Climate Change Vulnerability Index Report

Gaultheria hispidula (Creeping snowberry)

Date: 11 February 2020

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington   Heritage Rank: G5/S2

Index Result: Moderately Vulnerable   Confidence: Very High

Climate Change Vulnerability Index Scores

Section A	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	86
	-0.074 to - 0.096	14
	-0.051 to - 0.073	0
	-0.028 to -0.050	0
	>-0.028	0
Section B		**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		
1. Dispersal and movements		Somewhat Increase
2ai Change in historical thermal niche		Neutral/Somewhat 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		Neutral
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	
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 seven of the known occurrences of *Gaultheria hispidula* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4° F (Figure 1).
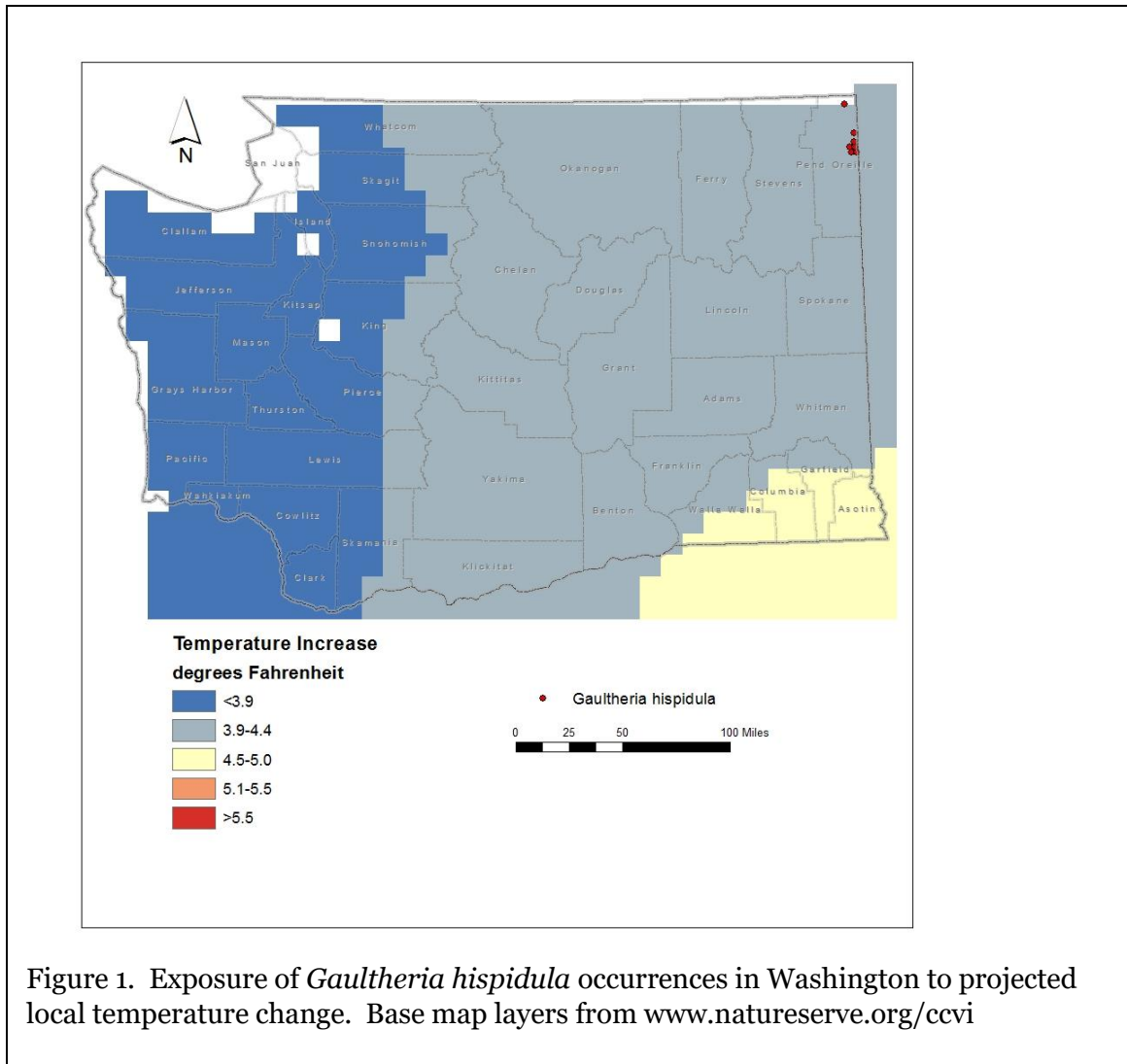

