LMR news

WINTER 2020

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 Energy and Environmental Readiness Division (OPNAV N45) 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.

PROGRAM OFFICE INSIGHTS

Meetings, conferences, our annual program brief and pre-proposal reviews kept program staff busy in the past quarter.

The 2019 LMR In-progress Review (IPR) was held November 4–7. Highlights are provided later in this issue.

The LMR program was one of the co-sponsors of the World Marine Mammal Conference, held in December in Barcelona, Spain. Prior to the conference, the Density Modeling (DenMod) working group held meetings to further project efforts. See the Program Participants Updates section for more information.

Anu Kumar, Program Manager

Anu Kumar and Mandy Shoemaker traveled to Washington, D.C. to provide their annual update on LMR program progress to the key senior Navy environmental professionals. The meetings with Mr. Larry Douchand (NAVFAC HQ), Dr. Susan Goodfellow (OPNAV N45) and Mr. Matt Senska (Office of the Deputy Assistant Secretary of the Navy for Environment (DASN(E)), provide critical exchange of information on LMR projects, how they support Navy efforts and future expectations.

The program's request for pre-proposals for Fiscal Year 2020 (FY20) closed November 12, 2019. With the three specific need topics (see sidebar), the solicitation resulted in numerous pre-proposals. The program staff and the LMR Advisory Committee (LMRAC) are wrapping up their review of the pre-proposals. Depending on available funding, the most promising submissions will be asked to submit full proposals.

As noted in our Fall-19 newsletter, the LMR program also submitted a research topic under the Small Business Innovation Research (SBIR) program, which was selected for the September SBIR Broad Agency Announcement (BAA) Solicitation. The BAA solicitation period closed on October 23, 2019. Comments and recommendations from the LMR program to SBIR were submitted January 31, 2020. Announcement of the three selected Phase I performers is expected by early May.

FY20 NEED TOPICS

1. **N-0228-20:** Marine Mammal Acoustic Software Application Enhancements
2. **N-0225-20:** Marine Mammal Conditioned Attenuation of Hearing Sensitivity
3. **N-0224-20:** Frequency-dependent, Underwater, Temporary Threshold Shift in California Sea Lions

As final note, we were saddened to learn of Dr. Whitlow Au's passing. Dr. Au's pioneering work in dolphin and whale echolocation significantly advanced our understanding of marine mammal bio-sonar and our ability to study acoustic behavior. On a personal level, Dr. Au had a major influence on my interest in studying bioacoustics. I admired his knowledge of engineering and science, and how he applied his knowledge to developing technology to study marine mammal acoustics. Most of all, I admired his dedication to the next generation of scientists. He found time to mentor those who reached out to him, even if they were not his graduate students. I will never forget the influence he had on me and the field of bioacoustics.

—Anu

LMR PARTNERSHIP UPDATES

Each year the LMR program obtains an allotment of sonobuoys that are available for research. These sonobuoys are playing 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 2020 requests for sonobuoys. Projects and organizations receiving sonobuoys in 2020 are listed in the following table.

Project	Organization
North Atlantic Right Whale shipboard and aerial surveys	NOAA Northeast Fisheries Science Center
Gulf of Mexico Bryde's whale surveys	NOAA National Marine Fisheries Service Southeast
NOAA Pacific Marine Environmental Laboratory surveys	NOAA Marine Mammal Laboratory/Alaska Fisheries Science Center
Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS)	NOAA Pacific Islands Fisheries Science Center

LMR PROGRAM PARTICIPANT UPDATES

The LMR program manager and deputy program manager participated in the 2019 World Marine Mammal Science Conference (WMMC), co-hosted by the Society for Marine Mammalogy and the European Cetacean Society. The conference was attended by 2,500 scientists, managers, policy makers and students from around the world. The LMR program presented a poster that provided an overview of the program, its mission and types of research conducted. LMR also supported the Navy's Stewards of the Sea information booth, which was visited by more than 800 people during the week. This international forum provided valuable opportunities for publicizing Navy marine species research and monitoring efforts and identifying new research results that could contribute to Navy projects.

