Climate Change Vulnerability Index Report

Spartina pectinata (Prairie cordgrass)

Date: 27 October 2021 Synonym: *Sporobolus michauxianus*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G5/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	30.8
	3.9-4.4° F (2.2-2.4°C) warmer	69.2
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	38.5
	-0.074 to -0.096	7.6
	-0.051 to -0.073	15.4
	-0.028 to -0.050	38.5
	>-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		Neutral
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
1. Dispersal and movements		Neutral
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		Greatly Increase
2c. Dependence on specific disturbance regime		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: 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: Ten of the 13 occurrences of *Spartina pectinata* in Washington (69.2%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1). Three other populations (30.8%) are from areas in southeast Washington with a projected temperature increase of 4.5-5.0˚ F.

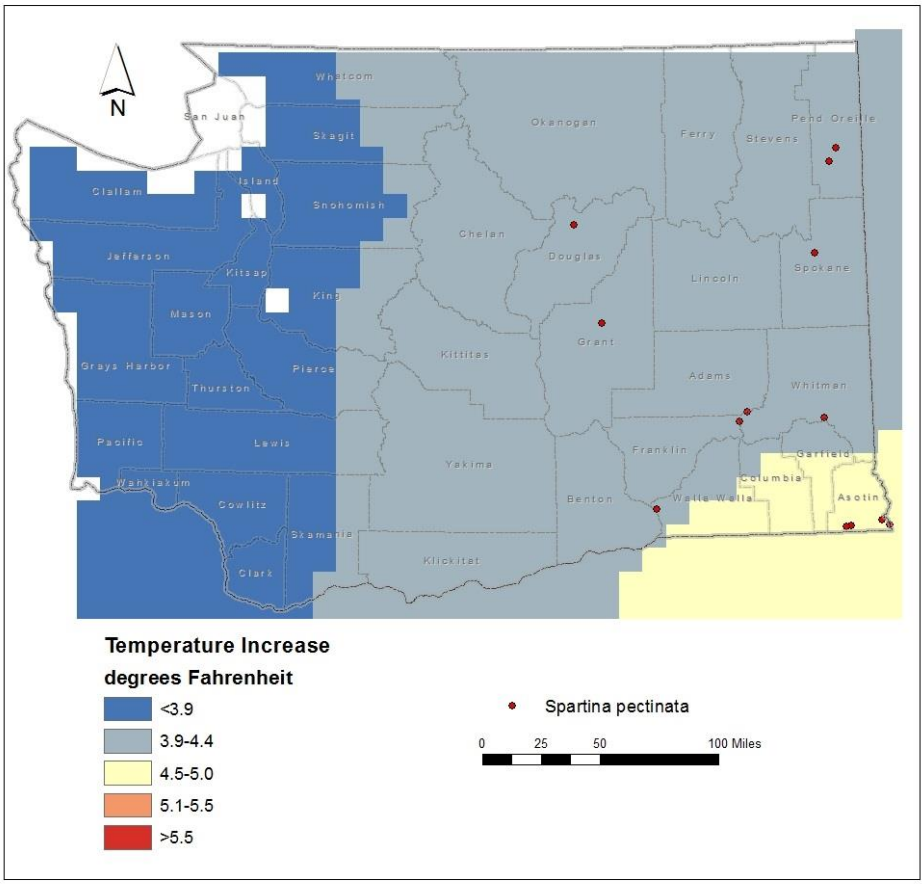

Figure 1. Exposure of *Spartina pectinata* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Five of the 13 occurrences of *Spartina pectinata* (38.5%) in the Blue Mountains and Canadian Rockies 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 -0.097 to -0.119 (Figure 2). One population in southeast Washington (7.6%) is found in an area of projected decrease in available moisture of -0.074 to -0.096. Two occurrences (15.4%) from eastern Washington are from areas with a projected decrease of -0.051 to -0.073. Five other populations from the central Columbia Plateau (38.5%) are from areas with a projected decrease in moisture of -0.028 to -0.050 (Figure 2).

