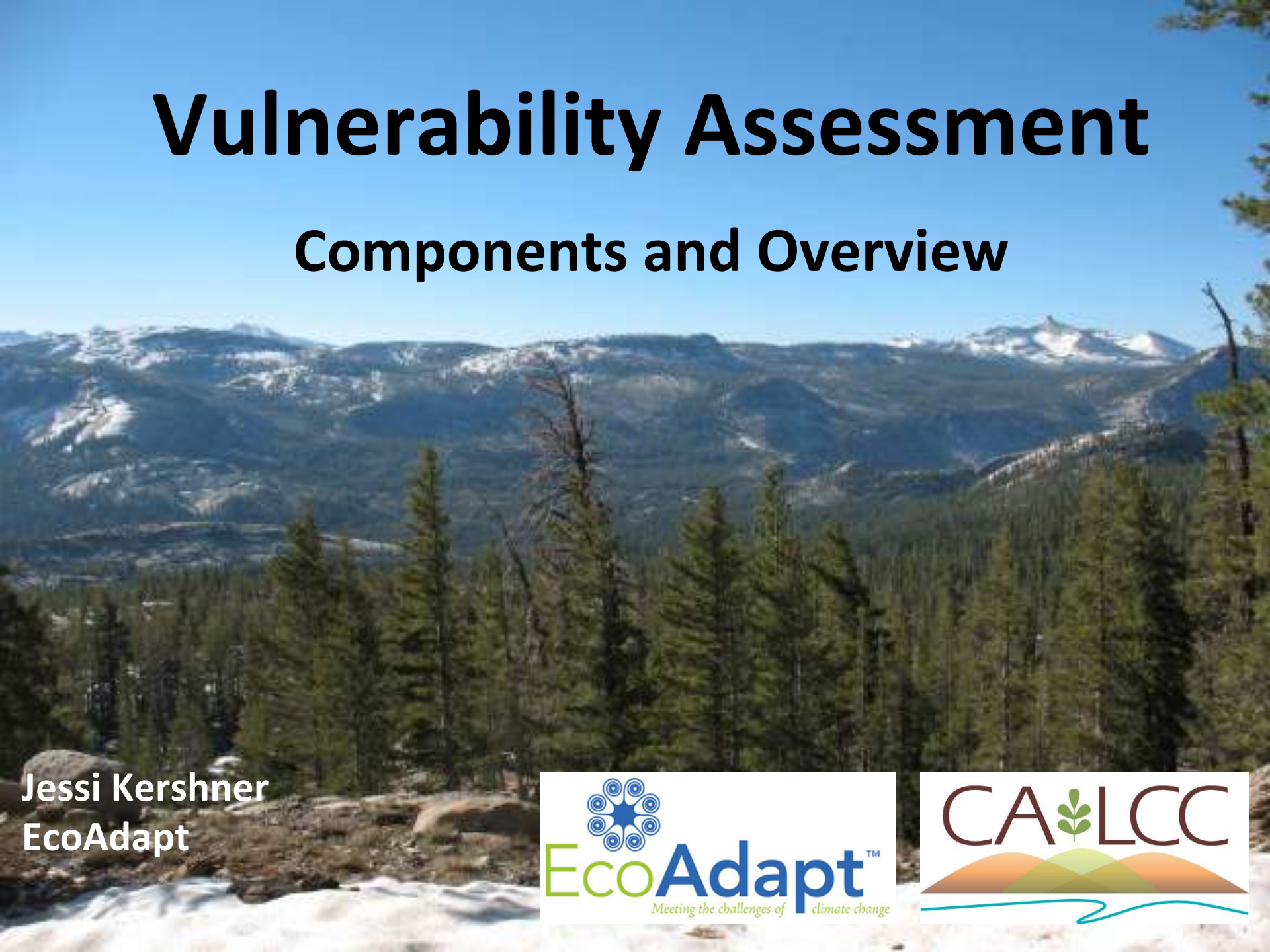
Vulnerability Assessment

Components and Overview



