# Ocean Acidification Impacts on Fisheries

11 March 2016

Jon Hare
NOAA Fisheries
Northeast Fisheries Science Center
Narragansett Laboratory
jon.hare@noaa.gov

NOAA FISHERIES

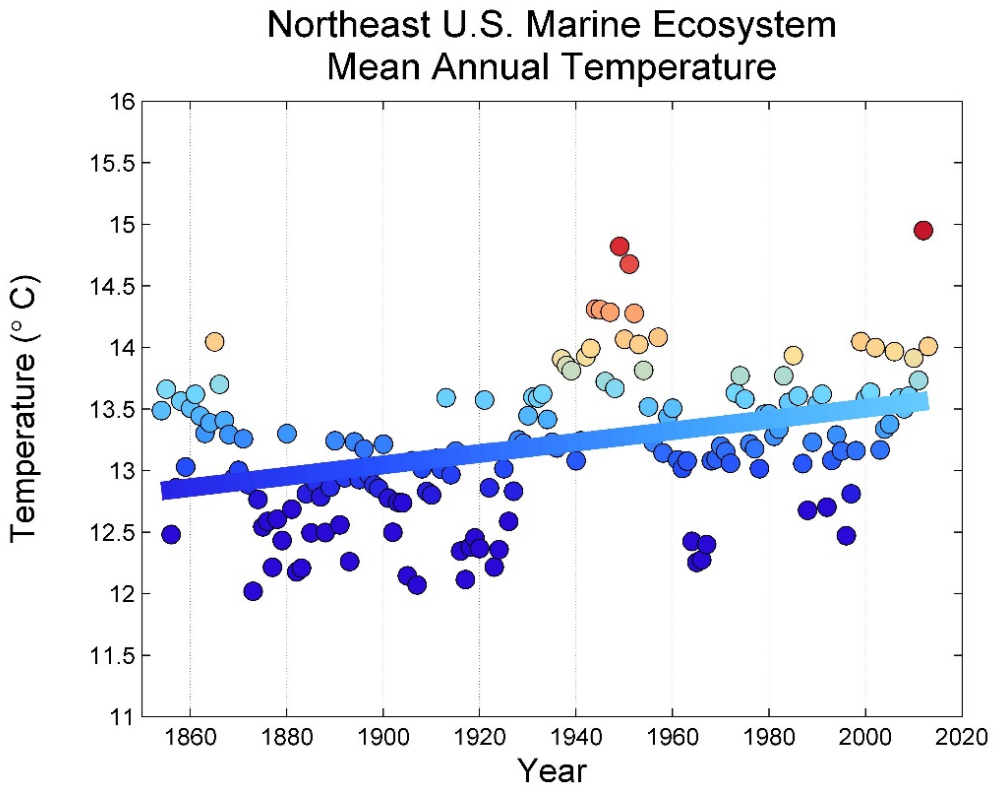
american geosciences institute
connecting earth, science, and people

# Climate Change

Climate Change – a long-term change in part of the land-atmosphere-ocean system

In the Northeast U.S.

- Temperature
- Salinity
- Precipitation
- Ocean Acidification
- Currents
- Winds
- Sea-level

