Living Marine Resources Program Launches New Initiatives

Efforts Continue to Expand the Navy's Knowledge of Marine Mammals

THE LIVING MARINE Resources (LMR) program recently launched several new projects to increase the capability of U.S. Navy programs critical to the operation of the Navy's testing and training ranges.

In order to comply with a host of federal regulations, including the Endangered Species Act and the Marine Mammal Protection Act, federal agencies must conduct environmental reviews to consider the potential impacts on the environment by their proposed actions. The Navy is responsible for meeting specific requirements for monitoring and reporting on military readiness activities involving active sonar and underwater detonations from explosives and explosive munitions. These military readiness activities include Fleet training events and Navy-funded research, development, test and evaluation activities.

The LMR program addresses the Navy's priority research needs and transitions the results and technologies for use within the Navy's at-sea environmental compliance and permitting processes.

In fiscal year 2016, the LMR program launched the following eight new projects—five support risk threshold criteria, two focus on monitoring technologies and one addresses standards and metrics:

1. Project no. 16-21
   Extended Duration Acoustic Tagging of Right Whales (Susan Parks)
2. Project no. 16-22
   Hearing and Estimated Noise Impacts in Three Species of Auk: Implications for the Marbled Murrelet (Aran Mooney)
3. Project no. 16-23
   Cuvier's Beaked Whale and Fin Whale Behavior During Military Sonar Operations (Greg Schorr)
4. Project no. 16-24
   Frequency-dependent Growth and Recovery of Temporary Threshold Shift (TTS) in Bottlenose Dolphins (Jim Finneran)
5. Project no. 16-25
   Blainville's Beaked Whale Behavioral Risk Function for Hawaiian Populations (Dave Moretti)
6. Project no. 16-26
   Effects of Underwater Explosions on Fish (Peter Dahl)
7. Project no. 16-27
   High Fidelity Acoustic and Fine-scale Movement Tags to Enable Behavioral Response Research on Deep Diving Whales (Alex Shorter)
8. Project no. 16-28
   Proposed ASA Standards on Towed Passive Acoustic Monitoring and Mitigation Systems (Aaron Thode)

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Building Data Sets to Support Risk Threshold Criteria

Building data sets that can provide insights into behavioral responses depends upon appropriate field methods, monitoring technology and skilled analyses of the data collected. To begin to understand marine mammal behavioral responses to Navy activities, researchers use behavioral and acoustic monitoring methods that can include field observations, Controlled Exposure Experiments (CEE) and passive acoustic monitoring (PAM) equipment including monitoring tags. The monitoring tags used during most CEEs to date have relied on high-resolution but short-duration archival tags. To expand the Navy's understanding of behavioral responses, longer-duration monitoring tags that can collect more high-resolution data need to be deployed.

Greg Schorr and Erin Falcone, research biologists at the Foundation for Marine Ecology & Telemetry Research, are heading LMR project no. 16-23 (Cuvier's Beaked Whale and Fin Whale Behavior During Military Sonar Operations: Using Medium-term Tag Technology to Develop Empirical Risk Functions) and plan to deploy longer-duration, high-resolution tags on fin whales (*Balaenoptera physalus*), which are included on the federal Endangered Species Act list, and Cuvier's beaked whales *(Ziphius cavirostris*). These data will contribute to developing defensible risk functions for use in impact assessments.

Data collection will coincide with actual Navy exercises on the Southern California Offshore Range (SCORE). Researchers will document the behavior of these two species before, during and after actual Navy exercises, with a goal of recording sufficient individual baseline data. This will increase the sample of high-resolution data during Mid-Frequency Active Sonar (MFAS) exposures from multiple platforms (e.g., ships, helicopters) across a range of distances.

The initial efforts will include refining tag technology and attachment methods, developing data analysis tools and models, conducting field efforts and documenting methods. The primary tag used will be a new version of the Wildlife Computers/Andrews Whale Lander tag, referred to as "Lander2" tag. The team will also use the Sound and Motion Recording and Transmitting (SMRT) tag if it becomes available during the study timeframe. During years three to five, the team will continue field work, data collection and data analyses.

