Climate Change Vulnerability Index Report

Cryptantha rostellata (Beaked cryptantha)

Date: 12 March 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G4/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	29.4
	3.9-4.4° F (2.2-2.4°C) warmer	70.6
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	5.9
	-0.074 to -0.096	11.8
	-0.051 to -0.073	17.6
	-0.028 to -0.050	64.7
	>-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		Neutral
2bi. Changes in historical hydrological niche		Somewhat Increase
2bii. Changes in physiological hydrological niche		Neutral
2c. Dependence on specific disturbance regime		Neutral/Somewhat Increase
2d. Dependence on ice or snow-covered habitats		Neutral
3. Restricted to uncommon landscape/geological features		Neutral
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	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: Twelve of the 17 extant and historical occurrences of *Cryptantha rostellata* in Washington (70.6%) occur in areas with a projected temperature increase of 3.9-4.4° F (Figure

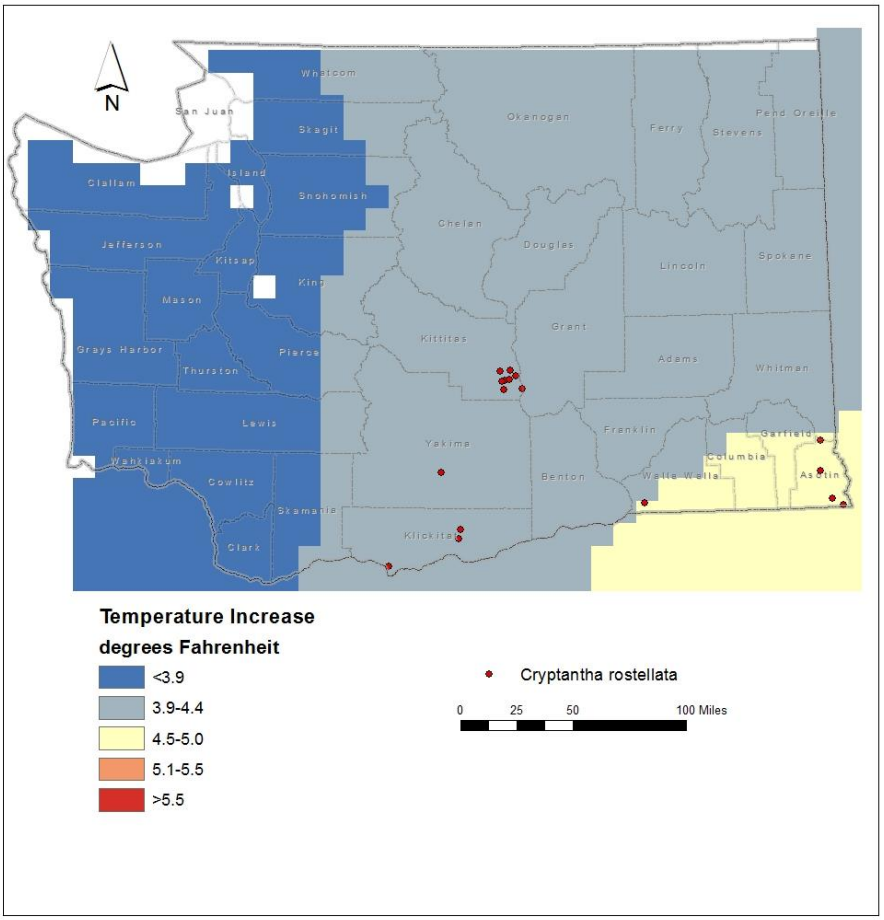

Figure 1. Exposure of *Cryptantha rostellata* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

1). The remaining five occurrences (29.4%) are from areas with a projected temperature increase of 4.5-5˚ F.

