NMFS/SEFSC South Atlantic Ecosystem Science Activities

1 - Ecosystem Status Report

2 - Climate Vulnerability Assessment

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NMFS / SEFSC / Beaufort, NC

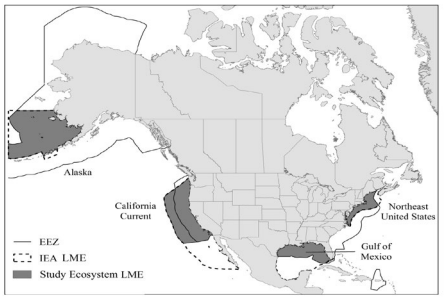
April 22, 2020

NMFS South Atlantic EBFM Regional Implementation Plan

Priority Activities:

1. **Develop an Ecosystem Status Report (ESR)**
2. Aggregate species production modeling
3. Develop Community Vulnerability Analysis (SERO)
4. **Complete a multi-species Climate Vulnerability Analysis (CVA)**
5. Coordinate with the SAFMC (FEP II, ecosystem modeling efforts)

Ecosystem Status Reports (ESRs)



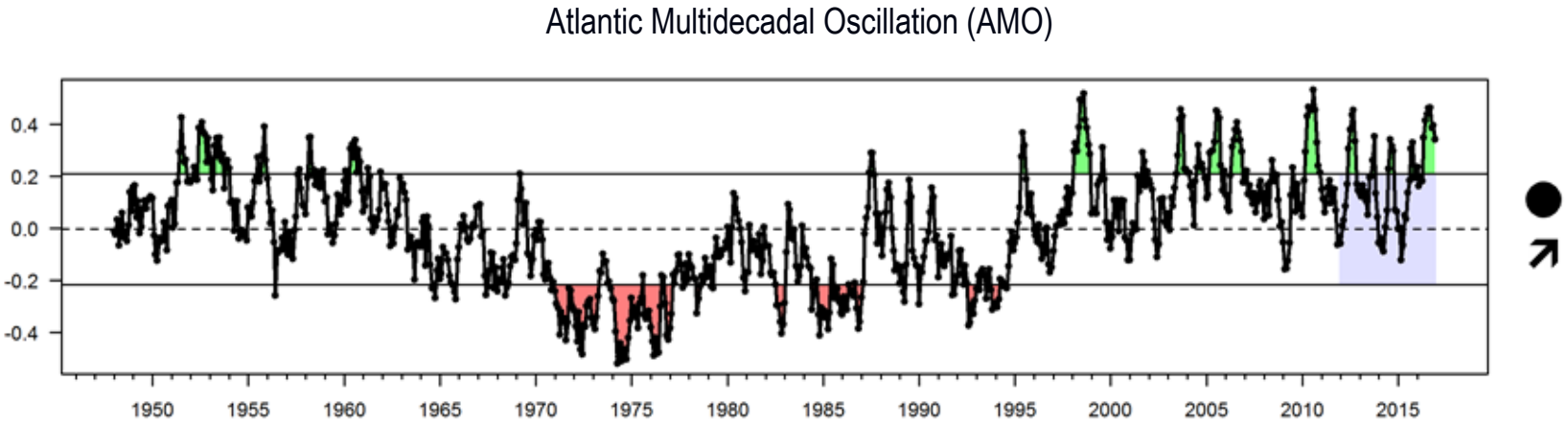
- Prescribed under NMFS EBFM Policy and Road Map
- Have been developed for:
  - California Current, Bering Sea/Gulf of Alaska, Northeast shelf, Hawaii, Gulf of Mexico
- Intended for use by Fishery Management Councils, other management bodies, and updated periodically

Contributors to South Atlantic ESR

- SEFSC (Beaufort, Miami, Pascagoula Labs)
- NOS (Beaufort, Charleston)
- AOML
- Gulf IEA
- NCAR
- US Geological Survey
- ACCSP
- State agencies: FL-FWC, GA-DNR, SC-DNR, NCDMF
- Universities: Delaware, Duke, UNC, NCSU
- NC Wildlife Resources Commission

Ecosystem Status Reports

- Provide trends over time in multiple ecosystem components (i.e., indicators)
- Typically focused on regional spatial scale and monthly to annual time scale
- How have ecosystem components changed over time, and are they interrelated?



Indicator Categories

- Climate drivers
- Physical/chemical pressures
- Habitat state
- Lower trophic levels
- Upper trophic levels
- EBFM components
- Human dimensions

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4.1 Atlantic Multidecadal Oscillation (Craig, SEFSC)
4.2 North Atlantic Oscillation (Craig, SEFSC)
4.3 El Nino Southern Oscillation (Craig, SEFSC)
4.4 North Atlantic Tripole (Sang-Ki Lee, AOML)
4.5 Atlantic Warm Pool (Sang-Ki Lee, AOML)

Indicator Categories

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5.1 Sea Surface Temperature (He, NCSU)
5.2 Bottom Temperature (Bacheler, SEFSC)
5.3 Florida Current Transport (Volkov, AOML)
5.4 Gulf Stream Position (He, NCSU)
5.5 Upwelling (He, NCSU)
5.6 River Flow (Craig/Hoos, USGS)
5.7 Nutrient Loading (Hoos, USGS)
5.8 Precipitation and Drought (Craig, SEFSC)
5.9 Sea Level Rise (Taylor, NOS)
5.10 Storms and Hurricanes (Karnauskas, SEFSC)
5.11 Ocean Acidification (Reimer, Univ. Delaware)

Indicator Categories

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6.1 Areal extent of estuarine habitats
6.2 Wetland Cover (Regan, NOS)
6.3 Coral Reef Cover (Groves/Viehmann, NOS)

