Climate Vulnerability Assessment
Habitats and Species

Clean Water and Climate Adaptation Summit 2010
Minnesota Landscape Arboretum
Ann Pierce
MNDNR
IPCC:

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Climate Vulnerability Assessment (VA)

IPCC: (Fussel and Klein, 2006 and Watson et.al. 1966)

“Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change.”

“...depends not only on a system’s sensitivity, but also on its ability to adapt to new climate conditions”
Decision to conduct VA

To certify the state’s systems and species conservation strategies are tailored to address climate change impacts.

To address needs related to meeting the objectives outlined in the State Wildlife Action Plan (SWAP).
Incorporating VA results into management planning

1. Assess CC impacts & vulnerability
2. Conservation Target
3. Evaluate management options
4. Develop management response
5. Implement strategies
6. Evaluate management options

Conservation Target

Evaluate management options

Develop management response

Implement strategies

Evaluate management options

Assess CC impacts & vulnerability
Importance of Adaptation & Mitigation

“There is high confidence that neither adaptation nor mitigation alone can avoid all climate change impacts . . . Adaptation is necessary in the short and longer term to address impacts resulting from the warming that would occur even for the lowest stabilization scenarios assessed”

IPCC 2007 Summary for Policy Makers
Vulnerability Assessment

Components of Vulnerability

- Potential impacts
  - Exposure
  - Sensitivity

- Adaption capacity
  - Existing threats
VA Approaches

• Habitat Assessment:
  – Expert Panel approach
  – Following Massachusetts Approach

• Species Assessment:
  – Vulnerability Index
  – NatureServe
  – Most obvious first
  – Priority Species
Habitat VA

- **Expert Panel approach (Massachusetts)**
  - What has been done to-date.
  - Develop draft assessment narrative for each habitat type
  - Meet with experts to review draft
  - Edit, amend, add, delete, new thoughts
  - Back to experts
  - Complete narrative, assign ranking, apply confidence value
  - We will likely use (Galatowitsch et.al 2009)
Habitat VA

- **Expert Panel Approach Benefits**
  - Makes use of institutional knowledge
  - Can be done at various scales
  - Low cost
  - Can be done relatively quickly
  - Iterative
  - Transparent
  - Process creates staff buy-in
Habitat VA

• Sensitivities to Consider (adapted from Massachusetts)

1. Current rate of loss
2. Latitude
3. Vulnerability to increasing temperature
4. Vulnerability to increased attack by biological stressors (grazers and browsers, pests, invasives, pathogens)
5. Vulnerability to increased frequency or intensity of extreme events (fire, drought, windstorms, floods)
6. Vulnerability to phenologic change
7. Vulnerability to human responses
8. Vulnerability due to obstacles to range shifts
9. Likely future impacts of non-climate stressors
Habitat VA

• Examples of Possible Categories
  – High Risk of being eliminated from the state
  – Majority but not all eliminated
  – No change
  – Increase
  – Navel assemblages
Habitat VA

• Examples of Possible Certainty Categories
  • High confidence >70% confidence
  • Medium confidence between 30% and 70% confidence
  • Low confidence <30% confidence
  • Based on the 5-category scale developed by Moss and Schneider for the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report.
Habitat VA

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
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 absence of 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 vulnerability 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.
Species VA

- **NatureServe Vulnerability Index**
  - Rapidly assess the vulnerability of species to climate change.
  - Uses distribution and natural history information for a species within a specific geographical area.
  - Analyzes the exposure and sensitivity of species to climate change.
  - 17 factors related to climate sensitivities
  - Three degrees of vulnerability
Species VA

- **NatureServe Vulnerability Index**
  - Uses climate wizard for projections
  - Results based on availability of data
  - Rapid analysis
    - May not be suitable for all species
  - Species with most information available and most knowledge
  - Prioritize species based on habitat assessment
  - Prioritize species based on need
Species VA

- NatureServe Vulnerability Index (Nevada)

Table 1. Vulnerability to climate change of thirteen plant and animal species from Nevada. The species were chosen because of concern that they might either decline or increase and displace other species as a result of climate change. The species are ordered by Index score and then S-rank.

