**Atlantic States Marine Fisheries Commission**

**Climate Change Workshop**

**Tuesday, May 3, 1:15pm-3:45pm**

**Agenda**

1. Review and Discuss Northeast Fish and Shellfish Climate Vulnerability Assessment (J. Hare) 1:20pm

2. Review and Discuss NOAA Climate Science Action Plans
    a. North East Climate Science Action Plan (J. Hare) 2:20pm
    b. South East (Atlantic) Climate Science Action Plan (H. Lovett) 2:40pm

3. Begin Discussion of Next Steps for Commission Action in Response to the Climate 3:00pm

**Discussion Questions**

1) For stocks that do not respond to management, how long do we continue the FMP (e.g. surveys, quotas, monitoring)?

   How do we as managers make the decision to adapt our current management tools for the stocks that do not respond because of climate change?

2) What are the management priorities given expected future environmental change?

3) What are the science priorities? There are several great ideas being put forward. What would ASMFC prioritize? Are there other science priorities not listed?
   - Improve/continue environmental monitoring
   - Improve/continue fish surveys (fisheries dependent and/or fisheries independent)
   - Monitoring zooplankton and forage species
   - Monitoring key species for changes in growth or recruitment
   - Incorporating environmental parameters into stock assessment
   - Quantifying changes in distribution
   - Analyzing changes in stock structure
   - Improving socio-economic surveys and analyses

4) How will management respond to current and future changes in climate and ocean? How will mangers use the science that integrate ecosystem monitoring and basic research into predictive models into fisheries management decisions?
   - precautionary management decisions in anticipation of shifting distributions and productivity
   - design and implement flexible allocation strategies
   - change permitting approaches and landings regulations

**Methodology for Assessing the Vulnerability of Marine and Anadromous Fish Stocks in a Changing Climate**

NOAA's National Marine Fisheries Service (NOAA Fisheries) works with our partners to sustainably manage U.S. marine and anadromous fisheries and to conserve and protected marine mammals, sea turtles, and species listed under the Endangered Species Act. NOAA Fisheries also recognizes that climate-related changes are affecting the nation's valuable living marine resources and the people, businesses and communities that depend on them. NOAA Fisheries recently released a National Climate Science Strategy (Link et al. 2015) that outlines the Agency's approach to tackling the science needs for managing fisheries and protected species in a changing climate. A primary goal of the science strategy is to better understand which species are more or less vulnerable to environmental changes and the factors driving the vulnerability. NOAA Fisheries has developed a methodology (Morrison et al. 2015) for assessing the relative vulnerability of marine and anadromous fish and invertebrate species to climate change. Implementing the methodology will help identify areas for in-depth analysis and assist fisheries and protected species decision makers in considering how to prepare for and respond to climate-related changes. We have implemented the methodology for 82 fish and invertebrate species off the Northeastern United States, including a mix of exploited, protected, and forage species (Hare et al. 2016). Similar assessments are currently underway for the Bering Sea and California Current ecosystems. The methodology is being modified in the California Current to better account for the vulnerability of Pacific salmon, an important anadromous protected species. NOAA Fisheries intends to replicate this process in other regions, depending on needs and available resources. In addition, NOAA Fisheries is in the process of creating a similar analysis for marine mammals and sea turtles.

The methodology is designed to generate three key results for each species: a relative vulnerability rank (based on exposure and sensitivity), an indication of a species' propensity for shifting distribution (based on a subset of the sensitivity attributes), and an overall directional effect (do experts expect the species to respond positively or negatively to expected climate changes). NOAA Fisheries designed the methodology to be applicable across tropical, temperate, and high latitude marine systems and address a wide range of fish and invertebrate life history characteristics. The vulnerability rank is a combination of a species' expected exposure to environmental change and its biological sensitivity to that change. The methodology assumes that current biological parameters are an indicator of the relative sensitivity of a species. The exposure variables may vary between different regions (e.g. extent of sea ice will be important in some but not all regions). However, the twelve life history attributes used to determine a species' sensitivity to climate change are consistent across regions, and include: habitat requirements, prey requirements, physiological tolerances, reproduction requirements, ability to change distributions, and other stressors. A subset of the life history attributes can be used to determine if a species is likely to respond to changes in climate by shifting distributions, which could have a large impact on some fishing communities and on the overlap among fisheries and with protected species.

The methodology uses expert elicitation to rank multiple species at the same time. Experts assign scores based on four well-defined scoring bins (low, moderate, high, very high) to ensure that the scores are consistent across species. Each expert is asked to independently score the exposure and sensitivity of the species using species profiles, scientific literature, and general knowledge. Later the experts are asked to review their scores compared to the other experts, discuss the results, and are allowed to adjust their scores based on those discussions. Using both individual and group expert elicitation practices helps minimize bias and increases precision of the results.

The results from a climate vulnerability assessment can be used to identify: 1) species with high relative vulnerability that may need additional research or monitoring; 2) species that have a propensity to change distribution in response to a changing climate; 3) species that may be positively impacted by projected change; and 4) a list of major data gaps identified during the assessment. The assessment does not predict or quantify the scale or magnitude of expected change for a species in the future. We recommend that the results, along with other relevant information, be summarized for each species in a short species narrative that provides an easily accessible resource that can be used by scientists, fishery managers, or the public. Scientists can use these results to identify research priorities, such as identifying stock assessments that can benefit from explicit consideration of climate vulnerability and species that could benefit from increased monitoring. Managers can use the results to help identify specific attributes that make a particular species more or less resilient to climate change and to craft management measures that account for those differences among species.

References:

Hare JA, Morrison WE, Nelson MW, Stachura MM, Teeters EJ, Griffis RB, 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. doi:10.1371/journal.pone.0146756.

Link, J. S., R. Griffis, and S. Busch (Editors). 2015. NOAA Fisheries Climate Science Strategy. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-155, 70p. Available: st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/NCSS_Final.pdf. (Febrary 2016).

Morrison, W.E., M. W. Nelson, J. F. Howard, E. J. Teeters, J. A. Hare, R. B. Griffis, J.D. Scott, and M.A. Alexander. 2015. Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OSF-3, 48 p. Available: st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/TM%20OSF3.pdf. (February 2016).

Photo: Summary results from Hare et al. 2016.