Northeast Fisheries Climate Vulnerability Assessment (NEVA): First Implementation of a National Methodology

Jon Hare, Wendy Morrison, Mark Nelson, Megan Stachura, Eric Teeters, Roger Griffis, Mike Alexander, Jamie Scott, Keirsten Curti, John Kocik, Larry Alade, Toni Chute, Lisa Milke, Sean Lucey, Tobey Curtis, Dan Kircheis, Cami McCandless, Eric Robillard, Dave Richardson, Rich Bell, Harvey Walsh, Conor McManus, and Katey Marancik

jon.hare@noaa.gov
Outline

1. Project needs, goals, and objectives
2. Vulnerability assessment methodology (covered by Wendy)
3. Results
4. Next Steps

Project Need, Goal, and Objectives

- Changes in stock productivity (e.g., a growing population or a declining population) (Bell et al. 2014a)

- Changes in distribution (e.g., shifting northwards, shifting deeper) (Nye et al. 2009, Bell et al. 2014b)

- Changes in species interactions (e.g., changes in forage species) (Richardson et al. 2014)
Project Need, Goal, and Objectives

Quantitative Approach

- Atlantic cod (Fogarty et al. 2008)
- Atlantic croaker (Hare et al. 2010)
- Cusk (Hare et al. 2012)
- Atlantic salmon (Todd et al. 2011)
- River herring (Lynch et al. 2013)
- Sea turtles (Saba et al. 2012)

1-2 years per species

50+ fishery species

>50-100 years before we have species-specific quantitative modeling

http://3.bp.blogspot.com/_TNHOonYQjgYY/Sj5OKI52BkI/AAAAAAAAAEI/YUnjWm1hgAk/s1600-h/fish2.jpg
Project Need, Goal, and Objectives

Goal: To assess the vulnerability of commercially and recreationally exploited fish and shellfish species in the Northeast U.S. Continental Shelf Ecosystem (including NEFMC & MAFMC managed species)

Used Methodology for Assessing the Vulnerability of Fish Species to a Changing Climate (Morrison et al.)

Objectives:

1. Develop relative vulnerability rank across species
2. Determine attributes/factors driving vulnerability rank
3. Identify data quality and data gaps

79 Species included (most exploited fish and shellfish species in the region and many others)
Vulnerability Assessment Methodology

- 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
- Provide an first cut for 79 species in the region (a triage)
- There as caveats and weaknesses
Vulnerability Assessment Methodology

Species Vulnerability

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

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

*modelled results (mean & variance)
**written description only
Vulnerability Assessment Methodology

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)

http://www.esrl.noaa.gov/psd/ipcc/ocn/
Vulnerability Assessment Methodology

Sensitivity Attributes

• 14 experts
• ~ 29 species each (assigned their “expertise” plus random subset of other species)
• Each species was scored by 5 different people
• Scores were completed individually and then discussed at workshop

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<thead>
<tr>
<th>Name</th>
<th>Expertise</th>
<th>Location</th>
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<tr>
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Results

Overall

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

Overall

• Exposure to temperature and OA most important
Next Steps

- Address CIE review of methodology and NE implementation
- Present results internally to NEFSC and GARFO
- Publish results in peer-review journal
- Present results to stakeholders
Next Steps

Science:
• Identify important unknowns in terms of species biology and ecology
• Identify important climate drivers to link with assessments

Management:
• Decisions regarding catch levels and rebuilding plans
• Information for EIS’s, BiOps and others
• Identify potential management actions to reduce climate vulnerability
Next Steps

- This is a step not an endpoint
- Continue quantitative studies
- Develop regional downscaling and high-resolution models
- Link effect of multiple stressors (e.g., trophic interactions, fishing, climate)
- Iterate Fisheries Climate Vulnerability Assessment in ~5 years
Questions?

Photo by: Dan Vendettuoli
Results

Spanish Mackerel

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

- Sensitivity Attributes

- Sea Surface Temperature
- Sea Surface Salinity
- Air Temperature
- Ocean Acidification
- Precipitation
- Var Sea Surface Temperature
- Var Sea Surface Salinity
- Var Air Temperature
- Var Ocean Acidification
- Var Precipitation
- Currents
- Sea Level Rise

- Climate Exposure

- Climate Vulnerability
Results

Spanish Mackerel

Bootstrap Expert Scores

Calculate an Uncertainty in Overall Climate Vulnerability

0  Very High

3  High

97  Moderate

0  Low
## Results

### Spanish Mackerel

#### Sensitivity Analysis

Identify important attributes and factors

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<th>Variability in Air Temp</th>
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