Climate Change Vulnerability Index Report

Lomatium tuberosum (Hoover's desert-parsley)

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Geographic Area: Washington Heritage Rank: G2G3/S2S3

Index Result: Moderately Vulnerable Confidence: Very High

Climate Change Vulnerability Index Scores

Section A	**Severity**	**Scope (% of range)**
1. Temperature Severity	>6.0° F (3.3°C) warmer	0
	5.6-6.0° F (3.2-3.3°C) warmer	0
	5.0-5.5° F (2.8-3.1°C) warmer	0
	4.5-5.0° F (2.5-2.7°C) warmer	0
	3.9-4.4° F (2.2-2.4°C) warmer	100
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to - 0.096	0
	-0.051 to - 0.073	13.3
	-0.028 to -0.050	86.7
	>-0.028	0
Section B		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Somewhat Increase
2b. Distribution relative to anthropogenic barriers		Neutral
3. Impacts from climate change mitigation		Neutral
Section C		
1. Dispersal and movements		Increase
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Neutral
2bi. Changes in historical hydrological niche		Increase
2bii. Changes in physiological hydrological niche		Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral
3. Restricted to uncommon landscape/geological features		Neutral/Somewhat Increase
4a. Dependence on others species to generate required habitat		Neutral
4b. Dietary versatility		Not Applicable
4c. Pollinator versatility		Unknown
4d. Dependence on other species for propagule dispersal		Neutral
4e. Sensitivity to pathogens or natural enemies		Neutral
4f. Sensitivity to competition from native or non-native species		Neutral
4g. Forms part of an interspecific interaction not covered above		Neutral
5a. Measured genetic diversity		Unknown
5b. Genetic bottlenecks		Unknown
5c. Reproductive system		Neutral

6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D	
D1. Documented response to recent climate change	Somewhat Increase
D2. Modeled future (2050) change in population or range size	Unknown
D3. Overlap of modeled future (2050) range with current range	Unknown
D4. Occurrence of protected areas in modeled future (2050) distribution	Unknown

Section A: Exposure to Local Climate Change

A1. Temperature: All 15 of the occurrences of *Lomatium tuberosum* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