7.1 Net primary productivity (Siegfried, SEFSC)
7.2 Zooplankton biomass
7.3 Forage fish abundance—menhaden (Schueller, SEFSC)
7.4 Penaeid Shrimp and Blue Crab landings (State partners)
7.5 Icthyoplankton abundance (Kellison SEFSC; Allen USC)

Indicator Categories

- Climate drivers
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8.1 Nearshore demersal fish diversity and abundance (Morley, UNC-IMS)
8.2 Offshore hard-bottom fish diversity and abundance (Bacheler, SEFSC)
8.3 Apex predator diversity and abundance (Munoz/Pollock, SEFSC)
8.4 Florida reef fish diversity and abundance (Johnson/Grove, SEFSC)
8.5 Mean trophic level (Binion-Rock, SEFSC)
8.6 Life history parameters (Buckel, NCSU)

Indicator Categories

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9.1 Biomass assessed species (Shertzer, SEFSC)
9.2 Recruitment assessed species (Shertzer, SEFSC)
9.3 Commercial landings and revenue (Burton, SEFSC)
9.4 Recreational landings and effort (Craig, SEFSC)
9.5 Overfishing status (Craig, SEFSC)
9.6 Bird abundance (Siegfried, SEFSC)
9.7 Marine mammal strandings (Byrd, SEFSC)
9.8 Sea turtle nest counts (Avens, SEFSC)

Indicator Categories

- Climate drivers
- Physical/chemical pressures
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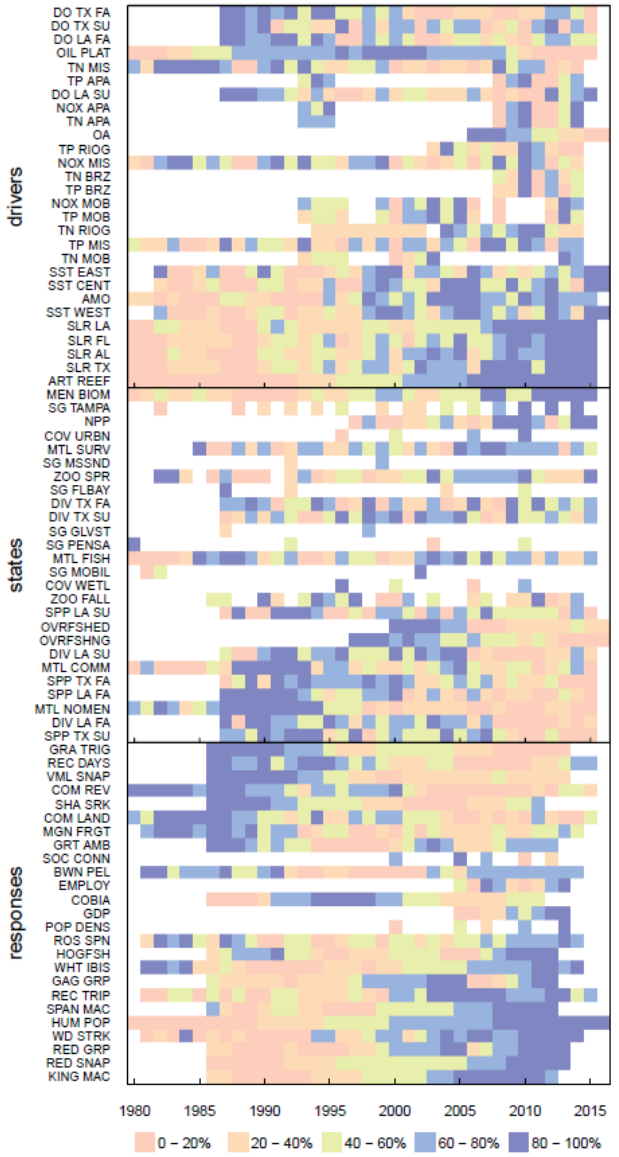
10.1 Human population (Murray, Duke; Regan, NOS)
10.2 Population density (Murray, Duke; Regan NOS)
10.3 Coastal urban land use (Regan, NOS)
10.4 Total ocean economy (Murray, Duke)
10.5 Social connectedness (Frietag/Regan, NOS)
10.6 Comm & rec fishing engagement (Jepsen, SEFSC)

Indicator Synthesis

- Integrated ecosystem perspective
  - ➢ Comprehensive view of changes in different part of the ecosystem
  - ➢ Integrated view of changes over time in the ecosystem
- Research Recommendations



