

Climate Change Vulnerability Index Report

Astragalus misellus var. *pauper* (Pauper milkvetch)

Date: 6 December 2021

Synonym: *Astragalus howellii* var. *pauper*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington

Heritage Rank: G5T3/S2

Index Result: Moderately 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	0
	-0.074 to -0.096	0
	-0.051 to -0.073	17.6
	-0.028 to -0.050	82.4
	>-0.028	0
Section B: Indirect Exposure to Climate Change		Effect on Vulnerability
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Neutral
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
2aii. Change in physiological thermal niche		Neutral
2bi. Changes in historical hydrological niche		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		Neutral/Somewhat 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: Documented or Modeled Response	
D1. Documented response to recent climate change	Neutral/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: All 17 of the extant and historical occurrences of *Astragalus misellus* var. *pauper* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4° F (Figure 1).

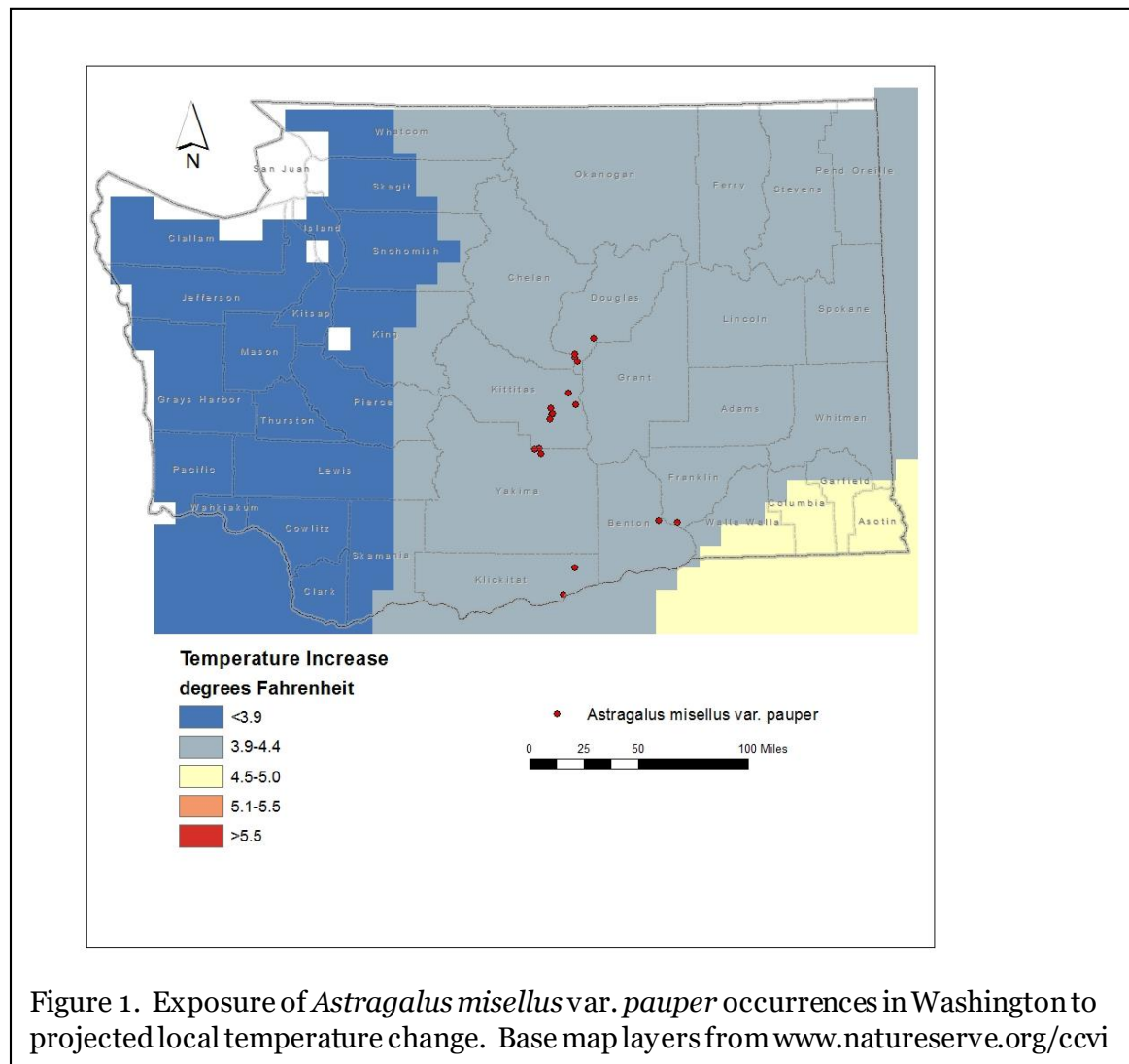


Figure 1. Exposure of *Astragalus misellus* var. *pauper* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Fourteen of the 17 occurrences (82.4%) of *Astragalus misellus* var. *pauper* in Washington 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). Three other occurrences (17.6%) are from areas with projected decrease of -0.051 to -0.073.

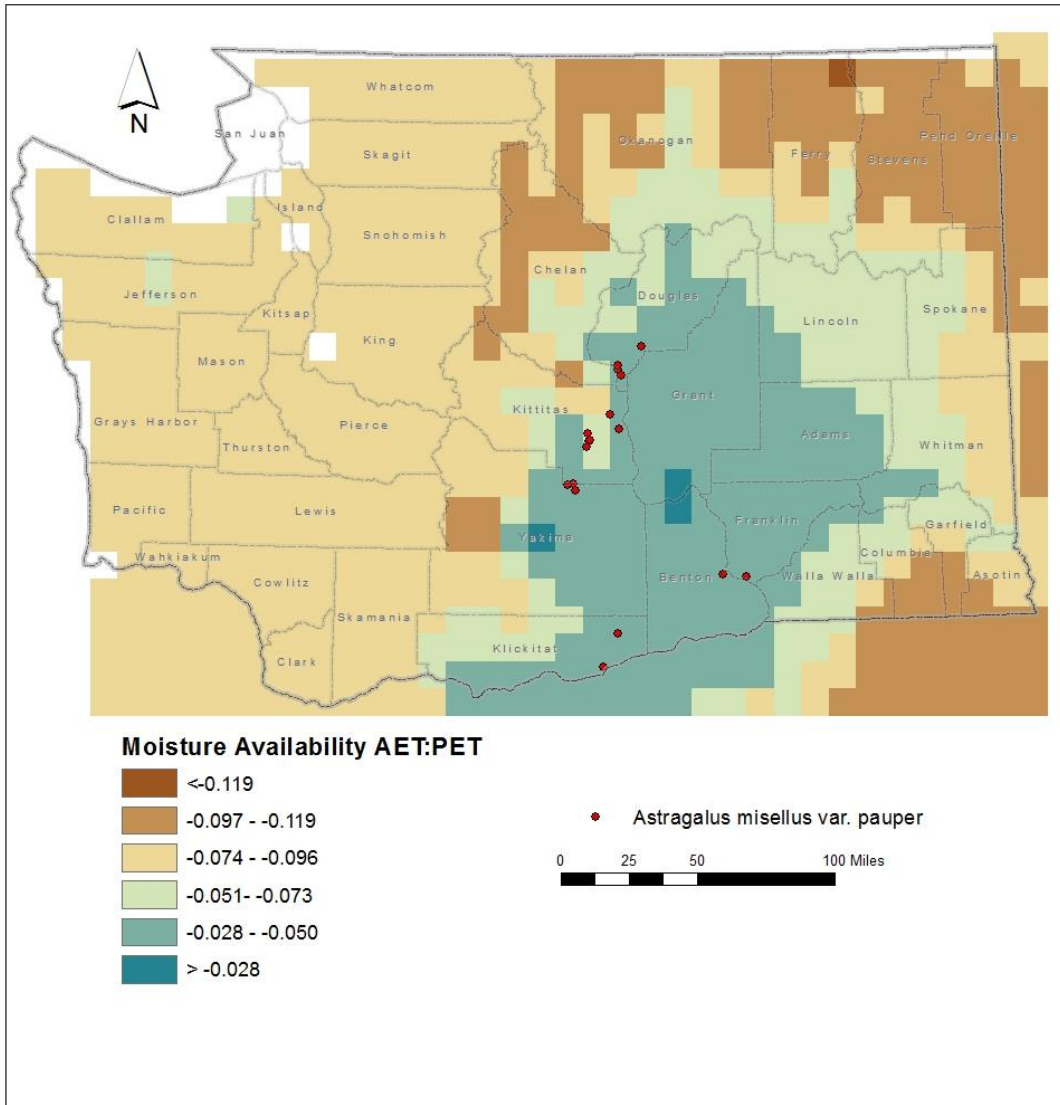


Figure 2. Exposure of *Astragalus misellus* var. *pauper* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.

