PROJECT SUMMARY: SHORT-TERM FORECASTS OF SPECIES DISTRIBUTIONS FOR FISHERIES MANAGEMENT

BACKGROUND: As water temperatures increase along the U.S. east coast, fish and invertebrate species are shifting their ranges, presenting challenges for managers tasked with setting catch limits and, in some fisheries, spatially allocating harvest.

PROJECT GOAL: This research will test a new method for predicting warming-induced movements of diverse species over short timescales (the next one to ten years) that better align with management timescales.

THE METHOD: Unlike previous approaches that use only environmental factors to predict distribution, the new method, called dynamic range modeling, will also factor in the unique population dynamics of individual species, since warming temperatures could affect a species' growth, mortality, movement patterns, and reproductive success. By modeling how these life-history parameters vary geographically along the U.S. Atlantic coast, the researchers may be able to more effectively predict species movements and productivity. The raw data used to fit the models will include species abundance data from state, regional, and federal surveys, as well as high-resolution coastal temperature and dissolved oxygen hindcasts. To validate whether the approach is effective, the team will simulate species distributions from previous years and compare those predictions with actual observed distributions and with predictions that relied only on environmental data.

FOCAL SPECIES FOR THIS RESEARCH: The research team has initially identified four candidate species for which to test the model's effectiveness. The team has solicited feedback from the Mid-Atlantic and South Atlantic Fishery Management Councils and stakeholders regarding other potential candidate species; therefore, the final list of candidate species may change. The researchers selected these species because they represent a broad diversity of life-history strategies, have supporting data available, and are likely susceptible to distribution shifts as a result of changing environmental conditions. *The team did not select these species in order to utilize the outcomes of this research to directly inform current management efforts and actions for those species*.

The four species are:

1. Shortfin squid (*Illex illecebrosus*): Pelagic, short-lived, highly productive, an important forage species, and have a very high potential for distribution change (Hare et al. 2016);
2. Spiny dogfish (*Squalus acanthias*): Demersal, long-lived, low-productivity, seasonal north-south migrations, an important predator, and have a very high potential for distribution change (Hare et al. 2016);
3. Summer flounder (*Paralichthys dentatus*): Demersal, highly productive, seasonal inshore-offshore migrations, and a well-documented northerly range shift since the 1960s; and
4. Grey triggerfish (*Balistes capriscus*): demersal and structure-oriented, and historically present in the Gulf of Mexico and South Atlantic but appearing to shift into the Mid-Atlantic region.

MANAGEMENT RELEVANCE:

At its core, this is a scientific study, meant to evaluate and test the use of a new modeling approach for predicting changes in species distribution in the short term. Eventually, depending on how the model performs, movement predictions derived from this technique or similar techniques *could* be used to help inform management discussions concerning:

- Spatial allocation of harvest;
- Advancing an ecosystem approach to fisheries management considerations, since species assemblages and relative abundance may change;
- Population reference points and catch levels; and
- Spatial planning considerations for offshore energy development, by incorporating projected species distributions (not just current distributions).

PROJECT TIMELINE:

The three-year project is scheduled to conclude in the spring of 2022, although results and progress will be shared with stakeholders, scientists, managers, and the interested public as they become available.

THE RESEARCH TEAM:

- Principal Investigator: Dr. Malin Pinsky, Rutgers University (malin.pinsky@rutgers.edu)
- Co-Principal Investigator: Brandon Muffley, Mid-Atlantic Fishery Management Council (bmuffley@mafmc.org)
- Post-Doctoral Researcher: Dr. Alexa Fredston-Hermann, Rutgers University (fredstonhermann@ucsb.edu)

Questions, comments, or suggestions? *Please email Emily Knight of the Lenfest Ocean Program at eknight@lenfestocean.org.*

Black Sea Bass, NOAA

REFERENCE:

Hare, J., et al. (2016). A vulnerability assessment of fish and invertebrates to climate change on the northeast U.S. continental shelf. PLoS ONE 11(2): e0146756. https://doi.org/10.1371/journal.pone.0146756.