

ACOUSTIC OBSERVATORIES OF THE AUSTRALIAN MARINE OBSERVING SYSTEM

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Abstract: *Three underwater acoustic observatories will be deployed on Australia's continental shelf in the Indian, Southern and Pacific Oceans in 2009 as part the Integrated Marine Observing System (IMOS) of the National Collaborative Research Infrastructure Strategy program. The observatories are a new national research facility, which will provide long-term passive underwater acoustic observations for studying abundance and migration of marine mammals in Australian waters and for investigating other natural sources of noise in the ocean, such as earthquakes, underwater volcanoes and ice breaking processes in Antarctica. Each observatory consists of four autonomous sea noise loggers deployed on the seafloor to form a triangular array of about 5-km sides with the fourth logger installed in the centre. The observatories can autonomously collect sea noise data over 8 to 12 months at useable frequencies up to 3 kHz, depending on the regime programmed for recording. After each cycle of autonomous recording, the observatories will be recovered for data retrieval and then redeployed for another recording cycle. It is planned to keep almost continuous data collection from the three observatories until at least 2011. Sea noise data from the IMOS acoustic observatories will be available for the scientific community worldwide.*

Keywords: *Underwater acoustic observatories, sea noise logger, marine mammals*

1. INTRODUCTION

A network of three underwater acoustic observatories is planned to be deployed on Australia's continental shelf in the Indian, Southern and Pacific Oceans as part the Integrated Marine Observing System (IMOS) [1] of the National Collaborative Research Infrastructure Strategy (NCRIS) program. One of the IMOS observatories has already been installed in the Perth Canyon area in Western Australia. The other two observatories will be deployed by mid 2009 on the continental shelf in Victoria and New South Wales. The proposed locations of the IMOS acoustic observatories are shown in Fig. 1.

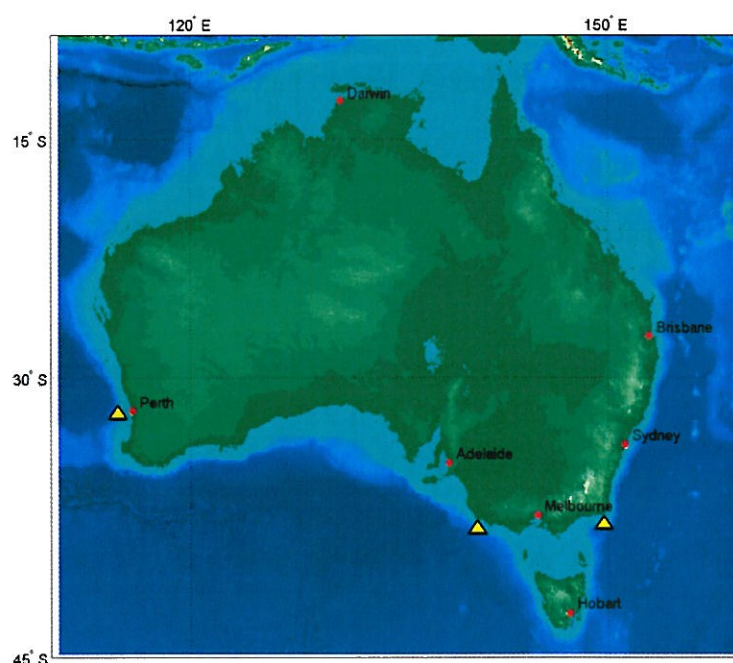


Fig. 1 Planned locations of the three IMOS acoustic observatories in Australia (triangles)

The observatories are a new national research facility, which will provide long-term passive underwater acoustic observations for studying abundance and migration of marine mammals in Australia's waters and for investigating other natural sources of noise in the ocean, such as earthquakes, underwater volcanoes and ice breaking processes in Antarctica. This new means for underwater acoustic measurements will support in particular long-term studies of sea ambient noise and marine mammals that have been conducted by the Centre for Marine Science and Technology (CMST) at Curtin University of Technology in Australia since the early 1990s. The design of the IMOS observatories is based on multi-year experience acquired by CMST in manufacturing and deploying autonomous sea noise loggers and analysing sea noise data. The CMST acoustic loggers have been collecting sea noise data from different areas all around Australia, which is used in particular for studying population and migration of marine mammals, for monitoring fish stocks and assessing their links with local productivity [2, 3]. The new observatories will continue such measurements on a regular basis. Figure 2 demonstrates an example of acoustic observation of pygmy blue whales around the Perth Canyon using sea noise loggers deployed over periods of several months in the recent years.

