Climate Change Vulnerability Index Report

Eriogonum codium (Umtanum wild buckwheat)

Date: 20 February 2020

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G1/S1

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	0
	-0.028 to -0.050	100
	>-0.028	0
Section B		**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		
1. Dispersal and movements		Somewhat Increase
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Neutral
2bi. Changes in historical hydrological niche		Greatly 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		Neutral
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
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: The single known occurrence of *Eriogonum codium* in Washington occurs in an area with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

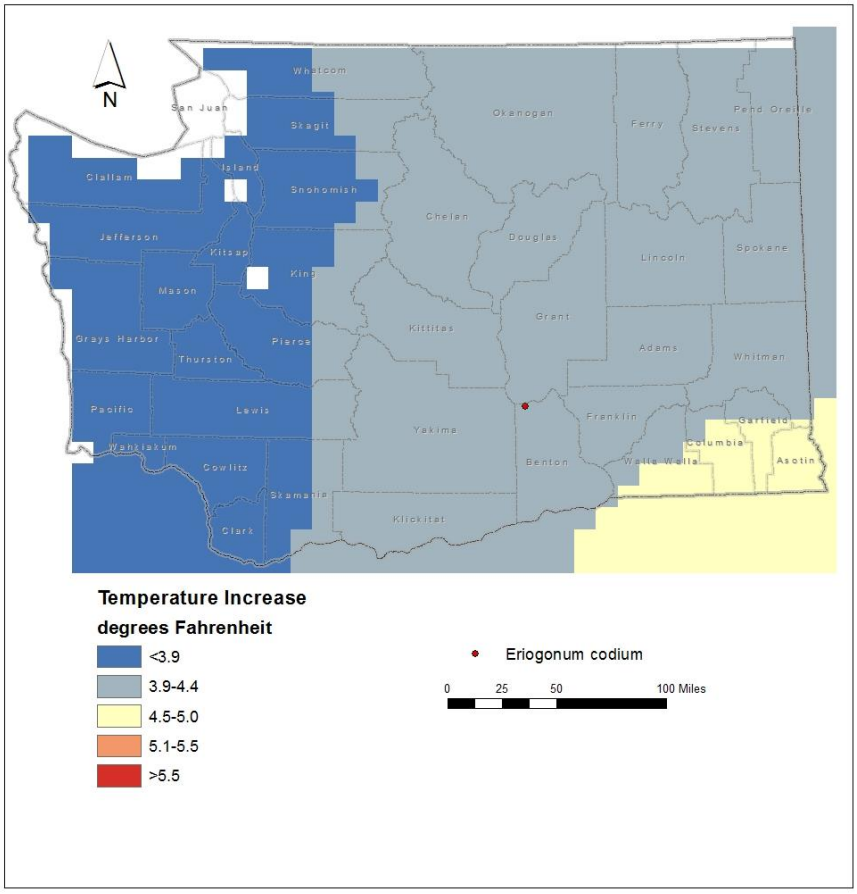

Figure 1. Exposure of *Eriogonum codium* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The Washington occurrence of *Eriogonum codium* is found in an area 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).