Figure 1. Exposure of *Gaultheria hispidula* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Six of the seven Washington occurrences of *Gaultheria hispidula* (86%) 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). One other occurrence (14%) is from an area with a projected decrease of -0.074 to -0.096.
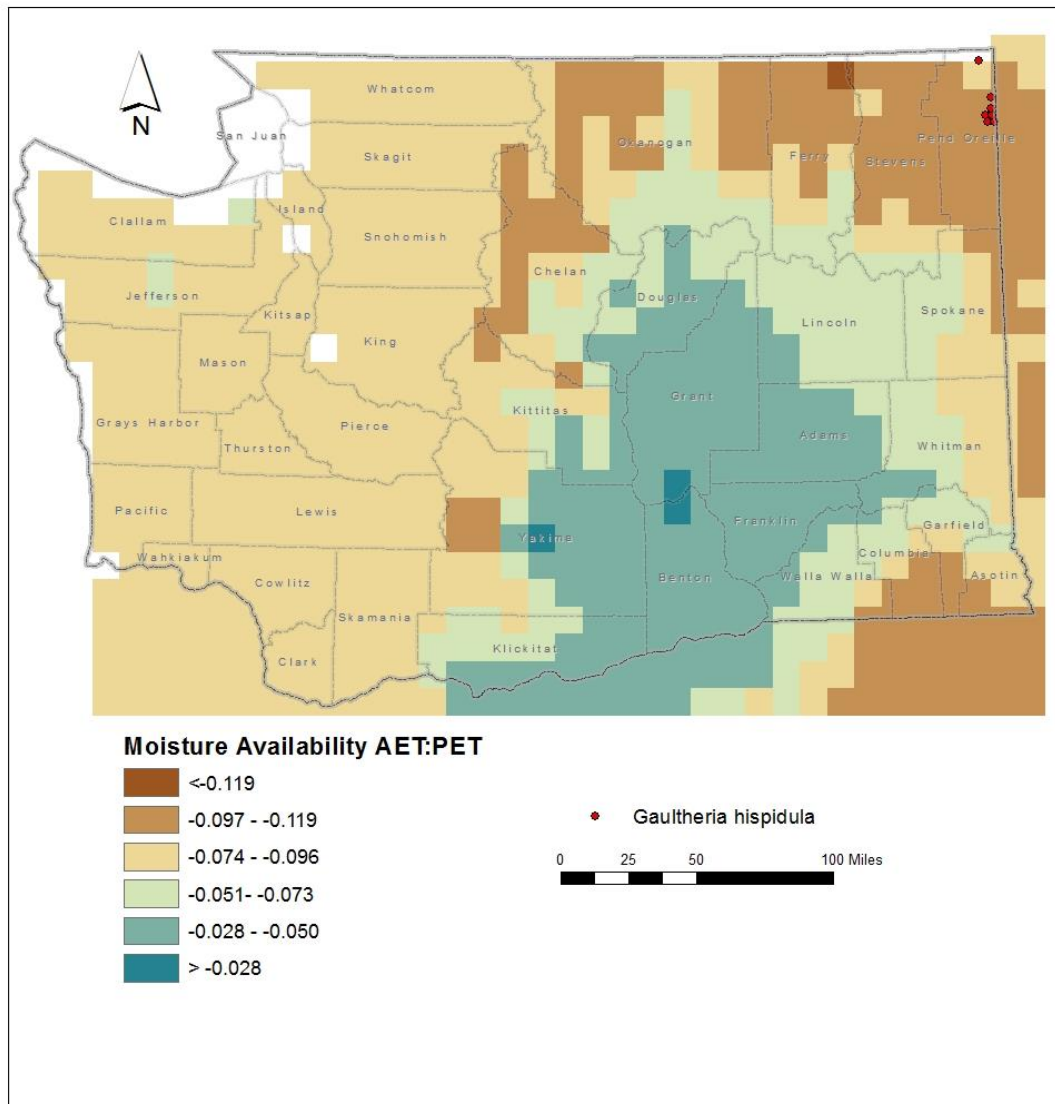

