Case Study: Development of Robust Management Procedures for Fish Stocks with Dynamic Population Distribution

Contact:

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Topic:

Develop applied spatial forecasting/predictive models to evaluate non-stationary population distribution, fleet dynamics and spatial management strategies and to quantify management risk for the international Pacific hake (whiting) fishery.

Background:

Fish populations are susceptible and responsive to ecological and climate processes that occur at various spatio-temporal scales. These processes, combined with individual fisher behaviors (e.g., choice of fishing location, gear, time, and target species), typically result in heterogeneous distributions of fishing mortality, which can lead to complex population structure and patterns and thereby complex population dynamics. It is largely understood that rational fisheries management decisions must include management procedures (data collection, stock assessment, and harvest rules – collectively forming a management strategy) that operate at a resolution consistent with the dynamics of the stock. Yet, management procedures are often conducted at an aggregate stock-level, possibly missing important spatial population patterns, which degrades harvest policy advice, and increases risk associated with maintaining sustainable fisheries.

Pacific hake (whiting), a semi-pelagic schooling species found along the west coast of North America, is the most abundant groundfish population in the California Current ecosystem and comprises the largest groundfish landings by volume in the commercial groundfish fishery. Data suggest that Pacific hake migrate according to seasonal and ontogenetic patterns, where larger/older individuals tend to move further north into Canadian waters before returning south to reproduce. The extent and timing of this migratory behavior (and possibly schooling behavior) are thought to be linked to oceanographic conditions and large-scale forcing (e.g., El Niño). However, drivers of hake distribution are not fully understood, especially across hake life history stages. A better understanding of how environmental conditions influence migratory patterns and, in turn, how changes in population distribution influences the selection of robust management strategies is needed.

In this case study, a group of students will collaboratively develop applied spatial models to evaluate the drivers of Pacific hake (whiting) variability in distribution, life history parameters (e.g., size-at-age), and evaluate how these changes ultimately influence stock assessment and management advice. Students will incorporate measures of uncertainty when developing empirical and simulation models, and will use simulations to compare/contrast risk associated with alternative management strategies. Students will have an opportunity to interact with stakeholders and stock assessment scientists, providing a valuable opportunity to communicate research objectives and results for an economically important international fish stock.

Existing Data:

* Acoustic survey data (population density estimate, age-composition, and *in situ* oceanographic information)
* Trawl survey data (occurrence/density, age composition, and oceanographic information)
* Fishery landings (size of catch, age-composition, location of catch, discarded catch)
* Biological information (maturity, fish length/weight/gender)
* Aggregated vessel economic data
* Satellite data (sea surface temperature, chlorophyll a)

Data Needs:

Compiling oceanographic data into a useable format will be needed. Stakeholder input and objectives will need to be solicited.

Desired Area(s) of Expertise for Students:

This collaborative project would benefit from students with expertise in mathematics, applied statistics, oceanography, quantitative ecology, fishery biology, computer science/numerical programming, or related experience.