Climate Change Vulnerability Index Report

Phacelia lenta (Sticky phacelia)

Date: 10 February 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G2?/S2?

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	0
	-0.028 to -0.050	100
	>-0.028	0
Section B: Indirect Exposure to Climate Change		**Effect on Vulnerability**
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
Section C: Sensitivity and Adaptive Capacity		
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		Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral
3. Restricted to uncommon landscape/geological features		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/Somewhat Increase

6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D: Documented or Modeled Response	
D1. Documented response to recent climate change	Neutral
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 nine of the occurrences of *Phacelia lenta* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

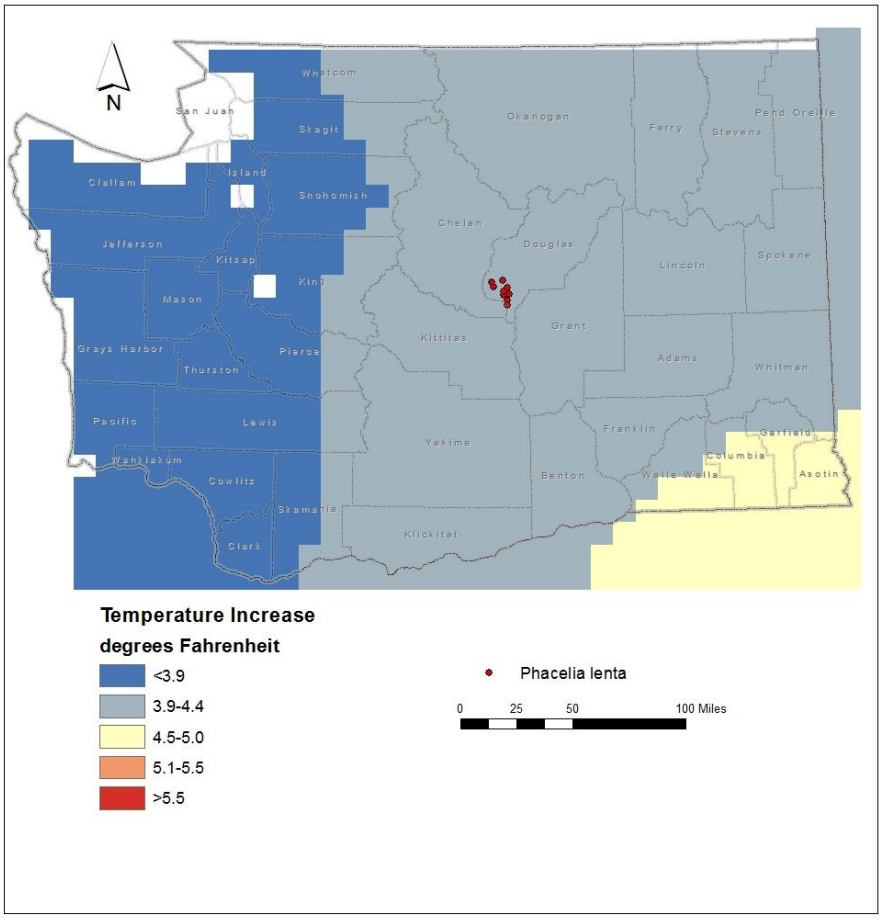

Figure 1. Exposure of *Phacelia lenta* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: All nine Washington occurrences of *Phacelia lenta* (100%) 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).

