Climate Change Vulnerability Index Report

*Ranunculus populago* (Mountain buttercup)

Date: 28 February 2020

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G4/S2

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 | 80 |
| | 3.9-4.4° F (2.2-2.4°C) warmer | 0 |
| | <3.9° F (2.2°C) warmer | 20 |
| 2. Hamon AET:PET moisture | < -0.119 | 0 |
| | -0.097 to -0.119 | 80 |
| | -0.074 to - 0.096 | 20 |
| | -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 | | Somewhat 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 | | Somewhat Increase |
| 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 |
| 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: Four of the five occurrences of *Ranunculus populago* in Washington (80%) occur in areas with a projected temperature increase of 4.5-5˚ F (Figure 1). One additional population (20%) is from an area with a predicted temperature increase pf < 3.9˚ F.

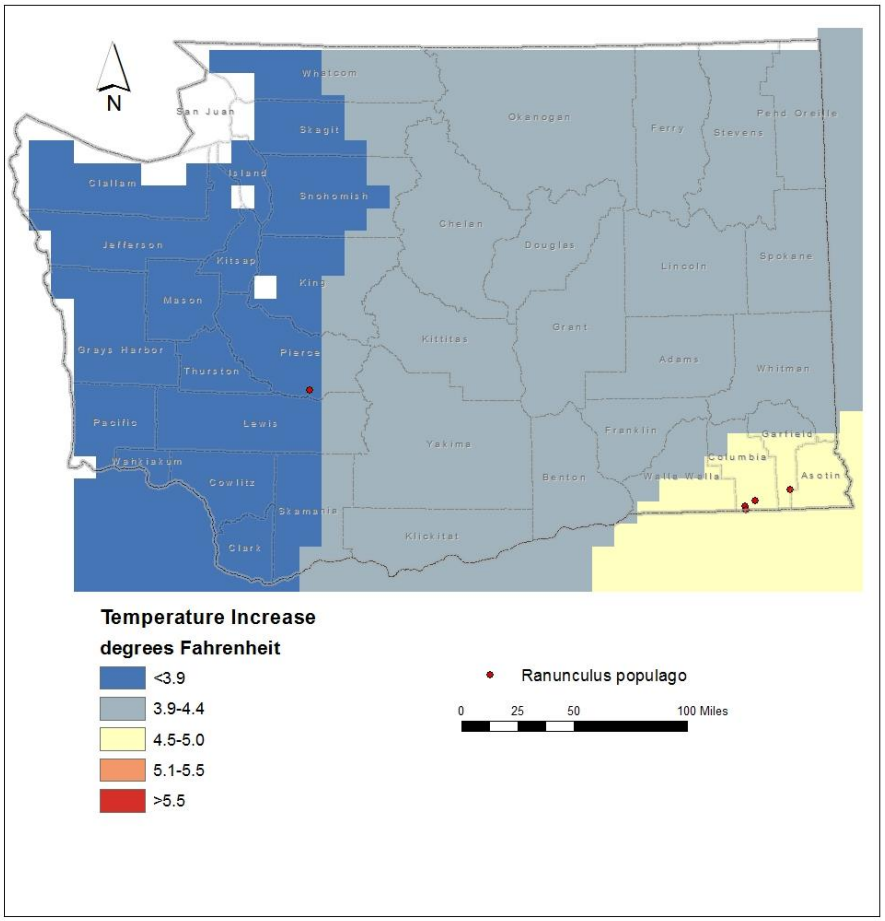


Figure 1. Exposure of *Ranunculus populago* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Four of the five Washington occurrences of *Ranunculus populago* (80%) 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 -0.097 to -0.119 (Figure 2). One occurrence (20%) is found in an area with a projected decrease in moisture of -0.074 to -0.096.