In the analysis phase, the team will combine whale movements and diving behavior from tags, as well as tracks from ships and helicopters participating in testing and training events on SCORE or Pacific Fleet exercises, and archived acoustic data from the range hydrophones and/or acoustic recording tags in a unified framework. Bringing these pieces together will help to predict the likelihood of a behavioral change as a function of sonar use, including variables such as sonar type, received level (recorded on animal or estimated), distance and orientation of the transmitting vessel, and duration, pattern or frequency of exposure. Where MFAS platform track data are unavailable, source positions will be derived from passive acoustic data if the ship is on Southern California Anti-Submarine Warfare Range.

This effort will generate significantly larger samples of high-resolution behavioral data, including accurate movements surrounding real MFAS exposure, particularly for beaked whales. Large sample sizes over broad

A LIMPET satellite tag being deployed on the dorsal fin of a fin whale during surveys associated with the SCORE project.
Gregory S. Schorr

This LMR effort will generate significantly larger samples of high-resolution behavioral data...particularly for beaked whales.

temporal and spatial scales around real exercises will yield results that are directly applicable to risk function development for Navy compliance efforts. Methods using these tags will be readily transferrable to other species and geographic regions where the Navy needs similar data to estimate the effects of its activities.

Key collaborators on this effort include Dave Moretti from the Naval Undersea Warfare Center, Stacy DeRuiter from Calvin College, and Russ Andrews and Alex Zerbini from the Foundation for Marine Ecology & Telemetry Research.

Improving the DTAG

Acoustic digital monitoring tags (DTAG) that can be non-invasively attached to an animal have provided baseline data on sound production for a wide range of critical marine mammal species. DTAGs capture fine-scale acoustic and movement data.

However, a historical problem with using DTAGs for passive acoustic monitoring is the short lifespan of the tags. This is due in part to limited battery life and in part because the tags have a tendency to fall off.

Earlier versions of these tags had limited recording capacity, ranging from 12 to 20 hours. Additionally, their suction cup attachment mechanisms usually lasted less than one day. To improve its compliance assessment effort, the Navy needs finer-scale data of acoustics and marine mammal behavior collected over longer time periods.

The latest generation of DTAG (the DTAG-3), offers significant data collection advancements over previous versions, with the potential to collect acoustic data for up to 72 hours from baleen whales. LMR project no. 16-21 (Extended Duration Acoustic Tagging of Right Whales), headed by Susan Parks of Syracuse University and Doug Nowacek of Duke University, plans to update the DTAG-3 with a new micro-texture suction cup and glue attachment method.

The new attachment mechanism was developed under a National Oceanographic Partnership Program project. A combination of micro-textured structures and bio-compatible glues has resulted in a tag that affixes more securely and resists drag, while still remaining non-invasive.

This study will be the first to apply the newly-developed attachment system to a free-ranging baleen whale. Researchers will test the attachment of the DTAG-3 during monitoring studies of North Atlantic right whales off the Southeastern United States. The monitoring studies, supported by U.S. Fleet Forces Command, are focused on right whales due to their endangered status and proximity to the undersea warfare training range off Jacksonville, Florida. This training range is one of the priority regions for the LMR program and the Navy. Tagging success will also be enhanced in this area due to the availability of significant aerial and vessel-based monitoring support.

The National Oceanic and Atmospheric Administration right whale monitoring program already in place on the

Attaching a monitoring tag to a whale.
Matthew Bowers

calving grounds in these waters will also aid in recovery of tags after they detach from whales. In the near future, the DTAG-3 will incorporate satellite position data, making recovery much easier. The project team plans to acquire these tags as soon as they become available for purchase.

Preliminary attachments will be made starting in 2017 as soon as cups are available, with a goal of attachment to a minimum of five whales in the 2018 field season.

