Climate Change Vulnerability Index Report

Packera porteri (*Senecio porteri*; Porter's butterweed)

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Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G4/S1

Index Result: Highly 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	100
	-0.074 to - 0.096	0
	-0.051 to - 0.073	0
	-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		Neutral
2ai Change in historical thermal niche		Increase
2aii. Change in physiological thermal niche		Greatly Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Neutral
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Somewhat Increase
3. Restricted to uncommon landscape/geological features		Somewhat Increase
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		Somewhat Increase

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 single occurrence of *Packera porteri* in Washington (100%) occur in an area with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

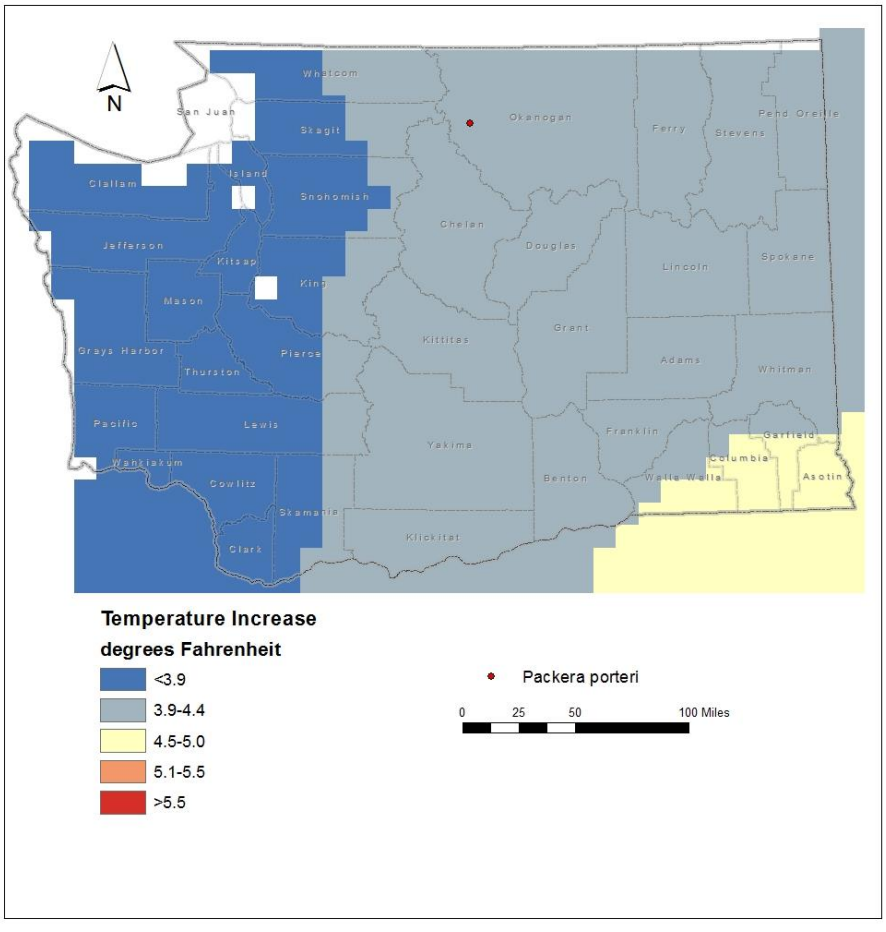

Figure 1. Exposure of *Packera porteri* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The single occurrence of *Packera porteri* (100%) in Washington is found in an area 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 (Figure 2).

