LMR news

SPRING 2022

SCIENCE • STEWARDSHIP • NAVY READINESS

Welcome!

Welcome to the latest issue of *LMR News*—the newsletter from the Living Marine Resources (LMR) program. Our goal is to provide you with the latest information about program operations, significant accomplishments and future focus areas for the LMR program. We hope you will find the content useful and that it provides insights into our efforts to improve our understanding of how Navy at-sea training and testing activities could affect marine species—their occurrence in training areas and potential exposure, response and consequences.

NAVFAC Naval Facilities Engineering Command
ENGINEERING AND EXPEDITIONARY WARFARE CENTER

INSIDE THIS ISSUE

WHO WE ARE

The LMR program is one of the U.S. Navy's applied research (6.4) programs, sponsored by the Chief of Naval Operations Installations (OPNAV N4I) and managed by the Naval Facilities Command Engineering and Expeditionary Warfare Center (NAVFAC EXWC) in Port Hueneme, CA. The LMR program's fundamental mission is to support the Navy's ability to conduct uninterrupted training and testing, which preserve core Navy readiness capabilities. Our efforts to achieve that mission include working to improve the best available science regarding the potential impacts to marine species from Navy activities, demonstrating and validating projects ready for applied research, and broadening and improving the technology and methods available to the U.S. Navy Marine Species Monitoring Program.

Anu Kumar
Program Manager

PROGRAM OFFICE INSIGHTS

We in the LMR program office have been working with the LMR Advisory Committee (LMRAC) to review proposals resulting from our Fiscal Year 2022 (FY22) Broad Agency Announcement (BAA). The three needs listed in the BAA generated significant interest and a breadth of responses. From the numerous pre-proposals received, a subset was invited to submit full proposals. We are currently finalizing our review and selections will be announced in the next newsletter.

Mandy Shoemaker
Deputy Program Manager

The needs submission period for FY23 recently closed. We received 18 submissions, which the LMR staff and LMRAC are reviewing. Following this review, recommendations on priority needs will be forwarded to our resource sponsor at N4I for approval. This sets the stage for our next BAA to solicit pre-proposals for projects to address the selected needs. We anticipate issuing the BAA in August 2022.

Our 2021 LMR report is now available on our website. The report summarizes the 30 projects that were completed, ongoing or newly started during 2021. If you are on the email list for *LMR News* you should have received an email with the report PDF.

Note that once again, the program website address has changed. The new URL—exwc.navfac.navy.mil/lmr—is now up and running. Please contact the program manager at exwc_lmr_program@navy.mil if you have any trouble accessing the website.

For the latest LMR publications, go to the Recent Publications section of this issue and for a spreadsheet listing all LMR-related publications, check out the publications tab at our website.

This issue's Project Spotlight is on a recently completed project under Investment Area 2 (Data Processing and Analysis Tools). See that section to read about the project, Analytical Methods to Support Development of Noise Exposure Criteria for Behavioral Response.

Right whale. *NOAA*

IN-PROGRESS REVIEW

The LMRAC and PIs can now save the date for the 2022 IPR. It will be held the week of November 14 to 18, 2022. Details will follow.

PROGRAM PARTICIPANT UPDATES

Mandy Shoemaker, LMR's Deputy Program Manager, attended the 182nd Meeting of the Acoustical Society of America (ASA) in Denver, Colorado. The ASA meetings bring together scientists from all over the world to share their work in all aspects of acoustic research. This offered the LMR program a great opportunity to learn about the most recent research in underwater acoustics and animal bioacoustics.

The LMR program was able to obtain, via the Sonobuoy Liaison Working Group, 480 research sonobuoys in 2022. These sonobuoys play a significant role in expanding our data sets, and thus knowledge, related to where animals occur and when they are present. The LMR management team recently completed the evaluation of the 2022 requests for sonobuoys. The three organizations receiving sonobuoys in 2022 are the:

1. NOAA Marine Mammal Laboratory/Alaska Fisheries Science Center
2. Scripps Institute of Oceanography/University of California San Diego
3. NOAA Pacific Islands Fisheries Science Center.

LMR PROJECT SPOTLIGHT

Wondering about some of the LMR-supported projects? This section provides a brief overview of one or more projects underway in the LMR program.

For this issue we present an overview of a recently completed project under Investment Area 2: Data Processing and Analysis Tools.

