

Sounds Recorded in the Presence of an Adult and Calf Bowhead Whale

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Introduction

There is little information available on sounds produced by bowhead whales, *Balaena mysticetus*. Aldrich (1889) described their sounds (heard through the hull of his boat and therefore somewhat modified) as resembling "the hoo-oo-oo of the hoot-owl, although longer drawn out, and more of a humming sound than a hoot. Beginning on F, the tone may rise to G, A, B, and sometimes to C, before slanting back to F again."

Attempts have been made to record bowhead whale vocalizations, but when analyzed, most of the sounds recorded proved to be those of the bearded seal, *Erignathus barbatus*¹.

On 23 May 1978 near Point Barrow, Alaska, vocalizations attributed to an adult bowhead whale and/or an accompanying calf were recorded. This paper describes the circumstances surrounding the recording of these sounds and summarizes basic characteristics of the sounds.

Methods

Personnel of the National Marine Mammal Laboratory (NMML), National Marine Fisheries Service (NMFS), NOAA, Seattle, Wash., maintained spring ice camp census stations (North Camp and South Camp) along the nearshore lead off Point Barrow, Alaska, to count migrating bowhead whales. This census was conducted during the annual spring migration of the western Arctic population of bowhead whales from their wintering grounds in the Bering Sea to their summering grounds in the Beaufort Sea (Braham et al., 1979).

¹W. A. Watkins, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, pers. commun. December 1978.

From 21 through 24 May 1978, we recorded underwater sounds at North Camp, approximate position lat. 71°28'N, long. 156°34'W. Sounds in the lead were monitored by a U.S. Navy (hydrophone) sonobuoy (AN/SSQ-41/A) modified to increase its frequency response to 40 kHz. The hydrophone was at a depth of 7 m. The signal was monitored by a 100 kHz bandwidth VHF receiver, Defense Electronics Instrumentation². The tape recorder (Nagra SJ) had a 40 kHz bandwidth.

Results

On the morning of 23 May 1978 the nearshore lead, which had been open to widths of up to nearly 7 km during the preceding 6 weeks, closed from just northeast of the camp to a distance of at least 10 km north. Although no whales were seen all morning, at 1250 hours sounds were audible, increasing in intensity for 10 minutes. At 1300 hours two bowhead whales were sighted, one estimated to be 13-15 m long and the other 4.5-6 m long. The whales surfaced in open water northwest of the camp at an estimated distance of 500 m. They approached to within 300 m of the hydrophone. Their relative sizes and closely coordinated movements led us to conclude that the two whales were an adult and calf.

During the 1-hour recording period (1250-1350 hours), 75 vocalizations were recorded. Of these, 33 were of sufficient intensity relative to background noise to be analyzed. Sounds were examined on a Spectral Dynamics real-time analyzer Model 301A, which provided a continuous cathode ray tube and paper display of frequency and relative amplitude level

²References to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

as a function of time. Frequency content and signal duration were determined from these displays.

The sounds were of two basic types, designated A and B. Type A sounds (Fig. 1, Table 1) were 0.30-0.85 seconds in duration (average 0.58 seconds) and characterized by higher frequencies, particularly near their termination. These sounds occurred 18 times and ranged in frequency from 50 to 580 Hz, with the average lower frequency limit of 135 Hz and average higher frequency limit of 337 Hz. Typically, the analysis showed no well-defined harmonics.

In comparison, the 15 Type B sounds (Fig. 1, Table 2) were usually longer in duration, 0.65-2.56 seconds, with an average of 1.65 seconds, and characterized by a relatively constant frequency. Their fundamentals ranged from 100 to 195 Hz, with an average lower frequency limit of 140 Hz and an average higher frequency limit of 164 Hz. These sounds often had energy up to the seventh harmonic, and could be classified by their harmonic structures (Watkins, 1967).

Discussion

Several factors support our conclusion that these sounds were produced by bowhead whales. Most convincing was the change in relative intensity level as the whales were seen to move by our recording station. The sound level increased as the whales approached our hydrophone position and decreased as they moved away. It was not possible, however, to determine whether one type of sound was made by the adult whale and the other by the calf. The distinctive sounds of bearded seals (Ray et al., 1969) and ringed seals, *Phoca hispida*, (Stirling, 1973) recorded earlier in the week, were conspicuously absent on this day. This enabled us to obtain recordings of a quality suitable for analysis.

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Table 1.—List of Type A sounds produced by bowhead whale adult and calf; sounds are arranged in order of signal duration.

