

## Climate Change Vulnerability Index Report

*Penstemon eriantherus* var. *whitedii* (Whited's fuzzytongue beardtongue)

Date: 6 December 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington

Heritage Rank: G4G5T2/S2

Index Result: Moderately Vulnerable

Confidence: Very High

### Climate Change Vulnerability Index Scores

<b>Section A: Local Climate</b>	<b>Severity</b>	<b>Scope (% of range)</b>
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	8.7
	-0.051 to -0.073	47.8
	-0.028 to -0.050	43.5
	>-0.028	0
<b>Section B: Indirect Exposure to Climate Change</b>		<b>Effect on Vulnerability</b>
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Somewhat Increase
2b. Distribution relative to anthropogenic barriers		Somewhat Increase
3. Impacts from climate change mitigation		Neutral
<b>Section C: Sensitivity and Adaptive Capacity</b>		
1. Dispersal and movements		Somewhat Increase
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Somewhat Increase
2bi. Changes in historical hydrological niche		Somewhat Increase
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral/Somewhat Increase
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		Somewhat Increase
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	Somewhat Increase
<b>Section D: Documented or Modeled Response</b>	
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 23 of the extant and historical occurrences of *Penstemon eriantherus* var. *whitedii* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4° F (Figure 1). The Spokane County population falls outside the traditionally-defined range of var.

