Climate Change Vulnerability Index Report

Astragalus asotinensis (Asotin milkvetch)

Date: 23 March 2020

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G2/S1

Index Result: Highly 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	100
	3.9-4.4° F (2.2-2.4°C) warmer	0
	<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	100
	-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
2aii. Change in physiological thermal niche		Neutral
2bi. Changes in historical hydrological niche		Somewhat Increase
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Somewhat Increase
2d. Dependence on ice or snow-covered habitats		Neutral
3. Restricted to uncommon landscape/geological features		Increase
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	
D1. Documented response to recent climate change	Somewhat Increase
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 *Astragalus asotinensis* in Washington (100%) occurs in an area with a projected temperature increase of 4.5-5.0˚ F (Figure 1).

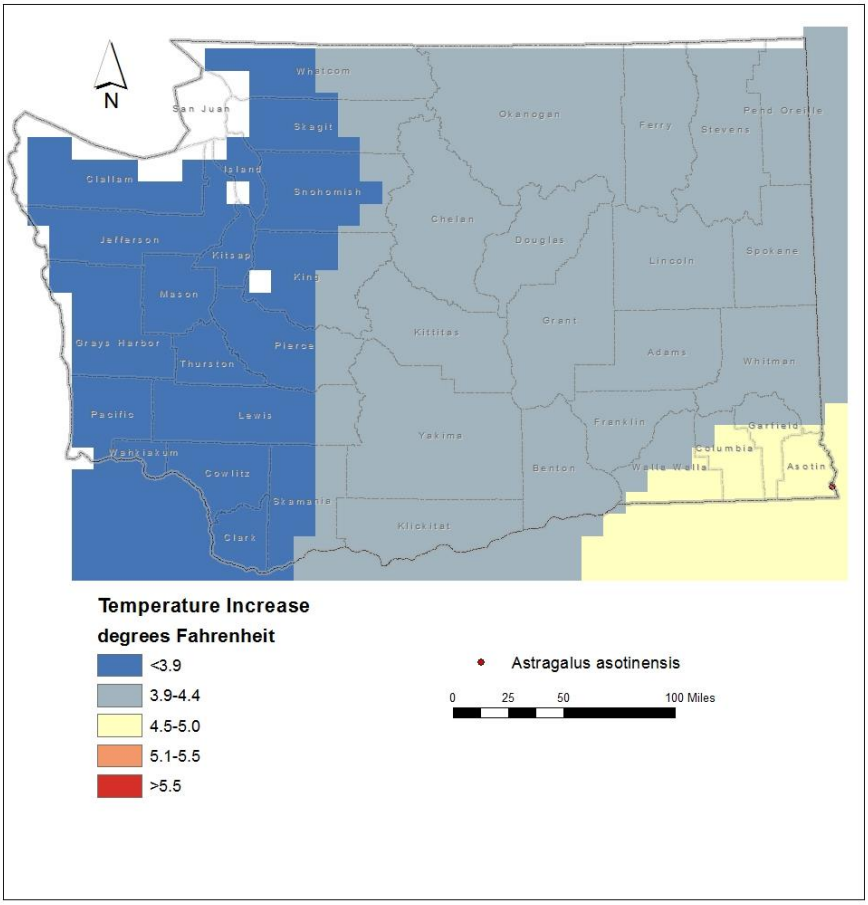

Figure 1. Exposure of *Astragalus asotinensis* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The single occurrence of *Astragalus asotinensis* (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 -0.074 to -0.096 (Figure 2).

