

LMR news

ISSUE 35

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.



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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 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 preserves 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.

PROGRAM OFFICE INSIGHTS

In this update to LMR activities, we discuss proposal reviews, announce new projects, highlight recently attended meetings and workshops (see the LMR Program Participants Update section), and provide a Project Spotlight on the completed project "Multi-spaced Measurement of Underwater Sound Fields from Explosive Sources." In addition, see the Recent Publications section for 13 new publication citations.



Program Manager Anu Kumar and Deputy Program Manager Mandy Shoemaker.

Program staff and LMRAC members have reviewed pre-proposals that were submitted in response to our Fiscal Year 2024 (FY24) solicitation. Full proposals have been requested for a subset of the submissions. We anticipate completing project selection by June 30.

We have four new projects from earlier submissions to announce.

Investment Area	Project Number & Title	Principal Investigator(s)	Need
Data to Support Risk Threshold Criteria	Project 69—Effect of Signal Duration on Perceived Loudness in Bottlenose Dolphins and California Sea Lions	Alyssa Accomando	N-0239-21: Relationship Between Perceived Loudness of a Signal and Signal Length
Data to Support Risk Threshold Criteria	Project 70—Behavioral Observations of Marine Mammals Around Impulsive Noise (BOOMIN)	Erin Falcone Stephanie Watwood	N-0281-23: Research that Pertains to the LMR Program Investment Area <i>Data to Support Risk Threshold Criteria</i>
Data to Support Risk Threshold Criteria	Project 71—Masking Parameters for Pinnipeds: The Effects of Noise Bandwidth and Level on Signal Detection	Colleen Reichmuth Jillian Sills	N-0281-23: Research that Pertains to the LMR Program Investment Area <i>Data to Support Risk Threshold Criteria</i>
Monitoring Technology Demonstrations	Project 68—Thermal Imaging for Vessel Strike Mitigation on Autonomous Vessels	Daniel Zitterbart	N-0279-23: Automated Detection of Marine Mammals for Unmanned Surface Vessel Strike Avoidance

IN-PROGRESS REVIEW

A heads up to all principal investigators (PI) and LMR Advisory Committee (LMRAC) members that the 2024 In-progress Review (IPR) is scheduled for the week of December 9, 2024. All PIs and LMRAC members will receive email from Anu Kumar and Mandy Shoemaker with additional details.

PROJECT STATUS UPDATES

Project 45—Frequency-dependent Underwater TTS in California Sea Lions

Principal investigator Ron Kastelein has initiated a new task that was added to this project. A sea lion that was previously tested for temporary threshold shift while free swimming is in training for stationary testing. The new testing will cover three frequencies: 4, 16 and 32 kHz. These three frequencies were also tested during the free-swimming testing and will provide an important methods comparison for hearing results.



California sea lion at SEAMARCO.
Ron Kastelein

LMR PROJECT SPOTLIGHT

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

For this issue we present an overview of a recently completed project from Investment Area 5: Emergent Topics.

Multi-spaced Measurement of Underwater Sound Fields from Explosive Sources

This project was established to collect underwater acoustic field measurements associated with explosive detonations near the water surface to validate results from the Navy Acoustic Effect Model (NAEMO).

The project team was led by Peter Dahl from the acoustics department at the University of Washington Applied Physics Laboratory and included David Dall'Osto (University of Washington Applied Physics Laboratory) and Altan Turgot (Naval Research Laboratory). After persisting through multiple delays caused by COVID-19 restrictions early in the project, the team successfully conducted an experimental field effort off the coast of San Clemente Island, California in July 2023. All detonations were carried out by a Navy explosive ordnance disposal team (EODMU3 DET SW).

The field effort entailed measuring the underwater acoustic field around a series of detonations. Six detonations were conducted, ranging in size from 10 to 40 pounds (C-4 explosive). For each detonation, the C-4 was tethered to a buoy, designed to sit just below the water surface (roughly 25 cm). The overall depth of the water at the study site was approximately 1300 meters. During the detonation phase of the experiment two marine mammal observers stationed on the research vessel (R/V *Diane G*) monitored the mitigation zone. No marine mammals were visually observed.