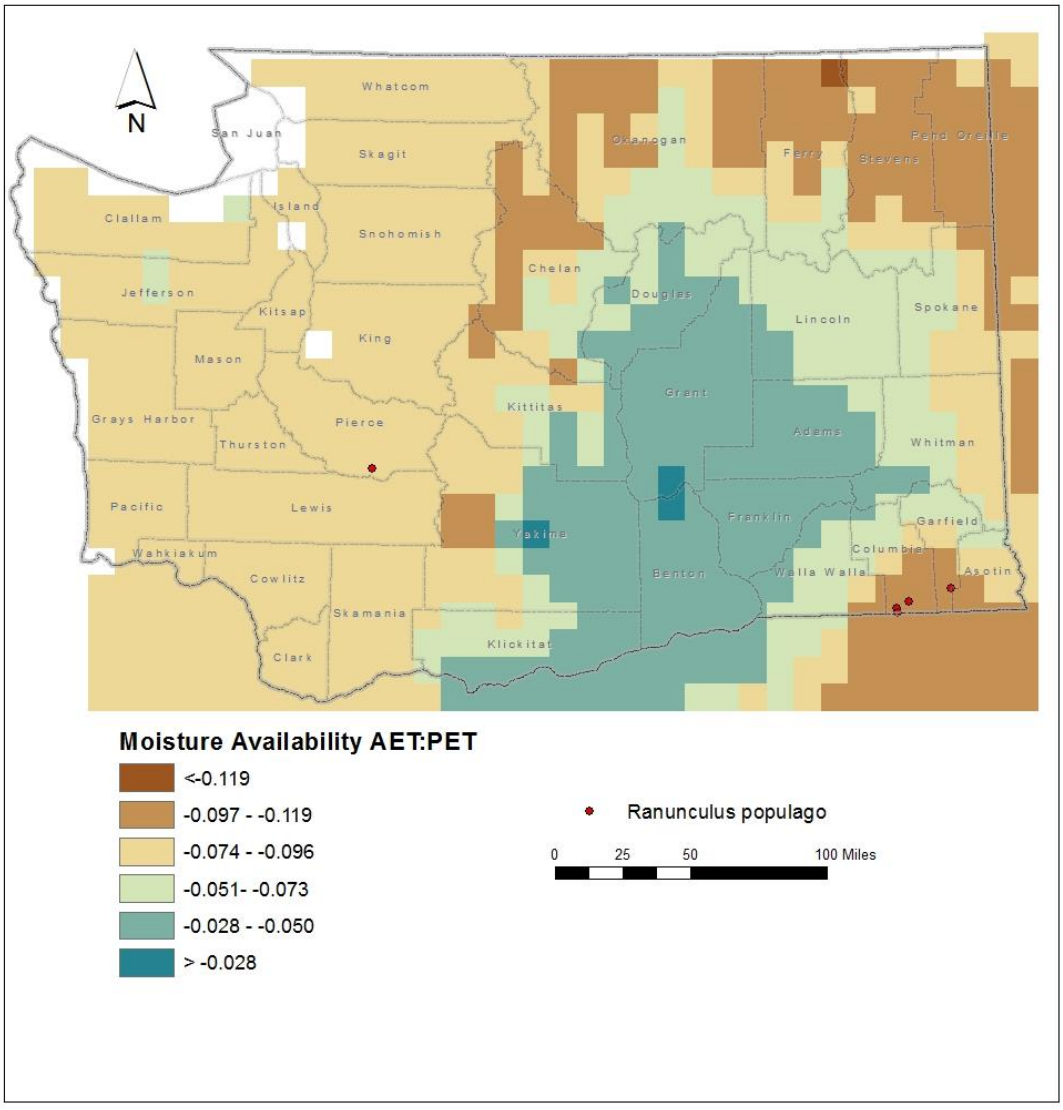


Figure 2. Exposure of *Ranunculus populago* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

## Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Ranunculus populago* are found at 4400-6000 feet (1300-1800 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Ranunculus populago* is found primarily in moist meadows, stream terraces, and riparian corridors within montane forests (Camp and Gamon 2011). Several populations are associated with springs (WNHP records). The habitat of *R. populago* is a component of the Rocky Mountain Alpine-Montane Wet Meadow ecological system (Rocchio and Crawford 2015). Individual populations in the Blue Mountains are separated by 1.6-11 km (2-16 miles), while the Mount Rainier National Park record is 321 km (200 miles) away. Intervening areas are probably not suitable habitat and could be a barrier to dispersal and gene flow.

B2b. Anthropogenic barriers: Neutral.
The range of *Ranunculus populago* in Washington is probably more constrained by natural conditions than human ones.

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

## Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
*Ranunculus populago* produces 7-25 1-seeded achenes per flower head. The achenes are small, flat, and have a small pointed beak to aid dispersal in the fur or feathers of animals or on muddy feet of waterfowl. Dispersal distances are mostly in the range 100 to 1000 m, but infrequent longer dispersal is possible.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Ranunculus populago* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Four of the five of the known occurrences (80%), all from the Blue Mountains, are found in areas that have experienced slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation during the past 50 years and are considered at somewhat increased risk from climate change. The fifth population from Mount Rainier (20% of the state occurrences) is from an area with small (37-47˚F/20.8-26.3˚C) temperature variation in the same period and is considered at increased vulnerability to climate change.