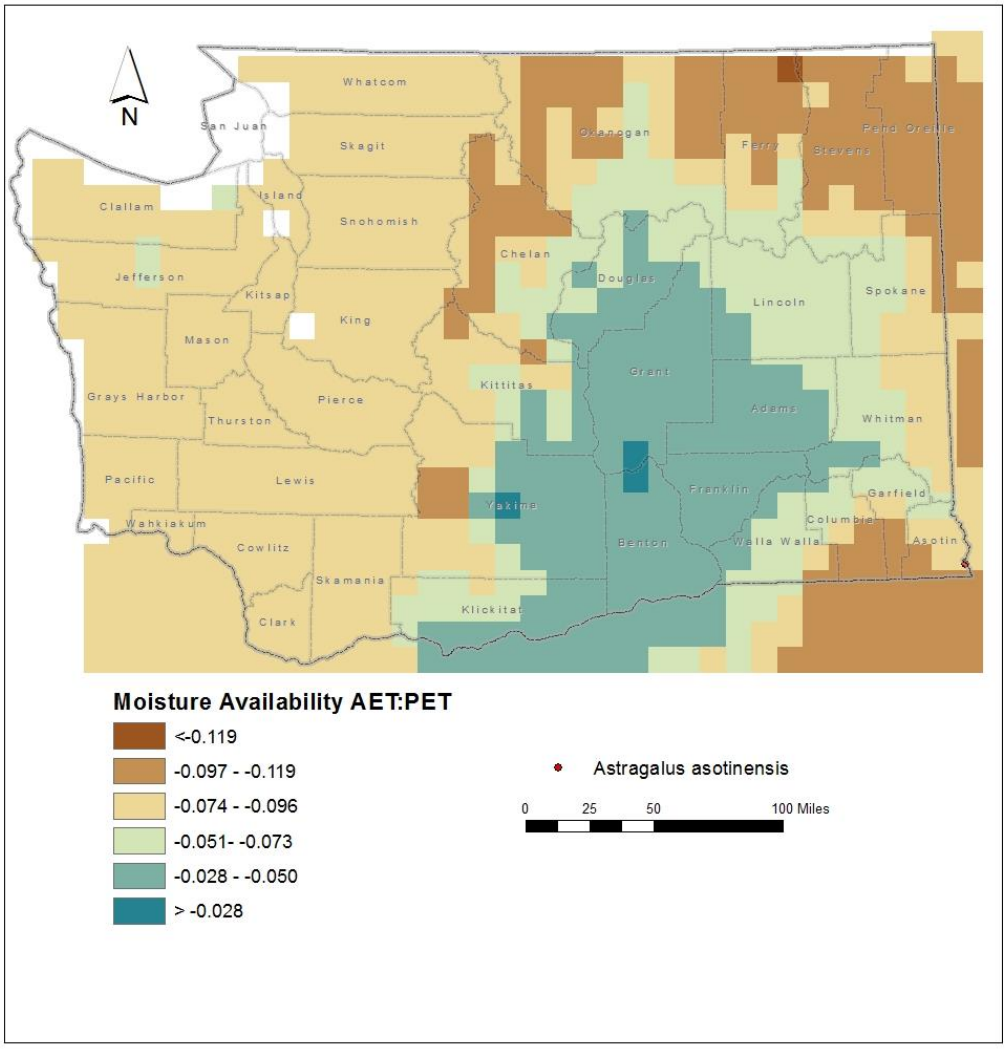

Figure 2. Exposure of *Astragalus asotinensis* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
The Washington occurrence of *Astragalus asotinensis* is found at 1300-3000 feet (400-900 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Astragalus asotinensis* is found on steep slopes in grasslands dominated by *Pseudoroegneria spicata* and *Festuca idahoensis* on ashy loess and limestone (Björk 2010, Camp and Gamon 2011, Fertig 2020). This habitat is a component of the Columbia Basin Foothill and Canyon Dry Grassland ecological system (Rocchio and Crawford 2015). The single occurrence in Washington covers about 300 acres and is isolated from populations in Idaho by the Snake River. Additional, unoccupied habitat in Washington has not been found (Björk 2010).

B2b. Anthropogenic barriers: Neutral.
The range of *Astragalus asotinensis* in Washington is bisected by old mining roads (now blocked by rockslides). These do not form 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: Somewhat Increase.
Astragalus asotinensis produces 7-20 flowers per inflorescence and each mature fruit contains 4-10 seeds that are released passively by dehiscence of the legume pod (Björk and Fishbein 2006). The seeds do not possess any wings, barbs, or hooks to promote dispersal by wind or animals. Dispersal distances are probably relatively short (no more than 100 m).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Astragalus asotinensis* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). The single occurrence (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.

