Climate Change Vulnerability Index Report

Draba taylorii (Taylor's draba)

Date: 8 March 2021 Synonym: *Draba taylori* (orthographic variant)

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G1G2/S1

Index Result: Highly 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	100
	-0.074 to -0.096	0
	-0.051 to -0.073	0
	-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		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		Increase/Somewhat Increase
2ai Change in historical thermal niche		Somewhat Increase
2aii. Change in physiological thermal niche		Greatly 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		Increase
3. Restricted to uncommon landscape/geological features		Somewhat Increase
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		Neutral/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	Increase
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: Both occurrences of *Draba taylorii* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

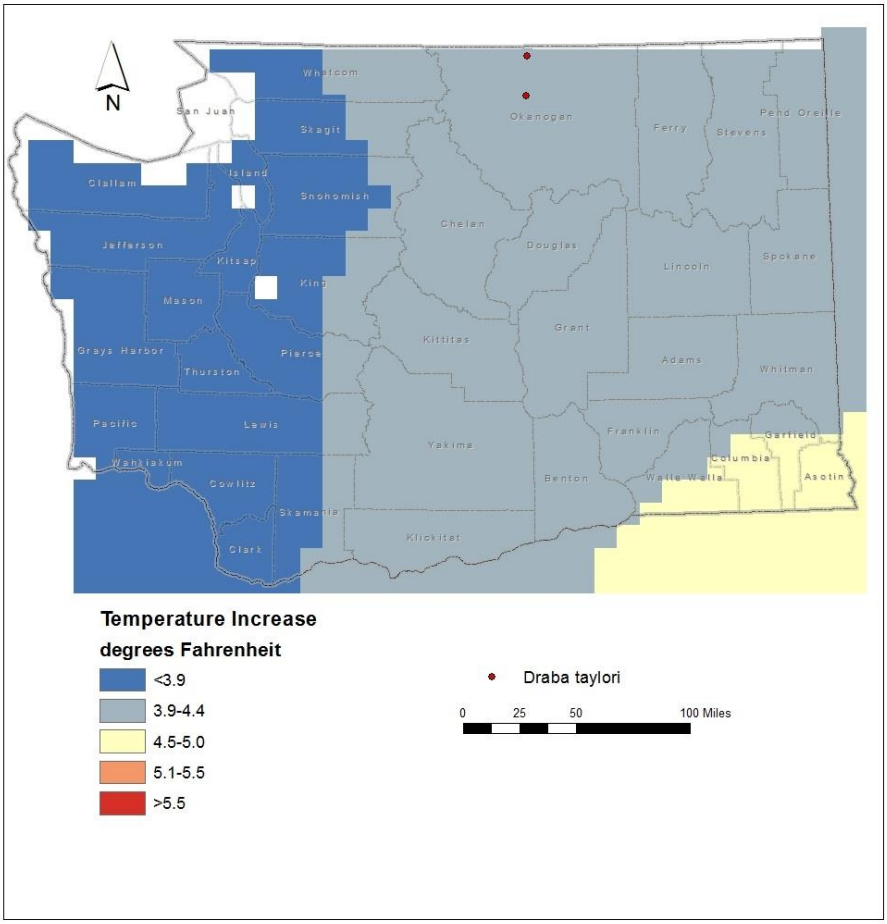

Figure 1. Exposure of *Draba taylorii* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The two occurrences of *Draba taylorii* 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 -0.097 to -0.119 (Figure 2).

