ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Region: Headquarters

Planning Area: Nationwide

Title: Development of Software and Hardware to Acoustically Detect, Classify, and Locate Marine Mammals --- NOPP co-sponsorship (NT-11-08)

BOEM's Information Needs to be Addressed: This study will inform BOEM's rulemaking for the purpose of offshore operator compliance with the mitigation requirements under the Marine Mammal Protection Act and the Endangered Species Act.

Total Cost: (in thousands) $250 plus joint funding

Period of Performance: FY 2011-2015 with extension of POP

Conducting Organization: San Diego State University (via NOPP with Office of Naval Research)

BOEM Contact: **James Price**

Description:

Background: Governmental agencies and industries that focus on marine environments need to optimally detect, locate and identify marine mammals during a variety of activities including marine geophysical surveys, naval exercises, and population assessment surveys. Of particular interest is achieving a capability for the detection, classification and localization (DCL) of marine mammals under circumstances where standard visual observation from ship-based marine mammal observers (MMOs) is ineffective, such as during night-time operations, periods of bad weather, with animals below the sea surface and/or beyond visual range. The 2009 report of the Joint Subcommittee on Ocean Science & Technology (JSOST) titled, "Addressing the effects of human-generated sound on marine life: An integrated research plan for U. S. Federal Agencies" identified the development of new methods to detect, identify, locate and track marine mammals in order to increase the effectiveness of detection and mitigation as an item of highest research priority.

Mitigation requirements under Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) provisions require the development of real-time (or near real-time) monitoring capability of marine mammals. Multiple agencies and groups have interest in the improvement of passive and active acoustic monitoring capability as a complement to standard visual observations from ship-based platforms. Ideally, a ship operator would have a single tool to detect, classify and locate marine mammals within a certain operational area such as an exclusion zone. Unfortunately, operational areas within the marine environment are often complex and unique, especially when operations are not conducted in a standard or fixed location. For example, some marine geophysical surveys, which use towed seismic equipment to collect data for research on Earth systems, are driven by scientific questions and

therefore are conducted in various locations around the world from deep-ocean to more shallow coastal environments. Some methods may be more appropriate than others under certain environmental conditions, such as deep ocean water versus shallow coastal environments. Therefore, while a single method for DCL would be ideal, due to the complexities of the marine environment and unique operations, different methods, or combinations of methods forming a DCL "system" for different environments may be necessary. Ultimately, any method developed needs to demonstrate, with a high level of confidence, the detection, localization, and range to marine mammals within a specified area.

Objective: The objective is to broadly solicit research proposals on the active and/or passive acoustic detection, classification and localization of marine mammals for the purpose of funding meritorious proposed research that will advance our current capabilities in these areas.

Methods: Through the National Oceanographic Partnership Program process, BOEM will join the National Science Foundation and the Office of Naval Research to solicit and review research proposals on the topic of interest. Proposals judged to be of scientific value by a panel of outside-the-government experts will be reviewed subsequently for relevancy to BOEMRE's informational needs. BOEM will co-fund those projects that have both scientific merit and serve BOEM's informational needs.

The solicitations will be through a broad agency announcement and will explicitly request proposals in the following areas.

Detection, Classification, and Localization Algorithms
the development and testing of fast, accurate and efficient algorithms for processing raw signals, and storing and transmitting processed information in such a manner (e.g. via sonograms) that overcomes limitations of current state-of-the-art technologies (e.g. memory, storage capacity, bandwidth for data transmission).

Active Acoustic Monitoring
using broadcast sound to actively detect the presence of marine mammals and other animals whether vocalizing or not; assessing the frequency-dependent ratio between the intensity of sound that strikes the target and that return to the sonar system; examining the development of multiple frequency bands to differentiate species

Database Services & Computational Capacity
the development of database services for the research community and collaborators; the development of computational capacity for timely data processing and display; constructing metadata formats useful for acoustic databases; develop new database structures enabling users to query against known human or machine-generated annotations (detections, classifications) of existing data; constructing new annotation sets including detailed information on how they were created, export data products to external visualization services, and interface with existing external analytical tool sets; develop community access methods, which may include a user interface, to high performance computing centers (HPC), such as the Open Science Grid (OSG). HPC interface may be

incorporated into existing visualization and/or analytical tool sets. Demonstration of HPC capability should address need for sustainability of access by acoustic community.

Current Status: Ongoing

Revised Date: March 2015

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All *completed* ESP studies can be found here:
http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp

Novel Use of Existing Technologies
develop uses of existing (or minor adjustments/enhancements to existing) hardware and software to achieve the goal of real-time detection, classification, and localization of marine mammals in habitats that may not otherwise have been surveyed or monitored with conventional approaches

Current Status: Ongoing

Final Report Due: September 30, 2015

Publications Completed:
Publications about the Tethys workbench and database:

1. M. A. Roch, S. Baumann-Pickering, H. Batchelor, D. Hwang, A. Širović, J. A. Hildebrand, C. L. Berchok, D. Cholewiak, L. M. Munger, E. M. Oleson, S. V. Parijs, D. Risch, and M. S. Soldevilla, "Tethys: A workbench and database for passive acoustic metadata," Proc. IEEE Oceans, San Diego, CA, 5 pp., October, 2013. Preprint available.

Publications using Tethys:

1. Baumann-Pickering, S., Roch, M. A., Brownell Jr, R. L., Simonis, A. E., McDonald, M. A., Solsona-Berga, A., Oleson, E. M., Wiggins, S. M. and Hildebrand, J. A. (2014). "Spatio-Temporal Patterns of Beaked Whale Echolocation Signals in the North Pacific". PLoS One 9, 17, Available at doi:10.1371/journal.pone.0086072.g001.
2. Roch, M. A., Stinner-Sloan, J., and Baumann-Pickering, S., accepted. "The Effects of Site and Equipment Variation on Species Identification of Delphinids from Their Echolocation Clicks." To appear: *J. Acous. Soc. Am.*

Affiliated WWW Sites:
http://tethys.sdsu.edu/

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