A2. Hamon AET:PET Moisture Metric: Eleven of the 17 occurrences (64.7%) of *Cryptantha rostellata* in Washington (all from the Columbia Plateau) 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). Three populations (17.6%) are

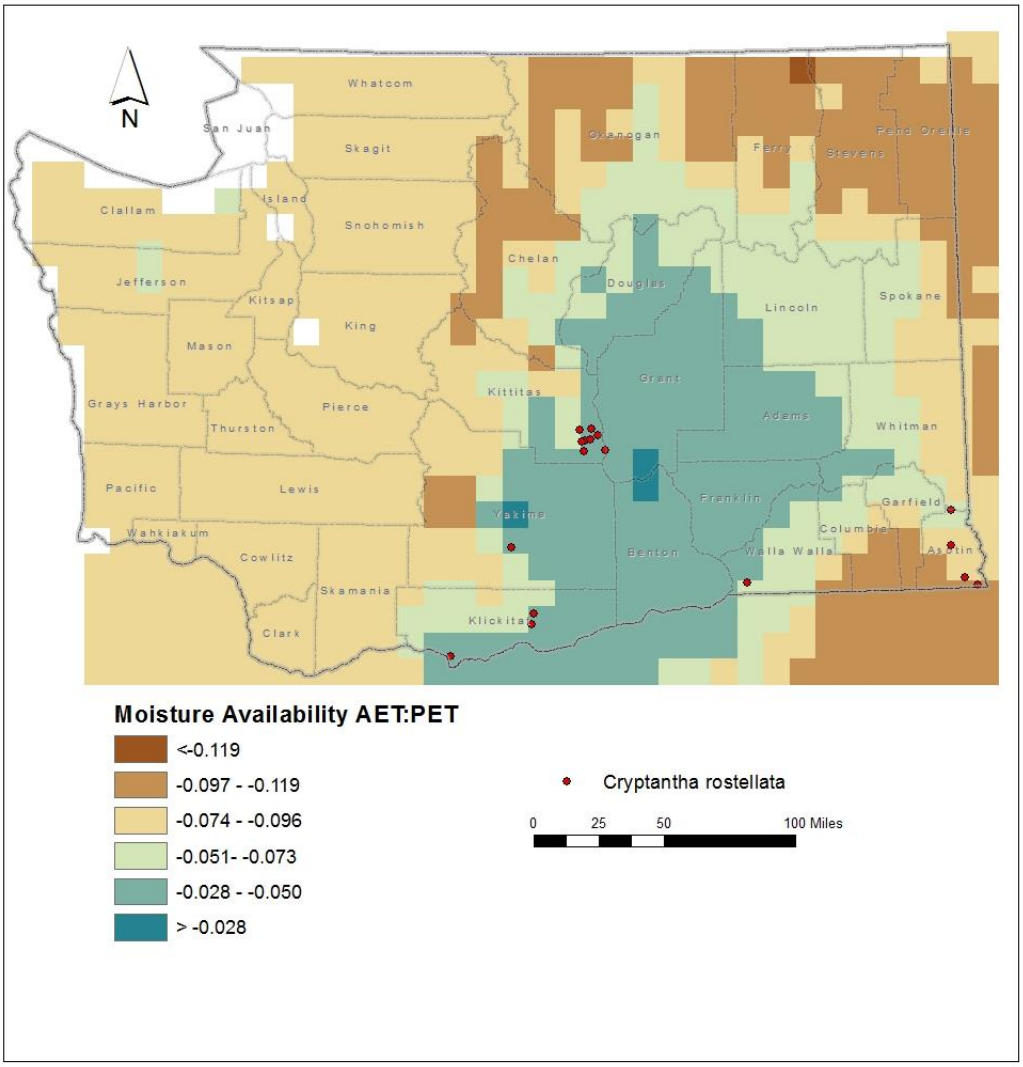

Figure 2. Exposure of *Cryptantha rostellata* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

from areas in the range of -0.051 to -0.073. Two occurrences (11.8%) from the foothills of the Blue Mountains have a projected decrease in available moisture of -0.074 to -0.096. One final occurrence from the Blue Mountains (5.9%) is in the range of -0.097 to -0.119.