Example: PCA and traffic light plots from Gulf ESR

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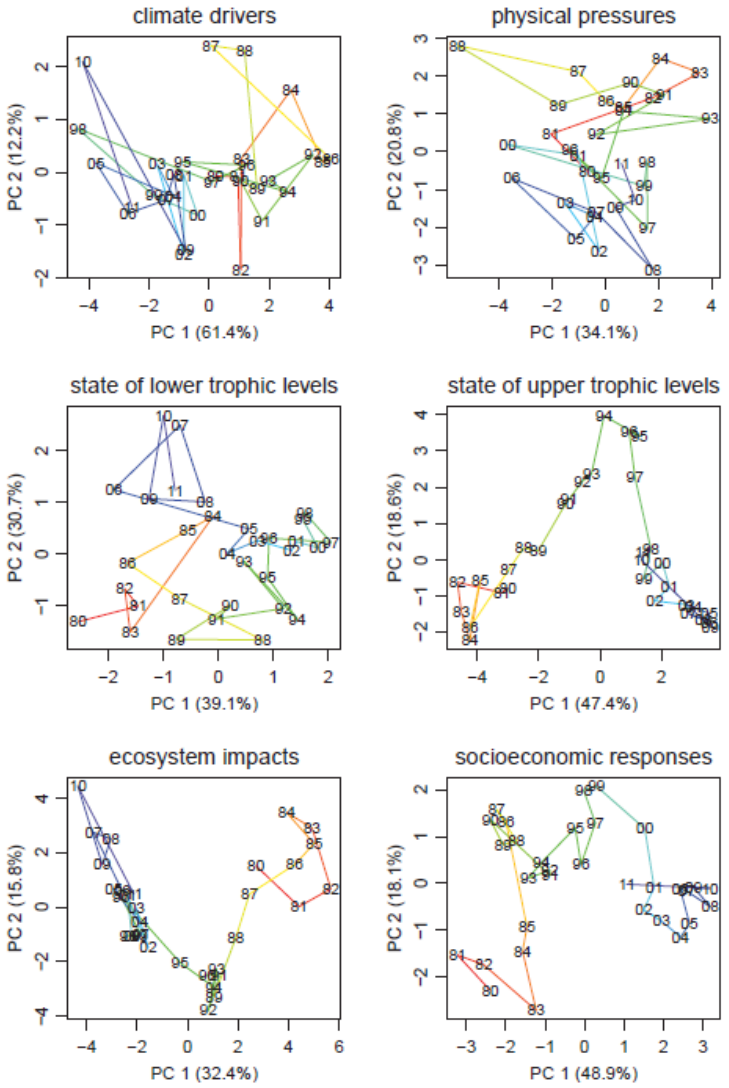


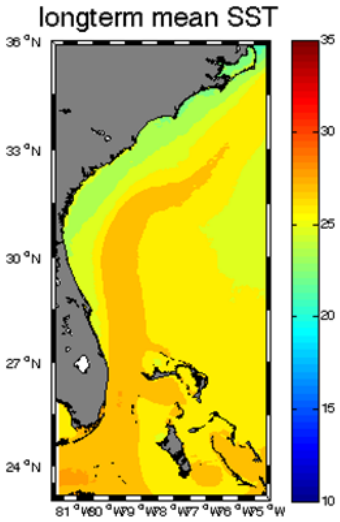
- Research Recommendations

Example: PCA and traffic light plots from Gulf ESR

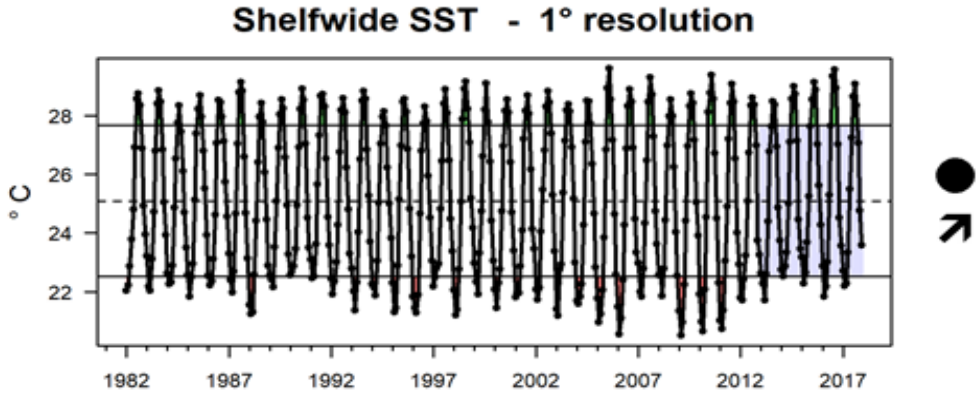
Next Steps

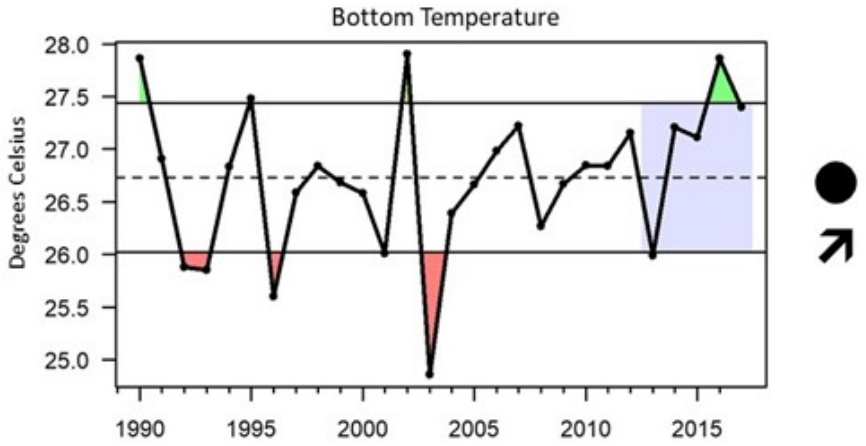
- Goal: draft report completed in July 2020
- Reviews and feedback in 2020
  - Southeast Fisheries Science Center (SEFSC)
  - South Atlantic Fishery Management Council (SAFMC)
  - SAFMC Science and Statistics Committee (SSC)
  - NMFS National ESR working group
  - Other partners (SECART, SECOORA, state agencies)
- Finalize report
- Coordination with SSC and SAFMC