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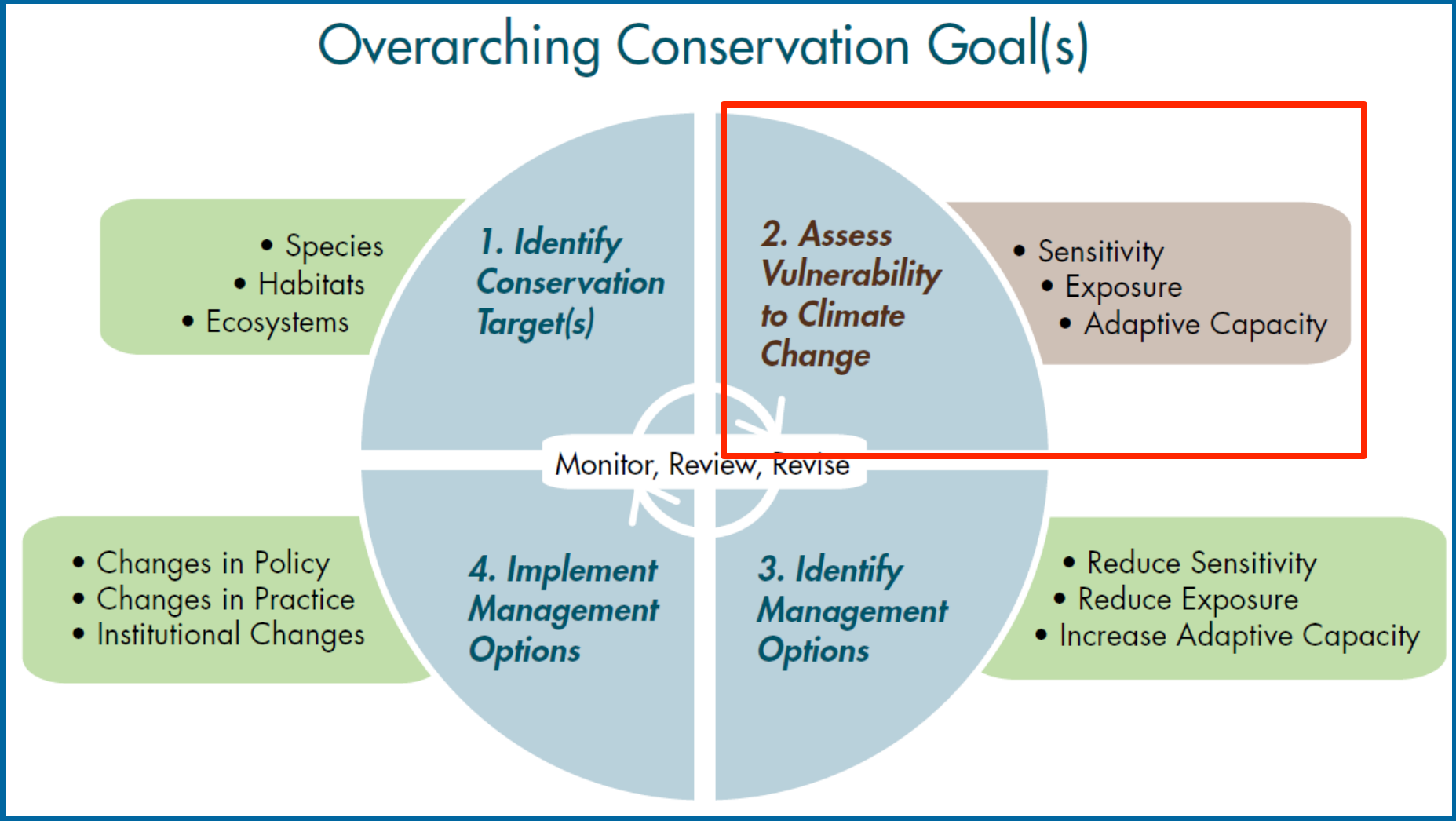
EcoAdapt™
Meeting the challenges of climate change