Successful use of the new attachment method and longer-term recording tags will open the potential for attaching these tags to a broad range of endangered coastal species in multiple Navy areas of interest, significantly extending acoustic data collection timeframes.

the downfalls of previous DTAG designs is their size and inability to adhere to small odontocetes such as dolphins and porpoises.

LMR project no. 16-27 (High Fidelity Acoustic and Fine-scale Movement Tags), headed by Alex Shorter of the University of Michigan, was initiated to demonstrate a new integrated mechatronics design with compact low power electronics that is small enough for use with even small odontocetes, such as dolphins and porpoises. This will enable the collection of on-animal information about communication and acoustic response from these smaller marine mammals for the first time.

This project is a good example of the distinct roles of the Navy's marine species research and monitoring

This project will build 20 new DTAGs to be made available for upcoming behavioral response studies. These tags are highly integrated, compact, low-power, high fidelity acoustic biologging tags that are well suited for studying both deep diving beaked and large baleen whales. In designing the tags, designers have worked to reconcile lower cost and ease-of-manufacturing objectives with multiple field requirements including reduced size for small odontocetes, longer duration tag attachments and wider bandwidth recordings. To achieve these potentially conflicting requirements, a number of innovative features were introduced in the new design. This project team will evaluate how the new design handles rigorous field testing by multiple researchers on a range of animals.

This study will be the first to apply the newly-developed attachment system to a free-ranging baleen whale.

The ability to collect longer term data sets will help fill gaps in knowledge related to call repertoires, individual and age/sex class variations, and trends in cue rates—all of which are needed for more precise density estimations and the detection of critical species.

Next Generation DTAGs

DTAGs which are attached to an animal, provide types of data that other PAM devices cannot. The tags include sensors that measure animal movement and record the sounds made and heard by the tagged animal. This information can then be used to infer several acoustic and behavioral activities. However, one of

programs, which progress from basic research to demonstration and validation to monitoring implementation. The Office of Naval Research (ONR) Marine Mammal Biology program supports basic research on developing new and improving existing monitoring tag technology. After the tags resulting from such research have been sufficiently tested, they need to be field demonstrated, which falls within the purview of the LMR program. LMR-funded researchers can then provide critical feedback on tag performance under field conditions, while concurrently collecting critical behavioral data. Once field-tested, the tags will support ongoing Fleet monitoring efforts.

The researchers using the tags will demonstrate tag field reliability and, as with previous DTAG technology, supply feedback to improve the design of future tags. In addition to field demonstrating an ONR-developed technology, the project will enable upcoming behavioral response studies by providing a tag with recording bandwidth, sensitivity and software support not offered via other commercially available tags.

DTAGs are an essential tool for many naval research programs, particularly those dealing with acoustic response. High-fidelity acoustic and movement tags play a critical role in the study of the impact of human disturbance on

This LMR project team is designing a DTAG small enough for use on dolphins and porpoises.

marine mammals, and aid in improving basic scientific knowledge about these animals. DTAGs can measure exposure intensity and the animal's responses on a precise timeline. Further, sensor data combined with new analysis methods are enabling the quantification of foraging and locomotor effort of animals, resulting in an improved ability to detect subtle acoustic responses and to interpret their biological significance.

Filling a Risk Criteria Data Gap: The Marbled Murrelet

Various Navy activities, including sonar and in-water construction, can generate sounds that can convey potentially disruptive acoustic energy long distances from the source. Some of these activities 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 federally threatened in Washington, Oregon and California, and State-listed as endangered in California. Potential effects from sound, both in-air and underwater, might include auditory impacts such as temporary and permanent hearing threshold shifts as well as non-physical behavioral effects

Currently there are no basic data on the hearing 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 criterion for evaluating the onset of behavioral change or injury in the marbled murrelet, the Navy has had to use criteria for other species to predict effects.