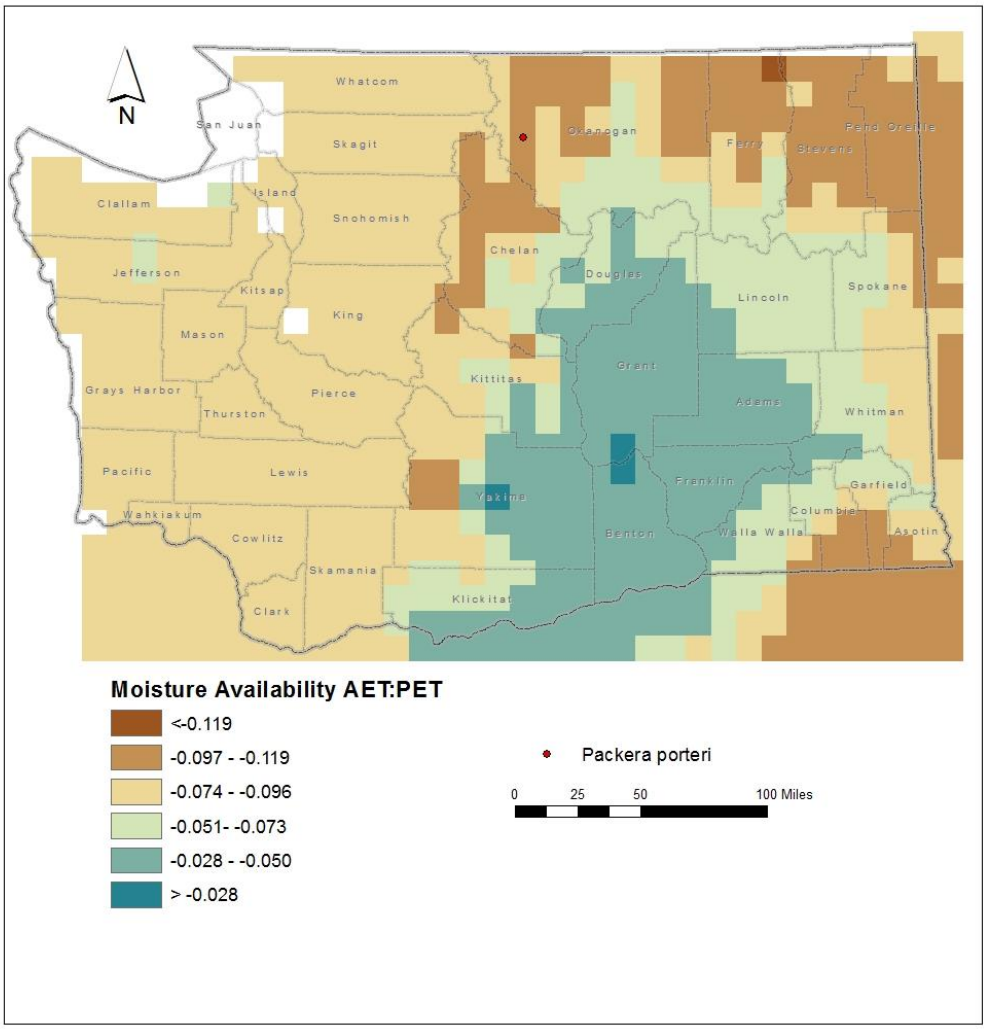

Figure 2. Exposure of *Packera porteri* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
The Washington occurrence of *Packera porteri* is found at 7800 feet (2735 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Packera porteri* is found on lichen-covered volcanic bedrock of the Midnight Peak Formation and loose talus in an unglaciated nunatak with *Pinus albicaulis, Juniperus communis*, and *Penstemon davidsonii* (WNHP 2005, WNHP Biotics database). This habitat is a component of the Rocky Mountain Alpine Bedrock and Scree ecological system (Rocchio and Crawford 2015). Similar scree outcrops of the Midnight Peak Formation are scattered in the Okanogan Range, with areas of unsuitable habitat in between, creating a barrier to dispersal. The current distribution of *P. porteri* in Washington may be an artifact of under-sampling, as its alpine habitat is difficult to access and identification of *Packera* species can be tricky.

B2b. Anthropogenic barriers: Neutral.
Human impacts in the alpine and subalpine of the Okanogan range are limited and do not impose more of a barrier than already exists naturally (Rocchio and Ramm-Granberg 2017).

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
Packera porteri produces numerous one-seeded achene fruits topped by feathery pappus bristles for ready dissemination by wind, potentially over distances of over 1 km in windy areas above tree line.

C2ai. Historical thermal niche: Increase.
Figure 3 depicts the distribution of *Packera porteri* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). The single known occurrence (100%) is found in an area that has experienced small (37-47˚F/20.8-26.3˚C) temperature variation during the past 50 years and is considered at increased vulnerability to climate change.

C2aii. Physiological thermal niche: Greatly Increase.
The rock outcrop/nunatak habitat of *Packera porteri* is strongly correlated with cold air drainage during the growing season and would have greatly increased vulnerability to climate change.