Washington occurrences of *Astragalus misellus* var. *pauper* are found at 500-3280 feet (150-1000 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.

Astragalus misellus var. *pauper* occurs primarily on ridgetops and gentle upper slopes in big sagebrush (*Artemisia tridentata*) or stiff sagebrush (*A. rigida*) communities with bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg's bluegrass (*Poa secunda*) (Camp and Gamon 2011, Washington Natural Heritage Program 2021). This habitat is part of the Intermountain Basin Big Sagebrush Steppe ecological system (Rocchio and Crawford 2015). Populations may be isolated from each other by 1.4-54 miles (2-86 km). Extensive areas of potential habitat are present along ridges on the west bank of the Columbia River, with populations separated by canyons or valleys. The Columbia River may have historically provided a conduit for dispersal downstream, but may also create a barrier to movement across the river.

B2b. Anthropogenic barriers: Somewhat Increase.

The ridgetop habitat of *Astragalus misellus* var. *pauper* is embedded within an anthropogenic landscape of agricultural development, which creates 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.

Astragalus misellus var. *pauper* produces dry fruits (legumes) that dehisce at maturity along two sutures to release seeds passively by gravity. Individual seeds are large and lack wings, barbs, hooks, or other features to enhance their dispersal by wind or animals. Secondary movement of seeds by insects or rodents may occur after seeds are shed, but total dispersal distance is probably limited to less than 100 m. Occasional long distance dispersal by floodwaters of the Columbia River may explain disjunct occurrences downstream of the core of the species range in Douglas and Kittitas counties.

C2ai. Historical thermal niche: Neutral.

Figure 3 depicts the distribution of *Astragalus misellus* var. *pauper* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All 17 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).

C2aii. Physiological thermal niche: Neutral.

The foothill big sagebrush steppe habitat of *Astragalus misellus* var. *pauper* is not associated with cold air drainage in the growing season and would have neutral vulnerability to climate change.