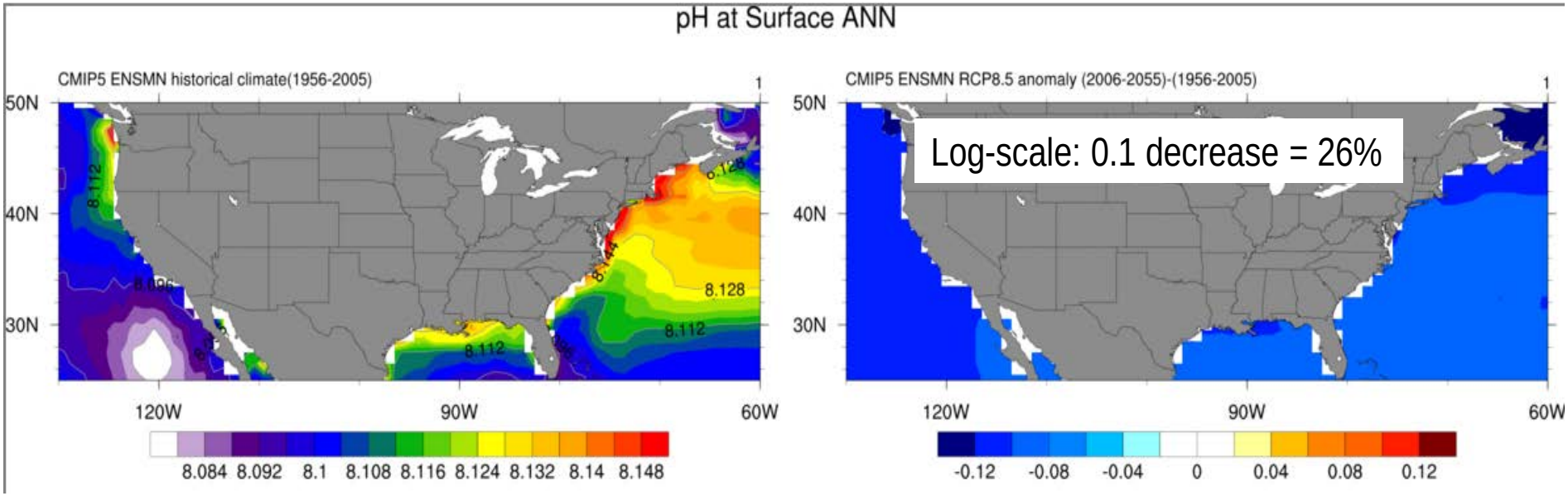


# Climate Change

Climate Change – a long-term change in part of the land-atmosphere-ocean system

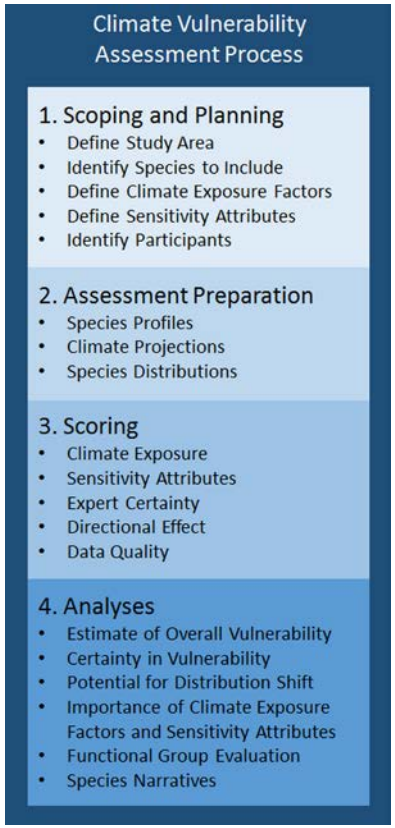
Changes will continue for foreseeable future

RCP8.5 – Regional Concentration Pathway 8.5 – a scenario for how climate change may proceed – Paris 2015 “worst-case” scenario



# Vulnerability Assessment

- Used **Methodology for Assessing the Vulnerability of Fish Species to a Changing Climate** NE is first implementation of the Methodology
- Based on Vulnerability Assessment Framework
- Used currently existing knowledge and expert opinion
- Uses quantitative data when available, and qualitative information when data is lacking






https://www.st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/TM%20OSF3.pdf

# Vulnerability Assessment


## Exposure

- Sea surface temperature*
- Air temperature*
- Salinity*
- Ocean acidification (pH)*
- Precipitation*
- Currents**
- Sea level rise**

