

Climate Change Vulnerability Index Report

Trillium albidum ssp. *parviflorum* (Small-flowered trillium)

Date: 28 February 2021

Synonyms: *Trillium parviflorum*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington

Heritage Rank: G4 G5T2T3/S2S3

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	0
	<3.9° F (2.2°C) warmer	100
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: 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		Somewhat Increase
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
1. Dispersal and movements		Increase
2ai Change in historical thermal niche		Increase
2aii. Change in physiological thermal niche		Somewhat 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		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		Neutral
4d. Dependence on other species for propagule dispersal		Neutral/Somewhat Increase
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		Somewhat Increase
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
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 48 of the occurrences of *Trillium albidum* ssp. *parviflorum* in Washington (100%) occur in areas with a projected temperature increase of <3.9° F (Figure 1).

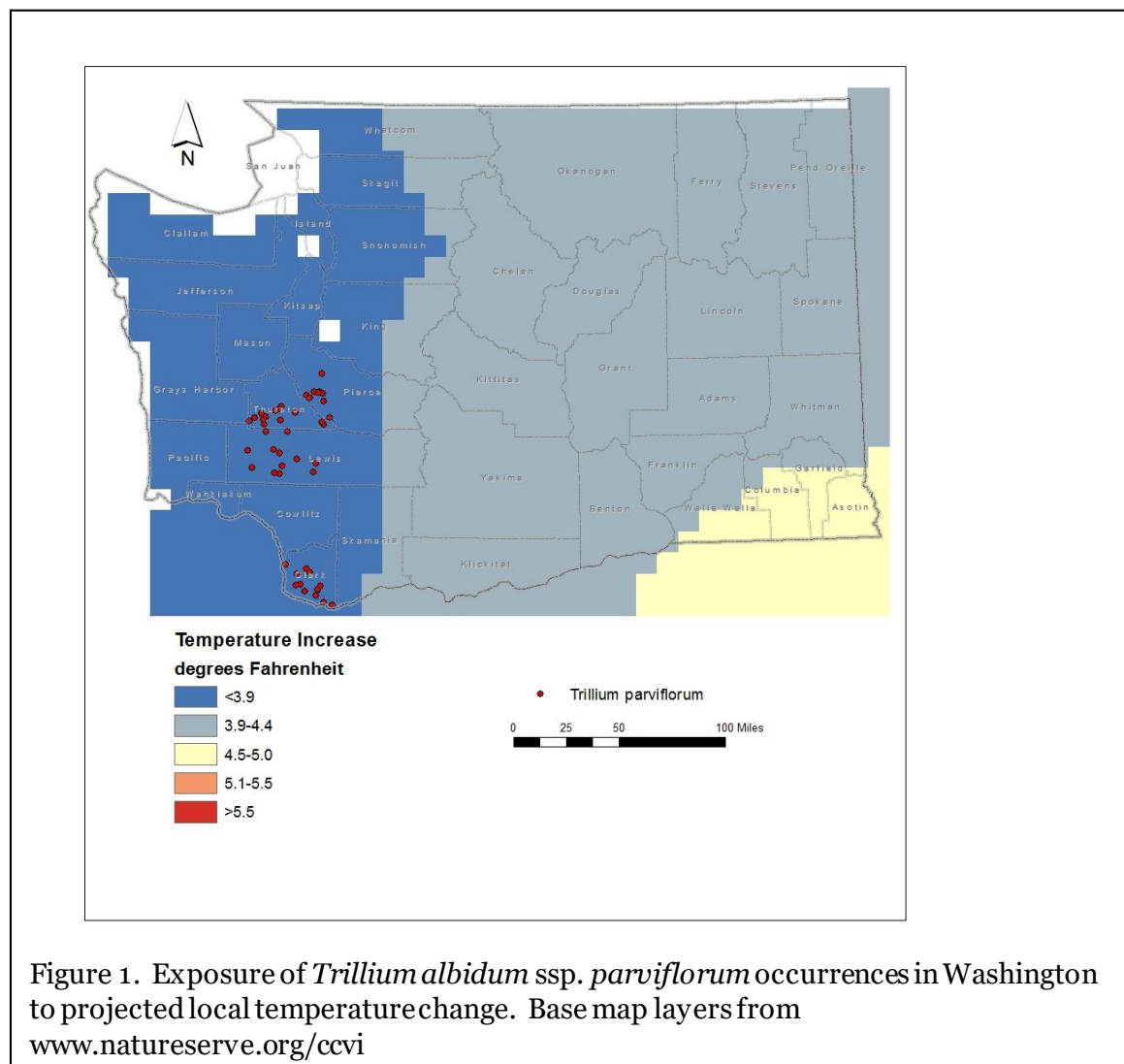


Figure 1. Exposure of *Trillium albidum* ssp. *parviflorum* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: All 48 of the Washington occurrences of *Trillium albidum* ssp. *parviflorum* (100%) 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 -0.074 to -0.096 (Figure 2).

