LENFEST OCEAN PROGRAM

A research project
December 2020

SUPPORTING SCIENCE AND COMMUNICATING RESULTS.

NEW RESEARCH ON THE ROLE OF HABITAT AND LIFE HISTORY IN FISHERIES VULNERABLE TO CLIMATE CHANGE

INTRODUCTION

Marine species live in a variety of habitats over the course of their lives. Where they move often reflects distinct habitat needs such as food, shelter, or physical conditions at different life-stages. As ocean waters warm, however, and fish move in search of their optimal temperature range, key habitats that are required for certain life stages may become restricted. Understanding the mechanisms of species distribution shifts is key to identifying and managing vulnerable fish species. The Lenfest Ocean Program is funding Dr. James Morley, East Carolina University, to lead a team of researchers to build a modeling framework to better understand, and ultimately predict, when habitat requirements at specific life-stages will restrict the ability of marine species to adapt to climate change.

THE NEED TO MORE FULLY UNDERSTAND SPECIES DISTRIBUTION SHIFTS

Stock assessment models account for many factors, including the life history of a fish species, environmental conditions, previous fishing pressure, and other factors that may be specific to the fishing jurisdiction's region. Unknown changes to any of these factors can result in uncertainty and lead to a stock assessment failure, or a mismatch between the predicted sustainable fishing levels and the actual ability of the stock to withstand harvest.

Marine species in U.S. waters are moving in response to warming ocean temperatures, increasing stress on the health and wellbeing of fishing industries and coastal communities. Moreover, current projections of marine species distributions suggest such shifts will only intensify during the 21st century. The National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) is working to advance fisheries management strategies to adapt to shifting fish stocks. In the NOAA Fisheries Climate Science Strategy (2015), agency staff note key science needs that could help such efforts to advance, including:

RESEARCH TEAM

- James Morley, East Carolina University
- Verena Wang, East Carolina University
- Matt Ajemian, Florida Atlantic University
- Stephanie Archer, Louisiana Universities Marine Consortium
- Lorenzo Ciannelli, Oregon State University
- Marissa Baskett, UC Davis
- Emmett Duffy, Smithsonian Institution
- Mark Nelson, Lummi Nation (previously NOAA Fisheries)

This project is an outcome of the Lenfest Ocean Program Ideas Lab, a workshop held in October 2019 to identify research priorities for shifting marine species.

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- increasing the availability of regional data on species distribution shifts;
- elucidating mechanisms that drive species shifts; and
- developing best practices for modeling with an eye towards generating robust predictions.

In recent years, research has accelerated to understand and predict shifts in fish distributions in response to ocean warming. The field has established new methods and approaches that more realistically reflect the dynamic relationship between fish populations and their environment. However, many of the current studies still focus on population level shifts without consideration of climate change exposure at different life stages. While it is known that life stage specific habitat requirements can also limit fish movement, incorporating such considerations into models of species distribution remains a critical gap.

RESEARCH APPROACH

In this project, Dr. Morley and his team aim to enhance the ability to anticipate how fish populations will respond to climate change. They will develop a quantitative modeling approach that:

- identifies potential bottlenecks in species ability to move in response to warming;
- elucidates the connectivity between life stages, such as spawning grounds to juvenile nursery areas; and
- predicts which fish habitat and life stage considerations are most important to understanding climate vulnerability.

The research will be conducted in four phases:

Phase 1: Researchers will select at least 15 species of both the U.S. Northeast and West coast regional fisheries based on management importance, life history characteristics, and availability of information. They will then conduct a literature review to identify and rank constraints across each life stage according to habitat availability, habitat requirements, and factors that influence species survival and growth.

Phase 2: The researchers will then introduce geographic constraints into the analyses, selecting a subset of the species from Phase 1 for which long-term biological data is available to model their distributions at different life stages. They can then estimate how consistently species rely on specific locations in a given year, including which parts of the life cycle are most tied to a certain place.

Phase 3: The team will then work to identify mismatches where exposure to stress from warming temperatures occurs within life stages that are more geographically fixed. They will do this by overlaying historical distribution data collected in Phase 2 with currently published climate projections. They can then predict species distributions forward 20 – 50 years.

Phase 4: The research team will combine the literature review-based analysis from Phase 1 with the more data intensive components from Phases 2 and 3 to design a decision tree that managers can use to work through these concepts for a given fish species. The decision tree will also help researchers and managers better understand which species lack necessary data and modeling and differ between data poor and data rich approaches.

Finally, the research team will communicate with management and stakeholder communities throughout the project, including responding to immediate policy concerns such as analyzing species identified by managers as having failed to meet rebuilding objectives.

This project began in September 2020 and will run for three-years.

CONTACT

For any questions, please contact Emily Knight, Manager, Lenfest Ocean Program, at eknight@lenfestocean.org.To learn more about this research and stay up to date on our latest projects, follow us on Twitter @lenfestocean or sign up for our newsletter at lenfestocean.org.

CITATION

Jason S. Link, Roger Griffis, Shallin Busch (Editors). 2015. NOAA Fisheries Climate Science Strategy. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-155, 70p.