

LMRnews

SCIENCE • STEWARDSHIP • NAVY READINESS

SUMMER 2018

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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Sperm whale.



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.



Anu Kumar, Program Manager

PROGRAM OFFICE INSIGHTS

We have many topics to share in this issue—new projects selected, program needs identified, the Fiscal Year 2019 Broad Agency Announcement (BAA) requesting pre-proposals published, field work conducted, our annual program report now available and a new standard on audiograms.

New Projects

Following careful review and discussion by members of the LMR Advisory Committee (LMRAC) and program staff, four new projects were selected for funding. They are listed in the following table.

Project	Principal Investigator	Need
Multi-spaced measurement of underwater sound fields from explosive sources	Peter Dahl University of Washington	N-0159-18 In-Situ Explosive Sound Characterization and Propagation Data Collection and Analysis
Standardizing methods and nomenclature for automated detection of Navy sonar	Elizabeth Henderson Space and Naval Warfare Systems Center	N-0158-18 Evaluations and Standardization of Sonar Signal Processing Tools for Marine Mammal Research
Analytical methods to support the development of noise exposure criteria for behavioral response	Len Thomas University of St Andrews	N-0135-17 Understanding the Range to Effect to the Behavioral Response of Marine Mammals from Sonar Exposure
TTS in harbor seals due to fatiguing noise noise of several frequencies: temporary threshold shift onset sound exposure level and growth curves for permanent threshold shift onset SEL estimation to set criteria	Ron Kastelein SEAMARCO	N-0103-16 Marine Species Hearing Research Related to the Acoustic Effects Criteria

Needs

Our program Need submission process closed on June 29, 2018. The needs chosen through this annual process are an important part of defining the LMR research portfolio. Forty-one needs were submitted and reviewed by the LMRAC. The selected needs have formed the basis for our FY19 BAA.

FY19 BAA

Our annual request for pre-proposals has been posted. It includes six topics:

1. Improvement of medium-term telemetry tag attachment duration
2. Demonstration and validation of passive acoustic monitoring-based density estimation methods using visually verified survey data
3. Investigation of the effects of cue rate and cue stability on passive acoustic monitoring-based density estimation methods.
4. Demonstration and validation of passive acoustic monitoring sparse arrays to estimate the density of low-frequency whales over large spatial areas
5. Identification of monitoring priorities for studying the population consequences of disturbance on marine mammals
6. Turtle Temporary Threshold Shift (TTS) feasibility study



Details on these topics and on submission requirements are available in the full BAA. The BAA can be downloaded from the LMR website (<http://navy-sustainability.dodlive.mil/lmr>) or from the Federal Business Opportunities website (<https://www.fbo.gov>) under solicitation number N3943018S2086.

The submission period closes October 22, 2018.

Field Work

Field work highlights from two of our projects are shared in the Program Participant Updates section. One project, “DECAF-TEA: Density Estimation for Cetaceans from Acoustic Fixed Sensors in Testing and Evaluation Areas,” deployed four passive acoustic monitoring buoys in June as part of a pilot study. An interesting twist occurred when the team went to recover the buoys. In addition, the “Cuvier’s Beaked Whale and Fin Whale Behavior During Military Sonar Operations” project had a field effort in which they had a rare sighting of some Baird’s beaked whales in southern California.

Audiogram Standard

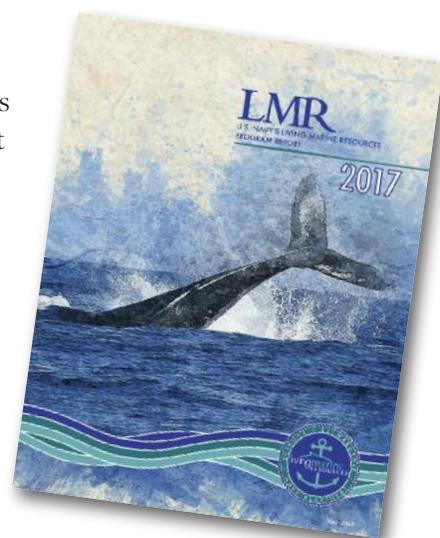
We are particularly pleased to note the publication of a new standard related to audiograms for toothed whales. The standard, *Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods*, is an important contribution to developing comparable hearing thresholds estimated from two types of auditory evoked potential (AEP) methods. This issue’s Project Spotlight offers more information on both the standard and the associated LMR-funded project.