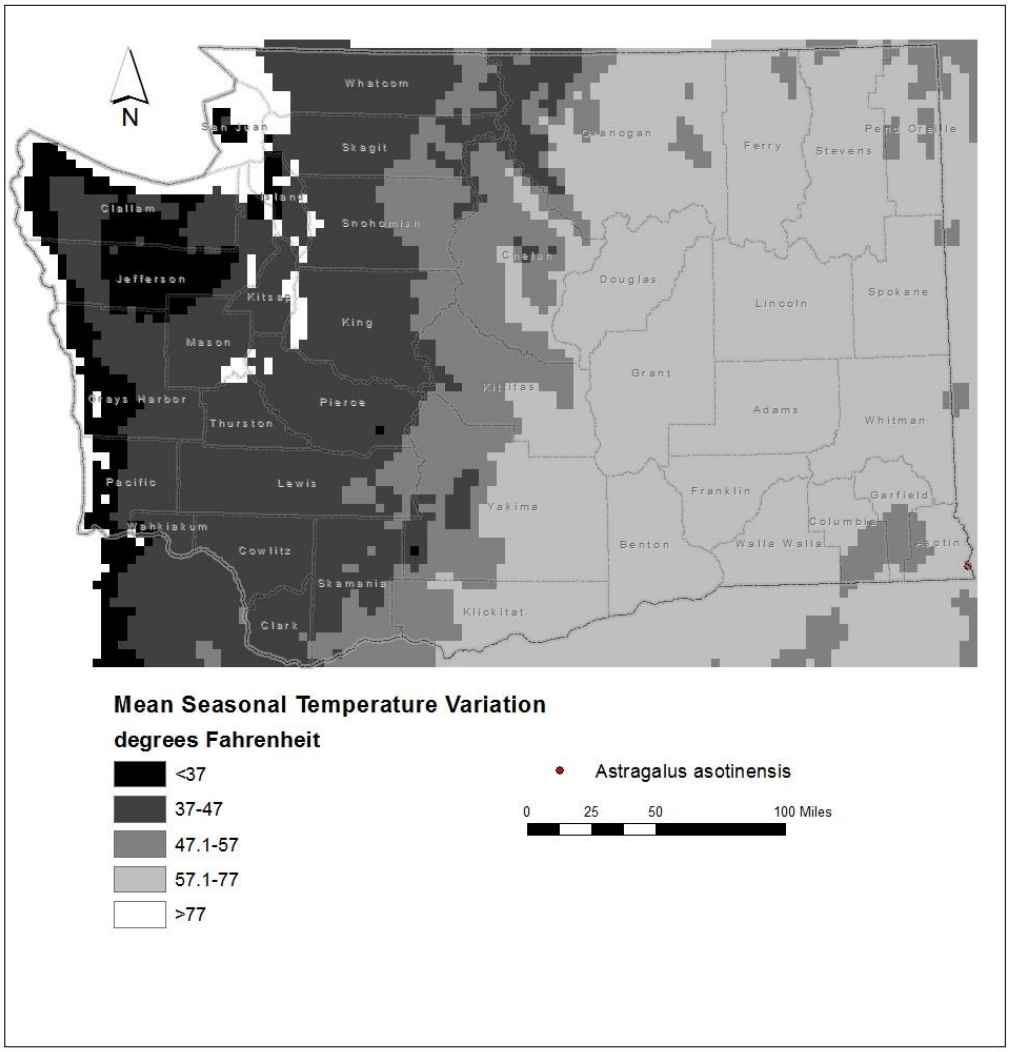

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Astragalus asotinensis* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
The Columbia Basin Foothill and Canyon Dry Grassland habitat of *Astragalus asotinensis* is not associated with cold air drainage during the growing season and would have neutral vulnerability to climate change.