<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
<th>Common Name</th>
<th>Index Score</th>
<th>S-rank</th>
<th>G-rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammal</td>
<td>Aplodontia rufa</td>
<td>Mountain beaver</td>
<td>Extremely Vulnerable</td>
<td>S1</td>
<td>G5</td>
</tr>
<tr>
<td>Fish</td>
<td>Rhinichthys osculus</td>
<td>Clover Valley speckled dace</td>
<td>Highly Vulnerable</td>
<td>S1</td>
<td>G5T1</td>
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<tr>
<td></td>
<td>oligophorus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butterfly</td>
<td>Limenitis archippus</td>
<td>Nevada viceroy</td>
<td>Highly Vulnerable</td>
<td>S1S2</td>
<td>G5T1T2</td>
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<tr>
<td></td>
<td>labontani</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mammal</td>
<td>Ochotona princeps</td>
<td>American pika</td>
<td>Highly Vulnerable</td>
<td>S2</td>
<td>G5</td>
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<tr>
<td>Mammal</td>
<td>Sorex palustris</td>
<td>Water shrew</td>
<td>Highly Vulnerable</td>
<td>S2</td>
<td>G5</td>
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<tr>
<td>Fish</td>
<td>Oncorhynchus clarkii</td>
<td>Lahontan cutthroat trout</td>
<td>Highly Vulnerable</td>
<td>S3</td>
<td>G4T3</td>
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<tr>
<td></td>
<td>benshawi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphibian</td>
<td>Rana pipiens</td>
<td>Northern leopard frog</td>
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<td>S2</td>
<td>G5</td>
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<tr>
<td>Plant</td>
<td>Draba cusickii var.</td>
<td>Cusick’s whitlow-grass</td>
<td>Moderately Vulnerable</td>
<td>S3</td>
<td>G4T3</td>
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<tr>
<td></td>
<td>pedicellata</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bird</td>
<td>Leucosticte atrata</td>
<td>Black rosy-finch</td>
<td>Moderately Vulnerable</td>
<td>S3</td>
<td>G4</td>
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<tr>
<td>Plant</td>
<td>Populus tremuloides</td>
<td>Quaking aspen</td>
<td>Moderately Vulnerable</td>
<td>SNR</td>
<td>G5</td>
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<tr>
<td>Plant</td>
<td>Asclepias eastwoodiana</td>
<td>Eastwood milkweed</td>
<td>Presumed Stable</td>
<td>S2</td>
<td>G2</td>
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<tr>
<td>Reptile</td>
<td>Phrynosoma platyrhinos</td>
<td>Desert horned lizard</td>
<td>Presumed Stable</td>
<td>S4</td>
<td>G5</td>
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<tr>
<td>Bird</td>
<td>Quiscalus mexicanus</td>
<td>Great-tailed grackle</td>
<td>Increase Likely</td>
<td>S5</td>
<td>G5</td>
</tr>
</tbody>
</table>
Table 2. Factors contributing to vulnerability status of selected Nevada plants and animals. The factors shown are a subset of the factors used in the Index. For more details on the factors, see the Index documentation (www.natureserve.org/climatechange). Species are scored on how a factor affects its vulnerability (GI, Greatly Increase; Inc, Increase; SI, Somewhat Increase; N, Neutral; SD, Somewhat Decrease; Dec, Decrease; U, Unknown). The abbreviations for Index Score refer to the corresponding scores shown in Table 1. For these species, natural dispersal barriers, dispersal ability, and micro-scale precipitation tolerance are the most important factors causing vulnerability to climate change.

<table>
<thead>
<tr>
<th>Species</th>
<th>Natural barri ers</th>
<th>Anthropogenic barriers</th>
<th>Dispersal ability</th>
<th>Macro-scale temperature requirements</th>
<th>Micro-scale temperature requirements</th>
<th>Macro-scale precipitation requirements</th>
<th>Macro-scale precipitation requirements</th>
<th>Dependence on ice/snow</th>
<th>Physical habitat requirement</th>
<th>Diet specialization</th>
<th>Migration movements</th>
<th>Genetic variation</th>
<th>Index Score</th>
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<tbody>
<tr>
<td>Aplodontia rufa</td>
<td>Inc</td>
<td>N</td>
<td>Inc</td>
<td>SI</td>
<td>SI</td>
<td>Inc-SI</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>U</td>
<td>EV</td>
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<td>N</td>
<td>Inc</td>
<td>N</td>
<td>N</td>
<td>GI-Inc</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>U</td>
<td>HV</td>
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<tr>
<td>Limenitis archippus labontani</td>
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<td>N</td>
<td>Inc</td>
<td>N</td>
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<td>GI</td>
<td>N</td>
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<td>N</td>
<td>Inc</td>
<td>SI</td>
<td>U</td>
<td>HV</td>
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<td>Ochotona princeps</td>
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<td>N</td>
<td>SI</td>
<td>SI-N</td>
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<td>GI-Inc</td>
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<td>SI</td>
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<td>HV</td>
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<td>Oncorhynchus clarkii benthawi</td>
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<td>N</td>
<td>N</td>
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<td>N</td>
<td>N</td>
<td>Inc</td>
<td>U</td>
<td>U</td>
<td>HV</td>
</tr>
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<td>Rana pipiens</td>
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<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>GI-Inc</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>U</td>
<td>MV</td>
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<td>Draba cusickii var. pedicellata</td>
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<td>Inc</td>
<td>N</td>
<td>SI-N</td>
<td>SI</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>N/A</td>
<td>U</td>
<td>MV</td>
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<tr>
<td>Leucosteche atrata</td>
<td>GI-Inc</td>
<td>N</td>
<td>Dec</td>
<td>SI</td>
<td>U</td>
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<td>SI-SI-N</td>
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<td>Populus tremuloides</td>
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<td>N</td>
<td>GI-Inc</td>
<td>N-SD</td>
<td>Inc</td>
<td>SI-N</td>
<td>SI</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N/A</td>
<td>U</td>
<td>SD</td>
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<tr>
<td>Aesclepias eastwoodiana</td>
<td>N</td>
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<td>SI</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N/A</td>
<td>U</td>
<td>U</td>
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<tr>
<td>Phrynosoma platyrhinos</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SD</td>
<td>Inc-SI</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SI</td>
<td>SI</td>
<td>U</td>
<td>PS</td>
</tr>
<tr>
<td>Quiscalus mexicanus</td>
<td>N</td>
<td>SD</td>
<td>Dec</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>SD</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>IL</td>
</tr>
</tbody>
</table>
Next Steps

