LIVING MARINE RESOURCES PROJECT 71

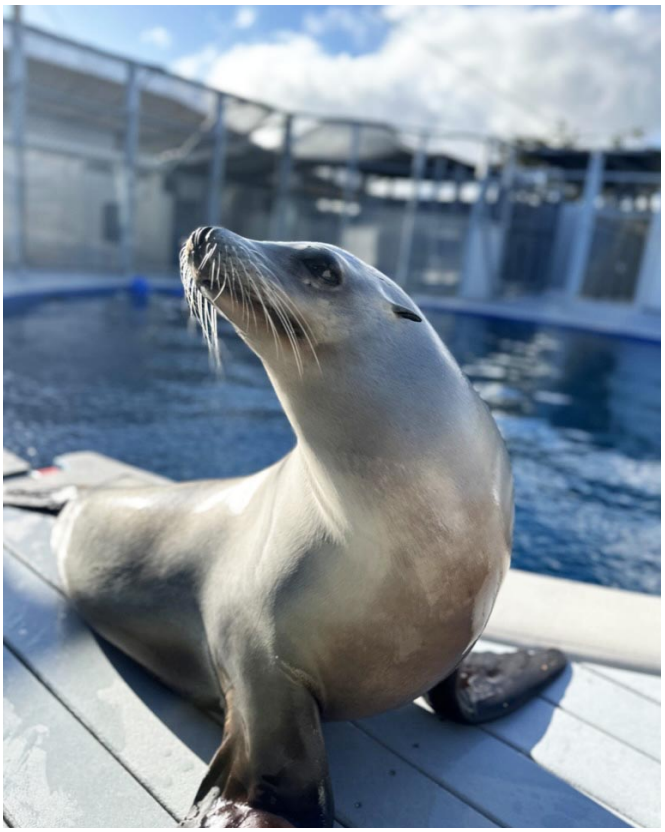
Masking Parameters for Pinnipeds: The Effects of Noise Bandwidth and Level on Signal Detection

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 is focused on providing quantitative auditory masking data for pinnipeds (odobenid, otariid and phocid carnivores) to improve knowledge of hearing and masking in these taxa and support environmental compliance efforts within the United States Navy. The project expands upon another LMR-funded effort (LMR Project 61: Auditory Masking in Odobenid and Otariid Carnivores) that characterized auditory masking from simultaneous noise in an odobenid carnivore, the Pacific walrus (*Odobenus rosmarus divergens*), and an otariid carnivore, the California sea lion (*Zalophus californianus*). With the addition of a phocid carnivore, this study includes one representative species from each of the three pinniped families. Results will describe auditory masking as a function of noise bandwidth and level, improving efforts to understand and predict the effects of noise on free-ranging marine mammals.



California sea lion at UCSC's Long Marine Laboratory.
C. Reichmuth, NMFS marine mammal research permit 23554

METHODOLOGY

The effort will collect direct critical bandwidth measurements and test the effects of noise level on masking at a range of frequencies.

The team will conduct behavioral audiometric testing to estimate critical bandwidths. Controlled noise fields will be established in outdoor conditions to enable the measurement of masked hearing thresholds. Testing will use one-second tonal signals at four target frequencies from 0.5 to at least 10 kHz and measure masked hearing thresholds for these signals in the presence of spectrally flattened, spatially even white noise of varying bandwidths. Results will be used to determine critical bandwidths for each species at each test frequency. These critical bandwidths describe the specific frequency range of noise that contributes to masking a given sound.

For the otariid and phocid study subjects, additional audiometric testing in the controlled acoustic conditions of a hemi-anechoic acoustic chamber will support investigating the effect of noise level on the

amount of masking. The results will help to determine masking onset and growth at each test frequency (i.e., determine associated noise levels resulting in no masking, partial masking and full masking). Data will be evaluated to determine 1) at what point environmental noise begins to influence hearing, 2) how the amount of masking changes with increasing noise level, 3) at what noise level critical masking ratios begin to apply and 4) whether these masking patterns vary across frequency or species. Information from both phases of this study can ultimately be applied to improve predictive masking models and to inform our understanding of auditory biology in marine mammals.

SCHEDULE

Data collection will occur throughout 2024 and should be completed in early 2025. Data analyses, manuscript preparation and publication are scheduled to be completed by late September 2025.

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 regions that include overlapping habitats for odobenid, otariid and phocid carnivores. This research will fill several data gaps related to auditory masking and provide information on marine mammal hearing to improve risk threshold criteria.

TRANSITION

Results will be shared with the Navy marine species monitoring program, the Navy environmental compliance community and the general scientific community through conference presentations and at least one peer-reviewed, open-access manuscript.

ABOUT THE PRINCIPAL INVESTIGATORS

Colleen Reichmuth is an animal behaviorist at the Institute of Marine Sciences, University of California Santa Cruz. She has extensive experience conducting psychological and physiological studies of marine mammals with a focus on sensory biology. 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 Santa Cruz.

Jillian Sills is a project scientist at the University of California Santa Cruz. She is a skilled bioacoustician 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 Santa Cruz.

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.