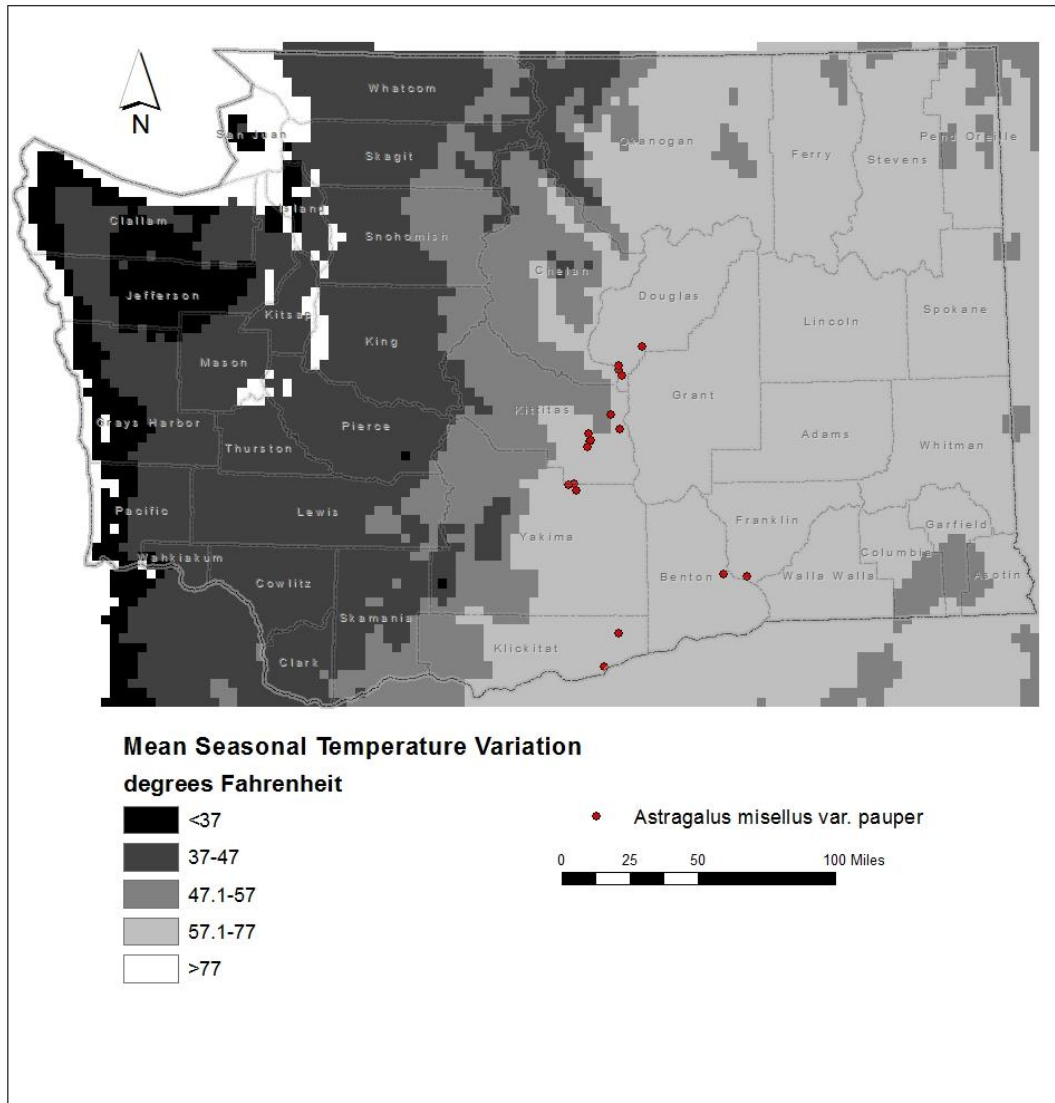


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Astragalus misellus* var. *pauper* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Increase.

Thirteen of the 17 populations of *Astragalus misellus* var. *pauper* in Washington (76.5%) 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 from climate change. Four other occurrences (23.5%) are from areas with slightly lower than average precipitation variation (11-20 inches/255-508 mm) during the same period and are at slightly increased risk from climate change.

