

Climate Change Vulnerability Index Report

Hackelia hispida var. *disjuncta* (Disjunct sagebrush stickseed)

Date: 2 November 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington

Heritage Rank: G4T3/S3

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	0
	-0.028 to -0.050	100
	>-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		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		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral
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		Unknown
4d. Dependence on other species for propagule dispersal		Somewhat Increase
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

they have recently been determined to be misidentified specimens of *Hackelia diffusa* var. *arida*.

A2. Hamon AET:PET Moisture Metric: All of the 19 recognized occurrences (100%) of *Hackelia hispida* var. *disjuncta* 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).

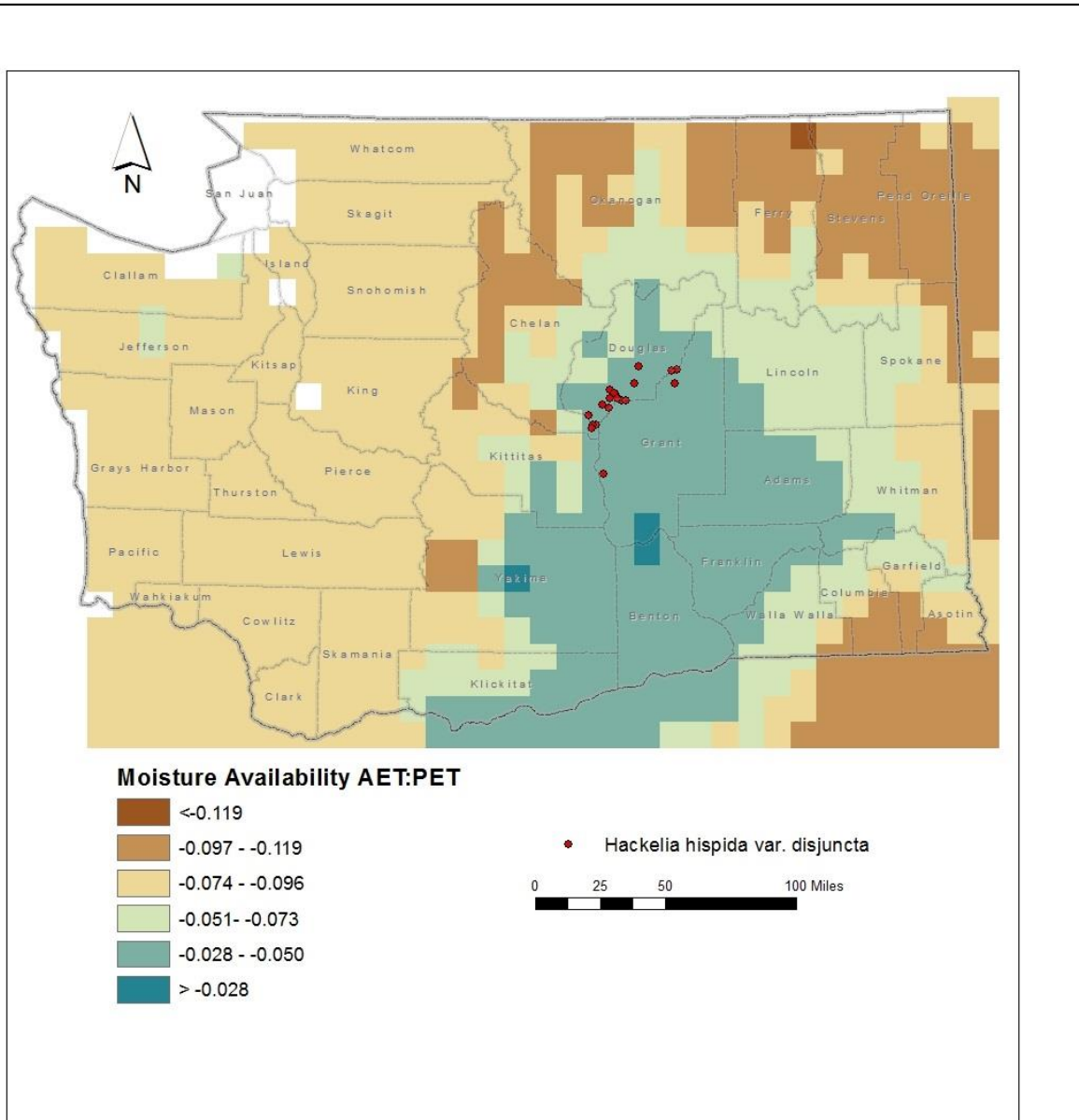


Figure 2. Exposure of *Hackelia hispida* var. *disjuncta* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.

