Climate Change Vulnerability Index Report

Erigeron basalticus (Basalt daisy)

Date: 22 January 2019

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		Neutral
2b. Distribution relative to anthropogenic barriers		Neutral
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
1. Dispersal and movements		Neutral
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Somewhat Increase
2bi. Changes in historical hydrological niche		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		Somewhat Increase
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		Neutral
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 six of the known occurrences of *Erigeron basalticus* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

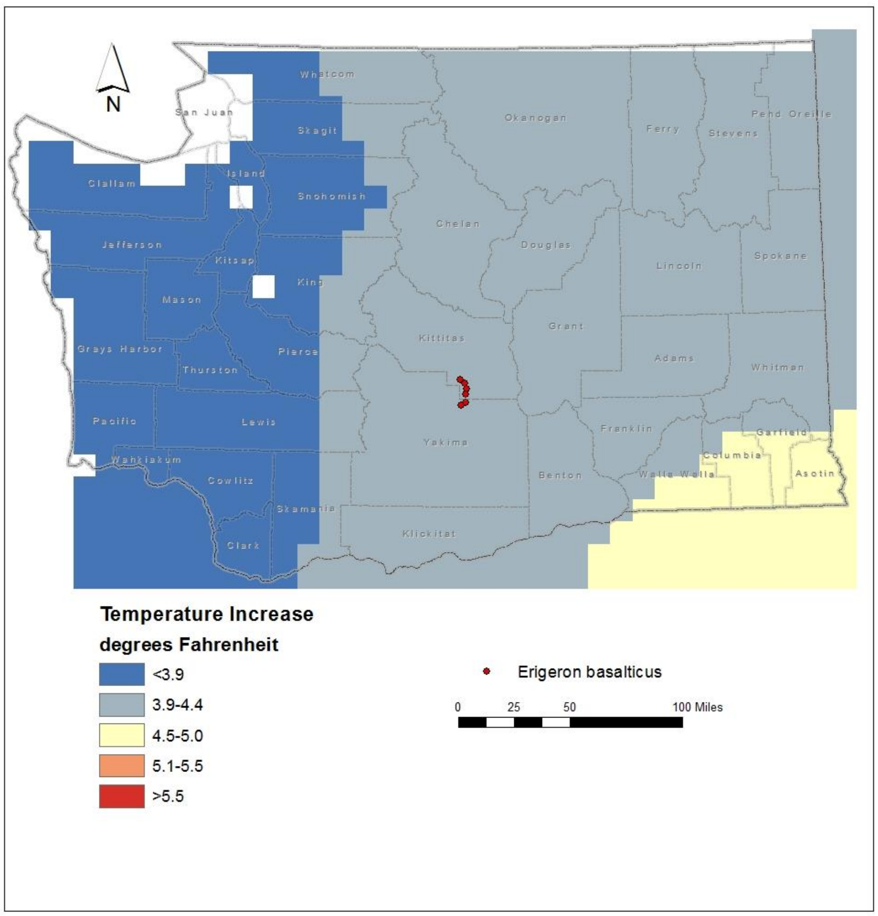

Figure 1. Exposure of *Erigeron basalticus* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The six Washington occurrences of *Erigeron basalticus* (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).