Example: Sea Surface Temperature



Data from NOAA Reynolds OI SST

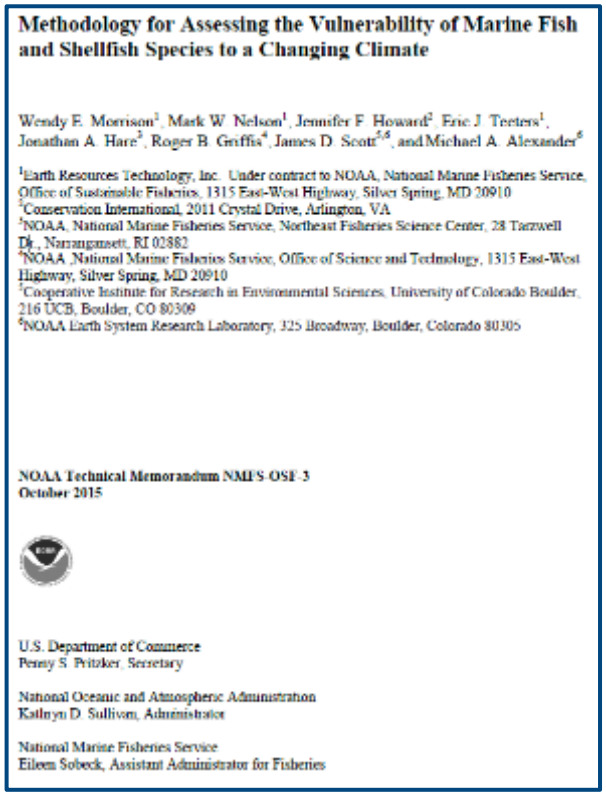




- Some indication of increasing sea surface temperature over the last ~ 5 years
- Driven by winter temperatures--rarely below 22 °C over last 5 years
- Greater than average bottom temperatures for most years since 2005

Climate Vulnerability Assessment

- Tool to determine the likelihood that species' abundance, productivity or distribution will be affected by a changing climate
- Priority under the NMFS National Climate Science Strategy, South Atlantic Climate Science Regional Action Plan and South Atlantic EBFM Implementation Plan
- Morrison et al. 2015. Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate. NOAA Tech Memo.
- Completed or underway for all NMFS regions



Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate

Wendy F. Morrison[1], Mark W. Nelson[1], Jennifer F. Howard[2], Eric J. Teeters[1], Jonathan A. Hare[3], Roger B. Griffis[4], James D. Scott[5,6], and Michael A. Alexander[6]

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NOAA Technical Memorandum NMFS-OSF-3
October 2015

U.S. Department of Commerce
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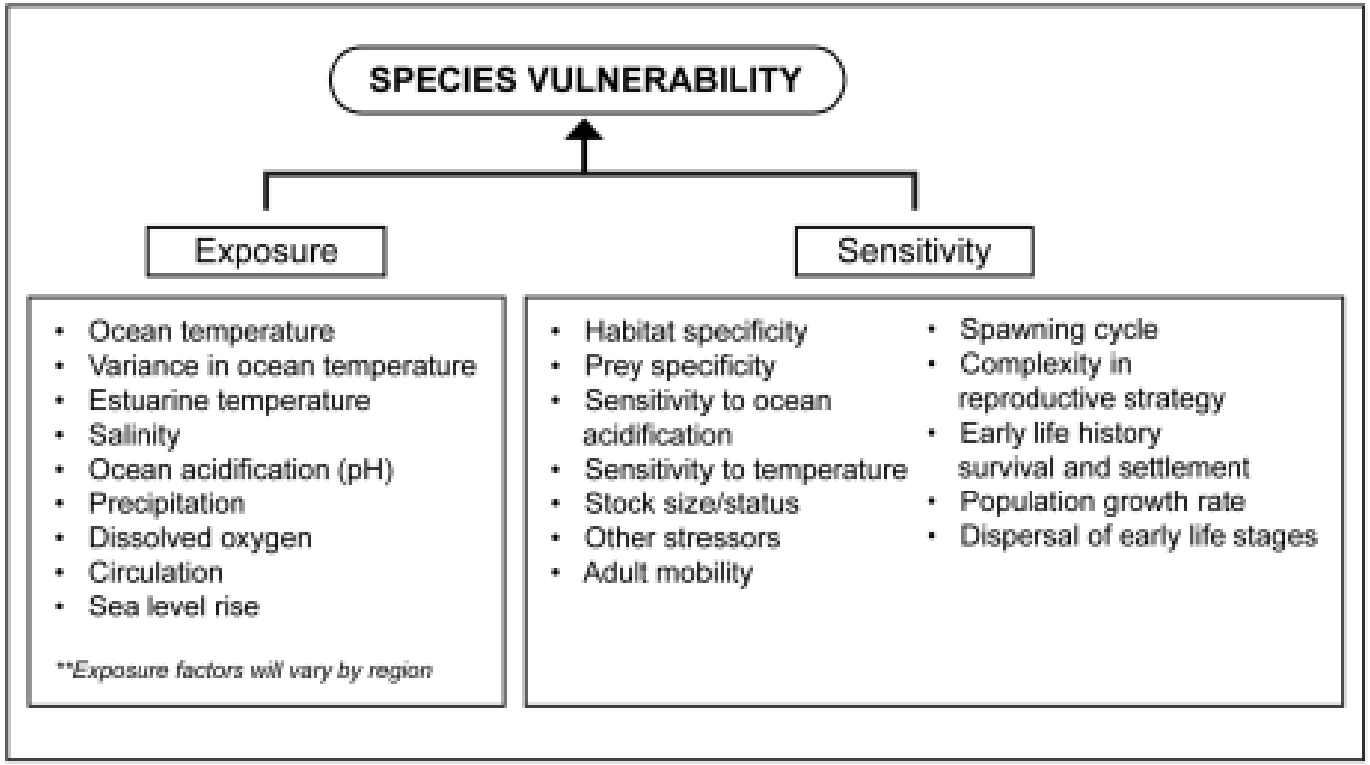
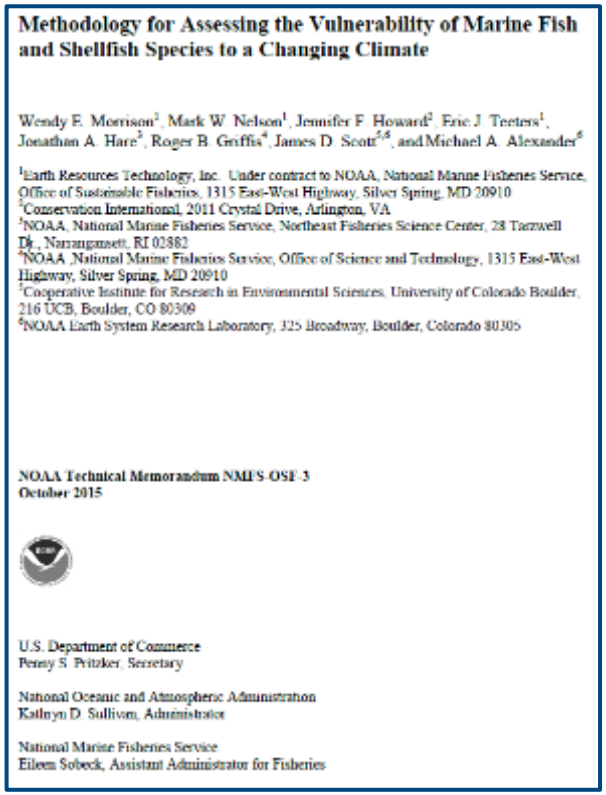
Climate Vulnerability Assessment



