Climate Change Vulnerability of Washington Rare Plants: A Preliminary Assessment

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Sticky sky-pilot
(Polemonium viscosum)
Talking About Climate Change

"I went back to warn them, but they already knew and didn’t seem to care."

Brendan Loper, The New Yorker, January 27, 2022
Climate Change in Pacific Northwest

Over next 80-100 years:
- Higher temperatures
- Changes in snowpack
- Lower precipitation
- Lower stream flows
- Shift from snow to rain
- Higher fire frequency
- High stochasticity


Alaska yellow-cedar (*Callitropsis nootkatensis*)
How will Plant Species Respond?

- Changes in timing of flowering & emergence
- Asynchrony with pollinators
- Ranges shift/contract
- Loss of habitat
- More competition
- Responses often species-specific based on life history

Marsh grass-of-Parnassus (*Parnassia palustris*)
How will Rare Plant Species Respond?

- Relatively few studies of rare plant spp in NW
- Case et al. 2015: 195 NW species (27 plants)
- Alpine/subalpine & grassland plants vulnerable
- **Rare species are more vulnerable than common species**

Spalding’s catchfly (*Silene spaldingii*)
Climate Change Vulnerability Index (CCVI)

- Funding from USFWS, BLM, & USFS (ISSSSSP)
- CCVI protocol developed by NatureServe to assess vulnerability of plant & animal species and plant communities to climate change

Young et al. 2016
Climate Change Vulnerability Index (CCVI)

- 29 environmental & biological variables
- Includes historical and projected temperature & precipitation change
- Habitat: snowpack, uncommon geology/landform, barriers

Quantitative values derived from location data
Qualitative scores from literature review (GI, I, SI, N, Unknown)
Climate Change Vulnerability Index (CCVI)

Life history traits:
- Dispersal ability
- Pollinators
- Genetic variability & breeding system
- Competition

Response to climate change
- Observed & Modeled

Cotton’s milkvetch (Astragalus australis var. cottonii)
Climate Change Vulnerability Index (CCVI): Results

- Four Summary Scores: Extremely Vulnerable, Highly Vulnerable, Moderately Vulnerable, Less Vulnerable

Completed CCVIs for 107/371 WA rare plants (28%)
Climate Change Vulnerability Index (CCVI): Results

Extremely & Highly Vulnerable species:
1. Wetter habitats likely to become less predictable
2. Dependent on winter snow/ice
3. Stable temperatures and cool microhabitats that are likely to change
4. Uncommon geologic features, poor dispersal, few pollinators, low genetic variability
5. Alpine, peatland, or groundwater-dependent wetland species
Climate Change Vulnerability Index (CCVI): Results

Surprise: Extremely & Highly Vulnerable species associated with Okanogan & Blue Mountains

Lance-leaved draba (*Draba cana*) by B. Legler
Climate Change Vulnerability Index (CCVI): Results

Less Vulnerable species

- Often found in successional habitats (native “weeds”)
- May actually benefit from anthropogenic changes

Coyote tobacco (*Nicotiana attenuata*)
Climate Change Vulnerability Index (CCVI): Results

Moderately Vulnerable Spp

- More likely to be from sites with more stable temperatures (often already warm, like Columbia Basin)
- Less associated with snow, uncommon geology
- Less limited by dispersal, pollinators, genetic variability

Snake River cryptanth (Cryptantha spiculifera)
Climate Change Vulnerability Index (CCVI): Results

Endemic & disjunct species tend to rank Extremely or Highly Vulnerable

- Often restricted to unusual geology, have specialized pollinators, low genetic diversity

- Some score Moderately Vulnerable when data are lacking on modeled change

Umtanum desert buckwheat (*Eriogonum codium*)
Climate Change Vulnerability Index (CCVI): Future Directions

- Complete CCVIs for all 371 state listed vascular plant species
- Conduct CCVIs for a cross section of more widespread & common native plant species

Intermediate sedge
(Carex media)
Climate Change Vulnerability Index (CCVI): Future Directions

- Need **better** data on genetic diversity of rare plant species
- **Model response** to climate change for rare species & ecological systems
Climate Change Vulnerability Index (CCVI) Results

- CCVI reports are a summary of current information
- Include brief rationale for each score & references
- Transparent
- Acknowledge data gaps
- Meant to be revised with new data

**Climate Change Vulnerability Index Scores**

<table>
<thead>
<tr>
<th>Section A</th>
<th>Severity</th>
<th>Scope (% of range)</th>
</tr>
</thead>
</table>
| 1. Temperature Severity | < -6.0°F (5.0°C) warmer | 0%
| | -6.0°F to -3.0°F (5.0°C to 3.0°C) warmer | 0%
| | -3.0°F to -0.0°F (3.0°C to 0.0°C) warmer | 0%
| | -0.0°F to 1.0°F (0.0°C to 1.0°C) warmer | 0%
| 2. Hanon AET-PET moisture | < 0.019 | 0%
| | -0.099 to -0.19 | 50%
| | -0.099 to -0.096 | 50%
| | -0.096 to -0.073 | 0%
| | -0.073 to -0.050 | 0%
| | > 0.05 | 0%

**Section B**

<table>
<thead>
<tr>
<th>Effect on Vulnerability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sea level rise</td>
<td>Neutral</td>
</tr>
<tr>
<td>2a. Distribution relative to natural barriers</td>
<td>Somewhat Increase</td>
</tr>
<tr>
<td>2b. Distribution relative to anthropogenic barriers</td>
<td>Neutral</td>
</tr>
<tr>
<td>3. Impacts from climate change mitigation</td>
<td>Neutral</td>
</tr>
</tbody>
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**Section C**

<table>
<thead>
<tr>
<th>Effect on Vulnerability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dispersal and movements</td>
<td>Somewhat Increase</td>
</tr>
<tr>
<td>2a. Change in historical thermal niche</td>
<td>Somewhat Increase</td>
</tr>
<tr>
<td>2a1. Change in physiological thermal niche</td>
<td>Increase</td>
</tr>
<tr>
<td>2b. Change in hydrological niche</td>
<td>Neutral</td>
</tr>
<tr>
<td>2c. Changes in physiological hydrological niche</td>
<td>Neutral</td>
</tr>
<tr>
<td>2d. Dependence on specific disturbance regime</td>
<td>Somewhat Increase</td>
</tr>
<tr>
<td>3. Restricted to uncommon landscape</td>
<td>Neutral</td>
</tr>
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</table>

Figure 3 depicts the distribution of Hackelia taylorii in Washington relative to mean seasonal temperature variation for the period from 1950-2000 (“historical thermal niche”). All of the known occurrences (100%) are found in areas that have experienced slightly lower than average (+3.1°F/1.8°C) temperature variation during the past 50 years and are considered to be Somewhat Increased vulnerability to climate change.
Climate Change Vulnerability Index (CCVI) Results

- 107 CCVI reports and summary report posed on WNHP website: https://www.dnr.wa.gov/NHPclimatespecies
- Or google “Washington Natural Heritage Program Assessing Species Vulnerability”