Climate Change Vulnerability Index Report

Lomatium lithosolamans (Hoover's biscuitroot)

Date: 18 September 2021 Synonym = *Tauschia hooveri*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G2G3/S2S3

Index Result: Moderately Vulnerable Confidence: Very High

Climate Change Vulnerability Index Scores

Section A: Local Climate	**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	38.7
	-0.028 to -0.050	61.3
	>-0.028	0
Section B: Indirect Exposure to Climate Change		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Neutral
2b. Distribution relative to anthropogenic barriers		Somewhat Increase
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
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		Somewhat 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: Documented or Modeled Response	
D1. Documented response to recent climate change	Neutral/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 31 occurrences of *Lomatium lithosolamans* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1). Two recent reports from

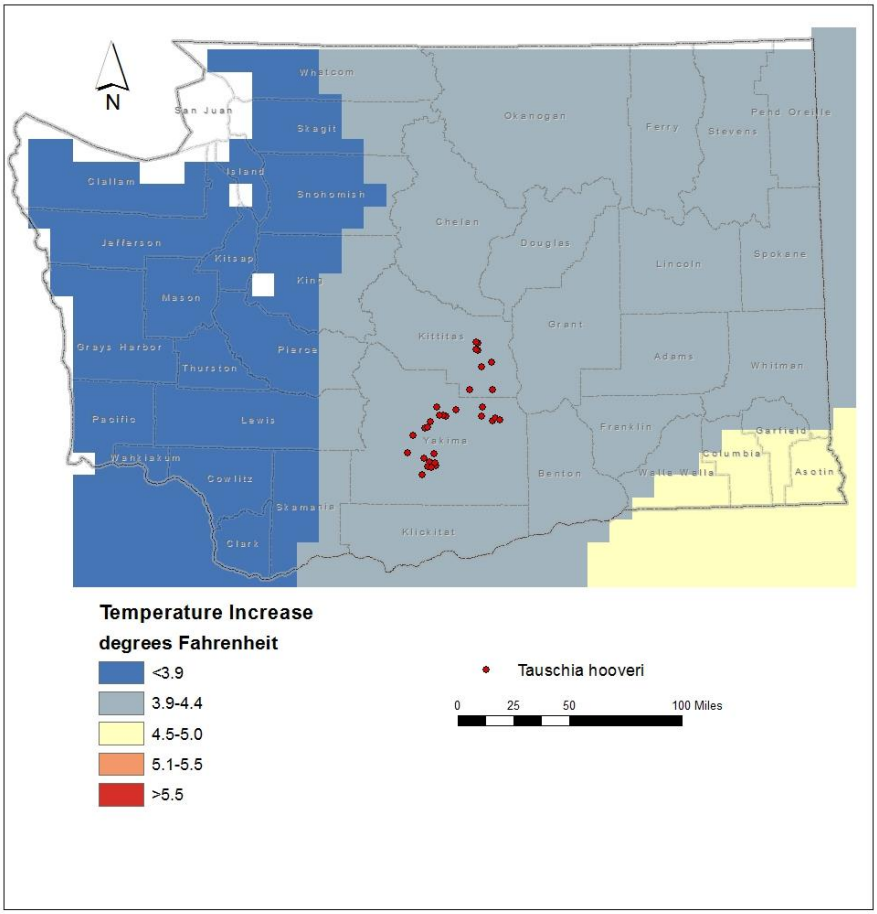

Figure 1. Exposure of *Lomatium lithosolamans* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

high elevations in the East Cascades need confirmation and have not been included in this analysis.

A2. Hamon AET:PET Moisture Metric: Nineteen of the 31 Washington occurrences of *Lomatium lithosolamans* (61.3%) 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). The other 12 populations (38.7%) occur in areas with a projected decrease in available moisture of -0.051 to – 0.073.

