Assessment of Acoustic Adaptations for Noise Compensation in Marine Mammals

Susan E. Parks
The Pennsylvania State University, Applied Research Laboratory
P.O. Box 30, State College, PA 16804-0030
phone: (814) 865-7683 fax: (814) 863-8783 email: sep20@psu.edu

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LONG-TERM GOALS

The proposed research will address the fundamental theoretical issue of noise compensation mechanisms in the vocal communication of marine mammals. Noise compensation mechanisms are important for improving signal transmission with an energy limited source. A better understanding of marine mammal noise compensation mechanisms can potentially provide effective means of improving signal transmission in a noisy marine environment and for assessing the impact of man-made sounds on the use of sound by marine mammals.

OBJECTIVES

The primary objectives of this project are to: 1) generate testable hypotheses of general vocal responses of marine mammals to particular noise types; and 2) test these hypotheses with data from two low-frequency baleen whale species in coastal shallow water environments using existing data from North Atlantic right whale (*Eubalaena glacialis*) acoustic tag recordings (Digital Archival Tag - Dtag) (Johnson and Tyack 2003) and new acoustic Dtag data collected from Southern right whales (*Eubalaena australis*).

APPROACH

The approach for this study is to first develop hypotheses about common mechanisms of noise compensation in marine mammals by investigating the matching of marine mammal signals to their acoustic habitats and general trends for noise compensation documented from different species of animals in response to noise sources in the environment. These hypotheses will then be tested using an extensive existing database of acoustic tag data collected from the North Atlantic right whale in the Bay of Fundy to determine what, if any, vocal compensation mechanisms were employed by North Atlantic right whales. The second stage of this study will involve collecting additional Dtag data from Southern right whales in Argentina. The Southern right whale population is present in large numbers (~700) in the austral spring in two adjacent gulfs, Golfo San José and Golfo Nuevo. Both gulfs experience similar weather conditions and are used by a single population of Southern right whales but differ in the level of human activity. Golfo San José has extremely low levels of human activity as it is an established marine sanctuary for the whales, and therefore is expected to have a close to 'natural' ambient noise structure. Golfo Nuevo in contrast has a commercial port (Puerto Madryn) on its western shore, with frequent transits of large container and transport vessels in and out of the gulf. Puerto Pirámides, a town on the northeastern shore has six companies that run whale watch trips

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14. ABSTRACT
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during all daylight hours from June to December with smaller outboard engine vessels. Dtags are planned to be attached to whales in both gulfs to compare the vocal behavior of the whales. Vessel traffic will be documented by both visual observers and continuous acoustic recorders in both bays to quantify and count the number of ships and levels of acoustic disturbance presented to the whales. These data will then be used to further test the general noise compensation hypotheses developed in the first part of the study.

WORK COMPLETED

A literature review of existing vocal noise compensation mechanisms has been completed, and a review manuscript is in preparation. Copies of the existing Dtag data from North Atlantic right whales were obtained and vocalizations from the tagged whales have been extracted. Measurements of call parameters (include duration, frequency content, and receive level) and noise have been completed and a draft manuscript is currently in preparation with submission planned before the end of the year. These results will be presented at the Society of Marine Mammalogy conference in Quebec, Canada in October 2009. A trip planned to collect data in Argentina for September 2009 was postponed due to delays in obtaining necessary permits for the research. Currently the permit application is still under review and plans are to renew this permit request for a 2010 field season.

RESULTS

An acoustic recording tag, the Dtag, was used to record the noise levels received by individual whales and the vocalizations they produced in the Bay of Fundy, Canada. These data were used to assess the variability in the received levels (and therefore source level), duration and frequency content of calls produced by the tagged whale in varying ambient noise environments. A single stereotyped call type, the 'upcall', was selected for these measurements. Results from the analysis of the 2000-2005 Dtag data from the Bay of Fundy indicate that individual call production is modified in increased ambient noise conditions with changes to call intensity. Individual whales producing multiple calls showed increases in received call amplitude (Figure 1) in increasing ambient noise conditions. These results are consistent with previous studies that have shown similar vocal modifications in odontocetes (Scheifele et al. 2005; Holt et al. 2009).

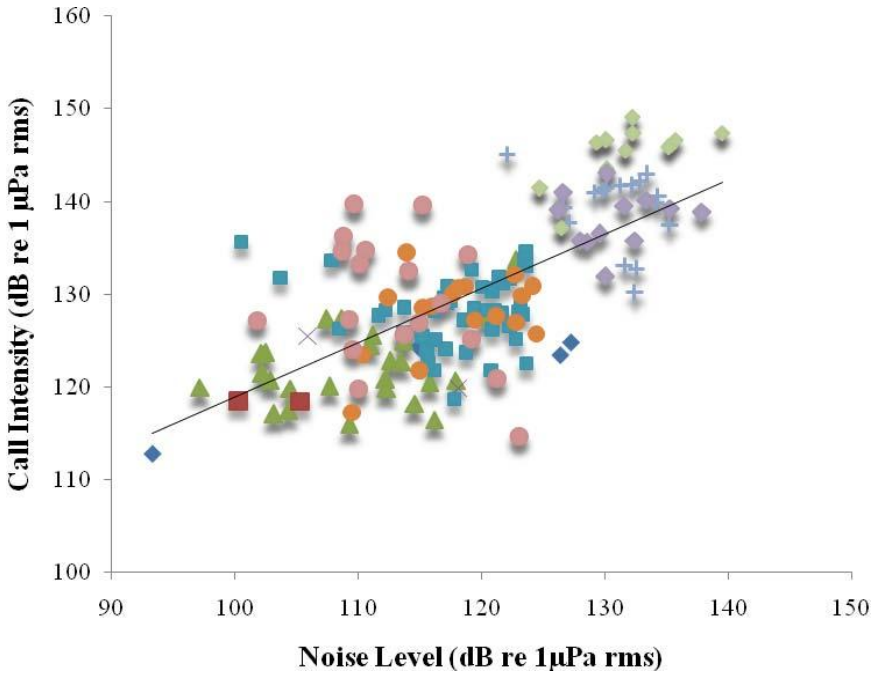

Figure 1. Measured received noise corrected call intensity of right whale upcalls vs. noise levels recorded on the tag for 10 individual North Atlantic right whales.

IMPACT/APPLICATIONS

This study will lead to a better understanding of the existence of acoustic adaptations in right whale vocalizations and the types of vocal compensation mechanisms that they employ for coping with increased ambient noise conditions, including both natural and man-made sound sources. This project is a first step in developing a general theory regarding noise compensation mechanisms in marine mammal species.

RELATED PROJECTS

None

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