CA LCC

Talk Goals

- Introduce climate change adaptation and the role of vulnerability assessment
- Unpack the concept of vulnerability
- Summarize key assessment steps

Adaptation Planning Framework



From Glick et al. 2011 *Scanning the Conservation Horizon*

Defining Vulnerability

Climate change vulnerability refers to the extent to which a species, habitat, or ecosystem process is susceptible to harm from climate change impacts

- *What* things are most vulnerable
- *Why* they are vulnerable

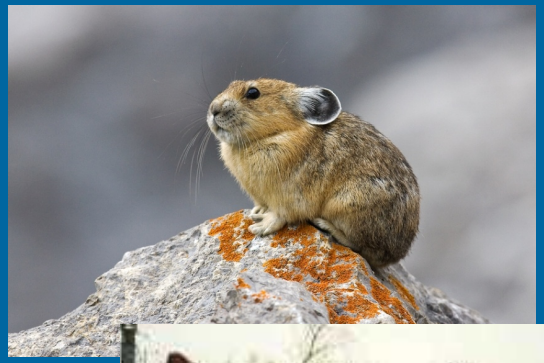
Why Assess Vulnerability?

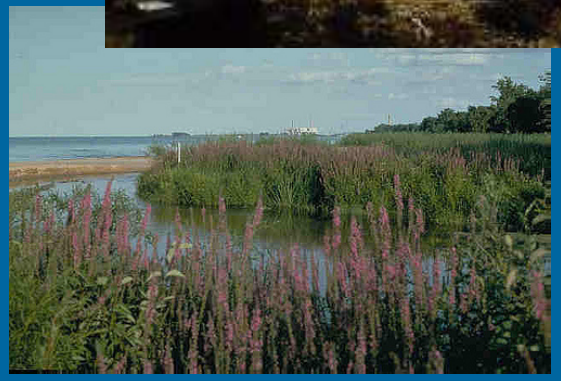
Vulnerability assessments can help:

- Prioritize species and systems for management actions
- Develop management strategies to address climate change
- Efficiently allocate resources

What vulnerability assessments cannot do:

- Make a conservation decision for you





Key Steps for Undertaking a Vulnerability Assessment

1. Determine objectives and scope
2. Gather relevant data and expertise
3. Assess the components of vulnerability
4. Apply assessment results in adaptation planning

Steps 1 and 2

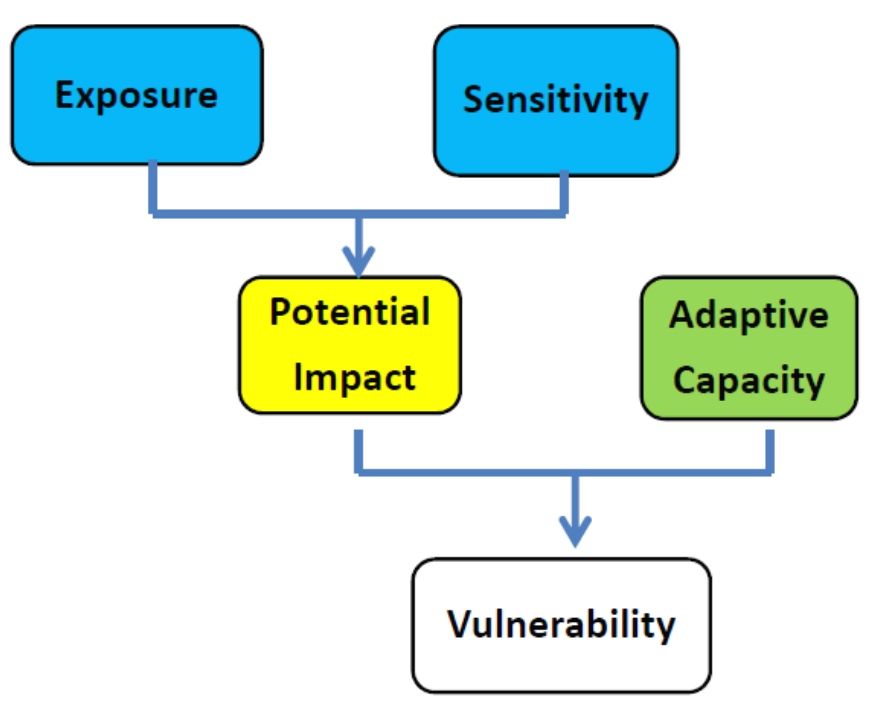
1. Determine objectives and scope
   - Audience/user needs
   - Goals and objectives
   - Assessment targets (species, habitats, ecosystems)
   - Scale (temporal and spatial)
   - Appropriate approach (no "one size fits all")
2. Gather relevant data and expertise
   - Review existing literature
   - Reach out to experts
   - Obtain/develop climate and ecological response projections