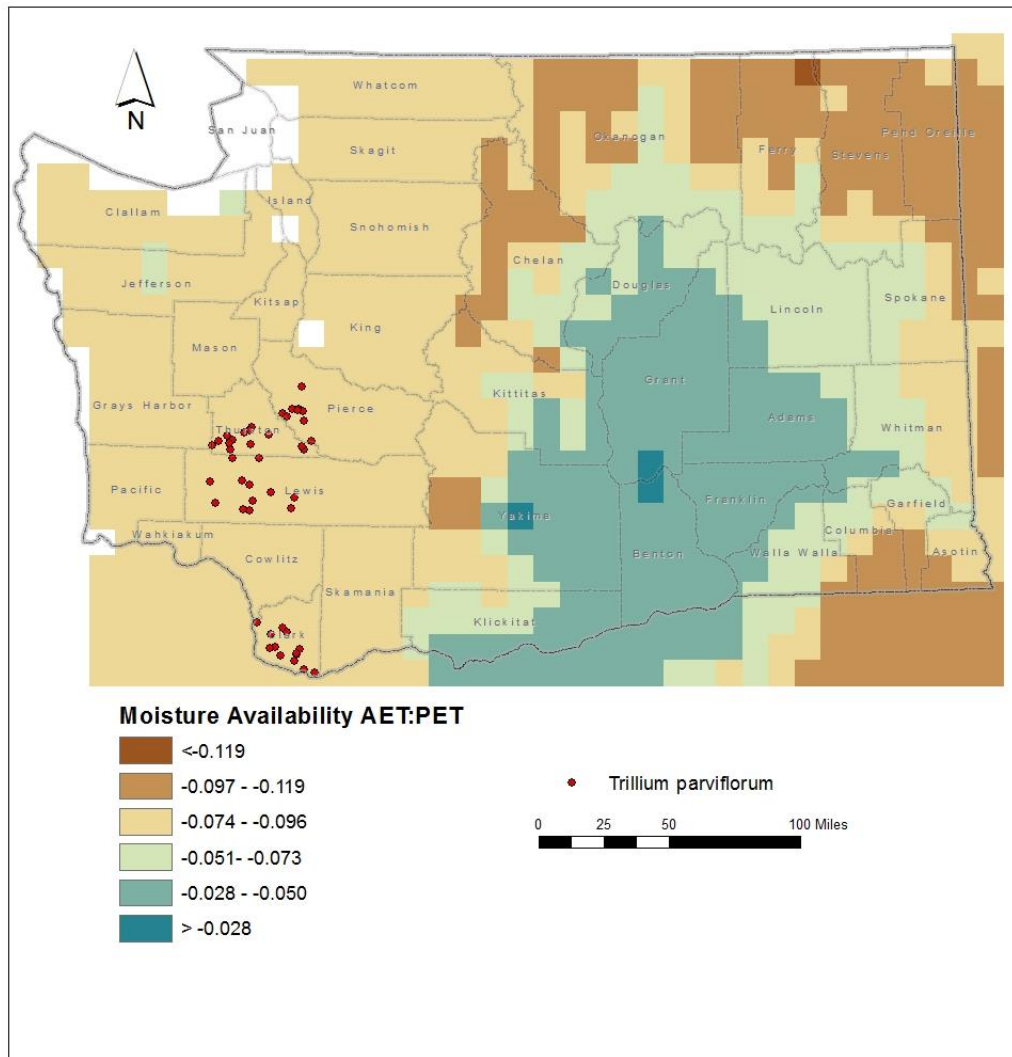


Figure 2. Exposure of *Trillium albidum* ssp. *parviflorum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.

Washington occurrences of *Trillium albidum* ssp. *parviflorum* are found at 25-700 feet (8-215 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.

In Washington, *Trillium albidum* ssp. *parviflorum* is found in moist, shady Oregon white oak (*Quercus garryana*) and Oregon ash (*Fraxinus latifolia*) forests on alluvial soils along streams or in low areas that may be periodically flooded in winter (Camp and Gamon 2011). Populations may also occur in moist prairie grasslands bordering deciduous forests. These habitats are a component of the North Pacific Lowland Riparian Forest and Shrubland and Willamette Valley Wet Prairie ecological systems (Rocchio and Crawford 2015). Individual populations are separated by 0.6-68 km (0.3-42 miles). Populations are embedded within a matrix of upland forest, prairie, and urbanized landscapes that create a barrier for long-distance dispersal between population clusters in the South Puget Sound (Thurston, Lewis, and Pierce counties) and southern Puget Trough/Vancouver area (Clark County).

B2b. Anthropogenic barriers: Somewhat Increase.

