



LMR news

SCIENCE • STEWARDSHIP • NAVY READINESS

SUMMER 2017

Welcome!

Welcome to the summer 2017 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 mammals—their occurrence in training areas and potential exposure, response and consequences.

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Right whale.

Brenda K. Rone, NOAA/AFSC/NMML,
permit 782-1719



WHO WE ARE

The LMR program is one of the 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 mission of the LMR program is to improve the best available science regarding the potential impacts to marine species from Navy activities, and improve the technology and methods available to the U.S. Navy Marine Species Monitoring program, while preserving core Navy readiness capabilities.

PROGRAM OFFICE INSIGHTS

New project starts and requests for pre-proposals are key highlights of this past quarter.

We have four new project starts now underway:

1. 3S³: Behavioral Responses of Sperm Whales to Naval Sonar, Principal Investigators (PI): Frans-Peter Lam, Petter Kvadsheim, and Patrick Miller. (For more on this project, see our Project Spotlight section.)
2. Measuring Effect of Range on Behavioral Response of Marine Mammals Through the Use of Navy Sonar, PI: Stephanie Watwood.
3. DenMod: Working Group for the Advancement of Marine Species Density Surface Modeling, PI: Len Thomas.
4. Behavioral Assessment of Auditory Sensitivity in Hawaiian Monk Seals, PI: Colleen Reichmuth.

Looking ahead to projects for Fiscal Year 2018 (FY18), we have posted our Broad Agency Announcement (BAA) for pre-proposals. For FY18 funding the LMR program is focused on one topic area related to underwater sound: In-situ explosive sound characterization and propagation data collection and analysis. The need topic can be viewed within the BAA (solicitation number N39430-17-R-7207) at www.neco.navy.mil, www.fbo.gov, or at <http://greenfleet.dodlive.mil/environment/lmrproposals>.

Note that our website address and procedures for pre-proposal submission have changed. The pre-proposal submittal process is now an email-based submission. Instructions, forms and reference documents can be found on the LMR website at <http://greenfleet.dodlive.mil/environment/lmrproposals>. Completed pre-proposal forms are to be submitted via email to exwc_lmr_program@navy.mil. All pre-proposal submissions must be received no later than 11:59 p.m., Pacific Daylight Time on 17 October, 2017.



Anu Kumar, Program Manager

PROGRAM INVESTMENT AREAS

The LMR program's five key investment areas are:

1. Data to Support Risk Threshold Criteria

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).

2. Improved Collection and Processing of Protected Species Data in Areas of Navy Interest

Develop methods to improve the ability to process large amounts of marine species data and provide cost-effective solutions to enhance marine species monitoring capabilities (e.g., new detection and classification algorithms, automated processing tools for passive acoustic monitoring data).

3. Monitoring and Mitigation Technology Demonstrations

Demonstrate technologies that offer to enhance marine species monitoring capabilities (e.g., new passive acoustic monitoring technologies and platforms such as gliders).

4. Standards and Metrics

Establish interagency and scientific community standards and metrics to evaluate marine species data to provide comparable results (e.g., standards for hearing studies, detector and classifier performance analysis standards).

5. Education and Outreach, Emergent Opportunities

Support education and outreach on LMR-funded research investments and new scientific methods

available to the broader scientific community. Emergent research topics of priority interest to the Navy (e.g., LMR website and program outreach on investments, Introduction to Density Estimation from Acoustics (IDEA) training, other study topics needed by the Navy).



Orcas.
Brandon Southall, NMFS/OPR

<http://greenfleet.dodlive.mil/LMR>

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.