**modelled results (mean & variance)*
***written description only*

## Sensitivity

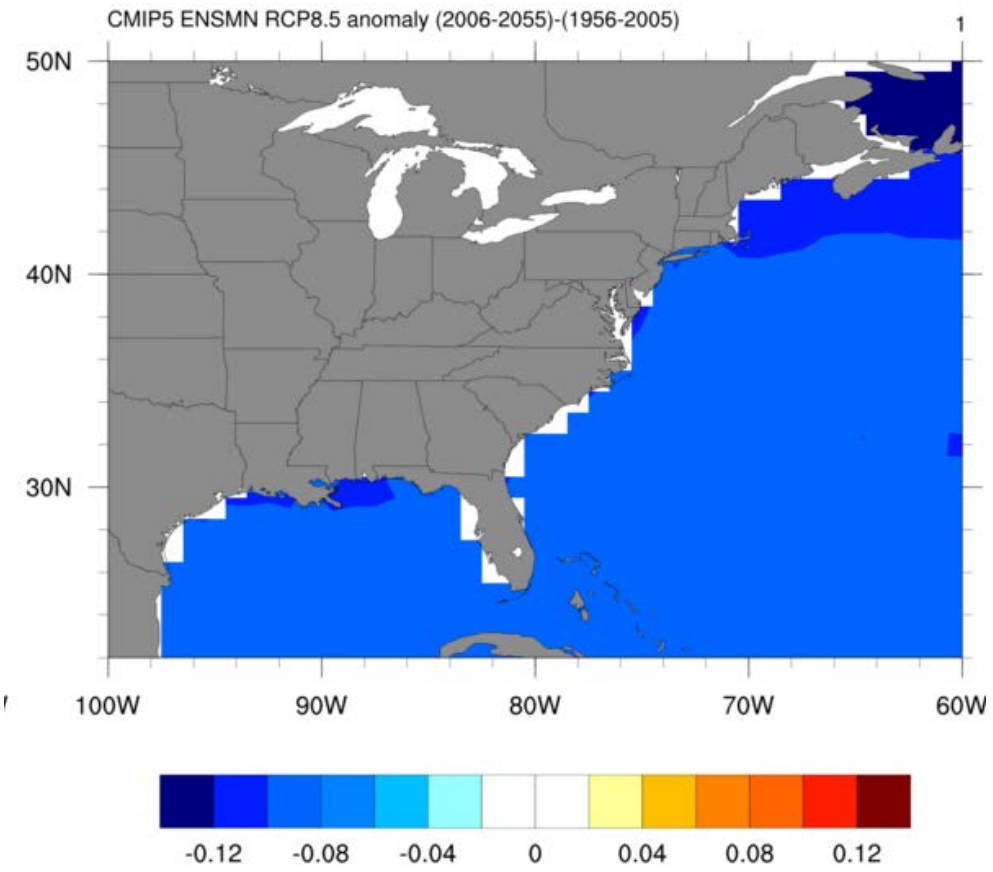
- Habitat Specificity
- Prey Specificity
- Sensitivity to Ocean Acidification
- Sensitivity to Temperature
- Stock Size/Status
- Other Stressors
- Adult Mobility
- Spawning Cycle
- Complexity in Reproductive Strategy
- Early Life History Survival and Settlement Requirements
- Population Growth Rate
- Dispersal of Early Life Stages



https://www.st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/TM%20OSF3.pdf

# Vulnerability Assessment

## Climate Exposure



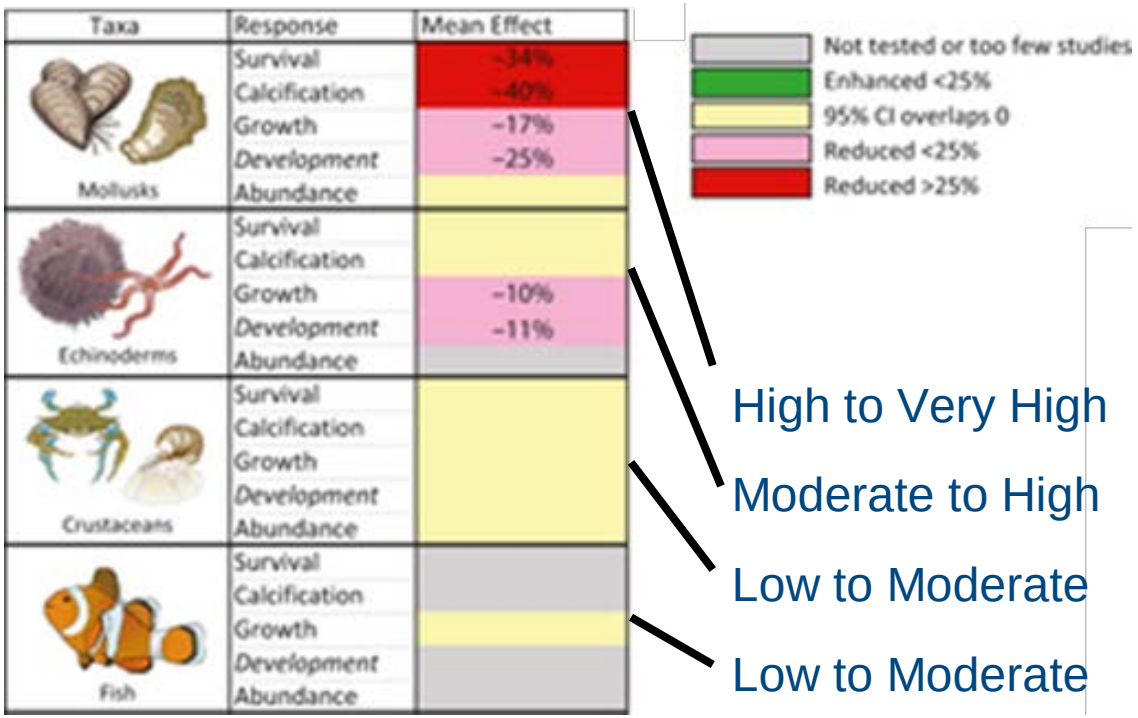

- Projected magnitude of change
- Overlap of current species distribution and expected climate change
- Comparing 2006-2055 to 1956-2005
- Used RCP8.5 (representative concentration pathways)