The range of *Trillium albidum* ssp. *parviflorum* in Washington has become increasingly fragmented through the conversion of mesic oak-ash woodlands and prairie to agriculture, roads, and urbanization. These anthropogenic barriers probably impose a more significant constraint on seed dispersal by insects within Washington, but natural barriers (such as the Columbia River) may be more significant over larger geographic areas (Bledsoe 1993).

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.

Trillium albidum ssp. *parviflorum* produces a fleshy capsule with many seeds. *Trillium* species produce lipid or protein-rich structures called elaiosomes on their seeds that provide food for ants or wasps. These insects may transport the seeds short distances to their nests. New seedlings of *Trillium ovatum* and other species tend to be found close to mature *Trillium* plants, suggesting that dispersal failed, or the insects ate the elaiosomes on site without moving the seed (Mesler and Lu 1983). Researchers in eastern North America have suggested that deer may feed on *Trillium* fruits and transport seeds more than 3 km before defecating them. Otherwise, the seeds of *Trillium* appear to have limited ability for dispersal over 100 meters.

C2ai. Historical thermal niche: Increase.

Figure 3 depicts the distribution of *Trillium albidum* ssp. *parviflorum* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 (“historical thermal niche”). All 48 of the known occurrences (100%) are found in areas that have experienced small (37-47°F/20.8-26.3°C) temperature variation during the past 50 years and are considered at increased risk from climate change.

