Climate Change Vulnerability Index Report

Erigeron aliceae (Alice's fleabane)

Date: 12 October 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	0
	3.9-4.4° F (2.2-2.4°C) warmer	0
	<3.9° F (2.2°C) warmer	100
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to -0.096	81.8
	-0.051 to -0.073	18.2
	-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
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		Neutral
2ai Change in historical thermal niche		Greatly 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		Neutral
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	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 11 of the extant and historical occurrences of *Erigeron aliceae* in Washington (100%) occur in areas with a projected temperature increase of <3.9˚ F (Figure 1).

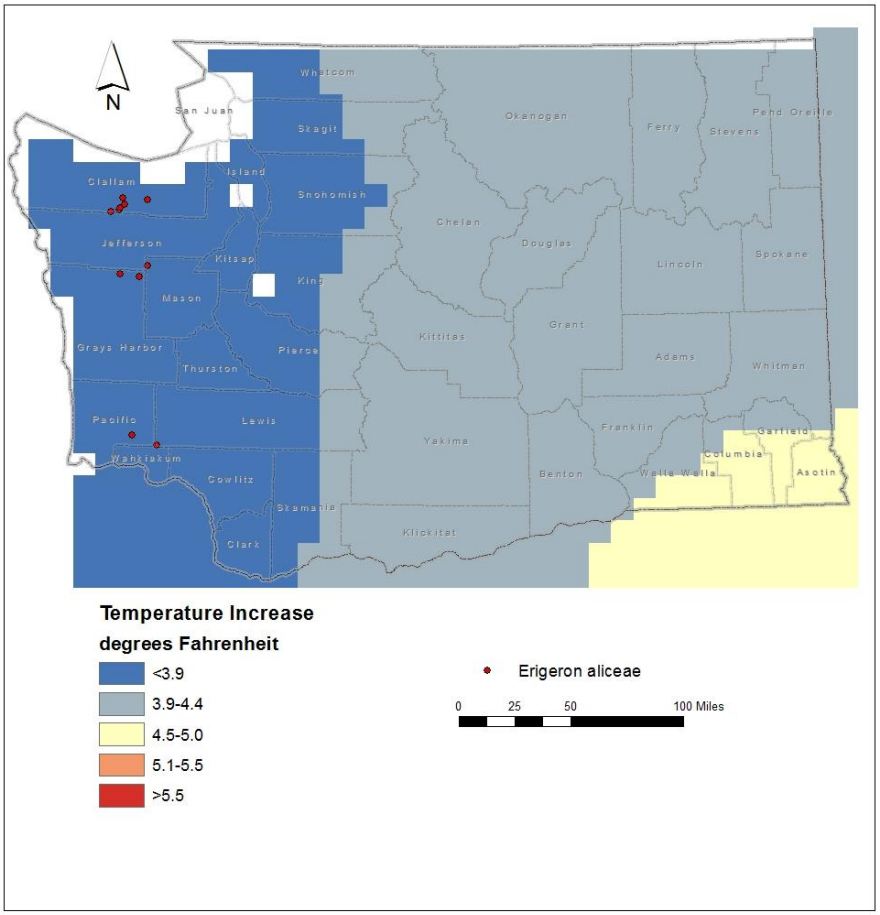

Figure 1. Exposure of *Erigeron aliceae* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

Two additional reports from Ferry and Yakima counties in eastern Washington have not been verified and are excluded from this assessment.

A2. Hamon AET:PET Moisture Metric: Nine of the 11 occurrences (81.8%) of *Erigeron aliceae* 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). The other two occurrences (18.2%) are in areas with a projected decrease of -0.051 to -0.073 (Figure 2).