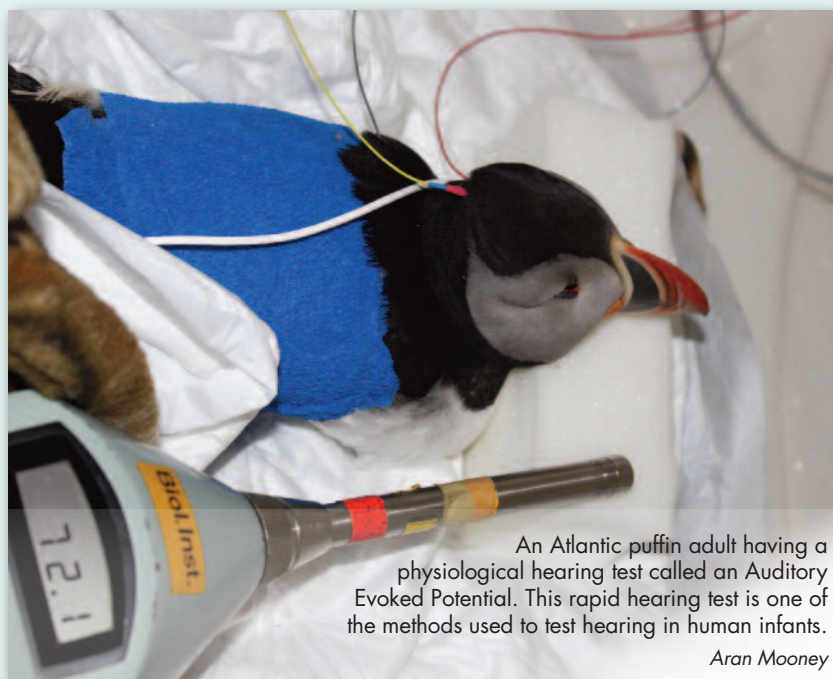
This quarter we present updates on two of our projects 1) Hearing and Estimated Acoustic Impacts in Three Species of Auk: Implications for the Marbled Murrelet and 2) 3S³: Behavioral Responses of Sperm Whales to Naval Sonar.

Hearing and Estimated Acoustic Impacts in Three Species of Auk: Implications for the Marbled Murrelet

This project is led by Aran Mooney, an Associate Scientist in the Biology Department at the Woods Hole Oceanographic Institution, where he leads the Sensory Ecology and Bioacoustics Laboratory. Key collaborators include Marianne Rasmussen from the University of Iceland and Magnus Wahlberg from the University of Southern Denmark.

Navy training and testing activities can occur in areas that overlap with the natural habitat of the marbled murrelet (*Brachyramphus marmoratus*), a member of the Auk family that is listed as threatened under the Endangered Species Act in Washington, Oregon and California. It also is state-listed as endangered in California and as threatened in Oregon and Washington. Navy training and testing activities that produce sound, both in-air and underwater, have the potential to affect marbled murrelets. Potential effects from sound might include auditory impacts such as temporary and permanent hearing threshold shifts as well as behavioral effects.

Currently there are no basic data on the hearing capabilities of marbled murrelets or any other Auk species, thus limiting predictions of the frequencies or sound levels that would actually induce effects. Lacking the information needed to predict with any certainty the appropriate criteria for evaluating the onset of behavioral response or injury in the marbled



An Atlantic puffin adult having a physiological hearing test called an Auditory Evoked Potential. This rapid hearing test is one of the methods used to test hearing in human infants.

Aran Mooney

murrelet, the U.S. Navy has had to use criteria for other species as a surrogate to predict effects.

This project will define the hearing of up to three Auk species—related to, but not including the marbled murrelet—to provide data needed to predict the marbled murrelet’s hearing. The study plan includes both auditory evoked potential (AEP) methods and behavioral audiometric methods to study hearing in Auk species. Efforts will include:

- Field-based, in-air physiological audiometric tests (using AEP methods)
- Lab-based, in-air behavioral audiometric tests
- Lab-based, underwater behavioral audiometric test
- Comparison of physiological and behavioral methods, as well as underwater vs. in-air results.

The resulting audiograms will then provide the data and training foundation for a temporary threshold shift (TTS) response feasibility study.



Atlantic puffin, Husavik, Iceland.
Aran Mooney

“We are looking forward to using the results of this research to improve the analysis of potential impacts to the Marbled Murrelet.”

—Andrea Balla-Holden

The team conducted initial field-based, in-air physiological AEP hearing tests on two Auk species—puffins and common murre. These field AEP tests, conducted in Iceland during summer 2017, are believed to be the first field hearing tests conducted on any Auk species.

The field-based AEP tests—widely used, non-invasive, rapid hearing test methods—involve measuring small voltages that the brain and auditory nervous system generate in response to sound. Results from these closely related species of Auks are expected to provide reliable surrogates for marbled murrelets.

