Climate Change Vulnerability Index Report

Heterotheca oregona (Oregon goldenaster)

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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	75
	<3.9° F (2.2°C) warmer	25
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to - 0.096	87.5
	-0.051 to - 0.073	6.25
	-0.028 to -0.050	6.25
	>-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		Somewhat Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Somewhat Increase
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: Twelve of the 16 occurrences of *Heterotheca oregona* in Washington (75%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1). The other four populations (25%) are from areas with a predicted temperature increase of <3.9˚ F.

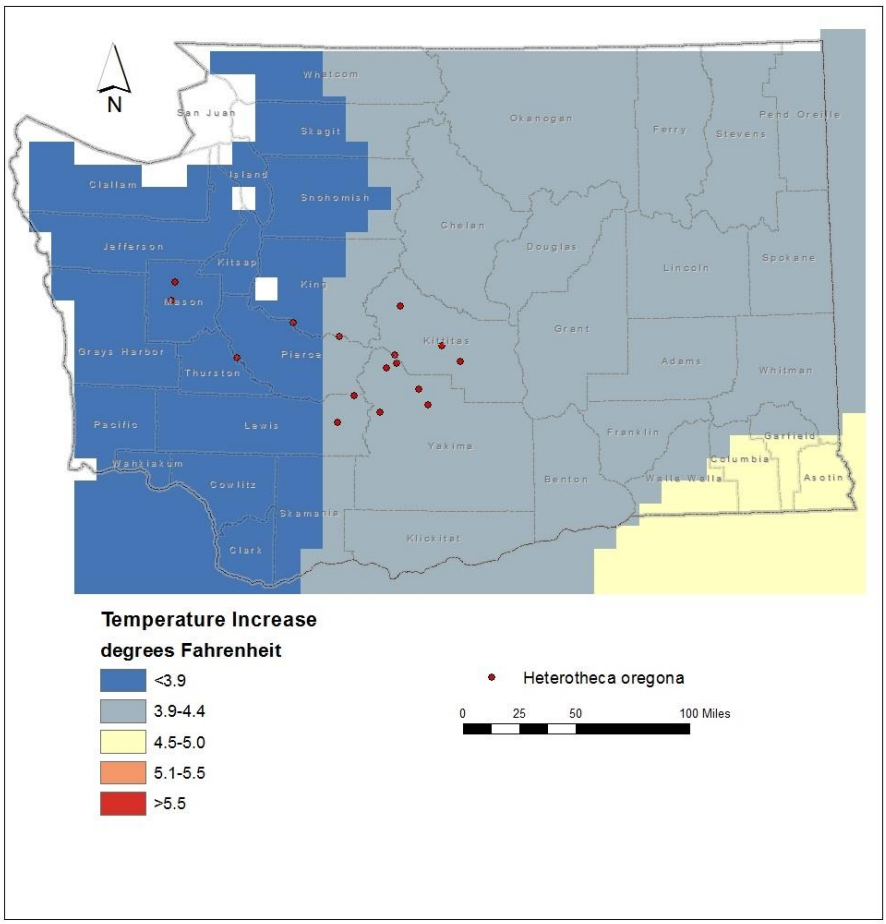

Figure 1. Exposure of *Heterotheca oregona* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Fourteen of the 16 occurrences of *Heterotheca oregona* (87.5%) 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). One population (6.25%) is from an area with a projected decrease in the range of -0.051 to -0.073 and one other occurrence (6.25%) is from a site with a predicted decrease in available moisture of -0.028 to -0.050 (Figure 2).