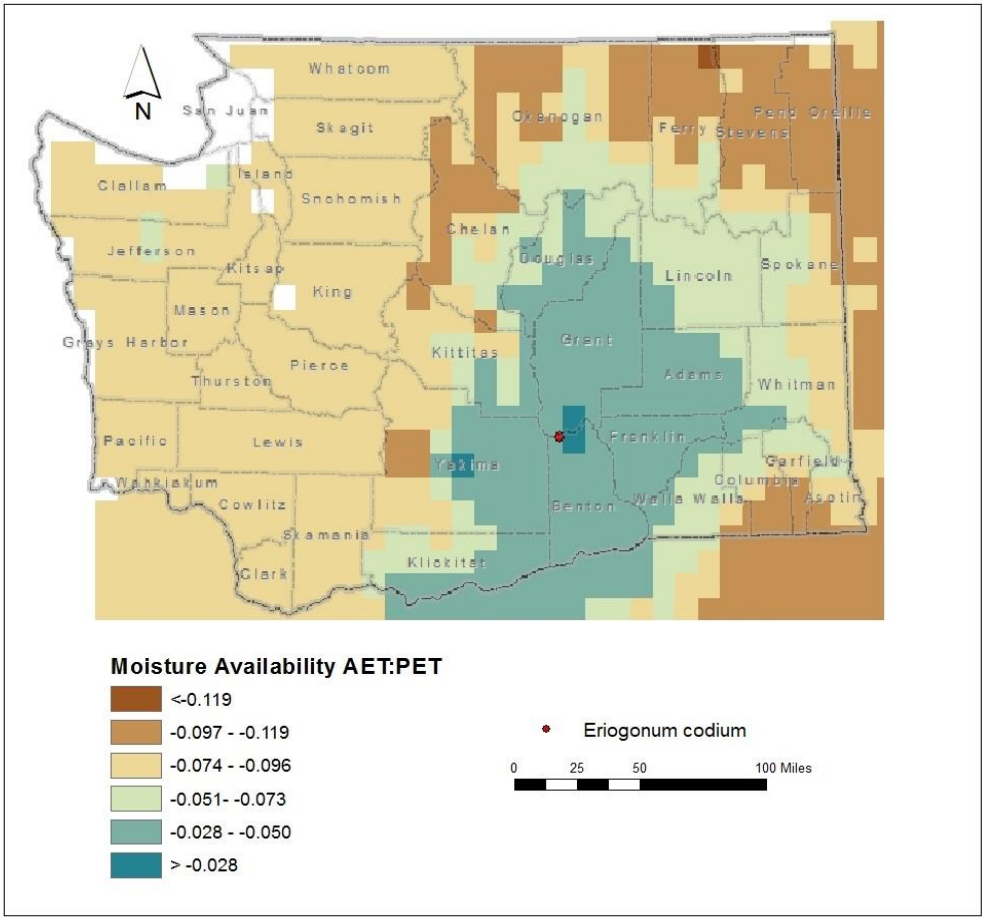

Figure 2. Exposure of *Eriogonum codium* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Eriogonum codium* are found at 1120-1300 ft (340-400 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.
In Washington, *Eriogonum codium* occurs in a sparsely vegetated cushion plant and bunchgrass community on the rim and uppermost north slope of basalt cliffs with thin, fine, pebbly or pumice-like soils of the Kiona silt loam series (Fertig 2019). This habitat is a component of the Inter-Mountain Basins Cliff and Canyon ecological system (Rocchio and Crawford 2015). The population extends discontinuously for about 1.5 km (1 mile). No other populations have been documented in central or southern Washington, although similar basal ridges occur elsewhere in Yakima, Kittitas, and Grant counties. These potential sites are separated by areas of unsuitable habitat. Whether the range of *E. codium* is constrained by its dispersal ability or lack of additional habitat is not known.

B2b. Anthropogenic barriers: Somewhat Increase.
The range of *Eriogonum codium* is restricted to the east end of Umtanum Ridge near the Hanford Reach of the Columbia River. Human development (including the Hanford Site, agricultural lands, and roads) surrounds much of this area, and could restrict potential expansion or migration of the species beyond Umtanum Ridge.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Seed of *Eriogonum codium* is dispersed primarily by gravity or wind (Dunwiddie et al. 2001). The majority of seeds are dispersed a short distance from their parents, though strong winds along Umtanum Ridge are likely to transport them at least 1 km. Movement of seed by Western harvester ants (*Pogonomyrmex occidentalis*) has been observed, but it is believed that ants are more significant as seed predators than dispersal agents (Dunwiddie et al. 2001; Rush and Gamon 1999). Concentrations of seeds near mature plants may be due to poor dispersal or an artifact of the limited number of microenvironments suitable for germination (these may be positively associated with nurse plants) (Dunwiddie et al. 2001).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Eriogonum codium* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). The single occurrence is found in an area that has experienced average (57.1-77˚F/31.8-43.0˚C) temperature variation during the past 50 years. This population is considered "neutral" in terms if climate change vulnerability by Young et al. (2016).