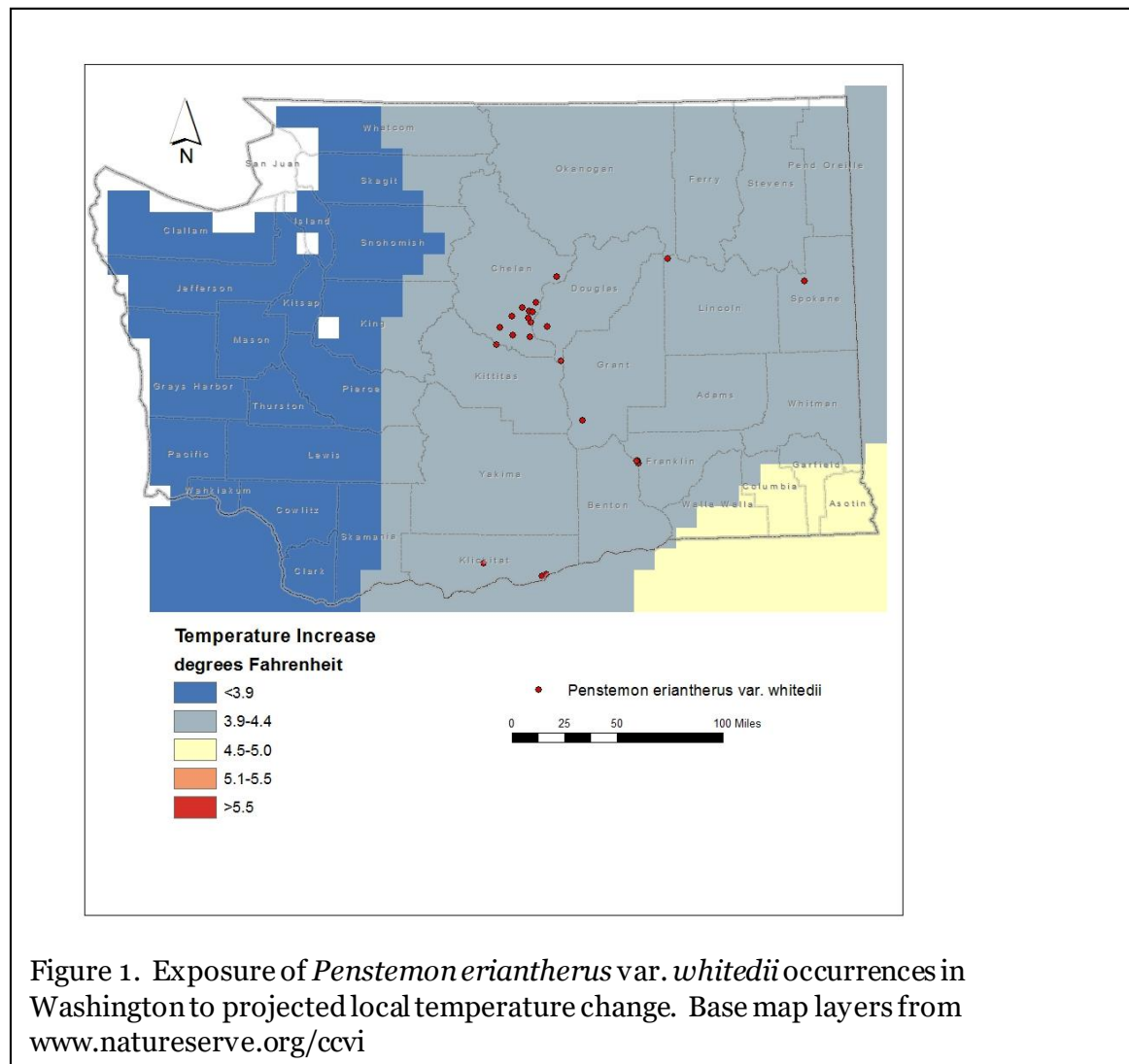


Figure 1. Exposure of *Penstemon eriantherus* var. *whitedii* occurrences in Washington to projected local temperature change. Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

*whitedii* and within the range of var. *eriantherus*, but is included in this analysis (Freeman 2019).

A2. Hamon AET:PET Moisture Metric: Eleven of the 23 historical and extant occurrences of *Penstemon eriantherus* var. *whitedii* in Washington (47.8%) 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 -0.051 to -0.073 (Figure 2). Ten populations (43.5%) are