Prior to the WMMC conference, the Density Modeling (DenMod) working group held a workshop to further project efforts. The working group, coordinated under a project funded in part by the LMR program, is working 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 recent workshop, attended by more than 100 participants, provided progress updates on the priority research areas identified at the first workshop that was held prior to the Society for Marine Mammalogy's Biennial Conference in 2017. The workshop focused on extrapolating density surface models beyond collected data and presented an online resource for common questions and practical problems that researchers encounter when using density surface models. The workshop was well received and participants provided positive feedback regarding accomplishments thus far and the direction that the overall project intends to go. A report on the workshop is available at https://synergy.st-andrews.ac.uk/denmod/.

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.

LMR PROJECT SPOTLIGHT

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

For this issue we present an overview of a soon-to-be completed project in the *Data to Support Risk Threshold Criteria* investment area.

Blainville's Beaked Whale Behavioral Risk Function for Hawaiian Populations

Blainville's beaked whale.
NOAA/NMFS

The Navy conducts acoustic impact assessments as part of the environmental regulatory framework for permitting at-sea training and testing activities. These assessments incorporate behavioral risk functions developed for groups of marine mammals, one of which is beaked whales. The behavioral risk function currently in use by the Navy incorporated data from Blainville's beaked whales (*Mesoplodon densirostris*) found at the Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas.

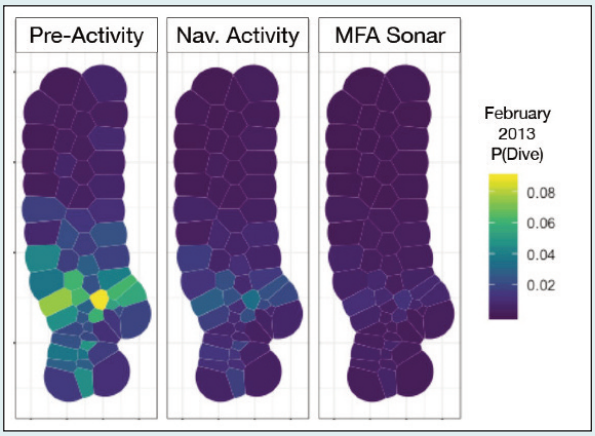
The primary goal of this project was to develop the first behavioral risk function for Blainville's beaked whales found on the Pacific Missile Range Facility (PMRF) undersea hydrophone range in Hawaii. It was designed to provide a direct comparison of risk functions derived for the same species, exposed to the same acoustic source types, in different ocean basins.

The project adapted the methods used at AUTEC to animal detections at PMRF and demonstrated how the methodology can be extended for use in different locations. A number of differences between the AUTEC and PMRF undersea hydrophone ranges required adjustments to the model used to develop the behavioral risk functions for Blainville's beaked whales at AUTEC. Differences include lower animal densities, more variable hydrophone spacing at PMRF and significantly different seafloor substrate and contours, which affect sound propagation.

The project was initiated in 2016 by Dave Moretti (now retired) from the Naval Undersea Warfare Center Newport and has been continued by co-principal investigators Len Thomas from the University of St Andrews Centre for Research into Ecological and Environmental Modeling (CREEM) and Elizabeth Henderson from the Naval Information Warfare Center (NIWC) Pacific. This team first applied the AUTEC model to available acoustic data collected on the PMRF hydrophones to identify additional data needs and model modifications. The existing data were from a previously conducted