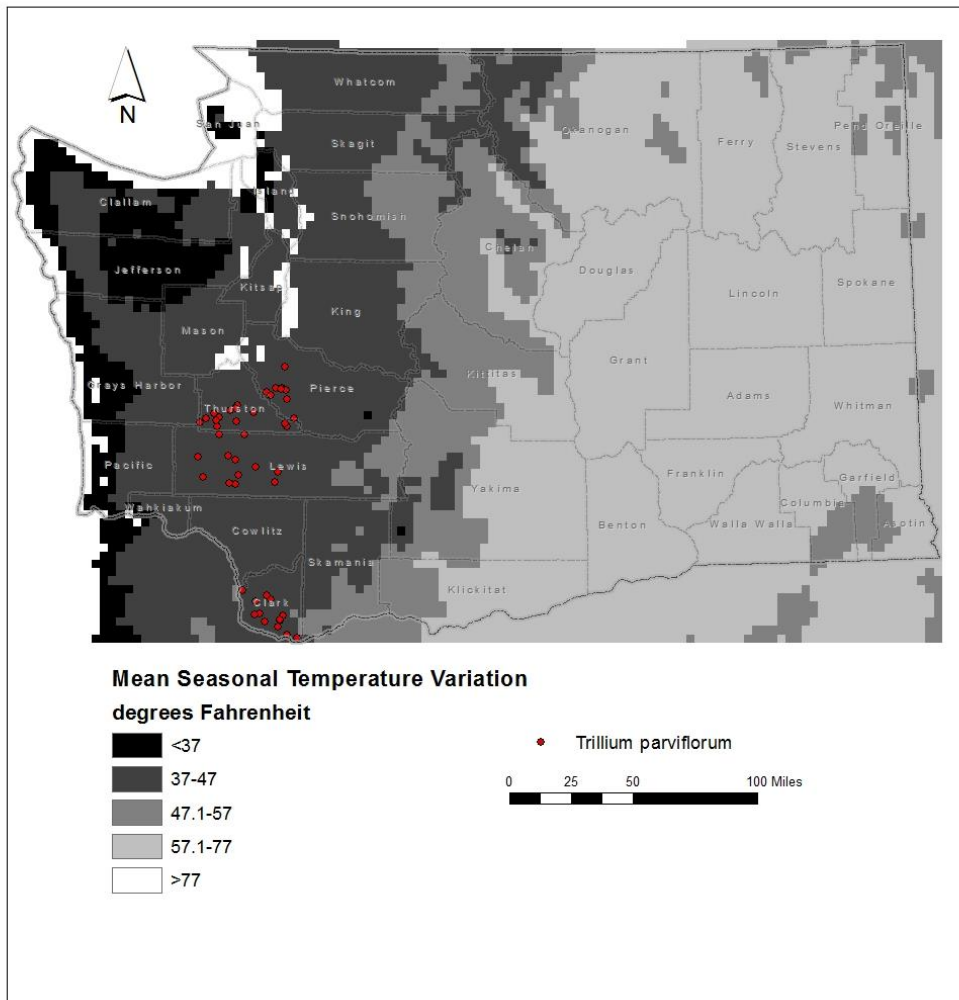


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Trillium albidum ssp. parviflorum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2a.ii. Physiological thermal niche: Somewhat Increase.

The microsites occupied by *Trillium albidum ssp. parviflorum* are often associated with cool, shaded conditions and seasonally flooded soils in winter and early spring. These sites would have somewhat increased vulnerability to climate change.

C2b.i. Historical hydrological niche: Neutral.

Forty-six of the 48 populations of *Trillium albidum ssp. parviflorum* in Washington (95.8%) are found in areas that have experienced greater than average (>40 inches/1016 mm) precipitation variation in the past 50 years (Figure 4). Two other occurrences (4.2%) are from areas with

average precipitation variation during the same period. According to Young et al. (2016), all of these occurrences are at neutral vulnerability from climate change.

