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

<table>
<thead>
<tr>
<th>Section A: Local Climate</th>
<th>Severity</th>
<th>Scope (% of range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temperature Severity</td>
<td>&gt;6.0° F (3.3°C) warmer</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5.6-6.0° F (3.2-3.3°C) warmer</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5.0-5.5° F (2.8-3.1°C) warmer</td>
<td>0</td>
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<tr>
<td></td>
<td>4.5-5.0° F (2.5-2.7°C) warmer</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3.9-4.4° F (2.2-2.4°C) warmer</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&lt;3.9° F (2.2°C) warmer</td>
<td>0</td>
</tr>
<tr>
<td>2. Hamon AET:PET moisture</td>
<td>&lt;-0.119</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-0.097 to -0.119</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-0.074 to -0.096</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-0.051 to -0.073</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-0.028 to -0.050</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>&gt;-0.028</td>
<td>0</td>
</tr>
</tbody>
</table>

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

2a(ii). 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 other 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](image-url)
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).

![Map of Washington showing moisture availability](image)

**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](http://www.natureserve.org/ccvi)
Section B. Indirect Exposure to Climate Change

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.

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.

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.

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).

C2aai. 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.
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 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
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.

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
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.

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.

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