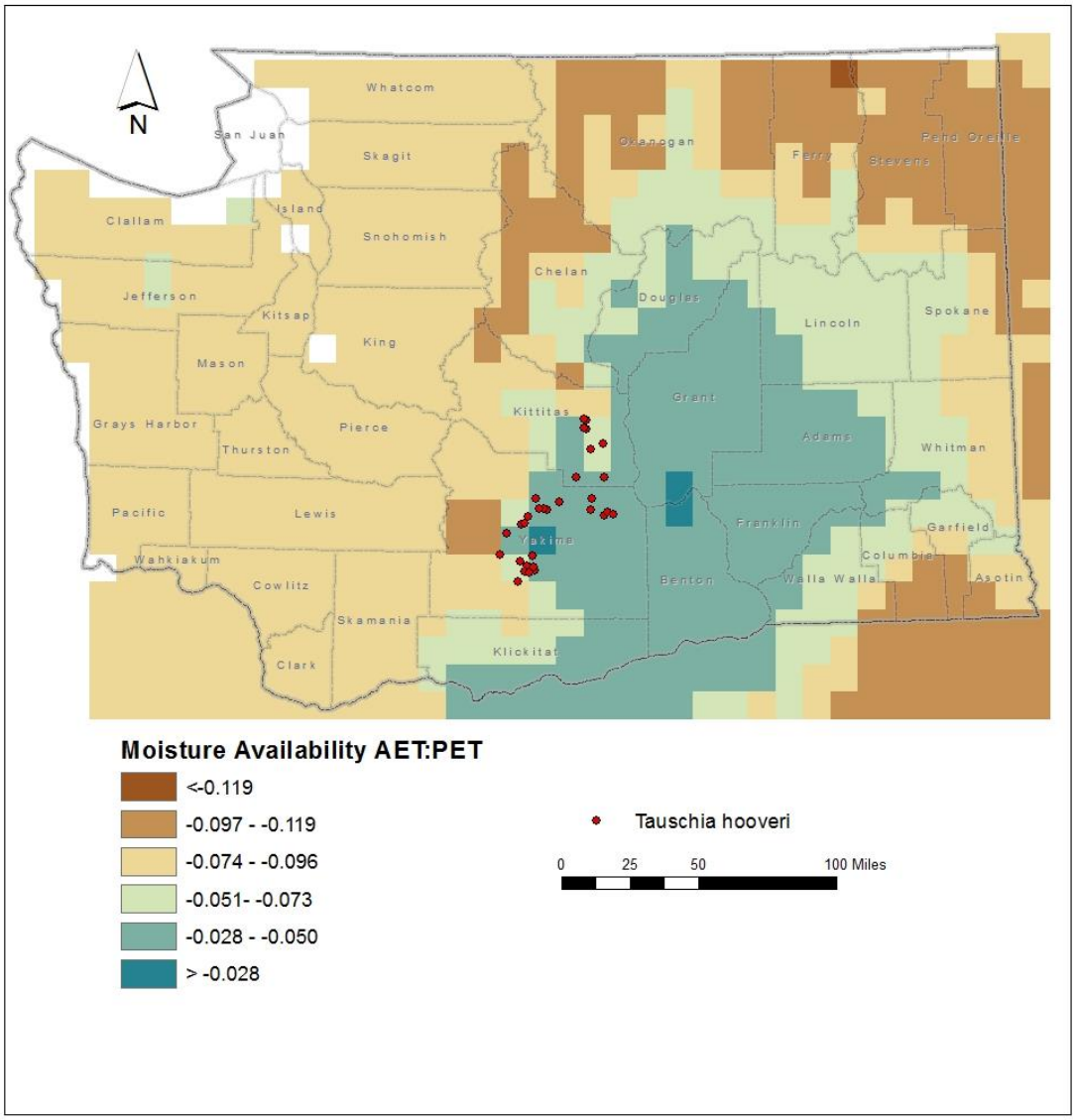

Figure 2. Exposure of *Lomatium lithosolamans* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Lomatium lithosolamans* are found at 1300-4000 feet (400-1220 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.
In Washington, *Lomatium lithosolamans* is found on well-drained basalt lithosols in mostly flat, shrub steppe habitats dominated by stiff sagebrush (*Artemisia rigida*) and Sandberg's bluegrass (*Poa secunda*) (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is a component of the Columbia Plateau Scabland Shrubland ecological system (Rocchio and Crawford 2015). Individual populations are separated by 2.1-18 km (1.2-11 miles) and restricted to an area of approximately 24 x 105 km (15 x 65 miles) (Camp and Gamon 2011). Potential habitat is intersected by drainages and ridges that present a moderate physical barrier to dispersal.