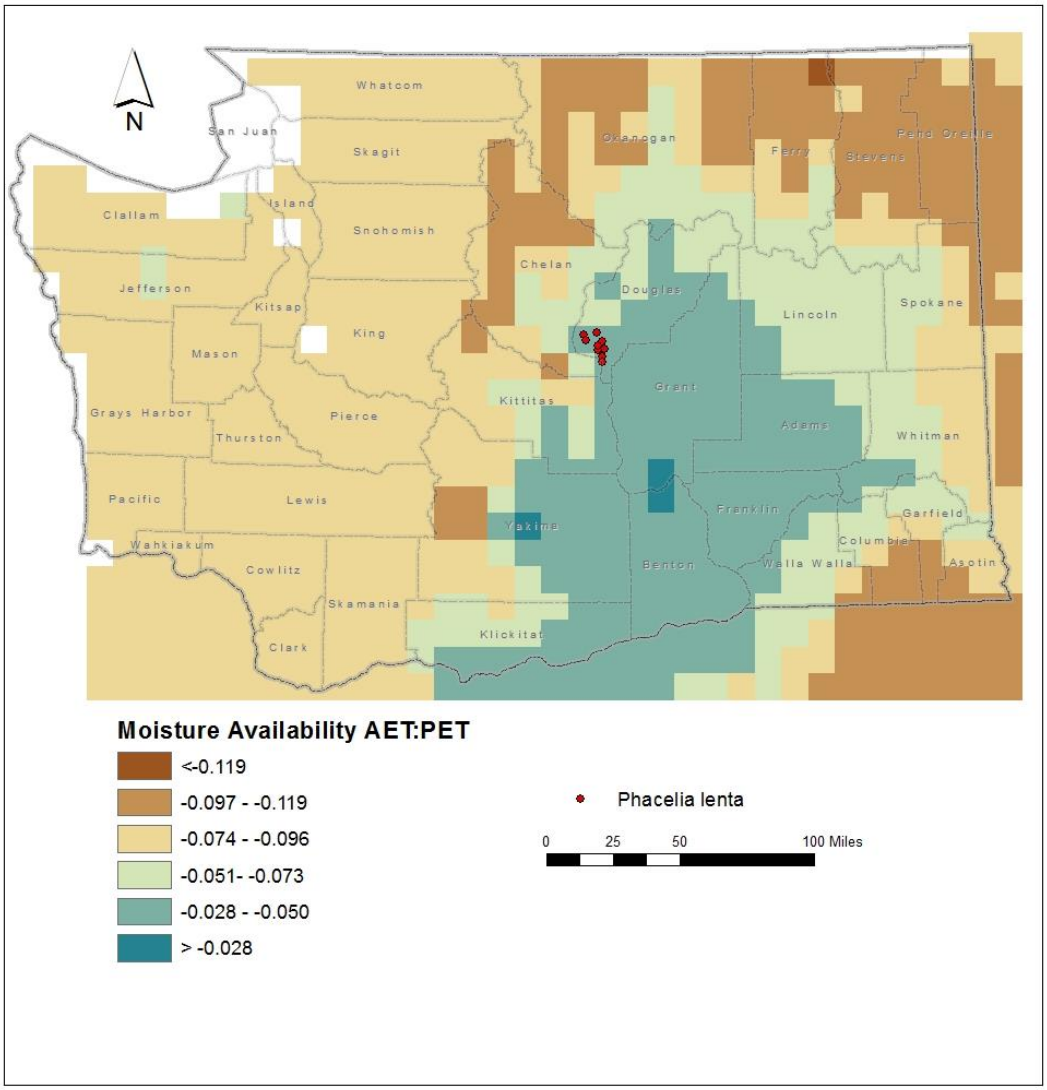

Figure 2. Exposure of *Phacelia lenta* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Phacelia lenta* are found at 1300-3400 feet (400-1040 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Phacelia lenta* is found on sparsely vegetated basalt cliff faces on north or west-facing slopes separated from other cliff sites by steep canyons (Camp and Gamon 2011; Fertig 2020). This habitat is a component of the Inter-Mountain Basins Cliff and Canyon ecological system (Rocchio and Crawford 2015). Individual populations are separated by 0.4-3.5 miles (0.75-5.7 km) and restricted to an area of 8 x 12 miles (13 x 19 km) (Camp and Gamon 2011; Gamon 1986). Ridgetops above the basalt cliffs and intervening canyons are unsuitable habitat for this species, and present a natural barrier to dispersal. Potential basalt cliff habitat elsewhere in the Columbia Plateau may be too isolated for ready dispersal.

B2b. Anthropogenic barriers: Somewhat Increase.
The range of *Phacelia lenta* in Washington is restricted to steep cliffs of basalt along the east side of the Columbia River. These sites are naturally patchy, but are further isolated by roads and agricultural fields on ridgetops that are likely restrict seed dispersal or spread of existing populations.

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

Section C: Sensitivity and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Phacelia lenta produces numerous small seeds that are finely reticulated on the surface. The seeds are released passively following dehiscence of the dry fruit capsule. Seeds are likely dispersed by gravity or strong winds. Average dispersal distances are probably relatively short (100-1000 meters).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Phacelia lenta* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All nine of the known occurrences (100%) 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 risk from climate change.

C2aii. Physiological thermal niche: Somewhat Increase.
The west and north-facing ledges and crevices within the basalt cliffs inhabited by *Phacelia lenta* are often associated with cool, shaded conditions during the growing season and would have somewhat increased vulnerability to climate change.

C2bi. Historical hydrological niche: Somewhat Increase.
Seven of the populations of *Phacelia lenta* in Washington (77.8%) 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. Two other occurrences (22.2%) 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).