Washington occurrences of *Hackelia hispida* var. *disjuncta* are found at 1000-2140 feet (300-650 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.

Hackelia hispida var. *disjuncta* occurs in sparsely vegetated, dry, rocky basalt talus and cliffs (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is part of the Inter-Mountain Basin Cliff & Canyon ecological system (Rocchio and Crawford 2015). Populations are separated from each other by 1-18 miles (1.5-29 km) and nearly confined to Moses Coulee and its tributary canyons. Additional habitat exists in other dry canyons in central Washington, but this species may be dispersal limited, or these sites are already occupied by related *Hackelia* species with a similar ecological niche. Carr (1974) suggested that large scale flooding events during the Pleistocene could have wiped out satellite populations of this species in other areas of central Washington.

B2b. Anthropogenic barriers: Neutral.

The rocky basalt talus habitat of *Hackelia hispida* var. *disjuncta* occurs in numerous coulees and canyons in central Washington. Some populations are associated with railroad banks and other human disturbances. The range of this species appears to be naturally constrained by poor dispersal or competition with other *Hackelia* species, rather than human influences, such as agricultural developments and roads. Carr (1974) speculates that human disturbance along roadcuts might actually create a new avenue for increased dispersal of *Hackelia* species.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.

Hackelia hispida var. *disjuncta* produces 4-parted hard nutlets with a rim of short prickles that allow the fruits to be transported on the fur of mammals. Dispersal distances are thus dependent on the home range of ungulates, rodents, or rabbits, which may be limited to less than 1,000 meters. Longer-distance dispersal is possible, but probably rare, as reflected in the limited natural range of the species.

C2ai. Historical thermal niche: Neutral.

Figure 3 depicts the distribution of *Hackelia hispida* var. *disjuncta* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 (“historical thermal niche”). All 19 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).

C2aaii. Physiological thermal niche: Neutral.

The basalt cliff and boulder talus habitat of *Hackelia hispida* var. *disjuncta* is often on southerly exposures or otherwise exposed to high temperatures, especially in summer. These site characteristics are not likely to be impacted by projected future climate change.