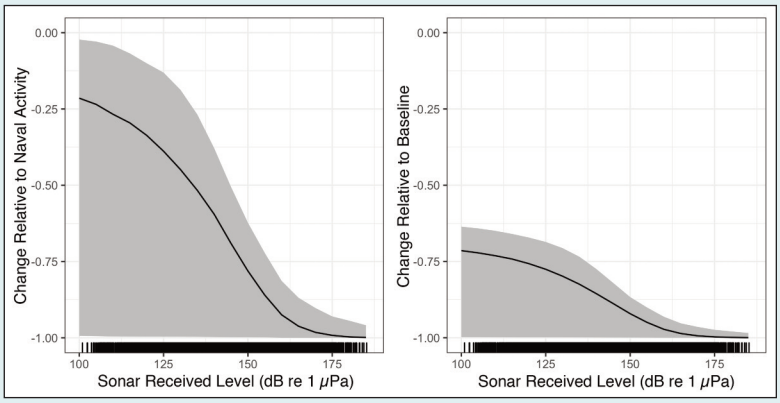
Submarine Command Course (SCC) training event. Those data were used to identify presence of Blainville's beaked whale group vocalization signals and sonar signals and to estimate received levels per group.

Building from the initial effort, the team expanded the data set to include multiple SCC events and modified the model to include three sub-models. One is a baseline spatial model (M1), which uses data collected prior to the SCCs, to account for uneven hydrophone spacing, to address variability of data available from different hydrophones and different SCCs and to incorporate the underlying distribution of Blainville's beaked whales. Because initial analyses indicated that vocalizations appeared to decrease at the onset of training activity, prior to the use of hull-mounted MFA sonar, a second model for training activity (M2) was developed to separate the expected decrease in vocalizations due to training activity from the expected decrease due to MFA sonar. This model uses the output of M1 to account for variability in hydrophone data and beaked whale distribution. The third model (M3) describes the probability of detecting groups of animals as a function of sonar received level (RL), with an offset for the initial decrease found due to training activity (M2).



Expected probability of acoustically detecting groups of Blainville's beaked whales (color scale) before (left panel), during training activity (middle panel) and during hull-mounted MFA sonar (right panel) at PMRF range hydrophones in February 2013.

These three models are used to calculate the expected percentage change in probability of detecting a group of whales between the baseline period (M1) and training activity (M2) and between the baseline period (M1) and different levels of sonar RL (M3).



Expected change (black line) in the probability of acoustically detecting Blainville's beaked whales (y-axis) with increasing received levels of hull-mounted MFA sonar (x-axis) as compared to periods when Naval training activity is present (left panel) and as compared to a pre-activity baseline period (right panel). Gray shading indicates 95% CIs.

The project, which is nearing completion, will contribute an empirical dose-response response function for SCCs at PMRF that can provide Navy environmental compliance analysts with data-based input to the next generation Navy Behavioral Response Criterion for Blainville's beaked whale. Methods and results were presented at the World Marine Mammal Conference in Barcelona, Spain in December 2019, and will also be available through a peer-reviewed publication in 2020.

IN-PROGRESS REVIEW 2019

LMR principal investigators (PI), LMRAC members and program staff again convened for our annual review of program projects. This year we had 28 project briefs presented over three days. Of those, four were final briefs of projects soon to be completed, 16 were ongoing projects and the remaining eight were introductory briefs on new projects. The new project briefs included two projects recently funded under the Subcommittee on Ocean Science and Technology (SOST) partnership. (For more on both the LMR and SOST new start projects, see our Summer-19 issue of *LMR News*.)

The four projects presenting final briefs were:

1. **Project 18: *Acoustic Metadata Management for Navy Fleet Operations***

   Marie Roch, from San Diego State University, discussed project efforts to expand the development of the Tethys passive acoustic monitoring metadata database, to improve its utility for long-term Navy monitoring data management and to strive toward consistent data standards that will promote monitoring data compatibility. Updated Tethys software is available for Navy stakeholders, including the Navy's Marine Species Monitoring Program. This project also has received support from the U.S. Bureau of Ocean Energy Management (BOEM).

2. **Project 20: *Dose Behavioral Response and Temporary Threshold Shift in Harbor Porpoises***

   Ron Kastelein, SEAMARCO, presented work completed for this project. The project established dose-behavior response of sound pressure thresholds of 53-C sound exposures under both quiet and noise conditions. It also measured sound exposure levels associated with temporary threshold shifts (TTS) and hearing recovery for five fatiguing sound frequencies (0.5, 16, 32, 63 and 88.4 kHz). All exposure testing is complete, six of nine planned manuscripts have been completed and published, one more has been submitted for review and two are in process. The results will be incorporated into updates to the Navy's Phase IV behavioral response curve and high-frequency cetacean TTS exposure function.