Can find information through:

- California Climate Commons
- TACCIMO
- Data Basin

Step 3

3. Assess components of vulnerability
   - Assess sensitivity, exposure, and adaptive capacity
   - Estimate overall vulnerability
   - Document confidence levels and uncertainties



Assessing Sensitivity

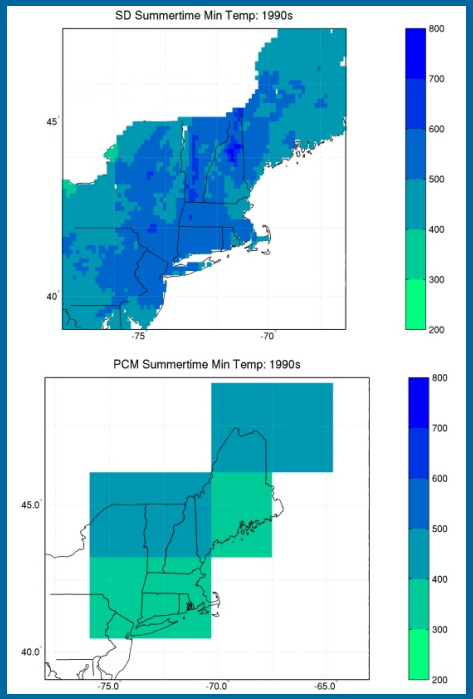
Measure of whether and how a species or system is likely to be affected by a given change in climate or factors driven by climate

Factors affecting sensitivity of species, habitats, ecosystems:

- Specialized habitat or microhabitat requirements
- Narrow environmental tolerances or physiological thresholds
- Dependence on interactions with other species

Assessing Exposure

Measure of how much of a change in climate or other environmental factor a species or system is likely to experience

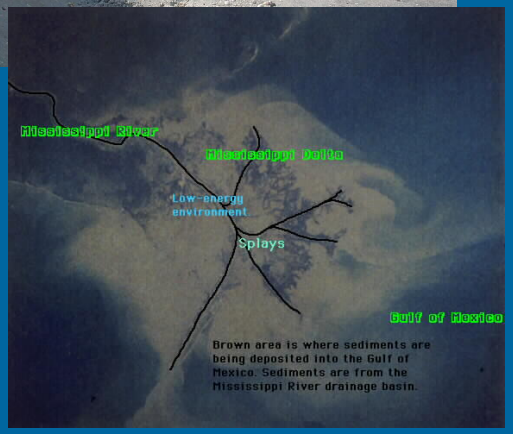


Factors to consider when assessing exposure:

- Climate models
  - Shifts in temperature, precipitation
  - Increasing availability of finer scale data (e.g., downscaling)
- Ecological response models
  - Sea level inundation
  - Climate related vegetation shifts
  - Landscape impediments to dispersal
  - Hydrologic projections

