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Ultrasonic analysis of pygmy sperm whale (*Kogia breviceps*) and Hubbs' beaked whale (*Mesoplodon carlhubbsi*) clicks

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Abstract

A male pygmy sperm whale (*Kogia breviceps*) stranded in Monterey Bay and two juvenile beaked whales (*Mesoplodon carlhubbsi*) stranded at Ocean Beach in San Francisco within a week of each other in August 1989. The animals were rescued and put in holding tanks in two different locations. Their vocalizations were recorded and analysed with ultrasonic equipment. The *Kogia* always emitted ultrasonic clicks (most of them inaudible) peaking at 125 kHz. The *Mesoplodon* gave sonic clicks centred at 1.77 kHz and bursts of 3 to 8 pulses ranging between 7 and 78 kHz.

Key words: pygmy sperm whale, *Kogia breviceps*, Hubbs' beaked whale, *Mesoplodon carlhubbsi*, clicks.

Introduction

Thomas *et al*. (1990), Caldwell & Caldwell (1987), and Caldwell *et al*. (1966) reported acoustic information from sound recordings of *Kogia breviceps*, and Lynn & Reiss (1992) reported on *Mesoplodon carlhubbsi*. Their acoustic data were limited to the sonic range, with the exception of 41 pulsed sequences recorded by Lynn & Reiss, which went to 40 kHz. The purpose of this note is to provide information for these species in the ultrasonic range, to 160 kHz for *Kogia* and to 80 kHz for *Mesoplodon*.

Materials and Methods

With ultrasonic research, the orientation of the subject animal(s) with respect to the hydrophone is important, because directionality increases with frequency. The nature of the odontocete echolocation beam is for the power spectrum to show greater representation of high frequencies the more centrally in the beam the hydrophone is located (Au, 1993). In this study, the orientation with respect to the hydrophone of the single *Kogia* and of the two *Mesoplodon* was narrated into a separate channel, and for some of the *Kogia* work a synchronized videotape was available. For analysis, sequences were chosen which had the single individual (*Kogia*) or both individuals (*Mesoplodon*) facing the hydrophone. With the single *Kogia*, this standard was achieved with a fair degree of success, but with the two *Mesoplodon*, not knowing which individual was vocalizing, it was less exact.

A pygmy sperm whale (*Kogia breviceps*) stranded on the beach at Pajaro Dunes in Monterey Bay on the coast of California on 31 August, 1989 and was brought to Long Marine Laboratory. It was kept in a 7.6-m dia cylindrical tank. It was a male, 179 cm long, and weighed 79 kg on arrival, dropping to 73 kg within the first five days in captivity. Sound recordings were made with two hydrophones, a B & K 8103 (linear up to 150 kHz) and a QMC Instruments Ltd. $\frac{1}{2}$-inch dia.spherical hydrophone (− 3 dB at 180 kHz) onto a Racal Store 4DS instrumentation recorder. Two tapes were recorded at 30 ips (recorder flat to 150 kHz) and six at 60 ips (recorder flat to 300 kHz), one in front of an acoustic baffle to diminish echoes. Sonograms with a 160 kHz bandwidth were made by playing the tape at $\frac{1}{4}$ speed into a Multigon Industries Uniscan II real-time 40 kHz bandwidth spectrum analyser (Figure 1). Above-water video recordings with sonic-range hydrophone (Magnavox navy sonobuoy, 0–30 kHz) also were made of this individual.

On 24 August 1989, two beaked whales stranded alive at Ocean Beach, California. Each animal was just under 3 m long and similar in appearance. These are the same two males reported on by Lynn and Reiss, one verified by skull characteristics to be *Mesoplodon carlhubbsi*, and the other presumed to be the same species. The animals were given

