Climate Change Vulnerability Index Report

Sabulina nuttallii var. *fragilis* (Nuttall's sandwort)

Date: 23 November 2021 Synonym: *Minuartia nuttallii* var. *fragilis*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G5T4/S1

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		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		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		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: All 4 of the occurrences of *Sabulina nuttallii* var. *fragilis* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

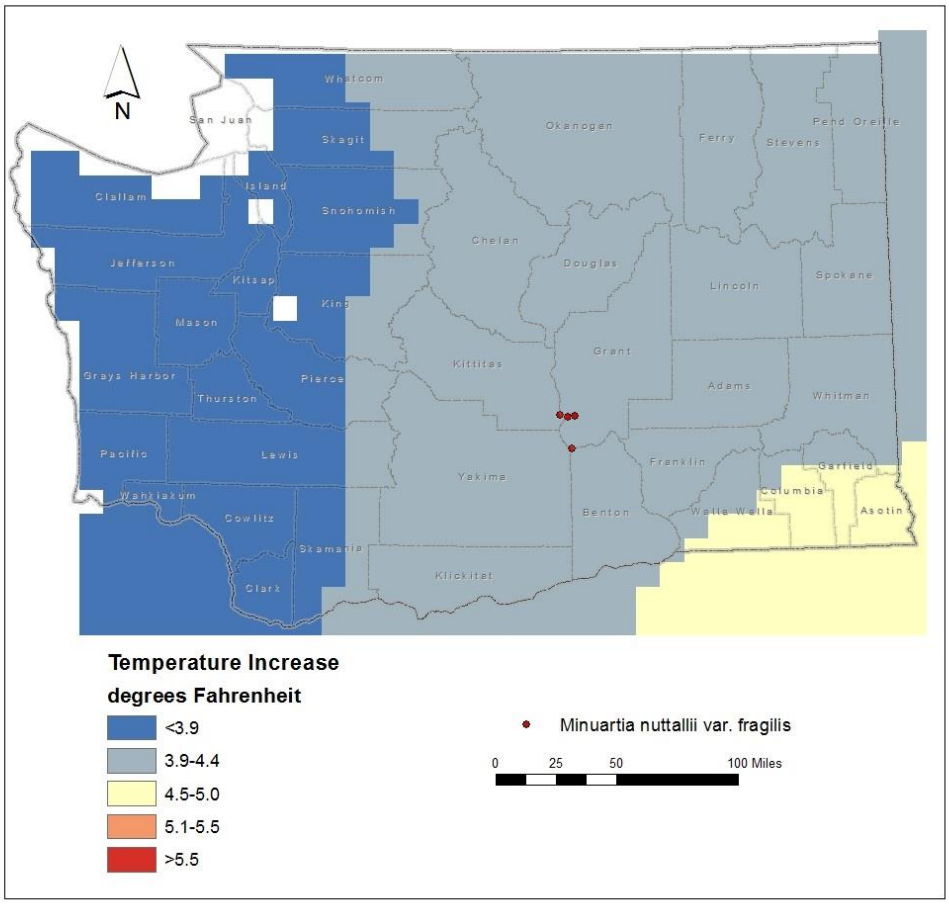

Figure 1. Exposure of *Sabulina nuttallii* var. *fragilis* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: All four occurrences of *Sabulina nuttallii* var. *fragilis* in Washington (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).