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Cryptantha rostellata* are found at 600-2900 feet (180-880 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
Cryptantha rostellata occurs primarily on dry, rocky slopes and canyon bottoms associated with coarse gravel, cobbles, silt, and sand in big sagebrush (*Artemisia tridentata*) and stiff sagebrush (*A. rigida*) shrublands (Camp and Gamon 2011; Salstrom 1996). This habitat is part of the Columbia Basin Palouse Prairie and Columbia Plateau Scabland Shrubland ecological systems (Rocchio and Crawford 2015). Populations are separated by distances of 1.2-82 miles (2-130 km). Gaps in the distribution of the species reflect natural discontinuities in the availability of suitable habitat that present a barrier to range expansion or future migration.

B2b. Anthropogenic barriers: Somewhat Increase.
The scabland and shrub habitat of *Cryptantha rostellata* in Washington is naturally patchy but also dissected by roads, agricultural fields, rangelands, and other human infrastructure that present an additional barrier to dispersal or migration.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Cryptantha rostellata produces one hard, 1-seeded nutlet per flower. Nutlets are smooth and lack wings, feathery plumes, or other structures for wind dispersal. The calyx surrounding the nutlet has bristly, curved hairs that can adhere to animals for potential transport. Average dispersal distances are probably relatively short (less than 1000 meters).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Cryptantha rostellata* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All 17 of the known occurrences in the state (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 vulnerability to climate change (Young et al. 2016).

C2aii. Physiological thermal niche: Neutral.
The scabland and rocky slope habitat of *Cryptantha rostellata* is not associated with cool air drainage or cold microhabitats.