Assessing Adaptive Capacity

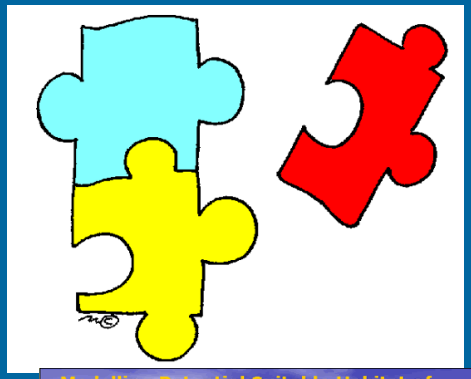
Ability to accommodate or cope with climate change impacts with minimal disruption

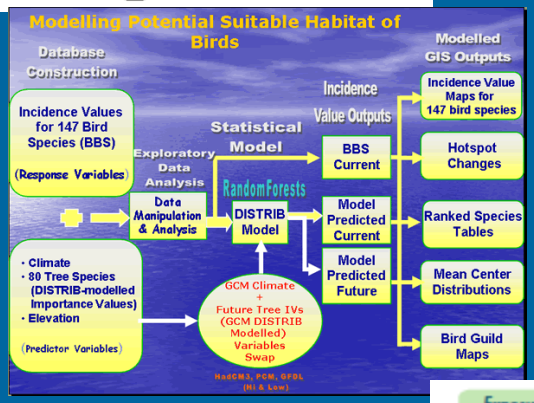


Factors that can influence amount of adaptive capacity of your species or system:

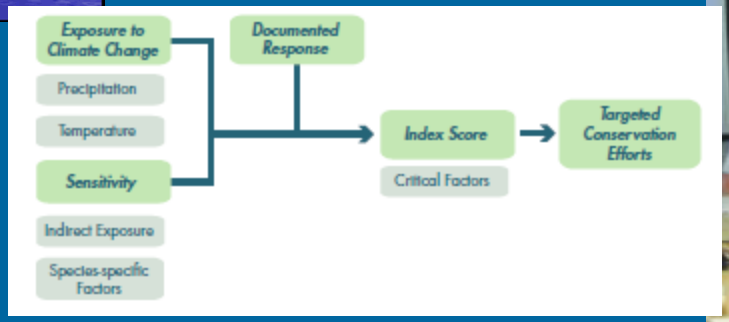
- Intrinsic factors
  - "Plasticity"
  - Dispersal abilities
  - Evolutionary potential
- Extrinsic factors
  - Existence of barriers to habitat migration
  - Institutional capabilities

Putting the Pieces Together: How to Assess Vulnerability Components





- Detailed modeling efforts
  - In-house or commissioned
  - Mark Schwartz, UC Davis
- Vulnerability indices
  - e.g., NatureServe Index
  - Rodney Siegel, IBP
- Expert elicitation
  - Supplement and/or supplant modeling



Example Expert Elicitation VA:
MA Fish & Wildlife

- Developed draft assessment narrative for each habitat type
- Met with experts to review draft
- Revised draft; Back to experts
- Experts asked vulnerability questions; assigned ranking, confidence value

Forested Habitats
Spruce-Fir Forest
Northern Hardwood Forest
Southern/Central Hardwood Forest
Pitch Pine-Scrub Oak Community
Freshwater Aquatic Habitats
Coldwater Rivers and Streams
Large Coldwater Lakes
Smaller Coldwater Lakes and Ponds
Warm-water Ponds, Lakes, and Rivers
Coldwater Kettle Ponds
Connecticut and Merrimack Mainstems
Freshwater Wetland Habitats
Emergent Marsh
Shrub Swamp
Spruce-fir Boreal Swamp
Atlantic White Cedar Swamp
Riparian Forest
Hardwood Swamp
Vernal Pools
Coastal Habitats
Intertidal Mud/Sandflats
Saltmarsh
Brackish Marsh