This LMR project (no. 16-22: Hearing and Estimated Noise Impacts in Three Species of Auk: Implications for the Marbled Murrelet), headed by Aran Mooney of Woods Hole Oceanographic Institution, intends to define the hearing of up to three Auk species—related to but not including the marbled murrelet—to provide the data needed to predict the marbled murrelet's hearing.

This study will include both auditory evoked potential (AEP) methods and behavioral audiometry methods.

The field-based AEP tests—widely used, non-invasive, rapid hearing test methods—involve inserting small subdermal electrodes to measure small voltages that the brain and auditory nervous system generate in response to sound. These tests will provide much needed hearing data on several Auk species. The marbled murrelet itself, due to its protected status, will not be used during testing, but results from three closely related species of Auks are expected to provide reliable surrogates. Testing will take place in Iceland, during annual population survey capture and release events.

After AEP testing, behavioral comparative in-air physiological and behavioral audiometry tests will be conducted. Results of the in-air tests will be used to outline the frequencies and sound levels for subsequent underwater tests. After conducting both studies, the underwater and in-air results will be compared to evaluate the differences, and the best means to quantify Auk hearing.

The results of these tests will serve to frame the frequencies, sound levels and ideal species to use in the subsequent threshold shift feasibility tests. Threshold shifts are changes in hearing sensitivity after exposure to sound. If hearing thresholds recover to pre-exposure levels after some time, the change in sensitivity is known as a temporary threshold shift (TTS). If thresholds do

not recover, the change from pre-exposure levels is a permanent threshold shift (PTS). Navy acoustic impact analyses currently used in the permitting process apply auditory weighting functions, similar to those used in assessing risk to human hearing, to predict the occurrence of TTS and PTS as functions of frequency.

take steps to ensure that it complies with regulatory criteria. Navy acoustic impact analyses currently used in the regulatory and permitting process apply auditory weighting functions, similar to those used in assessing risk to human hearing, to predict the occurrence of TTS and PTS as functions of frequency. Weighting functions are

AEP-based TTS data from being directly used to develop TTS/PTS thresholds, effectively limiting the number of species/frequencies represented in the underlying data. The sparse, behaviorally-based TTS data have also prevented adequate models of TTS recovery to be developed; as a result, Navy Phase III analyses ignore


The puffin is a member of the Auk family.

These basic data will provide both key hearing data needed for defining acoustic criteria for the marbled murrelet and refine the Navy's assessment of potential impacts from training and testing activities.

These basic data will provide key hearing data needed for defining acoustic criteria for the marbled murrelet. More accurate acoustic criteria could improve Navy impact assessments and result in more realistic mitigation zones around activities that include sonar, explosives and pile-driving.

Key collaborators in this effort include Marianne Rasmussen from the University of Iceland and Magnus Wahlberg from the University of Southern Denmark.

Bottlenose Dolphins: Expanding the Knowledge Pool

Another project supporting risk threshold criteria development is studying hearing threshold shifts in bottlenose dolphins.

Because active sonar and underwater detonations from explosives may affect these animals, the Navy must

mathematical functions that emphasize (or "weight") noise at different frequencies according to the listener's susceptibility to noise at that frequency.

Direct measurements of TTS in representative marine mammal species—across a broad spectrum of sound frequencies—are needed to support the TTS/PTS thresholds and weighting function derivations.

This project team, led by James Finneran of Space and Naval Warfare Systems Center Pacific (SSC Pacific), will measure hearing thresholds in bottlenose dolphins (*Tursiops truncatus*) using both behavioral and electrophysiological AEP methods. AEP methods involve applying surface electrodes to the animal to directly measure small voltages that the brain and auditory nervous system generate in response to sound. Historically, discrepancies between behavioral and AEP measures of TTS have prevented

recovery during intermittent exposures and therefore overestimate the impact from intermittent sources.