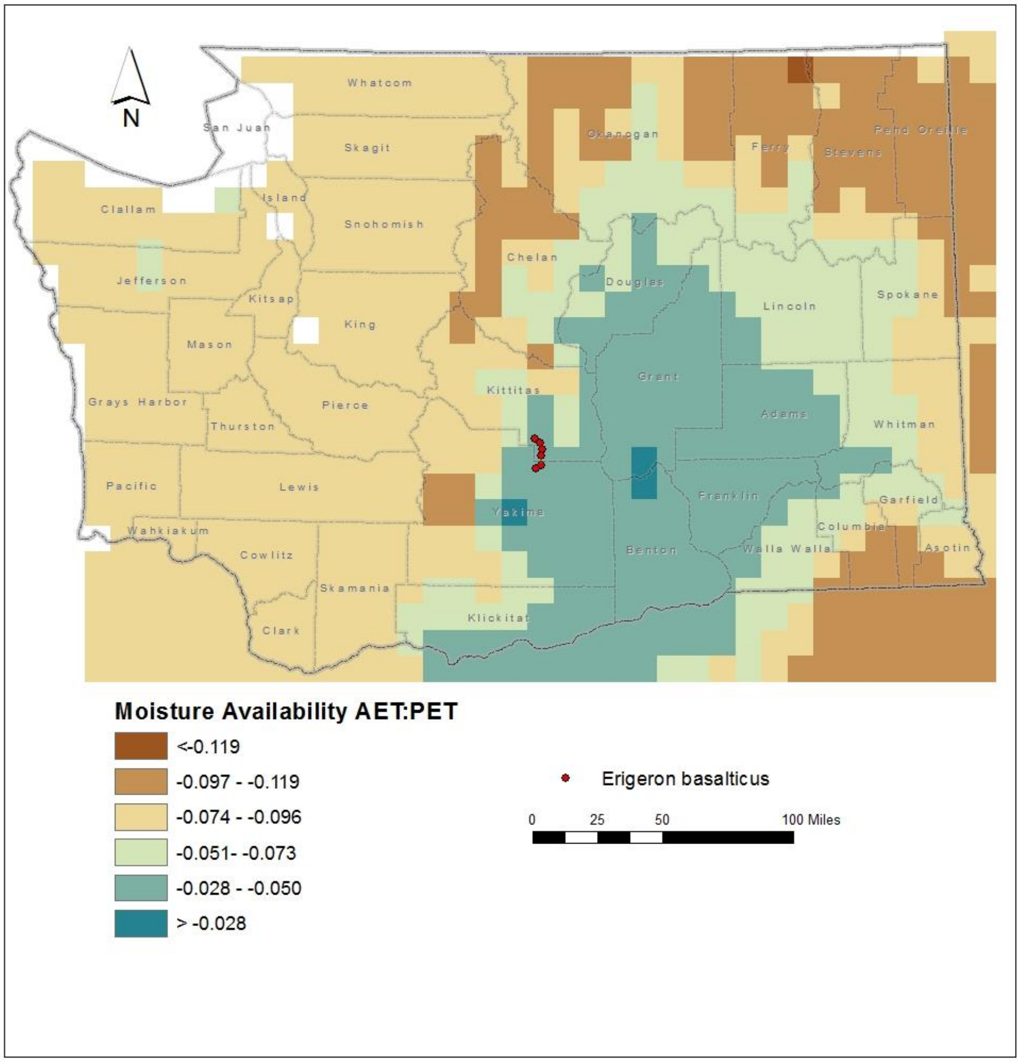

Figure 2. Exposure of *Erigeron basalticus* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Erigeron basalticus* are found at 1200-1500 feet (380-460 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.
In Washington, *Erigeron basalticus* is found in crevices in columnar basalt cliffs and basalt roadsides on east, west, and north-facing cliffs (Camp and Gamon 2011, Fertig 2020, Gamon 1998). This habitat is part of the Inter-Mountain Basins Cliff and Canyon ecological system (Rocchio and Crawford 2015). Individual populations are separated by 0.37-2.5 miles (0.5-4 km). The entire range of the species is restricted to a 3 x 11 mile area (4.5 x 17 km). Intervening lowland habitat is unsuitable, and the Yakima River bisects these populations, but probably does not impose a significant barrier to dispersal or gene flow.

B2b. Anthropogenic barriers: Neutral.
The range of *Erigeron basalticus* in Washington is constrained by the distribution of appropriate basalt cliff habitat in the Yakima River Canyon and Selah Creek areas. Washington State Highway 821 follows the Yakima River and Interstate 82 bisects the eastern edge of the population. These and bottomland agricultural lands present minor barriers to dispersal or gene flow.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Erigeron basalticus produces numerous small one-seeded achenes topped by a feathery pappus that are adapted for dispersal by wind. Dispersal distances will vary depending on prevailing weather conditions, but fruits have the potential for moderate to long-distance dispersal (over 1 km).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Erigeron basalticus* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All six 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.
Erigeron basalticus tends to occur in crevices and somewhat sheltered north, east, and west facing cliffs where temperature conditions are moderated by shade.