Analytical Methods to Support Development of Noise Exposure Criteria for Behavioral Response

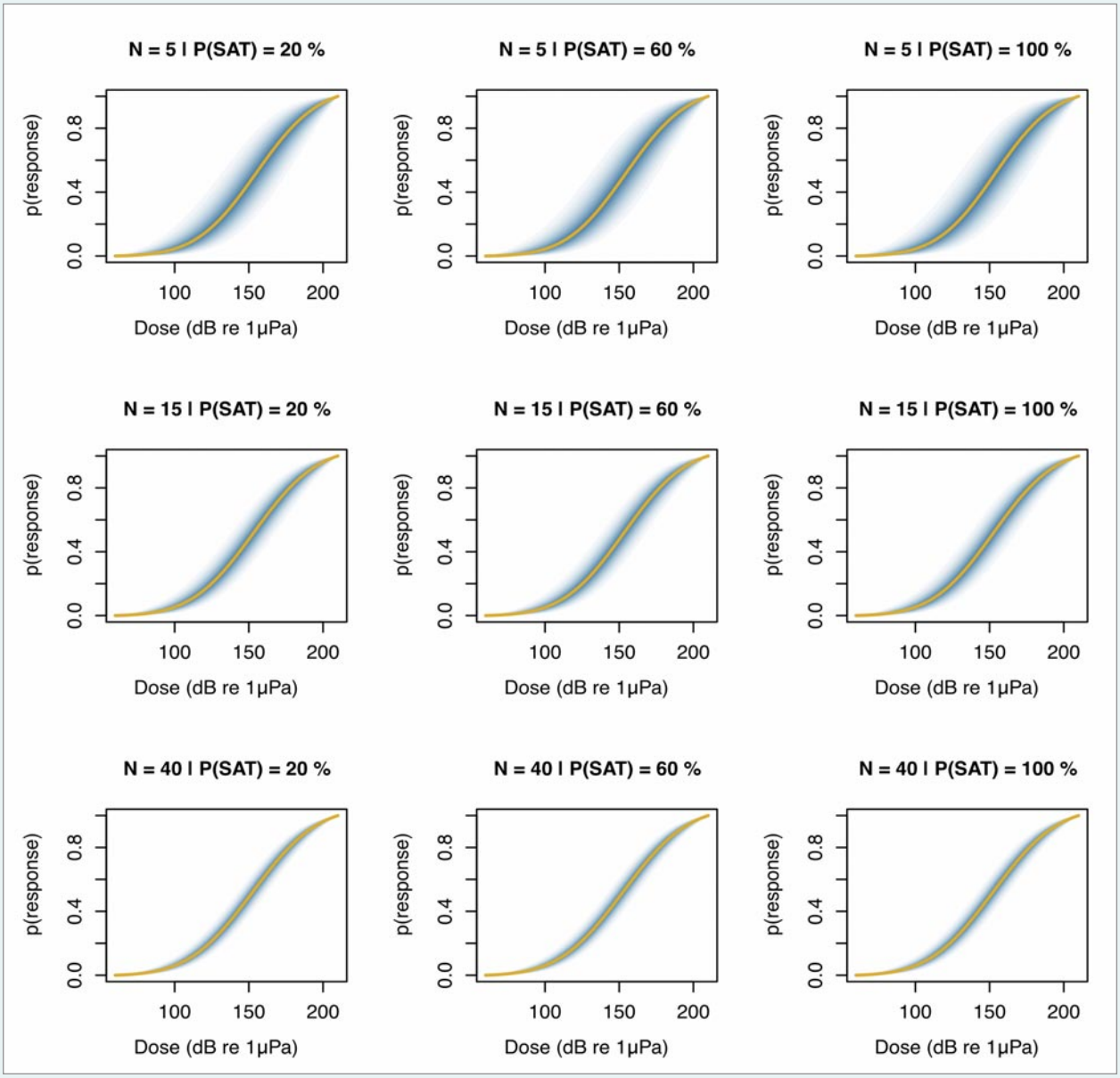
The criteria the Navy uses to estimate the effects of anthropogenic sound on marine mammal species are currently established for species groups based on functional hearing characteristics. Results of various behavioral response studies (BRS) suggest that these groupings might not be sufficient for predicting responses to sonar. To expand the utility of data collected from the BRS and to improve the approach to grouping species for exposure criteria, the Navy needs additional, more efficient modeling methods for estimating responses of multiple species.

This project, led by Len Thomas and Catriona Harris at the University of St Andrews (U.K.) Centre for Research into Ecological and Environmental Modelling (CREEM), focused on developing a new computationally efficient model selection method. The goal was a method that supports and expands upon the existing and often used Bayesian hierarchical dose-response framework.

