Habitat and Ecosystem-Based Vulnerability Assessments

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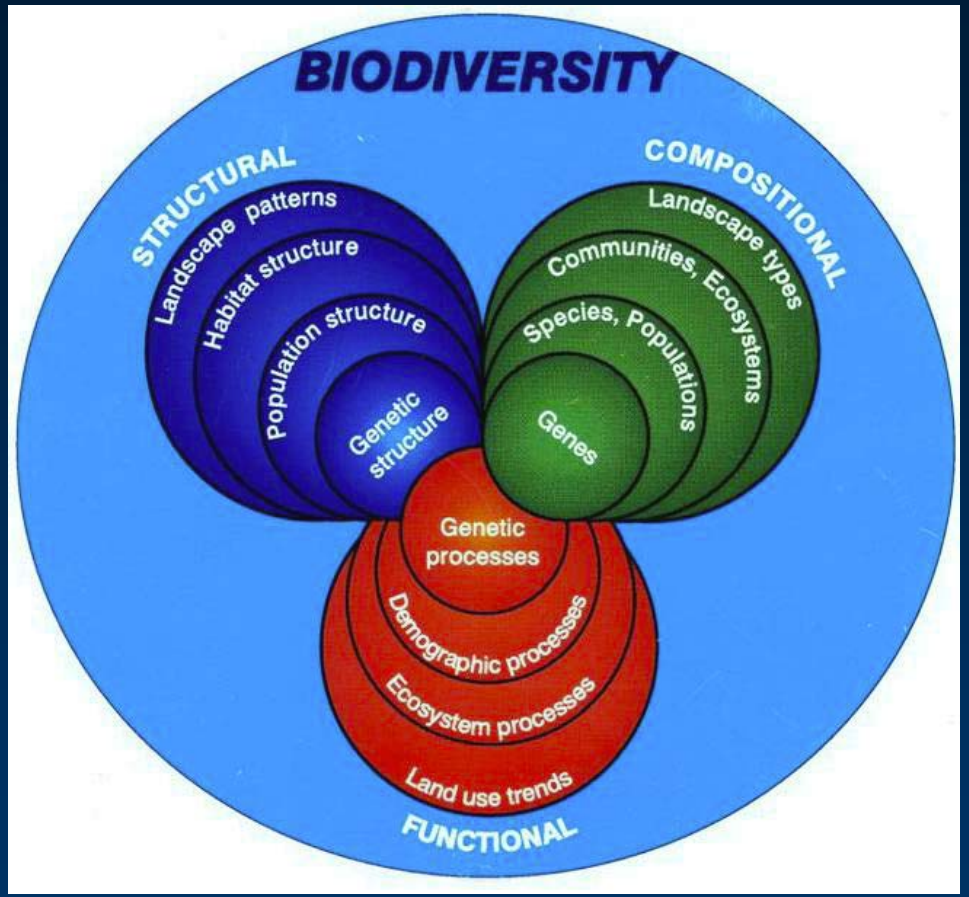
Levels of Biodiversity

- Biome
- Landscape
- Ecosystem
- Biological assemblage/ ecological community
- Species
- Population
- Individual
- Gene

Components of Biodiversity

- Structure
- Composition
- Function



From Noss 1990

Habitat vs. Ecosystem

- Habitat
  - Tends to refer requirements needed by a particular species
  - In practice, often refers to any ecological unit (e.g., specific vegetation type) or even to natural vegetation in general
- Ecosystem
  - Tends to refer to some ecologically defined unit
  - Technically, interaction between biotic and abiotic, in practice often defined mainly on biotic elements
  - Can vary considerably in spatial scale (e.g., tiny pond to million acre region)
  - In practice, often refers to regional landscapes (e.g., Greater Yellowstone Ecosystem)