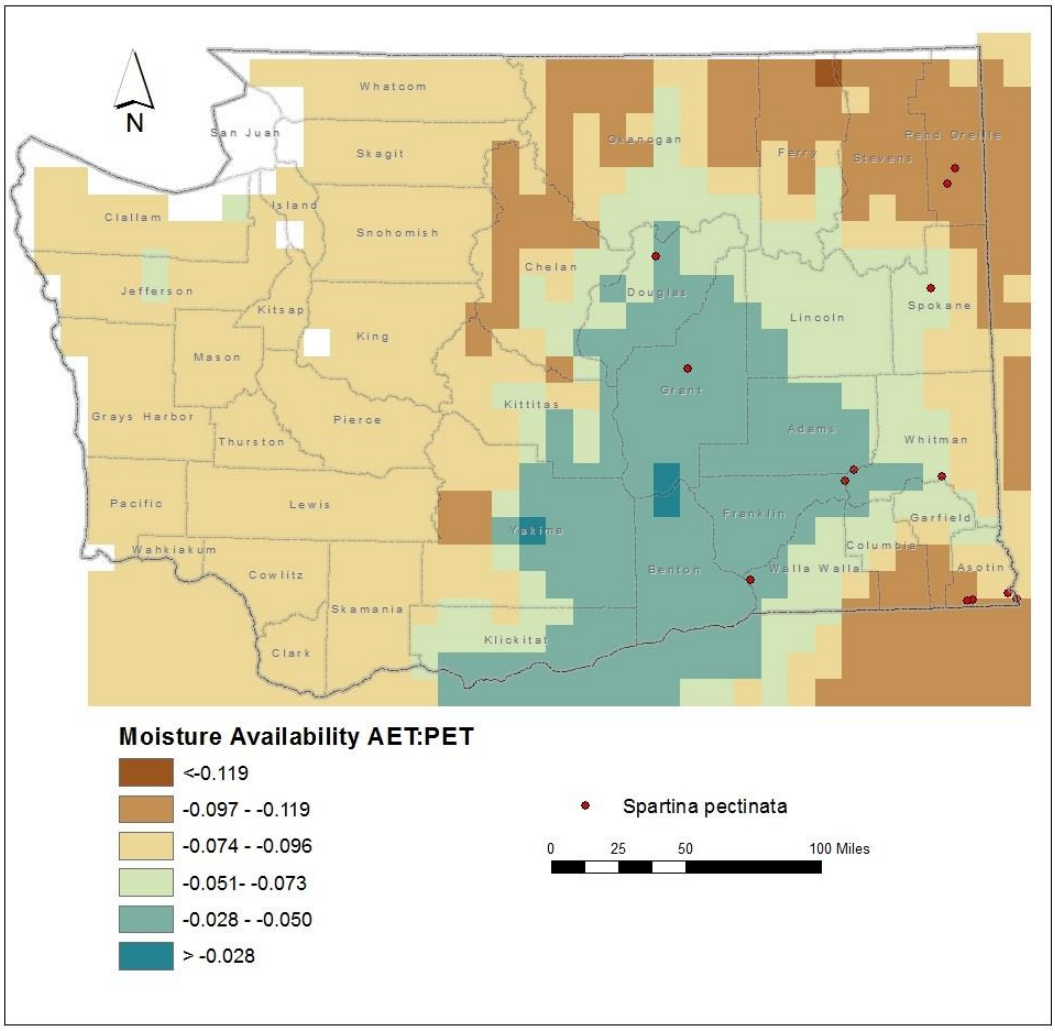

Figure 2. Exposure of *Spartina pectinata* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Spartina pectinata* are found at 335-2080 feet (103-630 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Spartina pectinata* is found on sandy or silty bars or rocky terraces along riverbanks, sloughs, wet meadows on the margins of lakes, or alkaline flats and cattail-bulrush thickets bordering rivers (Camp and Gamon 2011; Washington Natural Heritage Program 2021). These habitats correspond with the North American Arid West Emergent Marsh and Northern Columbia Plateau Basalt Pothole Ponds ecological systems (Rocchio and Crawford 2015). Populations are separated by 4-102 miles (6.2-165 km). Most populations in Washington are associated with rivers or ponds and are naturally isolated by intervening uplands that present a barrier to dispersal between watersheds.