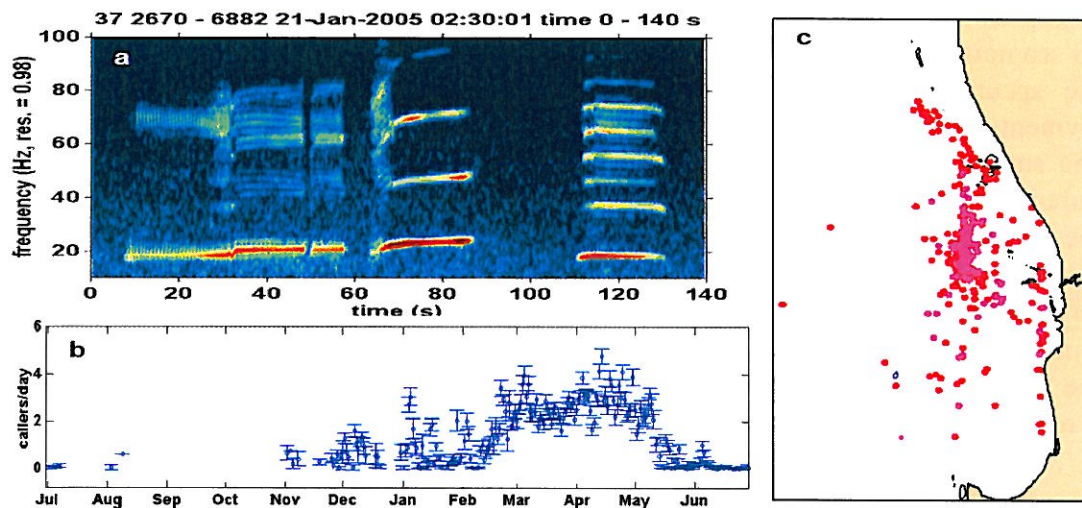


Fig. 2 (a) typical spectrogram of pygmy blue whale calls; (b) seasonal change in pygmy's call occurrence in 2005; (c) vocalising pygmy blue whales located off Perth in February-April 2003

2. DESIGN AND DEPLOYMENT SCHEME OF ACOUSTIC OBSERVATORIES

Each observatory consists of four autonomous sea noise loggers deployed on the seafloor to form a triangular array of about 5-km sides with the fourth logger installed in the centre as shown in Fig. 3a. The mooring scheme of each logger is shown in Fig. 3b. Such a mooring design provides decoupling of the hydrophone with the cable and floats of the mooring system and, hence, reduces significantly noise from cable vibrations.

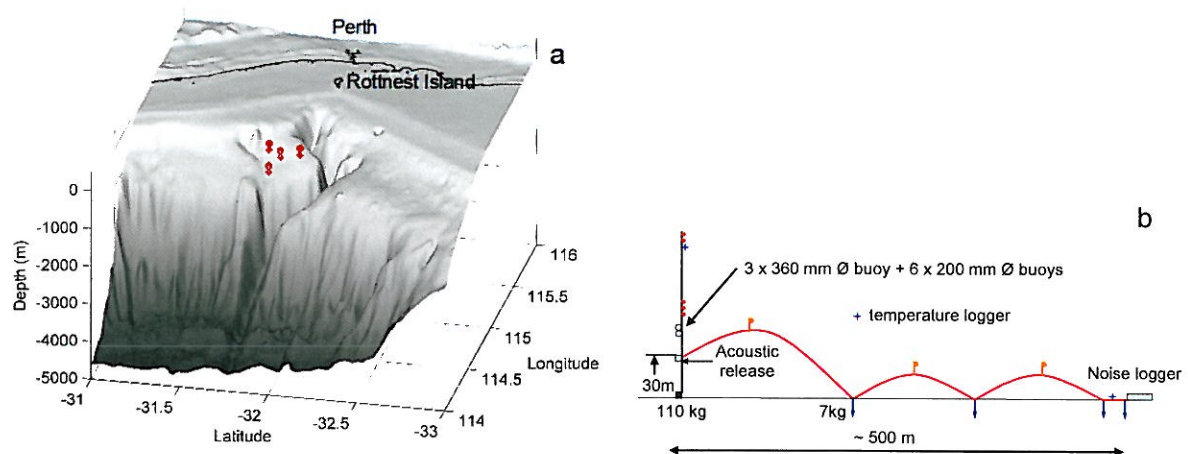


Fig. 3 (a) Geometry of the IMOS acoustic observatory deployed near the Perth Canyon; (b) Mooring design of individual sea noise loggers of the IMOS observatory array

The logger writes sea noise data to a 160-GB hard drive using a 512-MB flash drive for data buffering in real time. The length of continuous recordings is 500 s. The recordings are repeated with a 900-s interval. The nominal sampling rate kept most of the time is 6 kHz. It changes to 22 kHz for 200 s every day at the same time to record pulse signals from the

pinger of an acoustic release installed in the central mooring. The pinger signals are used for correcting different time drift rates in the quartz clocks of individual loggers. One of the IMOS sea noise loggers and its housing are shown in the photograph in Fig.4.