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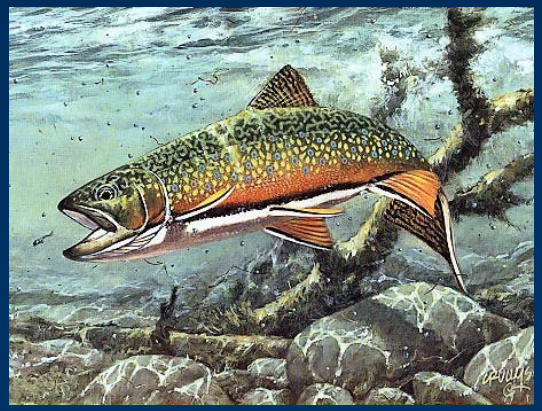
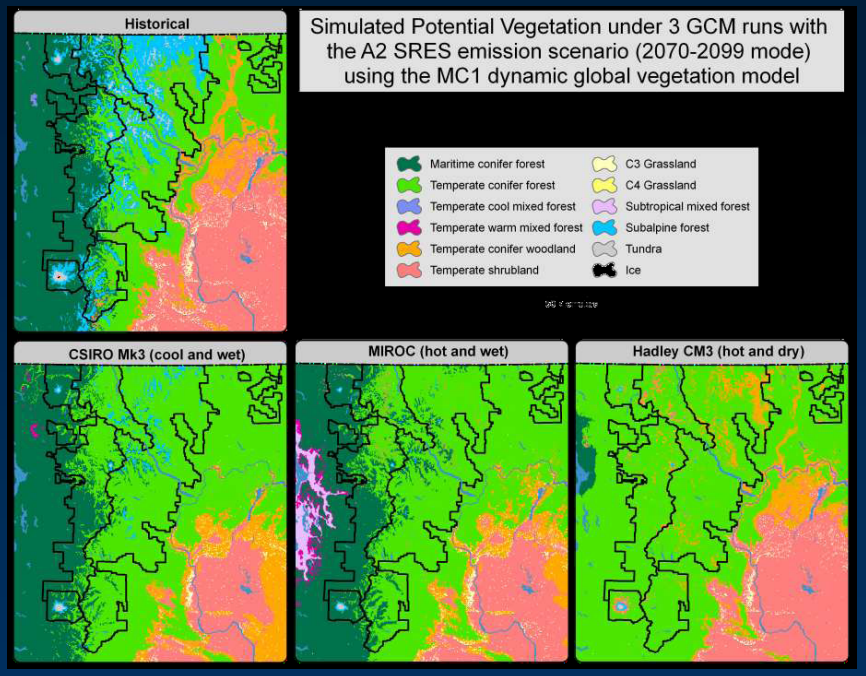
Ecologically Defined Assessment Targets

- Vegetation/Habitat types
  - Specific (“blue-oak woodland”)
  - General (“wetlands” “grasslands”)
- Physical structures
  - Sea ice, glaciers
- Physical processes
  - Cold-water streams
  - Fire frequency
- Ecosystem Services
  - Storm protection
  - Water production
  - Carbon sequestration



