

PRELIMINARY RESULTS OF ACOUSTIC SURVEYING FOR BEAKED WHALES IN THE CORAL SEA NEAR AUSTRALIA

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Abstract: A combined visual and acoustic survey for beaked whales was conducted over a three week period in August, September 2008 in the Coral Sea off the east Australia. The survey area is used for naval exercises and the survey was intended as a trial of methods of detection of beaked whales for the purpose of determining their distribution across the area. Two types of acoustic system were used: a towed array with four closely spaced hydrophones and two autonomous drifting recording systems with hydrophones suspended to 400 m depth. Water depths in the area vary from 300 m to more than 3,500 m. Data were sampled at 300 kHz (towed array) and 192 kHz (drifting recorders) and recorded on computer hard disks. Data were analysed using a range of acoustic analysis software, automated using matched filter techniques. Preliminary results have found many detections of acoustic signals with similar wave form, frequency range, frequency sweep, number of cycles and repetition rate as those reported for beaked whales in the northern hemisphere. Thousands of clicks typical of beaked whales have been counted, compared with only six sightings of 12 individual beaked whales. Higher densities of detections were found in areas of steep bathymetric slopes than over the deep plains.

Keywords: beaked whales, beaked whale surveys, beaked whale acoustics, passive acoustic monitoring.

1. INTRODUCTION

Beaked whales are particularly elusive whales. They are small and rarely seen and their distributions are poorly known. The predominance of beaked whales in strandings that have occurred at times of a number of naval exercises in the Northern Hemisphere has led to a need for improved knowledge of their distributions for management of impacts. The effectiveness of visual surveying for beaked whales is, however, too limited to be useful because they are so difficult to detect visually. A few years ago data from DTAG sound recorders placed on two species of beaked whale, *Ziphius cavirostris* (Cuvier's beaked whale) and *Mesoplodon densirostris* (Blainville's beaked whale) showed that their vocalisations are distinctively different in several acoustical characteristics from those of other toothed whales, providing a reliable means of detection and identification [1]. The recordings also showed that these two species vocalised repeatedly when several hundred metres down during deep foraging dives. This paper describes some preliminary results of a survey for beaked whales in an area of the Coral Sea off east Australia used for naval exercises. The survey was intended as a trial of equipment and techniques.

2. METHODS

A three week survey was conducted in August, September 2008 in the Coral Sea off the east coast of Australia. The survey covered a box extending about 171 km E-W and 60 km N-S (Fig. 1), the coordinates of the NW corner of the box being 22°20' S and 154°00' E. Water depths varied from 300 to over 3,500 m and included the continental slope in the western part of the area and coral islands with steep sloping edges to the east. A Royal Australian Navy landing craft, HMAS *Labuan* was provided for the survey which involved both visual and acoustic monitoring. Two types of acoustic passive recording systems were used: a towed array and two drifting recording systems ("acoustic loggers"). The towed array supplied by Ecologic UK Ltd., consisted of two mid frequency channels (500 Hz – 30 kHz) and two high frequency channels (500 Hz – 150 kHz) and depth sensor. The hydrophones were closely spaced at the end of the 400 m cable. Data were recorded on hard disk via a data acquisition card sampling at 300 kHz.

The two drifting systems ("acoustic loggers") were developed by the Centre for Marine Science and Technology at Curtin University for the purpose and comprised a computer controlled recording system in a container suspended below surface buoys and with a hydrophone at a depth of 400 m. A radio beacon transmitted the GPS position of the buoys allowing the survey team on the ship to keep track of their position. The logger systems were deployed for a period of a few days at a time, and then recovered, the data downloaded and the systems redeployed. While the towed array provided continuous monitoring, the much deeper hydrophones of the drifting systems were considered to provide an advantage in the detection of clicks from beaked whales foraging at depth.

Data have been analysed using MATLAB and the following acoustic software packages: Adobe Audition (Adobe Systems), Ishmael [1] and PAMGUARD. Click detections were compared with those presented by Johnson et al. [2] and samples that were verified as typical of beaked whale were used in matched filtering to automate the analysis.

Acoustic detection ranges of beaked whale clicks are limited because of the higher absorption of sound at the high frequencies of the vocalisations, and because of their narrow

beam pattern. Zimmer et al. [3] estimate that the range for 50% probability of detection using a receiver depth of 100 m 1.5 and 3.8 km, and detection beyond 4 km would be very unlikely. These estimates are for low background noise and shorter ranges are to be expected for higher noise levels as conditions (e.g. wind speed) changes. Hence a detection within our survey area would be localised to a small area compared to the size of the survey area, just by the limiting range of detection.