The accurate position of the hydrophones on the seafloor is measured after array deployment using the acoustic travel times from an impulsive source which is deployed near the sea surface and transmits signals from different locations above the hydrophone array measured by GPS.

The Perth Canyon IMOS acoustic observatory was deployed on 24 January 2009 at about 31°53'S and 115°00'E. It will be recovered for data retrieval after 2 October 2009 when the logger is programmed to stop recordings. The other two observatories will also be deployed for a period of about 8 months. After each cycle of autonomous recording, each observatory will be redeployed for another recording cycle. It is planned to keep nearly uninterrupted sea noise recordings at the three observatories until at least the end of 2011.

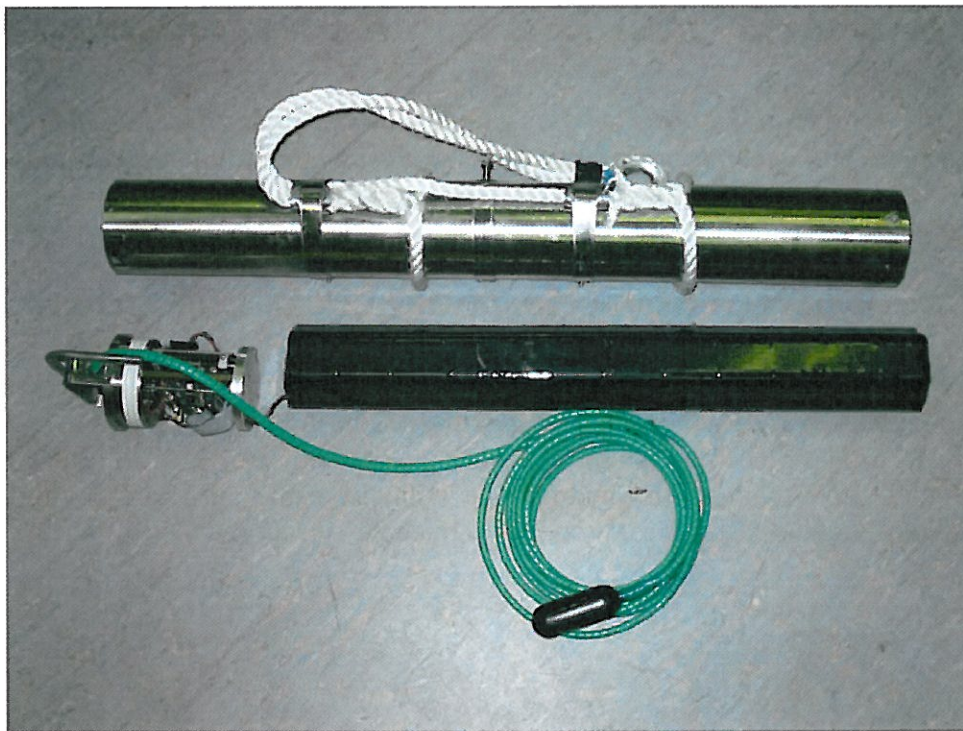


Fig. 4 IMOS sea noise logger with the hydrophone, its battery pack (alkaline batteries) and housing.

3. MANAGEMENT AND COMMUNICATION OF IMOS ACOUSTIC DATA

According to the NCRIS and, in particular, IMOS rules, all data collected with the new research facilities funded within the IMOS project should be freely available for the Australian and international scientific community. All sea noise recordings (raw data) will be archived at the CMST. Because of the very large size of data files, the raw data will not be available online. A set of metadata will be created for each cycle of sea noise recordings at the three IMOS acoustic observatories. These metadata will contain information on the hydrophones' position, start time and duration of all recordings, sampling rate, calibrations, *etc.* The metadata will be available from the eMarine Information Infrastructure (eMII) webpage [4] of the IMOS website and from the CMST website [5]. Raw acoustic data will be

provided upon request from potential users for certain time periods and location (observatory) selected by the users according to the metadata. Any additional processing of the raw sea noise data can be carried out at the CMST within joint projects or contracts with the interested institutions.

4. ACKNOWLEDGEMENTS

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