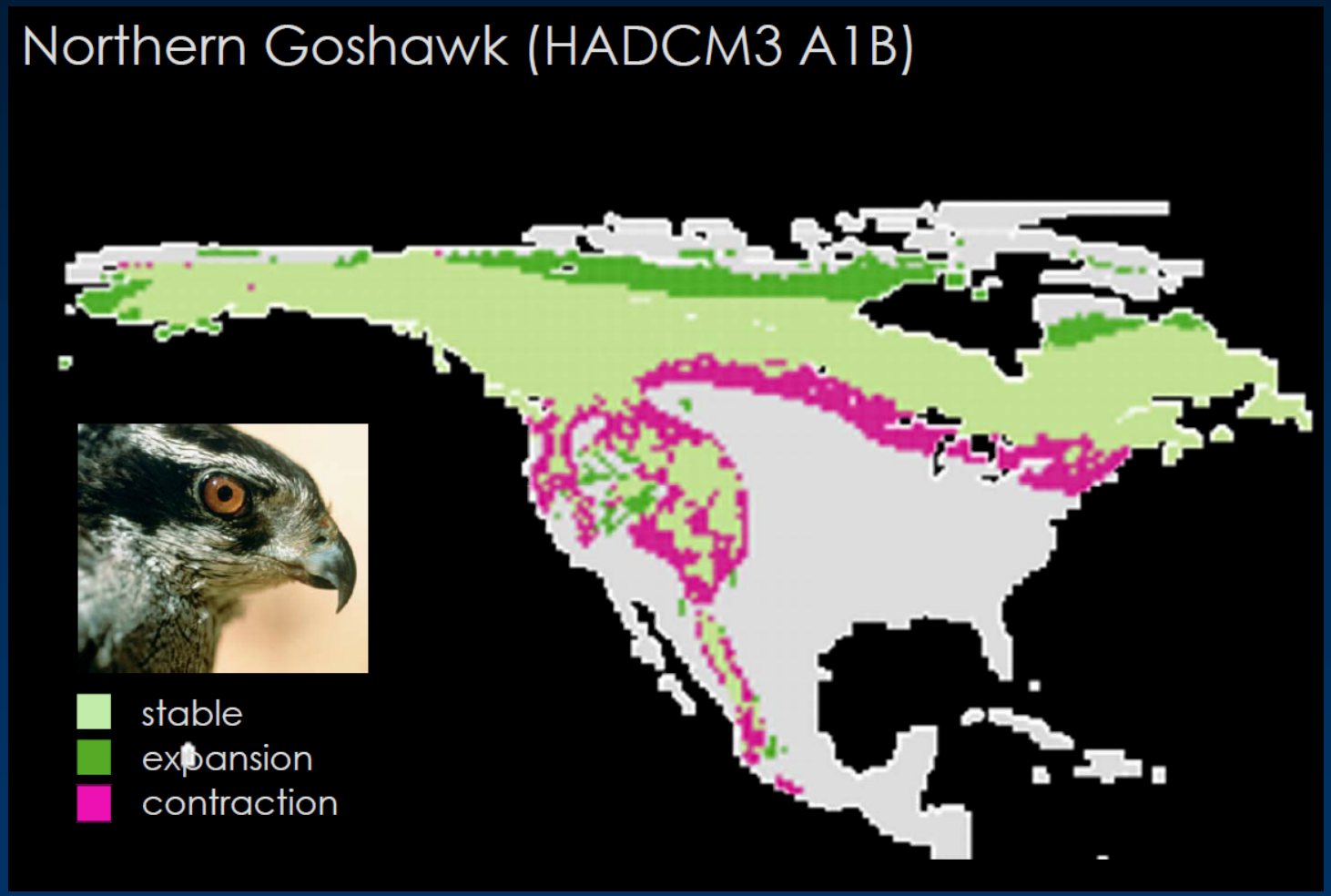
Vegetative Response Models

- Mechanistic or process models
  - Simulate effect of physical processes (e.g., water avail) on vegetation
- Gap models
  - High resolution based on changes in a tree blowdown
- Climate Envelope models
  - Based on expected changes in species distributions



Vegetation response models often used as part of "exposure" for species assessment.

Predicting Species Distribution Shifts Based on Process-based Vegetation Models



Courtesy Josh Lawler

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Conceptual Ecological Models

- Hypotheses about how systems work
- Assessment of system sensitivities
  - Climate breadth
  - Individual species sensitivities
  - Disturbance regimes
  - Other stressors
- Habitat distributional shifts
  - Likely decoupling of interacting species
  - Individual species will respond differentially