One of the objectives of this project (LMR project no. 16-24: Frequency-dependent Growth and Recovery of TTS in Bottlenose Dolphins) is to compare and contrast the results gained by behavioral versus AEP methods. Other objectives include determining exposure levels that correspond to the onset of TTS across a broad range of frequencies (up to about 140 to 160 kilohertz), and developing TTS recovery models for use in acoustic impact assessments.

Researchers will establish baseline hearing thresholds, then measure hearing thresholds immediately before and after exposure to a fatiguing noise to determine any threshold shift occurrences. After any measureable shift, post-exposure testing will continue up to

The Basics About the LMR Program

THE LMR PROGRAM seeks to develop, demonstrate and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. This mission is accomplished through the following five primary focus areas:

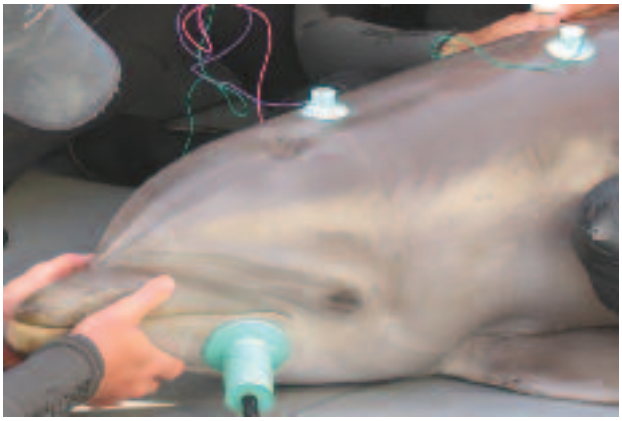
1. Providing science-based information to support Navy environmental effects assessments for at-sea training and testing.
2. Improving knowledge of the ecology and population dynamics of marine species of concern.
3. Developing the scientific basis for the criteria and thresholds to measure the biological effects of Navy-generated sound.
4. Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences of underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications).
5. Developing technologies and methods to mitigate and monitor environmental consequences to living marine resources resulting from naval activities on at-sea training and testing ranges.

The program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Command out of the Naval Facilities Engineering and Expeditionary Warfare Center in Port Hueneme, California.

For more information, visit the LMR program web site at greenfleet.dodlive.mil/environment/lmr.

several hours as needed to track recovery and to determine that no PTS has occurred. Subject health, welfare and behavior will be continuously monitored and managed by attending veterinarians and animal care staff at SSC Pacific.

The data resulting from the proposed effort will be used to define the Navy Phase IV weighting function and TTS/PTS threshold values for the mid-frequency cetacean group, validate the extrapolation procedures used to derive weighting functions and TTS/PTS thresholds for other species groups, develop practical models for recovery from TTS and enable broad comparisons between behavioral- and AEP-based measures of TTS. The data will be directly applicable to all Navy environmental documents analyzing acoustic effects of tonal sounds (e.g., sonars) and broadband noise sources.



AEP methods involve applying surface electrodes to the animal to directly measure small voltages that the brain emits.

Behavioral Risk as a Function of Geography

As part of the permitting process arising from the suite of Federal environmental laws and regulations that apply to marine mammals, Navy planners use behavioral risk functions to estimate how marine mammals, and particularly beaked whales, respond to real world sonar exposure situations.

Due to the complex nature of the underwater landscape, behavioral functions of marine mammals can differ from one location to another. While behavioral risk functions have been developed for Atlantic populations of Blainville's beaked whales (*Mesoplodon densirostris*) at the Atlantic Undersea Test and Evaluation Center (AUTEC) by previous ONR-sponsored work, this project was formed to do the same for

The primary goal of this LMR effort is to publish the first behavioral risk function for the Blainville's beaked whale in Hawaii.

Hawaiian populations of Blainville's beaked whale population at the Pacific Missile Range Facility (PMRF) undersea acoustic range.

This project (LMR project no. 16-25: A Blainville's Beaked Whale Behavioral Risk Function for Hawaiian Populations) seeks to directly compare risk functions derived for the same species, exposed to the same source types, in disparate ocean basins and to develop an extensible methodology that can be applied in other locations.