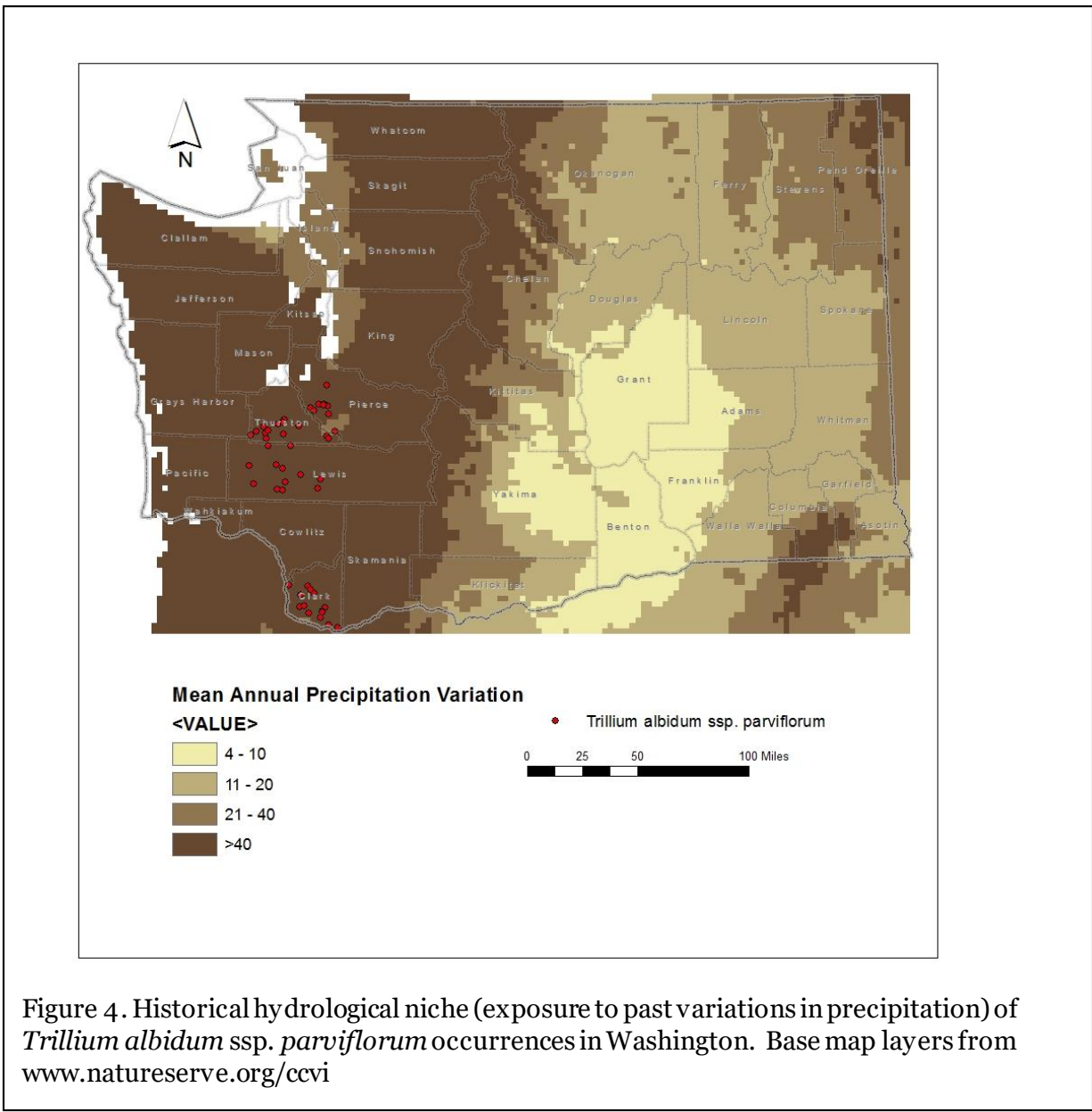


Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Trillium albidum ssp. parviflorum* occurrences in Washington. Base map layers from www.natureserve.org/cvi

C2bii. Physiological hydrological niche: Somewhat Increase.
 The riparian forest habitat occupied by *Trillium albidum ssp. parviflorum* is primarily dependent on precipitation, but could be impacted by early snowmelt in headwater streams. More severe winter storms or early season flooding could change channel sedimentation or erosion, resulting in a narrower riparian corridor. Decreased summer precipitation could shift these communities to drier forests and increased fire frequency could covert forests to wet meadows (Rocchio and Ramm-Granberg 2017). Willamette Valley wet prairie sites could

expand due to higher winter precipitation creating more water-logged soils, but a decrease in summer rainfall or increased temperature and drought could result in changes in species composition towards more xeric meadows (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.