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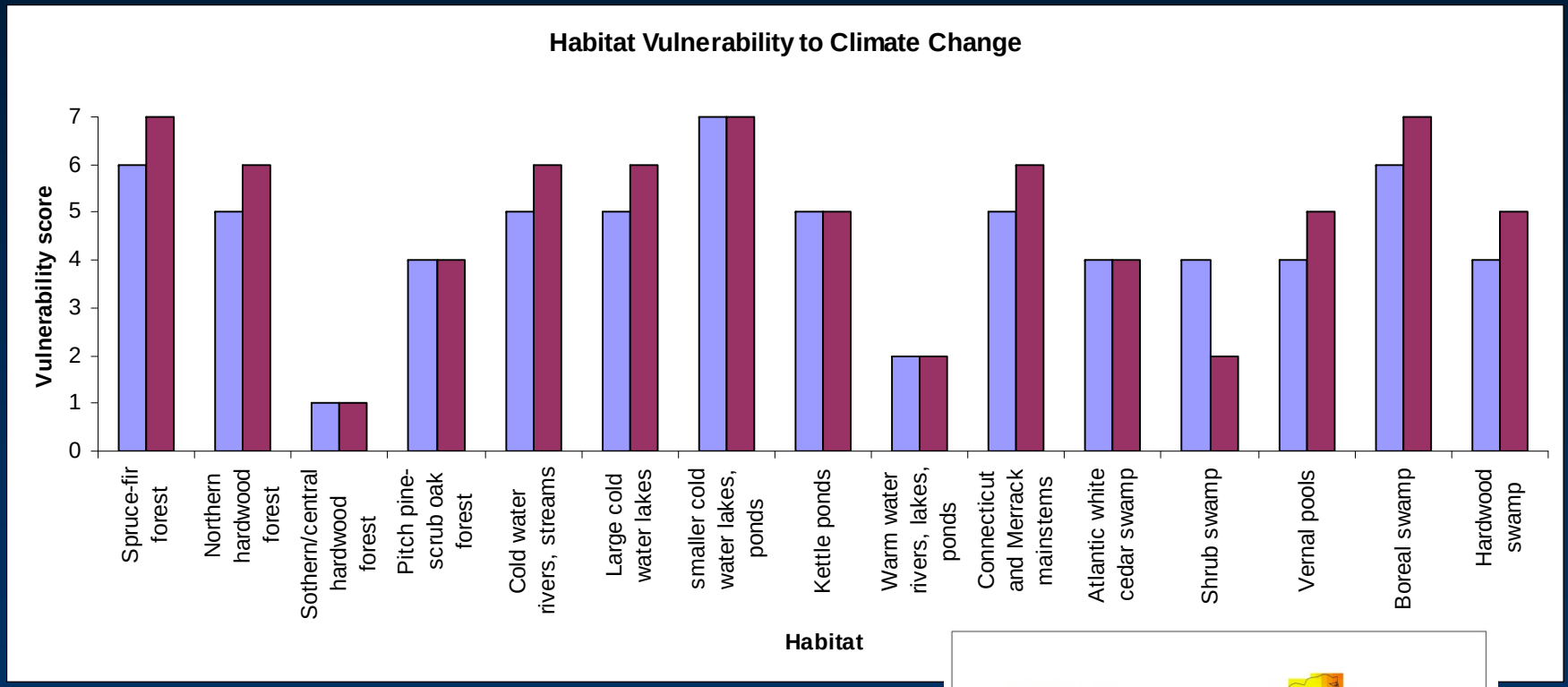
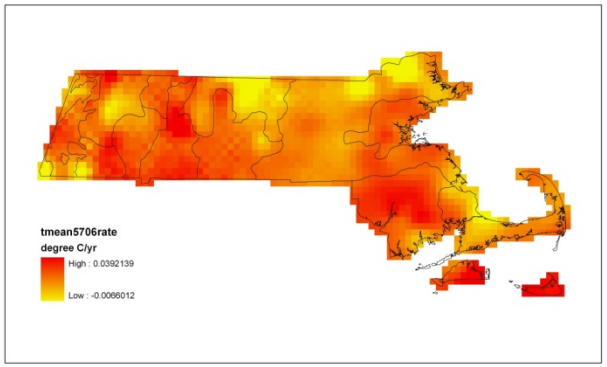
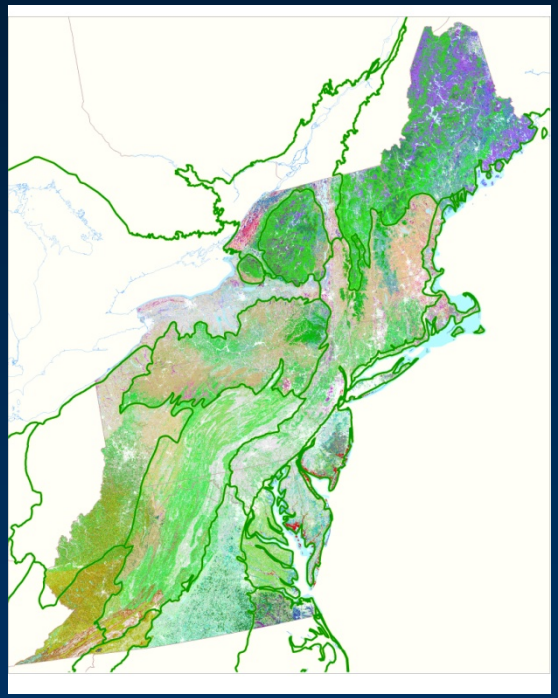
Massachusetts Habitat Assessment





Northeast Association of Fish and Wildlife Agencies (NEAFWA)

- As part of State Wildlife Grants Developed Consistent Regional Habitat Classification and Map
- Regional habitat vulnerability assessment being carried out by Manomet, NWF, and others
- Modeled after Massachusetts habitat assessment
- Based on expert elicitation; expert workgroups convened

