LIVING MARINE RESOURCES PROJECT 61

Auditory Masking in Odobenid and Otariid Carnivores

NEED

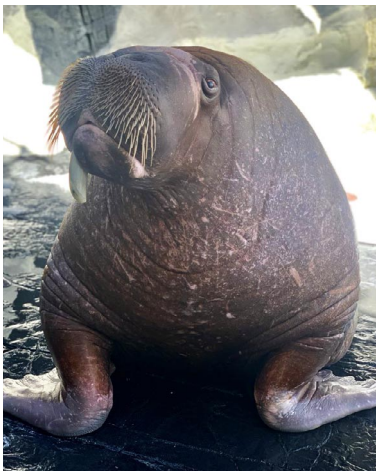
The Navy is interested in research regarding potential impacts to marine species from Navy training and testing activities, primarily focused on potential impacts from sound (e.g., hearing studies, sound exposure, and behavioral response studies).

SOLUTION

This project will provide auditory data for odobenid and otariid carnivores (Pacific walruses and California sea lions, respectively) that will enable comparison of acoustic sensitivity between these marine mammal taxa and support environmental compliance efforts. The Living Marine Resources (LMR) program funding to this project supplements an ongoing effort supported by the U.S. Fish and Wildlife Service in partnership with the U.S. Geological Survey to characterize auditory masking from simultaneous noise in the Pacific walrus (*Odobenus rosmarus divergens*). The added support from LMR enables the project team to expand the study scope to include a California sea lion (*Zalophus californianus*) and collect additional comparative data. The study will provide new information relevant to noise exposure criteria for the marine mammal functional hearing group designated as "Other Marine Carnivores." This is a grouping of amphibious marine mammals that are not phocids (true seals), including sea lions, fur seals, walruses and sea otters. They are among the least studied marine mammals with respect to hearing and the effects of noise, yet they occupy areas of the northern Pacific and Arctic waters essential to U.S. Navy operations.

METHODOLOGY

The project is working with trained marine mammals at SeaWorld San Diego and the University of California Santa Cruz. The team collects hearing data by conducting behavioral audiometric testing in outdoor conditions. This method involves the animal being trained to report the presence of a tone by touching a target, and to withhold responding in the absence of a tone. Tone frequency and level are varied to measure hearing thresholds. Hearing thresholds are measured in ambient conditions for one-second tonal signals from 0.2 to 16 kHz for walruses and from 0.2 to 32 kHz for sea lions.



Pacific walrus Mitik, a subject in cooperative hearing assessments.
Colleen Reichmuth, permit 23554

Graduate student Ryan Jones with trained sea lion Ronan.
Colleen Reichmuth, permit 23554

In addition to ambient hearing thresholds, the team will also measure masked hearing thresholds for the same tonal signals in the presence of controlled background noise (octave-band noise centered on the test frequency). Auditory critical ratios—which will be determined for each frequency—are a key parameter of auditory masking and can be used to predict the

effects of noise on hearing for these species. These data will also be used to validate the hearing measurements obtained in natural noise. Importantly, the auditory critical ratios to be measured in this study can be used to predict masking arising from both underwater and airborne noise.

SCHEDULE

Several tasks were initiated under separate funding, which is helping to move the overall project ahead. All data collection will be completed by the close of 2022. Data analyses, manuscript preparation and publication are scheduled to be complete by late September 2023.

NAVY BENEFITS

The auditory data resulting from the proposed study will improve environmental impact assessments of potential acoustic effects resulting from Navy training and testing activities in Pacific Northwest waters, including Oregon, Washington and Alaska, and in Arctic regions. These areas including overlapping habitat for both otariid and odobenid carnivores. This effort bolsters resources for Navy's at-sea environmental compliance and permitting processes, especially in the Northwest and Arctic regions of the North Pacific. It will contribute to datasets used to establish acoustic exposure criteria for free-ranging animals in both air and water.

TRANSITION

Project results will be shared through manuscript publication, a conference presentation, quarterly reports and primary data sets. These results will benefit the Navy marine species monitoring program, the Navy environmental compliance community and the general scientific community.

ABOUT THE PRINCIPAL INVESTIGATORS

Colleen Reichmuth is an animal behaviorist at the Institute of Marine Sciences, University of California at Santa Cruz. She has extensive experience conducting auditory research with marine mammals with a focus on behavioral psychoacoustic methods. Her expertise includes training marine mammals for voluntary participation in research, conducting field studies of animal acoustic communication and promoting best practices for the care and welfare of research animals. Dr. Reichmuth earned her Ph.D. in ocean sciences at the University of California at Santa Cruz.

Jillian Sills is a project scientist at the Institute of Marine Sciences, University of California at Santa Cruz. She is a skilled bioacoustican who has conducted auditory research with walruses, harbor seals, spotted seals, ringed seals, bearded seals, monk seals, sea lions and sea otters. She also studies sound production patterns in captive and free-ranging pinnipeds and conducts research on the effects of noise on marine mammals. Dr. Sills earned her Ph.D. in biological oceanography at the University of California at Santa Cruz.

Key contributor: graduate student Ryan Jones.

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 exwc.navfac.navy.mil/lmr.