Exposure to OA Very High

# Vulnerability Assessment

## Sensitivity Attributes

- Based on literature summaries for each of the 82 species
- Attribute definitions provided to guide expert scoring

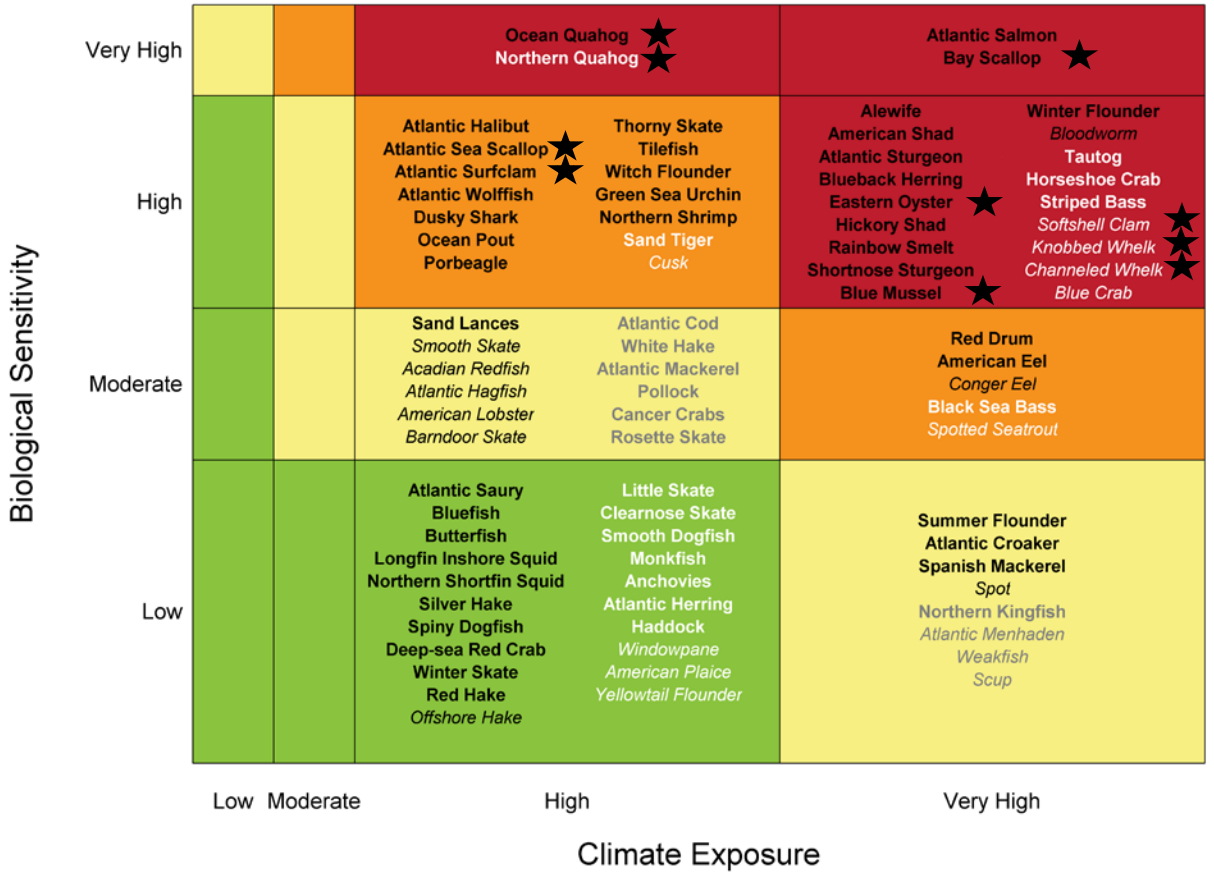





Kroeker et al. (2013) http://onlinelibrary.wiley.com/doi/10.1111/gcb.12179/full

# Vulnerability Assessment

- Exposure to climate change in NEUS is high to very high
- Sensitivity higher for diadromous and molluscs; lower for groundfish and pelagics