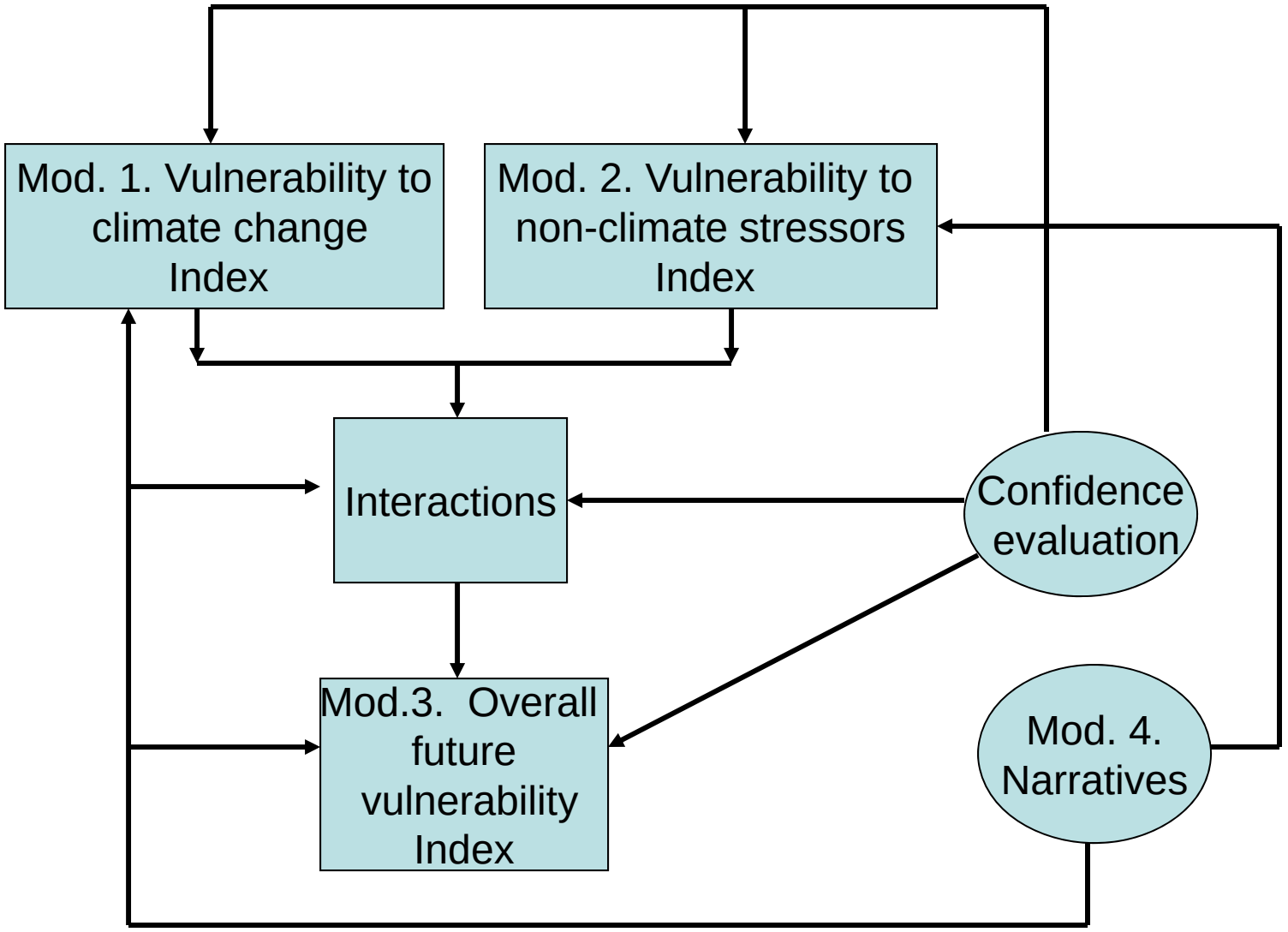


Process Model for NEAFWA Habitat Assessment

Has six major elements:

1. Module 1. Assessment of vulnerability to climate change
2. Module 2. Assessment of vulnerability to non-climate stressors
3. Module 2. Interaction potential
4. Module 3. Assessment of overall future vulnerability
5. All Modules. Confidence evaluation
6. Module 4. Narratives (transparency)