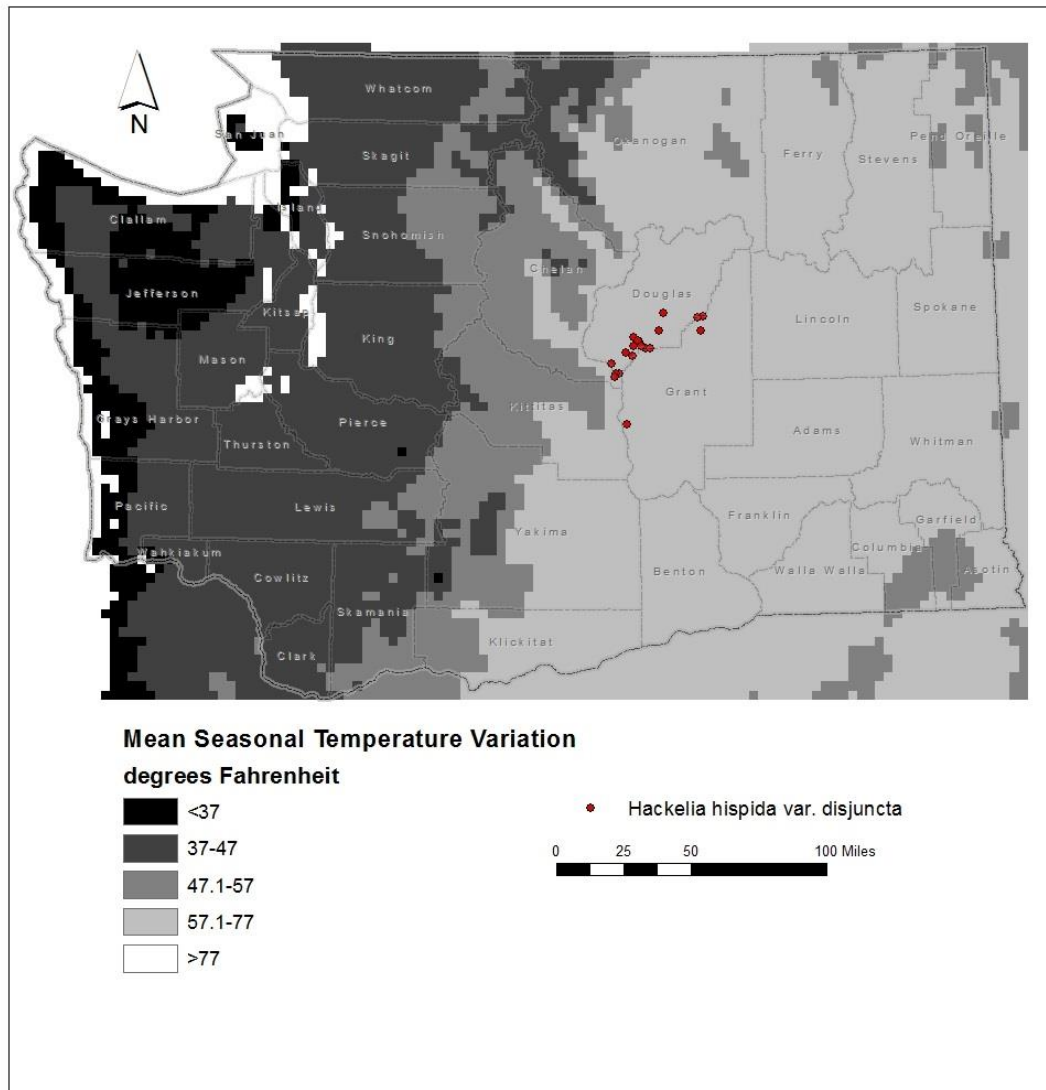


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Hackelia hispida* var. *disjuncta* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Increase.

Sixteen of the 19 populations of *Hackelia hispida* var. *disjuncta* in Washington (84.2%) are found in areas that have experienced small precipitation variation in the past 50 years (4-10 inches/100-254 mm) (Figure 4). According to Young et al. (2016), these occurrences are at increased vulnerability from climate change. Three other occurrences (15.8%) are from areas with slightly lower than average (11-20 inches/255-508 mm) precipitation variation over the same period and are at somewhat increased risk from climate change.

