Strategic Environmental Research and Development Program (SERDP)

FY 2020 STATEMENT OF NEED

Resource Conservation and Resiliency (RCR) Program Area

IMPROVED UNDERSTANDING OF RESPONSE OF DOD RELEVANT MARINE MAMMAL POPULATIONS TO MULTIPLE STRESSORS

1. **Objective of Proposed Work**

The objective of this Statement of Need (SON) is to advance scientific understanding of marine mammal response to exposure from multiple stressors, especially for threatened, endangered, and at risk (TES) species and populations. Currently, cumulative risk from exposure to multiple stressors cannot be predicted based on existing scientific theory and data for individual marine mammals or their populations. Specific research objectives include the following:

- Advance the understanding of the cumulative effects of exposure to multiple stressors in marine mammals. Of particular interest is interdisciplinary research (i.e. marine ecology, non-linear systems, toxicology/epidemiology, stress physiology, population biology, or others) to explore solutions to the problem of predicting how the effects of two or more stressors interact and affect a population, including the relevant theory, data, and measurement systems required for understanding the cumulative effects of exposure to multiple stressors in marine mammals.
- Identify and elucidate case studies that apply the Population Consequences of Multiple Stressors (PCoMS) Framework\(^1\) to marine mammals to investigate the effects of multiple stressors on marine mammal individuals and populations.

2. **Expected Benefit of the Proposed Work**

The expected benefit of the proposed work is the development of fundamental knowledge regarding the impact of multiple stressors on TES marine mammal species. The knowledge derived from this research will be transferred and integrated into efforts within the Office of Naval Research, Marine Mammal & Biology Program research program and thereby provide for the development of improved and more cost effective marine mammal management methods, especially for threatened, endangered, and at risk species (TES) populations responding to multiple stressors.

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3. Background

Most existing research on interactions between effects of stressors on living systems involves factorial experiments with species or systems in settings where treatments can be replicated and controlled. Factorial experiments are useful for detecting the presence of interactions but, because such systems are usually only exposed to one level of each stressor, they rarely provide sufficient information to predict responses at varying levels of stressors present in nature. Meta-analyses of results from studies of multiple stressors on various species have been conducted, but no general pattern has emerged for predicting how the effects of stressors will interact. Specific studies may find impacts as either non-interactive, synergistic or antagonistic. Beyond these generalities, the prediction of multiple stressors often assumes stressor effects to be additive and this assumption is often wrong. In spite of the inability to predict the effects of multiple stressors for environmental management, similar problems in a variety of fields have led to promising new approaches.

The National Research Council’s Ocean Studies Board has convened five highly successful panels on the subject of biological effects of manmade underwater sound and produced a progressive series of reports published in 1994, 2000, 2003, 2005, and 2017. While regulations require environmental assessments to analyze cumulative effects, the NRC\(^2\) concludes that the science is not in place to meet regulatory requirements and that understanding human impacts on highly migratory marine species, such as large whales, remains a major challenge.

Currently, environmental assessments often observe that when two or more stressors impact the same population or ecosystem, combined stressors can result in either synergistic or antagonistic interactions and little more beyond a general statement is made. Moreover, the broad scientific consensus is that adding impacts is not appropriate since cumulative effects are not consistently observed to be linearly cumulative. Therefore, in the absence of alternative approaches, most environmental assessments do not attempt to quantify cumulative effects but rather simply point out inchoate concerns about synergistic effects. Those that do attempt to make predictions to guide management actions typically rely on the predicted effects of individual stressors in spite of the consensus that such reliance is usually wrong. A similar problem also holds for estimating the effect of multiple doses of the same stressor. The current state of knowledge then is that cumulative risk from exposure to multiple stressors cannot be predicted based on existing scientific theory and data for individual marine mammals or their populations.

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. The proposals must describe a complete research effort. It is anticipated that the scope of this statement of need is such that a multi-disciplinary team will be required to execute a successful effort. Single investigator efforts will not be of sufficient scope to compete successfully. The proposer should incorporate the appropriate time, schedule, and cost requirements to accomplish the scope of work proposed. Preference will be given to proposals that best address and integrate both of the specific research objectives. Proposers are encouraged to consider the formation of a standing interdisciplinary research working group within the multi-disciplinary team structure to assist in addressing this complex research problem.

SERDP projects normally run up to four years in length. Project budgets vary but must remain consistent with the scope of the effort. Under this research initiative, the SERDP and Office of Naval Research, Marine Mammal & Biology Program will coordinate closely with the selected research efforts to advance understanding of the cumulative effects of exposure to multiple stressors in marine mammals within the Department of Defense. Limited scope proposals, proposals encouraged in previous statements of need for funding up to $200,000 and approximately one year in duration, will not be accepted under this statement of need.

5. **Point of Contact**

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the [SERDP website](#).