MA Fish & Wildlife Expert Elicitation

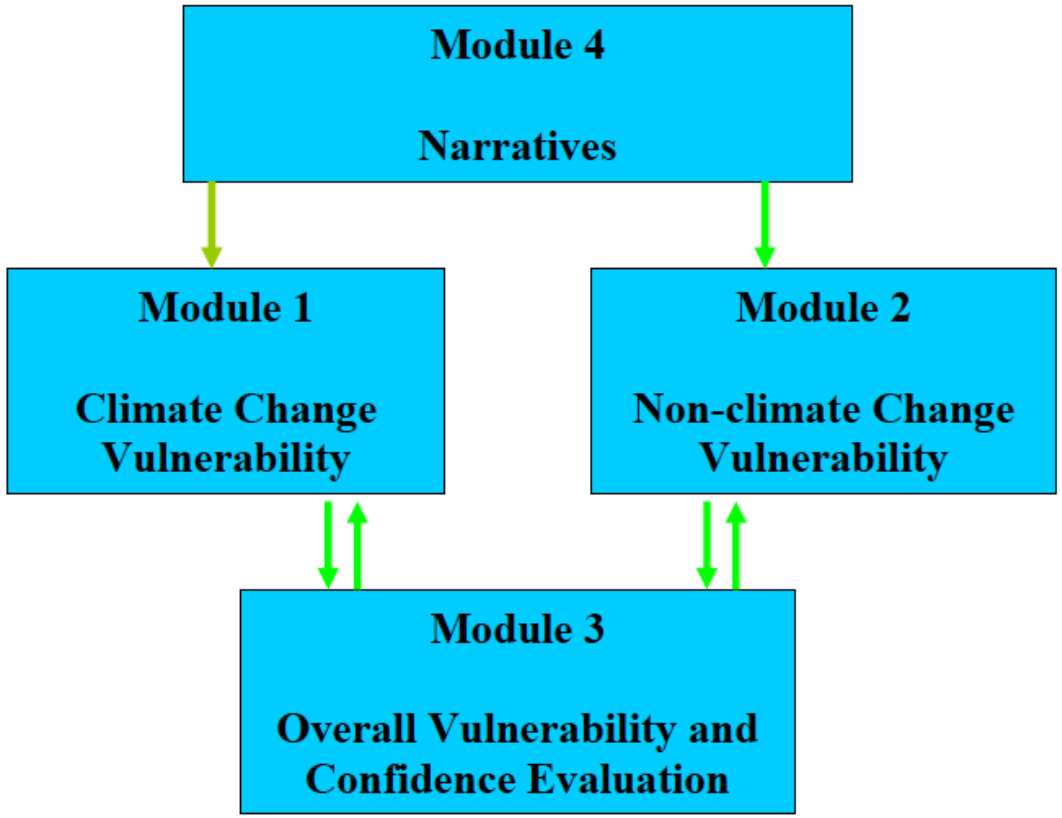


Figure 1. Structure of the NEAFWA Habitat Vulnerability Model.

