Climate Change Vulnerability Index Report

Allium campanulatum (Sierra onion)

Date: 5 November 2019

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G4/S1

Index Result: Less 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	33.3
	3.9-4.4° F (2.2-2.4°C) warmer	66.7
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	33.3
	-0.074 to - 0.096	33.3
	-0.051 to - 0.073	0
	-0.028 to -0.050	33.4
	>-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		Neutral
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Neutral
2c. Dependence on specific disturbance regime		Unknown
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
4e. Sensitivity to pathogens or natural enemies		Neutral
4f. Sensitivity to competition from native or non-native species		Neutral
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	Unknown
Section D	
D1. Documented response to recent climate change	Unknown
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: Two of the three known occurrences of *Allium campanulatum* in Washington (66.7%) are found in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1). The

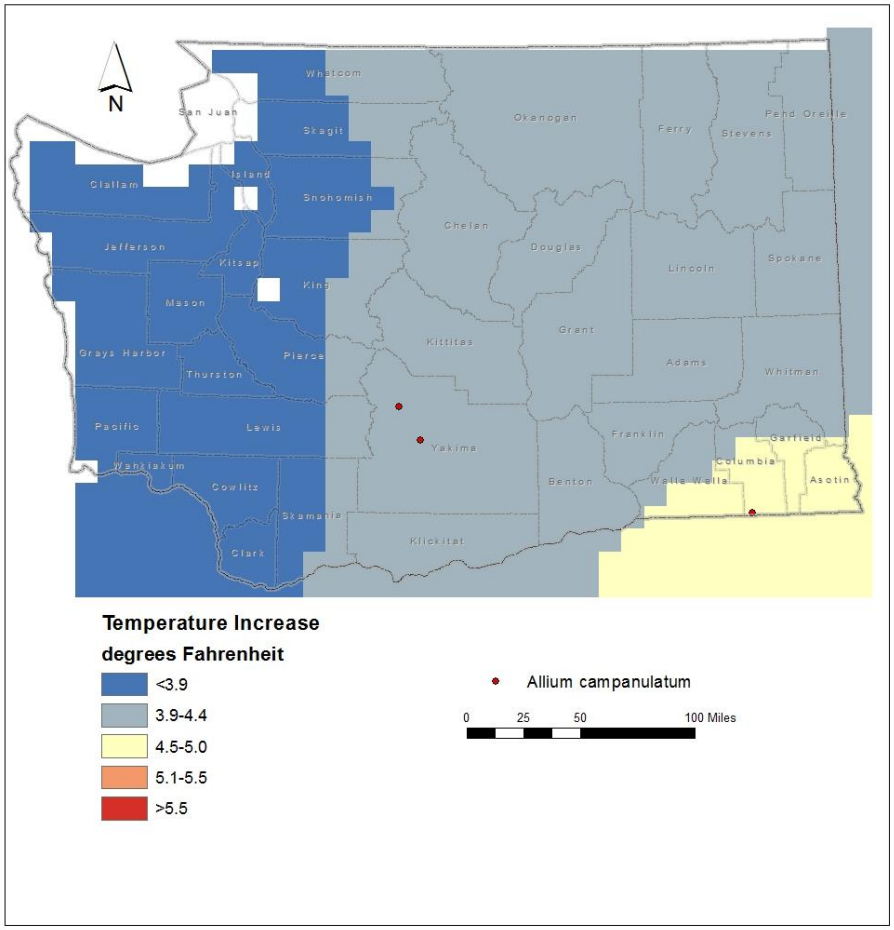

Figure 1. Exposure of *Allium campanulatum* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

third occurrence from the Blue Mountains (33.3% of state occurrences) is in an area with a projected temperature increase of 4.5-5˚ F.

A2. Hamon AET:PET Moisture Metric: One third of the Washington occurrences of *Allium campanulatum* 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. One third of the occurrences are in areas with a projected decrease in the – 0.074 to – 0.096 range. The final one third are from areas with a projected decrease in the – 0.028 to – 0.050 range.