Morrison et al. 2015

Steps in the CVA process

1. Identify species and compile detailed species-specific information (species profiles)
    - Snappers
    - Groupers
    - Other reef fishes
    - Sharks
    - Coastal nearshore species
    - Coastal pelagics
    - Invertebrates
    - Biomass / forage species
    - Lionfish
    - Diadromous species



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Steps in the CVA process

2. Assess species-specific sensitivity to climate change across a suite of life-history characteristics (sensitivity attributes). These attributes are constant across all regions.

- Complexity in Reproduction
- Spawning Cycle Specifics
- Dispersal of Early Life Stages
- Early Life History Survival and Settlement Requirements
- Habitat Specificity
- Prey Specificity
- Adult Mobility
- pH preferences
- Thermal preferences
- Population Growth Rate
- Stock Size/Status
- Other stressors (e.g., HABs, invasive species, pollution, habitat alteration)

Steps in the CVA process

2. Assess species-specific sensitivity to climate change across a suite of life-history characteristics (sensitivity attributes)

Contributors

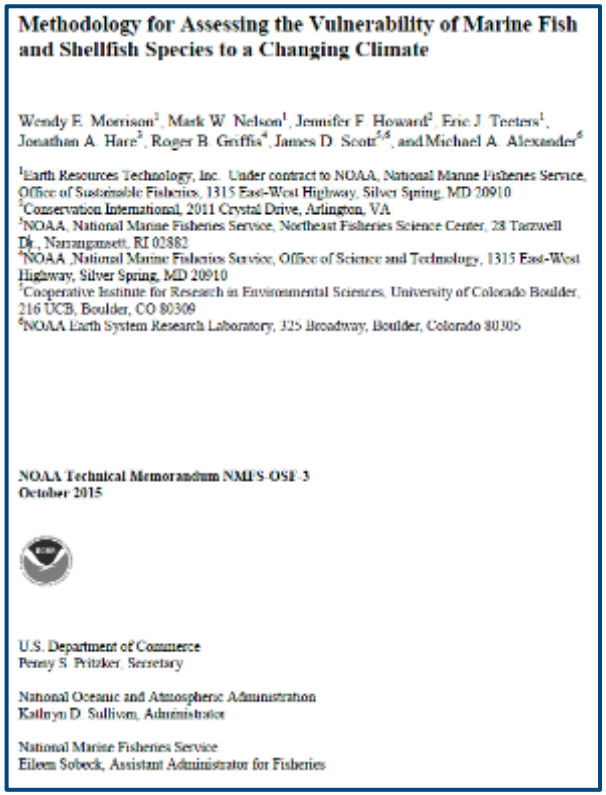
- NOAA Beaufort Laboratory
- South Atlantic Fishery Management Council
- Atlantic States Marine Fisheries Commission
- North Carolina Division of Marine Fisheries
- South Carolina Dept. Natural Resources
- Georgia Department of Natural Resources
- Florida Fish and Wildlife Commission
- Academic partners
- Retired experts (Laney, Sedberry, Smith)

Steps in the CVA process

3. Compile time series of **potential** physical and biological drivers ("exposure factors")

- SST
- Air temperature
- Salinity
- pH (ocean acidification)
- Productivity
- Precipitation
- Currents / upwelling - qualitative
- Sea level rise – qualitative

Assess "exposure" of each species to each exposure factor (i.e., degree to which species will experience change in that factor).