B2b. Anthropogenic barriers: Neutral.
The range of *Spartina pectinata* is fragmented by human infrastructure, including dams, farms, roads, and cities. Dispersal across the human landscape is probably less significant than natural barriers to dispersal associated with river drainages and isolated ponds and lakes.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.
The inflorescence of *Spartina pectinata* is a panicle bearing numerous 1-flowered spikelets consisting of a long-awned upper glume and unawned lemma and palea surrounding the 1-seeded fruit (caryopsis). At maturity, spikelets are shed as a single unit, with the awned glume potentially catching on the fur or feathers of animals for dispersal. Fruits may also be spread passively by gravity, strong winds, or water, potentially over long distances in riverine habitats. The majority of reproduction, however, is vegetative, as fertile caryopses are often not produced (Barkworth 2003).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Spartina pectinata* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All of the known occurrences in the state (100%) are found in areas that have experienced average (57.1-77˚F/31.8-43.0˚C) temperature variation during the past 50 years and are considered at neutral vulnerability to climate change (Young et al. 2016).

C2aii. Physiological thermal niche: Somewhat Increase.
The riverbank, pond, and slough habitat of *Spartina pectinata* in eastern Washington may be associated with cold soils and cool air drainage. These areas could be adversely affected by warmer temperatures in the future.