Figure 2. Exposure of *Gaultheria hispidula* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Gaultheria hispidula* are found at 2960-6470 feet (900-1160 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Gaultheria hispidula* is restricted to swamp forests in drainage bottoms dominated by *Thuja plicta* or *Picea engelmannii* with abundant *Sphagnum* in the understory and rotting logs (Camp and Gamon 2011, WNHP Biotics records). All of these records are from the Canadian Rockies ecoregion of northeastern Pend Oreille County. A report from the North Cascades in Snohomish County is based on a misidentified specimen of *Vaccinium oxycoccus* and is not included in this assessment. The habitat from northeastern Washington is part of the Rocky Mountain Subalpine-Montane Fen ecological system (Rocchio and Crawford 2015). Populations often consist of numerous subpopulations scattered along a drainage within 1 km of each other. Other populations may be separated by 3.7-8 km (2.5-5 miles) of unoccupied habitat. The natural heterogeneity of suitable habitat and its presence within a matrix of unsuitable environments creates a natural barrier to pollen and seed dispersal.

B2b. Anthropogenic barriers: Neutral.
The *Sphagnum*-rich wet forest habitat of *Gaultheria hispidula* in Washington is already naturally patchy, so additional habitat fragmentation by human activities is a relatively minor impediment 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.
Gaultheria hispidula produces berry-like edible fruits (technically a dry many-seeded capsule enclosed by a juicy calyx). These are primarily dispersed by small rodents (mice or chipmunks) for relatively short distances (Hays 2001).

C2ai. Historical thermal niche: Neutral/Somewhat Increase
Figure 3 depicts the distribution of *Gaultheria hispidula* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Four of the seven known occurrences (57%) are found in areas that have experienced average temperature variation (57.1-77˚F/31.8-43.0˚C) during the last 50 years and are considered neutral in terms of climate change vulnerability (Young et al. 2016). Three populations (43%) 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.

C2aii. Physiological thermal niche: Increase.
The montane *Sphagnum*-rich swamp forest habitat of *Gaultheria hispidula* is restricted to areas of cold air drainage and would have increased vulnerability to temperature increase from climate change.
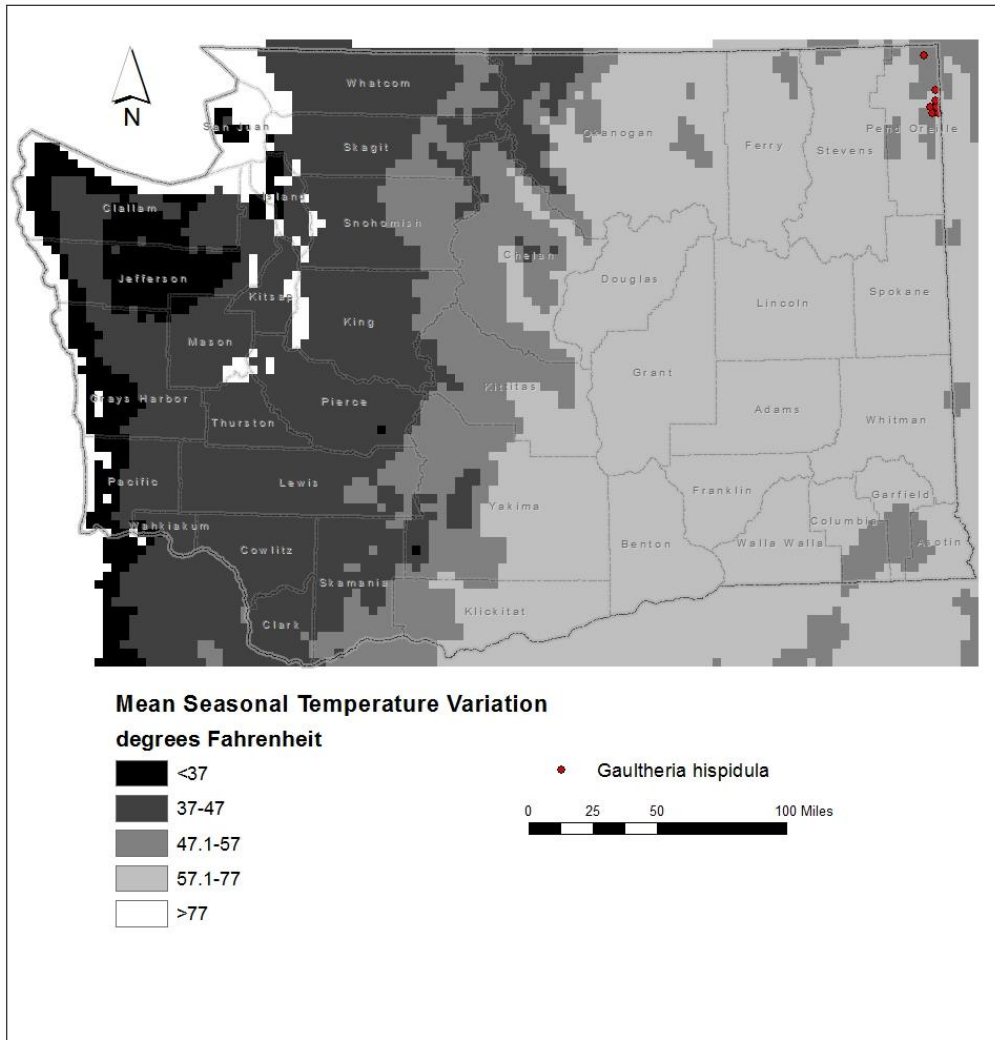