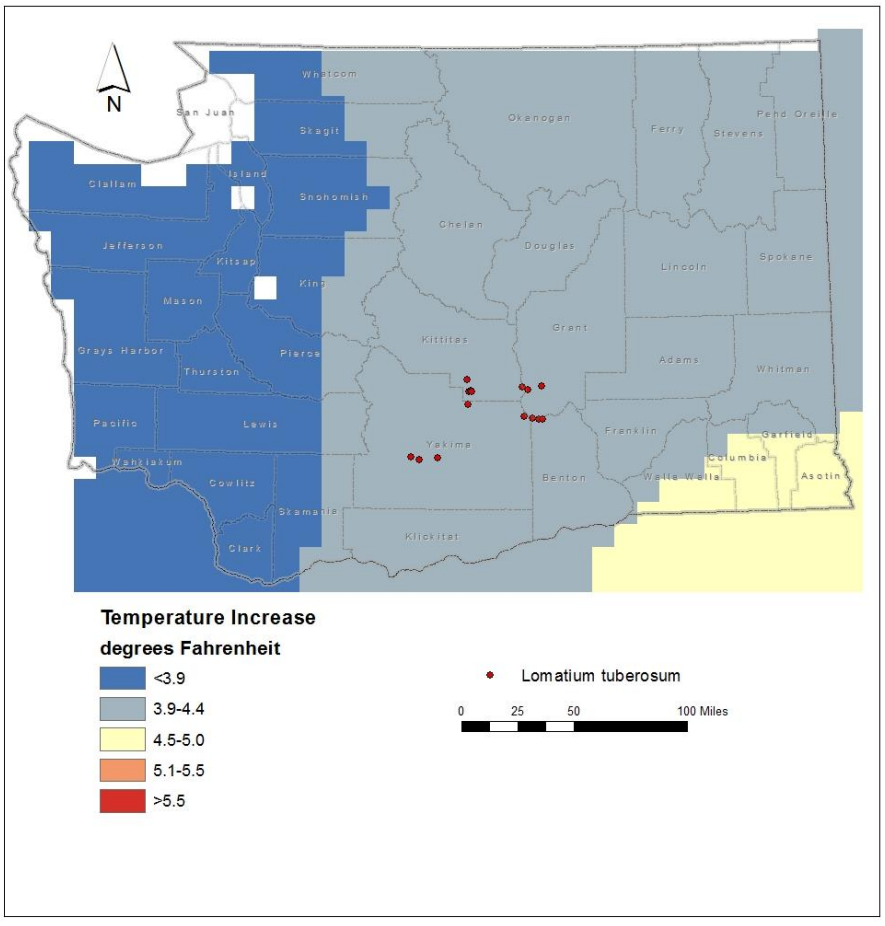

Figure 1. Exposure of *Lomatium tuberosum* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Thirteen of the 15 occurrences of *Lomatium tuberosum* (86.7%) in Washington are found in areas with a projected decrease in available moisture (as measured by the ratio of actual to potential evapotranspiration) in the range of --0.028 to -0.050 (Figure 2). Two populations (13.3%) are from areas with a projected decrease in the range of -0.051 to -0.073.

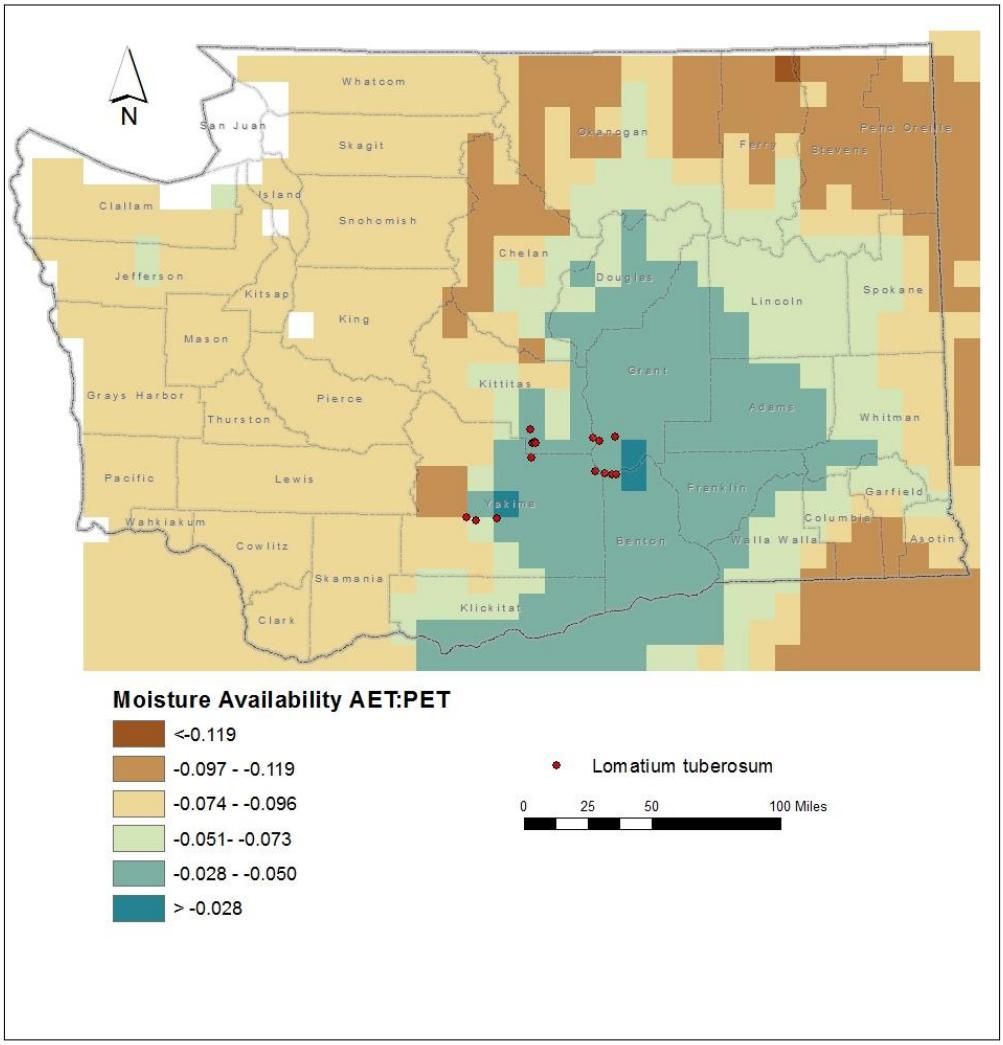

Figure 2. Exposure of *Lomatium tuberosum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Lomatium tuberosum* are found at 460-4000 feet (140-1220 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Lomatium tuberosum* occurs among loose basalt talus on slopes and ridgetops in sagebrush steppe dominated by *Artemisia rigida, Poa secunda*, and *Pseudoroegneria spicata* (Camp and Gamon 2011, Fertig and Kleinknecht 2020, Mastrogiuseppe et al. 1985). This habitat conforms with the Inter-Mountain Basins Cliff and Canyon ecological system (Rocchio and Crawford 2015). Washington populations often consist of a series of subpopulations separated by less than 0.1 miles. Other populations may be up to 27 miles (43 km) apart. The sparsely vegetated areas occupied by this species are isolated primarily by natural barriers.