B2b. Anthropogenic barriers: Somewhat Increase.
Much of the range of *Lomatium lithosolamans* in Washington has been converted to agriculture (especially grazing) or human development, resulting in a fragmented distribution. As a result, there is less opportunity for genetic exchange between populations along the east slope of the Cascades and those in eastern Kittitas and Yakima counties. Nearly one-third of all known occurrences are historical, suggesting the range may be contracting.

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

Section C: Sensitivity and Adaptive Capacity

C1. Dispersal and movements: Increase.
Lomatium lithosolamans produces dry, linear-oblong fruits (schizocarps) that split at maturity into two one-seeded segments. Each fruit segment has slightly raised ribs but otherwise lack structures such as hooks, barbs, or wings for attachment to animals or to catch air currents. In general, *Lomatium* species have poor dispersal ability (less than 100 meters) which may account for their unusually high degree of endemism in western North America (Marisco and Hellman 2009).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Lomatium lithosolamans* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Twenty-six of the 31 known occurrences (83.9%) are found in areas of the Columbia Basin 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 risk from climate change (Young et al. 2016). Seven of these 26 populations are historical. The other five occurrences in the state (16.1%) are from areas on the east slope of the Cascades with a slightly lower than average temperature variation (47.1-57˚F/26.3-31.8˚C) during the same period and are at somewhat increased vulnerability to climate change. Three of these occurrences are also historical.

