FishSET: a spatial economics toolbox to better incorporate fisher behavior into fisheries management

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Summary

NOAA Fisheries and partners are developing the Spatial Economics Toolbox for Fisheries (FishSET) to improve predictions about fleet behavior, enabling better management of marine resources and more effective design of marine protected areas (MPAs). FishSET organizes data with data management tools, establishes best practices for all aspects of modeling, packages a range of state-of-the-art fisher location choice models, and provides tools to compare the economic impacts of different potential MPAs. Here we provide an overview of the modeling approach, project implementation, and FishSET software. Pilot projects that utilize FishSET are underway in different regions of the United States, ensuring that the data challenges that confront modelers in different regions are addressed at the onset of the project. Implementing pilot projects in various environments also provides insight into how economic and fisheries data requirements for effective management may vary across different types of fisheries. We present examples from Alaska to the Gulf of Mexico of how FishSET is being used to estimate the economic impacts of different potential marine closures and other management actions.

Introduction

Since the 1980s, fisheries economists have utilized discrete choice models to identify the factors that influence fishers' spatial and participation choices. in order to understand the trade-offs of fishing in different locations and at different times. This knowledge can improve predictions of how fishers respond to and are economically impacted by the creation of MPAs, changing climate conditions, or management actions such as the implementation of catch shares. This information is valuable for reducing the costs and increasing the benefits of systems of MPAs. While a wide range of topics have been explored in this literature, discrete choice models have not been frequently used in policy decisions such as whether or where to create networks of MPAs. FishSET strives to make these models available to fisheries managers in a timely and consistent manner. An initial step of this project has been the development of best practices and tools to improve data organization. A second core component is the inclusion of estimation routines that enable comparisons among state-of-the-art fisher location choice models. FishSET allows new models to be more easily and robustly tested and applied when the advances lead to improved predictions of fisher behavior and efficiently organizes statistical code so that leading innovators can build on each other's work and methods can be widely available. FishSET is a stand-alone Windows-based MATLAB executable program that does not require a separate license. The modeling code is available for examination and modification by users with MATLAB licenses.

Materials and Methods

The core components of the project can be summarized in several main ideas:

1.   <u>Standardize data management and organization procedures</u>. We have examined the data sources available in all United States regions, facilitated discussions among advanced users on how to best standardize data organization methods, and have developed a variety of data-handling and analytical tools. We are integrating a variety of economic and fisheries effort data and providing

connections to fishery-independent and environmental data. Data and data integration efforts are always evolving so we are working to best connect to new resources as they become available.

2. <u>Develop best practices for modeling fisher behavior</u>. Working with leading academic modelers and NOAA Fisheries economists and data managers, we are formalizing best practices for the complete data integration, model execution, and model comparison processes.

3. <u>Provide easily accessible tools</u> to all organizations in the United States involved in fisheries management analysis (e.g., NOAA Fisheries Regional Offices and Science Centers and Fishery Management Councils) to enable them to use fisher location choice models to better assess the economic impacts of fishery management actions. This involves developing and disseminating best practices and having data and models in place ahead of when policy needs arise. Figure 1 provides an example of several of the FishSET tools.

4. <u>Ensure that new advances in the academic literature can be robustly tested and widely applied</u> when the advances are effective in improving predictions of fisher behavior.
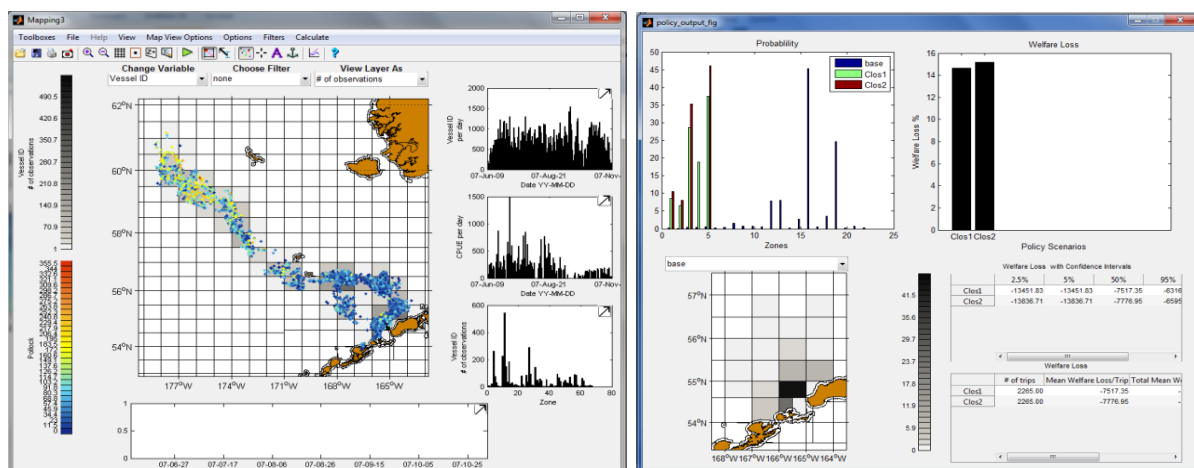

Figure 1: Views of the FishSET Mapping and Policy Analysis tools

Results and Discussion

FishSET facilitates the expansion of location choice and bio-economic modeling for fisheries management. We are currently augmenting the number of available models in FishSET and developing project-support and educational materials so that FishSET software can be widely distributed. Significant effort will need to be expended to implement FishSET in different fisheries. Pilot projects that utilize FishSET are underway in different regions of the United States, ensuring that the data challenges that confront modelers in different regions are addressed at the onset of the project. Implementing pilot projects in various environments also provides insight into how economic and fisheries data requirements for effective management may vary across different types of fisheries. Meta-analyses from similar models across a range of biological, economic, and institutional environments will provide a great increase in our collective understanding of how these factors interact to impact fisheries and fishing communities.

There is considerable variation in the costs of designing networks of marine protected areas. FishSET provides a new means to compare the costs and benefits of implementing different systems of MPAs.