LMR news

WINTER 2016

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Welcome!

Welcome to the winter 2016 issue of *LMR News*—the quarterly 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.

Blue whale.
NOAA/NMFS

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NAVFAC
Naval Facilities Engineering Command
ENGINEERING AND EXPEDITIONARY WARFARE CENTER

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

Program manager Anu Kumar provided his annual programmatic brief to OPNAV N45 during the past quarter. He shared information on the status of ongoing projects, identified the projects getting way under Fiscal Year 2015 (FY15) funding and summarized the FY16 needs that were used in the FY16 Broad Agency Announcement (BAA). The programmatic brief is a forum in which LMR program management and the resource sponsor can discuss program efforts, budgets, goals and progress. The resource sponsor was excited to hear about the changes that have been made to the program that allowed our financial benchmarks to be met for FY15.

Anu Kumar, Program Manager

The LMRAC completed recommendations for the full proposal round from the FY16 BAA pre-proposals. Of the 48 pre-proposals received, we have requested 20 full proposals—ten within the Behavioral Response Research need (N-0102-16) and ten with Marine Species Hearing Research (N-0103-16). Once again, the overall high quality of pre-proposals impressed the LMRAC members. It is always a challenge to narrow their recommendations to ensure meeting program needs and budget restrictions. We thank everyone involved in the process and are preparing to review full proposals, which were due 29 February 2016.

The Project Spotlight section of this issue provides an overview of one of the FY15 "new start" projects—*Behavioral Audiometry in Multiple Killer Whales*. In the Program Participant Updates section we highlight an upcoming technology demonstration and share the insights from one of our Principal Investigators, Erin Falcone, who looks back over multiple years of work studying marine mammals on the Southern California Off-shore Range (SCORE).

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).

Humpback whale.
NOAA/NMFS

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).

LMR PARTNERSHIPS

This year the LMR program instituted a Sonobuoy Request Form for researchers to fill out when requesting sonobuoys. This form details how many sonobuoys are needed, how they will be used, and how the data will support the Navy. This information is used to determine priority when the number of sonobuoys requested exceeds the number in our allotment. The LMR program received seven requests for sonobuoys in FY16, and was able to fulfill six of these requests. The seventh request will be fulfilled in early FY17. Currently, the researchers are coordinating with the Sonobuoy Liaison Working Group to schedule pick up dates and times.

IN-PROGRESS REVIEW 2016

A reminder that the 2016 IPR, which includes only those involved in LMR-funded projects, will be held the week of 14 November 2016 back at NAVFAC EXWC in Port Hueneme, California.

LMR PROGRAM PARTICIPANT UPDATES

Technology Test Drive

One of the LMR-funded projects taking its technology out for a test run is the Integrated Real-time Autonomous Passive Acoustic Monitoring System (IRAP). The IRAP system uses a REMUS Autonomous Undersea Vehicle (AUV) integrated with a low- to mid-frequency (LF/MF) sensor and a High Frequency (HF) sensor. The sensors include onboard Digital Signal Processors (DSPs) for the autonomous detection, classification, localization, and tracking (DCLT) of vocalizations from lower frequency baleen whales and higher frequency beaked whales.