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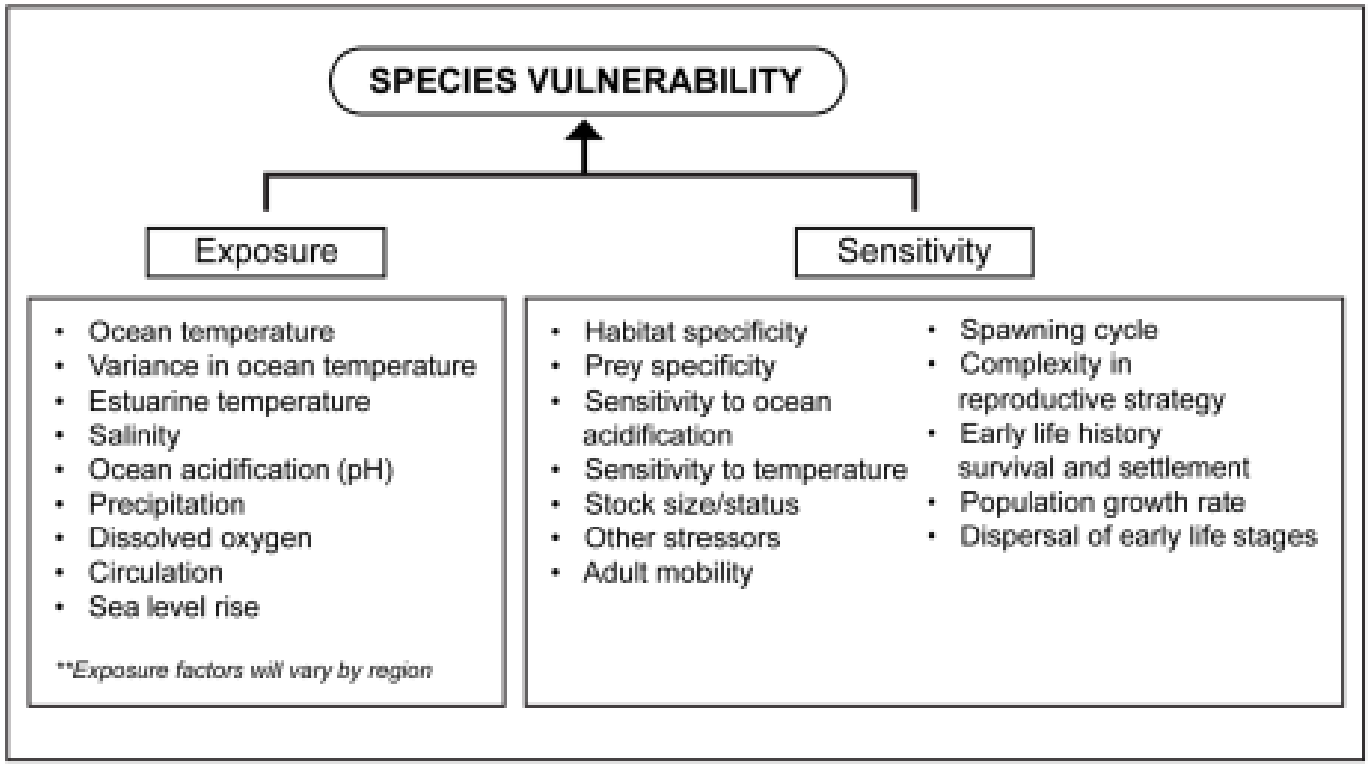
Steps in the CVA process

4. For each species, determine overall vulnerability and potential for distribution shifts



Morrison et al. 2015

Exposure Factors – *n* = 12

Quantitative – Data downloaded from ESRL data portal

Surface Temperature – Mean and Variance

Air Temperature – Mean and Variance

Surface Salinity – Mean and Variance

Precipitation – Mean and Variance

Surface pH – Mean and Variance

Qualitative – Exposure Factors created based on literature

Currents/Upwelling

Sea Level Rise

Steps in the CVA process

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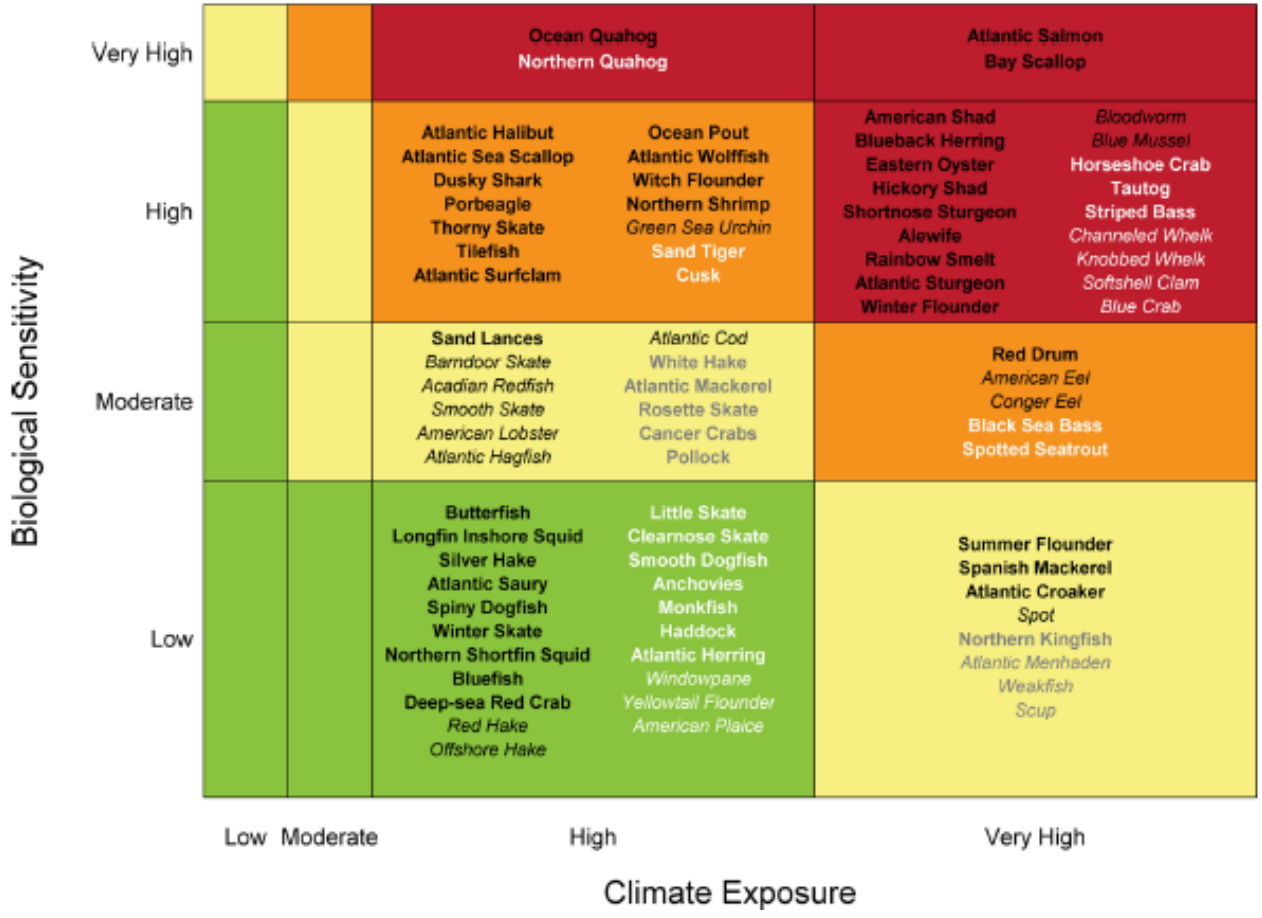

