Climate Change Vulnerability Index Report

Eryngium petiolatum (Oregon coyote-thistle)

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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: Local Climate	**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	33.3
	<3.9° F (2.2°C) warmer	66.7
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to -0.096	66.7
	-0.051 to -0.073	22.2
	-0.028 to -0.050	11.1
	>-0.028	0
Section B: Indirect Exposure to Climate Change		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Somewhat Increase
2b. Distribution relative to anthropogenic barriers		Somewhat Increase
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
1. Dispersal and movements		Neutral
2ai Change in historical thermal niche		Increase
2aii. Change in physiological thermal niche		Somewhat Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral/Somewhat Increase
3. Restricted to uncommon landscape/geological features		Neutral/Somewhat Increase
4a. Dependence on others species to generate required habitat		Neutral
4b. Dietary versatility		Not Applicable
4c. Pollinator versatility		Unknown
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: Documented or Modeled Response	
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: Six of the nine extant occurrences of *Eryngium petiolatum* in Washington (66.7%) are found in areas with a projected temperature increase of <3.9˚ F (Figure 1). Three other populations (33.3%) are from areas with a projected temperature increase of 3.9-4.4˚ F.

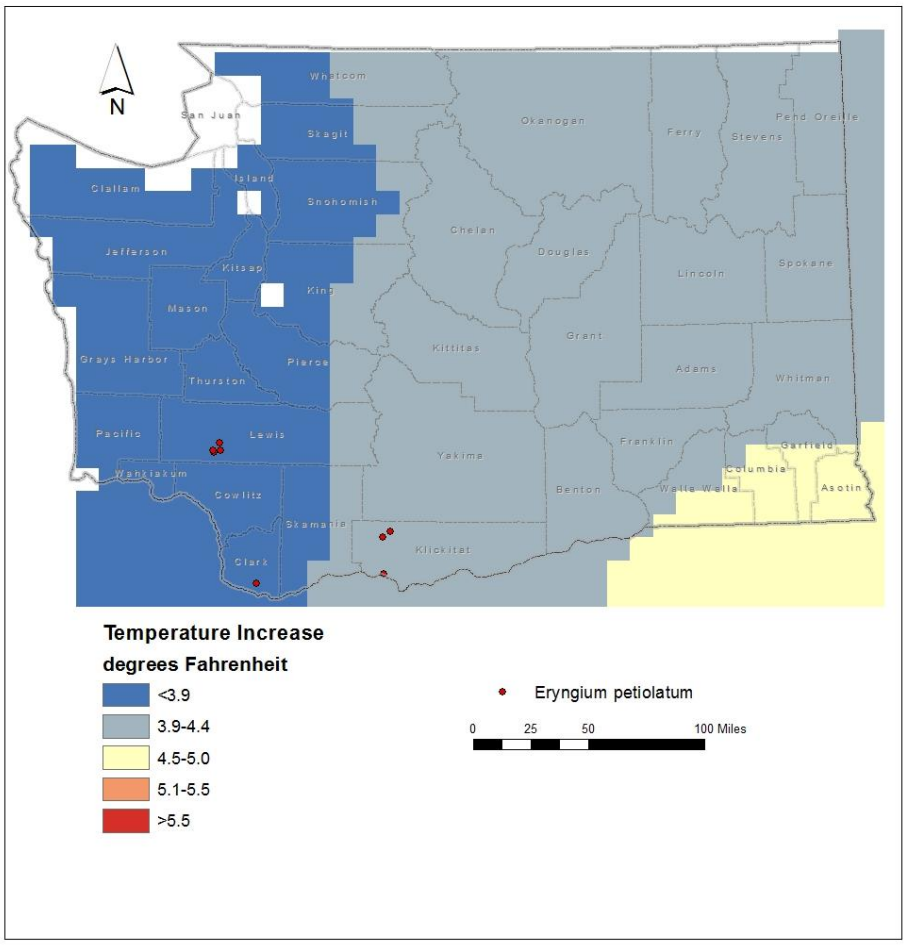

Figure 1. Exposure of *Eryngium petiolatum* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Six of the 9 occurrences of *Eryngium petiolatum* (66.7%) in western 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). Two populations from NW Klickitat County (22.2%) are from areas with a projected decrease in moisture in the range of -0.051 to -0.073. One other occurrence in SW Klickitat County (11.1%) has a projected decrease in moisture of -0.028 to -0.050.