2017 LMR Report

Our 2017 LMR Program Report on the status of the LMR program has been distributed and is available online. This annual document reviews the program’s mission and history and provides updates on LMR projects. In addition to a PDF version for download, the report can be viewed online in an interactive format. Links are available on our website at navysustainability.dodlive.mil/lmryir.



Fin whale.
Gregory S. Schorr, permit 16111



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 an ongoing project that recently achieved a significant milestone.

Standardization of Evoked Potential Audiometry Methods to Ensure Comparable Marine Mammal Hearing Data Inclusion in a National Hearing Database

To understand whether sound from Navy activities is affecting marine mammals, it is necessary to obtain information about marine mammal hearing, including hearing thresholds. This multifaceted project, led by Dr. Dorian Houser of the National Marine Mammal Foundation, has two primary components: 1) generating an agreed-upon national standard for auditory evoked potential (AEP) hearing test methods used in odontocetes (toothed whales) and 2) supporting the development and implementation of the Evoked Response Study Tool (EVREST) to increase marine mammal species representation and sample sizes in hearing threshold estimates.

The hearing threshold is the lowest level of sound that can be detected by an animal at a specific frequency of sound. While the most acceptable way of measuring hearing thresholds is through behavioral testing, that method is time consuming with marine mammals and can only be completed with animals under human care. An alternative approach is the use of AEP methods. An AEP is a voltage produced by the brain in response to the hearing of a sound. By measuring the AEPs at different sound levels, hearing thresholds can be obtained. With appropriate equipment, AEPs can be quickly measured in marine mammals with minimal subject cooperation, making it possible to determine hearing thresholds in wild-caught and stranded marine mammals, as well as those under human care. However, it will be necessary to compare hearing thresholds obtained with behavioral methods and those obtained with AEP methods before the latter are relied on for informing the potential impact of Navy acoustic activities on marine mammal hearing.



AEP hearing test being conducted on a pygmy sperm whale (*Kogia breviceps*).

Dorian Houser, permit 21026

Establishing a National AEP Standard

There are numerous methods by which AEP hearing thresholds can be determined and the method that is employed can affect the hearing threshold estimate. Differences might vary on the order of tens of decibels, which can have serious ramifications for determining the range of audibility for Navy acoustic sources, as well as for estimating impacts within mid- to low-frequency ranges where variances will be the greatest. For this reason, the Navy needs standardized AEP data collection methods to ensure that hearing threshold estimates are comparable across laboratories and researchers.

The results of a standardized approach will help to provide comparable hearing data for use in analyses conducted by the Navy as part of the environmental compliance process. Other beneficiaries include academia, regulators, and government and private agencies that need to assess the potential effects of human-caused sound on marine mammals.

A key component of the project has focused on developing a standardized AEP methodology. The methodology was recently published as an American National Standards Institute (ANSI) standard entitled, *Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods* (ANSI/ASA S3/SC1.6-2018). The standard is the first of its kind and is not comparable to any existing ANSI or International Organization for Standardization (ISO) standard.

The standard details how to measure odontocete hearing thresholds using a specific evoked potential method—the generation of the auditory steady-state response (ASSR). By measuring the ASSR at different frequencies and levels of sound, an audiogram can be produced for an animal. The two approaches to generating the ASSR are through the presentation of sinusoidally amplitude-modulated (SAM) tones or trains of tone bursts.

Several topics are covered by the standard to promote comparable results across laboratories and researchers, including:

- General equipment requirements
- Stimulus waveforms for measuring hearing thresholds
- Acoustic stimulus waveform calibration
- Threshold estimation methods
- Results reporting formats
- Modulation rate transfer function determination
- Background noise considerations
- Testing arrangements, including types of electrodes and their placement.

ANSI STANDARDS

The private, non-profit American National Standards Institute (ANSI) provides certification and guidelines for entities such as the American Acoustical Society (ASA) to develop voluntary standards. Key components of ANSI standard development guidelines include consensus, openness and due process. For more on ANSI standards see www.ansi.org.