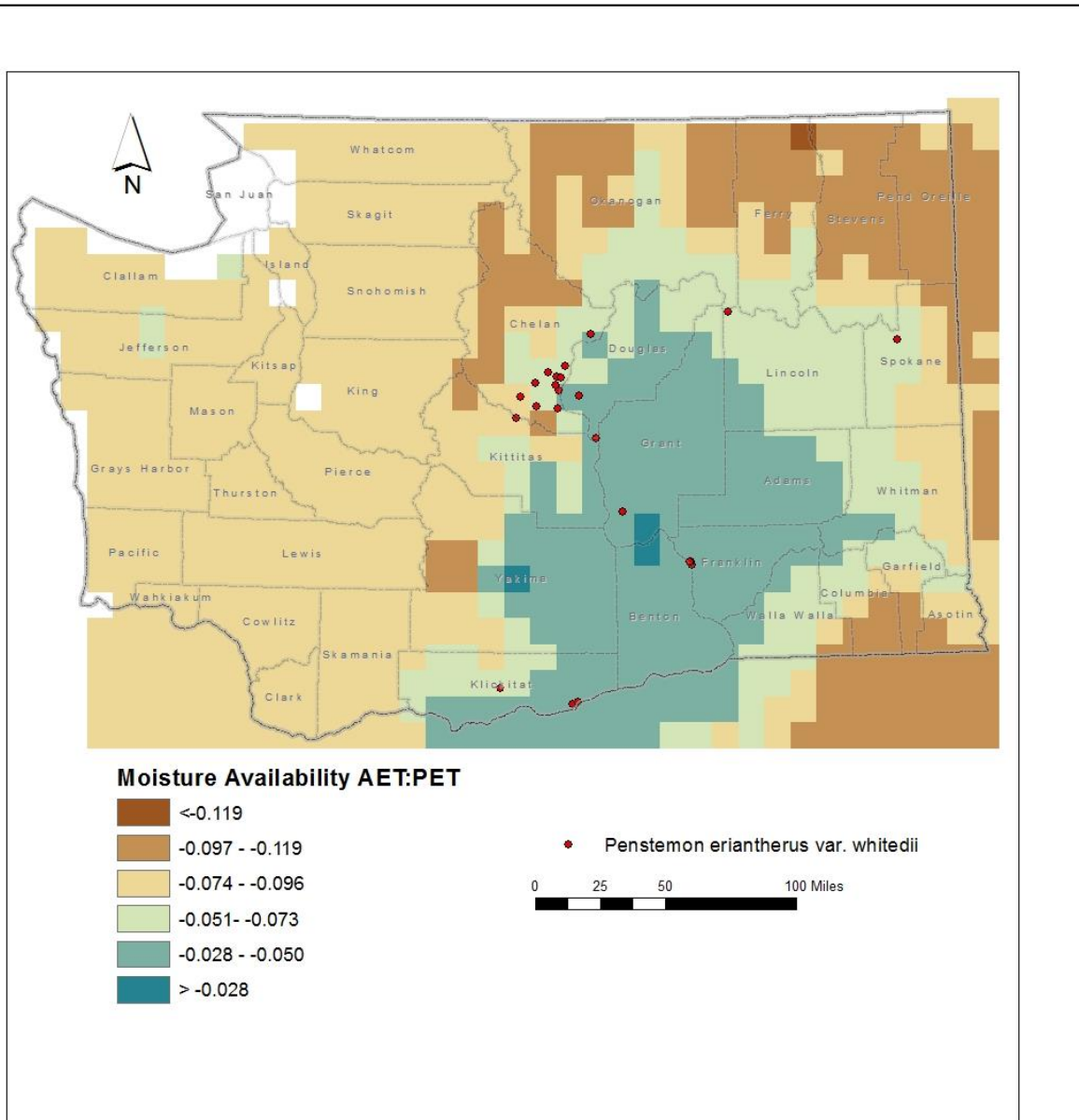


Figure 2. Exposure of *Penstemon eriantherus* var. *whitedii* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

from areas with a projected decrease of -0.028 to -0.050. Two other occurrences (8.7%) are from areas with a projected decrease of -0.074 to -0.096 (Figure 2).

## **Section B. Indirect Exposure to Climate Change**

B1. Exposure to sea level rise: Neutral.

Washington occurrences of *Penstemon eriantherus* var. *whitedii* are found at 500-4000 feet (150-1220 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.

*Penstemon eriantherus* var. *whitedii* occurs primarily on dry, rocky slopes or cut banks of small canyons and ridgetops in the foothills of the East Cascades and Columbia Basin in communities of antelope bitterbrush (*Purshia tridentata*), rubber rabbitbrush (*Ericameria nauseosa*), big sagebrush (*Artemisia tridentata*) or open ponderosa pine (*Pinus ponderosa*). These sites are often sparsely vegetated or being actively eroded and may be associated with caliche fragments, basalt rubble, or granite, sandstone, or volcanic talus (Camp and Gamon 2011, Washington Natural Heritage Program 2021). This habitat is part of the Intermountain Basin Cliff & Canyon; Intermountain Basin Semi-Desert Shrub-Steppe; and Rocky Mountain Cliff, Canyon & Massive Bedrock ecological systems (Rocchio and Crawford 2015). Populations are separated by 1.1-67 miles (1,8-108 km) of unoccupied and unsuitable habitat that presents a barrier to dispersal and gene flow.

B2b. Anthropogenic barriers: Somewhat Increase.

The foothill canyon and ridge habitat of *Penstemon eriantherus* var. *whitedii* in eastern Washington is naturally sporadic but also fragmented by human impacts, such as agriculture, roads, and human habitations that are likely to limit dispersal.

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

## **Section C: Sensitive and Adaptive Capacity**

C1. Dispersal and movements: Somewhat Increase.

*Penstemon eriantherus* var. *whitedii* produces many-seeded dry capsule fruits that split open at maturity to release the seeds passively by gravity or high winds. Seeds on the ground may be secondarily distributed short distances by insects or small mammals. Average dispersal distances are probably relatively short (100-1000 meters).

C2ai. Historical thermal niche: Neutral.

Figure 3 depicts the distribution of *Penstemon eriantherus* var. *whitedii* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 (“historical thermal niche”). Sixteen of the 23 known occurrences in the state (69.6%) 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). Seven other occurrences (30.4%) are from areas that have had slightly lower than average variation (47.1-57°F/26.3-31.8°C) in temperature over the same period and are at somewhat increased vulnerability to climate change.