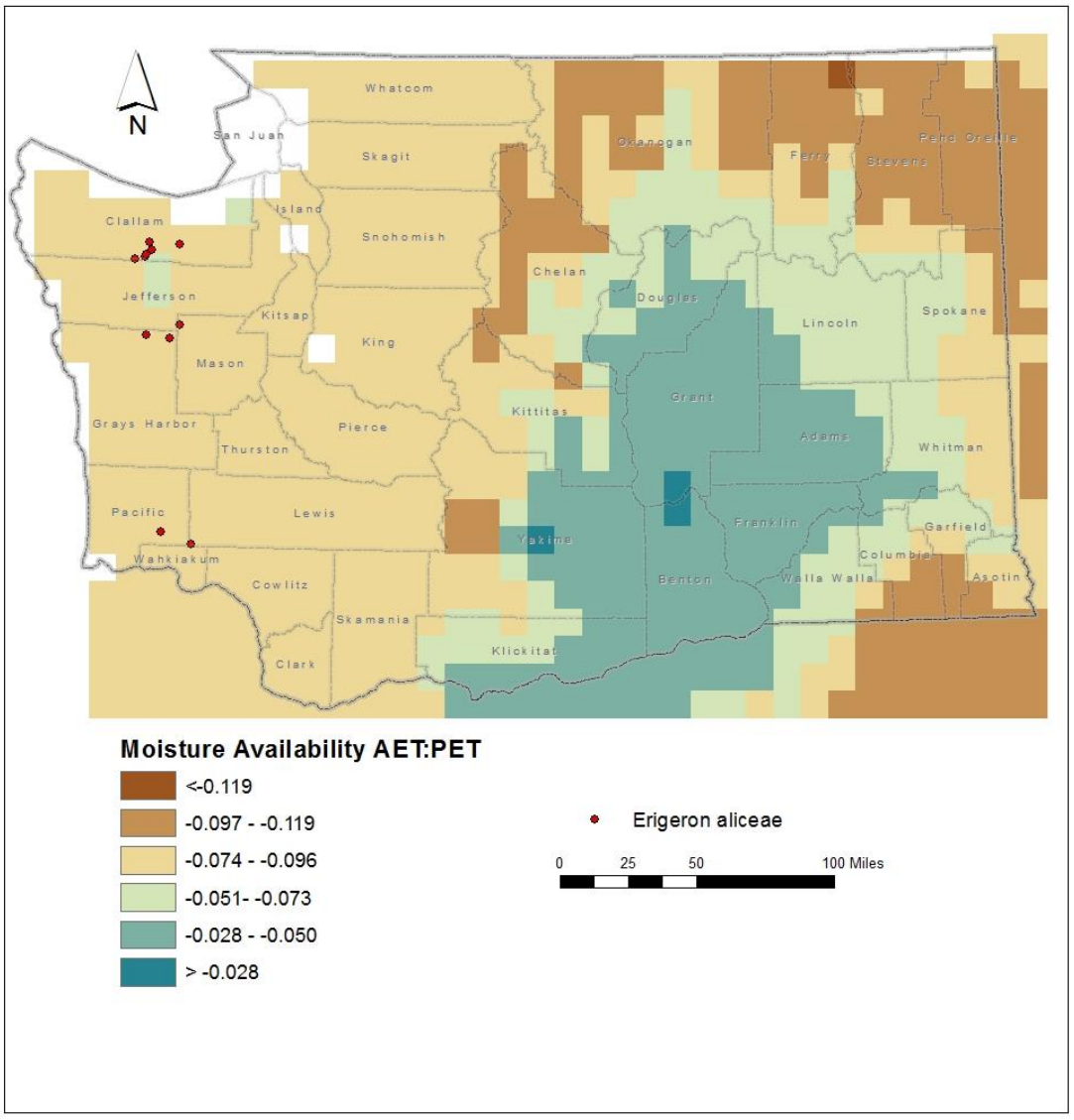

Figure 2. Exposure of *Erigeron aliceae* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Erigeron aliceae* are found at 2600-5475 feet (790-1670 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.
Erigeron aliceae populations in Washington are found primarily in subalpine meadows and rocky talus slopes or streamsides in forested areas (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is part of the North Pacific Alpine & Subalpine Dry Grassland and North Pacific Montane Massive Bedrock, Cliff, & Talus ecological systems (Rocchio and Crawford 2015). Populations may be isolated from each other by 1-70 miles (1.8-112 km) of unoccupied lowland habitat between the Olympic Range and the Willapa Hills.

