Climate Change Vulnerability Index Report

Vaccinium myrtilloides (Velvetleaf blueberry)

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Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G5/S1

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	100
	-0.074 to - 0.096	0
	-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		Neutral
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Increase
2bi. Changes in historical hydrological niche		Somewhat Increase
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		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		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	
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: The single occurrence of *Vaccinium myrtilloides* in Washington (100%) occurs in an area with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

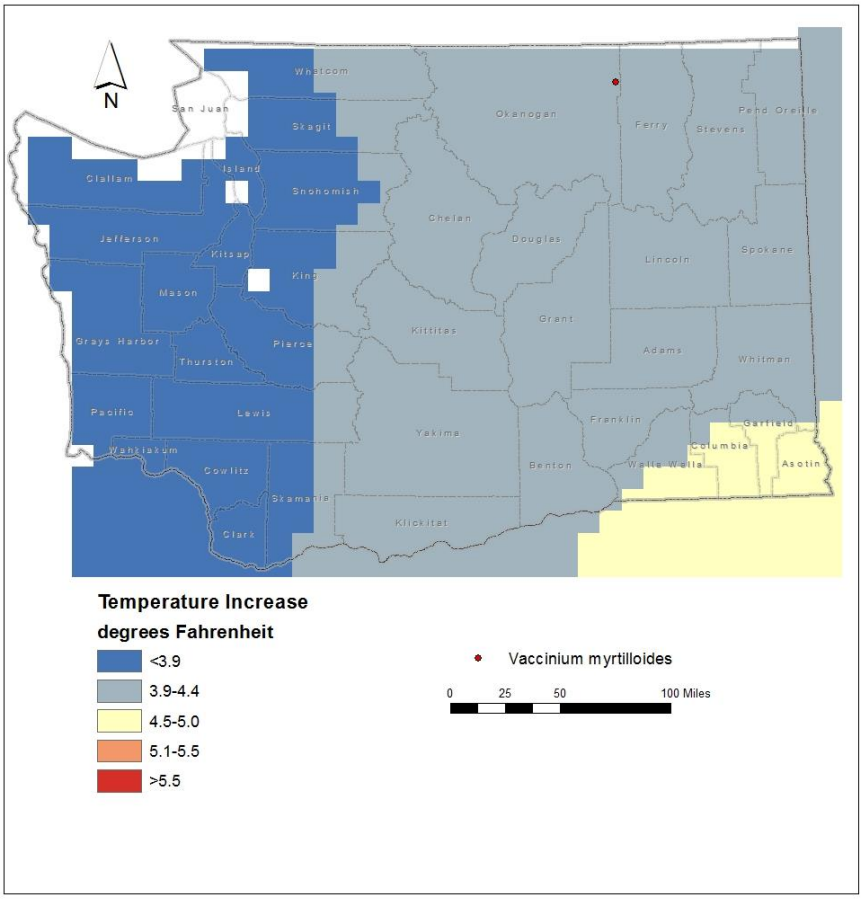

Figure 1. Exposure of *Vaccinium myrtilloides* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The single occurrence of *Vaccinium myrtilloides* (100%) in Washington is found in an area 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).