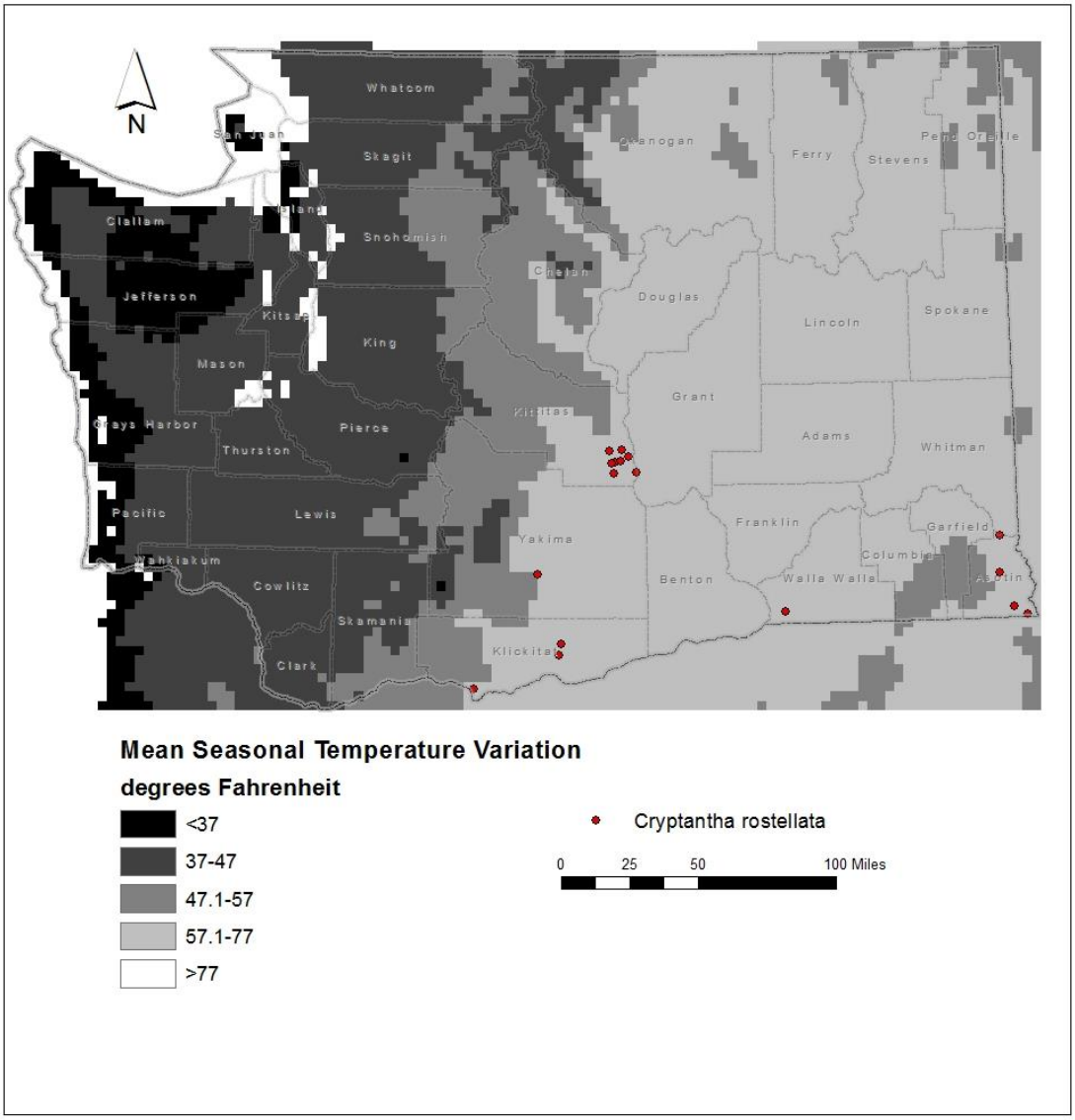

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Cryptantha rostellata* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Somewhat Increase.
Fifteen of the 17 known populations of *Cryptantha rostellata* in Washington (88.2%) are found in areas that have experienced slightly lower than average variation in the past 50 years (11-20 inches/255-508 mm) (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased vulnerability to climate change. The other two populations (11.8%) are from areas with small precipitation variation (4-10 inches/100-254 mm) during the same period and are considered at increased vulnerability.

