Climate Change Vulnerability Index Report

Carex sychnocephala (Many-headed sedge)

Date: 1 April 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	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	15.4
	-0.074 to - 0.096	15.4
	-0.051 to - 0.073	69.2
	-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		Neutral
2aii. Change in physiological thermal niche		Somewhat Increase
2bi. Changes in historical hydrological niche		Somewhat Increase
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		Somewhat Increase
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	
Section D	Neutral
D1. Documented response to recent climate change	Somewhat Increase
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 13 known occurrences of *Carex sychnocephala* in Washington are found in areas with a projected temperature increase of 3.9-4.4˚F (Figure 1).

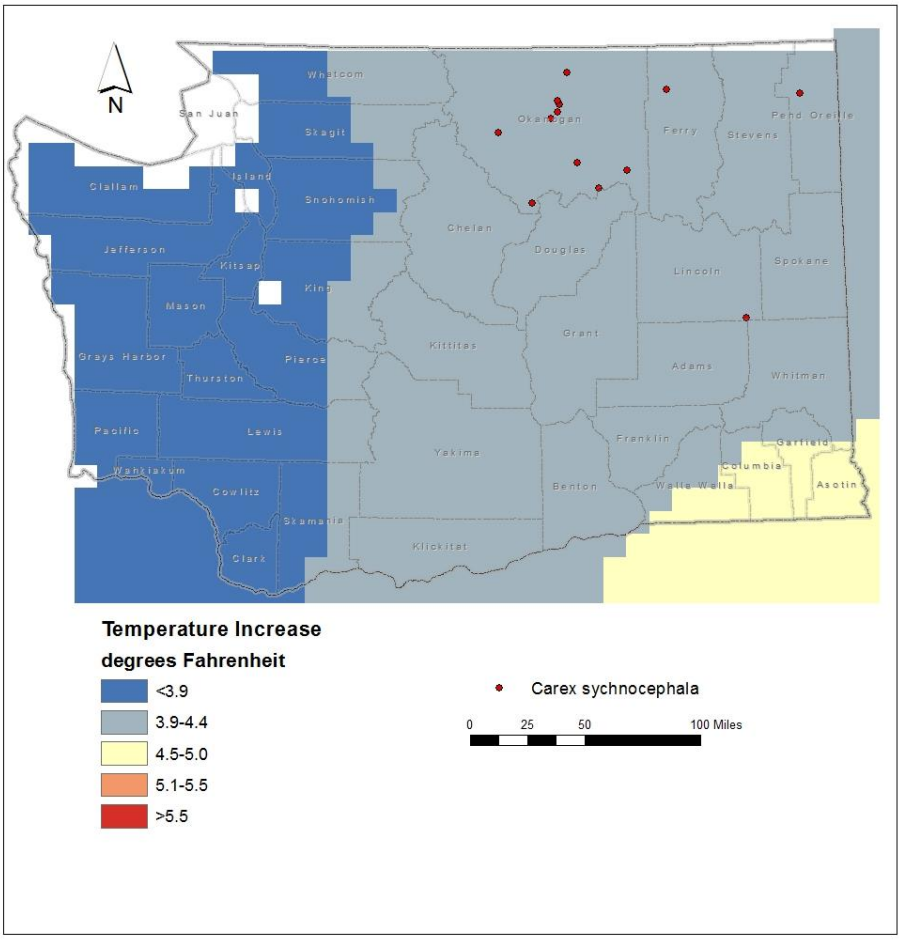

Figure 1. Exposure of *Carex sychnocephala* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Nine of the 13 occurrences of *Carex sychnocephala* in Washington (69.2%) 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 -0.051 to -0.073 (Figure 2). Two populations (15.4%) are from areas with a projected decrease in available moisture between -0.074 to -0.096 and two others (15.4%) are from areas with a predicted decrease of -0.097 to -0.119 (Figure 2).

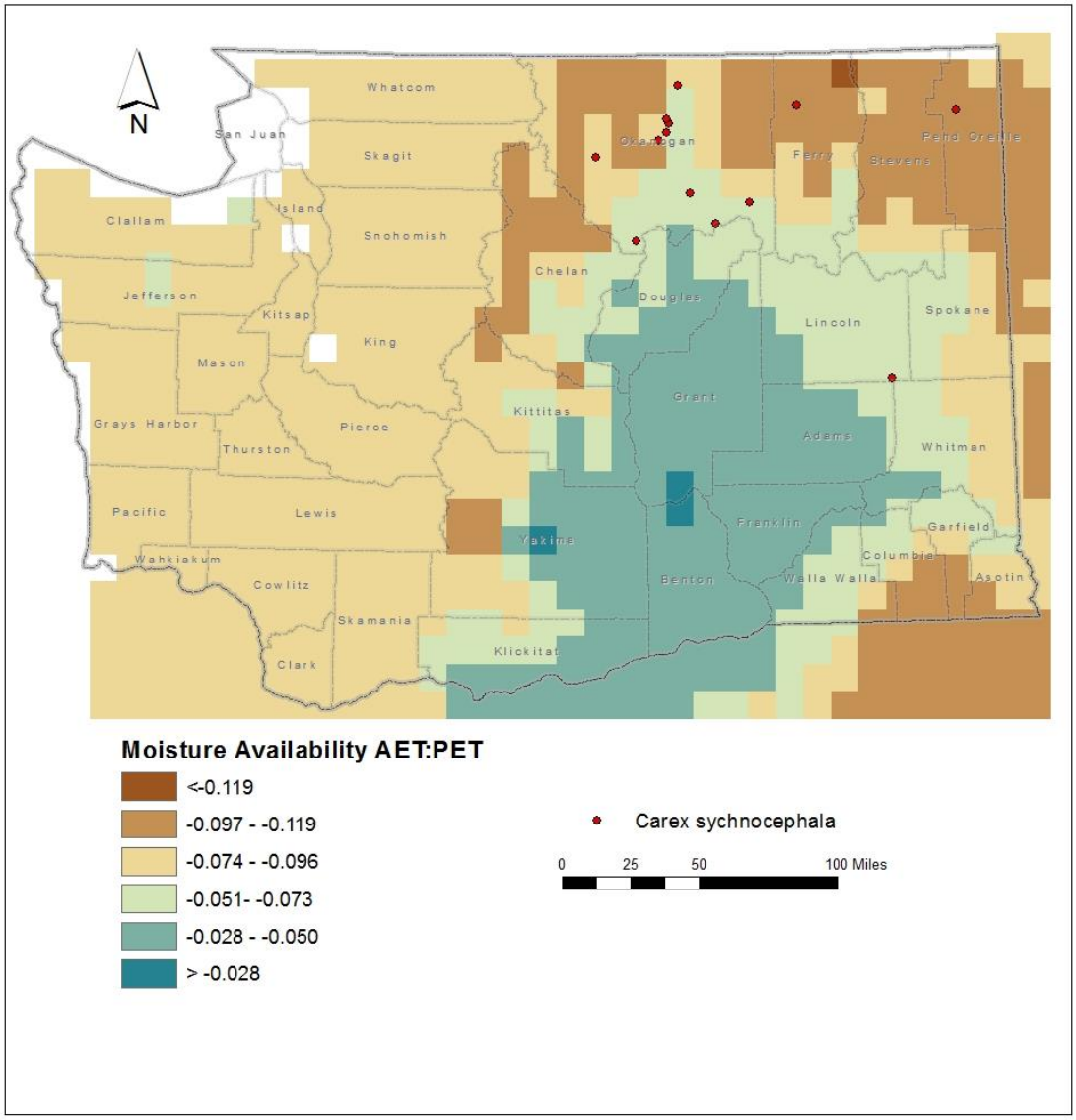

Figure 2. Exposure of *Carex sychnocephala* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
The entire range of *Carex sychnocephala* in Washington is at or above 1170-3400 ft (360-1040 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Carex sychnocephala* is found in moist depressions, marshy areas, and shores of small lakes and ponds on rocky, silty, or sandy soils (Camp and Gamon 2011, Wilson et al. 2014, WNHP records). Some occurrences on basalt bedrock are associated with ephemeral wetlands that become dry by late summer. Populations may be found in openings within forests or in sagebrush steppe. Shoreline habitats may have dense cover of Reed canarygrass (*Phalaris arundinacea*), bulrushes (*Scirpus* or *Schoenoplectus* spp), or other sedges. The habitat of most populations in Washington conforms with the North American Arid West Emergent Marsh ecological system, though a few associated with ephemeral basalt ponds might be better classified as Northern Columbia Plateau Basalt Pothole Ponds (Rocchio and Crawford 2015). Washington populations are separated by 1.7-85 miles (3-125 km) and isolated by large areas of unsuitable habitat.

B2b. Anthropogenic barriers: Neutral.
Most populations of *Carex sychnocephala* in Washington occur within a matrix of agricultural development, roads, and other human developments, but the distribution of this species is more strongly influenced by the availability of natural habitat.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Carex sychnocephala produces 1-seeded dry fruits (achenes) that are light weight and passively dispersed by gravity, high winds, or running water, mostly within a short distance of the parent plant (<1000 m). Longer distance dispersal might occasionally be facilitated by the fruits adhering to mud on birds or mammals.

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Carex sychnocephala* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All 13 of the known occurrences are found in areas that have experienced average (57.1-77˚F/31.8-43.0˚C) temperature variation during the past 50 years. The species is considered to have neutral vulnerability under projected climate change (Young et al. 2016).

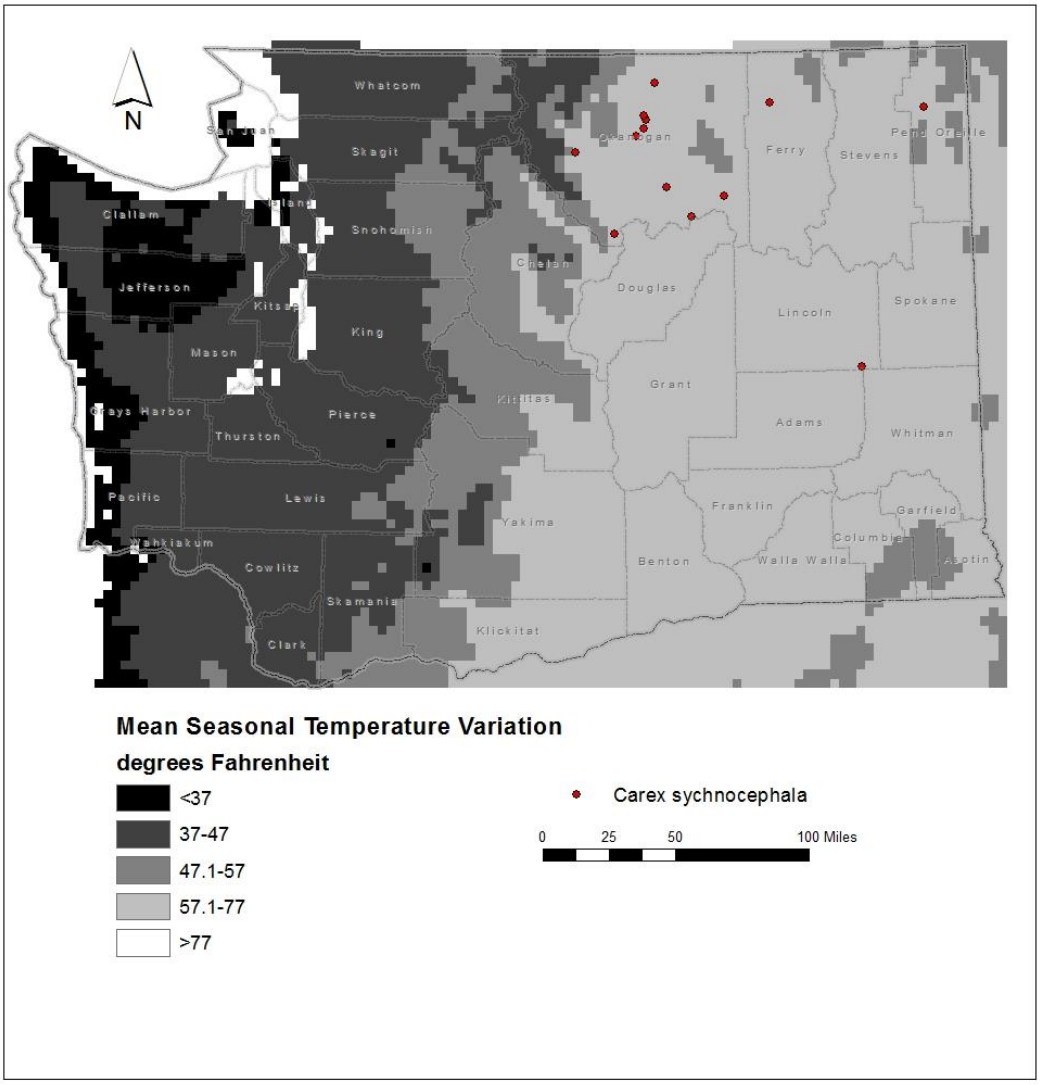

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Carex sychnocephala* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
Populations of *Carex sychnocephala* in Washington are found in depressions, lake shores, and wetlands associated with cool air drainages, often within mountain valleys. These microhabitats are cooler than the general landscape matrix.

C2bi. Historical hydrological niche: Somewhat Increase.
Ten of the 13 known occurrences of *Carex sychnocephala* in Washington (76.9%) occur in areas that have experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation in the past 50 years (Figure 4) and are considered to be at somewhat increased risk from climate change (Young et al. 2016). Three other populations (23.1%) have experienced average or greater than average (>20 inches/508 mm) precipitation variation over the same period and are at neutral risk from climate change.

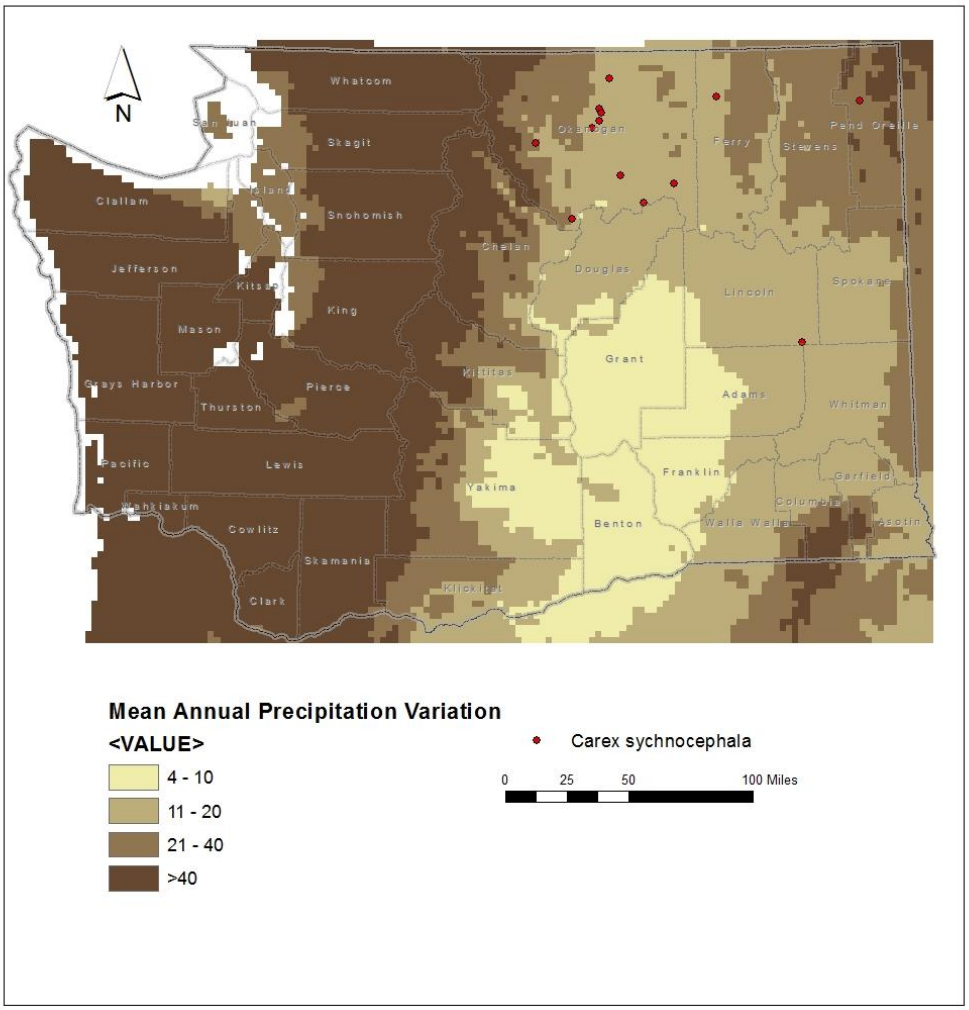

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Carex sychnocephala* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
The marsh, pond, and lakeshore habitat of *Carex sychnocephala* is dependent on adequate surface moisture. It would be negatively impacted by changes in the amount and timing of spring and summer precipitation and increased temperatures that would exacerbate drought

conditions. Some occurrences may also be dependent on groundwater that is influenced by snowpack (see C2d below). Drying conditions could favor transition of some sites to wet meadows (Rocchio and Ramm-Granberg 2017). Summer drought also helps maintain some populations in ephemeral wetlands (Wilson et al. 2014), but changes in precipitation timing might make these areas prone to longer periods of flooding.

C2c. Dependence on a specific disturbance regime: Neutral.
This species is not dependent on disturbance to maintain its wetland habitat.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Some occurrences of *Carex sychnocephala* in the Okanogan Mountains are in areas of relatively high snowfall and may depend on recharge of groundwater through snowmelt to maintain appropriate hydrological conditions.

C3. Restricted to uncommon landscape/geological features: Neutral.
Washington populations of *Carex sychnocephala* are found in a variety of widespread geological formations, including the Priest Rapids member of the Wanapum Basalt, Palmer Mountain Greenstone, O'Brien Creek Formation, Conconully granodiorite, and various Pleistocene geolacustrine deposits. The species is usually found in naturally occurring depressions or lakeshores formed by geomorphic processes.

C4a. Dependence on other species to generate required habitat: Somewhat Increase.
Herbivory of marsh vegetation (especially competing graminoids) may help maintain partially open lakeshore habitat for *Carex sychnocephala*.

C4b. Dietary versatility: Not applicable for plants.

C4c. Pollinator versatility: Neutral.
Carex species are entirely wind pollinated.

C4d. Dependence on other species for propagule dispersal: Neutral.
Dispersal of fruits is predominantly passive (gravity, water, high winds), but occasionally may occur by animal vectors transporting fruit embedded in mud.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
No impacts from pathogens are known. The species can withstand moderate grazing or trampling (Wilson et al. 2014), but may decline with heavy grazing.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Carex sychnocephala in Washington is sometimes found in densely vegetated wet meadows (Camp and Gamon 2011) and at one site has declined due to competition with reed canarygrass (WNHP records).

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

C5a. Measured genetic variation: Unknown.
No data are available on genetic variability in the state. Washington populations are near the southern edge of the species' range and might be expected to have lower genetic variation than populations closer to the core of its range.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
As a wind-pollinated, obligate outcrosser, *Carex sychnocephala* would be expected to have reasonably high genetic variability.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on records from the Consortium of Pacific Northwest Herbaria website, no significant changes have occurred in the onset of flowering or fruiting in *Carex sychnocephala* in the past 50 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Somewhat Increase
Four of the 13 known occurrences of this species in Washington have not been relocated in recent surveys (since 2000) and may have become extirpated. Whether this is due to local factors, such as competition with exotic plants, development, loss of water, over-grazing, or climate impacts is poorly known.

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.

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Wilson, B.L., R.E. Brainerd, D. Lytjen, B. Newhouse, and N. Otting. 2014. Field Guide to the Sedges of the Pacific Northwest, second edition. Oregon State University Press, Corvallis, OR. 432 pp.

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