B2b. Anthropogenic barriers: Somewhat Increase.
Most of the subalpine habitat of *Erigeron aliceae* in the Olympic Range is found in high elevation National Park or Wilderness lands with a minimal human imprint. Areas between the Olympics and Willapa Hills populations are a patchwork of second growth logged forests and other human infrastructure that may reduce dispersal.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Erigeron aliceae produces numerous, small, one-seeded dry fruits (cypselae), each topped by a pappus of 18-32 hair-like bristles that are adapted for dispersal by the wind. Dispersal distances may vary, but the species has the potential for moderate to long-distance dispersal (over 1 km).

C2ai. Historical thermal niche: Greatly Increase.
Figure 3 depicts the distribution of *Erigeron aliceae* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Seven of the 11 known occurrences in the state (63.6%) are found in areas that have experienced very small temperature variation (<37 °F/20.8 °C) during the past 50 years and are considered at greatly increased vulnerability to climate change (Young et al. 2016). The four other occurrences (36.4%) are from areas that have had a small variation (37-47 °F/20.8-26.3 °C) in temperature over the same period and are at increased vulnerability to climate change.

C2aii. Physiological thermal niche: Increase.
The subalpine meadow and exposed rocky talus habitat of *Erigeron aliceae* is entirely within a cold climate zone during the flowering season and vulnerable to increased temperatures from climate change.