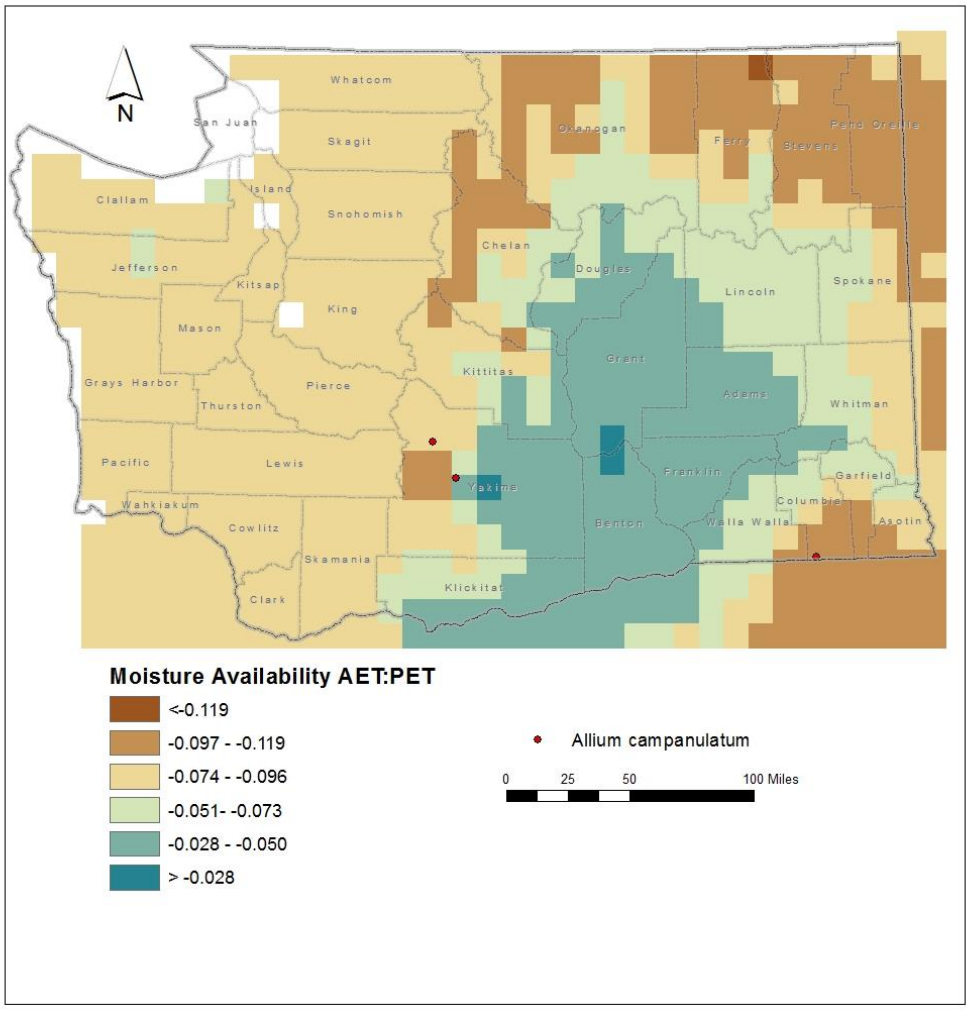

Figure 2. Exposure of *Allium campanulatum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
All occurrences of *Allium campanulatum* in Washington are found at elevations from 3200-6600 ft (975-2015 m) and would not be inundated by sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Allium campanulatum* occurs on thin, rocky or sandy soil of slopes and dry drainage channels or in dry, rocky meadows with sparse (10-25%) vegetative cover (Camp and Gamon 2011, WNHP records). This vegetation type is closest to the Northern Rocky Mountain Lower Montane, Foothills, and Valley Grassland ecological system (Rocchio and Crawford 2015), but represents a phase with lower vegetation cover and more exposed rocky soil. Washington populations are separated by 17-150 miles (27-240 km). The habitat occupied by this species may be relatively uncommon and widely scattered, presenting a potential barrier to dispersal for this species.

B2b. Anthropogenic barriers: Neutral.
Two of the known occurrences in Washington are bisected by two-track roads. Overall, the known range of this species in Washington is not strongly impacted by human development.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Allium campanulatum reproduces by seed formed in dry capsules with no active dispersal mechanism, such as barbs, hooks, parachutes, or wings to be transported by animals or the wind. Seeds are relatively small and could possibly be carried short distances by strong winds, but more likely are passively dispersed within 1000 meters of the parent plant.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of known *Allium campanulatum* occurrences in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All three of the Washington occurrences (100%) are found in areas that have experienced slightly lower than average (47.1-57˚F) temperature variation in the past 50 years. According to Young et al. (2016) these populations are at somewhat increased vulnerability to climate change.