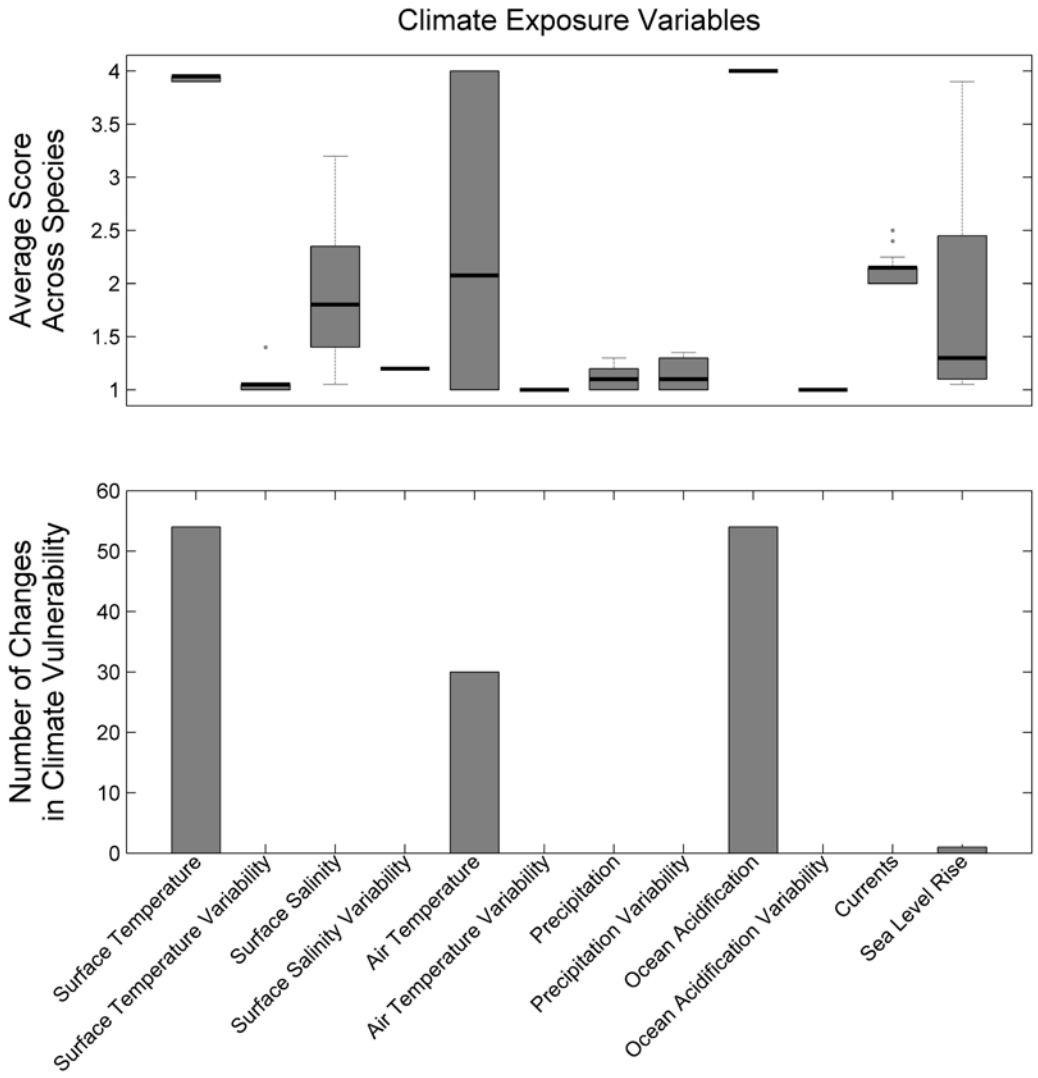



NOAA FISHERIES

Hare et al. (2016)
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0146756

# Vulnerability Assessment

- Exposure to temperature and OA most important
- Also prepared species-specific summaries




NOAA FISHERIES

Hare et al. (2016)
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0146756

# Next Steps

- Linking to community vulnerability
- Regional variability in carbonate chemistry – coastal acidification
- Multiple-stressors (e.g., temperature and ocean acidification)
- Work under conditions expected in next 20-30 years
- Work on fishery and aquaculture species