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

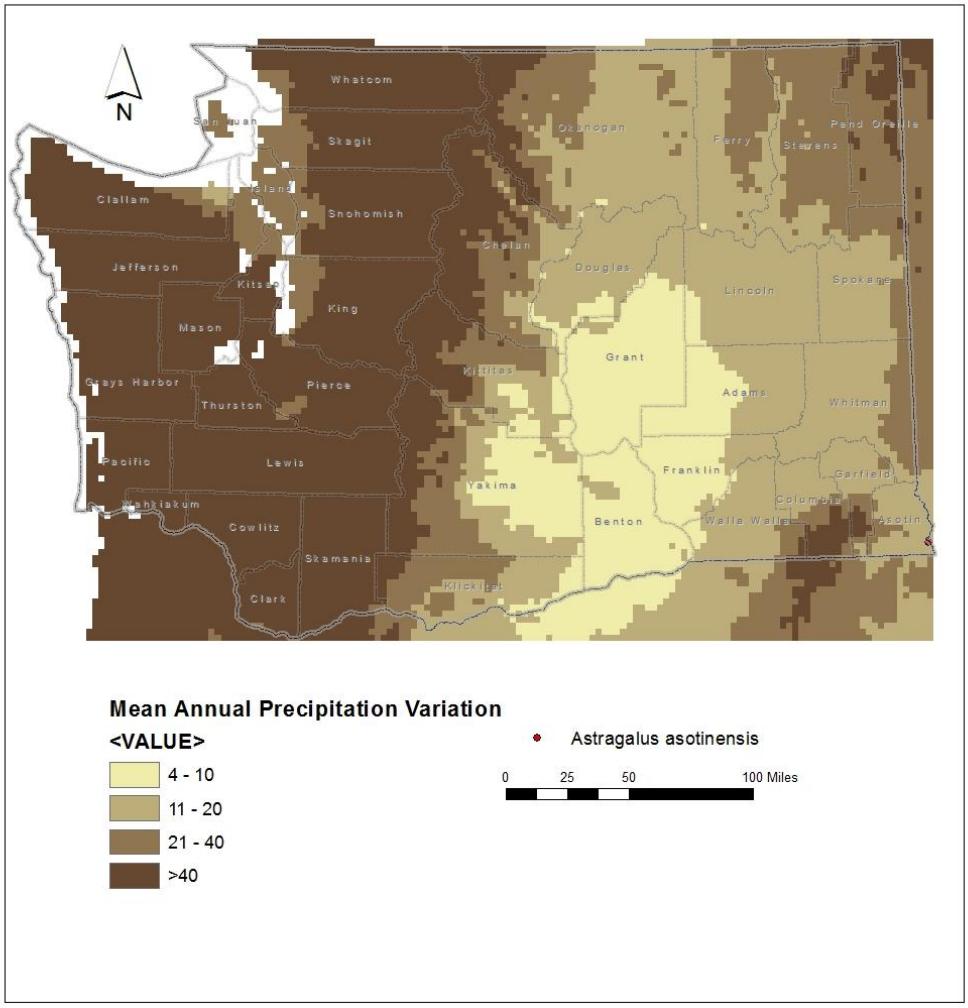

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Astragalus asotinensis* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is dependent primarily on adequate precipitation for its moisture requirements, because its habitat is typically not associated with springs, streams, or a high water table. The Columbia Basin Foothills and Canyon Dry Grassland ecological system is vulnerable to changes

in the timing or amount of precipitation (including extreme precipitation events that would accelerate erosion of steep slopes), This coupled with increases in temperature would result in more frequent and severe drought, and an increase in fire frequency (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Somewhat Increase.
Astragalus asotinensis is dependent on infrequent wildfire to reduce encroachment from less fire-adapted shrub species and to maintain open grassland habitat. Increased drought and reduced summer precipitation, however, might make wildfires too frequent and result in replacement of native perennial bunchgrass with annual introduced grasses (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral.
Snowpack is relatively low over the range of *Astragalus asotinensis* in the foothills of the Blue Mountains in southeastern Washington and a small component of its annual water budget.

C3. Restricted to uncommon landscape/geological features: Increase.
Astragalus asotinensis is restricted to limestone and shale outcrops of the Martin Bridge and Hurwal formations (called the Limekiln Formation in Björk and Fishbein 2006) on Lime Hill and adjacent ridges in Idaho near the confluence of the Columbia and Grande Ronde rivers (Björk 2010; Fertig 2020).

C4a. Dependence on other species to generate required habitat: Neutral
Browsing by ungulates, rodents, and insects that would impede shrub cover would help maintain the open grasslands occupied by *Astragalus asotinensis,* although drought and infrequent fire probably are more significant.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The specific pollinators of *Astragalus asotinensis* are not known, but other *Astragalus* species are usually pollinated by bees or other insects.

C4d. Dependence on other species for propagule dispersal: Neutral.
The fruits of *Astragalus asotinensis* dehisce when dry to release seeds passively. These seeds lack wings, barbs, or hooks for dispersal by wind or animals. Dispersal distances are probably relatively short.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. Herbivory has not been identified as a significant threat (Fertig 2020).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Astragalus asotinensis occurs in grassland slopes that burn infrequently. Under projected future climate change, these areas will be more prone to drought and increased frequency of wildfires, which in turn could lead to increased competition with non-native annual weeds (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.
No genetic data are available for *Astragalus asotinensis* in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Astragalus asotinensis is presumed to be an outcrosser, rather than self-pollinated. Presumably, genetic variation is average, compared to other species, but no studies have been done for confirmation.

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 *Astragalus asotinensis* populations in Washington have been detected over the past 20 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Somewhat Increase.
The population declined by 80-90% from 2005 to 2010 (Björk 2010) but has apparently increased since then (Fertig 2020). The cause of the decline is poorly known, but could have been influenced by fire or drought from 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

Björk, C.R. 2010. Results of 2010 *Astragalus asotinensis* surveys with notes on floristics of Hells Canyon, Idaho, Oregon, and Washington. Report prepared for USFWS Region 1. 101 pp.

Björk, C.R. and M. Fishbein. 2006. *Astragalus asotinensis* (Fabaceae), a newly discovered species from Washington and Idaho, United States. Novon 16:299-303.

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

Fertig, W. 2020. Potential federal candidate plant species of Washington. Natural Heritage Report 2020-01. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 97 pp.

Rocchio, F.J. and R.C. Crawford. 2015. Ecological systems of Washington State. A guide to identification. Natural Heritage Report 2015-04. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 384 pp.

Rocchio F.J. and T. Ramm-Granberg. 2017. Ecological System Climate Change Vulnerability Assessment. Unpublished Report to the Washington Department of Fish and Wildlife. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.

Young, B.E., E. Byers, G. Hammerson, A. Frances, L. Oliver, and A. Treher. 2016. Guidelines for using the NatureServe Climate Change Vulnerability Index. Release 3.02. NatureServe, Arlington, VA. 48 pp. + app.