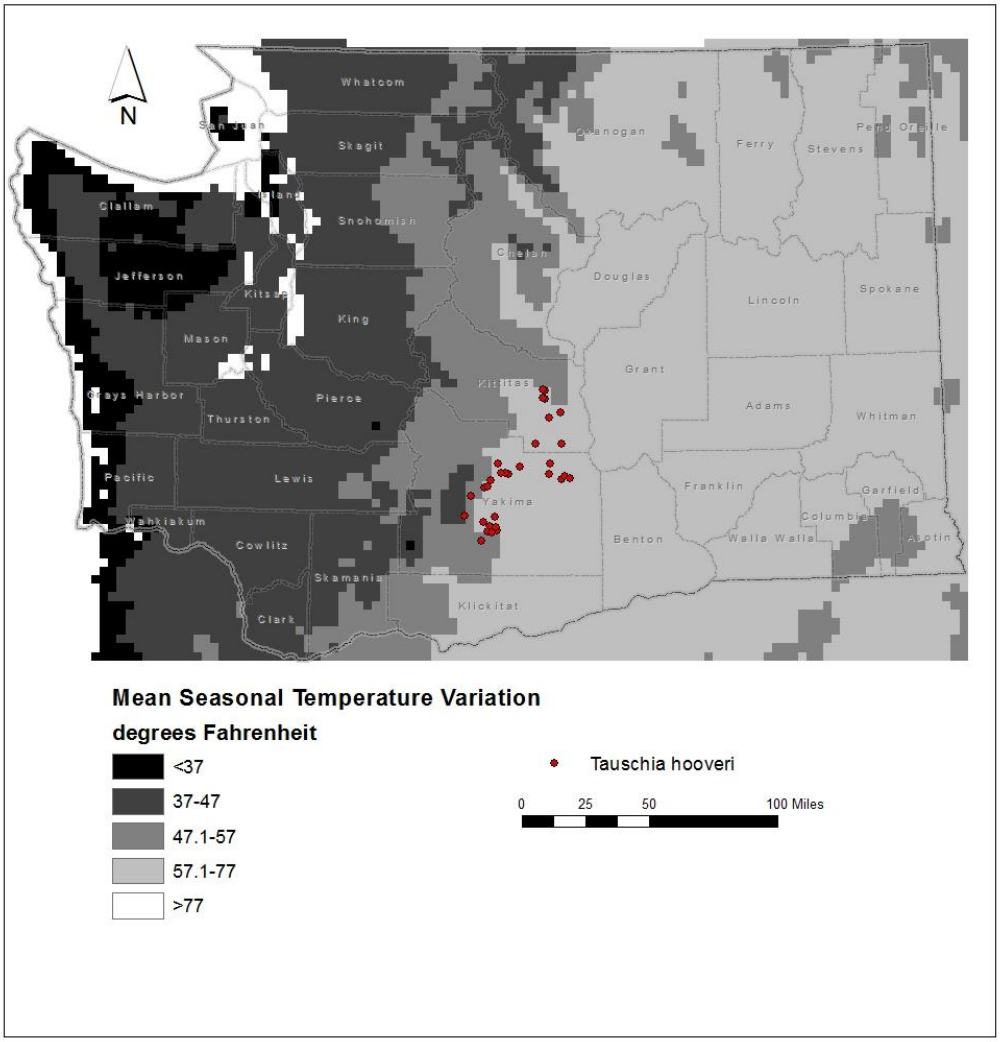

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Lomatium lithosolamans* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
The lithosol flats inhabited by *Lomatium lithosolamans* are not associated with cold air drainage during the growing season and have neutral vulnerability to climate change.

C2bi. Historical hydrological niche: Somewhat Increase.
Sixteen of the 31 populations of *Lomatium lithosolamans* in Washington (51.6%) are found in areas that have experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased vulnerability from climate change. Eleven occurrences

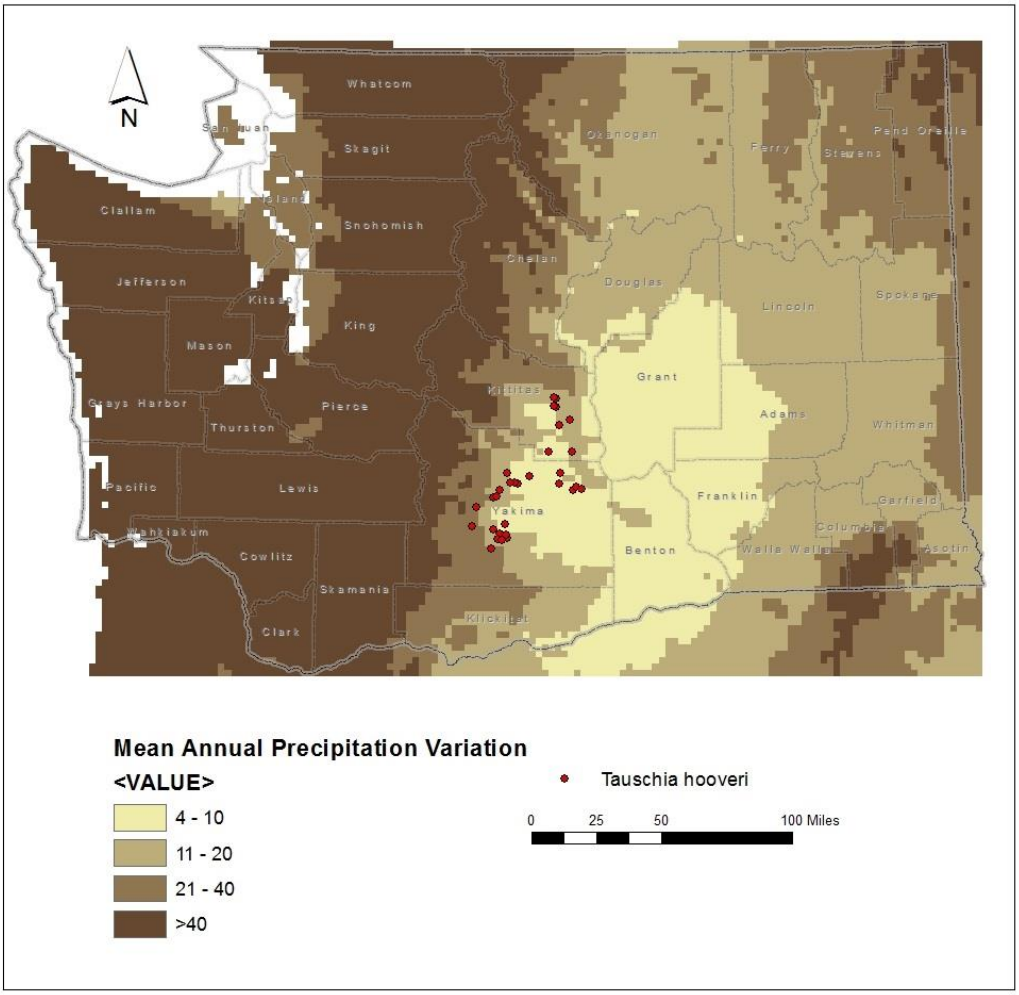

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Lomatium lithosolamans* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