An overview of the 25 July trial (Figure 1) shows the experimental geometry in terms of measurement range and depth for four acoustic measurement stations identified as 0, 1, 2, 3. The exact location of



Some members of the teams participating in the 25 July 2023 trial. Acoustic measurements: NRL (top) and APL-UW (center). Mammal observation: Marine Ecology and Telemetry Research (bottom).

Anu Kumar

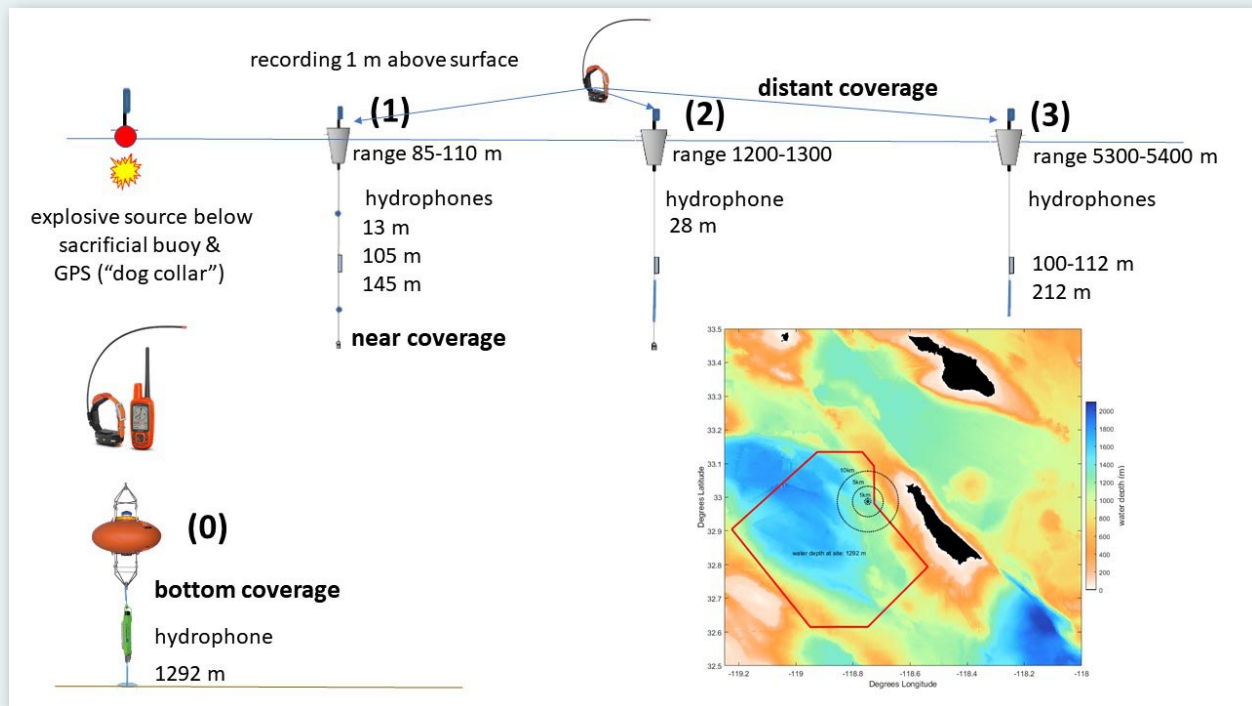


Figure 1: Experimental geometry for the 25 July trial based on four measurement stations identified as 0, 1, 2, 3 and explosive source station (upper left). A planned location identified the explosive source station with the exact location at the time of each detonation determined by a sacrificial GPS device. Plan view of the experimental area (lower right) shows location west of San Clemente Island.

receiving stations 1–3 was determined by a GPS device mounted at each acoustic measurement station. This information was then used in combination with the location of the explosive source buoy (upper left) at the time of each detonation, which was determined by sacrificial GPS devices. The range and depth data as shown represent actual depths as determined post-experiment. The measurement range shown for station 1 (e.g., 85–110 m) reflects the small variation of the source location for each new detonation. For station 1, the goal was to try and keep that station roughly 100 meters from the explosive source (Figure 2). Measurement stations 2 and 3 were designed to drift over the course of all the detonations, which provided a variety of measurement distances.