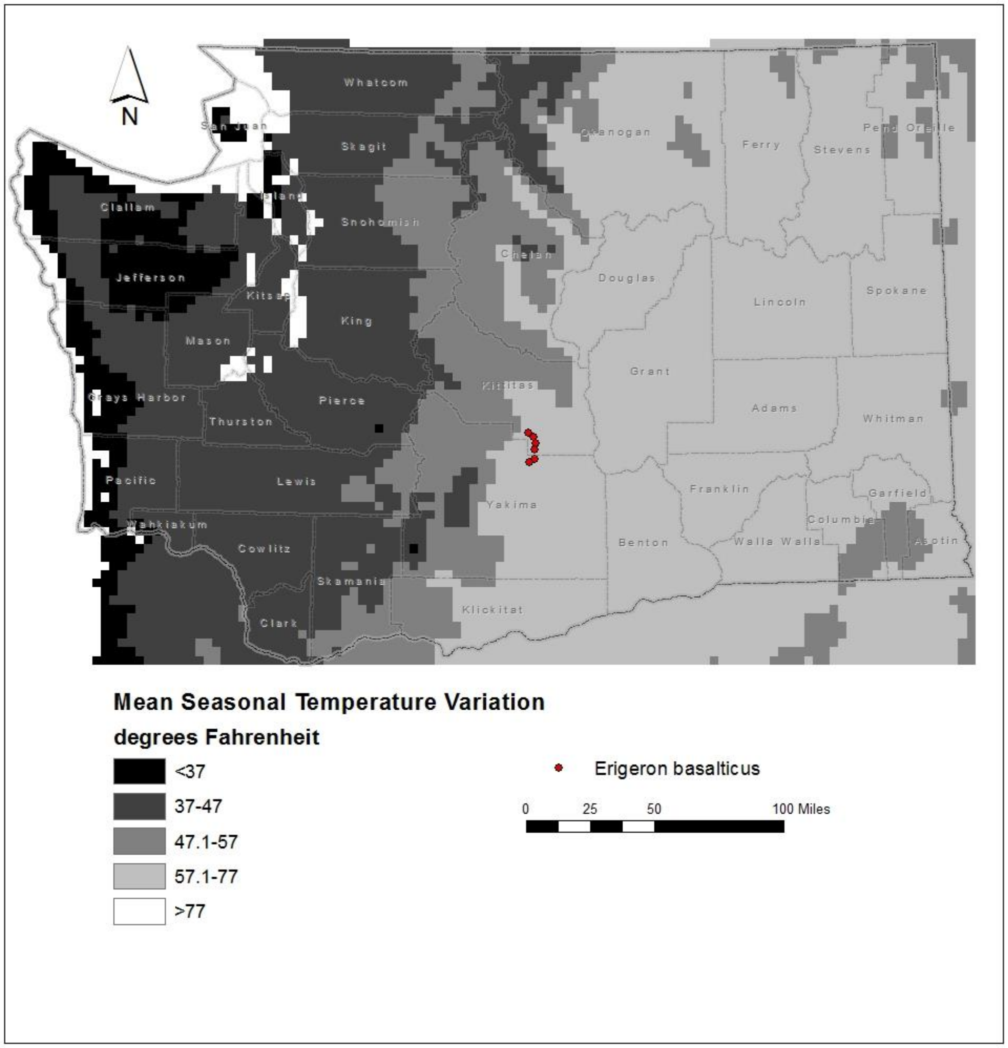

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Erigeron basalticus* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Increase.
Four of the six occurrences of *Erigeron basalticus* in Washington (66.7%) are found in areas that have experienced small (4-10 inches/100-254 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at increased vulnerability from climate change. Two other populations (33.3%) are from areas with slightly lower than average precipitation variation (11-20 inches/255-508 mm) over the same period and are at somewhat increased vulnerability.