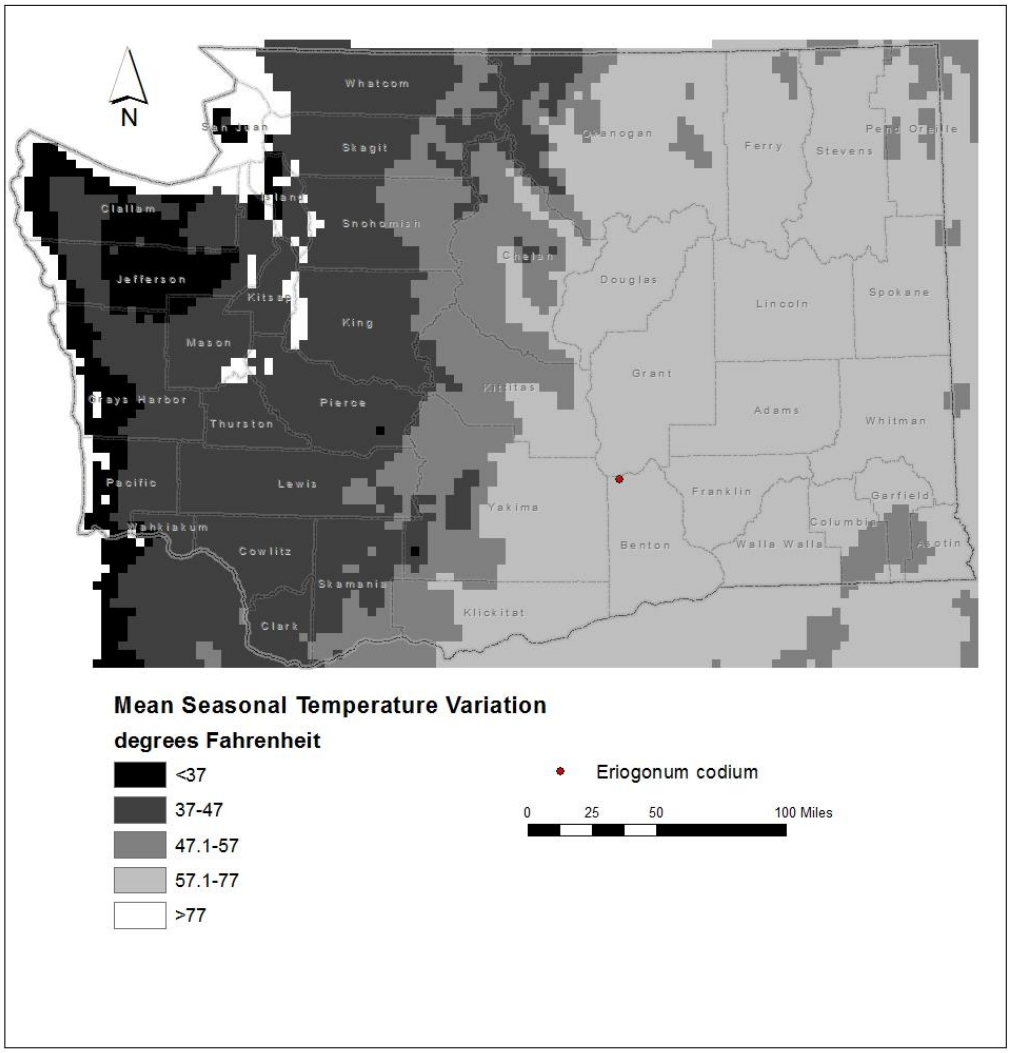

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Eriogonum codium* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
The sparsely vegetated basalt rim habitat occupied by *Eriogonum codium* is cooled by exposure to wind but is not otherwise associated with cold air drainage, especially during the growing season and would have neutral vulnerability to climate change.

C2bi. Historical hydrological niche: Greatly Increase.
The single population of *Eriogonum codium* in Washington is found in an area that has experienced very small (< 4 inches/100 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), this occurrence is at "Greatly Increased" vulnerability to climate change.