Early in the project, team members met with behavioral response study researchers to identify available data and formats. The team collated data from controlled exposure experiments (CEEs) for a wide range of variables including exposure history, signal type, animal behavior (foraging/non-foraging) in pre-exposure period, distance between source and animal and others. Working with Navy environmental compliance experts, data were carefully reviewed to ensure data quality. Team members also began developing methods for model selection, reviewing algorithms to be used and improving existing code.

Based on hypothetical CEE scenarios that included high-resolution data from digital acoustic tags (DTAGs) and low-resolution data from satellite tags, the project team conducted a simulation study to investigate the balance between the data types and the effect of uncertainty in received levels from both data types on the resulting dose-response functions. The team presented the results to the environmental compliance team. The results are available through a technical report available at http://hdl.handle.net/10023/19909 and in a 2021 publication in *Frontiers in Marine Science* (see sidebar for citation).

Next, the project team focused on testing and completing the model selection methods and applying methods to the full data set. Bayesian hierarchical dose-response models with a reversible-jump Markov chain Monte Carlo (RJMCMC) model selection algorithm were implemented in the R programming language. The R functions were generalized to apply to any number of species, and to allow the selection of both contextual covariates (both continuous and categorical) and functional forms for the dose-response



Example dose-response curves estimated for a range of sample sizes (N) and proportions of animals fitted with satellite tags (P(SAT)). The solid line represents the average posterior median across Ns=500 simulations, followed by the average 5%, 10%, 15%....and 95% credible intervals in darker to lighter shades of blue.

relationship (mono vs. biphasic). In addition, the code has been adapted to allow species groupings and functional forms to be specified *a priori*, in recognition that parameter estimation for pre-determined species groupings (e.g., based on hearing sensitivity) may be of interest to the Navy. The code has been tested on simulated data and benchmarked against other model selection methods. Model selection methods also have been extensively tested and refined.

Two key outcomes from this work include the R software package "espresso" and a simulation tool. The R package (https://pjbouchet.github.io/espresso) allows for dose-response modeling across functional forms, species and covariates, and model selection across species and covariates. This is a new capability that would have been infeasible with previous methods. The package is designed to be flexible for use by the research community and the Navy Environmental Compliance Team. It includes a step-by-step vignette for multi-species Bayesian dose-response model selection using RJMCMC and options for switching different elements of the model selection on and off depending on needs and questions. Some package capabilities specifically address Navy needs, including left-censoring required for CEE data from captive studies, and incorporating risk-function data. The simulation tool explored the role of satellite tag data in future dose-response functions. This tool and publication have expanded the conversation about including satellite tag data in Navy models when data are available.

The results offer the Navy a package to use during development of the Navy's behavioral risk functions. While the groupings may not be appropriate for use in the behavioral risk functions at this time, they will, at a minimum, help the Navy to understand the relationship between responsiveness and dose metrics other than those related to received sound level. This model selection method and simulation tool will offer guidance on data requirements, data formats, priority covariates and dose metrics to ensure data collected in the future can be utilized in this framework.

2021 PUBLICATION

Bouchet, P., Harris, C. and Thomas, L. (2021) Assessing the role of sampling uncertainty for predicting behavioural responses of tagged cetaceans exposed to naval sonar. *Frontiers in Marine Science*. DOI 10.3389/fmars.2021.674554.

PROJECT STATUS UPDATES

Project 31: The Working Group for the Advancement of Marine Species Density Surface Modeling project (DenMod)

The DenMod project team recently held a successful public webinar to share a summary of its final work. The collaborative DenMod group has worked to develop and implement innovative approaches to improve spatial modeling methods to characterize seasonal abundance and distribution of marine species, particularly in U.S. Navy training and testing areas.

This webinar was the last of three planned public workshops to discuss the efforts under the LMR-funded project. The first two workshop were held prior to the Society for Marine Mammalogy conferences in Halifax (2017) and Barcelona (2019). Due to travel limitations, this final event was held online. Registrants included individuals from at least 19 different countries, representing academic, government and non-governmental organizations; the U.S. Navy; industry and consultant groups. In addition to the 88 online participants, all registrants who were unable to participate should have received notification that the webinar recording is now available on the DenMod website (denmod.wp.st-andrews.ac.uk). Written responses to questions posed during the session are also available. In addition to the webinar recording, the DenMod website provides information on other workshops and on project outputs.