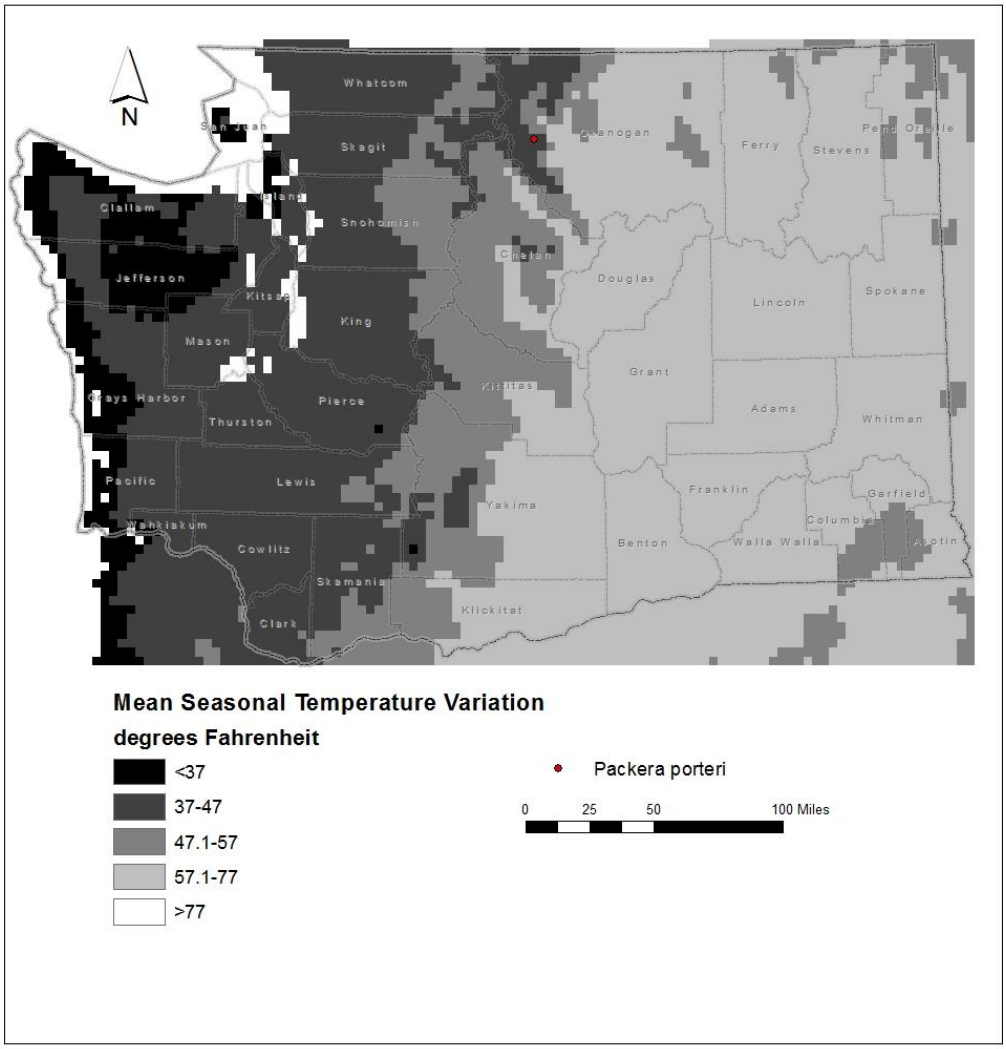

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Packera porteri* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.

The single population of *Packera porteri* in Washington (100%) is found in an area that has experienced average or greater than average (>20 inches/5080 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.