Subsequent work will include lab-based behavioral audiometric tests that will focus on one to three closely related Auk species, beginning with common murre. These tests will involve animals trained to perform a specific behavior in response to sound. The tests will begin with the in-air behavioral audiometric tests, followed by the underwater behavioral audiometric tests. The project team will then compare physiological and behavioral methods, and underwater versus in-air results to evaluate the best means to quantify Auk hearing.



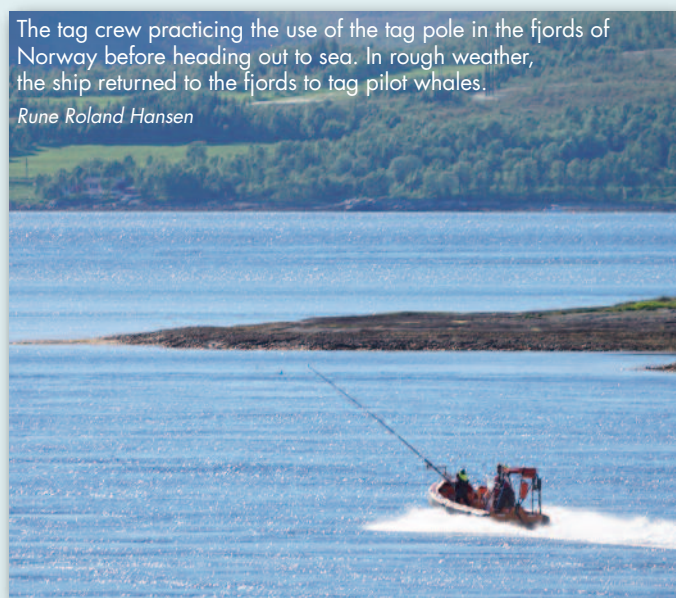
Atlantic puffins, Husavik, Iceland.
Aran Mooney

These data will provide key hearing data needed for defining auditory weighting functions for the marbled murrelet and support refining criteria for birds, criteria that are currently set using surrogate species such as fish or marine mammals. This will improve the Navy's assessment of potential impacts on birds from training and testing activities and other mission-critical operations. As Andrea Balla-Holden, Marine Resources Program Manager with the U.S. Pacific Fleet, Environmental Readiness Division NW Detachment, commented, "We are looking forward to using the results of this research to improve the analysis of potential impacts to the marbled murrelet."

3S³: Behavioral Responses of Sperm Whales to Naval Sonar

This project, part of an international research consortium, is led by Frans-Peter Lam from the Netherlands Organization for Applied Scientific Research (TNO), with Petter Kvadsheim from the Norwegian Defence Research Establishment and Patrick Miller from the Sea Mammal Research Unit in the United Kingdom.

The 3S (Sea mammals, Sonar, Safety) international research consortium has been conducting behavioral response studies on six different cetacean species in North Atlantic waters with great success since 2006. The current (third) phase of the 3S project (3S³) is being conducted in partnership with the U.S. Navy's LMR program



The tag crew practicing the use of the tag pole in the fjords of Norway before heading out to sea. In rough weather, the ship returned to the fjords to tag pilot whales.
Rune Roland Hansen

and the United Kingdom, French and Dutch naval authorities. This third phase is focused on addressing two separate questions in parallel using the same experimental design:

1. Does exposure to continuous-active-sonar (CAS) lead to different types or severity of behavioral responses than exposure to traditional pulsed active sonar (PAS) signals, or does the CAS feature of high duty cycle lead to acoustic responses that indicate masking?
2. How does the distance to the source affect behavioral responses?

The 2017 field season, conducted during late June to mid-July 2017, focused on tagging sperm whales with DTAG3s or mixed-DTAGs to record vocal, movement and dive behavior. This year's field season was a huge success, with non-invasive suction cup tags deployed on 11 sperm whales and two pilot whales. Seven successful sonar controlled exposure experiments were conducted on sperm whales, and 56 hours of baseline behavioral data were also collected on sperm whales. In addition, baseline data were collected from pilot whales.



For smaller, faster species like the pilot whale, a hand-held pole is used to deploy the DTAGs. Tags need to be placed high on the back so that researchers can track the whale using the VHF signals given off by the tag when at the surface.

Rune Roland Hansen, permitted by the Norwegian Animal Research Authority (Mattilsynet), permit 2015/223222



A team member from The Netherlands Organization for Applied Scientific Research (TNO) processing acoustic data in real time in order to localize whale vocalizations.
Sander van Ijsselmuide

Data from this project will help the U.S. Navy and our NATO allies to improve the assessment of potential impacts on these species from training and testing activities involving the use of sonar.

