Robust Harvest Strategies for Responding to Climate-Induced Changes in Fish Productivity

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Abstract

Evidence is accumulating that climate change and variability are affecting the distribution, recruitment and production of marine fish species. Even so, it is difficult to distinguish climate signals from other processes, including mortality from fishing and predation. At the same time, annual catch limits must be specified without full understanding of these production processes. This project will use state-space models to rapidly identify changes in stock productivity due to environmental factors for 20 managed fish species on the Northeast Shelf Large Marine Ecosystem. For the subset of stocks identified as being vulnerable to climate change, we will introduce environmental covariates, based on mechanistic hypotheses, into the Kalman filter, state-space models to identify which climate variables are most strongly related to observed changes in productivity. The second part of the project will identify harvest control rules for responding to climate-induced changes in productivity. Time-varying biological reference points will be calculated for those stocks exhibiting changes in productivity. Stochastic dynamic programming will be used to identify robust harvest control rules for two test-case species, winter flounder and yellowtail flounder.

Responding to the guidance in the competition, we propose a two-year project to enhance the use and application of climate-related data and information in fisheries stock assessments and management decisions. This research is highly relevant to NOAA's mission to conserve and manage marine ecosystems and fishery resources, as articulated in the Next Generation Strategic Plan. Our project primarily addresses Objective 1 of the Healthy Oceans Goal, which is improved understanding of ecosystems to inform research management decisions. In particular, our project will identify harvest policies that are resilient in the face of sudden and prolonged changes, to ensure the sustainable harvest of managed species.