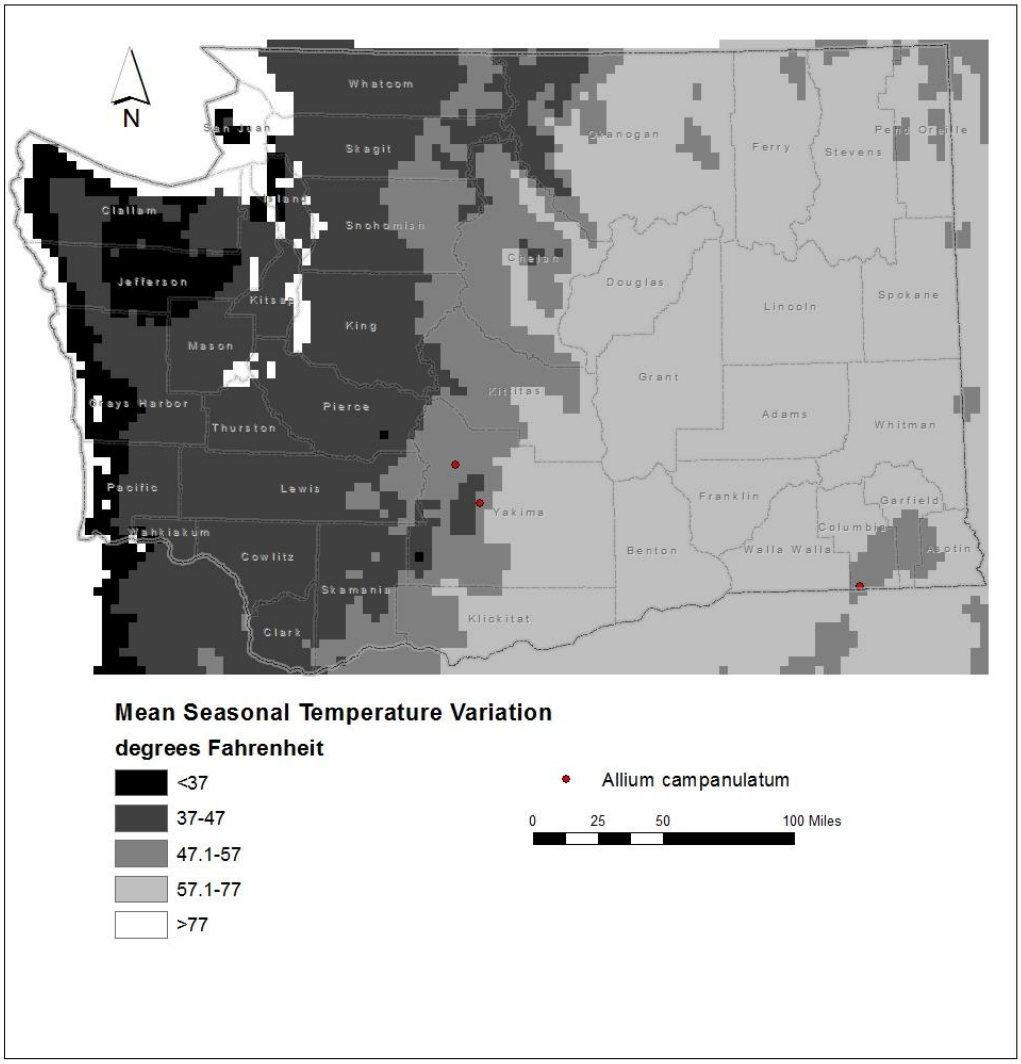

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Allium campanulatum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
Allium campanulatum occurrences in Washington are mostly on openings in upper slopes in area that are not cold air drainages.

C2bi. Historical hydrological niche: Neutral.
All three of the Washington occurrences (100%) of *Allium campanulatum* (Figure 4) are found in areas that have averaged more than 20 inches (508 mm) of precipitation variation in the past 50 years and are ranked neutral for climate change by Young et al. (2016).