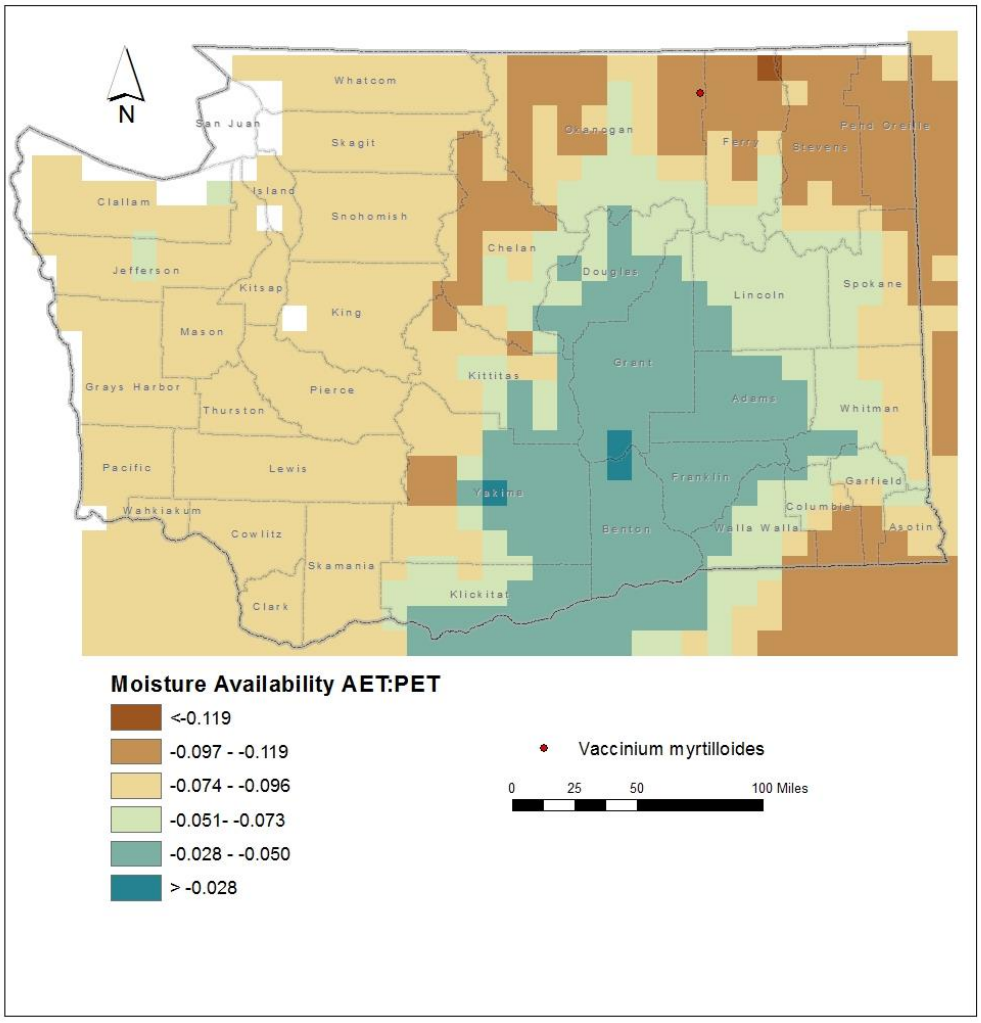

Figure 2. Exposure of *Vaccinium myrtilloides* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Vaccinium myrtilloides* are found at 3400-3500 feet (1035-1065 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Vaccinium myrtilloides* occurs in small, moss-rich openings within semo-mature *Picea engelmannii* forests with an understory of *Symphoricarpos albus, Cornus canadensis*, and *Linnaea borealis* (Camp and Gamon 2011). This habitat is probably a component of the Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland ecological system (Rocchio and Crawford 2015). The single Washington occurrence covers an area of less than 20 acres. The full extent of its range, and its dependence on micro-habitat characteristics, are probably incompletely known. Its distribution may be constrained by natural barriers.

B2b. Anthropogenic barriers: Neutral.
The range of *Vaccinium myrtilloides* in the Okanogan Range has some human imprint from roads and pockets of forestry and agriculture, but the dispersal of this species is probably more influenced by natural barriers than anthropogenic ones.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Vaccinium myrtilloides produces edible, many-seeded berries that are dispersed by birds and mammals. Research on the related species, *V. membranaceum*, shows that animal-dispersed blueberry seeds can be transported 1.5-10 km from their parent plant (Yang et al. 2008). Assuming comparable dispersal ability for *V. myrtilloides*, the range of this species is more likely to be constrained by the paucity of suitable habitat for germination.

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Vaccinium myrtilloides* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). The single occurrences in the state (100%) is found in an area that has experienced average (57.1-77˚F/31.8-43.0˚ C) temperature variation during the past 50 years and is considered at neutral vulnerability to climate change (Young et al. 2006).