B2b. Anthropogenic barriers: Neutral.
The range of *Lomatium tuberosum* is naturally fragmented. Human impacts on the landscape of central Washington have increased fragmentation, but overall are of less significance than natural barriers.

B3. Predicted impacts of land use changes from climate change mitigation: Neutral.

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.
Lomatium tuberosum produces flattened fruits that dehisce into one-seeded segments with prominent raised wings on the dorsal surface. The wings might help with dispersal by wind. In general, *Lomatium* species have surprisingly poor dispersal (less than 100 m), which may account for their unusually high degree of endemism in the northwest (Marisco and Hellman 2009).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Lomatium tuberosum* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Thirteen of the 15 occurrences (86.7%) are found in areas that have experienced average (57.1-77˚F/31.8-43.0˚C) temperature variation during the past 50 years and are considered at neutral vulnerability to climate change (Young et al. 2016). Two other populations (13.3%) have had slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation during the same period and are considered at somewhat increased vulnerability to climate change.

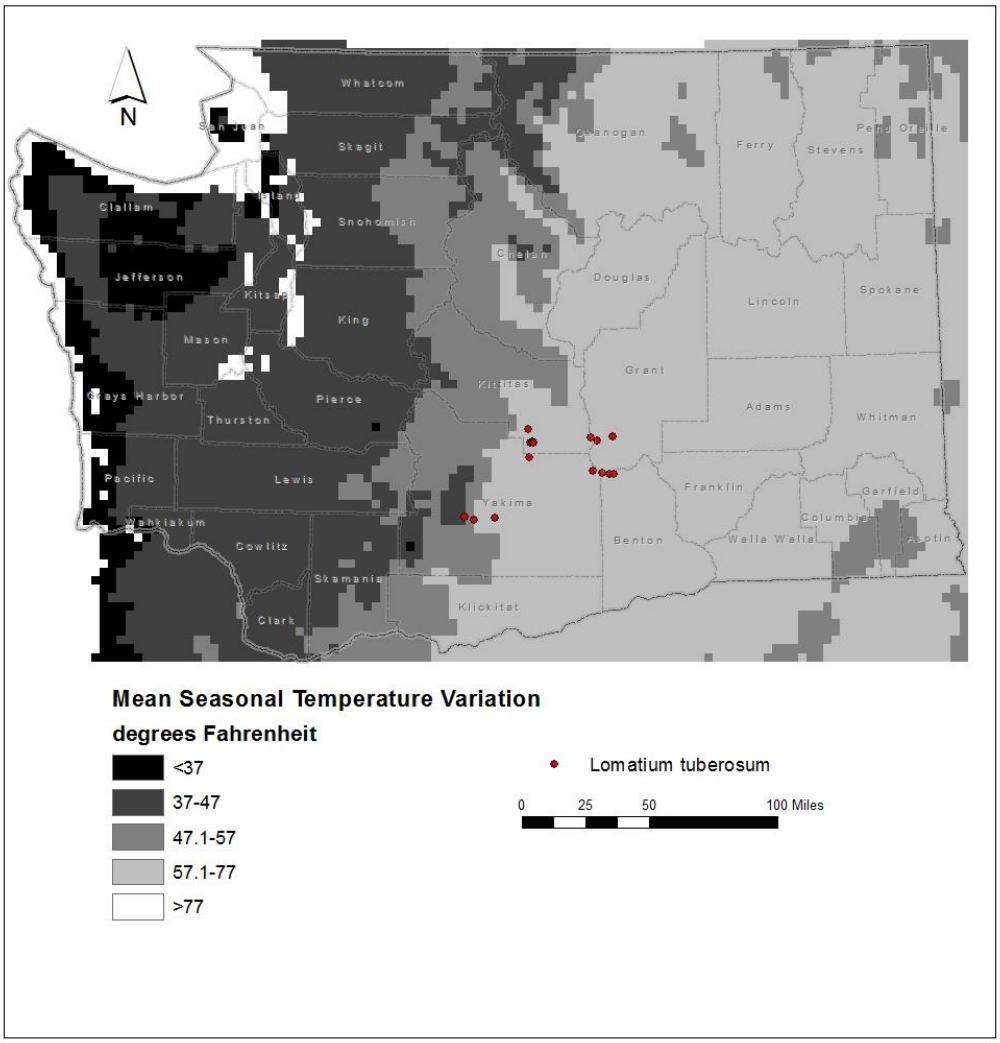

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Lomatium tuberosum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
The talus slope and ridge habitat of *Lomatium tuberosum* is not associated with cold air drainage during the growing season and would have neutral vulnerability to climate change.

