LENFEST OCEAN PROGRAM

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ADVANCING ECOLOGICAL REFERENCE POINTS FOR MENHADEN USING AN ECOSYSTEM MODEL

Atlantic menhaden is an important prey species for several marine predators, as well as the basis of the largest fishery on the U.S. East Coast. Managers at the Atlantic States Marine Fisheries Commission (ASMFC) are pursuing the development of ecological reference points (ERPs) to help them sustain both the fishery and the species that rely on menhaden as food.

The Lenfest Ocean Program is funding new research to support this effort. The project will update and enhance an ecosystem model that can be used to forecast the effects of different ERPs on menhaden and its full suite of predators, including fish, seabirds, and marine mammals. The project is led by Dr. Andre Buchheister of Humboldt State University. It will be timed to provide information on the ERP options that emerge from an analysis currently being conducted by an ASMFC working group.

> **"WE HOPE TO PROVIDE A VALUABLE TOOL TO SUPPORT THE NEXT STEP IN MANAGING THIS VITAL FISHERY."**
>
> Andre Buchheister

BACKGROUND: THE MOVE TO ECOLOGICAL REFERENCE POINTS

Fisheries management has increasingly shifted toward an "ecosystem approach," which places increased emphasis on the effects of fishing beyond the target species. Among the first fisheries to begin this shift were those targeting forage fish—small-bodied, schooling fish that are critical prey to higher predators in many marine ecosystems. Examples include herring, sardines, and menhaden.

Atlantic menhaden are primarily caught for production of fish meal and fish oil, and as bait for fisheries such as lobster and blue crab. Ecologically, menhaden are an important food source for fish such as striped bass, bluefish, and weakfish, and for marine mammals and seabirds. They are currently managed using single-species reference points—numerical values that are based on estimated abundance and catch rate of menhaden alone. These values can be either target reference points, which specify a state to be attained, or limit reference points, which specify a state to be avoided.

ERPs, if adopted, would provide additional guidance by specifying targets or limits that account for menhaden's broader role in the ecosystem, such as in supporting predators. For example, an ERP might specify a level of menhaden fishing mortality or abundance that would leave enough menhaden in the water to sustain a minimum amount of striped bass. But no such ERPs have been examined in depth. To do so, the ASMFC created the Biological and Ecological Reference Point Working Group (BERP).

SIMULATIONS TO EXPLORE REFERENCE POINTS AND MANAGEMENT STRATEGIES

To aid in developing ERPs, the BERP chose three mathematical models that focus on menhaden and its main fish predators. To complement this approach, Dr. Buchheister previously developed an ecosystem model of the Northwest Atlantic Continental Shelf, or "the NWACS model." It includes the same species as the BERP's models, plus dozens of other categories of organisms and eight fishing fleets.

The new research will enhance the utility of the NWACS model and use it to evaluate a range of reference points. Specifically, the research team will:

- Update and enhance their ecosystem model. This will include adding the most recent data, dividing menhaden into seven age classes to match the standard stock assessment model for menhaden, incorporating data on primary production, and separating the menhaden fishery into two fleets, representing reduction and bait fishing.
- Simulate the performance of a range of reference points, including the current single species reference points and the ERPs under development by the BERP. The team will describe the result of implementing each reference point in the model simulation in terms of the yield of menhaden fisheries, the biomass of predators, and the yield of fisheries for those predators.
- Ensure the model's reliability using sensitivity analysis. This will involve re-running the model using a range of parameter values, to ensure the findings are reliable and consistent even if these parameters change or were misestimated.
- Conduct management strategy evaluation (MSE) for setting menhaden catch regulations. The team will test several management strategies, each of which will involve using one or more reference points and a set of rules for when to change regulations (such as allowable catch or fishing mortality) based on the status of menhaden. MSE allows for testing under a range of scenarios, including ones in which managers act based on uncertain information.

The research team will interact frequently with the BERP to ensure the results are useful for that group and for other decision-makers. Two BERP members are already involved in the ecosystem modeling work, and the research team plans to present its results to the BERP and to interested managers and stakeholders.

The project will continue through 2020. It will produce peer-reviewed articles and make detailed results and the NWACS model itself available to the BERP.

Research Team

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