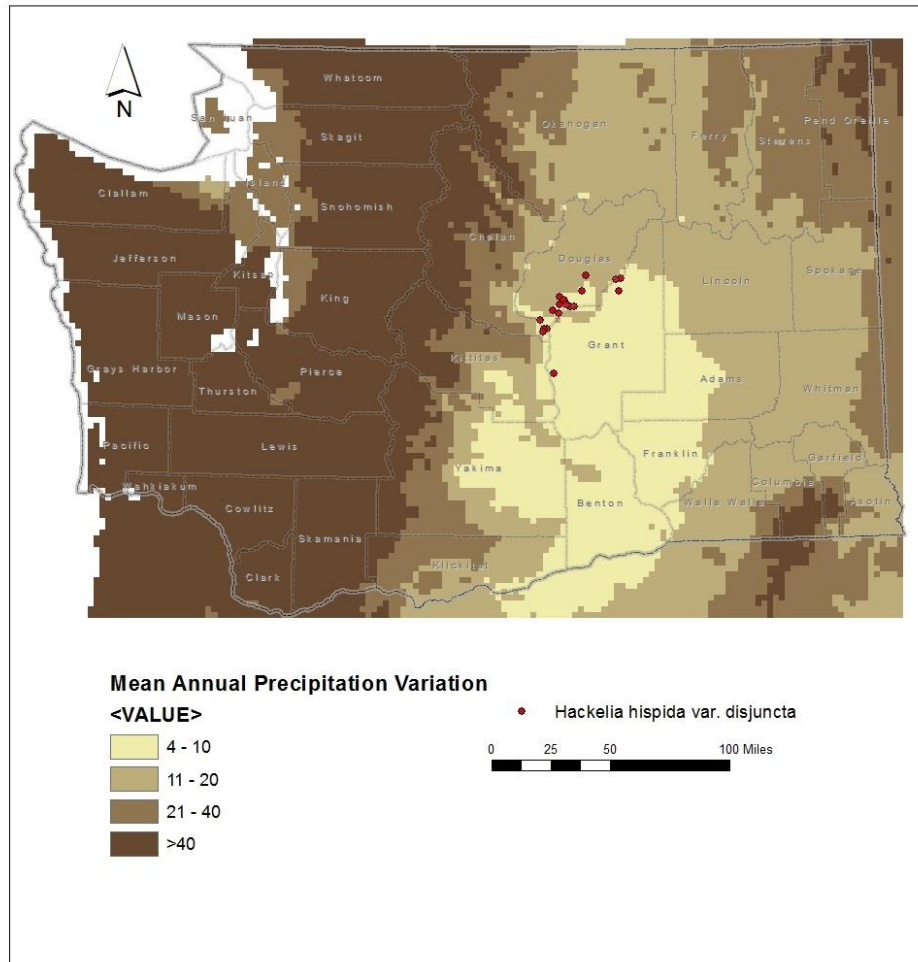


Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Hackelia hispidia* var. *disjuncta* occurrences in Washington. Base map layers from www.natureserve.org/cvvi

C2bii. Physiological hydrological niche: Somewhat Increase.

This species is not associated with perennial water sources or a high water table. Changes in the amount and timing of precipitation and increases in temperature are likely to make basalt cliff and talus habitat drier in the future and could shift dominance from vascular plants to lichens (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.

Hackelia hispidia var. *disjuncta* occurs in basalt cliff and talus habitats in dry canyons. These areas have naturally low vegetation cover and infrequent fires due to the paucity of fuels (Rocchio and Ramm-Granberg 2017).

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

The populations of *Hackelia hispida* var. *disjuncta* in Washington are found in low elevation areas that receive small amounts of snow and are not dependent on regeneration of groundwater from melting snow.

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

Hackelia hispida var. *disjuncta* is found on cliffs and large rock talus of the Miocene-age Grande Ronde Basalt and Quaternary alluvium (Washington Division of Geology and Earth Resources 2016). These outcrops are widespread in central Washington.

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

The basalt cliff and talus habitat occupied by *Hackelia hispida* var. *disjuncta* is maintained by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.

The specific pollinators of *Hackelia hispida* var. *disjuncta* are not known. Other *Hackelia* species are pollinated primarily by flies (families Tachinidae, Syrphidae, and Bombyliidae) and bees (families Halictidae and Megachilidae) and less frequently by butterflies (Carr 1974).

C4d. Dependence on other species for propagule dispersal: Somewhat Increase.

The nutlet fruits of *Hackelia hispida* var. *disjuncta* have marginal prickles that can adhere to the fur of mammal species for dispersal.

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.

Under present conditions, competition from non-native species is minor, as few introduced plants are adapted to the harsh environmental conditions of basalt cliffs and talus. Under projected climate change, these habitats may become even drier, which may shift dominance to lichens over vascular plants (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.

Carr (1974) sampled five populations of *Hackelia hispida* var. *disjuncta* and determined the chromosome number to be $2n = 48$, making the taxon a tetraploid. Additional data on genetic variability is not known.

C5b. Genetic bottlenecks: Unknown.

Not known.

C5c. Reproductive System: Neutral.

Hackelia species have perfect flowers in which the stamens and pistils mature at different times (dichogamy) to promote out-crossing (Carr 1974; Gentry and Carr 1976). Most obligate

outcrossing species have at least moderate levels of genetic diversity. *Hackelia hispida* var. *disjuncta* is disjunct from var. *hispida* of the Snake River drainage and has diverged morphologically and presumably genetically.

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

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral. No major changes have been detected in the distribution of *Hackelia hispida* var. *disjuncta* in Washington in recent years.

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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