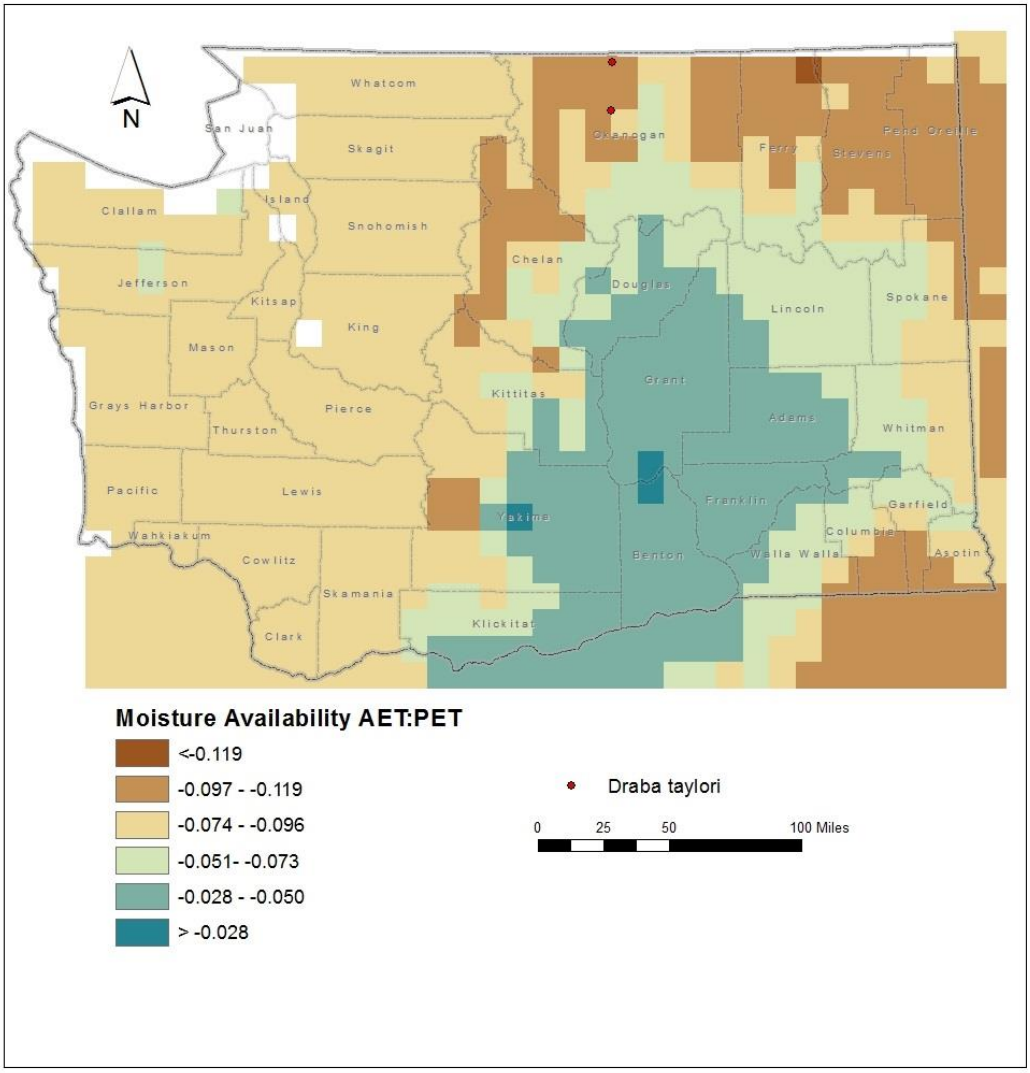

Figure 2. Exposure of *Draba taylorii* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Draba taylorii* are found at 7910-7980 feet (2410-2435 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
Draba taylorii occurs on east and southwest-facing rims and flat summits of gneiss and metagabbro bedrock in upper subalpine fellfield and turf communities of Engelmann sedge (*Carex engelmannii*), northern single-spike sedge (*C. scirpoidea*), Drummond's rush (*Juncus drummondii*), Spike oatgrass (*Trisetum spicatum*), alpine sandwort (*Cherleria obtuisloba*), blueleaf cinquefoil (*Potentilla glaucophylla*), and spotted saxifrage (*Saxifraga austromontana*) (Fertig 2020). This habitat is part of the Rocky Mountain Alpine Dwarf-Shrubland, Fell-Field, and Turf ecological system (Rocchio and Crawford 2015). The Washington populations are separated from each other by 21 miles (35 km) of mostly unoccupied and unsuitable habitat. The full range of the species may not yet be known, since it is recently described and probably under-collected. Natural barriers may be sufficient to restrict gene flow between populations and impede future migration.

B2b. Anthropogenic barriers: Neutral.
The subalpine/alpine habitat of *Draba taylorii* in Washington is located primarily within wilderness areas and sparsely developed areas in the Okanogan Range. Some roads and scattered ranches and homesites are present, but do not present a significant 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: Increase/Somewhat Increase.
Draba taylorii produces infructescences of 2-4 dry, silicle fruits with 6-10 smooth, wingless seeds 1-1.3 mm long (Al-Shehbaz and Mulligan 2013). These seeds are probably dispersed short distances by high winds or secondarily by insects or rodents once they land on the ground. Average dispersal distances are not known, but are likely to be less than 100 m from the parent plant, with longer dispersal possible under rare conditions, such as extreme weather events with high winds.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Draba taylorii* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Both known occurrences in the state (100%) 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).