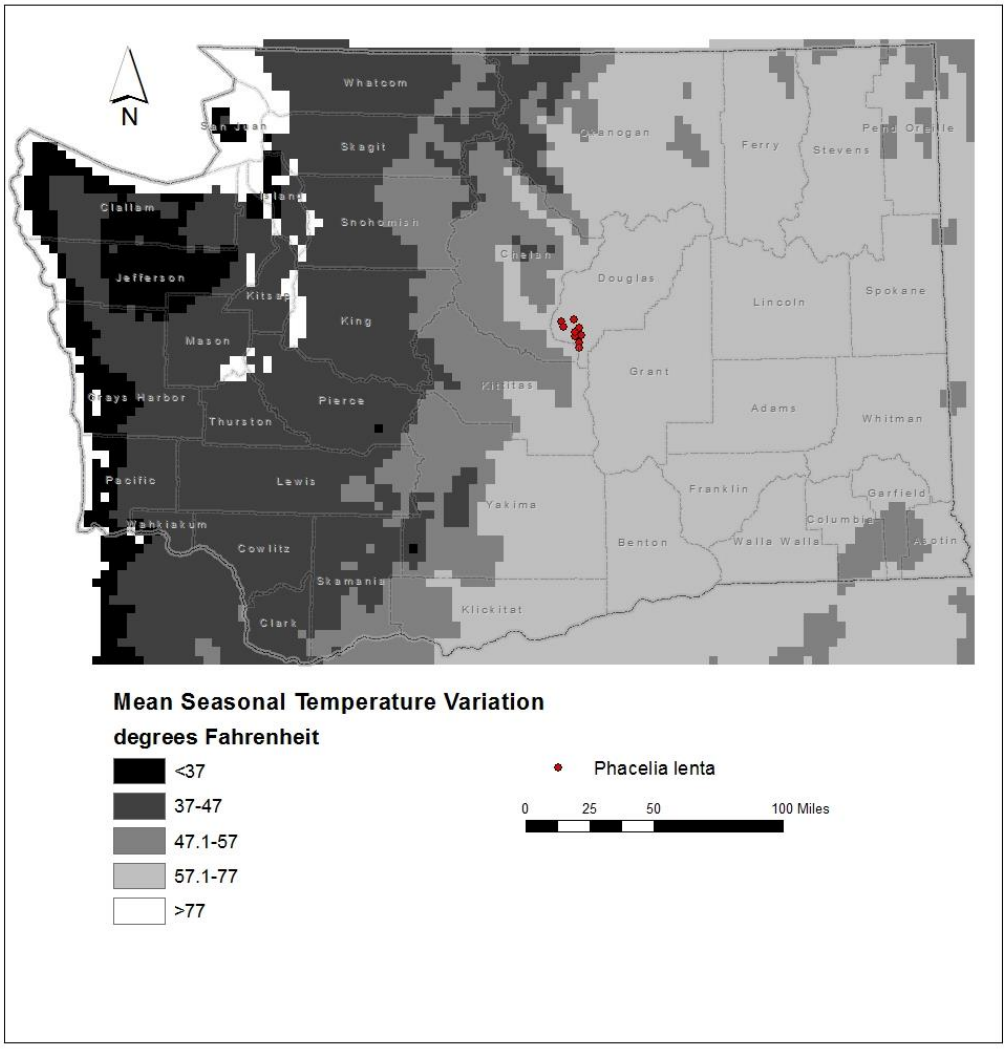

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Phacelia lenta* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

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 Inter-Mountain Basins Cliff and Canyon ecological system is vulnerable to changes in the timing or amount of precipitation and increases in temperature (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Phacelia lenta is not dependent on periodic disturbances to maintain its cliff and talus habitat. The species could, however, be detrimentally affected by increased summer temperatures,

drought, or decreased precipitation that might favor the establishment of lichens or annual plants in cliff crevices (Rocchio and Ramm-Granberg 2017).