The results of the 2017 field season are now being analyzed. Data from this project will help the U.S. Navy and our NATO allies to improve the assessment of potential impacts on these species from training and testing activities involving the use of sonar.

LMR PROGRAM PARTICIPANT UPDATES

We have two participant updates to share this quarter.

First, LMR's program manager, Anu Kumar, attended the National Oceanic and Atmospheric Administration (NOAA) acoustic archive meeting at the National Centers for Environmental Information (NCEI) in Boulder, Colorado. NOAA has been leading a working group to discuss and develop a means of archiving passive acoustic monitoring data at the NCEI. The primary objective has been to develop a user-friendly, standardized and cost effective process to archive acoustic data. In addition to the primary goal of preserving the data collected, NOAA is also developing the capability for easy public access to the data. NOAA recognized early on that this tool would be useful for other agencies too and invited representatives from the Navy, the Bureau of Ocean Energy Management and the National Park Service to be involved in the discussions. At this year's meeting NCEI unveiled a prototype archive process, user interface and standard metadata requirements using some initial acoustic data. It is becoming more apparent that with the advancements of technology and electronic media storage capacity, archiving the vast amounts of passive acoustic data collected is becoming an achievable and cost effective goal.

Second, we want to announce an upcoming Navy-sponsored workshop—Advancing Marine Species Density Surface Modeling (DenMod).

This open workshop will be held on Sunday 22 October 2017, prior to Society for Marine Mammalogy Conference in Halifax, Nova Scotia. The workshop will be of interest to researchers who create density surface models as well as those who use the outputs.

Density surface models (sometimes called spatial or habitat models) attempt to describe animal distribution as a function of spatially referenced variables. Data typically come from line transect surveys, although there is the potential to use other effort-indexed surveys, such as passive acoustics. Outputs include modeled relationships between density and explanatory variables, spatial maps of population density, and estimates of population size with uncertainty in areas of interest within the larger modeled region. Outputs are of practical use in, for example, marine spatial planning and impact assessment.

The DenMod project is collaboration between the University of St Andrews, Duke University and the regional NOAA Fisheries labs, and is funded by the U.S. Navy. The key focus of the DenMod project is to create a working group



A sperm whale tagged with a suction cup DTAG. The DTAG will take detailed data on the whale's movements, dives, and received sound levels.

Rune Roland Hansen, permitted by the Norwegian Animal Research Authority (Mattilsynet), permit 2015/223222

of scientists involved in density surface modelling to coordinate advances on this topic (particularly in relation to issues associated with data-poor areas).

There are many statistical methods available for density surface modeling. This one-day workshop is part of the start-up meeting of the DenMod research project, which aims to compare the different approaches, identify outstanding issues and identify potential solutions. The workshop goal is to solicit input on the overall project goals and plans from those who are involved in density surface models—developers and users of density surface models and model outputs. Project leaders will briefly present the methods being considered and invite comments. Interested participants are also invited to present their research relating to density surface modeling.

The workshop is free but due to venue size, places are limited. If you are interested in attending, please register by emailing Catriona Harris (catriona.harris@st-andrews.ac.uk). If you would like to be considered for a presentation slot, include a short abstract (no longer than 100 words) when you register.

LMR PARTNERSHIP UPDATES

Navy sonobuoys helped researcher Jessica Grance from the Alaska Fisheries Science Center's Marine Mammal Laboratory locate rarely seen North Pacific right whales in the Bering Sea. Grance was participating in the Pacific Ocean Whale and Ecosystem Research (POWER) program, a collaborative effort spearheaded by the International Whaling Commission and the Government of Japan, to survey for whales and porpoises in the eastern Bering Sea. Her focus during a two-month research cruise, undertaken during summer 2017 aboard a Japanese research vessel, the *Yushin Maru #2*, was using sonobuoys to listen for marine mammals.

Based on the sounds picked up by the sonobuoys, Grance and the other researchers tracked the signal to the whales where they were able to photograph them and take small skin samples from two whales. The skin samples are used to provide genetic information, particularly important for a species estimated to have only 30 to 50 remaining individuals.