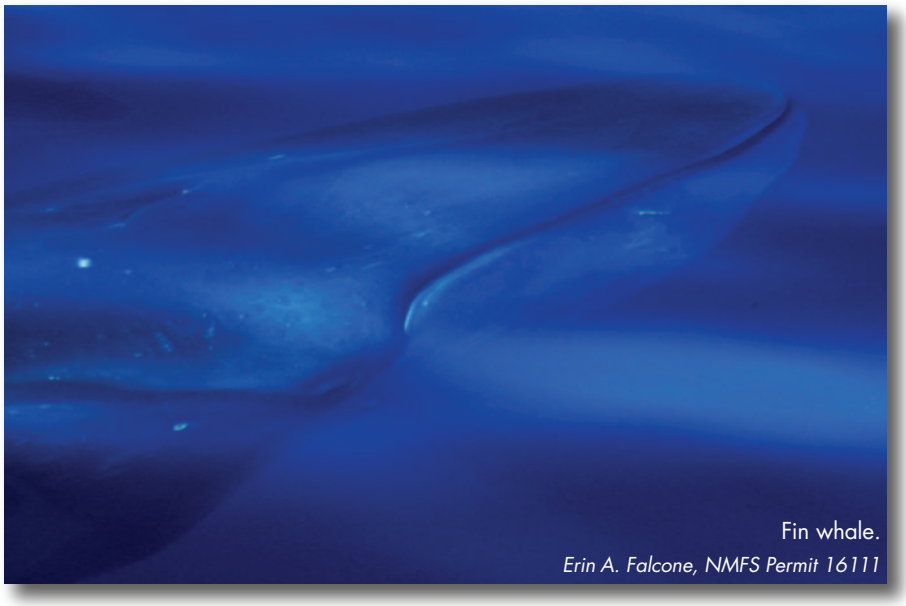
The IRAP system will be tested in February in coordination with the Submarine Commanders Course at Pacific Missile Range Facility. It will collect LF and HF whale vocalizations concurrently with data from multiple naval tactical sonar systems. The effort will demonstrate the autonomous system's ability to track low frequency baleen and high-frequency beaked whales while simultaneously monitoring the operation of mid-frequency active sonar.

Principal investigators Phil Abbot and Vince Premus from Ocean Acoustical Services and Instrumentation Systems, Inc. (OASIS), leveraged hardware and software they have developed under Office of Naval Research sponsorship, to develop the autonomous acoustic surveillance package being tested.

Insights from a Decade of Marine Mammal Research

LMR principal investigator Erin Falcone (Marine Ecology and Telemetry Research) reflects on work at the Southern California Offshore Range (SCORE).

When we were first approached to conduct visual surveys for marine mammals at the Southern California Offshore Range (SCORE) in 2006, we were skeptical. Small vessel surveys in the unprotected outer waters of the Southern California Bight at one of the most heavily used sonar training ranges in the world? What could we actually expect to see? We knew that beaked whales were the species of interest and seeing them seemed an unlikely prospect at the time. But we agreed to partner with the growing Marine Mammal Monitoring on Ranges (M3R) program, led by Dave Moretti at the Naval Undersea Warfare Center (NUWC). That team would guide us around the vast Southern California Anti-submarine Warfare Range (SOAR) to verify the location and species of any animals they could hear vocalizing on the bottom-mounted hydrophone array, which extends far into the deep basin west of San Clemente Island.



Fin whale.
Erin A. Falcone, NMFS Permit 16111

A decade later that project has grown into one of the most productive, though challenging, efforts of our careers. Much to our surprise, we found a pair of Cuvier's beaked whales during the pilot effort in 2006. Despite the logistical challenges of working 80 nautical miles from the mainland coast in a 21-foot boat, while staying clear of the frequent military training exercises this region supports year-round, we have built extensive demographic and behavioral datasets for the populations of both Cuvier's beaked whales and fin whales with whom the Navy shares these waters. Our focus has shifted from determining what species use the range, to understanding the local population structure of these species, describing the movement and diving patterns of individuals within

these populations, and most recently, figuring out how they are affected, both as individuals and populations, by their regular interactions with humans on the range. Of primary interest are the beaked whale exposures to Mid-Frequency Active (MFA) sonar-from ships, helicopters, and other sources.

The nearly intractable challenge of understanding how beaked whales are affected by sonar is creating novel combinations of researchers and data types to piece together a complex, and controversial, story. We bring two elements to this puzzle. First is a growing collection of individual sighting histories from Cuvier's beaked whales. We have photo-identified 126 unique individuals from this study to date, the results of pouring over thousands of often less-than-ideal quality images to figure out which animal has been seen where, when, and with whom. These data can be used to monitor the health of populations such as this one, where animals are seldom visible and thus difficult to systematically survey by other methods. Our photo-ID data have documented individuals using SOAR repeatedly, some in as many as five different years, a finding that suggests that acute, lethal effects of sonar exposure are, at a minimum, not universal. Repeated use of SOAR also suggests that for the Cuvier's that appear to preferentially use the area, effects are more likely to be related to chronic, cumulative disturbance than sudden, severe harm.