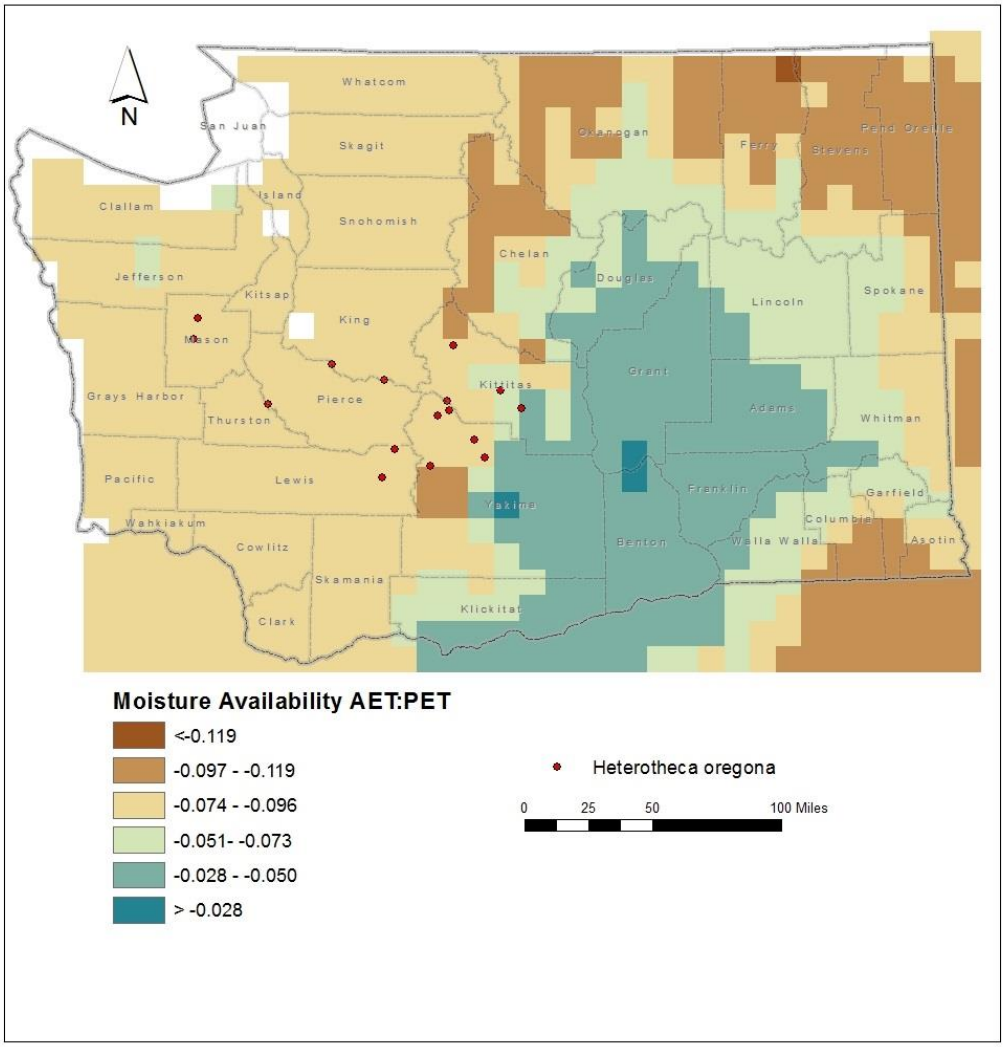

Figure 2. Exposure of *Heterotheca oregona* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Heterotheca oregona* are found at 90-2600 feet (30-800 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Heterotheca oregona* is found on riverbank terraces of smooth cobblestones and sand or gravel bars in sparsely vegetated openings with low shrubs, cottonwood saplings, and herbs amid more dense forest of Ponderosa pine or Douglas-fir (Camp and Gamon 2011, Fertig and Kleinknecht 2020). It is also occasionally found on steep gravel or sand bluffs above rivers and on gravelly roadsides. This habitat is an early seral component of the Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland ecological system (Rocchio and Crawford 2015). Washington populations are mostly restricted to small patches or narrow riparian strips separated from other populations by distances of 3-39 miles (5-63 km). The natural patchiness of the populations and large extents of unsuitable habitat between them creates a barrier for dispersal.

B2b. Anthropogenic barriers: Neutral.
The range of *Heterotheca oregona* is naturally fragmented. Human impacts on the landscape of central and western Washington have exacerbated this condition, but overall are of less significance than natural barriers.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Heterotheca oregona produces numerous, flattened, single-seeded achenes topped by a double papppus of bristles that help transport the fruit by wind. Dispersal might also be possible by moving water. While many fruits fall close to their parent, some are capable of being dispersed more than 1 km.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Heterotheca oregona* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Ten of the 16 known occurrences in the state (62.5%) 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 (Young et al. 2006). Five occurrences (31.2%) are from areas that have had small (37-47˚F/20.8-26.3˚C) temperature variation over the same period and are at increased vulnerability. One population (6.3%) is from a site with average (57.1-77˚F/31.8-43.0˚C) temperature variation over the past 50 years (Table 3) and is at neutral risk from climate change (Young et al. 2016).

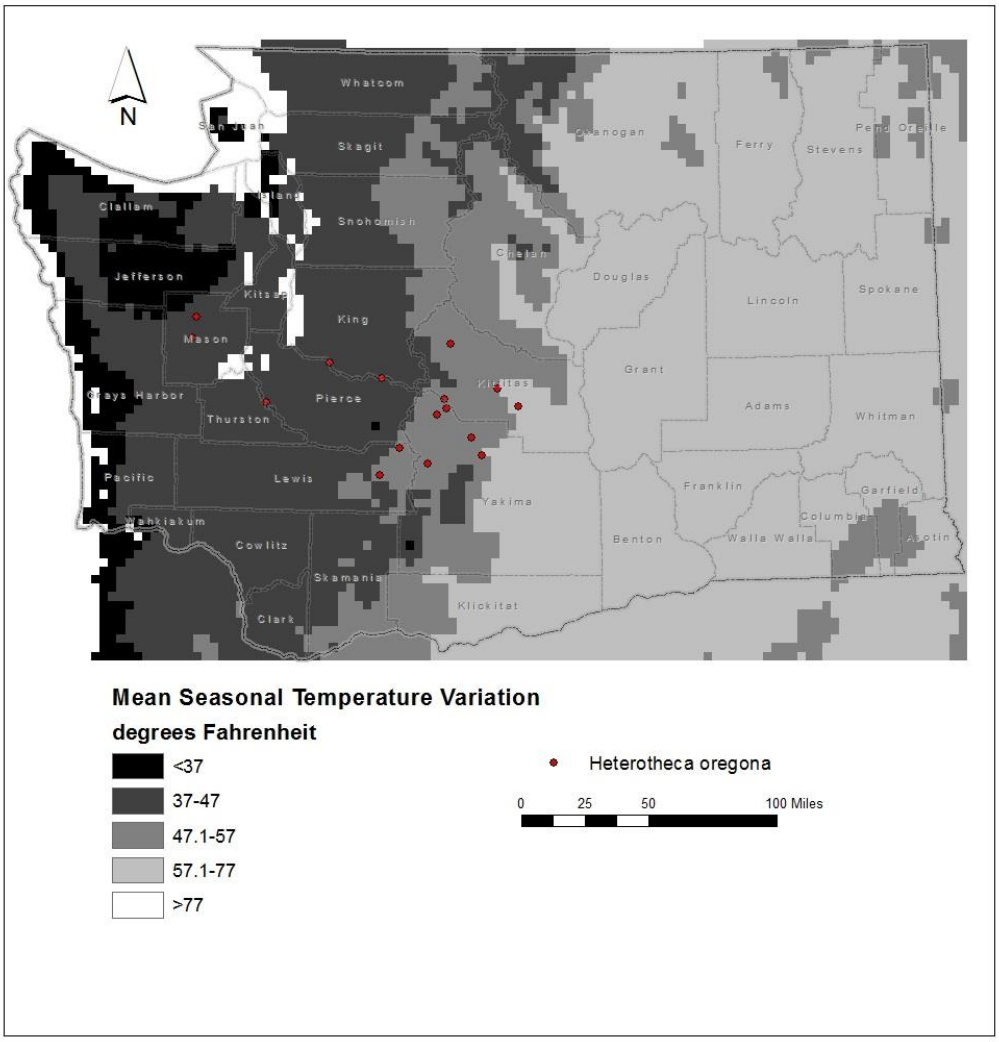

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Heterotheca oregona* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
Most populations of *Heterotheca oregona* are found along foothills streams in areas of cold air drainage and would be at somewhat increased vulnerability to temperature changes associated with global warming.

C2bi. Historical hydrological niche: Neutral.
Thirteen of the 16 populations of *Heterotheca oregona* in Washington (81.3%) are found in areas that have experienced average or greater than average (>20 inches/508 mm) of precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at neutral vulnerability to climate change. Two other populations (12.5%) have experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation over the same period and are at somewhat increased vulnerability (Figure 4), while one occurrence (6.3%) has experienced small (4-10 inches/100-254 mm) precipitation variation and is at increased vulnerability.

