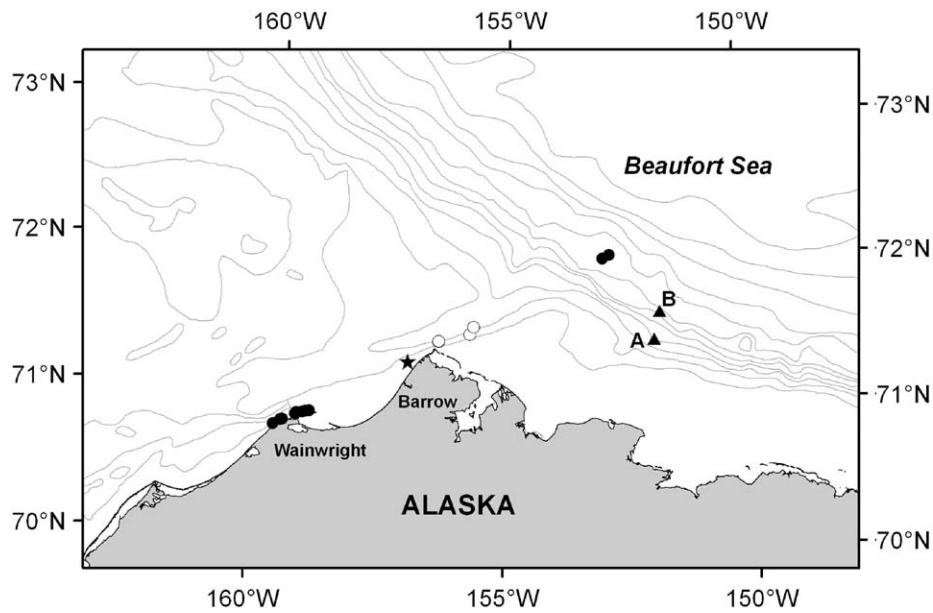


Fig. 1. Locations of two recorders (▲) deployed in early October 2003 in the Beaufort Sea. Recorder A was deployed at 71°28.3 N latitude, 151°56 W longitude in water 316 m deep, and recorder B was deployed at 71°39.3 N latitude, 151°48 W longitude in water 1258 m deep. Also shown are locations of bowhead whale sightings from opportunistic aerial surveys in July 1999 (light circles), July 2003 (dark circles) and at the outset of the NOAA OE survey (star) in late June 2005 (Moore unpublished). Please check the quality of Figs. 1 and 2.

support foraging bowhead whales, including large copepods (Ashjian et al., 2003; Hopcroft et al., 2005) and euphausiids advected to the Chukchi Sea from the northern Bering Sea (Maslowski et al., 2000; Shimada et al., 2004; Berline et al., 2008). Both copepods and euphausiids are commonly found in the stomachs of bowhead whales harvested at Barrow in autumn (Lowry et al., 2004).

The primary goal of both the NSF-SBI and NOAA OE acoustic surveys was the detection of bowhead whale calls. The SBI survey explored the possibility that bowhead whales remained in the western Beaufort Sea during winter, while the NOAA OE survey specifically addressed the question of bowhead whale summertime occurrence near the Chukchi Borderland. During the NOAA OE cruise, a first-ever visual survey for marine mammals to and near the Chukchi Borderland complemented the acoustic sampling, and a synopsis of all species seen along the cruise track is provided.

2. Materials and methods

2.1. Over-winter acoustic survey northeast of Barrow, Alaska

Three autonomous Acoustic Recording Packages (ARPs; hereafter, recorders) were deployed in the western Beaufort Sea in early October 2003 to provide continuous year-round sampling for cetacean calls within the 10–500 Hz frequency band (Wiggins, 2003). The recorders were placed near a SBI mooring array deployed for high-resolution sampling of physical oceanographic parameters along the Beaufort Sea slope, and in the vicinity of bowhead whale sightings in July 1999 and 2003 (Fig. 1). Although the transmission range of bowhead calls varies with the loudness of the call and ambient noise conditions, whales calling within ca. 20–30 km of the recorders would likely be detected. Unfortunately, recorder malfunction resulted in only two of the three instruments being recovered and both sampled only part of the year. Upon recovery, the internal hard drives from recorder 'A' and recorder 'B' were removed and the data downloaded for processing. Recorder A stored data only from 4 October 2003 to 29

December 2003, whereas recorder B stored data from 3 October 2003 until 12 May 2004. Due to the focus on seasonal occurrence of bowhead whale calls, only data from recorder 'B' were analysed in detail. The available data files were split into 2-hour segments to facilitate processing, and 20 s spectrogram equalization was applied to remove long-term noise produced from sources such as sea ice and ships. To ensure accurate classification of signals, data files were then scanned visually for the presence of bowhead whale calls and a daily record of occurrence compiled.

2.2. Acoustic and visual survey along NOAA ocean exploration (OE) cruise track

Acoustic sampling was conducted from the sea ice at stations where other sampling activities were undertaken during the 2005 NOAA OE cruise (Fig. 2). Sampling was conducted from 28 June to 21 July at distances 100–400 m from the ship, by lowering an Offshore Acoustics¹ hydrophone (frequency range 10 Hz–40 kHz) roughly 10–12 m below the ice surface and recording the signals on a Sony TCD-D7¹ Digital Audio Tape (DAT) recorder.

Visual surveys for all marine mammals were conducted from the ship's bridge (ca. 20 m eye height) and the bridge tower (a.k.a. aloftcon; ca. 30 m eye height) aided by handheld binoculars. Observations were made over 360° when the ship was on station (usually ca. 1-h morning and afternoon watches) and over 180° looking forward during transit between stations (usually 1–2 h per watch), for a total of 65 h of shipboard visual survey. This effort was opportunistically augmented by sightings made by the ship's crew, especially bridge personnel trained in marine mammal identification and familiar with NOAA Platform of Opportunity Program (POP) forms. In addition, eight opportunistic aerial surveys (total = 7.8 h) were conducted using the ship's helicopter when weather and other ship operations permitted. Surveys were flown at 1500 m altitude on ~30 km radial transects to and from the ship with a single observer searching for marine mammals.

¹ Use of Trade Names does not constitute endorsement.

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