Three informative annexes provide additional material on calibration distances and contact transducer placements, amplitude modulation rates for select small odontocetes, and specifying the sound pressure level of acoustic transients.

The standard is available to purchase at the ASA standards store, <https://acousticalsociety.org/standards>.

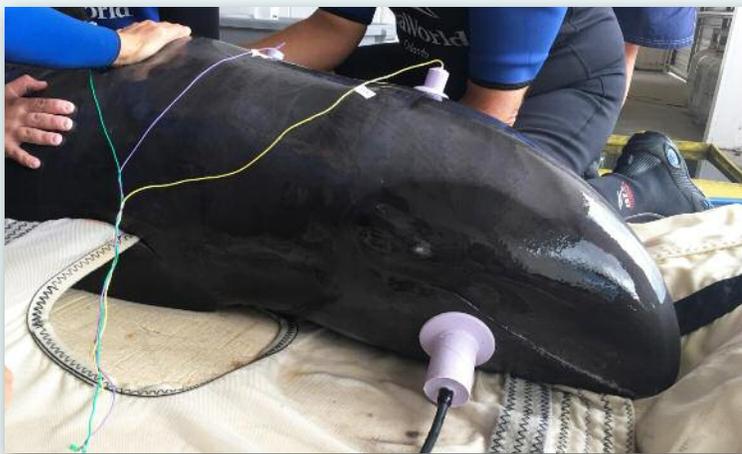
Supporting the Evoked Response Study Tool

The second significant component of this project is focused on the the Evoked Response Study Tool (EVREST)—the portable AEP system produced by Dr. James Finneran of the U.S. Navy Marine Mammal Program—to expand the number and types of species for which hearing threshold data are obtained. The system is currently being updated to reflect the new ANSI standard. Other tasks include maintaining and improving existing EVREST systems and training and assisting stranding network personnel on its use, which offers an important opportunity to collect hearing data from and generate audiograms for a wider range of species and to expand the sample sizes for a species that have already been tested.

Technical improvements to the EVREST systems have included making it possible to determine optimal amplitude modulation/stimulus presentation rates and incorporating a new biopotential amplifier (currently being tested). Steps to improve data flow for database storage are also being incorporated.

Currently available EVREST systems have been put to regular use over the course of the standardization effort in order to increase species representation and sample sizes in hearing threshold estimates. Twenty-seven small cetaceans representing nine species have had AEP hearing tests conducted on them by the principal investigator and stranding networks since the beginning of the project.

A parallel NOAA-sponsored project related to these efforts is developing a national database for archiving AEP audiograms and metadata. Data obtained with the EVREST system, or with other systems but in accordance with the ANSI standard, are to be included in the database. The database will benefit Navy compliance reporting efforts and permit applications by providing ready access to all available AEP data.



AEP hearing test being conducted on a melon-headed whale (*Peponocephala electra*).
Dorian Houser, permit 21026

LMR PROGRAM PARTICIPANT UPDATES

2018 Detection, Classification, Localization, and Density Estimation (DCLDE) Workshop

Several LMR program participants—principal investigators, LMRAC members and LMR staff—participated in the June 2018 DCLDE Workshop in Paris, France. The workshop provides a structured opportunity to share information on acoustic methods applied to marine mammals. As the workshop title suggests, the focus is on methods to detect, classify, locate, track, count and monitor marine mammals in their environment. Such methods are central to much of the work funded by the LMR program.

The LMR program specifically funded Scripps Institution of Oceanography to develop the workshop data set to which participants could apply their algorithms and methodologies for demonstration. This allowed for a more direct comparison of techniques and an assessment of performance. The workshop dataset included a variety of marine mammal species and acoustic environments.