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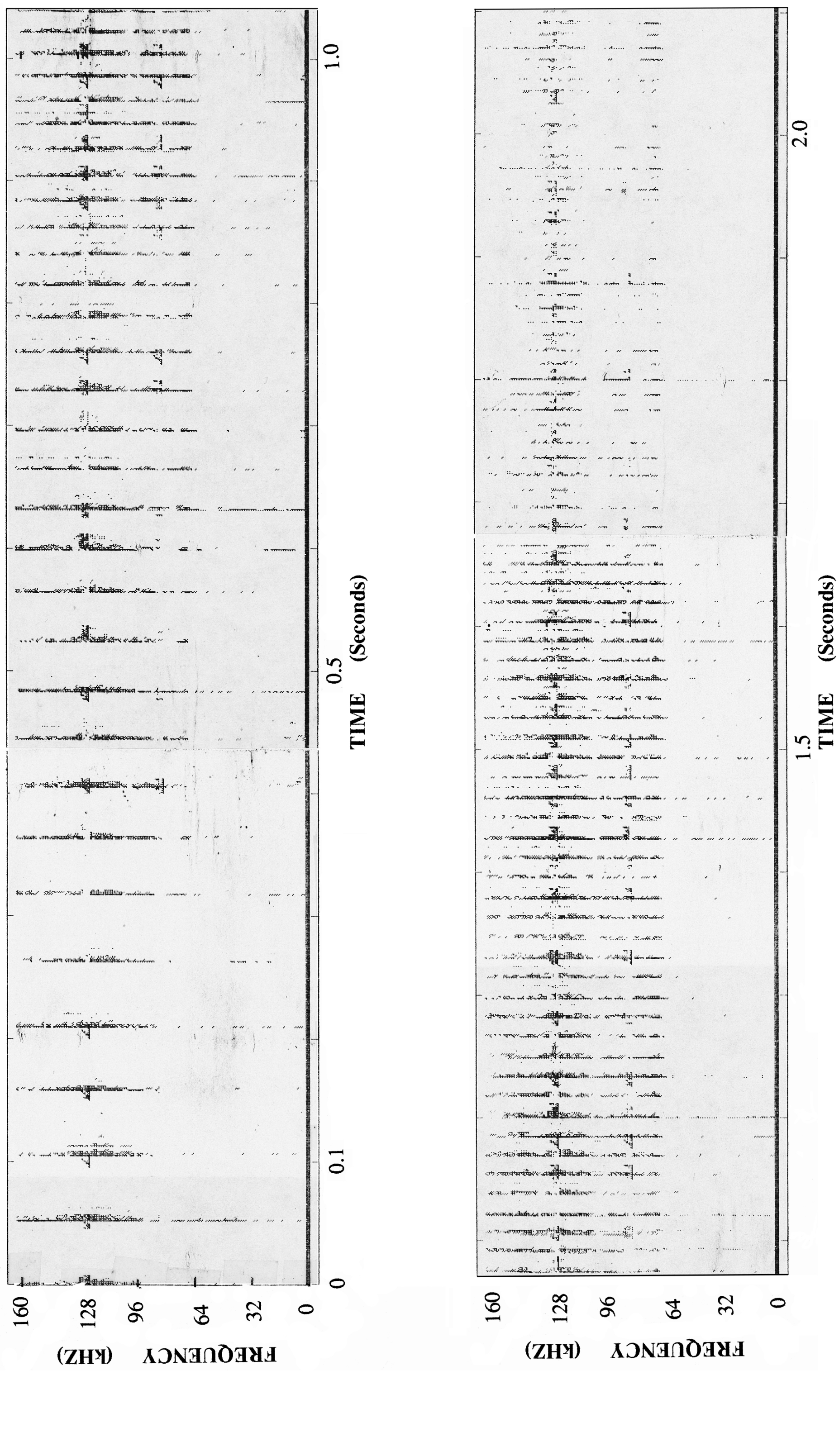

Figure 1. Sample 160 kHz bandwidth sonogram of a *Kogia breviceps* click train. Most click trains from this *Kogia breviceps* were inaudible to the human ear when listening through sonic range equipment.

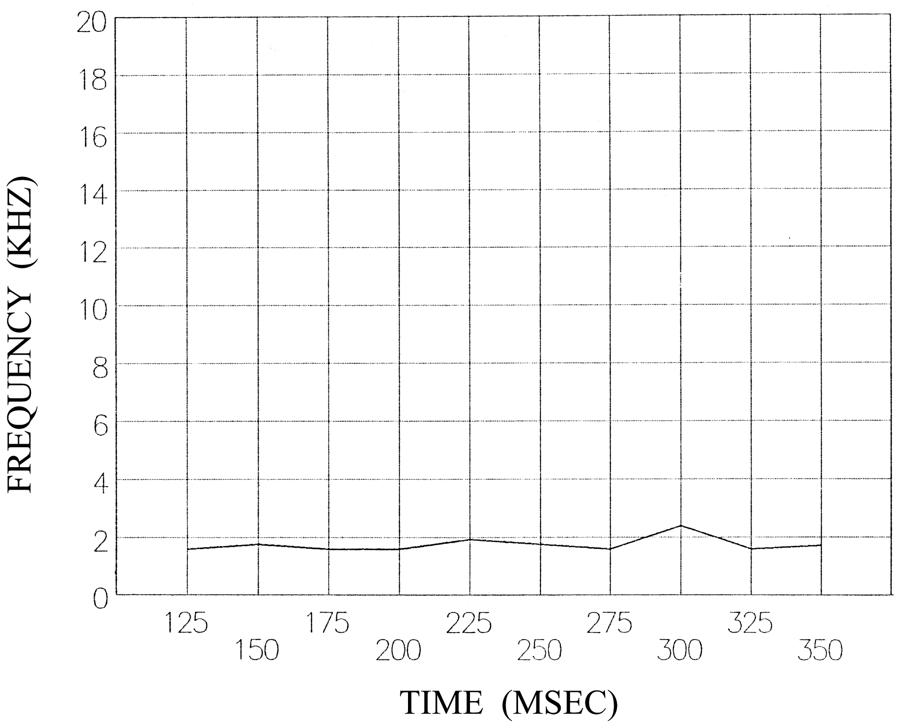

Figure 2. Peak frequency through time of a sample of low-freqency *Mesoplodon carlhubbsi* clicks.

emergency care and transported to Marine World Africa U.S.A. in Vellejo, California. From body size and some nursing behaviour, Lynn and Reiss suspected these individuals to be young, possibly neonates.