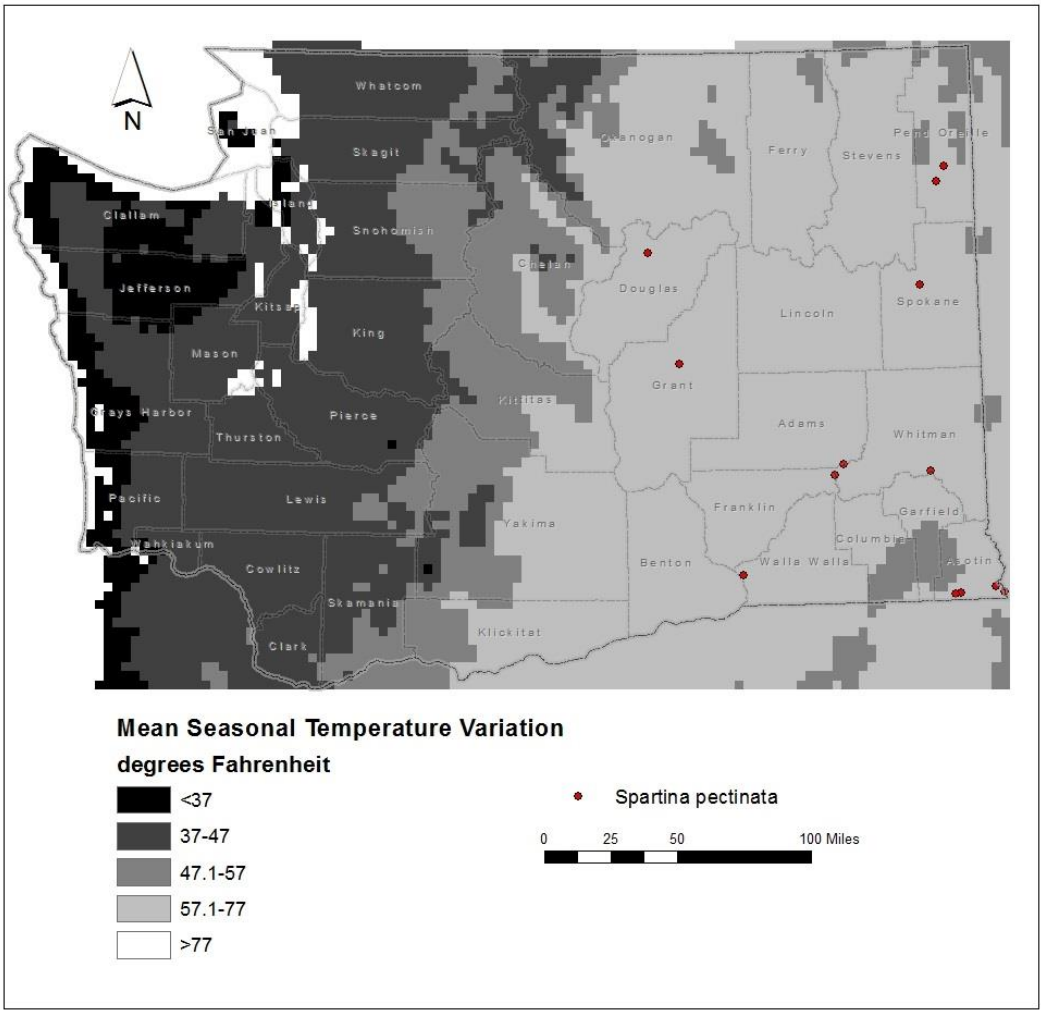

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Spartina pectinata* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Somewhat Increase.

Nine of the 13 populations of *Spartina pectinata* in Washington (69.2%) are found in areas that have experienced slightly lower than average (11-20 inches/255-508 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased vulnerability to climate change. Two occurrences from the central Columbia Plateau (15.4%) are from areas with small variation in precipitation over the same period (4-10 inches/100-254 mm) and are at increased risk from climate change. Two other populations from northeastern Washington (15.4%) are from areas with average (21-40

inches/508-1016 mm) precipitation variation and are at neutral vulnerability to climate change (Young et al. 2016).