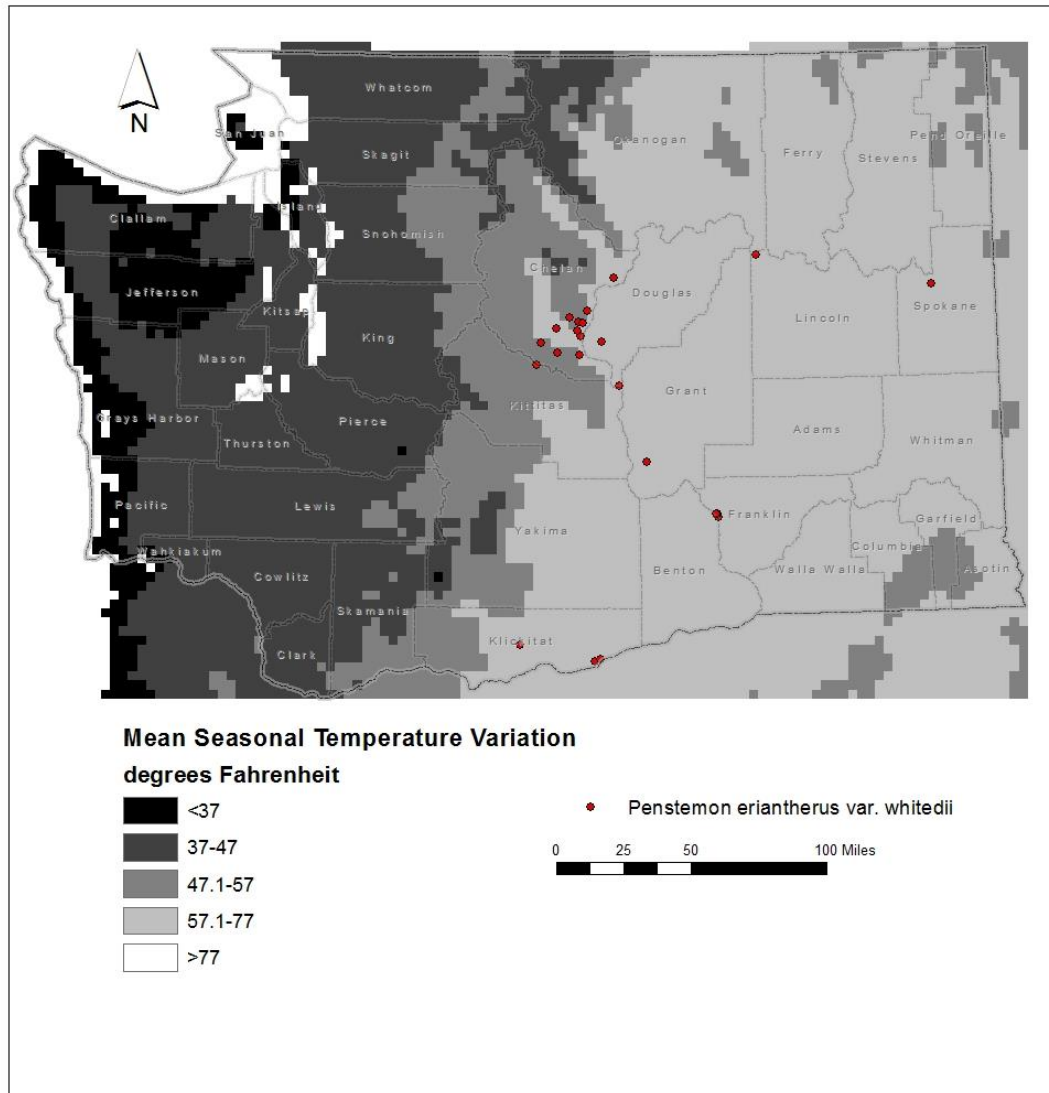


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Penstemon eriantherus* var. *whitedii* occurrences in Washington. Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