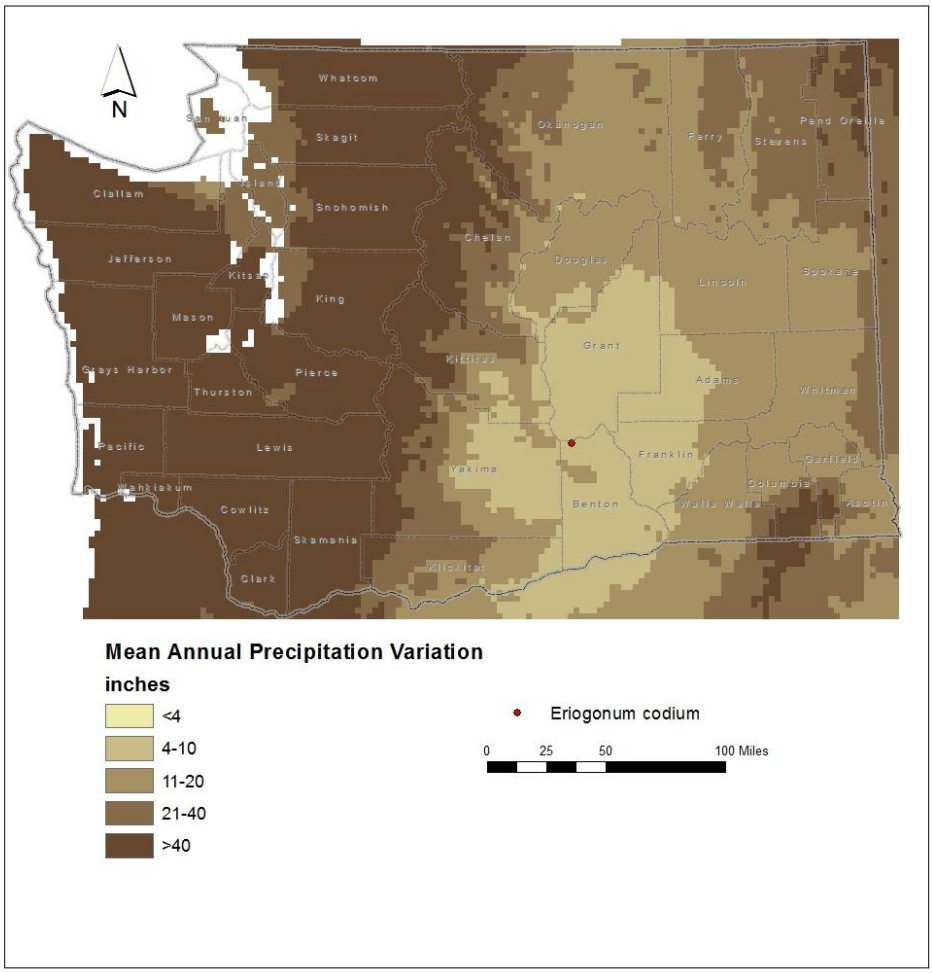

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Eriogonum codium* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Increase.
This species is dependent on winter and spring rainfall and winter snow for its moisture requirements because its cliff 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). Drought, replacement of native vegetation by annual exotics (especially cheatgrass, *Bromus tectorum*) and wildfire are the leading threats to this species (Fertig 2019) and likely to increase due to climate change.

C2c. Dependence on a specific disturbance regime: Neutral.
Eriogonum codium is not adapted to disturbance to maintain its partially barren basalt rim habitat and in fact is negatively impacted by disturbances, such as vehicle trampling, mineral prospecting, and wildfire (Camp and Gamon 2011, Rush and Gamon 1999)

C2d. Dependence on ice or snow-cover habitats: Neutral.
Snowpack is low in the Umtanum Ridge areas and a minor component of the annual water budget.

C3. Restricted to uncommon landscape/geological features: Increase
Eriogonum codium is restricted to the exposed top of the mid-Miocene age Lolo Flow of basalt, which is part of the Priest Rapids Member of the Wanapum Formation (Goff 1981). It is further restricted to fine pebbly or pumice-like soils of the Kiona silt loam series. The combination of ridgecrest exposure and soil type is apparently limited in south-central Washington.

C4a. Dependence on other species to generate required habitat: Neutral
The basalt rim and upper slope habitat occupied by *Eriogonum codium* is maintained by natural climatic phenomena, and not strongly influenced by animal species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Most *Eriogonum* species are generalists and not dependent on specific pollinators (J.R. Reveal, cited in Beck 1999). *Eriogonum codium* has been observed to be visited by ants, beetles, flies, spiders, moths, butterflies, and bumblebees (Beck 1999, Fleckenstein 2014). Inflorescence bagging studies suggest that *E. codium* may be capable of limited self-pollination (Beck 1999).

C4d. Dependence on other species for propagule dispersal: Neutral.
Dispersal of *Eriogonum codium* seeds is primarily by passive means (wind and gravity). Harvester ants have been observed moving seeds, but these insects are primarily seed predators (Dunwiddie et al. 2001). Occasionally, however, uneaten seeds might germinate and survive.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
No natural pathogens are known. Inflorescences and seeds may be consumed by rodents and ants. The low, compact growth form protects this species from herbivory by ungulates or livestock.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Historically, *Eriogonum codium* probably was not affected by competition from other plant species in its sparsely vegetated basalt rim habitat. Recent wildfires have removed much of the native cover and allowed invasive annual weeds to become established, such as cheatgrass and Russian-thistle (*Salsola tragus*). These species now compete for limited soil and moisture resources and make this habitat more prone to subsequent fires.

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

C5a. Measured genetic variation: Unknown.
No data are available on the genetic diversity of *Eriogonum codium*.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Eriogonum codium is primarily an outcrosser capable of producing large numbers of flowers each year, although fruit production may be as low as 10% (Beck 1999). The species potentially should have average levels of genetic diversity based on its life history.

C6. Phenological response to changing seasonal and precipitation dynamics: Somewhat Increase.
Eriogonum codium has a long flowering period, extending from May to late August (Camp and Gamon 2011). After the Silver Dollar Fire in 2017, plants were still flowering in early October (W. Fertig, personal observation).

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Somewhat Increase.
The population of *Eriogonum codium* has declined from 5169 plants in 2011 to 3016 in 2019 in large part due to mortality from several wildfires, including the Silver Dollar fire of 2017 that burned nearly 60% of its habitat (Fertig 2019). The increase in fire frequency is associated with drought and rising temperatures experienced over the past two decades, which may be related to ongoing 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

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