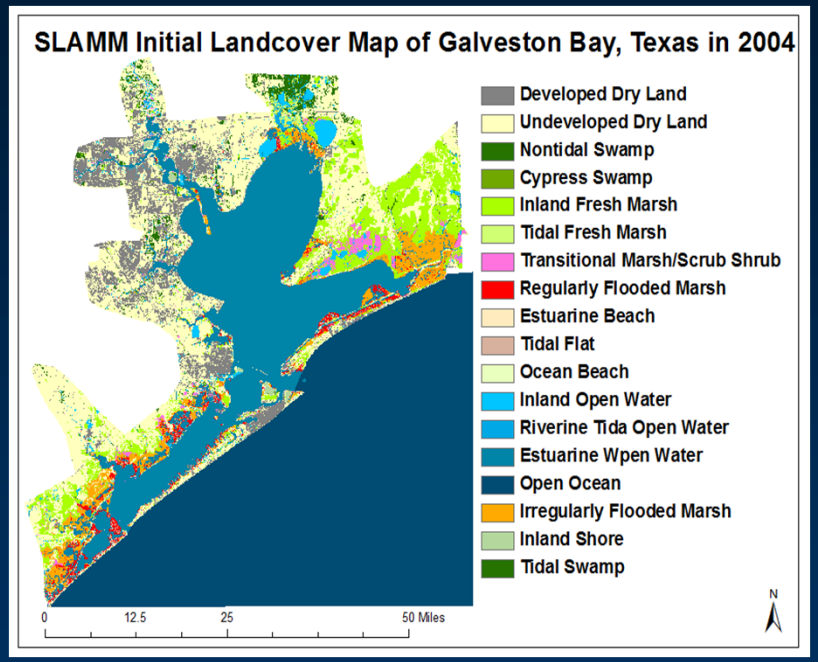
NEAFWA Model

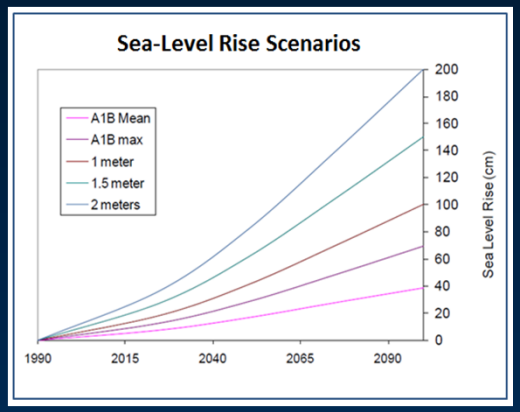


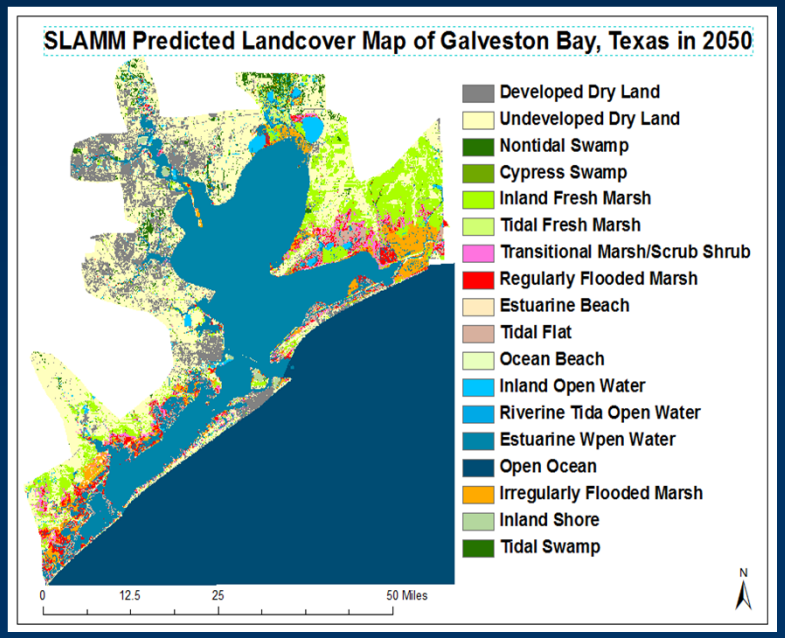
NEAFWA
Habitat Vulnerability Categories

- Least vulnerable – large habitat gain
- Less vulnerable – habitat gain
- Vulnerable – modest changes
- Highly vulnerable – substantial habitat loss
- Critically vulnerable – major habitat loss