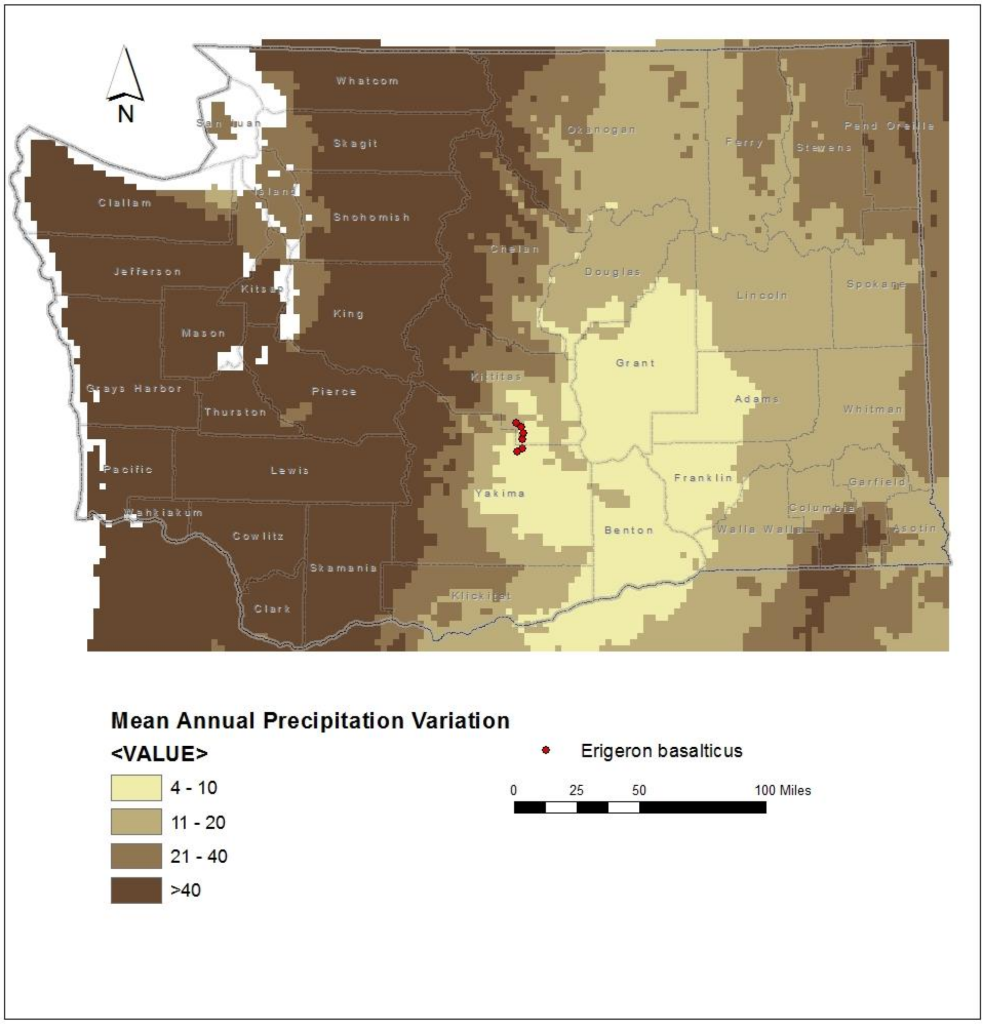

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Erigeron basalticus* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

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. At one occurrence, additional water comes from irrigation runoff from an orchard located above the cliff habitat (Petrina 2011). 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.
Erigeron basalticus is not dependent on periodic disturbances to maintain its basalt cliff habitat.

C2d. Dependence on ice or snow-cover habitats: Neutral.
In Washington, *Erigeron basalticus* occurs in areas of low to moderate snow accumulation. These populations are probably more adversely affected by 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.
Erigeron basalticus is restricted to the Yakima Basalt Formation (Fertig 2020; Gamon 1998, Washington Division of Geology and Earth Resources 2016). This formation is related to the widespread Columbia River Basalt Group, but is restricted to cliffs in Yakima Canyon between Ellensburg and Yakima (Mackin 1961).

C4a. Dependence on other species to generate required habitat: Neutral
The habitat occupied by *Erigeron basalticus* is maintained primarily by natural abiotic processes rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Somewhat Increase.
Petrina (2011) determined that *Erigeron basalticus* is primarily self-incompatible and pollinated by insects from at least 13 genera. At least 89% of observed insect visits were by species of Diptera (flies) in the genus *Mythicomyia* and Hymenoptera (bees and wasps) in the genera *Geron, Colletes,* and *Augochlora* (Petrina 2011). Mythicomyid flies are numerous but quite small and perhaps are ineffectual pollinators (Petrina 2011). The relatively low diversity of pollinators and irregular visitation (impacted by weather, pesticide drift, and number of flowering heads; Petrina 2011) makes *Erigeron basalticus* somewhat more vulnerable than more common Asteraceae species with generalist pollinators.

C4d. Dependence on other species for propagule dispersal: Neutral.
Erigeron fruits have a feathery pappus and are readily dispersed by wind, and thus not dependent on animal species for transport.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
In her study of its reproductive biology, Petrina (2011) observed that 14 of 60 tagged flowering heads of *Erigeron basalticus* (23%) were infected by fungi or eaten by herbivores. Due to its remote cliff habitat, *Erigeron basalticus* receives minimal impacts from livestock or ungulate grazing. Overall impacts are probably low.

C4f. Sensitivity to competition from native or non-native species: Neutral.
Rocky microsites occupied by *Erigeron basalticus* 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: Neutral.
No genetic data are available for *Erigeron basalticus* populations.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Erigeron basalticus produces perfect flowers that are pollinated by flies, wasps, and bees. Self-pollination is low (Petrina 2011).

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on data from the Consortium of Pacific Northwest herbaria website, no major changes have been observed in phenology in the last 50 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
The distribution of *Erigeron basalticus* 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

References

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