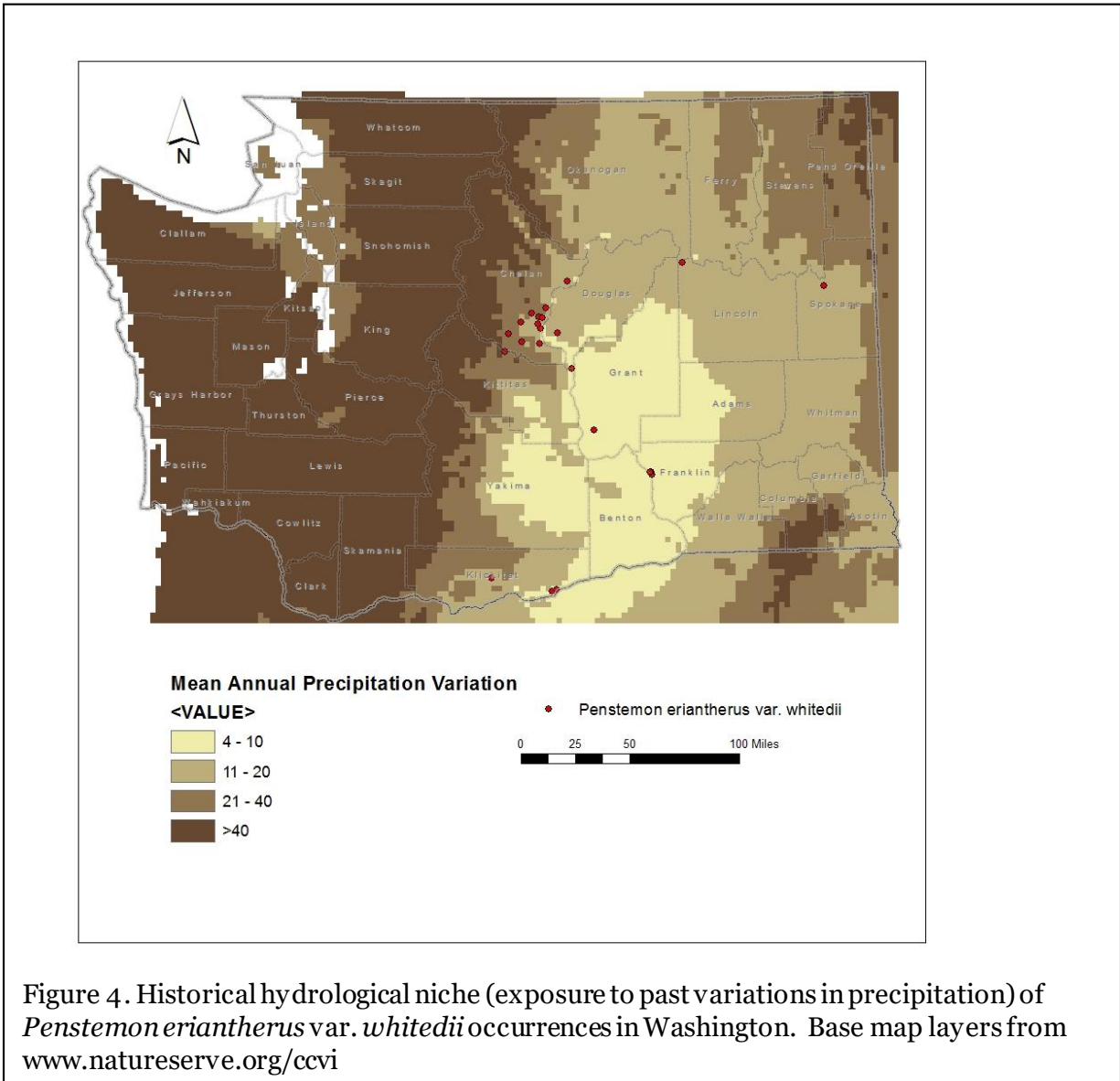
C2a.ii. Physiological thermal niche: Somewhat Increase.

The sagebrush/bitterbrush canyon and ridgetop habitat of *Penstemon eriantherus* var. *whitedii* may be exposed to cold air drainage early in the growing season, making these sites somewhat vulnerable to long-term increases in temperature related to climate change.

C2b.i. Historical hydrological niche: Somewhat Increase.

Ten of the 23 known populations of *Penstemon eriantherus* var. *whitedii* in Washington (43.5%) are found in areas that have experienced slightly lower than average precipitation

variation in the past 50 years (>20 inches/508 mm) (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased risk from climate change. Seven occurrences from the central Columbia Plateau (30.4%) are in areas with small (4-10 inches/100-254 mm) variation in precipitation over the same period and are at increased vulnerability due to projected climate change. Six populations in the foothills of the Cascades (26.1%) are from areas with average precipitation variation (21-40 inches/508-1016 mm) over the past 50 years and are at neutral vulnerability (Young et al. 2016).



C2bii. Physiological hydrological niche: Somewhat Increase.

This species is not associated with perennial water sources or high water tables and is dependent on spring precipitation or winter snow for much of its moisture needs during the growing

season. Changes in the amount or timing of precipitation and increased temperatures from projected future climate change are likely to exacerbate drought conditions in semi-desert scrub and grassland habitats of eastern Washington (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.

*Penstemon eriantherus* var. *whitedii* often occurs on actively-eroding slopes or road banks, where it may have an advantage over later seral species adapted to more stable conditions. Under drier conditions, these semi-barren sites could shift to dominance by lichens. Changes in precipitation could also result in increased cover of other herbaceous plants and ultimately greater risk from wildfire (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral/Somewhat Increase.

The populations of *Penstemon eriantherus* var. *whitedii* in Washington are found in foothills and low elevation ridges in the East Cascades and Columbia Plateau that receive relatively low quantities of snow. Reduced snowpack due to climate change would decrease the amount of moisture available through runoff in these areas (Rocchio and Ramm-Granberg 2017). Populations from the central Columbia Plateau receive low amounts of snow and would largely be unaffected by changes in the quantity or timing of snowmelt.