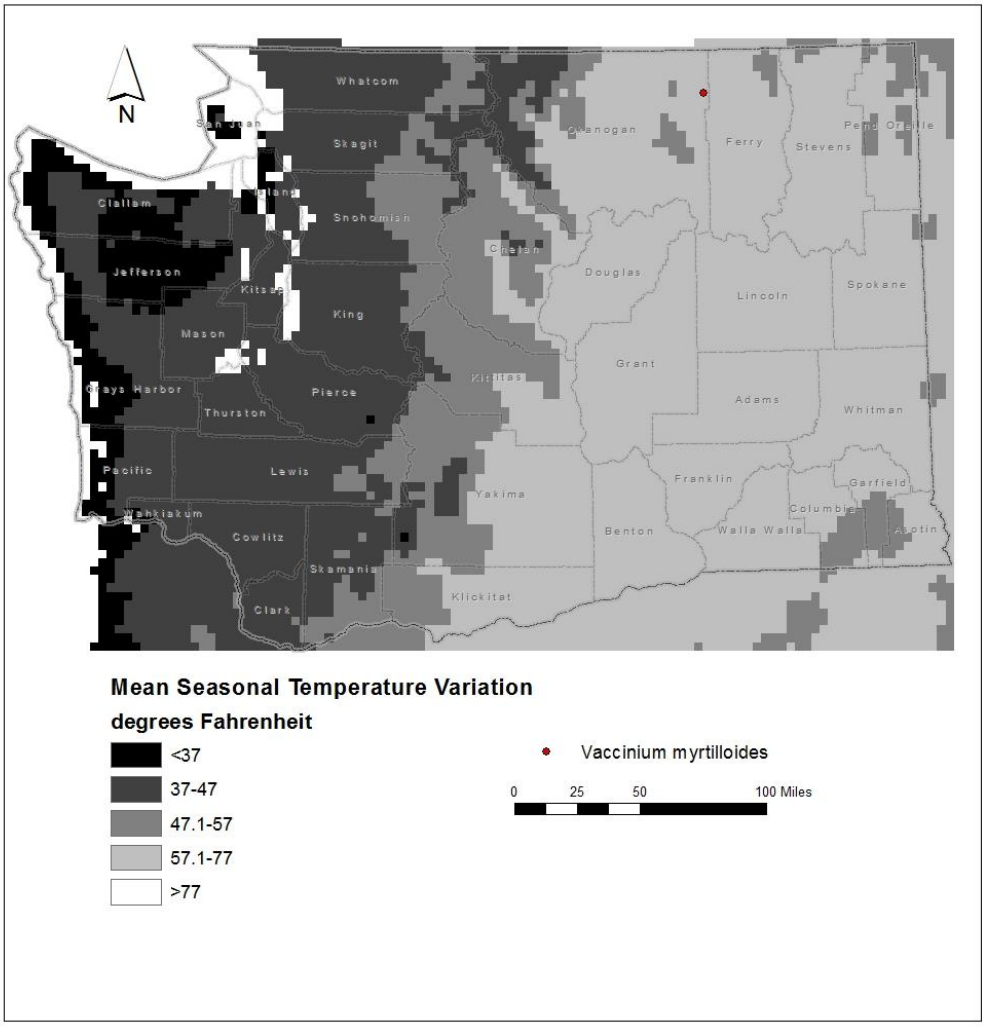

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Vaccinium myrtilloides* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Increase.
The Rocky Mountain Subalpine Mesic Spruce-Fir habitat of *Vaccinium myrtilloides* is moderately restricted to cold air drainages during the growing season and would have increased vulnerability to temperature changes associated with global warming.

C2bi. Historical hydrological niche: Somewhat Increase.
The single population of *Vaccinium myrtilloides* in Washington (100%) is found in an area that has experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased vulnerability to climate change.