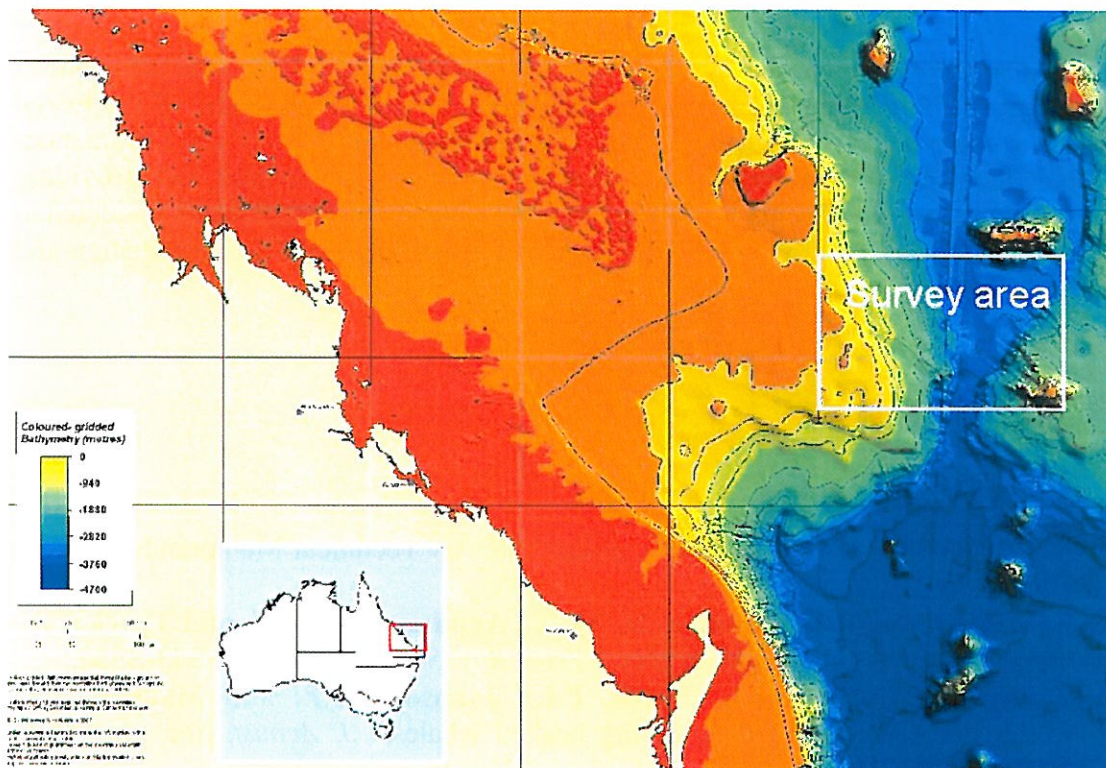


Fig.1: Map showing the location of the survey area and the bathymetry. Water depth varies from 300 m to over 3,500 m. The NW corner of the survey area is $22^{\circ}20' S$, and $154^{\circ}00' E$.

3. RESULTS

The visual survey resulted in 75 sightings of more than 500 individuals of a range of cetacean species including several species of dolphins, pilot whales, sperm whales, humpback whales, and minke whales. There were six sightings of 12 individual beaked whales of unidentified species. The acoustic survey detected sounds typical of a range of species.

A large number of clicks were detected, including some typical of sperm whales and some typical to dolphins. Some clicks were found to be remarkably similar to those reported by Johnson et al. [2] for the two species of beaked whales and were therefore identified as beaked whale sounds. They consisted of tone bursts sweeping up in frequency over the range from about 25 kHz to 50 to 60 kHz with durations of 200 to 300 μs . The envelopes of the tone bursts showed varying shapes, but generally within the range shown in [2]. Inter-click intervals were also similar. Using the automated detection techniques, thousands of clicks typical of beaked whales have been detected. Individual beaked whales are known to produce large numbers of clicks while foraging, so the actual numbers of individual numbers

of beaked whales detected will be much fewer than the number of clicks recorded. The highest density of clicks in the area surveyed has been over the steep slopes of Cato Is., a coral island, the lowest over the deep plains.

4. ACKNOWLEDGEMENTS

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