Minke whale.
Anne Smrcina

Project 37: Collection of AEP Thresholds in Minke Whales

The Project 37 team returned to Norway for this year's field season, scheduled for completion in late June. The project, funded in cooperation with the Subcommittee on Ocean Science and Technology Interagency Task Force on Ocean Noise and Marine Life (SOST ITF-ONML), is focused on obtaining in-situ auditory evoked potential (AEP) measurements of the hearing sensitivity of mysticetes. We will provide an update on their progress in the next newsletter.

RECENT PUBLICATIONS

This section includes recent publications and reports resulting from projects that are or have been partially or fully funded by the LMR program. The information provided in the publications is of significant value to the Navy's at-sea environmental compliance process and directly feeds into the National Environmental Policy Act, Marine Mammal Protection Act and Endangered Species Act compliance documentation.

And as a reminder, the full and updated Spring-22 publication spreadsheet, which includes these entries, is available on our website.

Becker, E.A., Forney, K.A., Miller, D.L., Barlow, J., Bracho, L.R., Urbán, J.R. and Moore, J.E. (2022). Dynamic habitat models reflect interannual movement of cetaceans within the California Current Ecosystem. *Frontiers in Marine Science*, DOI 10.3389/fmars.2022.829523. *(Note: this publication acknowledged using methods from a project funded through LMR, Project 31: The Working Group for the Advancement of Marine Species Density Surface Modeling project.)*

Coomber, F.G., Falcone, E.A., Keene, E.L. Cárdenas-Hinojosa, G., Huerta-Patiño, R. and Rosso, M. (2022). Multi-regional comparison of scarring and pigmentation patterns in Cuvier's beaked whales. *Mammalian Biology*. DOI 10.1007/s42991-022-00226-6.

Finneran, J.J., Mulsow, J., Strahan, M.G., Houser, D.S. and Burkard, R.F. (2022). Output compensation of auditory brainstem responses in dolphins and sea lions. *The Journal of the Acoustical Society of America*, 151(5):3070. DOI 10.1121/10.0010389.

Jacobson, E.K., Henderson, E.E, Miller, D.L., Oedekoven, C.S., Moretti, D.J. and Thomas, L. (2022). Quantifying the response of Blainville's beaked whales to U.S. naval sonar exercises in Hawaii. *Marine Mammal Science* (early view). DOI 10.1111/mms.12944.

California sea lion.
Josh Kaye-Carr, NOAA

Kastelein, R.A., Helder-Hoek, L., Defillet, L.N. Van Acoleyen, L. Huijser, L.A.E. and Terhune, J.M. (2022). Temporary hearing threshold shift in California sea lions (*Zalophus californianus*) due to one-sixth-octave noise bands centered at 0.6 and 1 kHz. *Aquatic Mammals*, 48(3), 248-265. DOI 10.1578/AM.48.3.2022.248.

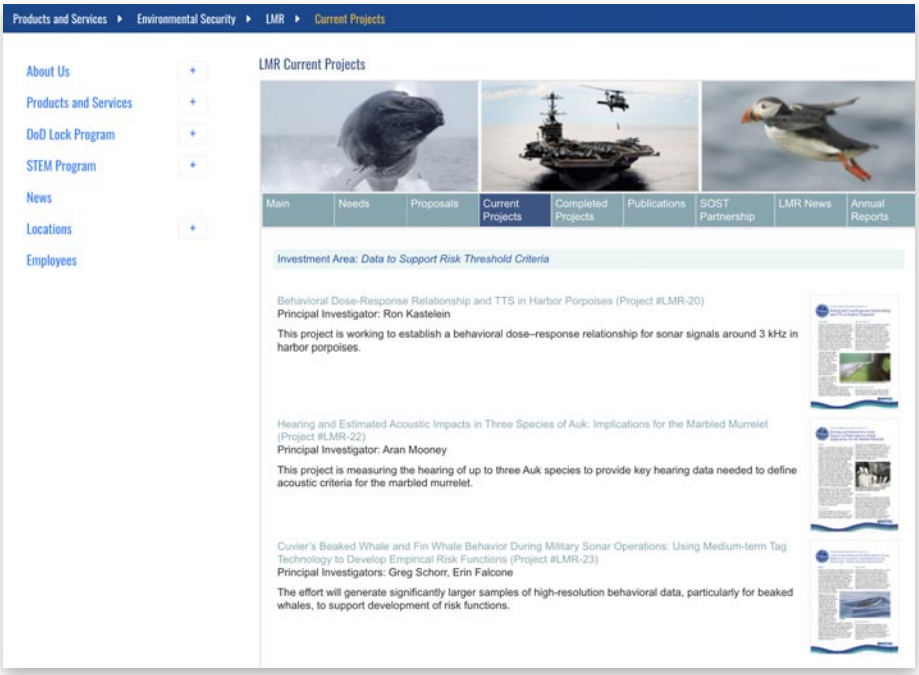
Miller, P.J.O., Isojunnoa, S., Siegala, E., Lam, F-P.A., Kvadsheim, P.H. and Curé, C. (2022). Behavioral responses to predatory sounds predict sensitivity of cetaceans to anthropogenic noise within a soundscape of fear. *The Proceedings of the National Academy of Sciences* (PNAS), 119 (13): e2114932119. DOI 10.1073/pnas.2114932119.