Cuvier's beaked whale.
Erin A. Falcone, NMFS Permit 16111

The second element is a dataset with thousands of hours of movements and diving records from 24 Cuvier's that were fitted Wildlife Computers Low-Impact Minimally-Percutaneous External-electronics Transmitter (LIMPET) satellite tags. Our satellite-tagged whales have demonstrated diving capabilities that were previously unfathomable in a mammal. These include reaching

depths up to 3,000 m (at which point the whale likely reached the bottom and could go no deeper), and remaining submerged for well over two hours at a time, immediately followed by surface bouts as short as two minutes to breathe. While it is suspected that the poorly-understood adaptations that allow these whales to dive this way may also make them uniquely susceptible to disturbance, these tagged whales demonstrated a greater breadth of behavioral flexibility than has been previously suggested. We still have a long way to go in understanding how a behavioral change might prove lethal for them.

Cuvier's beaked whales.
Gregory S. Schorr, NMFS Permit 16111

Data collection at SCORE will continue in 2016, with Pacific Fleet now supporting our fieldwork as part of their long-term monitoring plan for Cuvier's beaked whales in Southern California. We are partnering with Wildlife Computers and Russ Andrews to improve the spatial data capabilities of the LIMPET tag, which will address some limitations in our earlier deployments. As tag technology continues to advance, we also turn our attention more specifically to collaborative analyses using our existing data. These include work with M3R to re-create records of sonar use from SOAR acoustic archives throughout our tag deployments, then combing sonar use with behavioral data to create a multi-individual, multi-exposure data stream documenting how these whales behaved during the sonar exposures they actually experienced while tagged. We are providing photo-ID data to several analyses aimed at estimating population size, quantifying the likelihood of detecting population decline if it were occurring, and predicting the effects on calving and recruitment rates under different exposure scenarios.

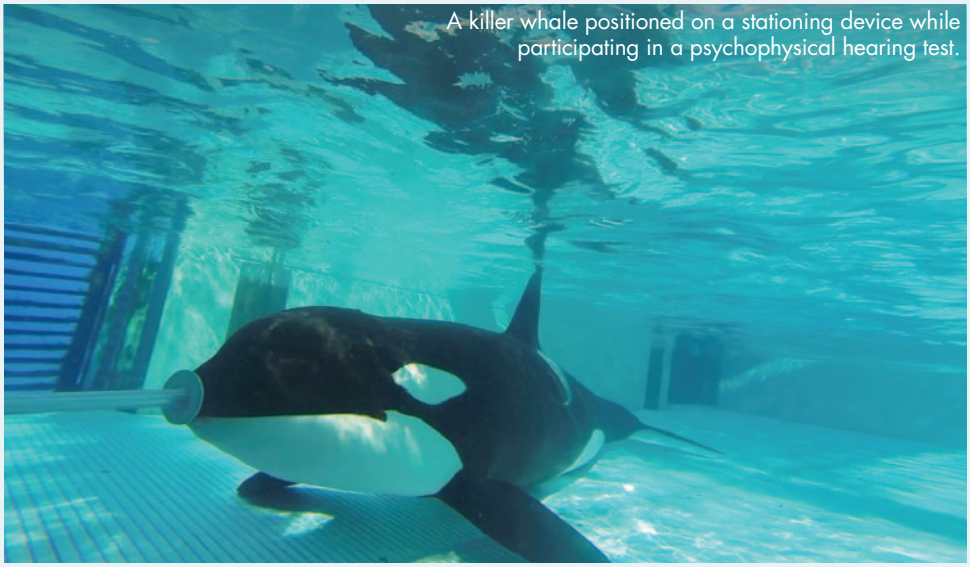
We hope that through the joint efforts of many, these methods and data can help us understand, and potentially mitigate, any effects of sonar on beaked whales—not only in Southern California, but also in areas where whales have been subject to more obvious, acute impacts. Many thanks are due to the Navy itself, from the highest levels of environmental compliance to the staff on the water with us at SCORE, for their continued support of slow, but steady, progress toward this goal.

LMR PROJECT SPOTLIGHT

Wondering about some of the new LMR projects? This section provides a brief overview of one or more projects in each issue of LMR News. This quarter we introduce a recently funded project for FY15, *Behavioral Audiometry in Multiple Killer Whales*, Principal Investigator Brian Branstetter, National Marine Mammal Foundation (NMMF).

