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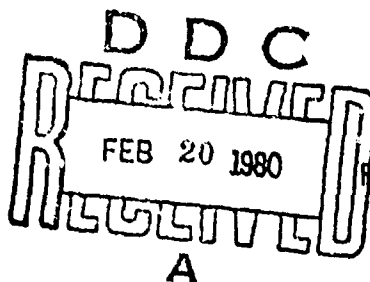
Technical Report 420
REVISION 1

SOUNDS RECORDED IN THE PRESENCE OF ADULT AND CALF BOWHEAD WHALES, *BALAENA MYSTICETUS*

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Low-frequency sounds were recorded in the presence of an adult bowhead whale and accompanying calf on 23 May 1978 near Point Barrow, Alaska. The ice pack was moving toward the shore, with the imminent possibility of total lead closure. Under these conditions, sounds were detected 10 min before the whales were sighted in the lead at an estimated distance of 400 to 500 m from the observers' position. Of the 75 vocalizations recorded, 33 were of sufficient quality to be analyzed. These sounds were of two types, identified throughout this text as type A and type B. Type A sounds were of brief duration; the fundamental frequency ranged from 50 to 580 Hz; and there were few or no harmonics. Type B sounds were longer in duration; the fundamental frequency ranged from		

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100 to 195 Hz; and these sounds remained relatively constant in frequency and were rich in harmonics.

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INTRODUCTION

To date, there has been 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 a hoot-owl, though longer and drawn out, and more of a humming sound than a hoot." He also referred to a slight rise in the pitch and number of calls: "Beginning on F, the tone may rise to G, A and B, and sometimes to C before slanting back to F again."

Over the years, attempts have been made to record sounds of the bowhead whale. Unfortunately, when analyzed most of the available recordings proved to be those of the bearded seal, *Erignathus barbatus*.*

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

The Northwest and Alaska Fisheries Center, Seattle, Washington, maintained spring ice-camp census stations along the near-shore lead off Pt. Barrow, Alaska, to count migrating whales (Krogman, 1979). This census was conducted during the annual spring migration of the Western Arctic bowhead whales from their wintering grounds in the Bering Sea to their summering grounds in the eastern Beaufort Sea and Amundsen Gulf (Braham et al., 1978).

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

RESULTS

On the morning of the 23 May, the near-shore lead, which had been open to widths of up to 6.6 km for 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 about 1250 hours sounds began to be audible, increasing in intensity for the next 10 min. At 1300, two bowhead whales were sighted; one estimated to be 13 to 15 m long and the other 4.5 to 6 m long. The whales surfaced in the open water northwest of the camp at an estimated distance of about 500 m. They approached the ice edge, then circled the area for 50 min, at one point approaching to within 300 m of the hydrophone. The relative sizes and closely coordinated movements of the two whales led the observers to conclude they were a female and her calf.

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* William A. Watkins, 1978, personal communication to D. K. Ljungblad.

During the 1-hr recording (1250 to 1350), 75 vocalizations were recorded. Of these, 33 were of sufficient intensity, relative to background noise, to be well analyzed. A Spectral Dynamics Model 301A real-time analyzer provided a continuous cathode ray tube and paper display of frequency and relative level as a function of time. Frequency content and signal duration were determined from these displays.

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

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

Table 1. List of type A sounds produced by adult and calf bowhead whales. Sounds are arranged in order of signal duration.

	Duration of Fundamental, s	Lowest Frequency, Hz	Highest Frequency, Hz	Funda- mental	Harmonics					
					2	3	4	5	6	7
	0.30	60	220	X						
	0.35	220	240	X						
	0.40	150	170	X						
	0.45	150	320	X						
	0.45	120	380	X						
	0.50	120	395	X						
	0.50	160	300	X						
	0.55	145	390	X						
	0.55	150	410	X						
	0.60	50	100	X						
	0.60	240	350	X						
	0.65	120	180	X						
	0.70	155	195	X	X					
	0.70	125	580	X						
	0.75	130	360	X						
	0.80	135	540	X						
	0.80	150	580	X						
	0.85	165	350	X						
Range	0.30-0.85 s	50-220 Hz	100-580 Hz							
Mean	0.58 s	135 Hz	337 Hz							

Table 2. List of type B sounds produced by adult and calf bowhead whales. Sounds are arranged in order of signal duration.