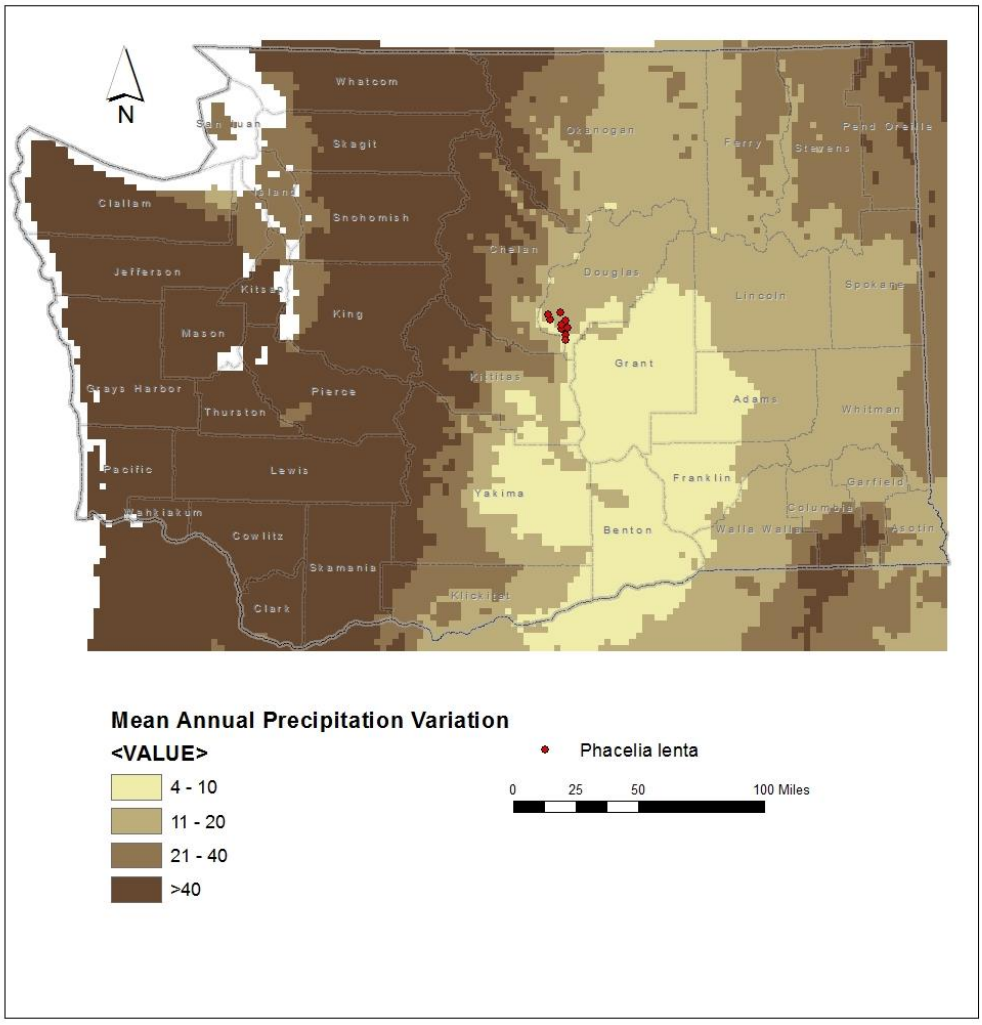

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Phacelia lenta* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2d. Dependence on ice or snow-cover habitats: Neutral.
Phacelia lenta occurs in areas of low accumulation of snow. These populations are probably more adversely affected by reduction in changes in the timing and volume of rainfall due to projected climate change (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Increase.
Phacelia lenta is restricted to Miocene-age columnar basalt cliffs and talus slopes of the Grande Ronde Basalt. Occupied habitat is found within the Upper flows, Hammond, and Keane Ranch subunits (Washington Division of Geology and Earth Resources 2016). The latter subunits have a relatively restricted distribution in central Washington and may have some chemical differences from other Grande Ronde basalt layers (Tabor et al. 1982).

C4a. Dependence on other species to generate required habitat: Neutral
The habitat occupied by *Phacelia lenta* 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 *Phacelia lenta* are not known, but related *Phacelia* species are pollinated by a variety of bee species and some are considered important plants for supporting pollinators in agricultural settings (Gilbert 2003). Like other related species in the *P. franklinii* group, *P. lenta* has flowers that produce nectar and have long-exserted stamens to attract insect pollinators and promote outcrossing (Gillett 1960). The diversity of pollinators may be threatened by insecticide drift from nearby agricultural fields (Fertig and Kleinknecht 2020, Gamon 1986).

C4d. Dependence on other species for propagule dispersal: Neutral.
The seeds of *Phacelia* are small, dry, and strongly ornamented with ridges, papillae, or indentations that resemble corrugations in cardboard. These surface features may help facilitate dispersal of seed by wind, but are not likely to adhere to animals.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. Due to its steep cliff habitat, *Phacelia lenta* receives minimal impacts from livestock or ungulate grazing (Fertig 2020).

C4f. Sensitivity to competition from native or non-native species: Neutral.
Rocky microsites occupied by *Phacelia lenta* are not especially vulnerable to competition from other native or introduced plant species.

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 *Phacelia lenta*. Gillett (1960) found that other species in the *P. franklinii* group had a base chromosome count of $n = 11$ and were diploids, except for one tetraploid species from Alaska. *P. lenta* material was not available at the time of this study, however (the species was known only from the original type collection from 1883 until it was rediscovered in 1981 [Alverson 1982]).

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral/Somewhat Increase.
Based on its floral morphology (showy flowers, prominent nectar production, exserted anthers), *Phacelia lenta* is probably an obligate outcrosser. Due to its restricted range, it may have less genetic diversity than more widespread species. Whether *P. lenta* was formerly wide-ranging but now has a more limited distribution (Alverson 1982), or is a recently evolved species with the potential to expand its range but is dispersal limited, is not known. Genetic data on within- and between-population variability is a high research priority (Fertig 2020).

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 in recent years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
The distribution of *Phacelia lenta* has not changed notably in the last 50 years.

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

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