LIVING MARINE RESOURCES PROJECT 70

Behavioral Observations of Marine Mammals Around Impulsive Noise (BOOMIN)

NEED

The U.S. Navy uses the Navy Acoustic Effects Model (NAEMO) for modeling the sound field around Navy training and testing events, which can include detonations that generate explosive sound, to assess their impact on marine species. The effects of explosive sounds on marine mammals are poorly known. More data are required to understand how cetaceans respond to explosive sounds in the open ocean environment.

SMRT tag on a goose-beaked whale.
Greg Schorr, permit 21163 (MarEcoTel)

SOLUTION

The goal of this project is to describe the behavioral response of cetaceans to anthropogenic impulsive noise sources and to verify the explosive propagation modeling for NAEMO. An LMR-funded controlled explosive exposure experiment (Project 35) collected data that can be used to verify propagation modeling of explosive events in NAEMO. Prior to the Project 35 detonations, six Sound and Motion Recording and Transmitting (SMRT) tags were deployed (five on animals, one floating in the area) to collect on-animal sound measurements with concurrent behavioral data. Data from additional SMRT tags deployed on the Southern California Anti-Submarine Warfare Range (SOAR) during other Navy-funded projects will also be evaluated for opportunistic impulsive sound exposures in coordination with data from SOAR hydrophones and Marine Mammal Monitoring on Navy Ranges (M3R) data collected from SOAR.

METHODOLOGY

The project includes three tasks:

- **Task 1: Before/During/After assessment of behavior during controlled detonations**

  The team will evaluate vocalization data from SOAR hydrophones and behavioral data from the five SMRT tags deployed on animals prior to the July 2023 controlled explosive exposure experiment (LMR Project 35).

- **Task 2: Comprehensive assessment of cetacean response to impulsive sounds**

  The team will evaluate data from previously deployed SMRT tags to examine responses to opportunistic impulsive event exposures.

- **Task 3: NAEMO validation**

  Team members from the Naval Undersea Warfare Center Newport (NUWC) will conduct a validation study of the NAEMO model using data collected from the July 2023 controlled explosive exposure experiment (LMR Project 35).

Through these tasks, the project will assess if:

- Whales exposed to impulsive sounds respond by altering their behavior (e.g., diving, horizontal movements, vocalizations).
- Responses to impulsive sounds are mediated by exposure characteristics (e.g., sound exposure levels (SEL), sound pressure levels (SPL), distance to source, duration, frequency of use).
- Received levels recorded on the tag are correlated both with received levels (RL) modeled using

source characteristics and location, and with RLs recorded on SOAR hydrophones.

- Received level metrics from modeled data differ appreciably from measurements for the equivalent weights of explosives modeled.

SCHEDULE

Analyses of data from the Project 35 controlled explosive experiments will begin in mid-2024 and be completed by January 2025. Analyses of previously collected SMRT data will begin in 2025 and continue into 2026. Completion of propagation model verification is expected by the end of 2026.

NAVY BENEFITS

Understanding the behavioral response of marine mammals to impulsive sounds (particularly explosives), is important to the Navy's monitoring and mitigation efforts. This project will provide both detailed behavioral data and accurate sound metrics (e.g., SEL, SPL) made possible by using high-resolution, multi-sensor tag data from multiple cetacean species around Navy explosive testing. In addition to improved behavioral response assessments, verifying the NAEMO explosive propagation model will help inform future acoustic impact modeling assessments and improve accuracy and reliability of modeling data.

An explosive detonation.
MC2 Josh Bennett

TRANSITION

The intended end users of these data are the Navy environmental compliance community and the general scientific community. Data and analyses will be distributed in technical reports and peer-reviewed publications. The technical report on explosive propagation model verification will be incorporated by reference into Navy compliance documentation.

ABOUT THE PRINCIPAL INVESTIGATORS

Erin Falcone, a research biologist at the Foundation for Marine Ecology & Telemetry Research, is a cetacean photo-ID and tagging specialist. Erin has been a principal investigator of marine mammal studies at the Southern California Offshore Range since 2006.

Stephanie Watwood has extensive experience in collecting and analyzing cetacean acoustic data, particularly related to cetacean behavior. She has been working at the Naval Undersea Warfare Center studying the impact of anthropogenic activities on marine species since 2009. Prior to that, she completed a Ph.D. and post-doctoral post at Woods Hole Oceanographic Institution, where her research focused on social and vocal behavior of a variety of mammalian species.

About the LMR Program

The Living Marine Resources (LMR) program seeks to develop, demonstrate, and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. For more information, contact the LMR program manager at exwc_lmr_program@us.navy.mil or visit exwc.navfac.navy.mil/lmr.