Multi-spaced Measurement of Underwater Sound Fields from Explosive Sources

NEED

The Navy models the effects of explosive detonations to determine the potential impacts to marine species (mammals, sea turtles, fish and birds). The current models are validated using in situ data recorded for a small subset of the types of munitions—largely data from small explosive charges in shallow water depths—that the Navy could use in training and testing activities. These data may not fully represent the sound source characteristics and propagation conditions that could be generated by larger size charges in more variable training and testing environments. Therefore, the Navy seeks to collect additional data on a broader range of charge sizes and at a variety of distances/depths to improve the validation of the Navy's Acoustic Effect Model (NAEMO) explosive propagation, and to ensure that predictions of effects to marine species are as accurate as possible.

SOLUTION

This project will conduct a set of well-documented and calibrated underwater acoustic field measurements associated with explosive detonations. It will include measurements at both very close range and longer ranges that are influenced by multipath reflections, changing bathymetry and sound speed conditions. Results will be used to update NAEMO, which simulates potential impacts on marine species.

An explosive detonation.
MC2 Josh Bennett

METHODOLOGY

For the near-field measurements, the team will deploy acoustic measurement instrumentation at two sites, arranged to measure both a direct waterborne path between the explosive source and the receiver

and a path reflected from the seabed. A vertical line array (VLA) will be used to measure the bottom reflection and tourmaline sensors deployed from a surface buoy will be used to measure the direct waterborne path. The surface buoy will house an airborne hydrophone to provide more information on the location of the explosion. Data from both near-field sites will be compared and used to estimate the location of the explosion.

There will be three far-field measurement sites, arranged to characterize propagation effects. These will be configured to provide data on effects of varying depths and distances from the explosive source. Each site will be equipped with VLAs to collect site-specific data, which will encompass varying depths (up to 1000 meters), thermocline influences and overall acoustic field. The equipment also will collect essential environmental data, such as water sound speed and surface wave spectra, needed for the modeling and interpretation of the observations of acoustic propagation.

SCHEDULE

This three-year project will include two rounds of explosive measurements, one during each of the first two years. In year one, equipment will be procured, instrumented and tested. For each round of measurements, equipment will be deployed, explosive measurements will be collected and equipment then recovered during a period encompassing 3–5 days. Initial data reports and final test reports will be

completed each year following the tests. An optional field trial may be conducted in year three as determined by the LMR program.

NAVY BENEFITS

The data collected directly apply to improving the accuracy and verification of NAEMO-based predictions of underwater sound fields from explosives at both close and long ranges. This is critical to improving the Navy's analysis of the effects of explosive sources on marine species.

TRANSITION

Data will be provided to the LMR program and NAEMO team, along with the final reports. A manuscript for journal submission, as coordinated with and approved by the LMR program, will be prepared.

ABOUT THE PRINCIPAL INVESTIGATOR

Peter Dahl is a senior principal engineer in the acoustics department and a Professor in the University of Washington's Department of Mechanical Engineering. Dahl's research is in areas of acoustics with a primary focus on underwater sound. Dr. Dahl earned his Ph.D. from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution in 1989.

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@navy.mil or visit navysustainability.dodlive.mil/environment/lmr/.