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Gaultheria hispidula* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.

All seven of the known populations of *Gaultheria hispidula* in Washington (100%) are found in areas that have experienced average or greater than average (>20 inches/508 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at neutral vulnerability from climate change.

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Gaultheria hispidula* occurrences in Washington. Base map layers from www.natureserve.org/ccvi
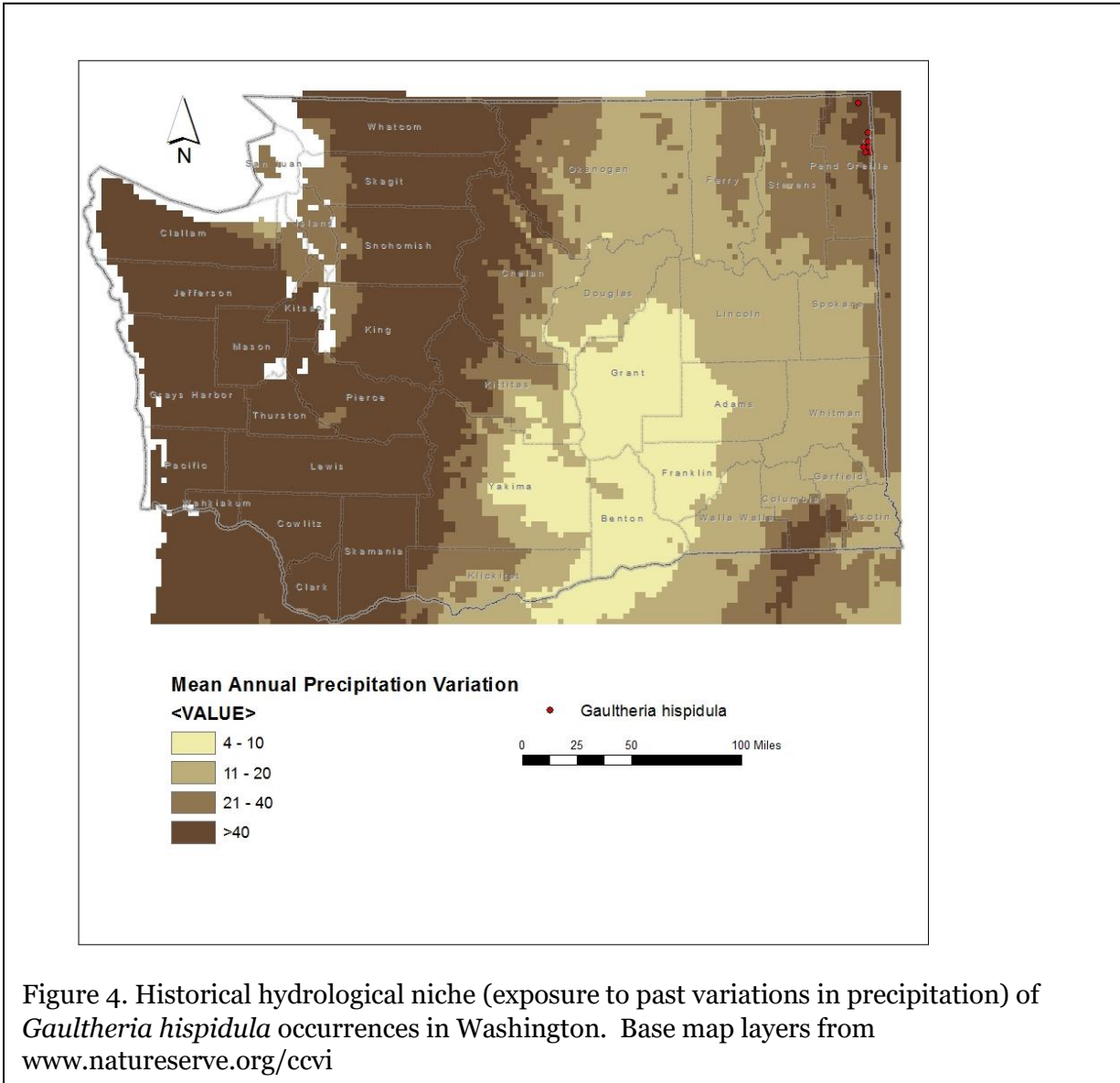
C2bii. Physiological hydrological niche: Somewhat Increase.