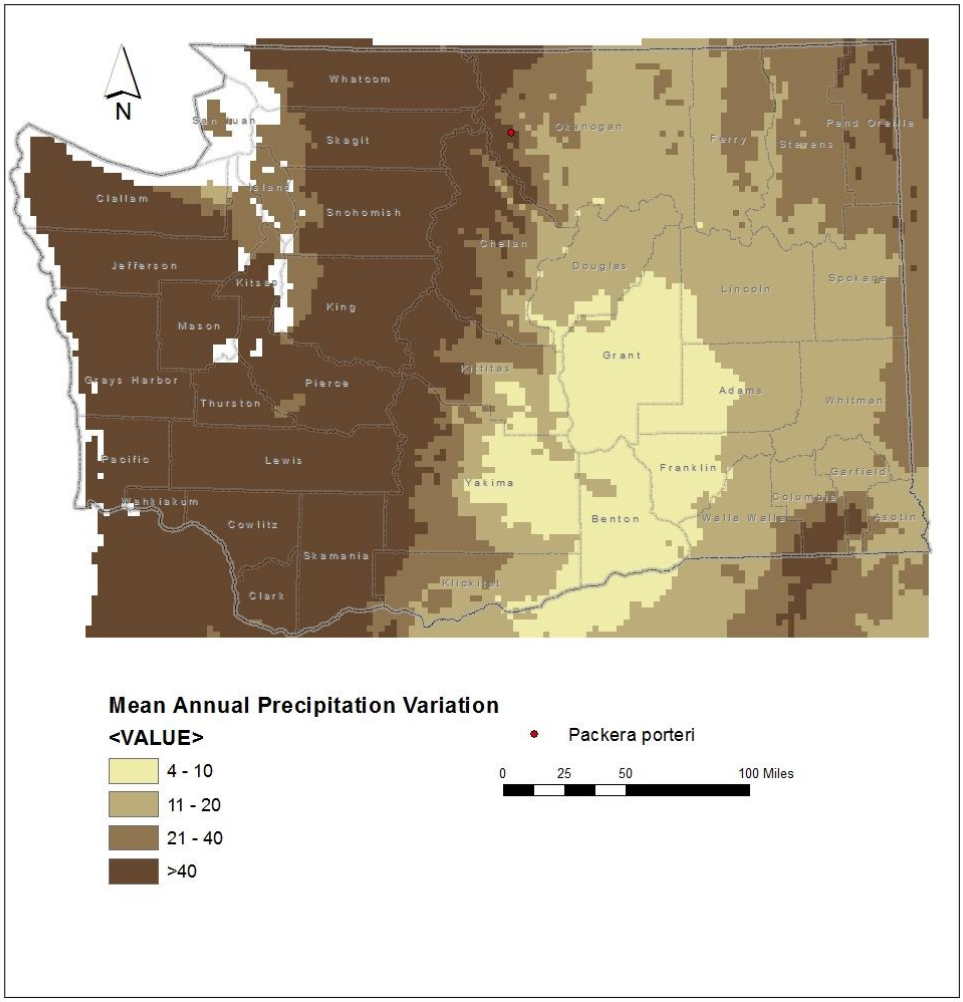

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Packera porteri* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Neutral.
This species is not dependent on a strongly seasonal hydrologic regime or specific wetland habitats (but see "Dependence on ice or snow-cover habitats" below).

C2c. Dependence on a specific disturbance regime: Neutral.
Packera porteri occurs in alpine talus and scree habitats that are subject to high winds. Other than occasional rock fall, these are largely undisturbed sites at present. Under future climate change scenarios, these sites could become invaded by tree or shrub species or lower elevation forbs and grasses, resulting in increased soil accumulation, more litter, and enhanced probability of fire (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The population of *Packera porteri* in Washington is found in alpine talus slopes that accumulate snow in winter and are dependent on gradual thawing of snowfields for moisture in the growing season. Some areas, however, may be snow free due to wind. Reduced snowpack due to climate change would reduce the amount of moisture available through runoff (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Somewhat Increase.
Packera porteri is restricted to the Midnight Peak Formation, a type of volcanic basalt found sporadically in the Okanogan Range in Washington.

C4a. Dependence on other species to generate required habitat: Neutral
The alpine talus habitat occupied by *Packera porteri* is maintained by natural abiotic processes and geologic conditions, rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
The exact pollinators of *Packera porteri* have not been documented, but other *Packera* and *Senecio* species have unspecialized inflorescences that can be pollinated by a wide variety of insects, including bees, flies, butterflies, and beetles.

C4d. Dependence on other species for propagule dispersal: Neutral.
The seeds of *Packera porteri* are wind dispersed.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Under present conditions, competition from non-native species is minimal, as few introduced plants are adapted to the harsh environmental conditions of the alpine zone. Vegetation cover is low in rocky talus slopes and fell-fields due to the paucity of germination sites and periodic rock fall. Under projected climate change, competition could increase if lower elevation plant species are able to expand their range into formerly uninhabitable habitat (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 *Packera porteri* populations from Washington.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Somewhat Increase
Packera porteri is presumed to be an outcrosser with good dispersal ability by its small, wind-blown fruits. In theory, it should have average genetic diversity across its range. Populations in Washington and northeastern Oregon are significantly disjunct from the core range of the

species in the southern Rocky Mountains of Colorado (Trock 2003). These isolated occurrences probably have a subset of the species' full genome due to founder effects or inbreeding depression. As a result, genetic diversity in Washington is probably low and the species is at somewhat increased vulnerability to climate change in the state.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records from the Consortium of Pacific Northwest herbaria website, no changes in the phenology of *Packera porteri* populations in Washington have been detected.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
Significant changes in the distribution of *Packera porteri* 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

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.

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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.