Harbor porpoise.
NOAA

3. Project 25: *Blainville's Beaked Whale Behavioral Risk Function for Hawaiian Populations*

Len Thomas, University of St Andrews, shared the status of this project. A project overview in this issue's Project Spotlight section provides details.

Blainville's beaked whale.
Mark Deakos, NMFS permit 14451

4. Partnership Project: *Developing Tools for Acoustic-only Behavioral Response Studies at Navy Instrumented Ranges*

This project, led by Tyler Helble (Naval Information Warfare Center, Pacific), has focused on developing three tools needed to conduct basic behavioral response assessments from passive acoustic monitoring (PAM) data on Navy ranges. The tools—acoustic modeling software interface, automated track kinematics software and automated classification of track information—will immediately support a broader Office of Naval Research project called Acoustic-Only Behavioral Response Study (BREVE) and will be available to the Navy Marine Species Monitoring program and for Pacific Missile Range Facility monitoring reports.

This annual gathering is an important part of managing LMR-funded projects to promote effective outcomes. For PIs new to the LMR program, briefs from program management and the program sponsor help to clarify how these projects address Navy needs, while seeing briefs from ongoing projects provides examples for future presentations. The project briefs also stimulate valuable information exchange between PIs and the Navy's representatives on the LMRAC to ensure projects are on-track to support Navy needs. Discussions among PIs also enhance the connections among similar projects, which leverages project efforts. Finally, the meeting also is a venue for the LMRAC members to meet in person and discuss among themselves how LMR projects can help to meet their commands' specific needs, to identify any changes that might be needed and to prepare for project results to be successfully transitioned to end-users.

We want to remind PIs and LMRAC members to mark their calendars for 2020 LMR IPR, which will be held the week of December 1, 2020.

RECENT PUBLICATIONS

This section includes recent publications and reports resulting from projects that are 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.

2020

Baumgartner, M.F., Bonnell, J., Corkeron, P.J., Van Parijs, S.M., Hotchkin, C., Hodges, B.A., Thornton, J.B., Mensi, B.L. and Bruner, S.M. (2020). Slocum gliders provide accurate near real-time estimates of baleen whale presence from human-reviewed passive acoustic detection information. *Frontiers in Marine Science*, February 2020; DOI: 10.3389/fmars.2020.00100.

Fregosi, S., Harris, D.V., Matsumoto, H., Mellinger, D.K., Negretti, C., Moretti, D.J., Martin, S.W., Matsuyama, B., Dugan, P.J. and Klinck, H. (2020). Comparison of fin whale 20 Hz call detections by deep-water mobile autonomous and stationary recorders. *The Journal of the Acoustical Society of America* 147, 961 (2020); DOI: 10.1121/10.0000617.

Helble, T.A., Guazzo, R.A., Martin, C.R., Durbach, I.N., Alongi, G.C., Martin, S.W., Boyle, J.K., and Henderson, E.E. (2020). Lombard effect: Minke whale boing call source levels vary with natural variations in ocean noise. *The Journal of the Acoustical Society of America* 147:2, 698-712. DOI: 10.1121/10.0000596.

2019

Finneran, J.J., Mulsow, J., and Burkard, R.F. (2019). Signal-to-noise ratio of auditory brainstem responses (ABRs) across click rate in the bottlenose dolphin (*Tursiops truncatus*). *The Journal of the Acoustical Society of America*, 145, 1143. DOI:10.1121/1.5091794.