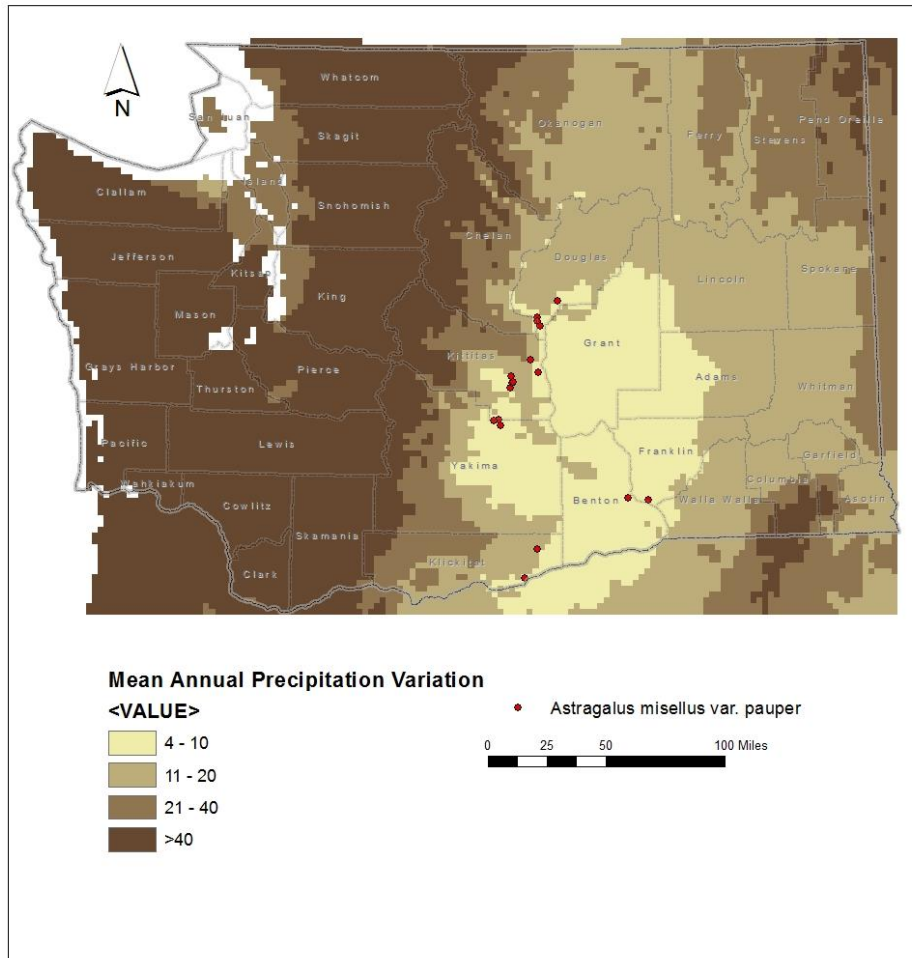


Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Astragalus misellus* var. *pauper* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.

This species is primarily dependent on adequate precipitation to meet its moisture requirements since its habitat is mostly not associated with springs, streams, or a high water table. Its Intermountain Basins Big Sagebrush Steppe habitat is vulnerable to changes in the amount or timing of precipitation. Coupled with projected increases in temperature, these habitats are likely to have more severe drought and increased fire frequency in the future (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Somewhat Increase.

Astragalus misellus var. *pauper* occurs in sagebrush grassland sites that burned sporadically and patchily in the past. Increased drought and reduced summer precipitation are likely to

increase the frequency and intensity of wildfire, which in turn could result in a shift in vegetation towards invasive annuals or more fire-resilient grasslands (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral.

Astragalus misellus var. *pauper* occurs in dry foothills of the Columbia Plateau that receive low amounts of winter snow.

C3. Restricted to uncommon landscape/geological features: Neutral/Somewhat Increase.

In Kittitas County, *Astragalus misellus* var. *pauper* is found primarily on Tertiary sedimentary rocks of the Ellensburg Formation. Other populations near the Columbia River are associated with various Miocene basalts (Saddle Mountain, Wanapum, and Grande Ronde basalts) or Quaternary alluvium. The Ellensburg Formation has a restricted distribution in the foothills between the East Cascades and the Columbia River, but the other formations are widespread in eastern Washington (Washington Division of Geology and Earth Resources 2016).

C4a. Dependence on other species to generate required habitat: Neutral.

Drought and fire are probably the primary drivers for generating the sagebrush steppe habitat of this species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.

The specific pollinators of *Astragalus misellus* var. *pauper* are not known, but other *Astragalus* species are usually pollinated by bees.

C4d. Dependence on other species for propagule dispersal: Neutral.

The pod-like fruits of *Astragalus misellus* var. *pauper* split open at maturity to passively release seeds. The seeds lack structure to facilitate their movement by animals, though foraging species may transport seed short distances to cache them.

C4e. Sensitivity to pathogens or natural enemies: Neutral.

Impacts from pathogens are not known. Most *Astragalus* species are toxic to grazing animals and not readily used as forage.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.

The sagebrush grassland habitat of *Astragalus misellus* var. *pauper* is likely to become drier and more prone to wildfire under project climate change. Vegetation may shift towards dominance by perennial grasses or invasive annuals and result in greater competition for space and resources (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 misellus* var. *pauper*.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.

Astragalus misellus var. *pauper* appears to be an outcrosser, rather than self-pollinated. Presumably, genetic variation is average, though no research has been done to compare its genetic variability with its close relative, *A. howellii* of Oregon. Both have been considered varieties of the same species (*A. howellii*) based on morphological characters (Isely 1983).

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.

Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), *Astragalus misellus* var. *pauper* has not changed its typical blooming time since the 1890s.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral/Somewhat Increase.

Populations of *Astragalus misellus* var. *pauper* from the vicinity of the Columbia River near the confluence of the Snake River are all historical and have not been observed since 1950. These occurrences may be extirpated due to habitat loss in the Tri-Cities area. Impacts from climate change on the habitat suitability of these sites are not known.

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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