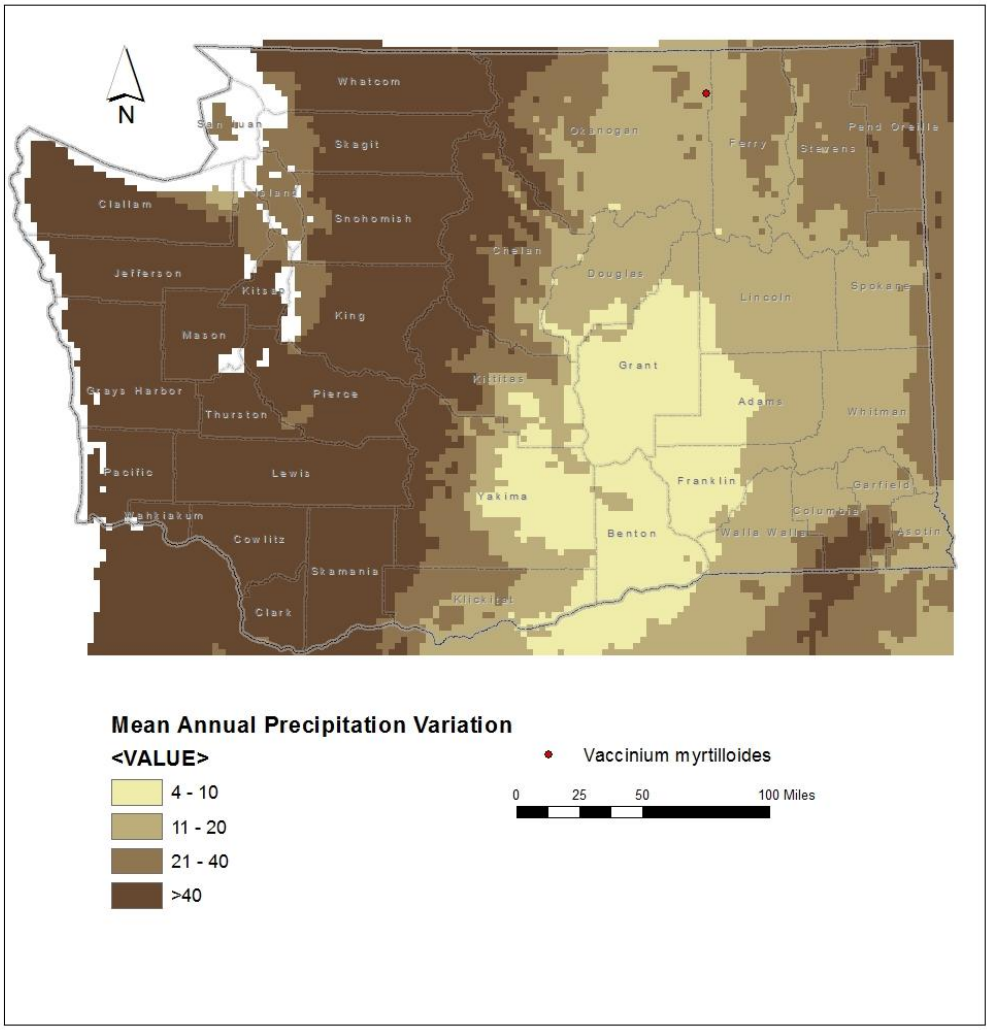

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Vaccinium myrtilloides* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
In Washington, *Vaccinium myrtilloides* is associated with moss-rich openings in *Picea engelmannii* forests and might be dependent on rainfall or subsurface moisture to maintain this habitat. Increased drought and fire frequency could facilitate conversion of the Rocky Mountain Subalpine Mesic Spruce-Fir ecological system to shrub or *Pinus contorta*-dominated systems more adapted to periodic wildfire (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Vaccinium myrtilloides occurs in open, subalpine Engelmann spruce forests that are vulnerable to wildfire or insect outbreaks (Rocchio and Ramm-Granberg 2017). These sites develop in environments where large scale disturbance regimes are infrequent.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The populations of *Vaccinium myrtilloides* in Washington are found in areas of moderate snowpack and in sites where subsurface moisture recharged by snowmelt is an important ecosystem driver. Groundwater recharge would be reduced if the amount of snow and timing of its melting were to change significantly due to rising temperatures. The Rocky Mountain Subalpine Mesic Spruce-Fir ecological system could convert to shrublands or Lodgepole pine forest under drier conditions in the future, or as a result of increased fire (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Somewhat Increase.
The single population of *Vaccinium myrtilloides* in Washington is found on rhyolite of the Klondike Mountain Formation, which is of limited distribution in the Okanogan Range. The species does not appear to be associated with specific geologic formations outside of Washington.

C4a. Dependence on other species to generate required habitat: Neutral.
The montane and subalpine wet meadow habitat of *Vaccinium myrtilloides* is maintained primarily by natural abiotic processes.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Vaccinium myrtilloides flowers release pollen in tetrads through apical pores in the anthers. This is done through buzz pollination, in which vibrations caused by flight muscles of large-bodied insects (mostly bees, but occasionally syrphid flies) shakes pollen loose from the anther onto the body of the insect, to then be deposited on stigmas of other flowers. Stephens (2012) observed pollination primarily by bumblebees (*Bombus*), although *Andrena* bees were also potential pollinators. *V. myrtilloides* is also capable of self-pollination.

C4d. Dependence on other species for propagule dispersal: Neutral.
The many-seeded berries of *Vaccinium myrtilloides* are edible and widely dispersed by numerous species of birds and mammals.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. *Vaccinium myrtilloides* is not a preferred forage species for browsers and may increase under grazing pressure from livestock (Hall 1955).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Competition with other species is probably moderate at present. In the future, as the subalpine mesic spruce-fir forest habitat of *Vaccinium myrtilloides* becomes drier due to increased temperatures or changes in the seasonality of precipitation, this habitat could become more prone to catastrophic wildfire and replacement of existing vegetation with more fire-adapted shrublands or Lodgepole pine forest (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.
Data are not available on the genetic diversity of this species in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Vaccinium myrtilloides is a diploid outcrosser and reproduces sexually by seed. Hokanson and Hancock (1998) found that populations of diploid *V. myrtilloides* in Michigan had levels of heterozygosity and numbers of alleles per gene locus comparable to other woody plants, but lower than those for tetraploid species of *Vaccinium*. Populations in Washington are at the southern edge of the species range in northwestern North America and probably have lower genetic diversity than populations in the Rocky Mountains due to inbreeding or founder effects.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
No changes have been detected in phenology in recent years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No changes in the distribution of this species have been noted due to climate change.

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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