

Using Passive Acoustics to Monitor the Presence of Marine Mammals During Naval Exercises

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1 Introduction

The US Navy has been collecting data on the presence of marine mammals in conjunction with Navy exercises involving active sonar activity. During July 2008, the US Navy performed antisubmarine warfare training exercises in Onslow Bay, North Carolina, using midfrequency active sonar (1–10 kHz). The exercises were conducted in one of the potential sites of the proposed east coast Undersea Warfare Training Range (USWTR). As part of the monitoring effort for these exercises, five bottom-mounted passive acoustic recorders were deployed in Onslow Bay. The recordings contain hundreds of odontocete vocalizations, including *Globicephala* sp. (pilot whales) and *Physeter macrocephalus* (sperm whales), occurring before, during, and after the sonar events.

2 Methods

During 6–27 July 2008, five bottom-mounted marine acoustic recording units (MARUs) from Cornell University, Ithaca, NY, were deployed ~7 km apart near the shelf break in Onslow Bay. This configuration was chosen to maximize the spatial coverage area because the exact location of the exercise can vary. Although the spacing between the MARU locations was greater than the average detection range of most odontocetes, recordings and subsequent vocal activity identified on each MARU were considered to be independent from each other.

Each recorder sampled continuously at 32 kHz during the duration of the deployment. The MARUs were deployed ~1 wk before a planned US Navy exercise involving active sonar activity was to occur at the site. This allowed us to start monitoring for marine mammal vocal activity before

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the Navy exercise. We analyzed these acoustic recordings for odontocete vocalizations (clicks, whistles, and burst-pulse sounds) using a combination of long-term spectral averages (LTSAs) and visual review of spectrograms and for sonar activity using a spectrogram correlation detector.

2 Results

Sonar activity was detected primarily from 16 to 18 July, with some activity also detected from 26 to 27 July, resulting in a total of 5 days with recorded sonar activity and 17 days without sonar present. From these records, we found odontocete vocal events, most of which were classified as unidentified odontocetes (i.e., odontocetes that could not yet be classified as to species). Of the vocal events identified, ~200 vocal events were made by *Physeter macrocephalus* and 13 were likely made by *Globicephala* sp. Because of a significant amount of hard drive noise, we were unable to examine the data for low-frequency calls of large whales below 200 Hz.

Unidentified odontocete vocal events were detected both day and night on each day. The *Physeter macrocephalus* clicks were detected on two MARUs in deeper water (>270 m) throughout the entire recording period mainly at night (from 2000h to 0600h).

The *Globicephala* sp. vocalizations were also detected on only the two deeper MARUs, but unlike *Physeter macrocephalus*, they were detected sporadically throughout the day and night and only from 14 to 18 July.

On a few occasions, we also found unidentified odontocetes that appeared to be mimicking sonar signals with frequency-modulated whistles of similar frequencies immediately after the sonar signal. The mimicry events would last for several sequential pings before ceasing to be heard.

The duration of the vocal events ranged from 1 min to >12 h, with an average duration of 41 ± 1.23 min. The total duration of vocal events by day for each classification group were compared with the total duration of sonar activity by day during the recording period. No statistical correlation was found between the number of vocal events heard and the duration of sonar activity.

4 Conclusions

The recorded acoustic data indicate that marine mammals were present in Onslow Bay when sonar was used. The majority of the vocalizations detected were whistles and clicks from unidentified odontocetes, with a number of identified clicks from *Physeter macrocephalus* and whistles and clicks from *Globicephala* sp. On several occasions, the *Physeter macrocephalus* clicks appeared to have been produced by a single individual; however, the clicks were not localized so we cannot rule out the possibility that there were multiple whales. It is possible that the same individual was consistently foraging near the shelf break at night during July 2008. The probable pilot whale vocalizations recorded on 17 July 2008, were recorded shortly after a sighting of *Globicephala* sp. was made by the University of North Carolina, Wilmington (UNCW) aerial survey team flying in the area on the same day.

The unidentified odontocete vocal events are most likely from either offshore bottlenose dolphins (*Tursiops truncatus*) or Atlantic spotted dolphins (*Stenella frontalis*) because these are the most commonly sighted species of odontocetes in the area based on 2 yr of periodic areal and shipboard surveys.

There was no correlation between the use of sonar and the daily duration of odontocete vocal activity. We noted several instances when odontocete vocalizations overlapped with midfrequency

sonar and a few instances where odontocetes apparently mimicked the sonar signals. From this project, we can determine that marine mammals are being exposed to sonar during this naval exercise, but we do not know at what levels and for what lengths of time they are exposed. Due to the extent of the spacing between the MARU locations, we were not able to determine location for any of the vocal events.

Overall, these recorders yield important information about the presence of odontocetes during these naval sonar exercises in Onslow Bay. Since this recording event, the Navy was able to arrange two more deployments in 2009 in conjunction with planned naval exercises occurring at the proposed USWTR site off Jacksonville, FL.