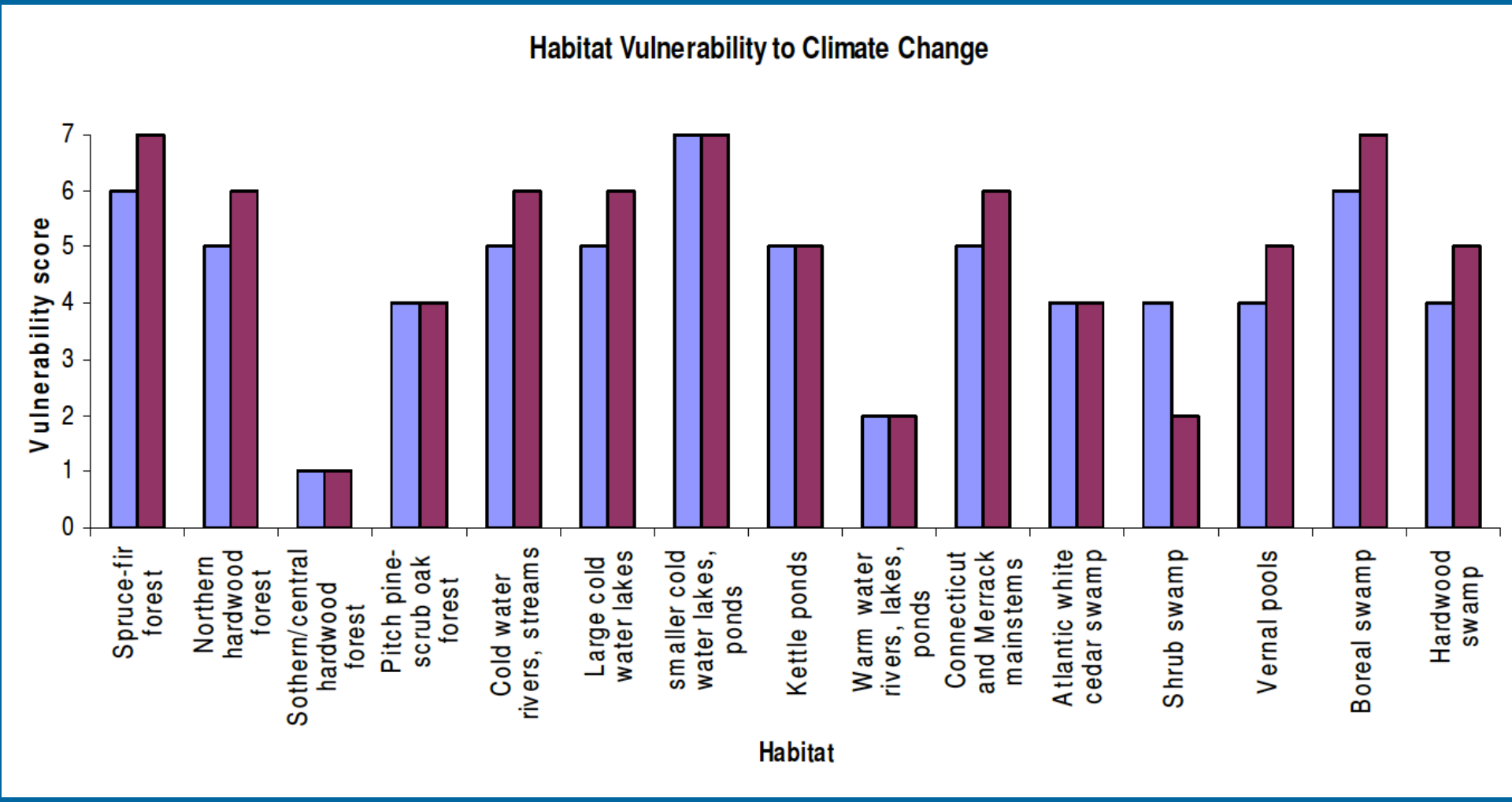
Five Vulnerability Categories:

1. Critically vulnerable
2. Vulnerable
3. Less Vulnerable
4. Likely to Benefit
5. Likely to Greatly Benefit

Three Confidence Rankings:

1. High
2. Moderate
3. Low

MA Fish & Wildlife Vulnerability Rankings



PITCH PINE-SCRUB OAK VULNERABILITY EVALUATION

NTWHCS category: Northeastern Interior Pine Barrens/North Atlantic Coastal Plain Pitch Pine barrens
State ranking S2

Vulnerability score **4 (both emissions scenarios)**

Confidence evaluation **Low**[sb1]

Rationale

Its range extending south to New Jersey and Maryland, this community type reaches its northern limit on sandy, nutrient-poor, drought-prone soils in southern Maine, on Cape Cod, in the southern part of the Massachusetts coastal plain, and in the Connecticut River Valley (see Massachusetts Natural Heritage and Endangered Species Program map below). It is therefore a southern community type that extends into southern and central New England. Its canopy is dominated by Pitch Pine, with an understory of Scrub Oak, Huckleberry, and Lowbush Blueberry. The system is fire-maintained and will revert to White Pine or oak-dominated forest in the absenceof fire (NHESP, 2007).