C2bi. Historical hydrological niche: Increase.
Eleven of the 15 populations of *Lomatium tuberosum* in Washington (73.3%) are found in areas that have experienced small 4-10 inches/100-254 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at increased vulnerability to climate change. Three other populations (20%) have experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation over the same period and are at somewhat increased vulnerability (Figure 4), while one occurrence (6.7%) has experienced average (>20 inches/508 mm) precipitation variation and is at neutral vulnerability.

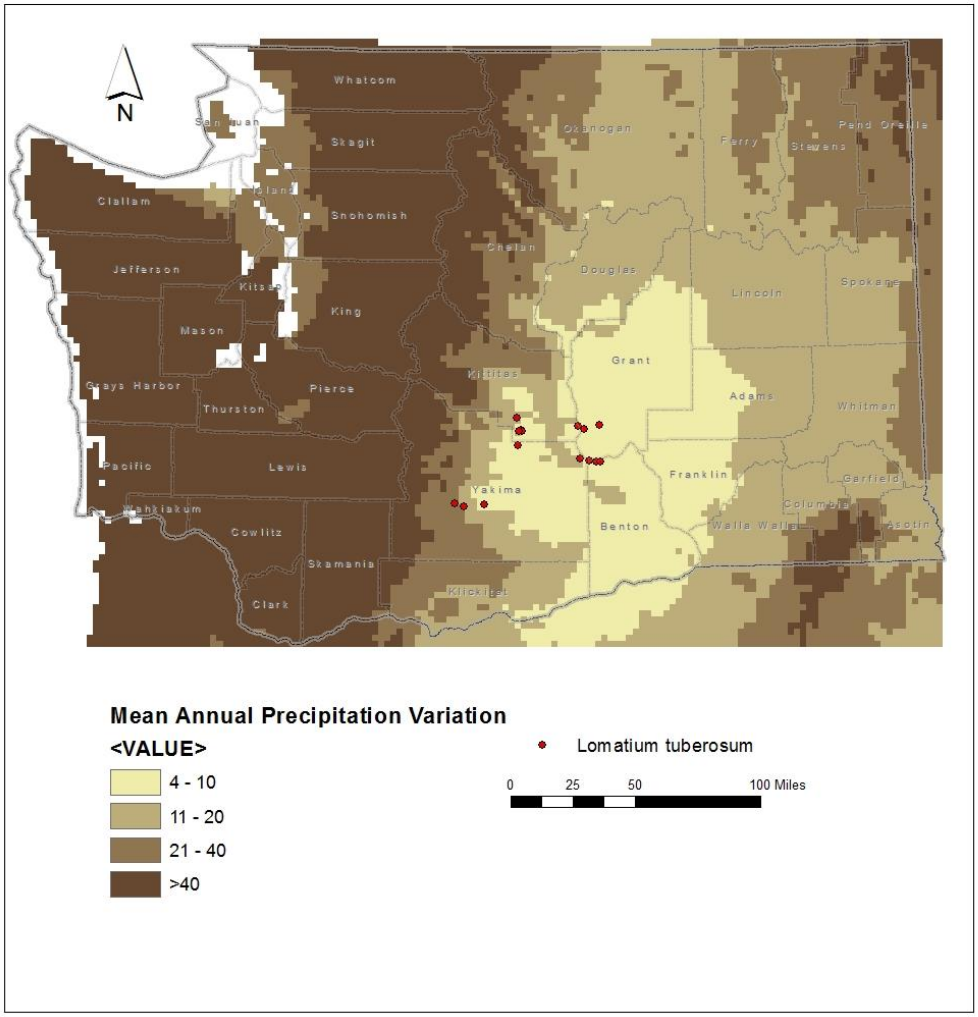

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Lomatium tuberosum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Increase.
Lomatium tuberosum populations occur on aridic basalt talus slopes and ridges in areas without springs, streams, or a high water table. These sites are dependent on winter snow and spring precipitation for a large proportion of their yearly water budget. Changes in the timing of snowmelt or the amount of precipitation could make these sites drier in the future and subject to displacement by lichens or invasive annuals (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Lomatium tuberosum occurs in areas that are sparsely vegetated due to unstable slopes, rock fall, and poor soil development. These areas are mostly not impacted by disturbances such as wildfire.

