Exploration of climate-induced shifts in historical and future distributions of marine species on the U.S. Northeast Shelf

Executive Summary

The overarching goal of this project is to advance conservation science management and ocean planning in the Northeast and Mid-Atlantic regions through the analysis of historical and future distribution shifts of commercially important species. As opposed to studies that examine shifts in distribution of individual species, this project takes an ecosystem approach and assesses the overall impact of changes to species that share similar depth and temperature preferences. The project team focused on a marine spatial analysis to estimate changes in species distributions. Changes were evaluated both retrospectively, using trawl survey data, and in the future, using climate model-generated predictions for the U.S. Northeast Shelf. The project team produced a comprehensive model used to identify model futures sensitive to temperature and habitat conditions in coastal and offshore areas, respectively. This study was designed to be useful to future oceanic, spatial planning, and the wider community of stakeholders in understanding and planning for potential climate-driven changes to valuable fisheries and the ocean ecosystems in this region.

The project was completed in two phases. During the first phase, the project team classified almost 1,000 species associated with the Northeast Shelf by their habitat and oceanographic characteristics from the spring and fall bottom trawl surveys. Each species was assigned to one of four groups based on similar depth and temperature preferences. For each species group, the project team conducted a series of exploratory and future temperature and depth predictions using climate models. The project team used a combination of temperature and habitat tracking data to examine how species groups have shifted over time in response to climate change.

In the second phase, the project team used climate model outputs to identify model futures sensitive to temperature and habitat conditions in coastal and offshore areas, respectively. This study was designed to be useful to future oceanic, spatial planning, and the wider community of stakeholders in understanding and planning for potential climate-driven changes to valuable fisheries and the ocean ecosystems in this region.

Overall, it is understood that climate change will have serious impacts on various species and their habitats. This study has helped to identify species that are most vulnerable and conservation efforts that can be made to mitigate these impacts. The project team has also worked to improve the understanding of how climate change is affecting the ocean ecosystems in this region.

Project Takeaways

Historical perspective

- Using a combination of temperature and habitat variables sampled on the U.S. Northeast Shelf, the project identified groups of species based on preferred temperatures and depths and explored historical distribution shifts.
- Exploring distribution shifts between the species groups on a regional basis illustrated different patterns between the Gulf of Maine, a region with variable bottom topography and complex currents, and the Mid-Atlantic Bight and Georges Bank in the south, a region with more uniform bottom characteristics.
- Changes were evaluated both historically, using trawl survey data, and in the future, using climate model-generated predictions for the U.S. Northeast Shelf.
- The project team produced a comprehensive model used to identify model futures sensitive to temperature and habitat conditions in coastal and offshore areas, respectively.

Future perspective

- Climate change is expected to have severe impacts on various species and their habitats. This study has helped to identify species that are most vulnerable and conservation efforts that can be made to mitigate these impacts.
- The project team has also worked to improve the understanding of how climate change is affecting the ocean ecosystems in this region.
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Exploring observed shifts

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