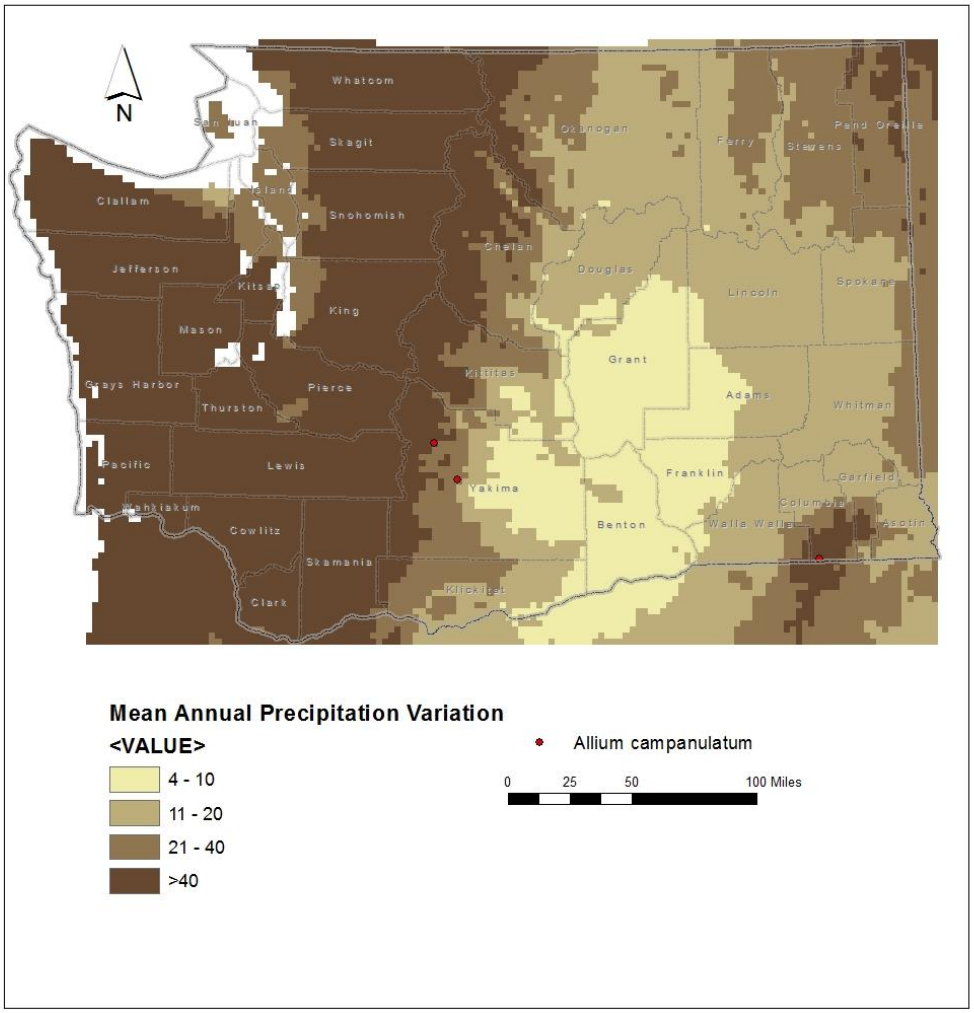

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Allium campanulatum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Neutral.
Allium campanulatum is not strongly associated with wetland habitats, and so is considered neutral for this factor.

C2c. Dependence on a specific disturbance regime: Unknown.
This species is found in sparsely vegetated, rocky sites on upper slopes or in dry drainages. These conditions may be maintained by erosion or exposure to wind. It is not known whether periodic disturbances are necessary to maintain this habitat.

C2d. Dependence on ice or snow-cover habitats: Neutral
In Washington, *Allium campanulatum* is found in foothills areas that receive moderate amounts of snow, and so may not be impacted by reductions in snow cover predicted by climate change.

C3. Restricted to uncommon landscape/geological features: Neutral.
All of the Washington occurrences of *Allium campanulatum* are found on Miocene-age basalts and breccia tuff. Two of the populations are associated with the Grande Ronde Basalt. These geologic substrates are widespread in the state.

C4a. Dependence on other species to generate required habitat: Neutral.
The barren slope and sparse meadow habitat occupied by this species is not a consequence of ecosystem engineering by other organisms.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
McNeal (1994) reports that most western species of *Allium* are pollinated by native bees. The specific pollinators of *A. campanulatum* are not known.

C4d. Dependence on other species for propagule dispersal: Neutral.
Dispersal of *Allium* seed is primarily passive and the small seeds can be spread by wind or gravity. Dispersal distances are probably short.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Livestock grazing has been identified as a potential threat to *Allium campanulatum* (Camp and Gamon 2011). One population in Yakima County is in an area with high gopher activity, though this disturbance might help maintain open habitats occupied by this species (WNHP records). *Allium* flowers and leaves are palatable, and underground bulbs are also consumed by fossorial mammals. Whether natural herbivory is a limiting factor in the survival of *A. campanulatum* is not known.

C4f. Sensitivity to competition from native or non-native species: Neutral.
The habitat of *Allium campanulatum* is mostly open and has low cover of introduced invasive weeds.

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

C5a. Measured genetic variation: Unknown.
No data are available on genetic variability within or between Washington populations of *Allium campanulatum*.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
Allium species generally are outcrossers and have non-specialized pollinators. It is probable that the full species has at least average levels of genetic diversity, though disjunct and reproductively isolated populations in Washington might be expected to have less total genetic diversity and some unique markers (WNHP 2003).

C6. Phenological response to changing seasonal and precipitation dynamics: Unknown.
Based on WNHP and Consortium of Pacific Northwest Herbaria records, no 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 range of *Allium campanulatum* has not been altered in recent years due to impacts 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

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