1. **Objective of Proposed Work**

The objectives of this Statement of Need (SON) are to improve our fundamental and applied understanding of how: (1) phenology\(^1\) of specific plant and animal species on Department of Defense (DoD) installations in the United States (U.S.) and its territories responds to abiotic features of the environment and how these responses may change under non-stationary climate conditions; (2) changes in phenology will affect key interactions involving species of management concern to DoD resource managers; and (3) these combined effects influence conservation and management challenges associated with affected species of concern.

Specific research needs include improving our understanding of the following:

1. Current phenological responses, their timing, and their thresholds to abiotic features of the environment for current and potential DoD species of management concern and how these responses may change under non-stationary climate conditions.
2. Key interactions involving species of DoD management concern that are dependent on the timing of phenologically determined events, how the timing and overlap of these events may be altered under future plausible climate conditions, and the implications for continued species interactions and ultimately population viability of species of concern.
3. Disruption of key ecological processes that may result from altered species interactions due to non-congruent phenology shifts in response to a changing climate and its implications.
4. Specific genetic factors and markers with known physiological effects that can be tied directly and quantitatively to variation in phenology that provide a predictive capability as to (a) how phenological responses to novel seasonal changes and related cascading effects may change under non-stationary climate conditions and (b) the degree to which species exhibit capacity for evolutionary adaptation.

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\(^1\) Study of periodic plant and animal life-cycle events and how these are influenced by seasonal and inter-annual variations in abiotic features such as climate, light, and elevation.
5. Changes in phenology and its causative agents through the use of data mining to ultimately develop and optimize monitoring protocols for detection and tracking of phenological changes, trends, and their implications.

6. Life-cycle modeling in relation to current and potential changes in phenological responses and species interactions under a changing climate that can be used to (a) assess emerging theoretical understanding of phenology and its role in maintaining species viability and structuring ecological communities and (b) address resultant conservation and management challenges within relevant, testable, and adaptable conceptual frameworks.

Proposals submitted in response to this SON may address one or more of the research needs listed above. Species of interest include terrestrial, freshwater aquatic, and near-shore marine species for which DoD has management responsibilities. Proposals should demonstrate an understanding of the appropriate use and limitations of available climate information.

2. Expected Benefits of Proposed Work

The DoD manages a broad range of ecosystems covering millions of acres on installations across the U.S. and its territories. Research conducted under this SON is intended to yield an improved understanding of how potential changes in abiotic features in a non-stationary world could cause changes in plant and animal populations and distributions of management concern to DoD resource managers. An understanding of the underlying causes of variation in phenological shifts will contribute to an understanding of the biological effects of climate change on phenology and species interactions and ultimately their implications for species conservation and management under a changing climate.

3. Background

Plants and animals respond to abiotic features of their environment in ways that determine the timing of specific life-cycle events, such as migration, flowering, and hibernation. These features can include climatic factors that may change inter-annually or seasonal changes in light duration. Key phenological relationships have developed over evolutionary time and can be rigidly fixed and exhibit explicit thresholds or show plasticity in responses that are not tightly tied to the environmental cue. Important species interactions are based on a shared phenology that also has evolved over time based on individual species fitness.

A changing climate can alter an individual species’ phenology and its interactions with other species that are determined by phenology; indeed, recent shifts in the phenology of numerous plant and animal species have provided powerful evidence of an already changing climate. Rapid shifts in phenology under a changing climate could (1) adversely alter the timing of a species’ response to an environmental cue that now puts it at a survival and fitness disadvantage (e.g., an animal terminates hibernation prior to adequate food supplies being available) and (2) alter the timing of key interactions between species that may respond differently to the new signal (e.g., butterfly larvae emerge before their host food plants are available). The rapidity of the shift may determine if species and their interactions will have adequate time to adapt behaviorally or physiologically in the short-term versus evolutionarily in the long-term to the new conditions.
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 of up to $200,000 over approximately one year. Such proposals may be 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 SERDP website at [www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations](http://www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations).