Climate Change Vulnerability Index Report

Scribneria bolanderi (Scribner's grass)

Date: 6 March 2020

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G4/S1

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	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	33.4
	-0.051 to - 0.073	33.3
	-0.028 to -0.050	33.3
	>-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		Neutral
2ai Change in historical thermal niche		Somewhat Increase
2aii. Change in physiological thermal niche		Neutral/Somewhat Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Greatly 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		Unknown
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		Somewhat Increase
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: The three accepted occurrences of *Scribneria bolanderi* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

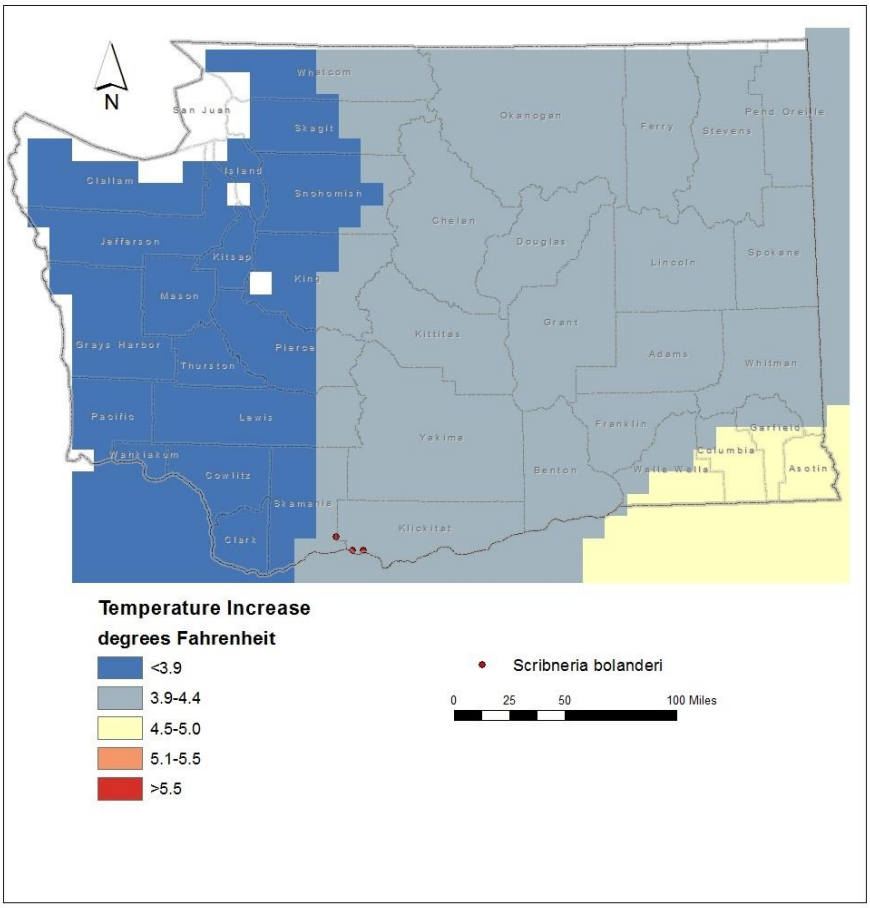

Figure 1. Exposure of *Scribneria bolanderi* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: One of the three accepted occurrences of *Scribneria bolanderi* (33.4%) 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 -0.074 to -0.096 (Figure 2). Another population (33.3%) is found in an area of projected decrease in available moisture of -0.051 to -0.073 and one other (33.3%) is found in an area of projected decrease in moisture of -0.028 to -0.050 (Figure 2).

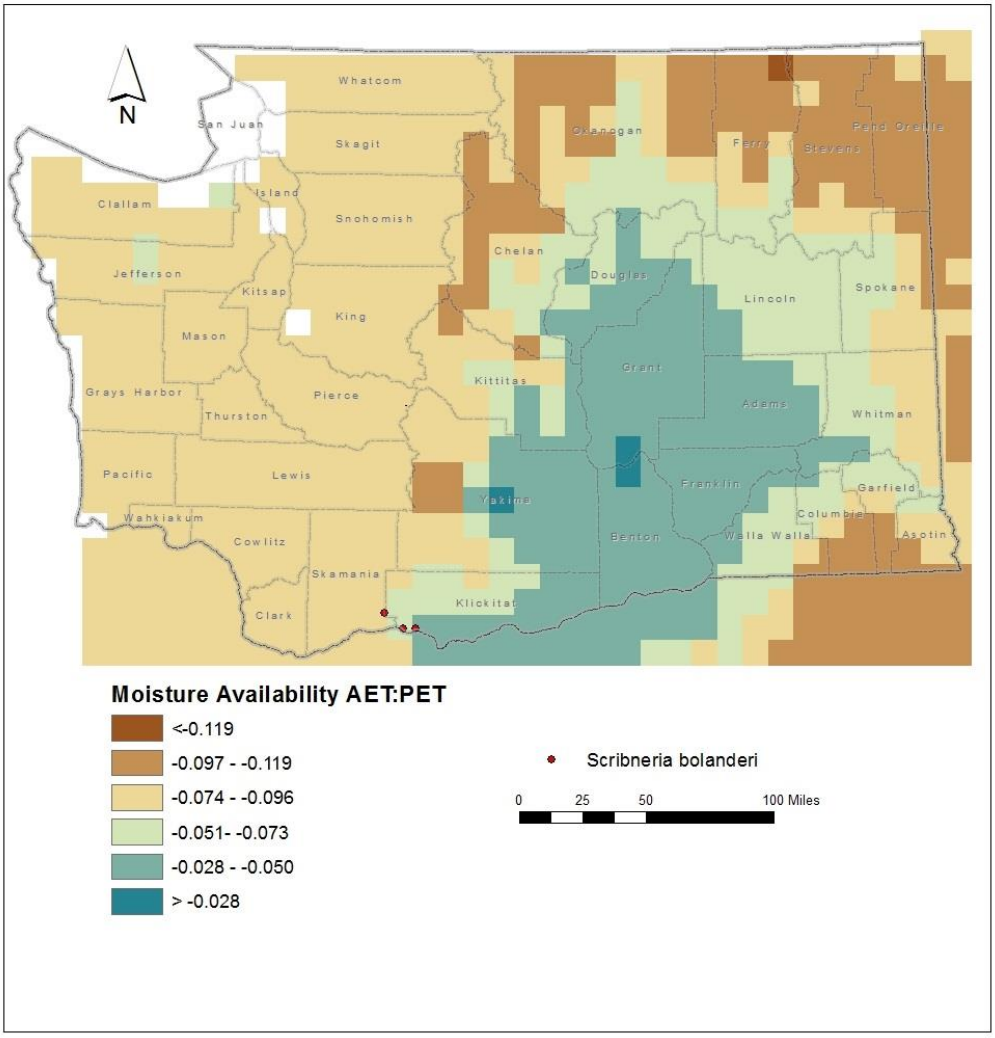

Figure 2. Exposure of *Scribneria bolanderi* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Scribneria bolanderi* are found at 90-2900 feet (28-890 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Scribneria bolanderi* is found in dry sandy or lithic soils along roadsides, river banks, and vernally moist areas (Camp and Gamon 2011; Hitchcock and Cronquist 2018). This habitat may correspond with the Columbia Plateau Vernal Pool ecological system (Rocchio and Crawford 2015). One population reported from Douglas-fir forests in the West Cascades is probably based on a misidentification and has been excluded. The confirmed populations are often restricted to small patches of suitable habitat separated by 10-575 meters within a matrix of grasslands. Other populations may be 5-9.5 miles (8 -16 km) apart. These sites are embedded within a matrix of unsuitable natural habitat and areas of human development. Of the two, natural barriers may be more significant than anthropogenic barriers in restricting dispersal.

B2b. Anthropogenic barriers: Neutral.
The range of *Scribneria bolanderi* is naturally fragmented. Human impacts in southern Washington have little effect on this condition.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Scribneria bolanderi reproduces by one-seeded dry fruits (caryopsis) that are equipped with a long awn and a tuft of basal hairs to assist with dispersal by wind or by catching onto the fur or feathers of animals. These fruits are capable of long-distance dispersal (over 1 km), though most fruits may spread by gravity and land close to their parent.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Scribneria bolanderi* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All three of the known occurrences (100%) 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 vulnerability to climate change.

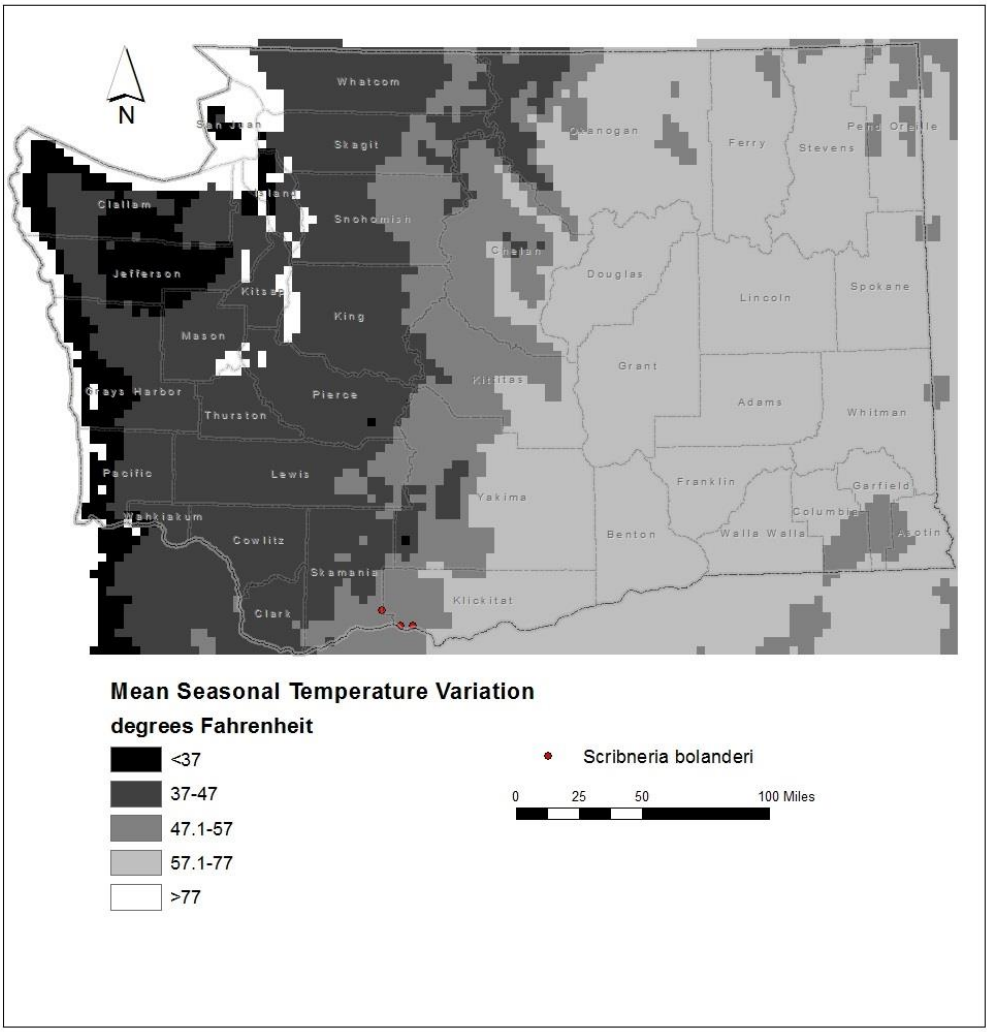

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Scribneria bolanderi* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral/Somewhat Increase.
The vernal area and roadside habitat of *Scribneria bolanderi* is not associated with cold air drainage during the growing season. Increased temperatures and longterm drought could convert vernal habitats to dry rock outcrop or meadow communities under climate change scenarios (Rocchio and Ramm-Granberg 2017).

C2bi. Historical hydrological niche: Neutral.
All three of the populations of *Scribneria bolanderi* 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 to climate change.

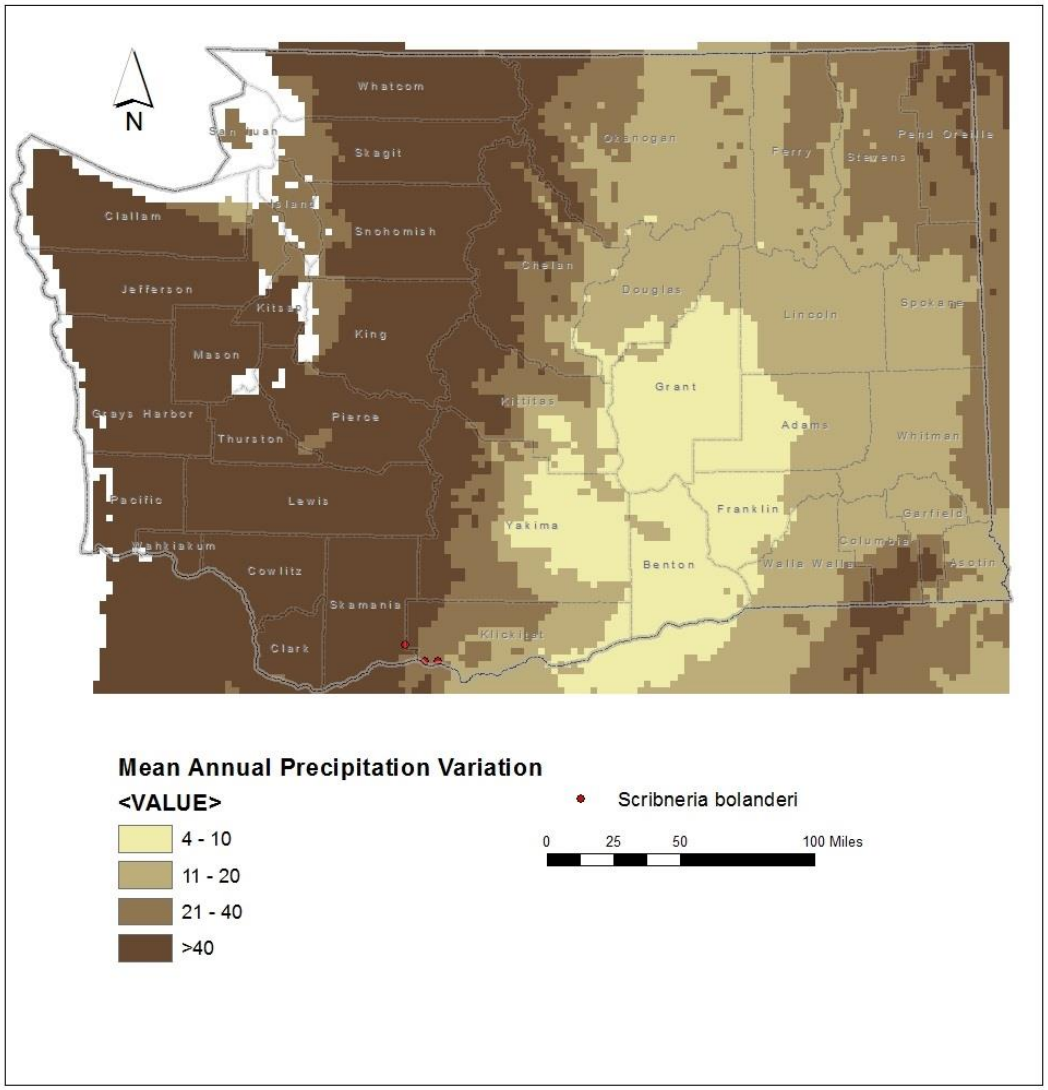

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Scribneria bolanderi* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Greatly Increase.
This species is dependent on episodic winter and early spring precipitation and snow melt followed by severe drought to maintain its specialized vernal wetland habitat. It is especially vulnerable to changes in the amount and timing of precipitation (Rocchio and Ramm-Granberg 2017). Potentially higher amounts of precipitation in winter could be offset by higher temperatures and greater evapotranspiration. Unpredictable climatic events could also be significant on this annual species which must rely on a seed bank to persist through unfavorable years.

C2c. Dependence on a specific disturbance regime: Neutral.
Some populations of *Scribneria bolanderi* in Washington are associated with periodic disturbances, such as road blading or river scour, to maintain their relatively open habitat characteristics. These kinds of disturbances are not likely to be affected by climate change (or might even increase in the case of roadside disturbance under drier conditions). Increased summer temperatures and drought could lead to the conversion of vernal habitats to sparsely vegetated scablands, or make the sites more vulnerable to invasion and competition by non-native annuals (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Reduced snowpack or changes in snow melt are a threat to many scabland vernal pool communities in the Columbia Plateau Columbia River Gorge (Rocchio and Ramm-Granberg 2017). Increased drought would favor transition to sparsely vegetated scabland communities.

C3. Restricted to uncommon landscape/geological features: Unknown.
Although *Scribneria bolanderi* is associated with vernally moist areas (these may in turn be tied to shallow depressions in basalt bedrock), the species is also found along disturbed roadsides and riverbanks in geologic substrates that are not necessarily limiting. Better information is needed on the specific microsite conditions needed for this species to become established and persist.

C4a. Dependence on other species to generate required habitat: Neutral
The vernal wetland habitat occupied by *Scribneria bolanderi* is probably maintained by natural abiotic processes and geologic conditions, rather than by interactions with other species. Disturbed roadside habitats are maintained by human activity (arguably, humans might be considered the ecosystem engineer in this instance).

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Scribneria bolanderi is wind pollinated, and thus not pollinator-limited.

C4d. Dependence on other species for propagule dispersal: Neutral.
The dry, one-seeded fruits of *Scribneria bolanderi* are probably dispersed by sticking to the feet or feathers of waterfowl. It is probably not dependent on just a few seed vector species.

C4e. Sensitivity to pathogens or natural enemies: Somewhat Increase.
Impacts from pathogens are not known. *Scribneria bolanderi* could be vulnerable to herbivory by livestock or native grazers.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Scribneria bolanderi could be sensitive to competition from other plant species (especially non-native invasive annuals) if its vernal wetland habitat became completely dried out due to climate change (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 Washington populations.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Scribneria bolanderi probably has average genetic diversity across populations due to its ability to outcross, accept pollen from distance sources, and disperse widely by wind. Washington populations are located at the northern edge of the species range and probably have less genetic diversity than occurrences from Oregon or California due to founder effects or genetic drift.

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 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.
Significant changes in the distribution of *Scribneria bolanderi* have not been documented.

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.

Hitchcock, C.L. and A. Cronquist. 2018. Flora of the Pacific Northwest, an illustrated manual, second edition. Edited by D.E. Giblin, B.S. Legler, P.F. Zika, and R.G. Olmstead. University of Washington Press and Burke Museum of Natural History and Culture, Seattle, WA. 882 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.