Hare et al. 2016

Steps in the CVA process

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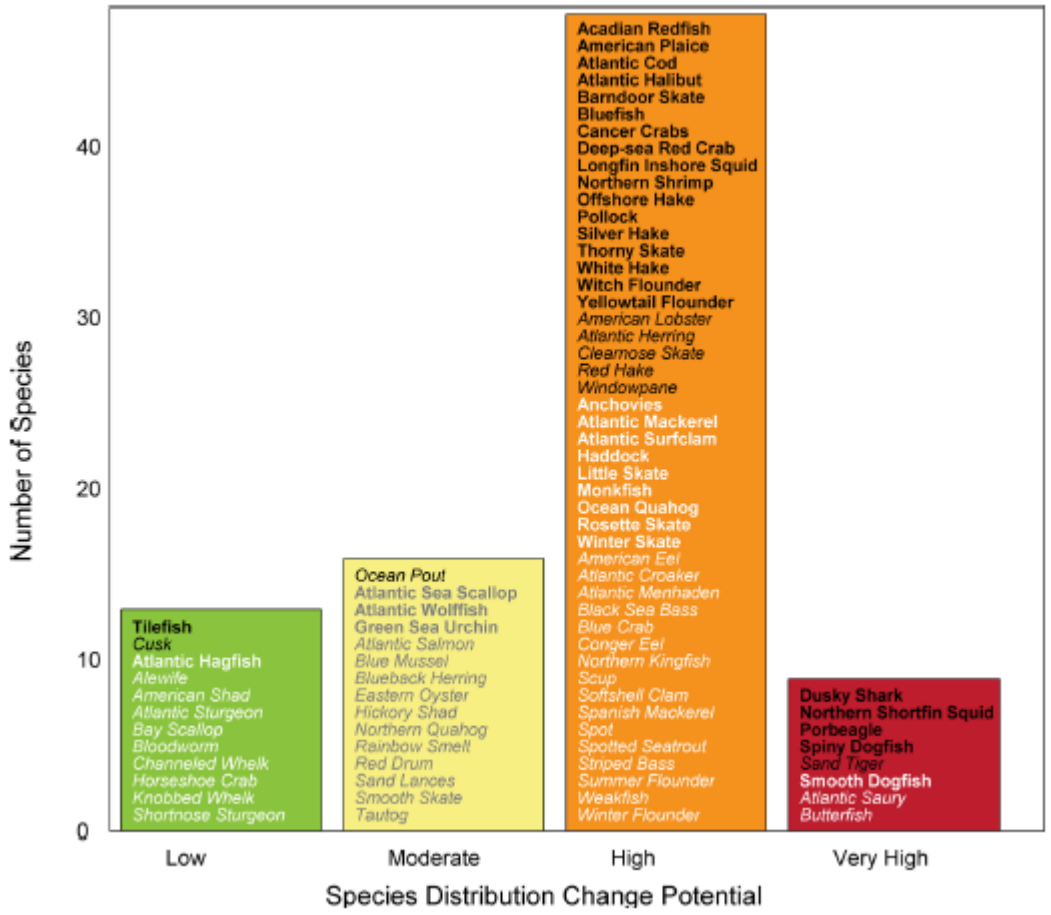
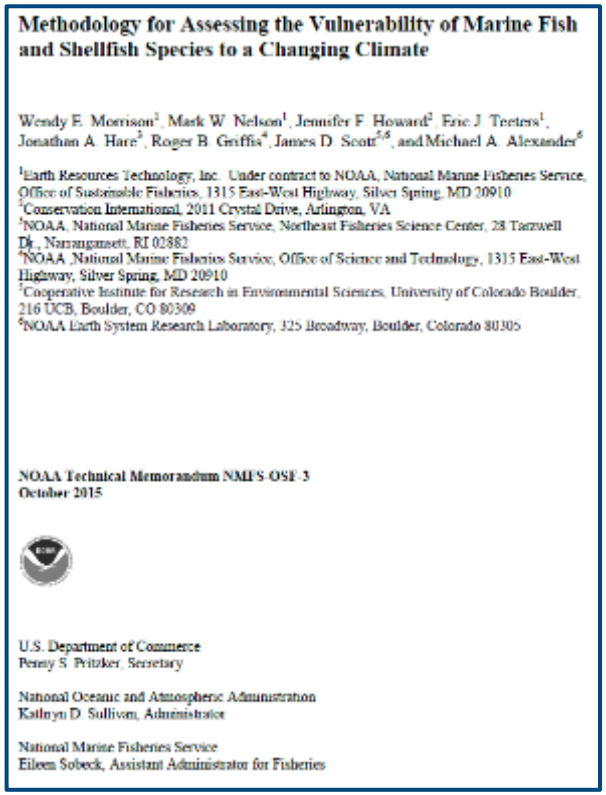


