BRAHSS: BEHAVIOURAL RESPONSES OF AUSTRALIAN HUMPBACK WHALES TO SEISMIC SURVEYS

E&P **SOUND**
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At present, the primary information required by regulators about the effects of human noise in the marine environment is the behavioural response of marine animals to that sound source. BRAHSS has been a large, seven-year collaborative study investigating the effects of seismic air guns on the behaviour of migrating humpback whales along the Australian coast. The project is one of the largest, most complex, and advanced Behavioural Response Studies (BRS) of cetaceans ever undertaken.

Background

There is currently concern about how manmade noises, such as military sonar, oil and gas exploration activity and commercial shipping, may adversely affect marine mammals. Despite this, little is known about how human-generated noise affects marine mammal behaviour and/or physiology. The study aimed to provide information that will reduce the uncertainty in management and mitigation of potential effects of seismic surveys on whales, allowing surveys to be conducted efficiently with minimal impact to marine life. The main objectives of the study were to observe the behavioural reactions of humpback whales to seismic air guns, to evaluate whether the observed reactions might potentially have longer term population level effects, and to determine whether the gradual ramp-up of air guns (in contrast to the hard start of an array at full power) at the start of a survey is effective as a mitigation measure.

This project was jointly funded by the Joint Industry Programme on E&P Sound and Marine Life (JIP) and by the United States Bureau of Ocean Energy Management (BOEM).

The Experiments

Humpback whales migrating south along the coasts of Australia were incrementally exposed to a single airgun, a 6-airgun array, and a full industry seismic airgun array over the course of four field seasons. On the East Coast, the behaviour of groups of whales was monitored from two land-based stations and from small boats before, during, and after whales were exposed to the sounds from seismic survey sources ("air guns"). Tags that recorded sound and whale movements were attached to some whales by suction caps to record hours-long periods of data throughout the observation period. During the one field season on the West Coast, all observations were made from boats and only the 6-airgun array was used.

Results

No abnormal behaviors were recorded during any of the trials. However, in response to the active seismic arrays and the controls, whales displayed changes in some measured behaviours, mainly in measured movement (speed and course) and dive parameters. There was, however, considerable variation in responses between individuals. Changes in respiration rate were also found in response to the full commercial array, though within the magnitude observed in normal behavior. The most consistent result was a short-term change in migratory movement to avoid the source. Some groups of individuals, more likely females with a calf, reduced their speeds below typical migratory speeds, but the reduction was minor and not long-lasting. This was most likely to occur if the group received levels of greater than 135 dB re 1 µPa2·s AND was within 4 km of the source. Therefore, the likelihood that a group responded, as well as the response magnitude, was influenced by both proximity to the source and received level. The results so far have been published in 11 journal papers, two book chapters, and four conference proceedings.

Significance

The BRAHSS study is the first scientific study to expose whales to a full-scale, operational, industry seismic array in a controlled manner. This approach was intended to address criticisms of studies that relied on pre-recorded stimuli or scaled down arrays during exposure experiments. The range of air gun array sizes used in BRAHSS provided a range of received levels at any distance, which enabled the effects of received level of the source to be separated from the effects of proximity. By doing this, the results showed that the context in which an exposure occurs is as important as received sound level and that using simple amplitude or "loudness" metrics may not be adequate for risk assessment and mitigation.

The observed avoidance of the source by most whales suggests that ramp-up is potentially effective in reducing sound exposure. However, there was no significant difference in response to a ramp-up scenario compared to a constant source meaning the ramping up of the source (i.e. source getting progressively louder over time) did not elicit a stronger reaction. The main value of ramp-up therefore appears to be that it limits sound exposure of whales initially close enough to the source. This reduces the likelihood that received levels will be of concern had the array started at full volume near a whale. The project has demonstrated the importance of having an adequate sample size with a balanced experimental design with treatment, controls and baseline data of normal behaviour. It also showed the importance of measuring propagation loss at a shallow water site where large variations in loss can occur.

Co-PI Dr. Rebecca Dunlop monitoring the project tracking display during an exposure experiment.

The Research Team

The project involves leading researchers from several Australian institutions. The research team included faculty, staff, students, and volunteers. The Chief Scientist was Dr. Douglas Cato from the Defence Science and Technology Group and University of Sydney, and the other Principal Investigators were Dr. Rebecca Dunlop, Dr. Michael Noad (Univ. Queensland), and Dr. Robert McCauley (Curtin Univ.). Investigators were also involved from the University of Newcastle and the Australian Antarctic Division, the University of Newcastle and Blue Planet Marine.

The team in the field for the final experiment with a full seismic array in 2014.

References

A list of BRAHSS publications is given on the E&P Sound & Marine Life website https://gisserver.intertek.com/JIP/dmsJIP.php (search for "BRAHSS") and on the BRAHSS website http://www.brahss.org.au/content/publications.html

ABOUT THE JIP

One of the most extensive environmental industry research programmes bringing together the world's foremost experts across industry, academia and independent research centres.

This fact sheet has been produced by the IOGP E&P Sound and Marine Life Joint Industry Programme (JIP). The JIP was founded in 2005 and supports research to help increase understanding of the potential effect of sound generated by oil and gas exploration and production activity on marine life.

To learn more about the JIP and our research, please visit www.soundandmarinelife.org

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