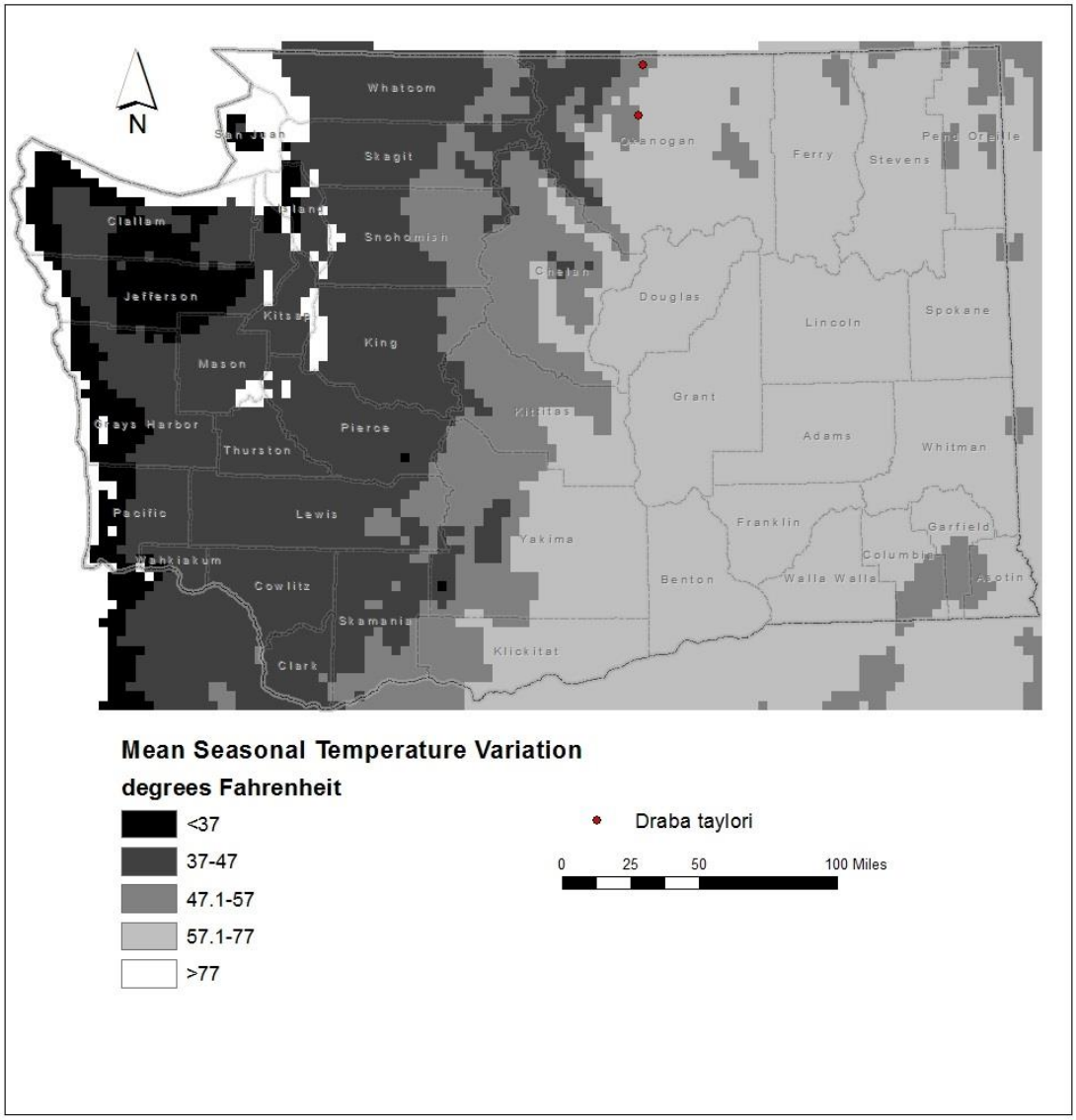

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Draba taylorii* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Greatly Increase.
The subalpine rock and ledge habitat of *Draba taylorii* is exposed to high winds and cold temperatures throughout the growing season and is highly vulnerable to temperature increases due to climate change.

C2bi. Historical hydrological niche: Neutral.
Both of the known populations of *Draba taylorii* in Washington (100%) are from areas that have experienced average precipitation variation in the past 50 years (20-40 inches/508-1016

mm) (Figure 4). According to Young et al. (2016), these occurrences are neutral for climate change.

