Climate Change Vulnerability Index Report

Chaenactis thompsonii (Thompson's chaenactis)

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Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G3/S3

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	22.2
	-0.074 to -0.096	61.1
	-0.051 to -0.073	16.7
	-0.028 to -0.050	0
	>-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/Somewhat Increase
2b. Distribution relative to anthropogenic barriers		Neutral
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		Somewhat Increase
2aii. Change in physiological thermal niche		Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Somewhat Increase
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
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 18 of the extant and historical occurrences of *Chaenactis thompsonii* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4° F (Figure 1). A population reported from Whatcom County (Camp and Gamon 2011) is now known

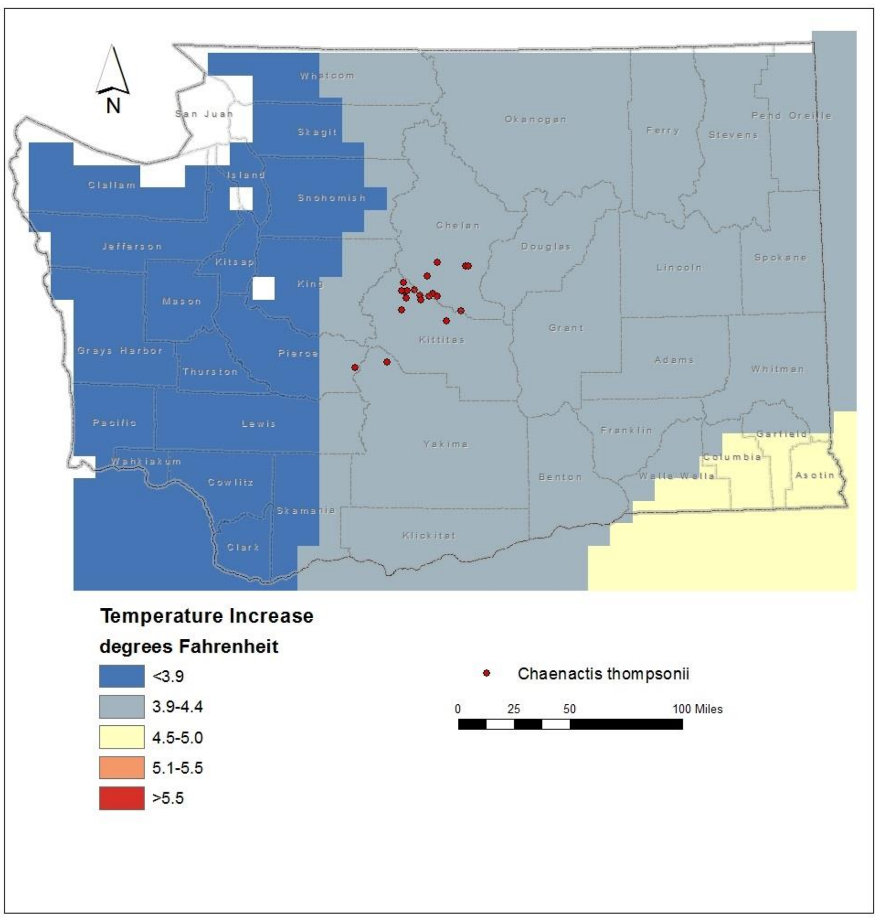

Figure 1. Exposure of *Chaenactis thompsonii* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

to be misidentified (Fertig and Kleinknecht 2020) and is excluded from this assessment.

A2. Hamon AET:PET Moisture Metric: Eleven of the 18 occurrences (61.1%) of *Chaenactis thompsonii* in Washington 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 -0.074 to -0.096 (Figure 2). Three populations (16.7%) are in areas with a projected decrease of -0.051 to -0.073. Four other populations (22.2%) are from areas with a projected decrease of -0.097 to -0.119 (Figure 2).