The sonobuoys used during the research were made available from the Navy's Non-Combat Expenditure Allocation (NCEA), which includes a quantity of non-expired sonobuoys that can be made available to researchers. The Navy's Sonobuoy Liaison Working Group (SLWG) works with the LMR program on the allocations. The SLWG helps to determine how many sonobuoys are made available and LMR works to match available sonobuoys with priority research projects.



North Pacific right whale.
Amy S. Kennedy, NOAA/AFSC/NMML permit 782-1719

IN-PROGRESS REVIEW 2017

Our 2017 IPR will be held the week of 13 November 2017, in Ventura, California. Principal Investigators on LMR projects can plan on three full days, November 14, 15 and 16. The pre-meeting LMRAC-only session will be held on November 13.

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.



Falcone, E. A., Schorr, G. S., Watwood, S. L., DeRuiter, S. L., Zerbini, A. N., Andrews, R. D., Morrissey, R.P. and Moretti, D. J. (2017). Diving behaviour of Cuvier's beaked whales exposed to two types of military sonar. *Royal Society Open Science*, 4(8), 170629.

Kastelein, R. A., Helder-Hoek, L., & Van de Voorde, S. (2017). Hearing thresholds of a male and a female harbor porpoise (*Phocoena phocoena*). *The Journal of the Acoustical Society of America*, 142(2), 1006-1010.

Scales, K. L., Schorr, G. S., Hazen, E. L., Bograd, S. J., Miller, P. I., Andrews, R. D., Zerbini, A. N., and Falcone, E. A. (2017). Should I stay or should I go? Modelling year round habitat suitability and drivers of residency for fin whales in the California Current. *Diversity and Distributions*.

Simonis, A.E., Roch, M.A., Bailey, B., Barlow, J., Clemesha, R.E.S., Iacobellis, S., Hildebrand, J.A., and Baumann-Pickering, S. (2017). Lunar cycles affect common dolphin *Delphinus delphis* foraging in the Southern California Bight. *Marine Ecology Progress Series*, 577:221-235.

In addition, data from multiple LMR-funded projects contributed to the following publication:

Kvadsheim, P.H., DeRuiter, S., Sivle, L.D., Goldbogen, J., Roland-Hansen, R., Miller, P.J., Lam, F.P.A., Calambokidis, J., Friedlaender, A., Visser, F. and Tyack, P.L., (2017). Avoidance responses of minke whales to 1–4kHz naval sonar. *Marine Pollution Bulletin*.

For lists of other publications, please see our FY16, FY15 and FY14 program reports and recent issues of *LMR News*.

OUR WEBSITE—CHANGES

As noted in our winter/spring 2017 newsletter, our website address has changed. For many years DLA-Defense Automated Printing Service (DAPS) hosted the LMR website. Over these years we obtained great service from DAPS at a low cost. However, in mid-May the DAPS data center that hosts LMR was permanently shut down. The LMR program website was transitioned to another host and has a new website address. The public information portion of the LMR website is currently available on the Navy's GreenFleet site. You can now find links to all of our informational materials at <http://greenfleet.dodlive.mil/LMR>.

PROGRAM SCHEDULE

No.	What	When
1.	Proposal Solicitation & Review	
a.	FY18 BAA Solicitation Closes	October 17, 2017
b.	Notify Submitters of pre-proposal evaluation results	January, 2018
2.	Project & Contracts Management	
a.	FY18 New Start Contracts	September 30, 2018
3.	Quarterly Status Reports (QSR)	
a.	Submit fall QSR	October 2, 2017
b.	Submit winter QSR	January 2, 2018
c.	Submit spring QSR	April 2, 2018
d.	Submit summer QSR	July 2, 2018
4.	In-progress Review	
a.	Ventura, California	November 14, 15 & 16, 2017

HELP WITH OUR MAILING LIST

If you want to subscribe to, or unsubscribe from, *LMR News*, please send your email address to Lorraine Wass at ljwass@outlook.com.

CONTACT THE LMR PROGRAM

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

IN THE NEXT ISSUE OF *LMR NEWS*

Our next issue will provide updates and notes on project field tests and more as available.

Watch for a new article about Navy contributions to and use of monitoring tags to research and track marine mammals in the fall-17 issue of *Currents* magazine at <http://greenfleet.dodlive.mil/currents-magazine>.