(35.5%) are from areas that have had small precipitation variation (4 -10 inches/100-254 mm) during the same period and are considered at increased vulnerability (Young et al. 2016). Four populations from the east slope of the Cascades (12.9%) are from areas with average precipitation variation (20-40 inches/508-1016 mm) and are at neutral vulnerability (Figure 4).

C2bii. Physiological hydrological niche: Increase.
This species is dependent on precipitation and winter snow for its moisture requirements, because its habitat is not associated with springs, streams, or groundwater. The Columbia Plateau Scabland Shrubland ecological system is vulnerable to changes in the timing or amount

of precipitation and increases in temperature that could lead to longer periods of drought (Rocchio and Ramm-Granberg 2017). Drought could result in a shift to more non-native annual species and increase fire frequency, which historically would have been low due to a lack of continuous fuel.

C2c. Dependence on a specific disturbance regime: Neutral.
Lomatium lithosolamans is not dependent on periodic disturbances to maintain its sparsely vegetated lithosol habitat. The species could, however, be negatively impacted by increased summer temperatures, drought, or decreased precipitation that might favor the establishment of annual plants and make sites more vulnerable to wildfire (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral.
Lomatium lithosolamans occurs in areas of low accumulation of snow. These populations are more influenced by reduction in the timing and volume of rainfall (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral/Somewhat Increase.
Lomatium lithosolamans is found mostly on Miocene-age outcrops of the Grande Ronde and Wanapum Basalt (Washington Division of Geology and Earth Resources 2016). These formations are widely distributed in the Columbia Basin. It is strongly associated with level areas of shallow lithosols, which are mostly found at the toe of the eastern Cascades and western rim of the Columbia Basin in Yakima and Kittitas County (these are covered by Quaternary fill over much of the basin). Additional outcrops occur to the south in Yakima County, where this species is replaced by other tuberous *Lomatium* taxa. The small global range of *L. lithosolamans* is strongly correlated with the distribution of suitable substrates.

C4a. Dependence on other species to generate required habitat: Neutral.
The lithosol habitat of *Lomatium lithosolamans* is maintained primarily by natural abiotic processes rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

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

C4d. Dependence on other species for propagule dispersal: Neutral.
The dry, one-seeded fruits of *Lomatium lithosolamans* are dispersed primarily by wind, gravity, or other passive means. The species is not dependent on animals for transport.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. The species could be impacted by livestock grazing and trampling, though the plant's short stature and limited time above ground (it starts flowering in early March, sets fruit by mid-April, and senesces by the end of April) reduces its exposure.

C4f. Sensitivity to competition from native or non-native species: Neutral.
The shallow, rocky lithosol soils occupied by *Lomatium lithosolamans* are not especially vulnerable to competition from other native plant species. Introduced annual weeds could become more common under projected hotter and drier conditions in the future and compete for space and resources (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 genetic diversity within *Lomatium lithosolamans*.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
Lomatium lithosolamans may be 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 flowering dates from specimens in the Consortium of Pacific Northwest herbaria website, no major changes have been detected in phenology of low elevation populations in recent years. Some recent records from high in the East Cascades were flowering and fruiting in July, but these reports may represent another species.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral/Somewhat Increase.
The present distribution of *Lomatium lithosolamans* has contracted during the past 40 years, with 10 of 31 populations considered historical (32.3%). This includes most of the occurrences from the east slope of the Cascades and many from the Yakama Nation. Whether these populations are extirpated or in need of revisiting is not known. If the populations are extirpated, the cause may be habitat loss due to agricultural development, although perhaps influenced by climate change.

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

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