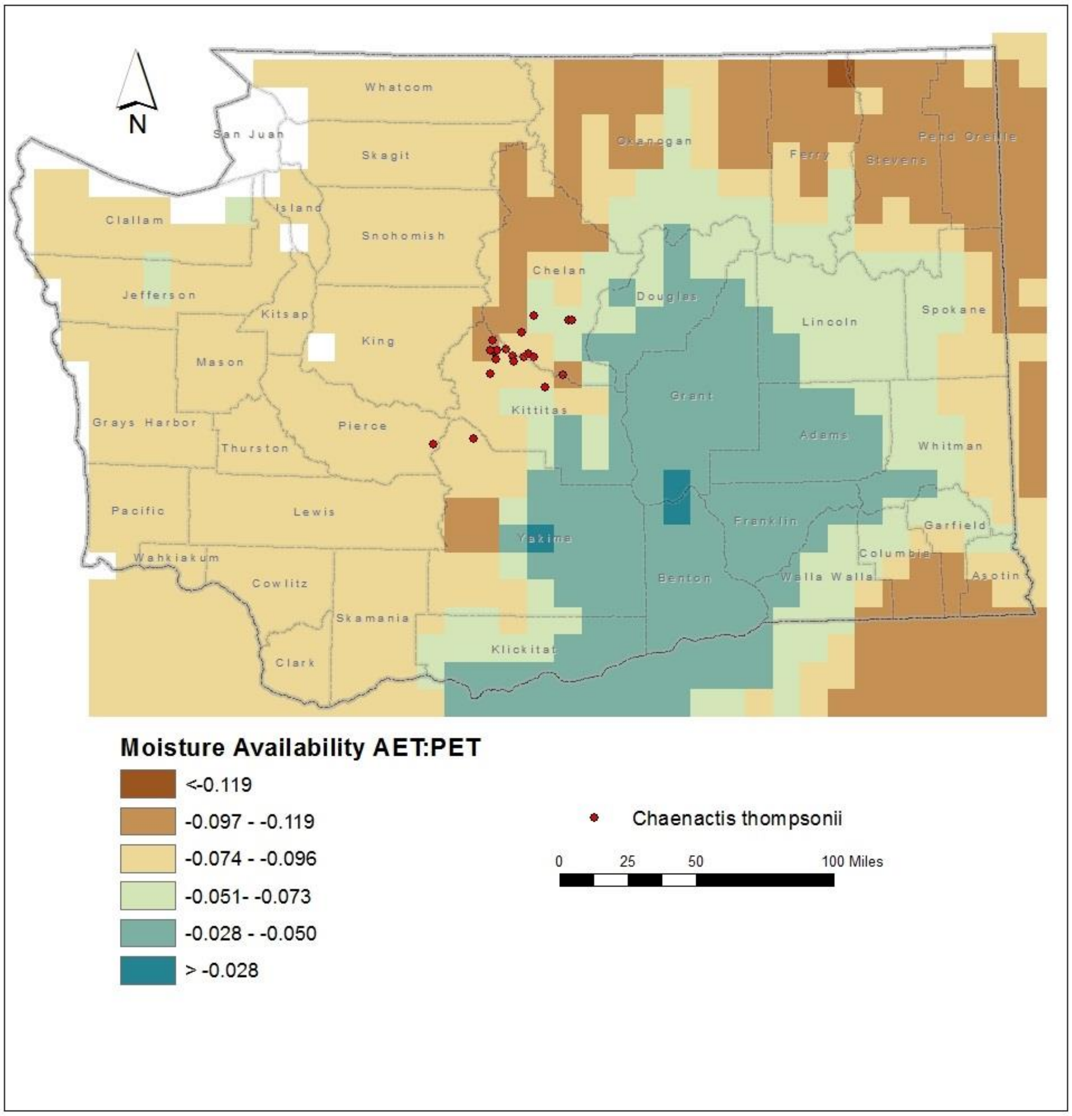

Figure 2. Exposure of *Chaenactis thompsonii* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Chaenactis thompsonii* are found at 2900-7000 feet (880-2130 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral/Somewhat Increase.
Chaenactis thompsonii occurs primarily on dry, rocky subalpine to alpine slopes and ridges derived from serpentine bedrock (Camp and Gamon 2011). This habitat is part of the North Pacific Serpentine Barren ecological system (Rocchio and Crawford 2015). Populations are separated from each other by 0.7-24 miles (1.4-39 km) of unoccupied and unsuitable forested habitat. Many of these populations are within the dispersal range of this species, and so natural barriers are relatively small; however future migration in response to climate change will be restricted due to the lack of additional serpentine habitat beyond the Wenatchee Range.

