

**Strategic Environmental Research and Development Program
(SERDP)**

FY 2011 STATEMENT OF NEED

Sustainable Infrastructure (SI) Focus Area

BEHAVIORAL ECOLOGY OF CETACEANS

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop the underlying science and supporting technology needed to improve our understanding of the effects of anthropogenic sound, in particular Navy sonar, on the behavior of cetaceans. Research proposals are sought that: (1) improve our understanding of the baseline behavioral ecology of key cetaceans of management concern in the absence of significant anthropogenic acoustic stimuli and (2) develop needed technologies and tools to enhance both our ability to collect baseline behavioral data and future efforts to quantify potential responses to anthropogenic sound. Research needs include but are not limited to the following:

1. Quantify and model the baseline behavioral ecology of key cetacean species and taxonomic groups to include foraging, reproduction, predator avoidance, and social behaviors and associated environmental and habitat conditions.
2. Develop advanced tags and tools that enable data collection and telemetry of data on cetaceans, including location, diving and other behaviors, physiological properties in situ, acoustic exposure, and other relevant variables across time scales of a few days to weeks to months.
3. Develop behavioral or statistical models, or a combination of the two, to exploit existing tags and passive acoustic monitoring technologies, as well as newly developed technologies, for data collection and to support future studies on the response of cetaceans to anthropogenic sound.

The following species and taxonomic groups are of priority interest to the Department of Defense:

- Beaked whales (family Ziphiidae), including Blainville's (*Mesoplodon densirostris*) and Cuvier's (*Ziphius cavirostris*) beaked whales, and the harbor porpoise (*Phocoena phocoena*) based on their responsiveness to sound;
- Other small to midsize odontocetes, including pilot whales (*Globicephala* spp.) and pelagic dolphins (family Delphinidae) based on the high number of estimated regulatory takes;
- Baleen whales (suborder Mysticeti), with a focus on right (*Eubalaena* spp.), minke (*Balaenoptera* spp.), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*),

and blue (*Balaenoptera musculus*) whales, and sperm whales (*Physeter macrocephalus*; locale specific) based on their listing status and overlap in distribution with areas of Navy operations.

Proposals submitted in response to this SON may address one or more of the research needs listed above and may address one or more species or taxonomic group of relevance to DoD resource managers.

2. Expected Benefits of Proposed Work

The desired outcome is improved knowledge that provides an understanding of the baseline behavioral ecology of priority species and taxonomic groups of cetaceans that can be used to help set protective and defensible dose-response thresholds. Such knowledge then can inform and improve science-based monitoring and mitigation measures when cetaceans of concern might be exposed to naval sounds. An additional expected benefit is development of a suite of sensors, platforms, algorithms, software, and tag attachments to detect, locate, and identify individual marine mammals in situ, to study their behaviors over periods of time ranging from a few days to weeks to months, and to measure basic physiological properties of individuals in situ while they engage in a range of both natural activities and activities potentially impacted by the presence of anthropogenic sound.

3. Background

Behavioral response sets the legal and policy lower threshold for noise exposures of concern above which adverse effects to individuals may occur that result in a regulatory take. The science challenges are first to be able to detect responses attributable to noise exposure and second to determine when these responses are biologically significant. Thresholds of exposure below which responses are non-significant will provide adequate protection of individuals from exposure and prevent a take situation. Because thresholds will likely differ by species, individual physiological and life history status, and environmental conditions, additional complexity is added and must be assessed. Finally, the marine environment and the manner in which cetaceans use marine habitat offer special challenges in obtaining the requisite information about exposure and response.

To distinguish behavioral responses to anthropogenic sounds requires understanding baseline behavior—that is, how the animal behaves in its environment in the absence of anthropogenic sounds. Without such information, it would be difficult to identify, detect, and assess responses. Dose-response thresholds to anthropogenic sounds, if based on an erroneous understanding of a species' behavioral ecology or on inadequate baseline data, may be set too conservatively or, worse, may provide inadequate protection. The response of cetaceans to U.S. Navy-generated sounds is expected to depend in many instances on the context of exposure and the physiological condition, previous experience, and motivation (i.e., internal condition or external driver that activates and directs goal-oriented behavior) of exposed individuals. The responses of animals may be influenced at the time of exposure by the age or sex of the animal, time of year, an

animal's physiological state (e.g., its reproductive and energetic states), history of exposure, social conditions (e.g., whether exposure occurs while the animal is in a social grouping, including a mother with young), and environmental conditions. Understanding the behavioral ecology of a species or taxonomic group is important for predicting the contexts when animals may be most sensitive to sound and for predicting when they may be most vulnerable to any potential adverse impacts. Changes in the natural environment (e.g. seasons, changes in food supply or level of predation) may make specific age-sex classes more vulnerable to the effects of sound and other potential stressors. A thorough understanding of the baseline behavioral ecology of species exposed to anthropogenic sound also is required to interpret the biological significance of any responses observed. It follows that over time the ability to stratify behavioral variance by age class, sex, animal condition, social situation, and season will further our understanding; however, such stratification will be difficult to achieve and may require research over long periods of time. As a result, it is important that the research conducted under this SON at least capture population-level variance in baseline behavioral ecology attributes.

Finally, in aquatic environments it is almost impossible to directly observe individual animals. As a result, animal-borne data loggers and passive acoustic monitoring technologies are crucial to studying the eco-physiology and biomechanics of animals under natural conditions. Bio-logging and acoustic monitoring lies at the interface between scientific inquiry and technological feasibility. Instrumentation has improved in terms of the data loggers themselves, with increased memory capacity and with the availability of new sensors, methods of data recovery, and new techniques for data analysis; however, additional advances are needed to improve the quantity and quality of data collection and its efficient transmission and processing. Key to implementation of these advances is the need to make them available to the wider research community through open source and well-conceived commercialization approaches.

4. Cost and Duration of Proposed Work

The cost and time to meet the requirements of this SON are at the discretion of the proposer. Two options are available:

Standard Proposals: These proposals describe a complete research effort. The proposer should incorporate the appropriate time schedule and cost requirements to accomplish the scope of work proposed. SERDP projects normally run from two to five years in length and vary considerably in cost consistent with the scope of the effort. It is expected that most proposals will fall into this category.

Limited Scope Proposals: Proposers with innovative approaches to the SON that entail high technical risk or have minimal supporting data may submit a Limited Scope Proposal for funding up to \$150,000 and approximately one year in duration. Such proposals are eligible for follow-on funding if they result in a successful initial project. The objective of these proposals should be to acquire the data necessary to demonstrate proof-of-concept or reduction of risk that will lead to development of a future Standard Proposal. Proposers should submit Limited Scope Proposals in accordance with the SERDP Core Solicitation instructions and deadlines.

5. Point of Contact

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the Funding & Opportunities page on the SERDP web site: <http://www.serdp.org/funding>.