Friedlaender, A.S., Bowers, M.T., Cade, D., Hazen, E.L., Stimpert, A.K., Allen, A.N., Calambokidis, J., Fahlbusch, J., Segrem, P., Visser, F., Southall, B.L. and Goldbogen, J.A. (2019). The advantages of diving deep: Fin whales quadruple their energy intake when targeting deep krill patches. *Functional Ecology*, 00:1–10. DOI: 10.1111/1365-2435.13471

Miller, D. L., Glennie, R., Seaton, A. E. (2019) Understanding the stochastic partial differential equation approach to smoothing. *Journal of Agricultural, Biological, and Environmental Statistics*. DOI: 10.1007/s13253-019-00377-z

Pedersen, E.J., Miller, D.L., Simpson, G.L. and Ross, N. (2019) Hierarchical generalized additive models in ecology: an introduction with mgcv. *PeerJ* 7:e6876. DOI: 10.7717/peerj.6876

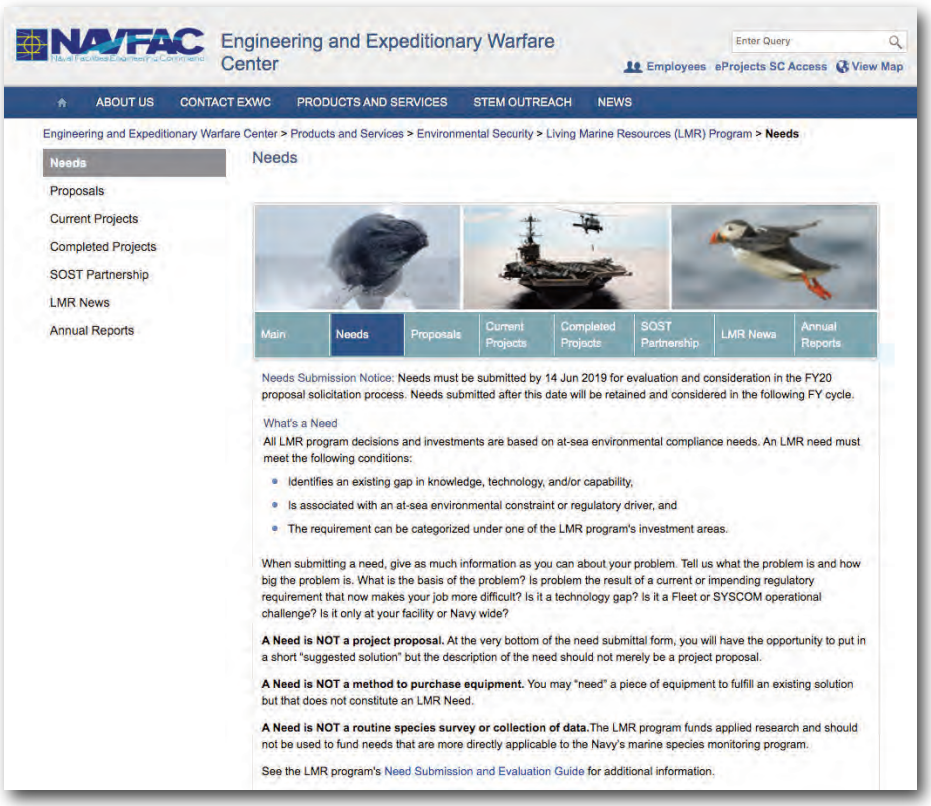
For lists of other publications, please see our annual program reports and recent issues of *LMR News*.

PROGRAM SCHEDULE

No.	What	When
1.	**Proposal Solicitation & Review**	
a.	FY20 proposal review	March/April, 2020
b.	FY20 proposal decisions	May, 2020
2.	**Quarterly Status Reports (QSR)**	
a.	Submit spring QSR	April 30, 2020
b.	Submit summer QSR	July 31, 2020
c.	Submit fall QSR	October 30, 2020
d.	Submit winter QSR	January 29, 2021

OUR WEBSITE

You can find links to all of our informational materials, including our 2018 annual report, at our website—www.navfac.navy.mil/lmr.



www.navfac.navy.mil/lmr

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 the LMR newsletter and give you credit—right there with your photo.

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

Atlantic puffin.
Aran Mooney

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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 information on project field efforts, proposal reviews and more as available.