C2d. Dependence on ice or snow-cover habitats: Neutral.
Snowpack is low in the desert ridges and talus slopes occupied by *Lomatium tuberosum*. Drifting snow within talus, however, may help augment the annual water budget.

C3. Restricted to uncommon landscape/geological features: Neutral/Somewhat Increase.
Populations of *Lomatium tuberosum* occur primarily on outcrops of the Grande Ronde basalt and Quaternary alluvium, both common geologic formations in central Washington. The distribution of volcanic talus slopes is less widespread, and mostly restricted to east-west oriented ridge systems near the Columbia River.

C4a. Dependence on other species to generate required habitat: Neutral.
The cliff habitat occupied by *Lomatium tuberosum* is maintained by natural abiotic processes and geologic conditions, rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The exact pollinators of *Lomatium tuberosum* are not known, but other tuberous *Lomatium* species are pollinated by solitary bees, tachinid flies, syrphid flies, muscid flies, bee flies, and beetles (Schlessman 1982).

C4d. Dependence on other species for propagule dispersal: Neutral.
Fruit dispersal in *Lomatium tuberosum* is probably by wind, gravity, or other passive means. The species is not dependent on animals for dispersal.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. This species could be vulnerable to grazing, but actual use may be low due to the poor accessibility of its talus slope habitat (Fertig & Kleinknecht 2020, Mastroguiseppe et al. 1985).

C4f. Sensitivity to competition from native or non-native species: Neutral.
Lomatium tuberosum occurs in sparsely vegetated talus slopes and ridgetops with low cover or competition from other plant species. Climate change could shift the species composition towards lichens or invasive annual species (Rocchio and Ramm-Granberg 2017).

C4g. Forms part of an interspecific interaction not covered above: Neutral.
Does not require an interspecific interaction.

C5a. Measured genetic variation: Unknown.
Data are not available on the genetic diversity of this species in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Lomatium tuberosum is probably similar to other tuberous *Lomatium* species in being andromonoecious, with hermaphroditic and functionally staminate flowers produced in different parts of the same inflorescence and maturing at different times to promote outcrossing and higher genetic variability (Schlessman 1982).

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on WNHP and Consortium of Pacific Northwest Herbaria records, no changes have been detected in phenology in recent years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Somewhat Increase.
The range of *Lomatium tuberosum* has contracted, with three disjunct occurrences from south-central Yakima County having not been relocated for more than 40 years and possibly extirpated. Whether this absence is due to climate change, local exploitation, or is an artifact of incomplete survey is not known.

D2. Modeled future (2050) change in population or range size: Unknown

D3. Overlap of modeled future (2050) range with current range: Unknown

D4. Occurrence of protected areas in modeled future (2050) distribution: Unknown

References

Camp, P. and J.G. Gamon, eds. 2011. Field Guide to the Rare Plants of Washington. University of Washington Press, Seattle. 392 pp.

Fertig, W. and J. Kleinknecht. 2020. Conservation status and protection needs of priority plant species in the Columbia Plateau and East Cascades ecoregions. Natural Heritage Report 2020-02. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 173 pp.

Marsico, T.D. and J.J. Hellman. 2009. Dispersal limitation inferred from an experimental translocation of *Lomatium* (Apiaceae) species outside their geographic ranges. Oikos 118:1783-1792.

Mastrogiuseppe, J.D., S.J. Gill, K.S. Simmons, and G.K. Brown. 1985. Morphologic and

cytotaxonomic evaluation of *Lomatium tuberosum* (Apiaceae). Brittonia 37(3):252-260.

Rocchio, F.J. and R.C. Crawford. 2015. Ecological systems of Washington State. A guide to identification. Natural Heritage Report 2015-04. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 384 pp.

Rocchio F.J. and T. Ramm-Granberg. 2017. Ecological System Climate Change Vulnerability Assessment. Unpublished Report to the Washington Department of Fish and Wildlife. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.

Schlessman, M.A. 1982. Expression of andromonoecy and pollination of tuberous *Lomatium*s (Umbelliferae). Systematic Botany 7(2): 134-149.

Young, B.E., E. Byers, G. Hammerson, A. Frances, L. Oliver, and A. Treher. 2016. Guidelines for using the NatureServe Climate Change Vulnerability Index. Release 3.02. NatureServe, Arlington, VA. 48 pp. + app.