Duration of fundamental (sec)	Lowest frequency (Hz)	Highest frequency (Hz)	Fundamental	Harmonics						
				2	3	4	5	6	7	
0.30	60	220	X							
0.35	220	240	X							
0.4	150	170	X							
0.45	150	320	X							
0.45	120	380	X							
0.5	120	395	X							
0.5	160	300	X							
0.55	145	390	X							
0.55	150	410	X							
0.6	50	100	X							
0.6	140	350	X							
0.65	120	180	X							
0.7	155	195	X	X						
0.7	125	580	X							
0.75	130	360	X							
0.8	135	540	X							
0.8	150	580	X							
0.85	165	350	X							
Range	0.30-0.85 seconds		50-220 Hz	100-580 Hz						
Average	0.58 seconds		135 Hz	337 Hz						

Table 2.—List of Type B sounds produced by bowhead whale adult and calf; sounds are arranged in order of signal duration.

Duration of fundamental (sec)	Lowest frequency (Hz)	Highest frequency (Hz)	Fundamental	Harmonics						
				2	3	4	5	6	7	
0.65	140	150	X							
1.2	120	160	X	X	X					
1.35	160	190	X	X	X	X	X	X		
1.45	100	120	X	X						
1.5	150	160	X	X	X					
1.55	140	150	X		X	X				
1.65	100	130	X							
1.65	120	150	X	X	X	X	X	X	X	
1.7	180	195	X	X	X	X				
1.75	150	180	X	X						
1.75	120	170	X	X	X	X	X	X	X	
1.85	125	150	X	X	X	X	X	X	X	X
2.0	140	180	X	X	X	X	X			
2.1	180	190	X	X	X	X	X	X		
2.56	175	180	X	X						
Range	0.65-2.56 seconds		100-180 Hz	120-195 Hz						
Average	1.65 seconds		140 Hz	164 Hz						

Some similarities exist between the sounds we recorded and those of southern right whales, *Eubalaena glacialis* (Cummings et al., 1972). To study the similarities further, more data will be required.

During spring 1979, recordings were made by Naval Ocean Systems Center (NOSC) and NMFS personnel of sounds attributed to bowhead whales. Analysis of these recordings, now being undertaken at NOSC, San Diego, Calif., and Woods Hole Oceanographic Institution, Woods Hole, Mass., should provide more detailed information about sounds produced by this species.

Acknowledgments

The authors wish to thank R. G. Dronenberg, D. Fitzpatrick, and R. Nageak of the Naval Arctic Research Laboratory, Barrow, Alaska, and R. McLain, NMFS, for their field support. K. C. Balcomb, Moclips Cetological Society, assisted with the interpreting of results. Special thanks go to W. A. Watkins, Woods Hole Oceanographic Institution, and F. G. Wood, NOSC, for their helpful comments in reviewing this paper.

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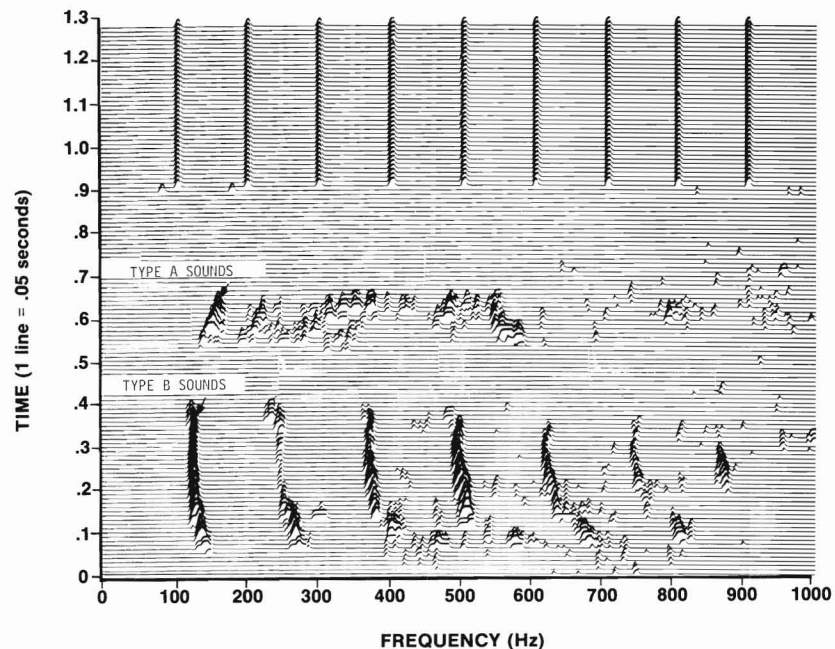


Figure 1.—Sample spectrograph of sounds produced by bowhead whale adult and calf.

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