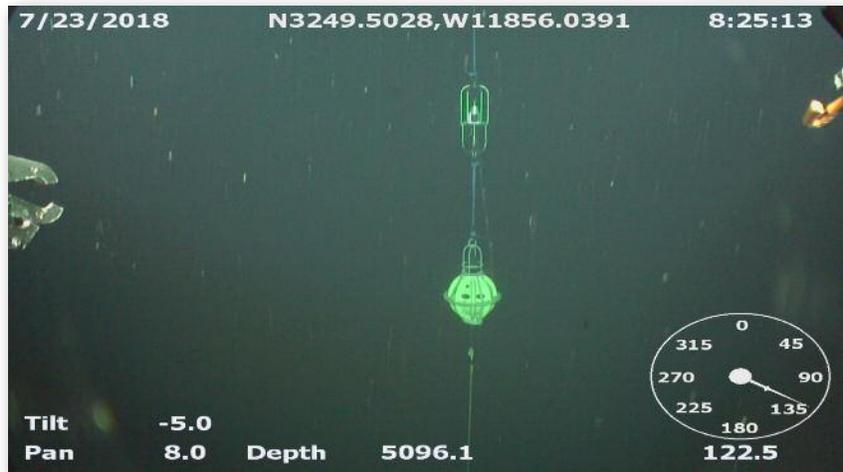
Field efforts

DECAF-TEA: Density Estimation for Cetaceans from Acoustic Fixed Sensors in Testing and Evaluation Areas

Back in June 2018, the DECAF-TEA project field team, led by Dave Moretti at the Naval Undersea Warfare Center (NUWC) Newport, successfully deployed four passive acoustic monitoring buoys moored near the seafloor of the Southern California Offshore Range (SCORE). This project is testing the capability of monitoring beaked whale population sizes occurring near navy training areas, using acoustics alone. The plan was to leave the buoys out for one month to collect data on vocalizing marine mammals in the area. These buoys were configured to be released by an acoustic signal then float to the surface. However, when the DECAF-TEA project team went to recover the buoys on July 10th only one of the buoys resurfaced and was recovered.

In an attempt to find the three remaining buoys that were still moored at 1500 meters depth, the LMR program funded the M/V *Independence* and their team of remotely operated vehicle (ROV) operators. The vessel departed from Port Hueneme, CA on the evening of July 22nd and began transiting south. The vessel was on station at SCORE by the morning of July 23rd and deployed the ROV. The ROV, directed to each of the buoy deployment locations, successfully conducted a search, located each buoy and cut the mooring line. Once the mooring line was cut, the buoy floated to the surface where it could

then be recovered by the vessel crew. By early afternoon, all three buoys had been found and successfully recovered and the vessel began transiting back to Port Huene, CA. The LMR program owes a huge thank you to the crew of the M/V Independence for recovering the buoys and their valuable data. Now the DECAF-TEA project team can analyze the data and troubleshoot what went wrong with the buoy release mechanism to ensure successful recovery in the future.

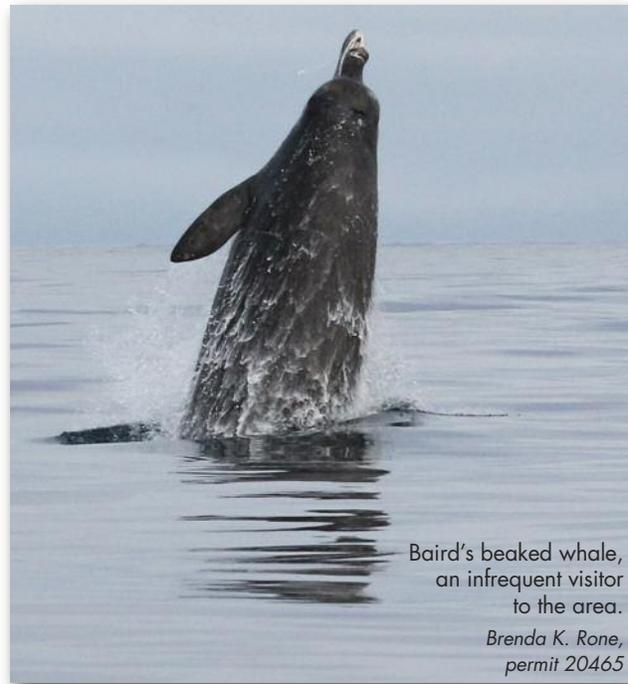


View from the ROV camera showing one of the passive acoustic monitoring buoys in the water column. The ROV claw tool can be shown on the far left and the cutting tool can be shown in the upper right corner.

