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Warming Ocean May Bring Major Changes for U.S. Northeast Fishery Species

NOAA scientists have released the first-ever multispecies assessment of just how vulnerable U.S. marine fish and invertebrate species are to the effects of climate change. The study examined 82 species that occur off the Northeastern U.S., where ocean warming is occurring rapidly. Researchers found that most species evaluated will be affected, and that some are likely to be more resilient to changing ocean conditions than others. The study appears today in PLOS ONE, an online scholarly science journal.

"Our method identifies specific attributes that influence marine fish and invertebrate resilience to the effects of a warming ocean and characterizes risks posed to individual species," said Jon Hare, a fisheries oceanographer at NOAA Fisheries' Northeast Fisheries Science Center and lead author of the study. "This work will help us better account for the effects of warming waters on our fishery species in stock assessments and when developing fishery management measures."

The study is formally known as the Northeast Climate Vulnerability Assessment and is the first in a series of similar evaluations planned for fishery species in other U.S. regions. Conducting climate change vulnerability assessments of U.S. fisheries is a priority action in the NOAA Fisheries Climate Science Strategy. Similar assessments are now underway for the Bering Sea and California Current Ecosystems.

The 82 Northeast species evaluated include all commercially managed marine fish and invertebrate species in the Northeast, a large number of recreational marine fish species, all marine fish species listed or under consideration for listing on the federal Endangered Species Act , and a range of ecologically important marine species.

Researchers from NOAA Fisheries and NOAA's Office of Oceanic and Atmospheric Research (OAR)'s Earth System Research Laboratory, along with colleagues at the University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES), worked together on the project. NOAA OAR and CIRES scientists provided climate model projections of how conditions in the region's marine environment are predicted to change in the 21st century. The method for assessing vulnerability was adapted for marine species from similar work by the U.S. Fish and Wildlife Service to characterize the vulnerability of wildlife species to climate change.

The method tends to categorize species that are “generalists” as less vulnerable to climate change than are those that are “specialists.” For example, Atlantic cod and yellowtail flounder are more generalists, since they can use a variety of prey and habitat, and are ranked as only moderately vulnerable to climate change. The Atlantic sea scallop is more of a specialist, with limited mobility and high sensitivity to the ocean acidification that will be more pronounced as water temperatures warm. Sea scallops have a high vulnerability ranking.

The method also evaluates the potential for shifts in distribution and stock productivity, and estimates whether climate change effects will be more negative or more positive for a particular species.

“Vulnerability assessments provide a framework for evaluating climate impacts over a broad range of species by combining expert opinion with what we know about that species, in terms of the quantity and the quality of data,” Hare said. “This assessment helps us evaluate the relative sensitivity of a species to the effects of climate change. It does not, however, provide a way to estimate the pace, scale or magnitude of change at the species level.”

Researchers used existing information on climate and ocean conditions, species distributions, and life history characteristics to estimate each species’ overall vulnerability to climate-related changes in the region. Vulnerability is defined as the risk of change in abundance or productivity resulting from climate change and variability, with relative rankings based on a combination of a species exposure to climate change and a species’ sensitivity to climate change.

Each species was evaluated and ranked in one of four vulnerability categories: low, moderate, high, and very high. Animals that migrate between fresh and salt water (such as sturgeon and salmon), and those that live on the ocean bottom (such as scallops, lobsters and clams) are the most vulnerable to climate effects in the region. Species that live nearer to the water’s surface (such as herring and mackerel) are the least vulnerable.

A majority of species also are likely to change their distribution in response to climate change. Numerous distribution shifts have already been documented, and this study demonstrates that widespread distribution shifts are likely to continue for the foreseeable future.

A specific summary of results has been prepared for each species to help put the rankings into context. These narratives discuss what is known about the effects of climate change on the species and provide the foundation for future research.

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Related Links:

PLOS ONE article: http://dx.plos.org/10.1371/journal.pone.0146756

NOAA Northeast Fisheries Science Center Fisheries and Climate website: http://www.nefsc.noaa.gov/fisheries-climate/

NOAA Fisheries Ecosystem Science Website: Fish Stock Climate Variability Assessments:
https://www.st.nmfs.noaa.gov/ecosystems/climate/tools/assessing-vulnerability-of-fish-stocks

NOAA Fisheries Climate Science Strategy:
https://www.st.nmfs.noaa.gov/ecosystems/climate/index

NOAA Fisheries Ocean Adapt Tool: Where will fishery stock go as ocean temperatures change?
https://www.st.nmfs.noaa.gov/ecosystems/climate/tools/oceanadapt

NOAA Climate Change Web Portal: http://esrl.noaa.gov/psd/ipcc/