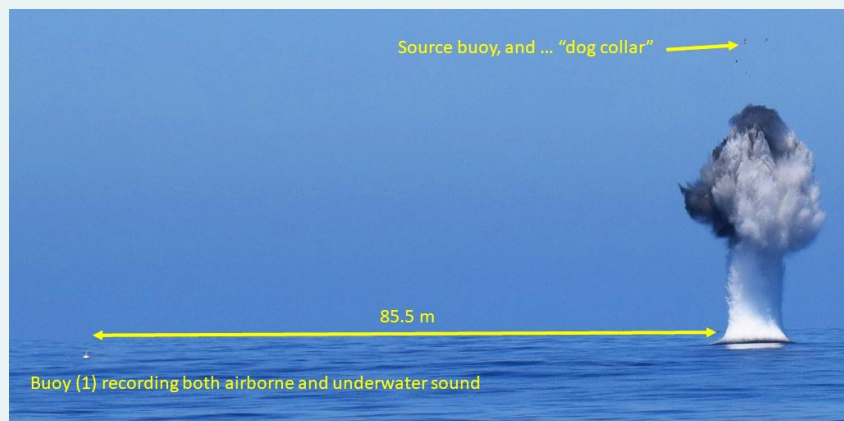


Figure 2: The exact instant of the detonation of a 40 lb. C-4 explosive. Measurement station 1 is seen 85.5 m from detonation. The source location was determined by a sacrificial GPS system. Remnants of the explosive source buoy and GPS unit can be in the air (approximate height of 50 m).

Mandy Shoemaker

This field trial produced a calibrated dataset of underwater acoustic recordings of six near-surface explosions measured at a variety of ranges and depths. The dataset included environmental and meta data necessary for the NAEMO team to use these results to compare against the NAEMO modeling results using the provided input data.

An animal tagging component added to the July 2023 field effort was conducted by members of Marine Ecology and Telemetry Research. They were tasked with tagging as many animals as they could in the days leading up to the field test detonations. In total, they were able to tag two fin whales, two Cuvier's beaked whales and a blue whale. These data will be analyzed for any potential behavioral reactions to the explosive detonations as part of a new project beginning in 2024, Project 70—Behavioral Observations of Marine Mammals Around Impulsive Noise (BOOMIN).

In addition to the primary goal of this project, as described above, an additional task was added during the delay caused by the COVID pandemic. Project team members from the Applied Physics Laboratory were tasked with providing one of the environmental teams on the Navy's full ship shock trial (FSST) with a portable device for measuring the explosive signal. Specifically, the APL team assembled an easy-to-use portable sound recording package capable of recording high-intensity acoustic fields from explosive sources and trained personnel on an environmental support vessel to deploy and retrieve it.

The team completed data analyses that included existing oceanography data for the area and measurements taken during the FSST. Following analyses and full quality control checks, the team transferred data to the NAEMO group. The results will complement recordings taken in the broader effort under the completed Project 48—Collection of *in situ* Acoustic Data for Validation of U.S. Navy Propagation Models of Ship Shock Trial Sound Sources, which the NAEMO group will be analyzing.

The data collected from both efforts 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.



PROGRAM PARTICIPANT UPDATES

LMR program managers, Anu Kumar and Mandy Shoemaker, participated in several notable meetings during the last few months. In January they met with NAVFAC HQ and OPNAV N4I to update leadership on the overall status and accomplishments of the LMR program. The discussions highlighted a growing interest in research about an invasive marine species affecting Pearl Harbor, Hawaii, as well as interest in research on the effects of in-water construction activities to marine species. These are two new research areas that the LMR program will continue to explore for potential future investment.

In March the LMR program participated in the NOAA-organized Right Whale Strike Avoidance Technology Workshop. This meeting included several stakeholders from federal

agencies, non-government organizations and industry. The workshop included discussions about the status of vessel-based right whale detections systems to help avoid ship strikes. Over the past decade, the Office of Naval Research has invested in research on using thermal imaging cameras to detect whale blows. LMR is currently investing in a project (Project 68—Thermal Imaging for Vessel Strike Mitigation on Autonomous Vessels) to advance this technology and to demonstrate its application to the Navy's

unmanned surface vessels. The Navy will continue to share the results of this demonstration with the scientific community, in hopes of advancing the technology for other broader applications.