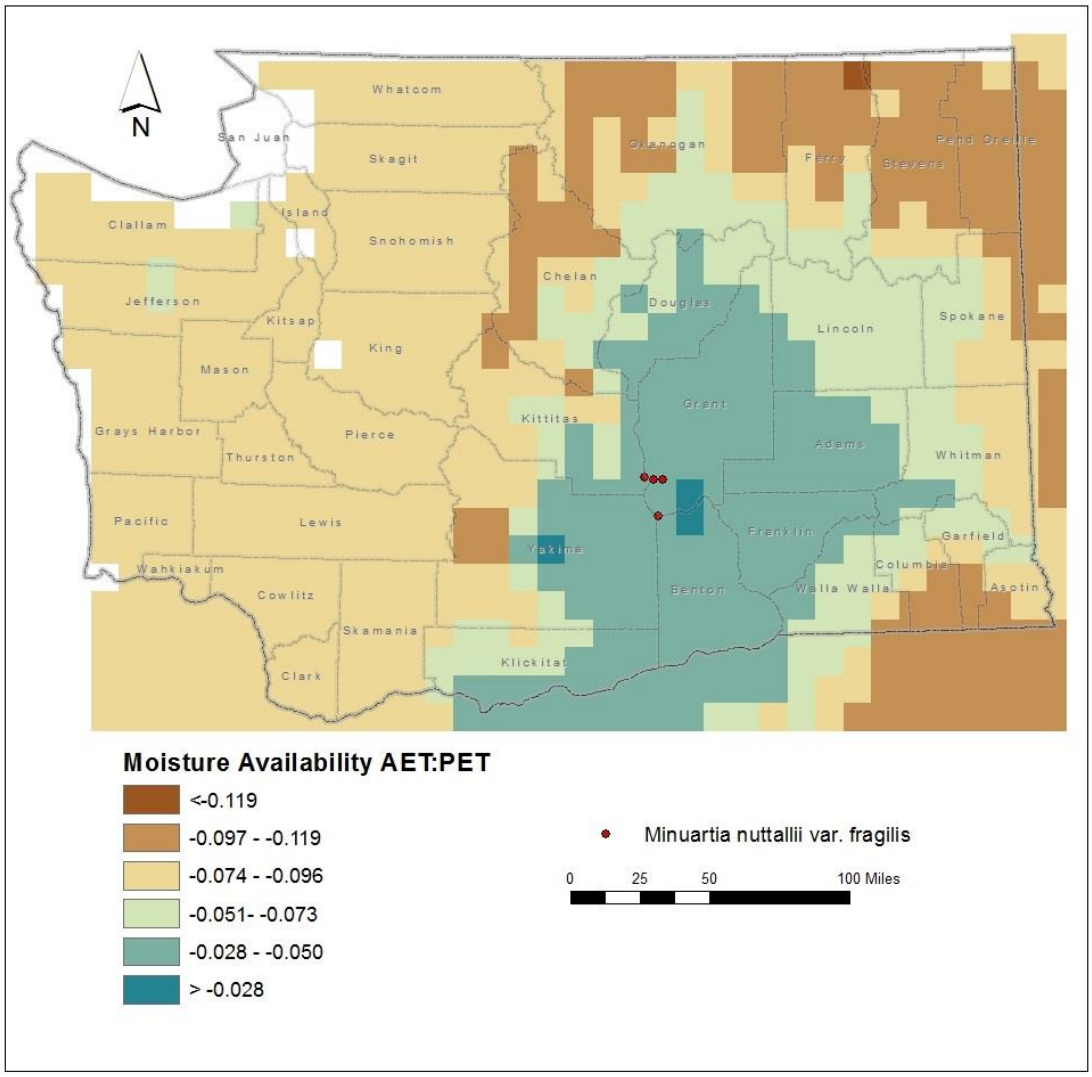

Figure 2. Exposure of *Sabulina nuttallii* var. *fragilis* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Sabulina nuttallii* var. *fragilis* are found at 520-2350 feet (160-715 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Sabulina nuttallii* var. *fragilis* occurs primarily on steep, often north-facing, slopes of basalt talus (sometimes with intermixed sand) of desert ridges (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is part of the Intermountain Basin Cliff & Canyon ecological system (Rocchio and Crawford 2015). The entire range of var. *fragilis* in Washington is restricted to an area of 7 x 15 miles (11 x 24 km) with individual populations separated by 1.9-13.5 miles (3.2-21.4 km). Additional potential habitat is present in desert ridges of the central Columbia Plateau, but dispersal may be constrained by unsuitable habitat in intervening valleys.

B2b. Anthropogenic barriers: Somewhat Increase.
The desert ridge habitat of *Sabulina nuttallii* var. *fragilis* in Washington is embedded within an anthropogenic landscape used for human habitation and agriculture that present a barrier to dispersal.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Sabulina nuttallii var. *fragilis* produces numerous dry capsule fruits that split open along 3 sutures at maturity to passively release 1-3 seeds covered by low, bump-like tubercles (Rabeler et al. 2005). These seeds could be dispersed relatively short distances by high winds. Seeds that fall to the ground near the parent plant may be secondarily dispersed by seed-caching insects or rodents. Inflorescences of var. *fragilis* are also quite brittle and could be dispersed by wind as a unit, like a tumbleweed. Average dispersal distances are probably short (<1000 m), though rare, long-distance events are likely.

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Sabulina nuttallii* var. *fragilis* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All four 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 basalt talus habitat of *Sabulina nuttallii* var. *fragilis* is not associated with cold air drainage during the growing season and would have neutral vulnerability to climate change.