Hare et al. 2016

Timeline - Original

- Identify species (n = 67)
- Complete species profiles
- Expert scoring of species' sensitivity
- Select exposure factors
- Create species distributions and compile related data
- Data analysis and vulnerability assessment
- Final report - 2020



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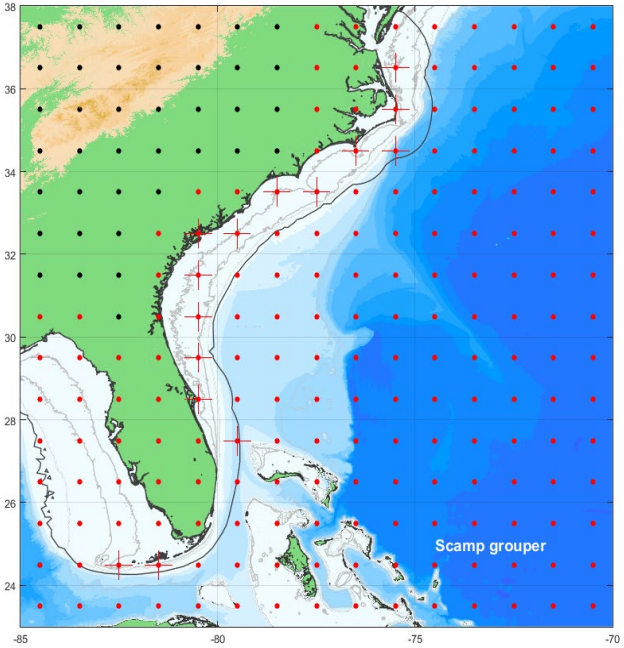
Timeline – Progress to Date

- Identify species (n = 71), 4 additional species added as a result of partner input
- Complete species profiles
- Complete expert scoring of species' sensitivity.
- Complete species distribution maps – needed to select data nodes to include
- Select exposure factors and compile related data
- Exposure factor scoring
- Data analysis and interpretation
- Final report - 2020



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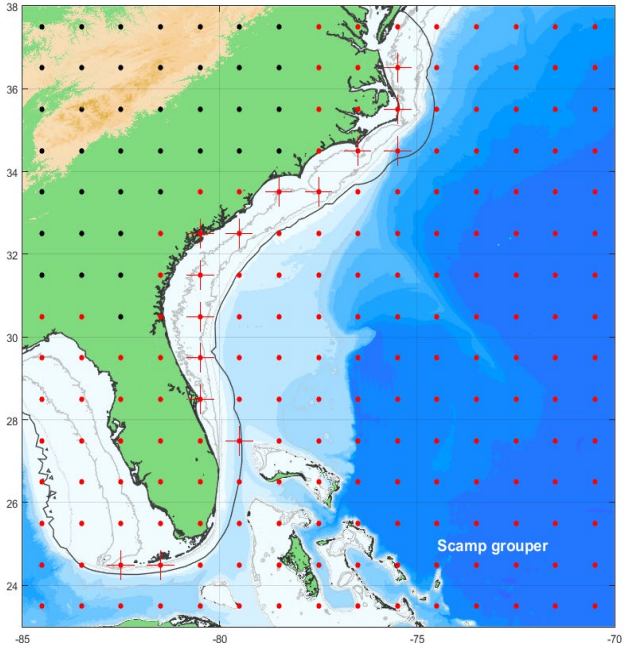

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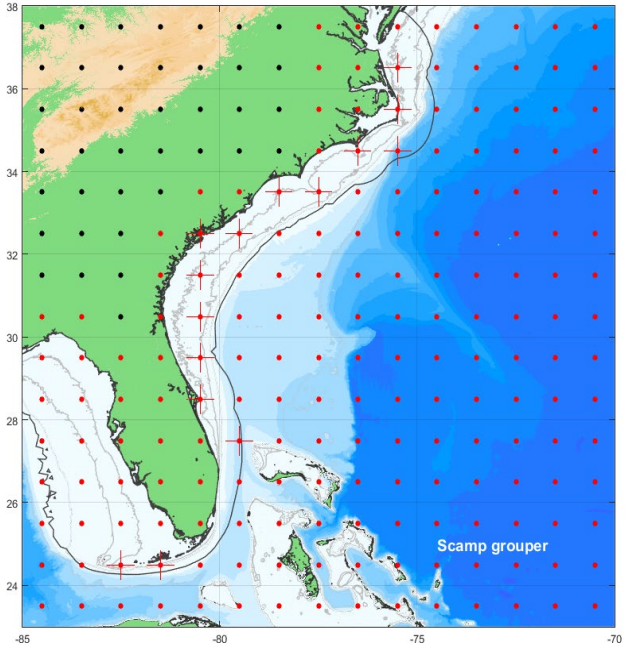

Thank you!

Questions?

Relevance to regional-scale priorities

SAFMC Fishery Ecosystem Plan II

- Actions 3 & 5 under “South Atlantic Food Webs and Connectivity and EFH”
  - Develop ecosystem indicators for key species and environmental drivers
  - Compile time series and/or spatial maps of temperature, chlorophyll -a, freshwater flow, salinity, etc.
- Action 2 under “South Atlantic Climate Variability and Fisheries”
  - Develop or select previously developed climate indicators and define triggers for when management action is needed

NMFS / SEFSC EBFM Implementation Plan

- One of five priority activities

Questions?

Relevance to regional-scale priorities

SAFMC Fishery Ecosystem Plan II

- Action 2 under “South Atlantic Climate Variability and Fisheries” (“Develop or select previously developed climate indicators and define triggers for when management action is needed”)

NMFS / SEFSC EBFM Implementation Plan

- One of five priority activities

Questions?