Marsh Vulnerability to Sea Level Rise







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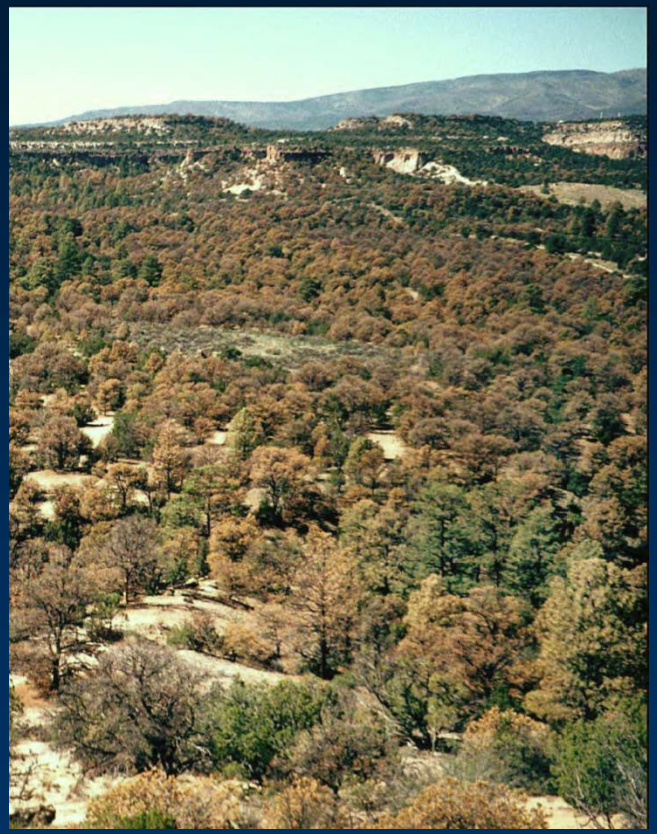
Habitat Change in Southwest

October 2002



May 2004

Drought, insect pests, and fire primary climate-related drivers of change

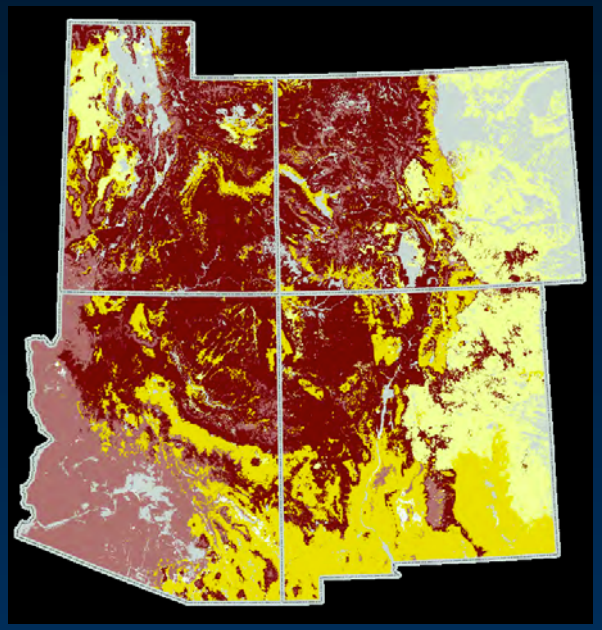
Southwest Climate Change Initiative

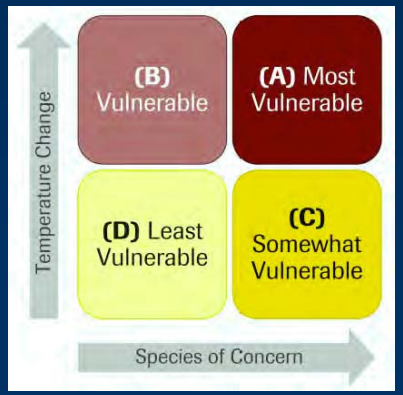
<u>Habitats</u>

- Most warming and most species of concern:
  - Subalpine forests
  - Piñon-juniper woodlands
  - Sage shrublands
  - Colorado Plateau canyonlands and grasslands

<u>Species</u>

- 40% of habitats show ecological change attributable to warming
- At least 119 species already affected
- Hundreds more species likely to be affected by changes in fire and flows





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Habitat *vs.* Species Assessments

- If conduct a habitat/ecosystem assessment, ultimately will end up identifying species or concern
- If conduct species-oriented assessment, ultimately will end up identifying habitats of concern
- Which approach to choose depends largely on decisions and users, data available, and comfort/ familiarity working from different perspectives.