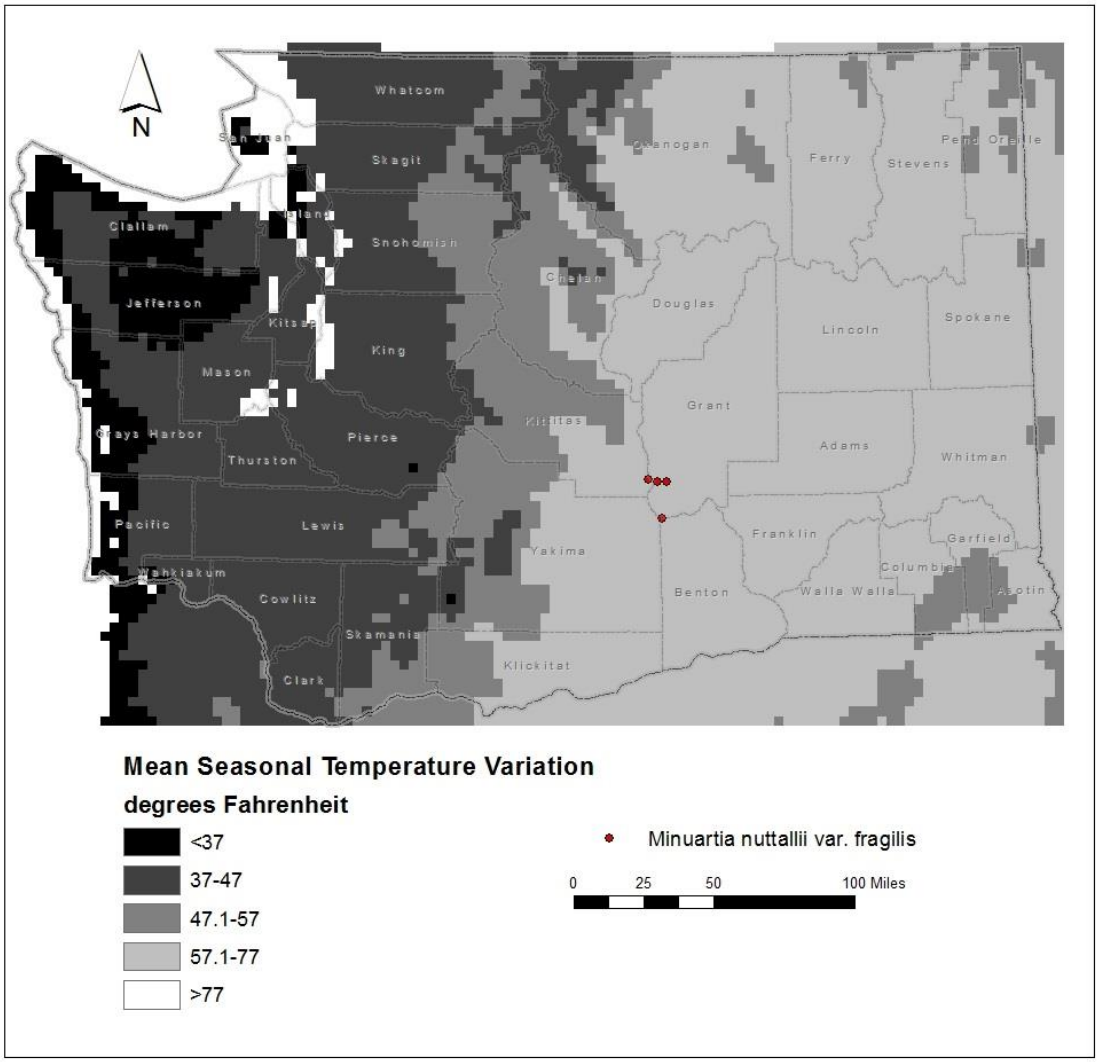

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Sabulina nuttallii* var. *fragilis* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Increase.
All of the known populations of *Sabulina nuttallii* var. *fragilis* in Washington 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 to climate change.