Also, in March and April the LMR program managers participated in program review meetings held by its two key Navy marine program partners, the Navy's Marine Species Monitoring Program and the Office of Naval Research Marine Mammals and Biology Program. The LMR program works closely with these two other Navy research programs to invest in research and monitoring to understand potential effects of Navy activities on marine species. These program review meetings provide the LMR program with important insights on both future research need topics and those research efforts that may need additional development prior to application in the Navy's monitoring program and environmental compliance process.



Right whale.

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.

Branstetter, B.K., Nease, K., Accomando, A.W., Davenport, J., Felice, M., Peters, K. and Robeck, T. (2023). Temporal integration of tone signals by a killer whale (*Orcinus orca*). *The Journal of the Acoustical Society of America*, 154(6):3906-3915.
DOI 10.1121/10.0023956.

Chudzińska, M., Klementisová, K., Booth, C. and Harwood, J. (2024). Combining bioenergetics and movement models to improve understanding of the population consequences of disturbance. *Oikos*, e10123. DOI 10.1111/oik.10123.

Finneran, J.J., Lally, K., Mulsow, J. and Houser, D.S. (2024). Dolphin short-term auditory fatigue and self-mitigation. *The Journal of the Acoustical Society of America*, 155(3):2241-2246.
DOI 10.1121/10.0025387.

Gransier, R. and Kastelein, R.A. (2024). Similar susceptibility to temporary hearing threshold shifts despite different audiograms in harbor porpoises and harbor seals. *The Journal of the Acoustical Society of America*, 155(1):396-404. DOI 10.1121/10.0024343.

Helble, T.A., Alongi, G., Guazzo, R.A., Allhusen, D.R., Martin, C., Martin, S.W. and Henderson, E. (2024). Swimming and acoustic calling behavior attributed to Bryde's whales in the central North Pacific. *Frontiers in Marine Science*, 11. DOI 10.3389/fmars.2024.1305505.

Jenkins, K.A., Kotecki, S.E., Dahl, P.H., Bowman, V.F., Casper, B.M., Boerger, C. and Popper, A.N. (2023). Physical Effects from Underwater Explosions on Two Fish Species. In: Popper, A.N., Sisneros, J., Hawkins, A.D., Thomsen, F. (eds) *The Effects of Noise on Aquatic Life*. Springer, Cham. DOI 10.1007/978-3-031-10417-6_70-1.



Killer whale.

Kastelein, R.A., Helder-Hoek, L., Defiliet, L.N., Terhune, J. M., Beutelmann, R. and Klump, G. M. (2023). Masking release at 4 and 32 kHz in harbor seals associated with sinusoidal amplitude-modulated masking noise. *The Journal of the Acoustical Society of America*, 154(1):81–94. DOI 10.1121/10.0019631.

Kastelein, R.A., Smink, A. and Jennings, N. (2023). Atlantic Green Turtles and Hawksbill Turtles: Behavioral Responses to Sound. In: Popper, A.N., Sisneros, J., Hawkins, A.D., Thomsen, F. (eds) *The Effects of Noise on Aquatic Life*. Springer, Cham. DOI 10.1007/978-3-031-10417-6_75-1.

Pardini, M.R., Mulsow, J., Schlundt, C., Accomando, A. and Finneran, J. (2023). Bottlenose dolphin (*Tursiops truncatus*) temporary threshold shift in response to frequency-modulated and pure-tone exposures centered at 28 kHz. *The Journal of the Acoustical Society of America*, 154, A18. DOI 10.1121/10.0022645.

Publications that included data from or work in cooperation with LMR projects

Baumann-Pickering et al. (2023). Geographic differences in Blainville's beaked whale (*Mesoplodon densirostris*) echolocation clicks. *Diversity and Distributions*, 29:478–491. DOI 10.1111/ddi.13673.

Hin, V., de Roos A.M., Benoit-Bird, K.J., Claridge, D.E., DiMarzio, N., Durban, J.W., Falcone, E.A., Jacobson, E.K., Jones-Todd, C.M., Pirotta, E., Schorr, G.S., Len Thomas, L., Watwood, S. and Harwood, J. (2023). Using individual-based bioenergetic models to predict the aggregate effects of disturbance on populations: A case study with beaked whales and Navy sonar. *PLoS ONE* 18(8):e0290819. DOI 10.1371/journal.pone.0290819.