B2b. Anthropogenic barriers: Neutral.
The subalpine and alpine habitat of *Chaenactis thompsonii* in Washington is located entirely on National Forest lands in the Wenatchee Range and vicinity. Although there are some roads and trails within this range, dispersal is probably not limited due to anthropogenic impacts.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Chaenactis thompsonii produces numerous, dry achenes topped by 10-16 transparent scales that may assist with dispersal by the wind. Dispersal distances may vary, but the species has the potential for dispersal of 100-1000 m from the parent plant.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Chaenactis thompsonii* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Seventeen of the 18 known occurrences in the state (94.4%) are found in areas that have experienced slightly lower than average (47.1-57°F/26.3-31.8°C) temperature variation during the past 50 years and are considered at somewhat increased vulnerability to climate change (Young et al. 2016). One other occurrence (5.6%) is from an area with small variation (37-47°F/20.8-26.3°C) in temperature over the same period and is at increased vulnerability to climate change. The identity of this occurrence (from Pierce County) has not been confirmed.

C2aii. Physiological thermal niche: Increase.
The alpine to subalpine serpentine talus habitat of *Chaenactis thompsonii* is primarily within a cold climate zone during the flowering season and highly vulnerable to temperature increase from climate change.

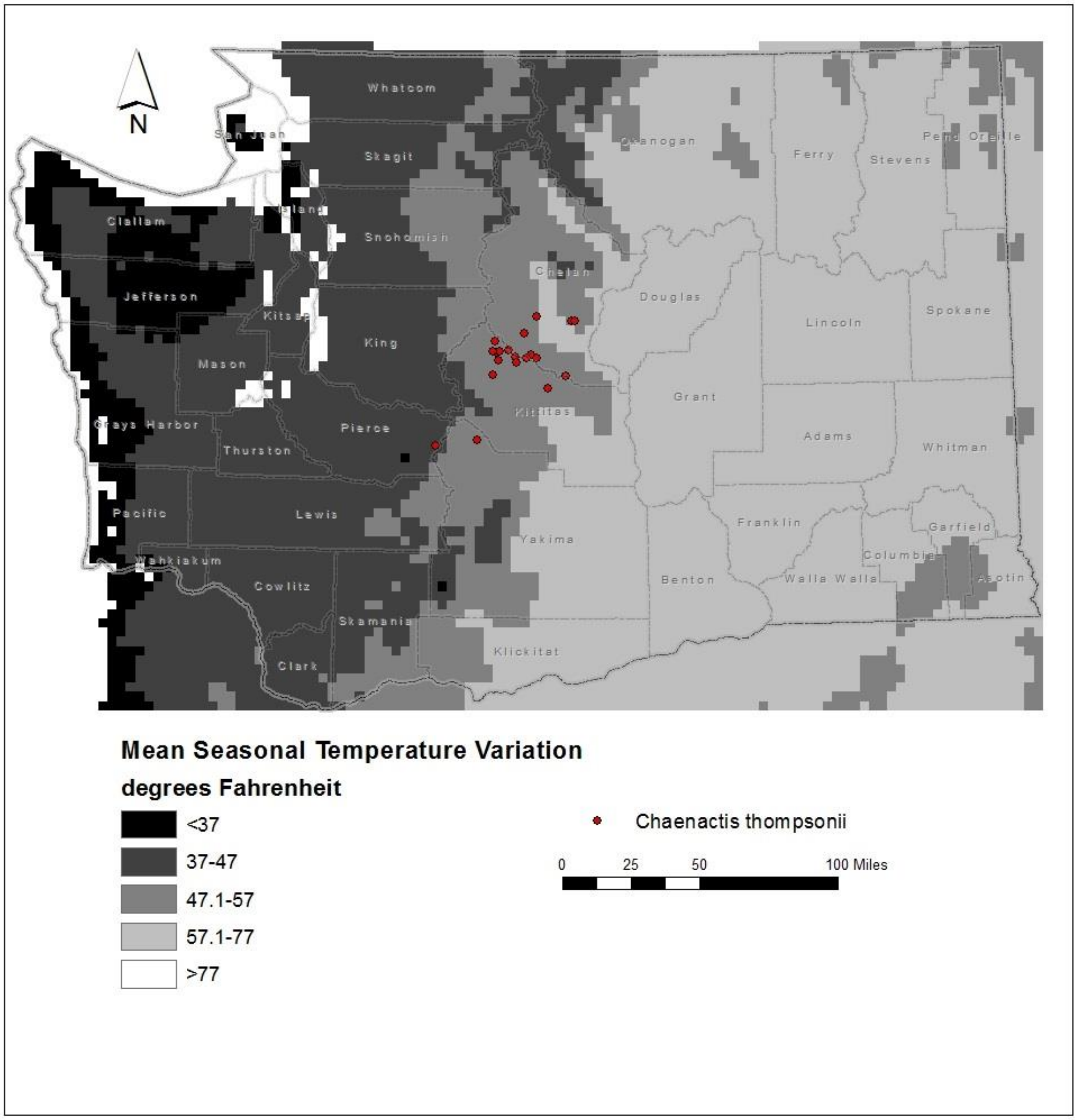

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Chaenactis thompsonii* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.
Sixteen of the 18 populations of *Chaenactis thompsonii* in Washington (88.9%) are found in areas that have experienced average precipitation variation in the past 50 years (20-40 inches/508-1016 mm) (Figure 4). Two other occurrences (11.1%) are from areas with greater than average precipitation variation (> 40 inches/1016 mm). According to Young et al. (2016), all of these occurrences are neutral for climate change.