PROGRAM SCHEDULE

No.	What	When
1.	**Proposal Solicitation & Review**	
a.	FY22 Full Proposal Review	March–June 2022
b.	FY23 Needs Submission Deadline	10 June 2022
c.	FY23 Needs Approval	August 2022
d.	FY23 BAA Pre-proposal Solicitation Announcement	August/September 2022
2.	**Quarterly Status Reports (QSR)**	
a.	Submit summer QSR	July 30, 2022 (effort from April–June)
b.	Submit fall QSR	October 28, 2022 (effort from July–September)
c.	Submit winter QSR	January 31, 2023 (effort from October–December)
d.	Submit spring QSR	April 28, 2023 (effort from January–March)
3.	**In-progress Review**	**November 14–18, 2022**

OUR WEBSITE

At our website—exwc.navfac.navy.mil/lmr—you can find links to all our informational materials, including fact sheets, an updated publication spreadsheet and our most recent annual report. Note that this is a new address for the website.



LMR-RELATED PHOTOS—KEEP THEM COMING

We encourage all LMR participants to share photos of marine mammals, survey efforts, personnel who were involved and the equipment used. We'd like to include some of those images in a future issue of *LMR News* and give you credit—right there with your photo.

Cuvier's beaked whale .
Jenny Trickey, SEMARNAT permit SGPA/DVGS/00451/18

Surely among all of those photos from field work you have a few that you're particularly proud of. Please send them along, accompanied by a caption, photo credit and permit number (as applicable) and be sure that the photos are in high resolution format. Who knows, you may see one of those photos in a future issue of the LMR newsletter. Submit your photos via email to: exwc_lmr_program@navy.mil.

HELP WITH OUR MAILING LIST

If you want to subscribe to, or unsubscribe from, *LMR News*, please send your email address to Eric Rasmussen at eric.rasmussen@navy.mil.

CONTACT THE LMR PROGRAM

For more information about the LMR program and its operations, contact Anu Kumar, Program Manager, at exwc_lmr_program@navy.mil and 805-982-4853.

IN THE NEXT ISSUE OF *LMR NEWS*

Our next issue will provide available information on the new FY22 projects and project field efforts.

exwc.navfac.navy.mil/lmr

LMR INVESTMENT AREAS

The LMR program focuses its research funding in five investment areas:

1. Data to Support Risk Threshold Criteria

Collect data to improve the Navy's acoustic and explosive impact assessments and validate mitigation requirements, information critical to the Navy's environmental compliance and permitting process. This includes data on how well animals can hear, how and when animals may be exposed to acoustic and explosive sources, and how animals respond or are affected when exposed. Projects in this area can include hearing studies, sound exposure and behavioral response studies.

2. Data Analysis and Processing Tools

Make required monitoring program data processing and analysis more efficient and cost-effective. This includes developing tools to automate the processing of large amounts of data to reduce costs, increase efficiency and provide consistency. These tools support the Navy's environmental compliance process and permitting process. Projects in this area can include new detection and classification algorithms, improvements to software programs, or development of novel analytical methods.

3. Monitoring Technology Demonstrations

Continue to develop and demonstrate technologies that can improve field data collection methods. The technologies enable efficient and cost-effective implementation of the Navy's Marine Species Monitoring program. Examples include new monitoring technologies and platforms, including sensors, tags, moored devices, buoys, gliders and REMUS 600s.

4. Standards and Metrics

Work to establish interagency and scientific community standards and metrics for data collection, management and analysis. This promotes data comparability and enables data aggregation from different data sets. It ensures consistent, agreed-upon standards and metrics in order to provide cost-effective improvements to data and results that can be incorporated into the environmental compliance process. Projects in this area can include standards for data collection methods, standardized data management tools, and new metrics for reporting performance of data analysis methods.

5. Emergent Topics

This investment area is reserved for other priority topics needed by the Navy that may come up and do not fall within the preceding topics.