The principal investigators for this effort include Dave Moretti of the Naval Undersea Warfare Center's Marine Mammal Monitoring Program, Len Thomas, head of the University of St. Andrews Centre for Research into Ecological and Environmental Modeling, and Elizabeth Henderson, from SSC Pacific.

Blainville's beaked whale.
Mark Deakos

To accomplish their goal, the investigators will adapt the methods used at AUTEC to animals detected on the PMRF range. The movement of beaked whales in response to sonar is being documented using a combination of passive acoustic monitoring, recording tags and visual observation.

Blainville's beaked whale groups were acoustically detected on the AUTEC range before and during a Submarine Command Course (SCC), which included an intensive three- to four-day multi-ship MFAS operation. Precise ship-track data for each MFAS platform were provided by AUTEC. Passive acoustic detection data were recorded during the operation. From these data, the emission times of sonar pings from each MFAS platform were determined. These data were used as input to a propagation model to generate a behavioral risk function.

While PMRF has a hydrophone set-up similar to AUTEC, several differences between the two locations—including lower species abundance and distribution, ship and range use scenarios and hydrophone spacing—preclude the use of the same modeling approach, and will require additional long-term data and some variation in the statistical approach.

The effort began by applying available PMRF data, using the method developed for AUTEC, to evaluate how well the data fit the AUTEC model and identify additional data needs. Additional data gained following two SCC events at PMRF will contribute to a refined statistical model to derive a PMRF Blainville's beaked whale risk function.

This project will provide the first behavioral risk function for Blainville's beaked whales in the Pacific. The risk function will be based on real source data over a broad scale and will include a large number (more than 100) of beaked whale dive starts from multiple groups to provide insight into levels at which these animals react in the Hawaiian waters.

Having this dataset and risk function for Blainville's beaked whales in the Pacific, at another Navy range, will provide invaluable information on the potential similarity of responses by these whales across populations and in different propagation environments. This analysis will help improve future behavioral risk functions developed by the Navy for use with Phase III Environmental Impact Statement analyses, and may ultimately be utilized by other regulators, such as the National Marine Fisheries Service (NMFS) as has been done for other acoustic criteria developed by the Navy.

Studying Underwater Explosions and Fish

The use of underwater explosives are a necessary part of training for the Navy's Explosive Ordnance Disposal (EOD)

team. However, very little is known about the effects of such explosives on fish. The existing data on which criteria are based are decades old and do not address all the metrics and fish types needed. To quantify potential impacts to threatened and endangered species of fish, data are needed related to sizes, depths and distances to the subjects that are relevant to Navy explosives training activities.

LMR project no. 16-26 (The Effects of Underwater Explosions on Fish) was formed to quantify potential impacts to multiple fish species. A multidisciplinary team of researchers, led by Peter Dahl of the University of Washington, and Navy EOD technicians will conduct field-based experiments to collect the data needed to develop guidelines and threshold criteria for effects on fish resulting from exposure to underwater explosives.

The project team will analyze fish species with differing physical characteristics at varied water depths and distances from the source. Overall test protocol will follow similar studies that examined the effects of exposure to seismic air guns on fishes. The questions in that study, and the experimental design, closely parallel the work proposed here, with the primary difference being the nature of the signal source. Art Popper and Anthony Hawkins, who led the air gun experiments, will consult on this phase of the project.

The team's approach will provide a broader and more comprehensive understanding of dose-response relationships that combine variables such as distance from the source, water depth, size and type of fish, types (and number) of injuries and explosive charge size. Tissues from exposed fish (as well as from an extensive set of control samples) will be examined using quantified necropsy techniques. Collecting these data in an open-water environment will enable criteria development using the most appropriate and accurate metrics available.