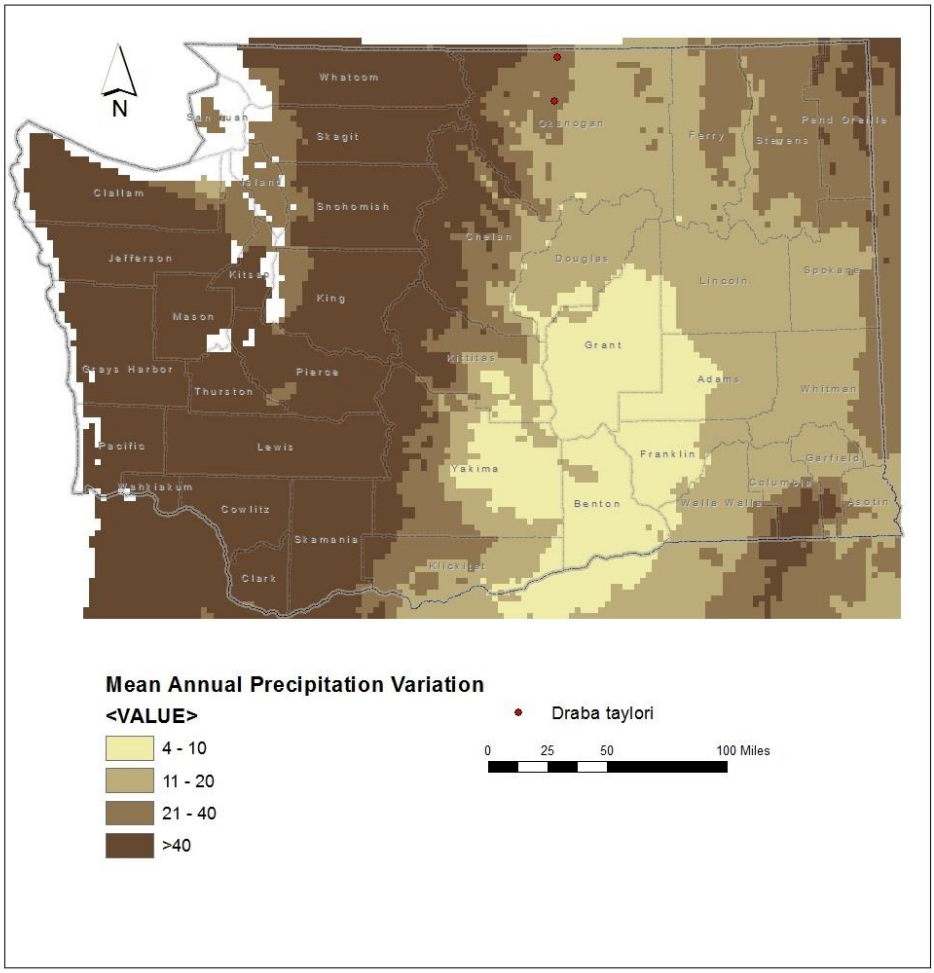

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Draba taylorii* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is dependent on winter snow and summer precipitation for meeting its moisture needs, as it is not associated with wetlands or soils with a high water table. As such, it could be vulnerable to changes in the timing or amount of snow and rainfall and to warmer conditions changing the timing of snowmelt (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Draba taylorii occurs in upper subalpine ledge and rock outcrop habitats that are subject to high winds and occasional rock fall.

C2d. Dependence on ice or snow-cover habitats: Increase.
The populations of *Draba taylorii* in Washington are found on upper subalpine ridgecrests and rocky ledges in areas of moderate to high snowfall. 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: Somewhat Increase.
Draba taylorii is found on outcrops of gneiss and metagabbro in the Okanogan Mountains (Washington Division of Geology and Earth Resources 2016). These rock types are of limited distribution in Washington outside of the Okanogan Range.

C4a. Dependence on other species to generate required habitat: Neutral.
The alpine talus and tundra habitat occupied by *Draba taylorii* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Based on its small flower size and sterile anthers, *Draba taylorii* appears to be an apomictic species capable of producing fertile seed without pollination (Al-Shehbaz and Mulligan 2013; Hitchcock and Cronquist 2018).

C4d. Dependence on other species for propagule dispersal: Neutral.
The seeds of *Draba taylorii* are small and light weight and are probably dispersed by wind. Insects or rodents might transport seeds short distances and cache them for later consumption. *Draba taylorii* is probably not dependent for dispersal by a specific animal species.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Not known, but probably not a limiting factor.

C4f. Sensitivity to competition from native or non-native species: Neutral/Somewhat Increase.
Currently, competition from non-native species is low, as few introduced plants are adapted to the harsh environmental conditions of the upper subalpine zone and cover of native species is low. Under projected climate change, competition could increase if lower elevation plant species are able to expand their range into formerly uninhabitable habitat (Rocchio and Ramm-Granberg 2017) due to longer growing seasons and increases in primary productivity resulting in more soil formation (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.
Not known.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Increase.
Al-Shehbaz and Mulligan (2013) consider *Draba taylorii* to be an apomictic species based on it not producing fertile pollen. Apomixis is a form of asexual reproduction in which fertile ovules are produced without pollination (also called agamospermy) and is common in the genus *Draba*, particularly for species from northern latitudes or of hybrid or polyploid origin (Al-Shehbaz et al. 2010, Brochmann 1992). Due to the lack of genetic intermixing, apomictic species tend to have low genetic diversity. Studies of the genetic variability and chromosome number have not been conducted for *D. taylorii* (Al-Shehbaz and Mulligan 2013).

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), *Draba taylorii* has not changed its typical blooming time since the 1930s.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
The distribution of *Draba taylorii* is poorly known since it was only described as a new species in 2013. One population discovered in 1933 was relocated in 2018.

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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