Trillium albidum ssp. *parviflorum* is more dependent on adequate precipitation than natural disturbances to maintain its wet forest and prairie/forest ecotone habitat.

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

The range of *Trillium albidum* ssp. *parviflorum* in lowland valleys of western Washington receives relatively low amounts of snow in winter (though very high winter rainfall).

Populations along perennial streams in the Puget Trough could be indirectly affected by changes in the timing of snowmelt runoff from mountain headwaters, leading to earlier flooding events and earlier onset of lower summer flows (Rocchio and Ramm-Granberg 2017).

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

In the South Puget Sound area, *Trillium albidum* ssp. *parviflorum* is found primarily on Fraser-age Pleistocene glacial till. At the south end of the Puget Trough in Clark County, populations are mostly associated with Missoula glacial flood deposits (Washington Division of Geology and Earth Resources 2016). Both formations are relatively widespread in the valleys of western Washington.

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

The habitat occupied by *Trillium albidum* ssp. *parviflorum* is maintained primarily by natural abiotic processes rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.

Trillium albidum ssp. *parviflorum* has a sweet floral scent, similar to cloves (Bledsoe 1993). The aroma, in conjunction with the open flowers, suggest pollination by a variety of unspecialized pollinators (Soukup 1980).

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

Trillium seeds are dispersed primarily by ants feeding on oil-rich bodies (elaiosomes) on the seed (Bledsoe 1993, Mesler and Lu 1983). Yellow jackets and deer have also been observed transporting seed of eastern *Trillium* species (Vellend et al. 2003; Zettler et al. 2001). *Trillium albidum* ssp. *parviflorum* is dependent on animals for seed dispersal, but the number of potential seed vector species is not known.

C4e. Sensitivity to pathogens or natural enemies: Neutral.

Impacts from pathogens are not known. Thomas and Carey (1996) observed seed predation on plants monitored at Fort Lewis, but otherwise impacts from herbivory appear to be low.

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

Forested wetland sites in western Washington are vulnerable to invasion by reed canarygrass (*Phalaris arundinacea*) and other non-native species.

C4g. Forms part of an interspecific interaction not covered above: Neutral.
Does not require an interspecific interaction.

C5a. Measured genetic variation: Somewhat Increase.

Trillium albidum ssp. *parviflorum* populations from Washington are genetically similar to each other, suggesting a period of inbreeding (Bledsoe 1993). The Washington occurrences also contain one unique karyotype and are missing another genetic marker typical of populations from southern Oregon. Overall, the Washington populations have somewhat less genetic variability than other occurrences found across the range of *T. albidum* (Bledsoe 1993).

C5b. Genetic bottlenecks: Unknown.

The genetic similarity of Washington populations may be the result of past inbreeding that could have been the result of a genetic bottleneck (Bledsoe 1993).

C5c. Reproductive System: Neutral.

Trillium albidum ssp. *parviflorum* is an outcrosser with relatively large and showy flowers pollinated by insects. Data from Bledsoe (1993) indicate that Washington populations have a largely homozygous genome and lack some diagnostic chromosome markers found in southern Oregon populations. Bledsoe (1993) suggested that the genetic and morphologic characters of *T. parviflorum* overlapped enough with *T. albidum* to suggest that the former should be treated as a subspecies, rather than a full species as originally proposed by Soukup (1980).

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

Based on flowering dates from specimens in the Consortium of Pacific Northwest herbaria website, no major 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.

The distribution of *Trillium albidum* ssp. *parviflorum* has not changed notably in the last 50 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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