# Northeast Region Habitat Climate Vulnerability Assessment

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Eastern Region Climate Services Webinar
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# Northeast Region Habitat Climate Vulnerability Assessment

PLOS ONE, December 2021

Farr ER, Johnson MR, Nelson MW, Hare JA, Morrison WE, Lettrich MD, Vogt B, Meaney C, Howson UA, Auster PJ, Borsuk FA, Brady DC, Cashman MJ, Colarusso P, Grabowski JH, Hawkes JP, Mercaldo-Allen R, Packer DB, Stevenson DK

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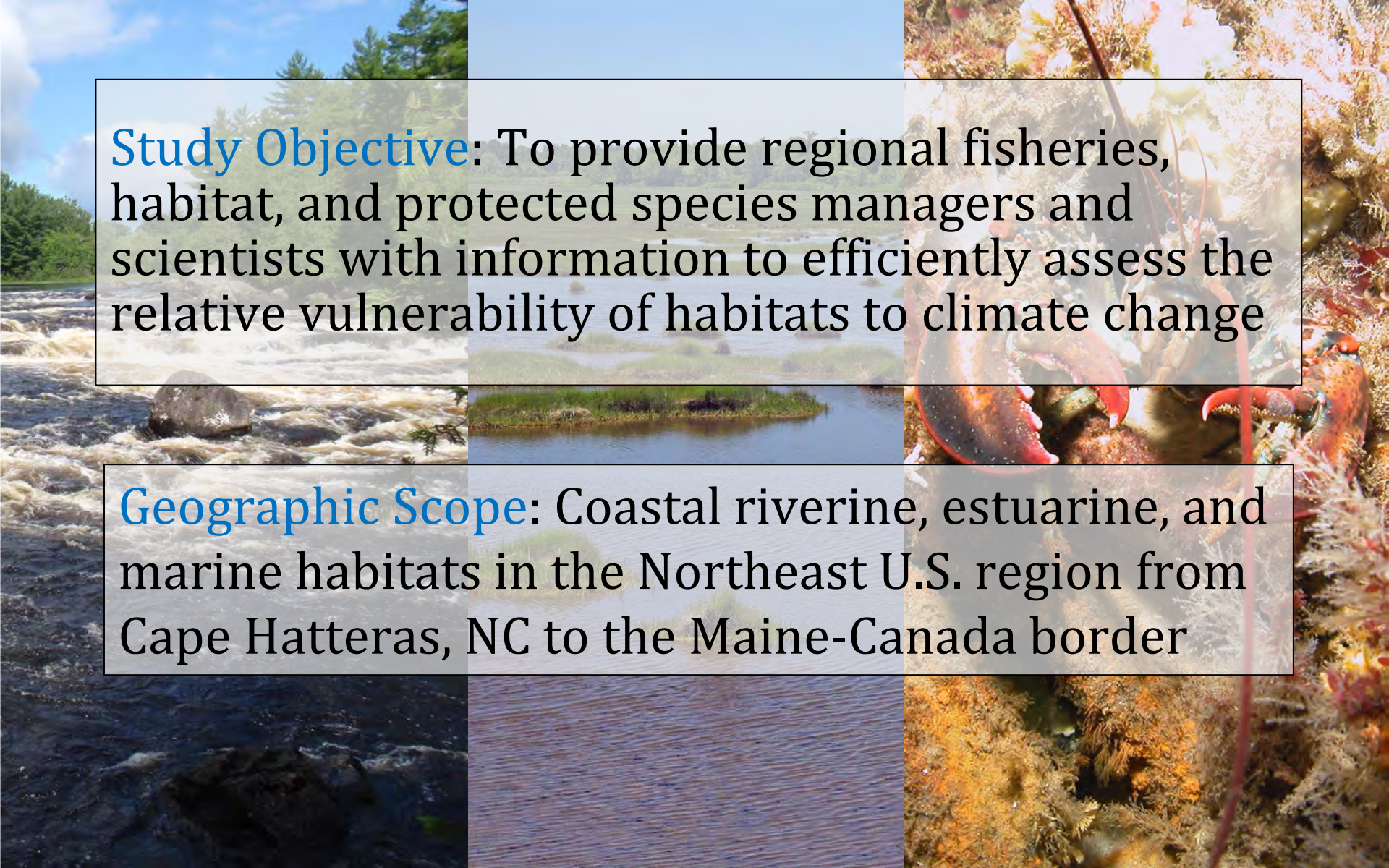
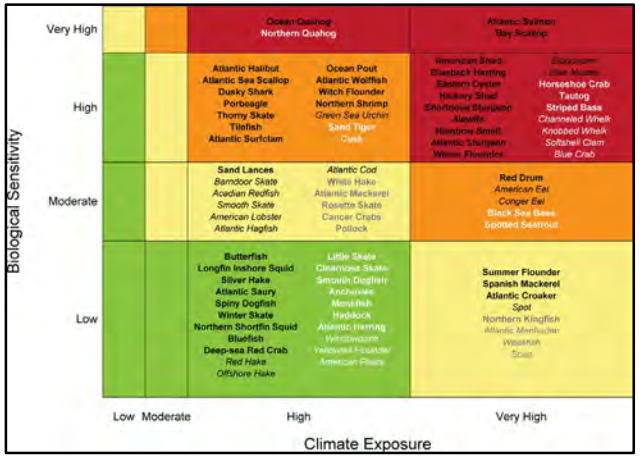