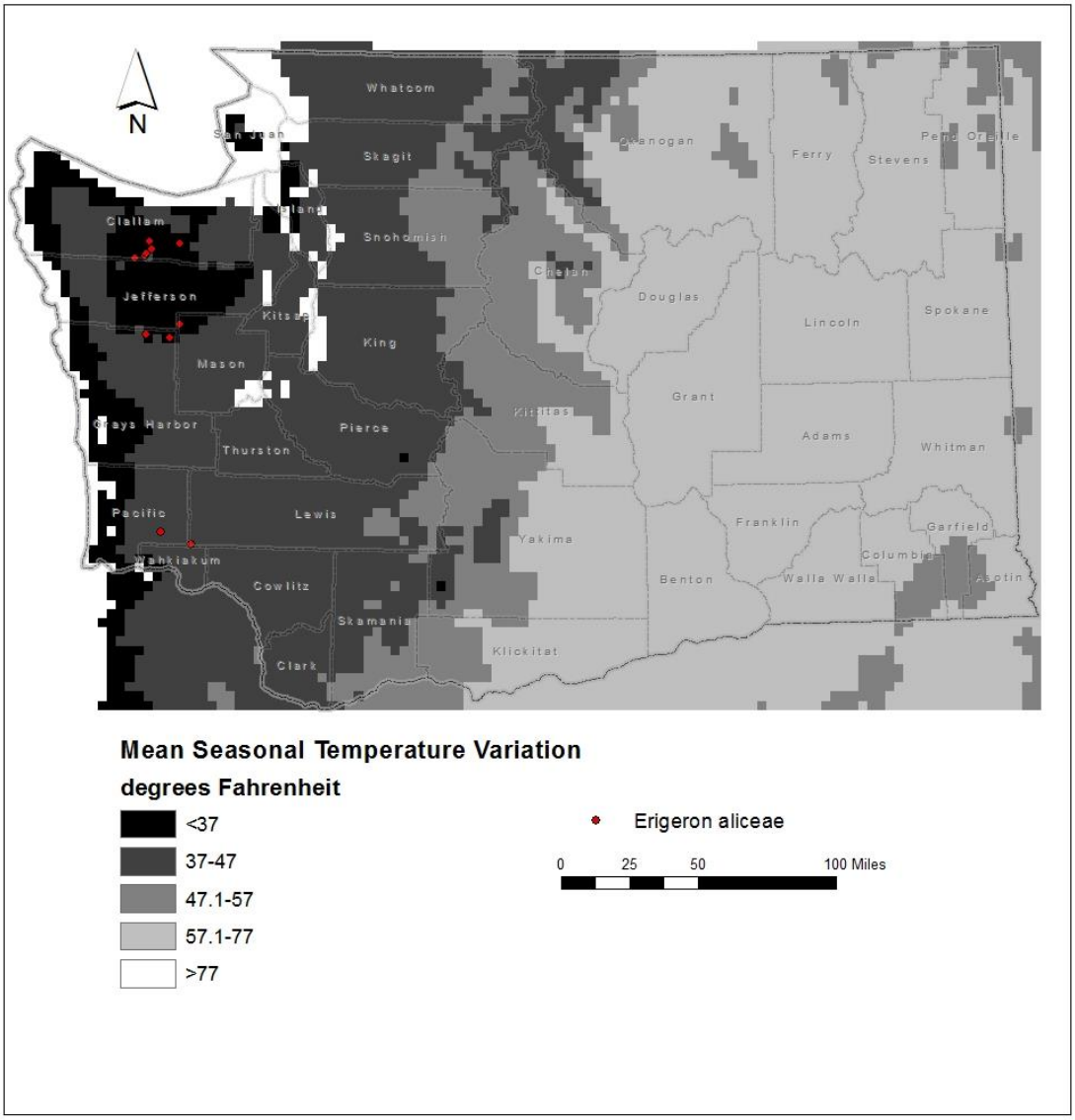

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Erigeron aliceae* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.

All of the known populations of *Erigeron aliceae* in Washington are found in areas that have experienced greater than average precipitation variation in the past 50 years (>40 inches/1016 mm) (Figure 4). According to Young et al. (2016), these occurrences are neutral for climate change.