We recorded sounds from the beaked whales in their 9.8 m enclosure, using a Racal instrument recorded (at 15 ips) with a B & K 8103 hydrophone and 2635 charge amplifier. The recorder speed of 15 ips limited the flat frequency range of the recording system for this species to 100 Hz to 75 kHz. We sub sampled one hour from a total of four, and counted more than 3500 clicks or pulses which lasted between 3 and 7 msec.

Results

In all tapes, the *Kogia* made only click trains, and no other sounds. Most of the clicks are inaudible, with energy from approximately 60 kHz to over 200 kHz, peaking at 125 kHz (Figure 1). The click trains given by this individual were much higher in frequency than those reported by Caldwell and Caldwell & Caldwell *et al.* (peak frequencies below 13 kHz), and although Thomas *et al.* reported no echolocation click trains of the type picked up by Caldwell and Caldwell, their subject might have been echolocating in the ultrasonic range like this one. Click duration varies, averaging 600 μsec. Click repetition rate (Figure 1), which is typical of many, started at 20 Hz and rose, much like a 'closure click train' in delphinids, such as killer whales (*Orcinus orca*) and bottlenose dolphins (*Tursiops truncatus*) when they close in on a target (Marten *et al.*, 1988). Most of the click trains had this rising repetition rate through time. Thomas *et al.* reported a short duration (0.42 sec) ascending sweep 'cry', but of greater frequency (1.36–1.48 kHz) than the click repetition rates observed here. The major energy in the beaked whale clicks was consistently centred near 1.77 kHz (Figure 2). Clicks occurred also in bursts or packets composed of between 3 and 8 pulses (mean=5.63, SD=1.62). Bursts lasted between 24 and 307 msec. Figure 3 shows peak frequency through time for a sample burst-pulse sequence. The average interval between clicks in a burst was 18.8 sec and ranged between 4 and 36 msec. Sequences of at least 3 bursts were emitted to form rhythms which lasted between 1 and 12 sec and often were repeated.

Discussion

As with Lynn and Reiss, two types of click trains were identified: low-frequency (Figure 2) and high-frequency (Figure 3). The high-frequency pulse

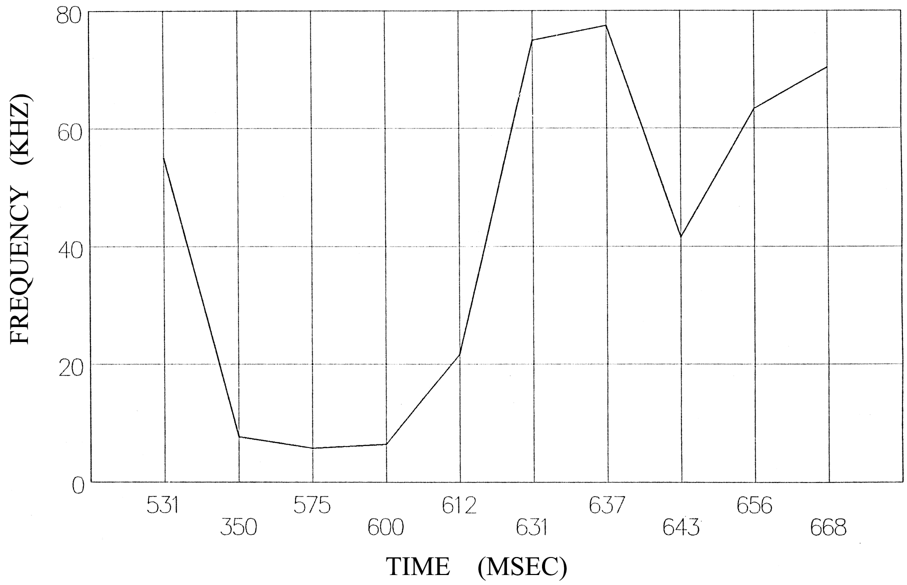

Figure 3. Peak frequency through time of a sample high-frequency *Mesoplodon carlhubbsi* burst-pulse sound.

trains have peak frequencies ranging all the way from 5–10 kHz to 78 kHz, which was at the upper frequency limit determined by the 15 ips recording speed used for this species, suggesting that the peaks probably range higher in frequency. This is a lesson to anyone recording an unknown stranded species to record with the maximum bandwidth possible.

The sounds reported here from *Mesoplodon* are from very young, possibly neonatal animals, and should not necessarily be considered to be present in adults. As respiratory infections are often present in dying cetaceans, such infections, as well as captivity itself, could affect sound production (applies to any stranded marine mammal); different sounds might be made by healthy individuals in the wild.

Acknowledgments

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