The results of the applied research and accompanying derived criteria will be immediately useful for Navy environmental compliance by providing thresholds for mortality, injury and hearing loss for a variety species at varying depths. Consulting regulatory agencies (i.e., NMFS and the U.S. Fish and Wildlife Service) that are concerned about effects of explosives on fishes, will also benefit from the knowledge gained through this work.

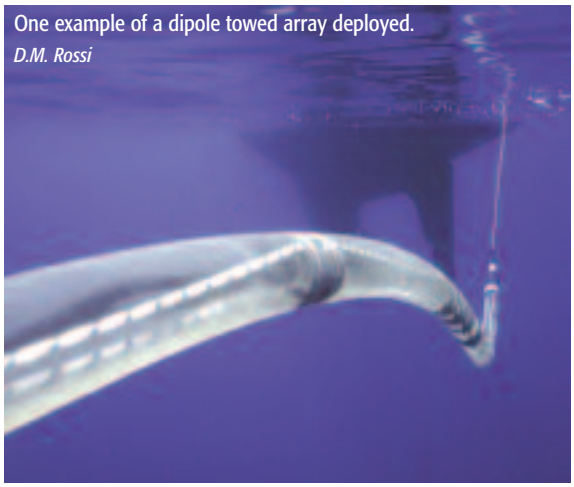
A Standard for PAM Technology

A variety of passive acoustic monitoring methods can be employed in marine mammal monitoring efforts. These methods can include fixed range hydrophones, fixed single sensor hydrophones, hydrophones deployed on mobile unmanned underwater vehicles (such as sea gliders and wave gliders), tags and towed cabled hydrophone arrays.

Several U.S. federal agencies and departments, including the Navy, need consistent standards regarding how to implement PAM methods for monitoring and compliance purposes. Developing a standard for towed cabled PAM would create both greater simplicity in assigning PAM contracts and greater consistency in

Measuring underwater explosives on the Pu'uloa naval test range.
Lee Shannon

Towed array deployment.
G. Pavan



One example of a dipole towed array deployed.
D.M. Rossi

PAM operations across multiple organizations and contractors. It also would improve transparency in the collection and dissemination of PAM data.

LMR project no. 16-28 (Proposed ASA Standards on Towed Passive Acoustic Monitoring and Mitigation Systems) is part of a collaborative effort among the Navy, NMFS and the Bureau of Safety and Environmental Enforcement to develop a standard for towed cabled PAM.

Although towed PAM devices comprise a relatively minor portion of Navy marine mammal PAM efforts, the technology is perceived as the most mature, and at least one U.S. federal regulatory agency (NMFS) is requiring towed PAM operations for real-time mitigation and monitoring, in order to comply with the Marine Mammal Protection Act. These factors make it the best candidate for starting a standards process.

To date no specific guidelines have been developed or implemented for towed PAM, although the National Oceanic and Atmospheric Administration has issued some general guidelines in the past.

The principal investigator, Aaron Thode of the Scripps Institution of Oceanography Marine Physical Laboratory, will consolidate and extend the results of a recent working group to create an American National Standards Institute (ANSI) standard. This standard will cover requirements and recommendations for initial planning, hardware, software, training, real-time mitigation and monitoring procedures and performance validation. It will also include guidelines for when PAM is not appropriate for a planned field operation. The standard will be sponsored by the Acoustical Society of America (ASA). The society has a branch dedicated to the development of ANSI standards, which are defined as "voluntary consensus standards" that are commonly incorporated into federal regulations. ASA is accredited by ANSI as a Standards Developing Organization.

In year one of this project, the working group will prepare a draft working standard that can be circulated throughout the marine mammal and acoustic communities. During year two, the working group will address comments and produce the new draft standard. By the end of year two, the group intends to submit the draft for a vote by the appropriate ASA committee.

The successful implementation of a towed PAM standard could provide a template for other PAM technologies (e.g., moored and drifting) to become standardized as their technologies mature, potentially shaving years off future standardization efforts.

For more information about any of these projects, visit greenfleet.dodlive.mil/environment/lmr and select "Project Highlights."⚓

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