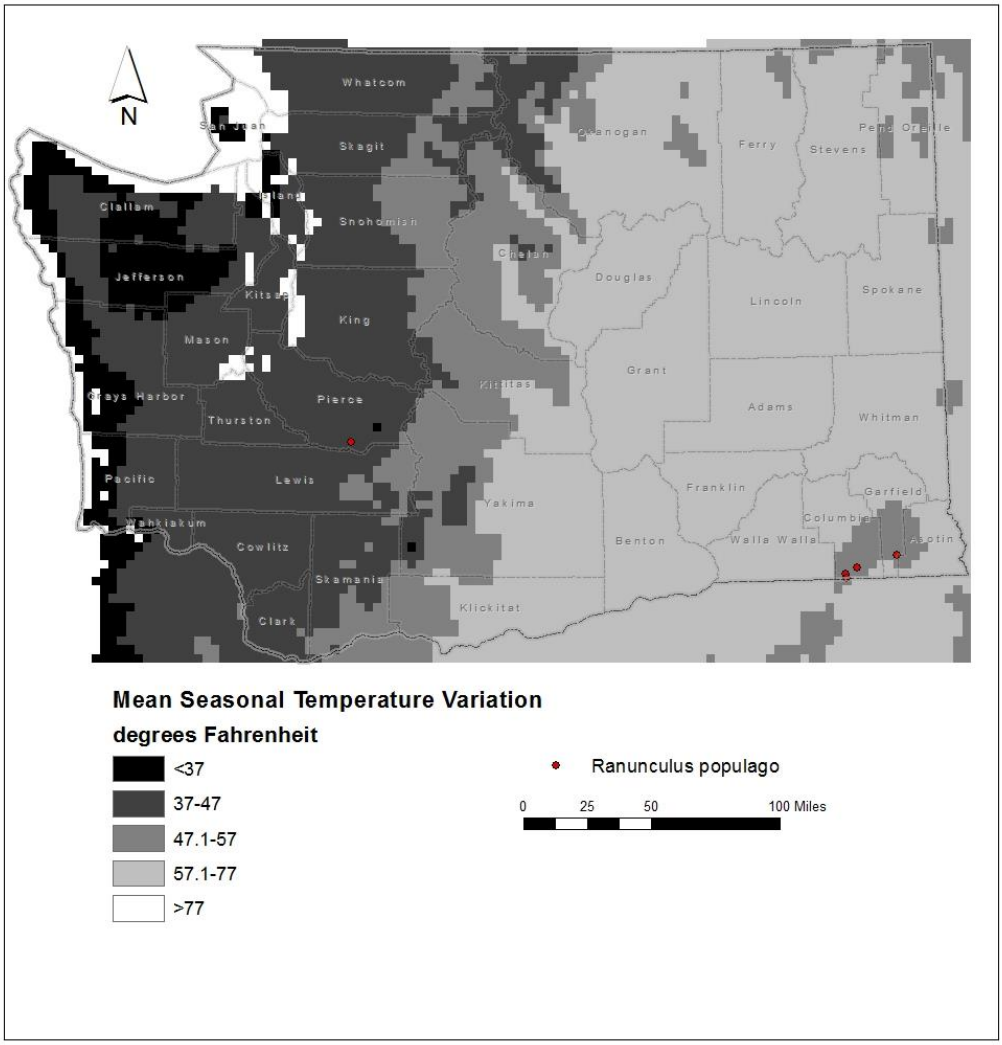


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Ranunculus populago* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
The moist mountain meadows occupied by *Ranunculus populago* are associated with cold air drainage or partial shade during the growing season and would have somewhat increased vulnerability to climate change.

C2bi. Historical hydrological niche: Neutral.
All five of the populations of *Ranunculus populago* in Washington (100%) are found in areas that have experienced average or greater than average (>20 inches/508 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at neutral vulnerability from climate change.