Macaulay, J.D.J., Rojano-Doñate, L., Ladegaard, M., Tougaard, J., Teilmann, J., Marques, T.A., Siebert, U. and Madsen, P.T. (2023). Implications of porpoise echolocation and dive behaviour on passive acoustic monitoring. *The Journal of the Acoustical Society of America*, 154(4):1982-1995. DOI 10.1121/10.0021163.

Buckland, S. T., Borchers, D.L., T.A. Marques and Fewster, R.M. (2023). Wildlife Population Assessment: Changing Priorities driven by Technological Advances. *Journal of Statistical Theory and Practice*, 17, 20. DOI 10.1007/s42519-023-00319-6

As a reminder, the full and updated publication spreadsheet, which includes these entries, is available on our website.

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.

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 annual reports.

LMR Publications

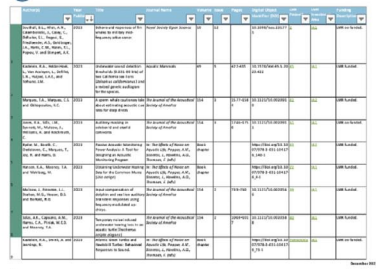
Main
Needs
Proposals
Current Projects
Completed Projects
Publications
SOST Partnership
LMR News
Annual Reports

Building on our quarterly publication listings, and recognizing the value of the publications generated over the life of the LMR program, we are excited to announce our latest [Fall 2023 issue](#). The below Excel file is a list of publications that were partially or fully funded by the LMR program. The list includes publications from 2013 to the current year, and will be updated quarterly as new publications become available. The below figure is a summary of how these publications are distributed amongst our five Investment Areas. These publications are of great value to the Navy's at-sea environmental compliance process, as well as the scientific community, and directly feed into the NEPA, MMPA, and ESA compliance documentation.

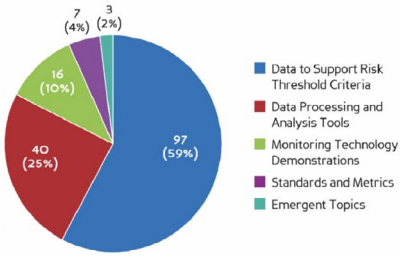
As an introduction, the [Excel file](#) includes three tabs: LMR Publications, LMR Project List, and LMR Investment Areas. Each publication is linked to the relevant LMR project and LMR investment area, so that readers can learn more information. A column titled 'Funding Description' is included to recognize when publications were co-funded by other programs or agencies. If there are any errors, please email exwc_lmr_program@us.navy.mil so that any necessary corrections can be made.

Click on image to download publications list

Publications List Fall-23



Publications by Investment Area



Investment Area	Count	Percentage
Data to Support Risk Threshold Criteria	97	59%
Data Processing and Analysis Tools	40	25%
Monitoring Technology Demonstrations	16	10%
Standards and Metrics	7	4%
Emergent Topics	3	2%

PROGRAM SCHEDULE

No.	What	When
1.	Proposal Solicitation & Review	
a.	FY24 Revised Pre-proposals Due	April 15, 2024
b.	FY24 Proposal Selection Complete	June 30, 2024
2.	Quarterly Status Reports (QSR)	
a.	Submit spring QSR	April 30, 2024 (effort from January–March)
b.	Submit summer QSR	July 31, 2024 (effort from April–June)
c.	Submit fall QSR	October 31, 2024 (effort from July–September)
d.	Submit winter QSR	January 31, 2025 (effort from October–December)
3.	In-progress Review	December 2024

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.

Surely among all 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@us.navy.mil.



Anna Selbmann, Iceland Marine and Freshwater Institute permit

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CONTACT THE LMR PROGRAM

Note that we have had a slight change in our program email address. It now includes 'us.' before navy.mil. For more information about the LMR program and its operations, please use this new format to contact Anu Kumar, Program Manager, at EXWC_LMR_program@us.navy.mil and 805-982-4853.

IN THE NEXT ISSUE OF *LMR NEWS*

Our next issue will provide available information on the proposal review process, project updates and our soon-to-be-released 2023 annual report.

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