Duration of Fundamental, s	Lowest Frequency, Hz	Highest Frequency, Hz	Fundamental	Harmonics						
				2	3	4	5	6	7	
0.65	140	150	X							
1.20	120	160	X	X	X					
1.35	160	190	X	X	X	X	X	X		
1.45	100	120	X	X						
1.50	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		
1.70	180	195	X	X	X					
1.75	150	180	X	X						
1.75	120	170	X	X	X	X	X	X		
1.85	125	150	X	X	X	X	X	X	X	
2.00	140	180	X	X	X	X				
2.10	180	190	X	X	X	X	X			
2.56	175	180	X	X						

Range 0.65-2.56 s 100-180 Hz 120-195 Hz
Mean 1.65 s 140 Hz 164 Hz

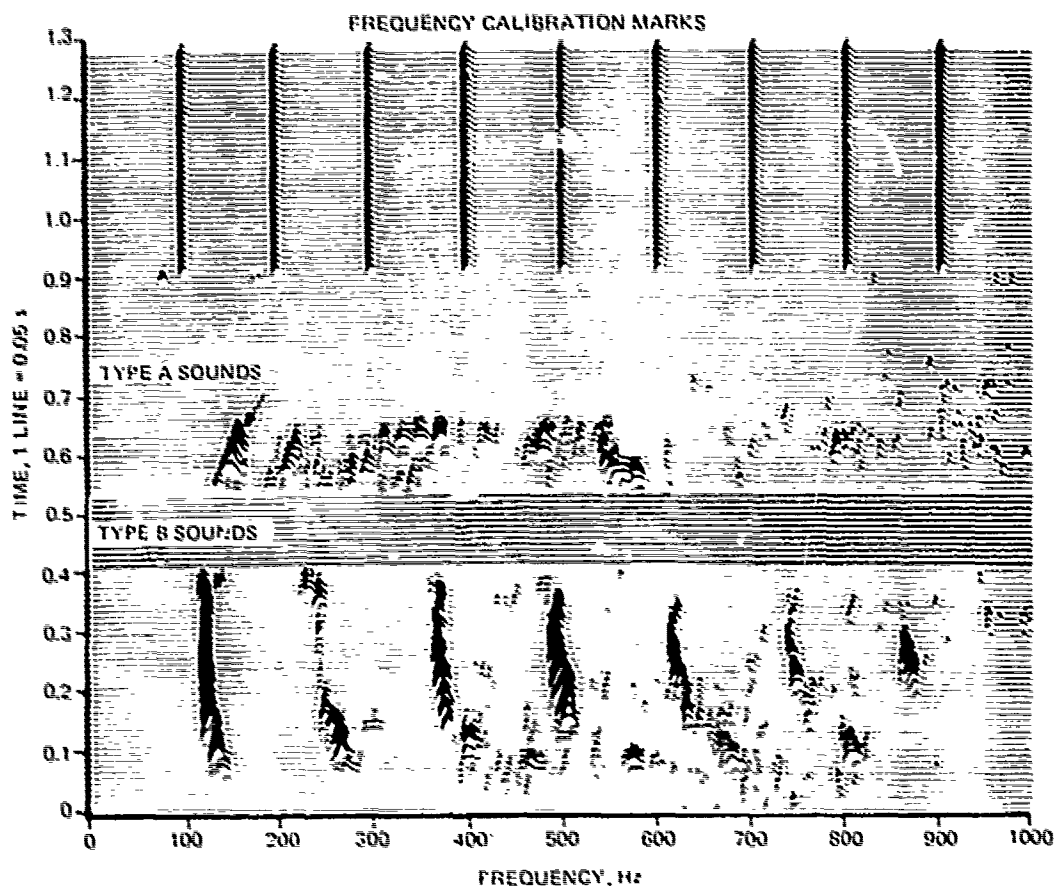


Figure 1. Sample spectrograph.

DISCUSSION

Several factors contribute to the argument that these sounds were produced by bowhead whales. The most convincing factor was the change in relative intensity level as the whales passed. The sound level increased as they approached the hydrophone position and decreased as they moved away. It was not possible, however, to determine whether one kind of sound was made by the adult whale and the other by the calf. The distinctive sounds of bearded seals, *Erignathus barbatus* (Ray, Watkins, and Burns, 1969), and ringed seals, *Phoca hispida* (Stirling, 1973), recorded earlier in the week, were conspicuously absent on this day. This enabled the observers to obtain recordings of a quality suitable for analysis.

There appear to be some similarities between the recorded sounds and those of the southern right whale (Cummings et al., 1972). To study the similarities further, more data will be required for an objective comparison.

During the spring of 1979 additional recordings were made of sounds attributed to bowhead whales. Analysis of the recordings, now being undertaken at the Naval Ocean Systems Center, should provide much more detailed information on these sounds.

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