USGS NSF GRIP, GSP Opportunity

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USGS Center:	DOI Northeast Climate Science Center
Project Title:	Climate-induced changes in phenology in coastal ecosystems
Summary:	Shifts in phenology provide one of the strongest indicators of an organism's adaptive capacity to climate change, yet it is one of the most poorly known consequences of future impacts. This project seeks to improve understanding and develop adaptation strategies of the effects of phenological shifts and trophic mismatches in Atlantic coastal fish, seabird and marine mammal species.
Project Hypothesis or Objectives:	Shifts in phenology have been described as a "fingerprint" of spatiotemporal responses of species to climate change impacts, and thus provides one of the strongest indicators of the adaptive capacity of organisms to cope with future environmental conditions. In the greater Gulf of Maine (GOM) region, there is substantial evidence that many species have already shifted their geographical ranges, and ecosystems are undergoing major shifts in composition, dominance, and structure. Yet, few studies have explicitly addressed climate-induced shifts in phenology and potential resultant mismatches in forage and habitat resources. This project seeks to improve fundamental and applied understanding of how climate change is impacting phenology of nearshore marine species inhabiting the GOM through the following objectives: 1) determine if and how phenological changes are occurring in the GOM through the analysis of ecological and environmental datasets targeting coastal fish, seabird, and marine mammal species; and 2) assess the potential for trophic mismatches in food and habitat resources by comparing responses among interdependent species. 3) Develop adaptation strategies and actions that address the socio-ecological consequences of phenological shifts and trophic mismatches. Potential case studies to be explored include forage fishes such as alewife and sandlance; predatory fishes such as striped bass and bluefish as well as a suite of seabirds, seals, baleen and toothed whales. Additional case studies may be suggested by the intern. This project will provide unique opportunities to collaborate and

	partner with an interdisciplinary group of quantitative ecologists, climate scientists, fisheries and marine biologists at university, non-governmental (NGO), federal, and state institutions from across the region. The position will be located at the DOI Northeast Climate Science Center (NE CSC), which is based at the University of Massachusetts Amherst in Amherst MA. The NE CSC is part of a national federal network of 8 CSCs created to provide scientific information, tools, and techniques that managers and other parties interested in natural and cultural resources can use to anticipate, monitor, and adapt to climate change. The NE CSC is also part of a regional consortium of 6 institutions including Columbia University and the Marine Biological Laboratory.
Duration:	Up to 12 months
Internship Location:	Amherst, MA
Field(s) of Study:	Geoscience, Life Science
Applicable NSF Division:	OCE Ocean Sciences, DEB Environmental Biology, SES Social and Economic Sciences
Intern Type Preference:	Either Type of Intern
Keywords:	climate change, phenology, marine mammals, fish, invertebrates, seabirds, shorebirds, wildlife, Gulf of Maine, coastal, marine, ecology, trophic, mismatches, Climate Change Vulnerability Assessments, adaptation, conservation, management,
Expected Outcome:	The selected intern will gain skills and knowledge related to biological responses to climate change impacts, and be part of a collaborative and interdisciplinary workgroup seeking to deliver applied and actionable science to the natural resource community. Outputs build on preliminary results of the ongoing project, Ecological and management implications of climate change induced shifts in phenology of coastal fish and wildlife species in the Northeast CSC region. Results will lead to increased understanding of the underlying ecological and environmental drivers that are causing species of conservation and management concern, including endangered marine mammals and seabirds, to shift their distribution and timing in the greater Gulf of Maine region. This information is critical for informing conservation tools such as Climate Change Vulnerability Assessments and related adaptation strategies.
Special skills/training Required:	We are seeking an intern with an interest in biological responses to climate change and excellent quantitative and statistical skills. The selected individual will be responsible for analyzing long-term ecological and environmental datasets. Ideally, this person will be familiar with R, Matlab, or other statistical program, and have the ability to work with multivariate models and GLMs. There are

	opportunities to work with quantitative ecologists and climatologists at the NE CSC who can assist with the development and refinement of these approaches.
Duties/Responsibilities:	1) Analyze historical time-series and legacy datasets from multiple ecologically connected coastal and marine species to determine how and why the timing of phenological events (e.g., migration, breeding) are changing. 2) Develop quantitative and conceptual models that synthesize the ecological and management implications of shifting phenology. 3) Assist in the preparation of publications and other final products.