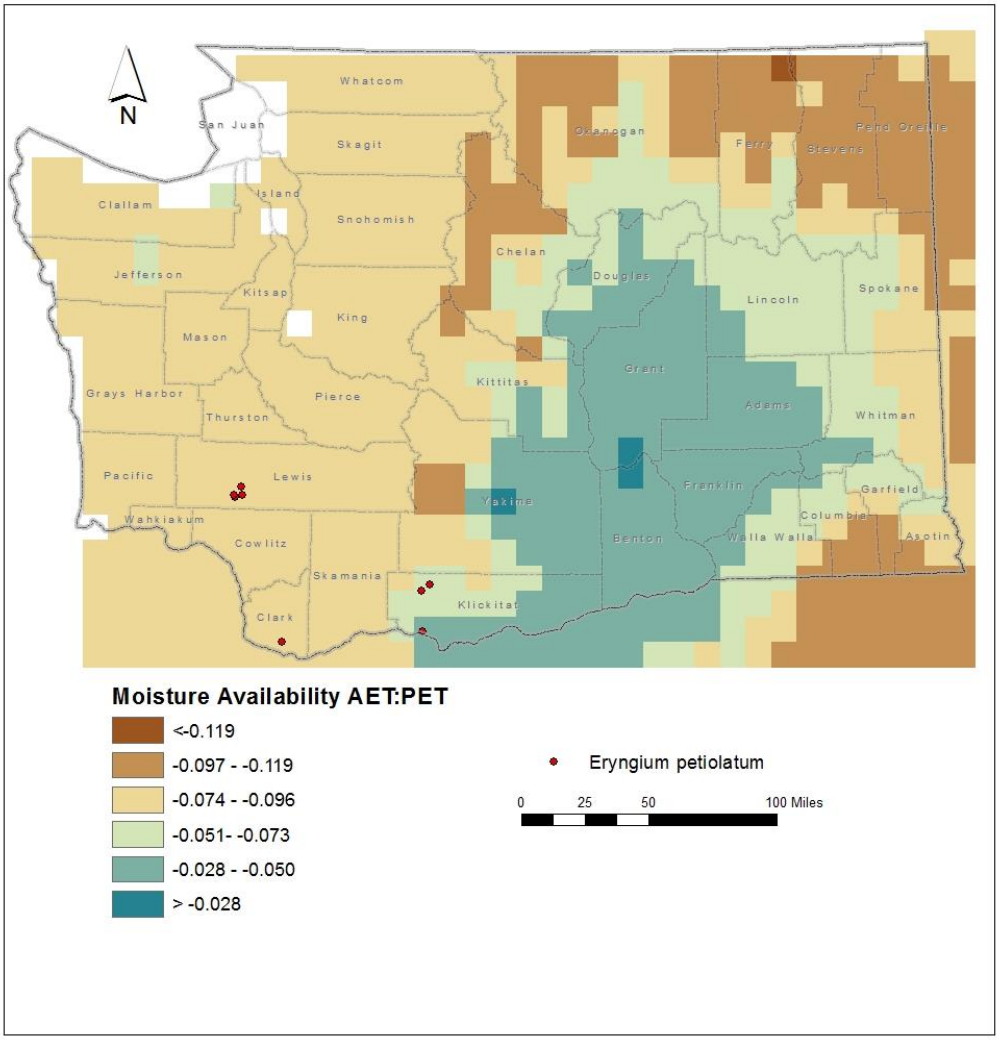

Figure 2. Exposure of *Eryngium petiolatum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
The Washington occurrences of *Eryngium petiolatum* are found at 180-1850 feet (55-560 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Eryngium petiolatum* is found in seasonally wet meadows and shores of vernal ponds dominated by herbaceous and graminoid species (Camp and Gamon 2011). Sites may be flat or consist of swales or ditches and have alkali or organic-rich soils. Populations occur in areas that may be flooded or saturated in winter and spring, but become dry by mid summer (Fertig and Kleinknecht 2020). These occurrences conform to the Rocky Mountain Alpine-Montane Wet Meadow and Willamette Valley Wet Prairie ecological systems (Rocchio and Crawford 2015). Washington populations are found in three main clusters in southern Lewis Couty, Clark County east of Vancouver, and western Klickitat County. Occurrences are separated by distances of 0.3 to 54 miles (0.5-89 km) with large areas of unsuitable habitat between population clusters. Dispersal between populations is naturally restricted by unsuitable forest and dry prairie matrix habitat between occurrences.

B2b. Anthropogenic barriers: Somewhat Increase.
The range of *Eryngium petiolatum* in Washington is bisected by roads, farmland, and human infrastructure that contributes to a fragmented landscape matrix. Areas of suitable habitat for this species, however, are naturally limited to sites that favor winter/spring flooding and summer drying. Historically, many of these areas have been converted to agricultural use through plowing and changes in hydrology (Camp and Gamon 2011).

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Eryngium petiolatum produces numerous flowers in a compact, thistle-like capitate inflorescence subtended by spine-tipped bracts. Individual fruits are ovoid, 1-2 mm long, and covered by tapering scales (Camp and Gamon 2011). At maturity, fruits split into two 1-seeded segments. The scaly covering of the fruits can catch onto the fur of mammals or feathers of birds. Birds could spread some fruits well over 1 km from the parent plant.

C2ai. Historical thermal niche: Increase.
Figure 3 depicts the distribution of *Eryngium petiolatum* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Six of the 9 known occurrences in Washington (66.7%) are found in areas that have experienced small temperature variation (37-47˚F/20.8-26.3˚C) during the past 50 years and are considered at increased vulnerability to climate change (Young et al. 2016). Three other populations (33.3%) have slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation during the same period and are at somewhat increased vulnerability.

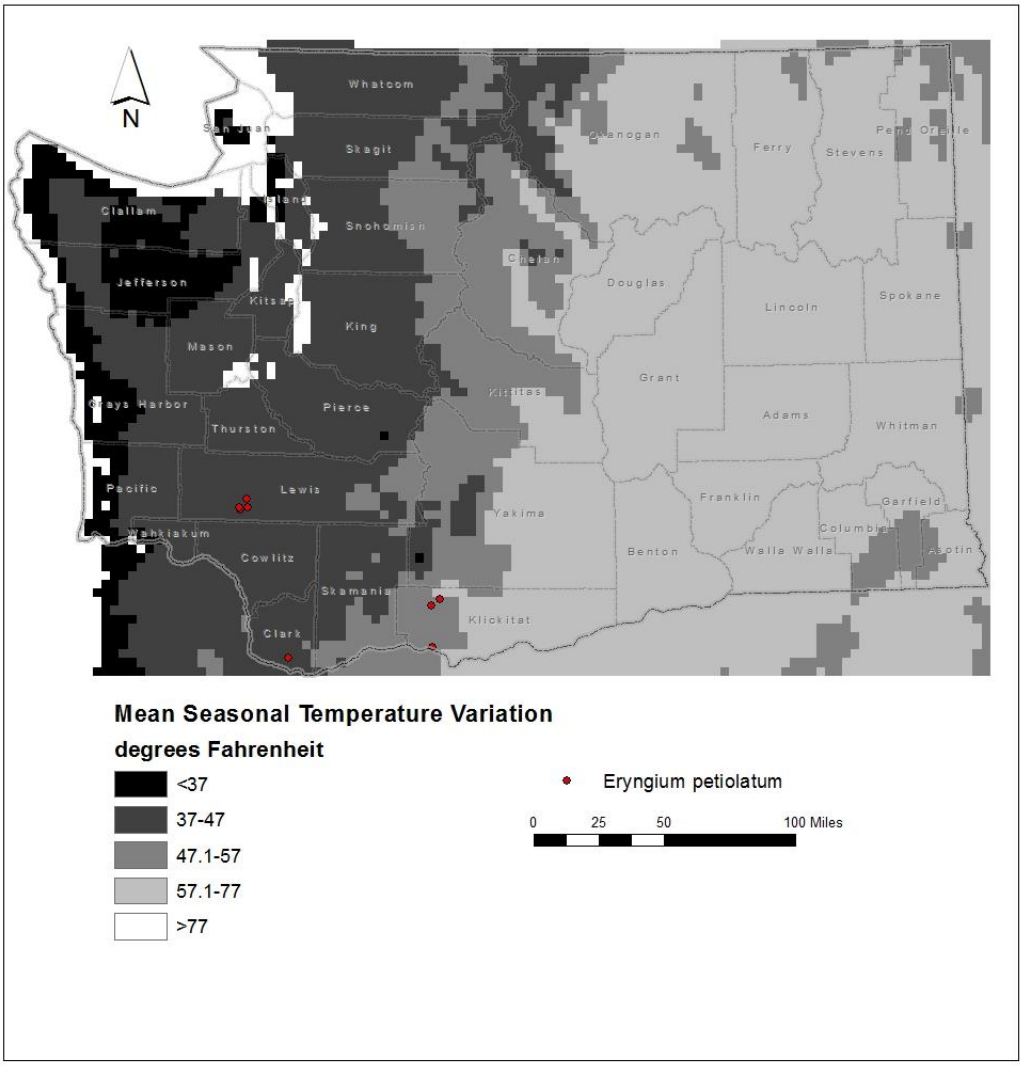

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Eryngium petiolatum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
The wetland habitats of *Eryngium petiolatum* are often associated with cold air drainage during the growing season and would have somewhat increased vulnerability to climate change.

C2bi. Historical hydrological niche: Neutral.
Six of the 9 occurrences of *Eryngium petiolatum* in Washington (66.7%) are found in areas that have experienced average (21-40 inches/508-1016 mm) precipitation variation in the past 50 years (Figure 4). The other three occurrences (33.3%) are from areas with greater than average precipitation variation (>40 inches/1016 mm) during the same period. According to Young et al. (2016), these areas are all at neutral vulnerability to climate change.

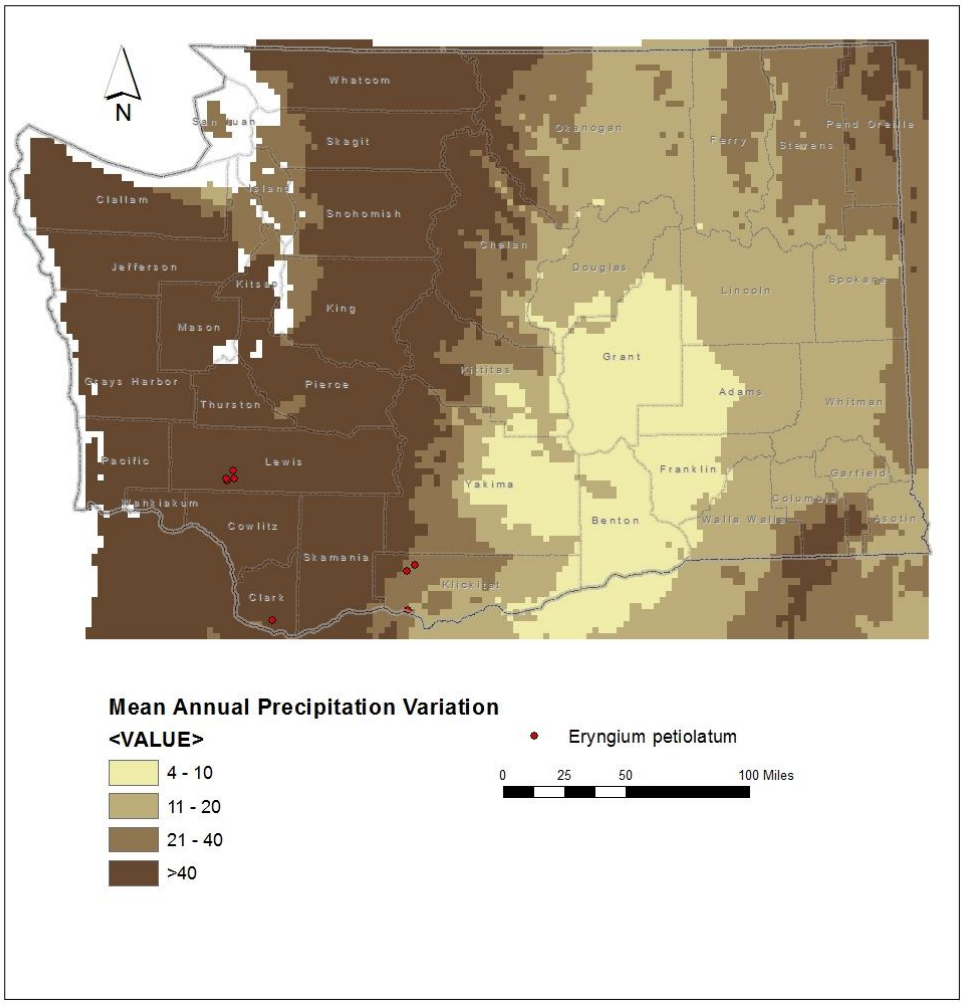

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Eryngium petiolatum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Increase.
Populations of *Eryngium petiolatum* in Washington occur in seasonally wet meadows dominated by graminoids that become dry in the summer. Such communities are vulnerable to changes in the timing of precipitation, especially in sites that are not fed by perennial springs. Populations from the east side of the Cascades Changes may be vulnerable to changes in hydrology, such as a drop in the water table, associated with long-term drought. This could result in the conversion of seasonally wet meadows to dry meadows dominated by upland plant species (Rocchio and Ramm-Granberg 2017). In the Puget Trough region, populations could be vulnerable to greater flooding in winter and increased drought in summer, which could result in shifts to marshland or dry meadow communities. Summer drought could make meadow sites

more prone to wildfire and subsequent invasion by weedy species (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Eryngium petiolatum is dependent on a specific hydrological environment (high water table from winter/spring precipitation and summer drought) to maintain its graminoid-dominated meadow habitat. Wildfire, which could be enhanced by summer drought, may play a role in keeping these sites from becoming invaded by shrub species (Rocchio and Ramm-Granberg 2017). Climate change may actually increase the frequency of wildfire.