• Adaptation strategies developed
• Mitigation Strategies developed
• Analysis of Mitigation and Adaptation interactions
DNR Mission

• Our mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.

✓ Own and Manage
✓ Influence
✓ Regulate
How can we use these results

- **Management**: Develop site and landscape Management
- **Acquisition**: Add results of the Vulnerability Assessment under to acquisition decision making process
- **Regulation**: Climate change impacts may require changes to existing regulations.
- **Monitoring**: Design monitoring protocols and processes
Own and Manage
DNR Lands

Major Management Areas (acres)

- Natural Areas (183,000)
- State Parks (227,000)
- Wildlife Areas (1,300,000)
- State Forests (4,800,000)
From an operational Standpoint

1. Select Conservation Targets
2. Assess Climate Change impacts and vulnerability
3. Evaluate management options
4. Develop management response
5. Implement management and monitoring strategies
6. Review and Revise
Regulate

• Water use
• Aquatic Vegetation
• Species
  – Game
  – Non-game
  – Plant Harvest
  – Mineral
Influence

• Technical Assistance
• Private lands programs
  – Forestry
  – Fisheries and Wildlife
  – Ecological Resources
• Education
  – Parks – Ecological Resources
    • Non-game program
  – Waters – Forestry
  – Fisheries and Wildlife
    • MinnAqua
Awareness Building

- Senior Manager’s Forum (2006)
- Climate Change & Biodiversity Workshop (2008) U of MN
- Climate Change Boreal Forest Focus Conference (2008) U of MN
- Summits and Symposium
Wildlife Working Group

Recommendations

Similar to review by Glick et al. (2009)

• Reduce non-climate stressors
• Maintain connected, diverse wildlife populations
• Link monitoring & decision making to reduce key uncertainties
• Prevent & control invasive species
Trends
(From Strategic Conservation Agenda)

✓ Changes in outdoor recreation participation

✓ Changes in energy and climate

✓ Landscape changes from growth and development
Currently underway

1. Select Conservation Targets
2. Assess Climate Change impacts and vulnerability

3. Evaluate management options
4. Develop management response

5. Implement management and monitoring strategies

6. Review and Revise

SLICE
SWAP
Climate
Monitoring

- Sustaining Lakes in a Changing Environment (SLICE) Program
  - What is “healthy” and “normal” *multiple* components of lakes?
  - Which indicators are *most* informative about lake status?
  - Which stressors drive changes in status?
Planning

1. Select Conservation Targets
2. Assess Climate Change impacts and vulnerability
3. Evaluate management options
4. Develop management response
5. Implement management and monitoring strategies
6. Review and Revise

SLICE
Ecological Resources/Fisheries and Wildlife
Climate
Existing Options

1. Select Conservation Targets
2. Assess Climate Change impacts and vulnerability
3. Evaluate management options
4. Develop management response
5. Implement management and monitoring strategies
6. Review and Revise

- Ecological Resources/Fisheries and Wildlife
- SLICE
- LTRM
- SWAP
- MCBS
- Climate
Challenges/Barriers to Progress

- Lack of knowledge
- Lack of ability to plan/face uncertainty
- Lack of management/policy options
- Lack of funds/resources
- Lack of political will

Thank you

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