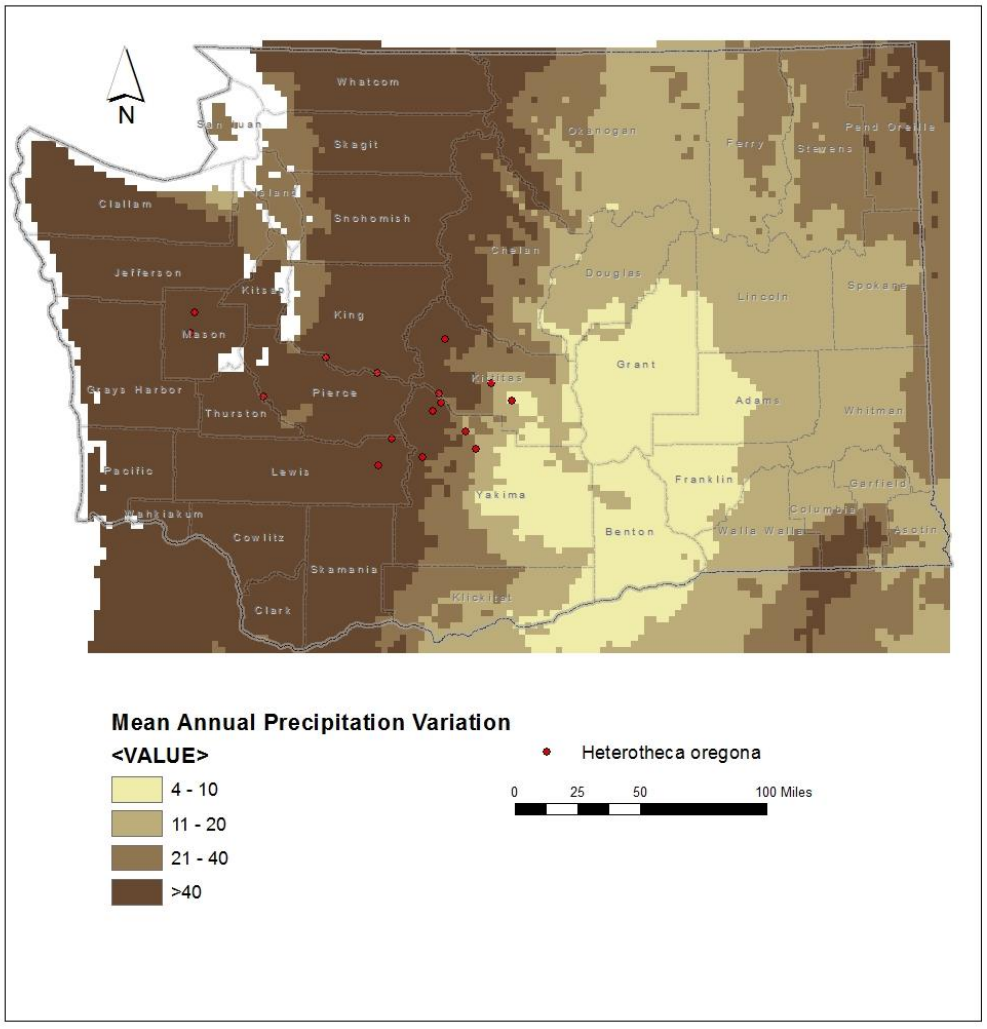

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Heterotheca oregona* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
Heterotheca oregona populations occur along streams and rivers on low-lying cobblestone terraces that are seasonally flooded by meltwater. Changes in the timing of snowmelt or the amount of precipitation could make these sites drier in the future and subject to invasion of meadow or forest species (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Somewhat Increase.
Most populations of *Heterotheca oregona* in Washington occur on partly sand or cobble terraces along streams and rivers and are maintained by late winter or early spring flooding. These habitats are vulnerable to changes in the timing and magnitude of floods, which in turn is influenced by snowpack and timing of snowmelt. All of these factors are likely to be affected by warming temperatures (Rocchio and Ramm-Granberg 2017). A reduction in disturbance from flooding could result in increased tree cover or replacement of current riparian vegetation with species adapted to drier conditions.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The populations of *Heterotheca oregona* in Washington occur in the lower montane and foothill zones of mountains and receive relatively low snowfall, but are tied to river systems fed by deeper snowfall at their headwaters at higher elevations. Reduction in snowpack or changes in the timing of snowmelt will impact flooding in the late winter and early spring that is important to maintain the plant's partially open river terrace habitat (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.
Populations of *Heterotheca oregona* in Washington occur primarily on Quaternary alluvium, glacial till, and landslide deposits. These features are widespread along smaller rivers and streams in the foothills of mountains across the state.

C4a. Dependence on other species to generate required habitat: Neutral.
The partly open sand and cobble terrace habitat occupied by *Heterotheca oregona* is maintained primarily by natural abiotic processes.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Heterotheca oregona flowers are pollinated by a variety of insects including bees, wasps, and butterflies and reproduction is not limited by pollinator availability.

C4d. Dependence on other species for propagule dispersal: Neutral.
The small fruits of *Heterotheca oregona* have a feathery pappus and can be dispersed relatively long distances by wind or water. The species is not dependent on animals for dispersal.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. This species is not a preferred forage plant and does not appear to be adversely impacted by grazing.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
In the absence of annual flooding, competition from other plant species could become a significant threat to *Heterotheca oregona* populations along floodplain terraces (Fertig and Kleinknecht 2020).

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

C5a. Measured genetic variation: Unknown.
Data are not available on the genetic diversity of this species in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Heterotheca oregona reproduces sexually and is an out-crosser. Genetic diversity is presumed to be average.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
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 this species within Washington has not changed significantly in recent 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.

Fertig, W. and J. Kleinknecht. 2020. Conservation status and protection needs of priority plant species in the Columbia Plateau and East Cascades ecoregions. Natural Heritage Report 2020-02. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 173 pp.

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