NAVFAC EXWC

Cuvier's Beaked Whale and Fin Whale Behavior During Military Sonar Operations

The Marine Ecology and Telemetry Research (MarEcoTel) team had an exciting field effort in July. The team encountered a large group of Baird's beaked whales in southern California and deployed the first depth-reporting Low Impact Minimally Percutaneous Electronic Transmitter (LIMPET) tag to one individual. The Baird's beaked whale tag transmitted for 6.5 days, during which time the whale traveled north along the shelf-edge more than 400 nautical miles from the tagging location. Dives as deep as 1,968 meters and as long as 78 minutes were recorded as whale was heading north. The team hopes to encounter additional groups going forward and deploy more tags, as there is very little data on the ecology of this species in the Eastern North Pacific.



Baird's beaked whale, an infrequent visitor to the area.

Brenda K. Rone, permit 20465

In addition to the Baird's beaked whale encounter, the team also had six encounters with Cuvier's beaked whales, including two mom-calf pairs, one group of three, and the rest single individuals. Overall, the field effort was very successful.

IN-PROGRESS REVIEW 2018

LMR principal investigators and LMRAC members are reminded to mark their calendars for the 2018 IPR. It will be held the week of December 3rd in Ventura, California. Email with specific details will be sent soon.

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.

Kastelein, R.A., Helder-Hoek, L., Van de Voorde, S., de Winter, S., Janssen, S., and Ainslie, M. (2018). Behavioral Responses of Harbor Porpoises (*Phocoena phocoena*) to Sonar Playback Sequences of Sweeps and Tones (3.5-4.1 kHz). *Aquatic Mammals*, 44(4): 389-404.

Tubelli, A., Zosuls, A., Ketten, D. and Mountain, D. (In press). A Model and Experimental Approach to the Middle Ear Transfer Function Related to Hearing in the Humpback Whale (*Megaptera novaeangliae*). *Journal of Acoustical Society of America*.

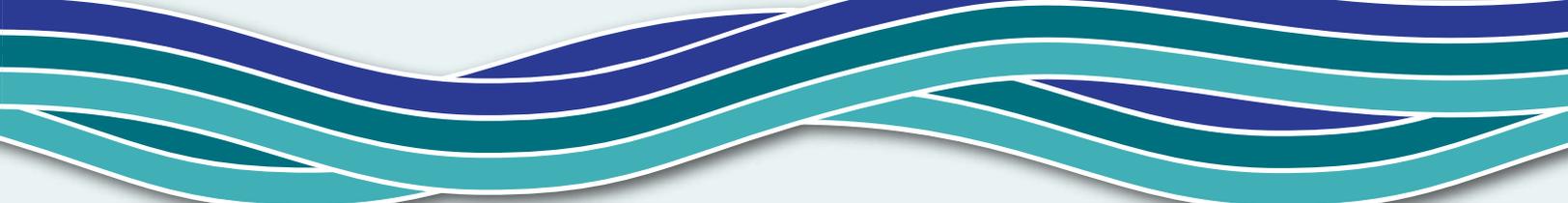
For lists of other publications, please see our annual program reports and recent issues of *LMR News*.

OUR WEBSITE

On our website you can find project highlights, our annual reports and other LMR information. The address is navysustainability.dodlive.mil/LMR.



navysustainability.dodlive.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.

PROGRAM SCHEDULE

No.	What	When
1.	Proposal Solicitation & Review	
a.	FY19 Needs Approved	July, 2018
b.	FY19 BAA	Opened September 4, 2018 Closes October 22, 2018
2.	Project & Contracts Management	
a.	FY18 New Start Contracts	September 30, 2018
3.	Quarterly Status Reports (QSR)	
a.	Submit fall QSR	October 31, 2018
b.	Submit winter QSR	January 31, 2019
c.	Submit spring QSR	April 30, 2019
d.	Submit summer QSR	July 31, 2019

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. 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.

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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, at exwc_lmr_program@navy.mil and 805-982-4853.

IN THE NEXT ISSUE OF *LMR NEWS*

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

The spring-18 issue of *Currents* magazine includes photos from LMR's 3S3 project in the magazine's Best Shots. View the issue at navysustainability.dodlive.mil/currents-magazine/.