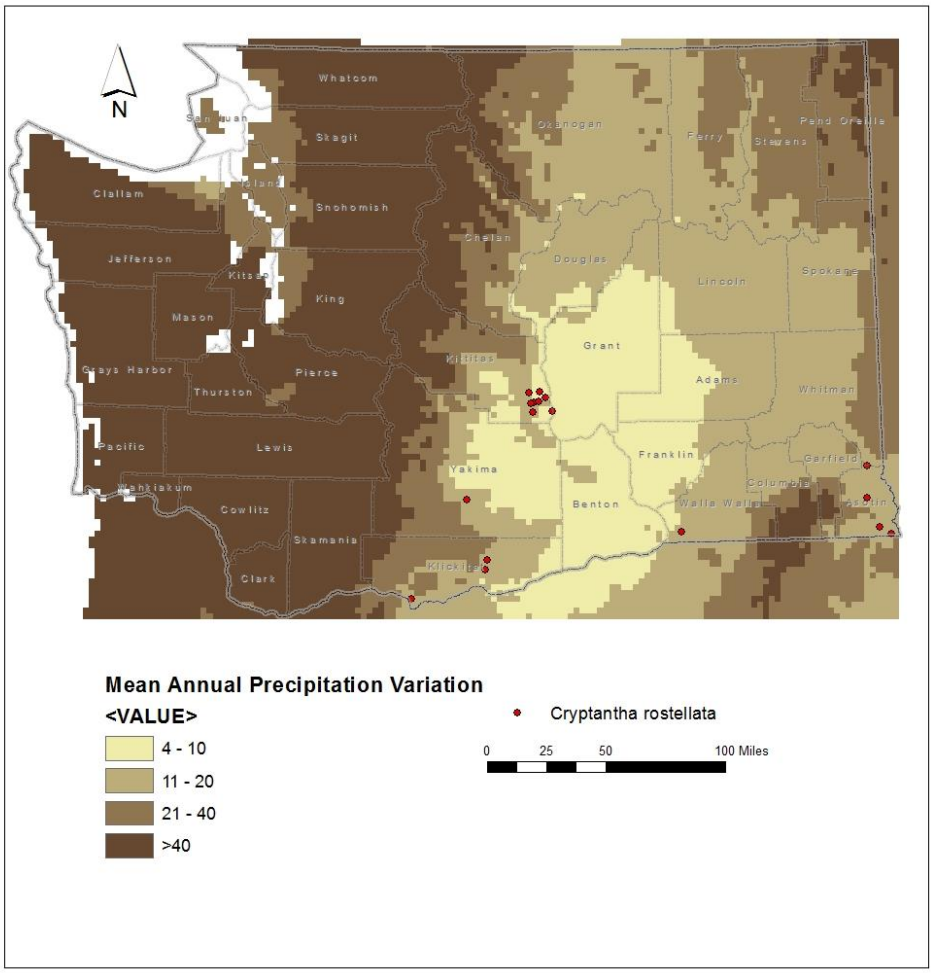

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Cryptantha rostellata* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Neutral.
This species is not dependent on a strongly seasonal hydrologic regime or specific wetland habitats. Under projected climate change, the rocky slope and sagebrush scabland habitats occupied by *Cryptantha rostellata* are likely to become even more drought prone due to increased temperatures and changes in the amount and timing of precipitation. Coupled with human disturbance, these areas may become invaded by non-native annual weed species and more vulnerable to wildfire (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral/Somewhat Increase.
Cryptantha rostellata occurs on sparsely vegetated rocky slopes and valley bottoms and big sagebrush and stiff sagebrush shrub communities. Historically, these sites had infrequent

wildfire due to the paucity of fuels. With climate change, these areas may become invaded by non-native annual plant species that may make the sites more prone to wildfire that could alter the species composition of native plant communities, especially those dominated by sagebrush species (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral.
The populations of *Cryptantha rostellata* in Washington are found in low elevation basin or foothill areas with low winter snow cover.

C3. Restricted to uncommon landscape/geological features: Neutral.
Cryptantha rostellata is found primarily on rocky slopes and valley bottoms on a variety of soil texture types derived primarily from basalt bedrock types (such as the Grande Ronde and Wanapum basalts) that are widely distributed across the state (Washington Division of Geology and Earth Resources 2016).

C4a. Dependence on other species to generate required habitat: Neutral.
The rocky slope and canyon bottom and sagebrush habitat of *Cryptantha rostellata* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The exact pollinators of *Cryptantha rostellata* in Washington are poorly known. Other annual *Cryptantha* species with small flowers (1-2 mm wide) may be pollinated by flies and mosquitos.

C4d. Dependence on other species for propagule dispersal: Neutral.
Individual nutlets lack ornamentation to promote dispersal by wind or animals. Fruits that remain within the bristly calyx could be transported on the fur of a variety of animal species.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. As an annual, this species is probably not abundant enough most years to be a significant food source for most herbivores. Impacts from grazing are low.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
The barren rocky and sagebrush habitat of *Cryptantha rostellata* is vulnerable to invasion by non-native annuals, such as cheatgrass. Competition is likely to increase under predicted future climate change in response to increased drought, temperatures, and fire frequency, which may result in the conversion of sagebrush habitats to annual grasslands (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.
No data are available on genetic diversity of Washington populations.

C5b. Genetic bottlenecks: Unknown.

Not known.

C5c. Reproductive System: Neutral.
Cryptantha rostellata, like other small-flowered annual *Cryptantha* species, may produce two types of flowers: open, chasmogamous flowers that produce seed from cross-pollination, and smaller, closed, self-fertilizing, cleistogamous flowers in which seed matures without cross-pollination (Simpson and Hasenstab 2009). This adaptation helps ensure that at least some seed is produced each year depending on climate conditions or availability of pollinators. This species is likely to have average genetic variability, but studies to confirm this have not been conducted.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), *Cryptantha rostellata* has not changed its typical blooming time since the late 1800s.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
At least three occurrences of *Cryptantha rostellata* in Washington are historical (not relocated in the last 40 years) (Fertig and Kleinknecht 2020). These populations may be extirpated due to habitat loss rather than 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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