C2d. Dependence on ice or snow-cover habitats: Neutral/Somewhat Increase.
Snowpack is low within the range of *Eryngium petiolatum* in the Puget Trough but is moderate to high along the east slope of the Cascades east of Mount Adams. Changes in the amount of snowfall, or in the timing of snow melt, can have ramifications for wet meadow sites that are dependent on springs or underground recharge enhanced by snowpack (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral/Somewhat Increase.
Eryngium petiolatum occurs primarily on Quaternary alluvium and glacial flood deposits that are widely distributed in the Willamette Valley and on the east side of Mount Adams (Washington Division of Geology and Earth Resources 2016). The geologic setting for the species is not restricted, although precise hydrological conditions that contribute to winter/spring flooding and summer drying may be uncommon.

C4a. Dependence on other species to generate required habitat: Neutral.
The vernal conditions of wet meadows inhabited by *Eryngium petiolatum* are maintained primarily by hydrological factors (timing and amount of rainfall and snowpack), topographic drainage patterns, or wildfire to maintain moist grasslands with low shrub cover, rather than by herbivory by wildlife.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
Eryngium petiolatum has showy heads of white flowers and is presumed to be an outcrosser. The exact pollinators of this species in Washington are not known. *Eryngium yuccifolium*, a related species from the Great Plains, is pollinated by a variety of insect species, including small bees, bumblebees, flies, wasps, butterflies, and moths (Molano-Flores 2001). Members of the Apiaceae family have unspecialized flowers and tend to be pollinated by a wide diversity of species.

C4d. Dependence on other species for propagule dispersal: Neutral.
The dry fruits of *Eryngium petiolatum* split into two 1-seeded segments at maturity, each covered with scales that can attach to the fur or feathers of a variety of vertebrate species.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. The leaves and flower heads of *Eryngium petiolatum* have spiny tips and margins, protecting them from herbivory by large browsers. Herbivory has been identified as a potential threat (Camp and Gamon 2011), though is likely to be of less

significance than habitat loss through changes in hydrology, conversion to agriculture, residential development, or competition from invasive weeds (Fertig and Kleinknecht 2020).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Eryngium petiolatum occurs in moist meadow sites that become dry in the summer. These areas could be vulnerable to invasion by annual weed species under conditions of prolonged drought and increased wildfire (Rocchio and Ramm-Granberg 2017).

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

C5a. Measured genetic variation: Unknown.
No genetic data are available for *Eryngium petiolatum* in Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
Eryngium petiolatum is presumed to be an outcrosser, rather than self-pollinated. In the related species, *E. yuccifolium*, stamens mature before the stigmas become receptive within the same flower, making individuals "temporally dioecious" and promoting outcrossing (Molano-Flores 2001). Presumably, genetic variation is average, compared to other species, but no studies have been done for confirmation.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records from the Consortium of Pacific Northwest herbaria website, no significant changes in the phenology of *Eryngium petiolatum* populations in Washington have been detected over the past 20 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
Trend data are lacking for most occurrences of *Eryngium petiolatum*. Most populations contain 25-200 plnts, but at least two have 10,000-22,000 individuals (Engler and Stutte 2010; Fertig and Kleinknecht 2020). At present, state populations appear to be stable, though historically trends are likely to be downward due to widespread habitat loss.

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.

Engler, J.D. and A. Stutte. 2010. 2010 Status of Oregon coyote-thistle (*Eryngium petiolatum*

Hook.), Conboy Lake National Wildlife Refuge, Klickitat County, Washington. US Fish and Wildlife Service. 8 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.

Molano-Flores, B. 2001. Reproductive biology of *Eryngium yuccifolium* (Apiaceae), a prairie species. Journal of the Torrey Botanical Society. 128(1): 1-6.

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.

Washington Division of Geology and Earth Resources. 2016. Surface geology, 1:100,000 --GIS data, November 2016: Washington Division of Geology and Earth Resources Digital Data Series DS-18, version 3.1, previously released June 2010.
http://www.dnr.wa.gov/publications/ger_portal_surface_geology_100k.zip

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.