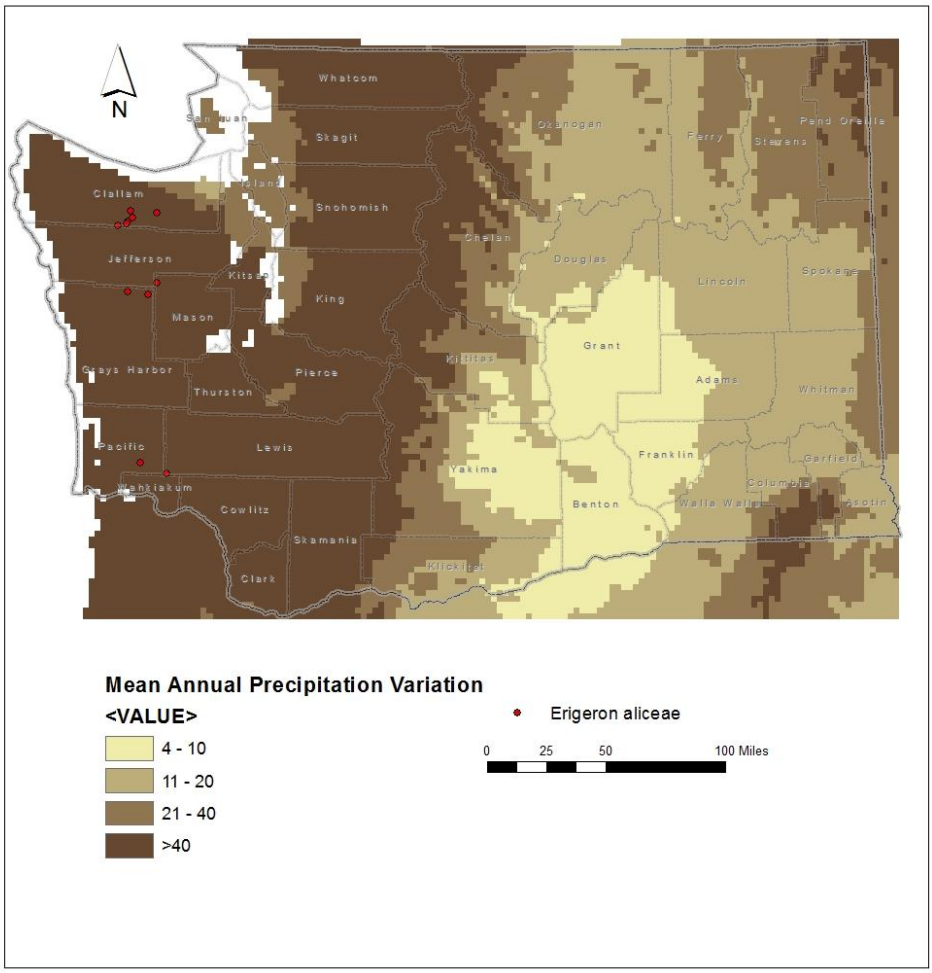

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Erigeron aliceae* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
Some populations of this species are associated with perennial water sources, but others are dependent on adequate winter snowpack or rainfall during the growing season. Changes in the amount or timing or precipitation or snowmelt could impact the persistence of *Erigeron aliceae* in meadow or talus sites.

C2c. Dependence on a specific disturbance regime: Neutral.
Erigeron aliceae occurs in subalpine meadows, talus, and forested streambanks. Open sites may be exposed to strong winds. Fire is infrequent in these high elevation habitats (Rocchio and Ramm-Granberg 2017). Soil characteristics and snowmelt dynamics may be the key drivers in maintaining these systems, rather than disturbance.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The populations of *Erigeron aliceae* in the Olympic Range are associated with high winter snow accumulation. Reduced snowpack due to climate change, or changes in the timing of snowmelt, could decrease the amount of moisture available during the growing season (Rocchio and Ramm-Granberg 2017) and favor plant species adapted to drier conditions. Populations from the Willapa Hills are less dependent on winter snow, but occur in areas of high winter rainfall.

C3. Restricted to uncommon landscape/geological features: Neutral.
Erigeron aliceae is found primarily on uplifted Eocene or Oligocene-age marine sediments that are relatively widespread in the Olympic Range and Willapa Hills (Washington Division of Geology and Earth Resources 2016).

C4a. Dependence on other species to generate required habitat: Neutral
The subalpine meadow and talus habitat of *Erigeron aliceae* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Erigeron aliceae, like most composites, is pollinated by generalist insect pollinators.

C4d. Dependence on other species for propagule dispersal: Neutral.
The dry, one-seeded fruits of *Erigeron aliceae* have a pappus of hair-like bristles for dispersal by wind, and thus are not dependent on animal species for transport.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. This species may be vulnerable to grazing or trampling by introduced mountain goats in the Olympic Range (Camp and Gamon 2011).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Under projected climate change, the subalpine meadow and talus habitat of *Erigeron aliceae* could become drier during the growing season due to changes in the amount or timing of snowmelt or summer rainfall, favoring native and introduced plant species adapted to drier conditions (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.
The genetic diversity within and between populations of *Erigeron aliceae* in Washington is not known. Molecular analysis of *E. aliceae* has focused mostly on deducing its relationship with other *Erigeron* taxa. Noyes (2000) found a relationship with species in Section *Asteroidea* (such as *E. eatonii* or *E. corymbosus*), whereas Nesom (2008) found stronger morphological similarities with other tall, leafy, aster-like species of Section *Fruticosus* (such as *E. glacialis*, *E. formosissimus*, and *E. howellii*). Being at the north end of its range, Washington populations of *E. aliceae* might be expected to have less overall genetic diversity due to limits on gene flow or founder effects.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral.
Erigeron aliceae is an obligate outcrosser and is not limited by pollinators or dispersal, so 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), no changes have occurred in the blooming period of *Erigeron aliceae* (June through August) in 90 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 *Erigeron aliceae* in Washington since it was first discovered in the state in the 1930s.

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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