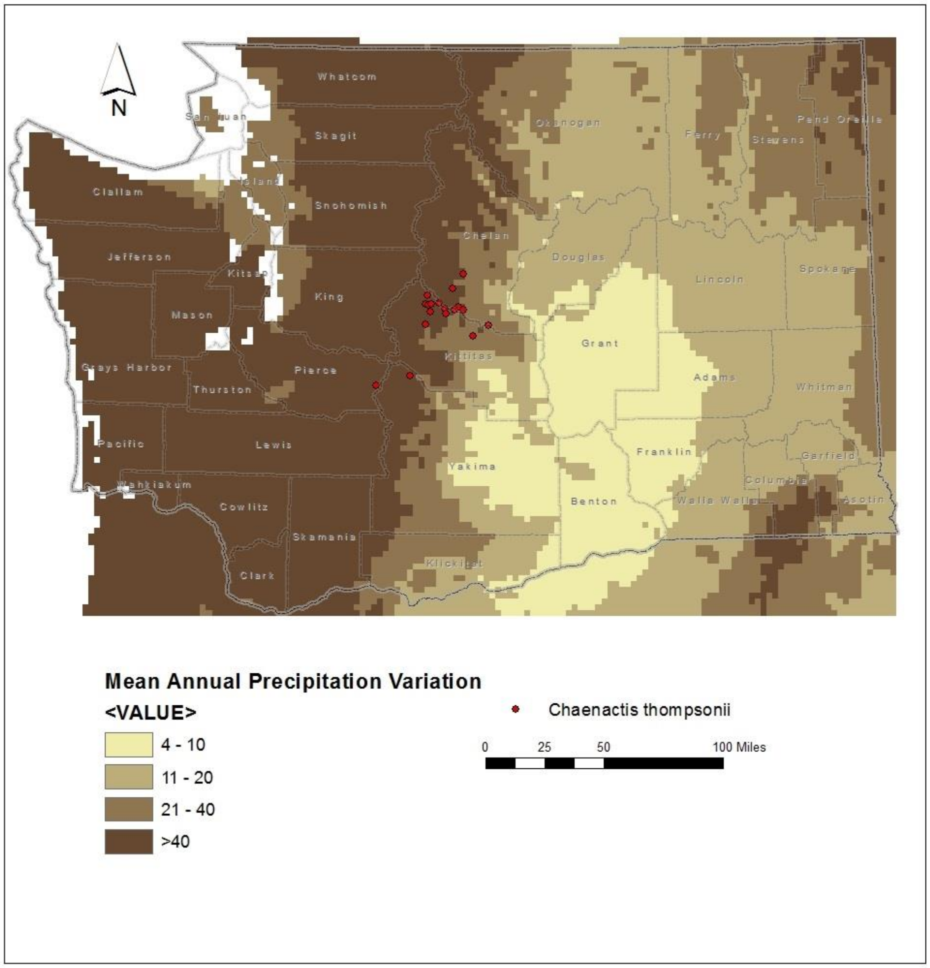

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Chaenactis thompsonii* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is found in upland areas without perennial streams or a high water table. It is dependent on winter snowfall and summer precipitation for its moisture needs and so is potentially vulnerable to changes in the timing and amount of snow and rain.

C2c. Dependence on a specific disturbance regime: Neutral.
Chaenactis thompsonii occurs on rocky, barren slopes of serpentine soils in alpine and subalpine sites that may be prone to higher winds than adjacent forested areas. Other than occasional rock fall, these are largely undisturbed sites. Wildfire is uncommon within this habitat due to lack of vegetative cover and fuel, although fire has recently occurred in nearby forested areas.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Populations of *Chaenactis thompsonii* are found on subalpine and alpine ridgecrests and talus slopes associated with winter snow accumulation, though the areas may be free of snow due to evaporation or wind during the growing season. Reduced snowpack due to climate change would decrease the amount of moisture available through runoff (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Increase.
Chaenactis thompsonii is restricted to serpentine outcrops in the Wenatchee Mountains and vicinity (Washington Division of Geology and Earth Resources 2016). Serpentine is a metamorphic formation derived from igneous peridotite and diorite and weathers to soils high in magnesium, nickel, and chromium but low in calcium, nitrogen, and phosphorus (Kruckeberg 1969). These soils support a suite of uncommon and localized endemic species that are often poor competitors or absent from adjacent sites.

C4a. Dependence on other species to generate required habitat: Neutral.
The subalpine and alpine serpentine rocky slope habitat occupied by *Chaenactis thompsonii* is maintained primarily by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The precise pollinators of *Chaenactis thompsonii*, are not known. Its close relative, *C. douglasii,* is pollinated by common, generalist bee species (Cane et al. 2012).