Lack of knowledge of hearing capabilities and the effects of sound on marine mammals continue to challenge Navy environmental compliance efforts. Killer whales (*Orcinus orca*) are the most widely distributed marine mammal species and have recently been suggested as being an extremely sensitive species to acoustic disturbance. This study will provide the first demographic hearing data from five to eight killer whales that vary in age and gender.

The project team will test hearing using the behavioral audiogram method, one of the two primary ways to test hearing in marine mammals. While the alternative hearing test method, the auditory evoked potential (AEP) test, is easier for data collection, the behavioral audiogram remains the "gold standard" in audiometric testing and accuracy.



A killer whale positioned on a stationing device while participating in a psychophysical hearing test.

To date, only two complete behavioral audiograms from two adult female killer whales exist. These audiograms, compiled in 1999, returned questionably low threshold levels (lower than any odontocete [toothed whale] tested) and require replication and validation. Furthermore, the limited data fail to provide any insight into individual differences or demographic variability (e.g., age) in

hearing capabilities that have been demonstrated in other odontocete species, such as the bottlenose dolphin. The primary reason for such sparse data is limited of access to trained killer whales for behavioral audiograms and the difficulty in measuring AEP thresholds with large animals.

In early 2014, the National Marine Mammal Foundation, SeaWorld San Diego, and SeaWorld San Antonio participated in a cooperative effort to obtain behavioral audiometry from SeaWorld's killer whale collection. This effort, which directly supports Navy environmental compliance, was partially funded by U.S. Fleet Forces Command. The goal of this new project, headed by Principal Investigator Brian Branstetter, is to complete the audiograms of the whales at SeaWorld San Diego, potentially add extra subjects from that facility, and add additional subjects from SeaWorld San Antonio.

Killer whale.
Allen Shimada,NOAA/NMFS/OST/AMD

Audiograms will be measured using well-established psychoacoustic methods that are regularly employed by the NMMF for the testing of hearing in dolphins. The whales are housed at SeaWorld of San Diego and SeaWorld of San Antonio, where the experiments are in progress. A collaborative arrangement exists between SeaWorld and the NMMF for SeaWorld killer whales to participate in audiometric studies.

Data from this study will more than double the number of individual killer whales that have been tested, as well as provide hearing data over a large age range of 12 to 49 years. This will help to determine accurate mid-frequency cetacean composite audiograms and weighting functions for Navy at-sea environmental compliance.

OUR WEB SITE—WHAT'S AVAILABLE NOW

Our web site (www.lmr.navy.mil) is a ready source of up-to-date information about the LMR program. Factsheets on recently funded FY15 LMR projects are a recent addition of particular interest. See the "Project Highlights" tab to find downloadable PDFs of the factsheets.

PROGRAM SCHEDULE

No.	What	When
1.	**Proposal Solicitation & Review**	
a.	Full proposals due	29 February 2016
b.	Announce project new starts	Summer 2016
2.	**Project & Contracts Management**	
a.	Award FY16 projects	Fall 2016
3.	**Quarterly Status Reports (QSR)**	
a.	Submit spring QSR	April 4, 2016
b.	Submit summer QSR	July 5, 2016
c.	Submit fall QSR	October 3, 2016
d.	Submit winter QSR	January 3, 2017

Check out our web site at www.lmr.navy.mil for possible changes and new dates.

LMR-RELATED PHOTOS—KEEP THEM COMING

Thanks once again to Erin Falcone and Greg Schorr for images used in this issue. We continue to welcome the wonderful high resolution photographs of marine mammals taken during survey work. 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.

Bryde's whale.
Gregory S. Schorr, NMFS Permit 16111

So please, go through those photos and send us a few that you're particularly proud of. Include a caption, photo credit and permit number (as applicable) and be sure that the photos are in high resolution format. And who knows, you may see one of those photos in a future issue of the LMR newsletter. Submit your photos via email to: exwc_lmr_program@navy.mil.

HELP WITH OUR MAILING LIST

If you want to subscribe to or unsubscribe from LMR News, please send your email address to Lorraine Wass at 207-384-5249 or 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 announce where you can find the LMR Fiscal Year 2015 Report, which currently is under development. We will also share highlights from IRAP test as available.

You also can find past articles about the LMR program in issues of *Currents* magazine at http://greenfleet.dodlive.mil/currents-magazine.