The *Sphagnum*-rich swamp forest habitats of *Gaultheria hispidula* are associated with groundwater discharge that in turn is affected by snowpack and precipitation. In the face of projected climate change, extended summer drought would reduce the amount of moisture avaiable for the *Sphagnum* understory. Increased fire frequency would negatively impact

swamp forests and create open conditions, reducing habitat quality for this species (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Gaultheria hispidula occurs in *Sphagnum*-rich swamp forest habitats that are maintained by a high water table and are not adapted to frequent natural disturbance cycles. Prolonged drought that might reduce groundwater or increase wildfire in surrounding forested habitat could make these sites more prone to invasion by wetland plants adapted to less specific environmental conditions.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The populations of *Gaultheria hispidula* in Washington occur in *Sphagnum*-rich swamp forest habitats maintained by groundwater in regional aquifers. Ultimately, these sites are dependent on adequate winter snowfall for recharge. Reduction in winter snow accumulation could have a long term negative impact on the hydrologic conditions necessary to maintain this habitat (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.
Gaultheria hispidula occurs on a variety of Quaternary glacial till formations that are relatively widespread. It is not directly associated with unusual topography.

C4a. Dependence on other species to generate required habitat: Neutral
The swamp forest habitat occupied by *Gaultheria hispidula* is maintained by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Gaultheria hispidula is probably self-sterile and pollinated by bumblebees, solitary bees, bee flies and syrphid flies (Hays 2001).

C4d. Dependence on other species for propagule dispersal: Neutral.
Dependent on several species of small mammals for dispersal (Hays 2001).

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Palatable, but not thought to be threatened by grazing from native species (livestock grazing may be a localized impact).

C4f. Sensitivity to competition from native or non-native species: Neutral.
Under present conditions, competition from non-native species is not limiting, as few introduced plants are adapted to the harsh environmental conditions of *Sphagnum*-dominated swamp forests. Under projected climate change, competition could increase if these sites are converted to drier meadows due to a reduction in groundwater availability from prolonged drought, reduced snow recharge, or fire (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 are no published studies specifically addressing the population genetics of this species.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
Gaultheria hispidula is presumed to be an outcrosser and pollinated by numerous species of bees and flies, suggesting that genetic variability should be average rangewide. Populations at the southern edge of its range (like Washington) might be expected to have lower overall diversity due to founder effects.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records from the Consortium of Pacific Northwest Herbaria website, no significant changes in the phenology of this species have occurred over the past 50 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No change in the distribution of this species in Washington has been documented.

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

Camp, P. and J.G. Gamon, eds. 2011. Field Guide to the Rare Plants of Washington. University of Washington Press, Seattle. 392 pp.

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