Study Objective: To provide regional fisheries, habitat, and protected species managers and scientists with information to efficiently assess the relative vulnerability of habitats to climate change

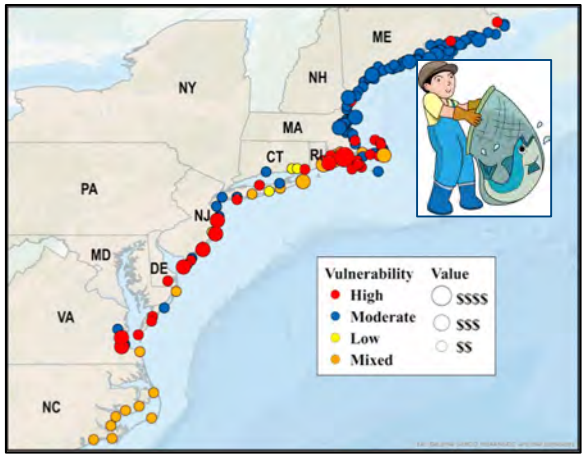
Geographic Scope: Coastal riverine, estuarine, and marine habitats in the Northeast U.S. region from Cape Hatteras, NC to the Maine-Canada border

# Growing Toolbox of Climate Vulnerability Assessments

- This study builds on prior NOAA climate vulnerability assessments for fish stocks (northeast region, Pacific salmon, and Bering Sea); northeast region fishing communities
- Seven others in progress (marine mammals, sea turtles, regional fish stocks)




**Fish and Invertebrates**




**Fishing Community**

**Marine Mammals & Sea Turtles**



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# 52 Habitats Assessed in Marine, Estuarine, and Coastal Riverine Systems

| | | | |
|---|---|---|---|
| Marine & Estuarine | ● Rocky Bottom<br>● Sand Bottom<br>● Mud Bottom<br>● Shellfish Reef<br>● Kelp & Turf Algae<br>● Submerged Aquatic Vegetation<br>● Water Column<br>● Manmade Hard Substrate | Riverine | ● Rocky Bottom<br>● Sand Bottom<br>● Mud Bottom<br>● Algal Bed<br>● Submerged Aquatic Vegetation<br>● Emergent Wetland<br>● Water Column |
| Marine | ● Deep Sea Coral | | |
| Estuarine | ● Emergent Wetland | | |

- Nearshore, offshore, marine habitats
- Subtidal and intertidal marine and estuarine habitats
- Riverine tidal and non-tidal habitats

## Climate Sensitivity

Attributes indicative of a response to change in climate

- Habitat condition
- Habitat fragmentation
- Distribution/range
- Ability to spread or disperse
- Resilience
- Resistance
- Changes in abiotic factors
- Critical ecological linkages
- Non-climate stressors

Examples: dredging, shoreline hardening, eutrophication, offshore energy development

## Climate Exposure

Climate variables that could impact a habitat

- Sea surface temperature
- Bottom temperature
- Air temperature
- Salinity (surface & bottom)
- pH
- Precipitation
- Streamflow
- Stream temperature
- Sea level rise