C3. Restricted to uncommon landscape/geological features: Neutral/Somewhat Increase.

*Penstemon eriantherus* var. *whitedii* occurs on a variety of geologic substrates. In the Wenatchee Mountains and vicinity, it is mostly associated with the Swakane biotite (gneiss) and Chumstick Formation (granitic sandstone), with at least one population found on serpentine talus. Along the Hanford Reach of the Columbia, this species is found on the Ringold Formation, a white caliche-rich sandstone. Elsewhere, it is found on talus derived from the Miocene-age Grande Ronde Basalt or Quaternary alluvium (Washington Division of Geology and Earth Resources 2016). Several of these formations are of limited distribution (Swakane, Chumstick, and Ringold), while others are widespread in eastern Washington. Soil testing might indicate that this species has more restricted geologic requirements than presently known.

C4a. Dependence on other species to generate required habitat: Neutral.

The foothill talus and rock outcrop habitat occupied by *Penstemon eriantherus* var. *whitedii* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.

*Penstemon eriantherus* has medium to large lavender, blue, or purple flowers with an inflated (ampliate) corolla and large, bushy staminate (Freeman 2019). *Penstemon* species with this syndrome of characters tend to be pollinated by medium to large-sized bumblebees, such as the genus *Bombus* (Montana Natural Heritage Program 2021, Wilson et al. 2004). The specific pollinators of var. *whitedii* have not been reported.

C4d. Dependence on other species for propagule dispersal: Neutral.

Seed dispersal in *Penstemon* is passive, with small seeds spreading by gravity or high winds once the dry fruit capsule is ripe and splits open. The genus is not dependent on animals for dispersal.

C4e. Sensitivity to pathogens or natural enemies: Neutral.

No impacts from pathogens are known. This species is not an important forage plant for wildlife or livestock.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.

Vegetation cover is low in many of the talus habitats occupied by this species. Warmer, wetter winters projected in the future could negatively impact some native shrub taxa in semi-desert shrub steppe sites occupied by *Penstemon eriantherus* var. *whitedii*, resulting in a shift towards perennial grassland communities (Rocchio and Ramm-Granberg 2017). Increased cover of annual species following disturbance or altered fire regimes could also result in more competition (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.

Not known. Broderick (2010) assessed the genetic variability of 104 of the 270 *Penstemon* taxa in North America and used *P. eriantherus* var. *redactus*, an endemic of the Snake River Basin in Oregon, Idaho, and Montana, as a stand-in for *P. eriantherus*. Var. *redactus* is a diploid ( $2n = 16$ ) and had one of the largest genomes of all sampled diploid taxa, despite its small geographic range (Broderick 2010). This finding is somewhat counter-intuitive, as small geographic ranges and isolation are often correlated with low genetic diversity (Hamrick and Godt 1989). Three other varieties of *P. eriantherus* also have relatively narrow geographic ranges (vars. *argillosus*, *cleburnei*, and *whitedii*), while diploid var. *eriantherus* is widespread from southern Canada and northeastern Washington to North Dakota and Colorado. Genetic diversity might be expected to be low in var. *whitedii* due to its geographic isolation (though it may be enhanced from potential gene exchange with var. *eriantherus* in northeast Washington).

C5b. Genetic bottlenecks: Unknown.

Not known.

C5c. Reproductive System: Neutral.

*Penstemon eriantherus* var. *whitedii* produces relatively large flowers that are insect pollinated. It is presumed to be an outcrosser and should have at least average genetic variation.

C6. Phenological response to changing seasonal and precipitation dynamics: Somewhat Increase.

Based on herbarium records in the Consortium of Pacific Northwest Herbaria website ([pnwherbaria.org](http://pnwherbaria.org)), *Penstemon eriantherus* var. *whitedii* has historically flowered from early May to early June. In the last 20 years, the species has been observed flowering in the last week of April.

## **Section D: Documented or Modeled Response to Climate Change**

D1. Documented response to recent climate change: Neutral/Somewhat Increase.

At least 5 populations of *Penstemon eriantherus* var. *whitedii* in Washington are historical and have not been relocated since 1981. These occurrences may be extirpated or just have not been



revisited. One historical occurrence from the East Cascades in Klickitat County may be a misidentified record.

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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