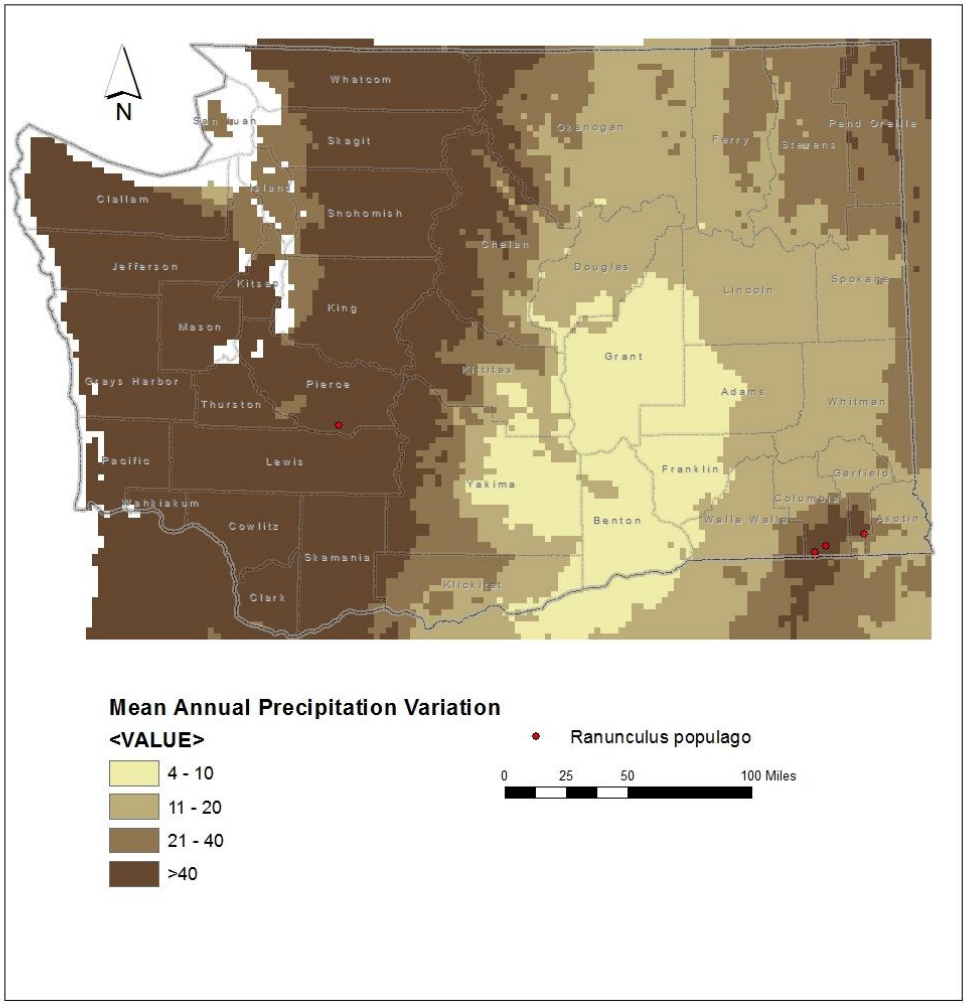


Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Ranunculus populago* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
The montane meadow habitat of this species is dependent on spring-fed moisture or precipitation. The Rocky Mountain Alpine-Montane Wet Meadow ecological system is vulnerable to changes in the timing or amount of precipitation and drought from increased temperature (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
*Ranunculus populago* is probably not dependent on periodic disturbances to maintain its montane wet meadow habitat, which may be too wet to support trees. The species could, however, be detrimentally affected by increased summer temperatures, drought, or decreased precipitation that might favor conversion of this habitat to drier meadow conditions or forest encroachment (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The five populations of *Ranunculus populago* in Washington occur in areas of moderate to high accumulations of snow. Recharge of groundwater from melting snow may be important for maintaining adequate moisture in spring-fed wet meadows. *R. populago* populations could be vulnerable to reductions in the depth or changes in rate of melting of snowpack (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.
The populations of *Ranunculus populago* from the Blue Mountains are associated with the Grande Ronde basalt, which is a widespread geological formation in southeastern Washington. At Mount Rainier, the population is found on glacial drift material. This species is not strongly associated with unusual geology types or landforms in the state, and so ranked neutral.

C4a. Dependence on other species to generate required habitat: Neutral
The habitat occupied by *Ranunculus populago* 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.
*Ranunculus* flowers are unspecialized and visited by a wide variety of generalist insect pollinators.

C4d. Dependence on other species for propagule dispersal: Neutral.
Seed dispersal in *Ranunculus populago* is facilitated by animals, with the small, flattened 1-seeded fruits able to stick to fur or feathers by a pointed beak. Fruits might also be distributed in mud on the feet of waterfowl, or by passive means (gravity, water, wind). Dispersal is probably not a limiting factor.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. Impacts from herbivory are poorly known, but probably low.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
The moist mountain meadow habitat of *Ranunculus populago* could be vulnerable to competition from other native or introduced plant species if these sites become drier and cover of dry meadow or forest species increases (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 data are available on the genetic diversity of *Ranunculus populago* in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
*Ranunculus populago* produces open, perfect flowers that are pollinated by a variety of insects. Due to the small size of the flowers, the species might be capable of some self-pollination. There is little in the life history of this species to suggest it has low genetic diversity overall, though the populations in Washington are at the edge of its continuous range (or widely disjunct, in the case of the Mount Rainier occurrence) and so could have lower genetic diversity due to founder effects or inbreeding depression.

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 *Ranunculus populago* 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

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