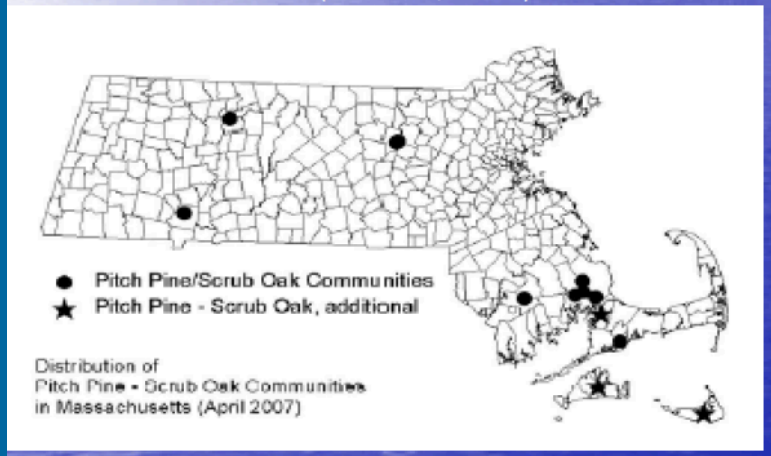


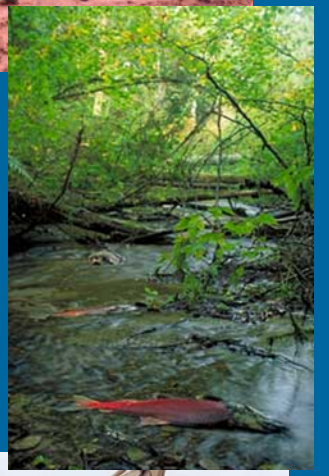
Figure 1. Distribution of Pitch pine-scrub oak communities in Massachusetts.

Pitch pine-scrub oak occurs in significantly warmer climates to the south in New Jersey and Maryland. If the only determinant of its distribution were climate, it would be likely that its distribution in Massachusetts would extend under a warming climate. However, non-climatic factors, mainly the distribution of sandy, nutrient-poor soils; fire frequency; and development, are also important factors. These are likely to be the main limiting factors in any future spread of pitch pine barrens, not climate change. Based on this, a vulnerab score of 4 (extent of habitat may not change appreciably under climate change) has been assigned for both scenarios. The confidence score that we assign for this community type is Low. This is because its future distribution is dependent on uncertain human settlement patterns and responses to climate change. Urban development is already a major fragmenting factor affecting this forest type and it is unlikely that this pressure will ease over the next few decades. Also, as the summers warm and droughts become more frequent and prolonged, fire outbreaks may become more frequent and/or intense. How humans respond to this is a major uncertainty. If the societal response is increased fire suppression (to protect property and lives), it could result in further loss and fragmentation of this habitat type

Step 4

4. Apply assessment results in adaptation planning

- Reduce Sensitivity
  - Example: Actively plant drought-tolerant species in an area projected to get drier
- Reduce Exposure
  - Example: Identify and protect cold-water refugia
- Enhance Adaptive Capacity
  - Example: Remove coastal armoring to facilitate wetland accretion



Addressing Uncertainty

- Natural resource management has always faced uncertainty
  - Anxiety about uncertainty often leads to “analysis paralysis”
  - Don’t deny it, embrace it
- Document where/why there is uncertainty
- Three types of uncertainty
  - Climate predictions
  - Ecological responses
  - Management effectiveness
- Distinguish between uncertainty in trend vs. rate and magnitude

Likelihood Scale	
Terminology	**Likelihood of the Occurrence/Outcome**
Virtually certain	>99 percent probability of occurrence
Very likely	>90 percent probability
Likely	>66 percent probability
About as likely as not	33 to 66 percent probability
Unlikely	<33 percent probability
Very unlikely	<10 percent probability
Exceptionally unlikely	<1 percent probability

Up Next: Intro to Assessing Sensitivity