C4d. Dependence on other species for propagule dispersal: Neutral.
Fruits of *Chaenactis thompsonii* have a scale-like pappus that likely facilitates dispersal by wind. Fruits might be secondarily transported and cached short distances by insects or rodents.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
This species is not known to be impacted by pathogens or herbivory (Fertig and Kleinknecht 2020).

C4f. Sensitivity to competition from native or non-native species: Neutral.
At present, competition from non-native species is minimal due to the harsh growing conditions of its serpentine habitat. Under projected climate change, these naturally barren sites may become even less hospitable to other plant species due to increased drought stress (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 genetic data are available for *Chaenactis thompsonii*. The related species, *C. douglasii*, which occurs widely across western North America, may be a diploid, tetraploid, or hexaploid. A diploid variant formerly recognized as *C. ramosa* occurs in the Wenatchee Range and has been considered intermediate between *C. thompsonii* and *C. douglasii* (Cronquist 1955). *Chaenactis ramosa* is now treated as a synonym of *C. douglasii* var. *douglasii* (Morefield 2006).

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral.
Chaenactis thompsonii, like other *Chaenactis* species, appears to be an obligate outcrosser without specialized pollinators. Though dispersal may be limited due to habitat suitability, it is presumed to have average genetic variation.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), the phenology of *Chaenactis thompsonii* has not changed significantly in the past 50 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No major changes have been detected in the distribution of *Chaenactis thompsonii* in Washington 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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