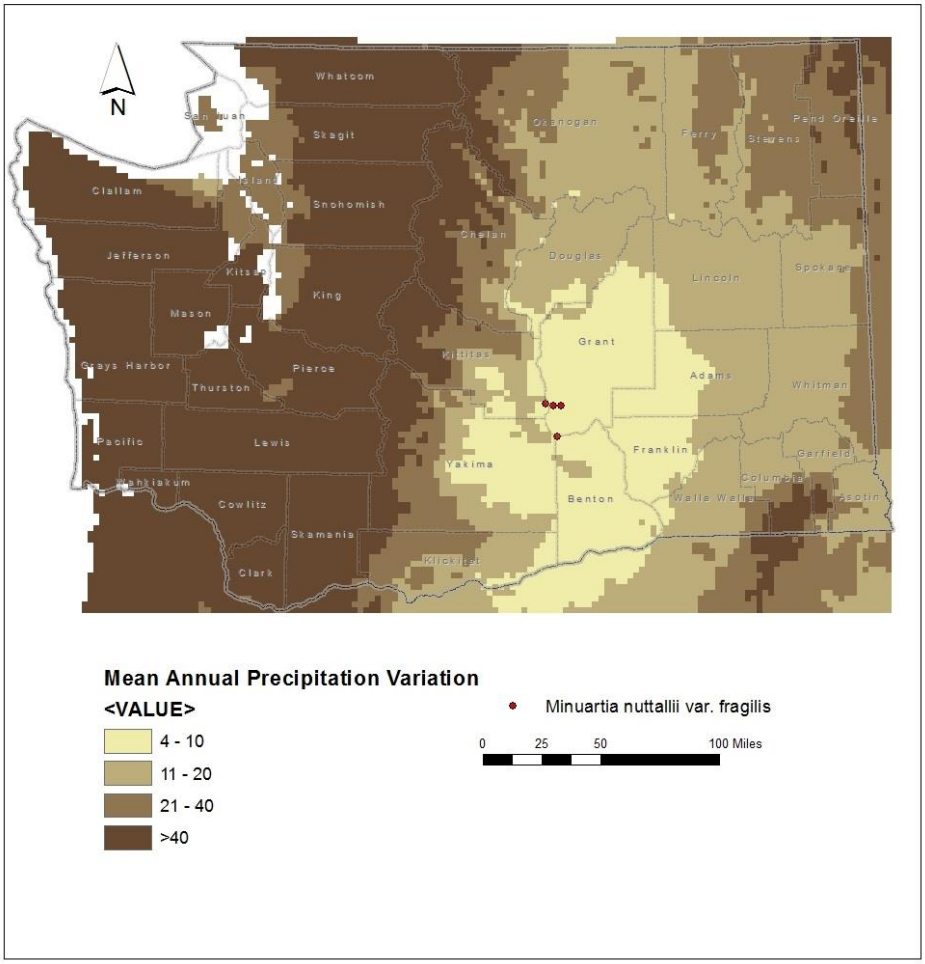

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Sabulina nuttallii* var. *fragilis* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

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 perennial water sources or a high water table. The Intermountain Basins Cliff and Canyon ecological system is vulnerable to changes in the timing or amount of precipitation and increases in temperature that make these sites more drought-prone (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Sabulina nuttallii var. *fragilis* occurs in sparsely vegetated desert talus sites subjected to high winds. Historically, these sites had relatively low cover and probably burned infrequently.

C2d. Dependence on ice or snow-cover habitats: Neutral.
The populations of *Sabulina nuttallii* var. *fragilis* in Washington are found in areas of the central Columbia Plateau that receive low amounts of winter snow. Some drifting snow may accumulate in talus areas and recharge ground water, providing a short-term hydrologic boost in early spring. Overall, this species is probably more dependent on winter or spring rainfall.

C3. Restricted to uncommon landscape/geological features: Neutral.
In Washington, *Sabulina nuttallii* var. *fragilis* is found on steep talus slopes of reddish-brown basalt talus derived from the middle Miocene Grande Ronde basalt (Washington Division of Geology and Earth Resources 2016). Some sites contain wind-blown sand from adjacent dune fields, or are associated with Quaternary-age landslide deposits. The Grande Ronde basalt is widely distributed in central and eastern Washington.

C4a. Dependence on other species to generate required habitat: Neutral.
The desert basalt talus habitat occupied by *Sabulina nuttallii* var. *fragilis* is maintained by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The specific pollinators of *Sabulina nuttallii* var. *fragilis* are not known. Many *Sabulina* species possess floral nectaries to attract a variety of insect pollinators, including flies, bees, and butterflies (Rabeler et al. 2005).

C4d. Dependence on other species for propagule dispersal: Neutral.
Seeds of *Sabulina nuttallii* var. *fragilis* have no morphologic features to promote dispersal by wind or for attaching to fur or feather of animals.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. The prickly foliage of this taxon probably reduced herbivory from ungulates and livestock, but not smaller grazers (insects or rodents). Impacts from grazing is probably low (Washington Natural Heritage Program 2021).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Sabulina nuttallii var. *fragilis* occurs in sparsely vegetated steep talus slopes where competition from other plant species is naturally low. Under projected climate change, cover of weedy annual species might increase. Prolonged drought might also shift species composition from vascular plants to lichens (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.
There is no published research on genetic diversity of var. *fragilis*. Hartman (1971) found *Sabulina nuttallii* (as *Arenaria nuttallii*) to be a tetraploid with $2n = 36$ chromosomes. Washington populations of var. *fragilis* are disjunct from the closest occurrences in central Oregon and might have reduced genetic diversity due to inbreeding or founder effects.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral.
Sabulina nuttallii var. *fragilis* appears to be an obligate outcrosser and is not limited by pollinators, 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), *Sabulina nuttallii* var. *fragilis* has not changed its typical blooming time in the last 40 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No changes have been detected in the distribution of *Sabulina nuttallii* var. *fragilis* in Washington since it was first discovered in the state in 1984.

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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