## Habitat Climate Vulnerability

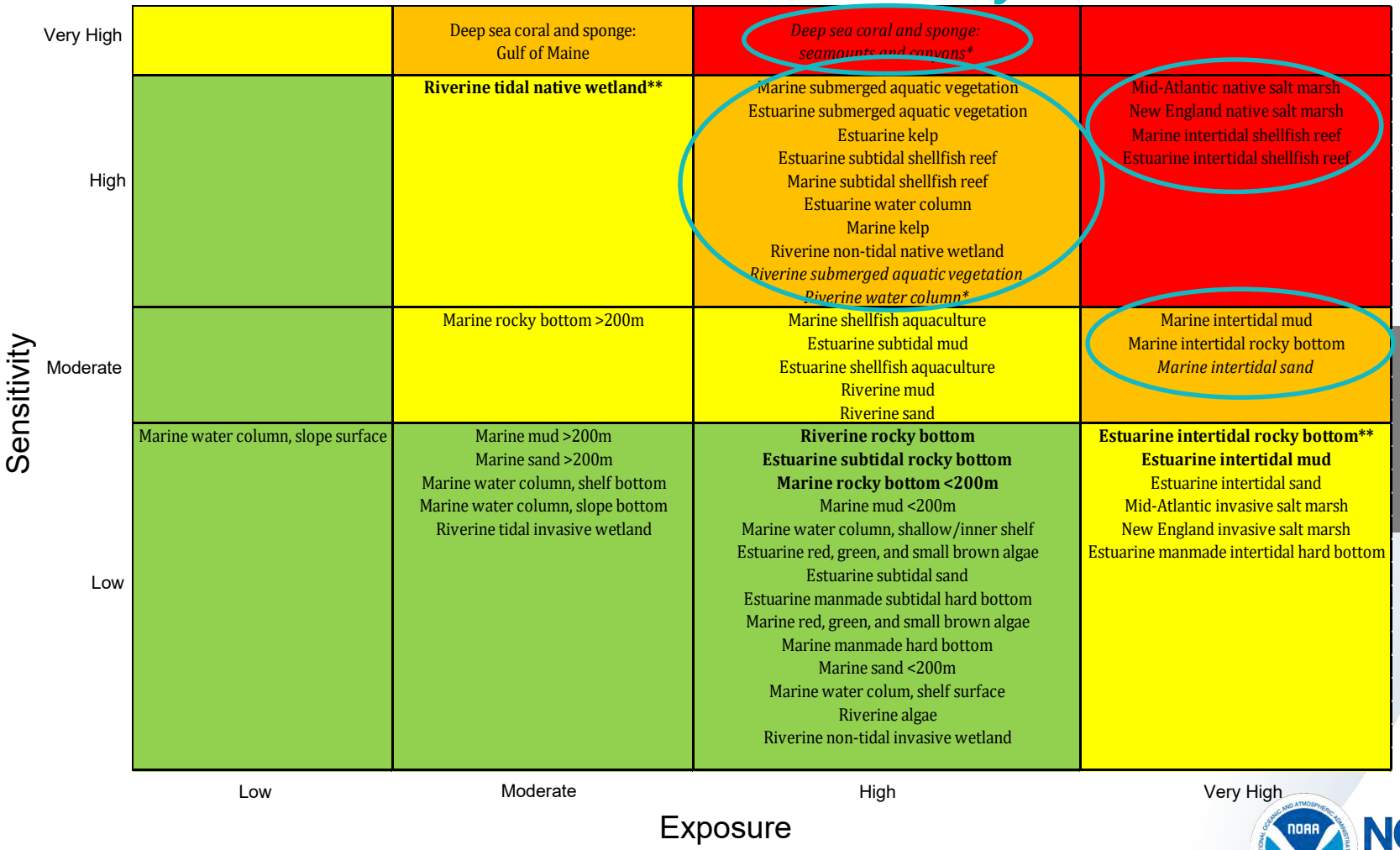
# Sensitivity and Exposure Scoring

- Expert elicitation: 15 habitat experts (5 per system) for habitat sensitivity scoring; 5 climate experts for climate exposure scoring of each habitat type

- Expert's scores distributed across pre-defined sensitivity bins (low, moderate, high, and very high)
- Experts able to place 5 tallies across 4 sensitivity scoring bins to reflect uncertainty and/or variability

- Used maps to visually integrate habitat occurrence and climate exposure
- Used regional downscaled, end-of-century climate projections using RCP8.5

# Habitat Climate Vulnerability Results




**Vulnerability Key:**
**Red = Very High**
**Orange = High**
**Yellow = Moderate**
**Green = Low**

# Potential Study Applications

- Essential Fish Habitat (EFH) and Habitat Area of Particular Concern (HAPC) designations, and EFH and ESA consultations
- Ecosystem context for fisheries management decisions (e.g., stock assessments, fishery management plans, NEPA documents)
- Project siting decisions (e.g., aquaculture, ocean wind energy)
- Tools for coastal resource managers for habitat restoration (e.g., salt marsh, and eelgrass) and climate resiliency projects (e.g., living shorelines,)
- Assessment framework as a template for other regions

# Future Work:
# Linking Habitat and Species Climate Vulnerability

- Fish stock climate vulnerability assessment (Hare et al. 2016) reported winter flounder as very highly vulnerable due to the low stock status and poor population productivity linked to high projected SST
- This study: several habitats important to this species (i.e., SAV, kelp, intertidal sand and mud, and tidal wetlands) were found to be high or very highly vulnerable to climate change
- Implies potential climate vulnerability risk, and fishery management concerns

# Climate Vulnerability of Salt Marsh

- Mean SLR 2–6 mm/yr. over 20th century for northeast region
- Projected to exceed 10 mm/yr. by end of this century under a 1.0 m global SLR scenario (Sweet et al. 2017)

- Maximum vertical accretion rates for salt marshes (~5–7 mm/yr.) (e.g., Donnelly and Bertness 2001; Carey et al. 2017; Cahoon et al. 2009; Kirwan et al. 2010)

- Hardened shorelines will restrict the capacity of coastal wetlands to migrate inland with increasing SLR, suggesting extirpation of large areas of salt marshes over this century