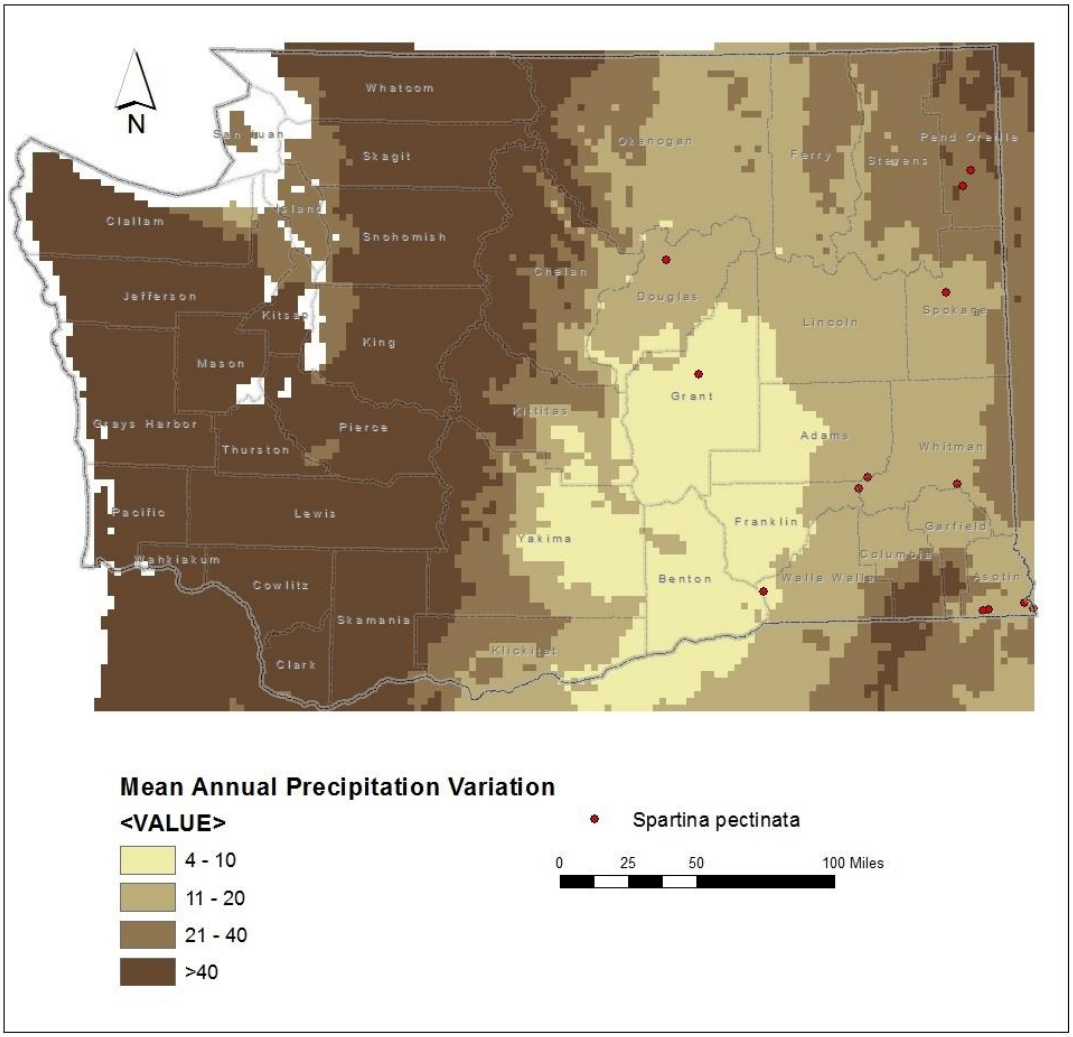

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Spartina pectinata* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Greatly Increase.
Populations of *Spartina pectinata* along rivers are associated with seasonal flooding which may be important in preventing shore sites from shifting towards wet meadow or aquatic habitats. River and pond shore populations may also be vulnerable to changes in the amount or timing or precipitation (including snowmelt upstream) and increased temperatures that would exacerbate

drought (Rocchio and Ramm-Granberg 2017). Lowered water tables could result in shifts from emergent marsh vegetation to wet meadows or riparian shrub or forest systems (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Increase.
Most populations of *Spartina pectinata* in Washington are associated with periodic disturbance from annual flooding along the shores of large rivers or ponds. Changes in hydrology from dams (either eliminating floods entirely or permanently inundating former habitat) is an important threat to this species (Camp and Gamon 2011). Increased drought or lower precipitation from climate change could make natural flooding events less common or less predictable in the future, hastening the conversion of emergent marsh habitat to wet meadow or riparian shrub or forest communities (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Most of the areas in eastern Washington where *Spartina pectinata* grows has relatively low winter snowfall. Reductions in the amount of snow or timing of snowmelt in mountainous areas at the head of drainages could make downstream *S. pectinata* habitat drier in the future. In many areas, however, existing dams regulate seasonal high water flows and make snowmelt flooding less significant.

C3. Restricted to uncommon landscape/geological features: Neutral.
Washington populations of *Spartina pectinata* are mostly found on Quaternary alluvium or soils derived from Grande Ronde basalt (Washington Division of Geology and Earth Resources 2016). Both of these geologic types are widespread in the eastern half of the state.

C4a. Dependence on other species to generate required habitat: Neutral.
The emergent marsh habitat of *Spartina pectinata* is maintained primarily by hydrologic factors, rather than other species.

C4b. Dietary versatility: Not applicable for plants

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

C4d. Dependence on other species for propagule dispersal: Neutral.
The dry, one-seeded fruits of *Spartina pectinata* are dispersed as part of an entire spikelet (consisting of an awned glume and a single floret). The awn helps adhere the spikelet to passing animals. Fruits might also be dispersed by flowing water or on mud on waterfowl. *S. pectinata* is not limited to a single seed vector species.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. *Spartina pectinata* is not a preferred forage species for livestock or native herbivores because of its coarse foliage, hard culms, and wet habitat (Walkup 1991).

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
Spartina pectinata is sensitive to competition from some invasive plant species (Camp and Gamon 2011). Reductions in the frequency of flooding or increased drought (with a lowered

water table) due to climate change are likely to make emergent marshland habitats more vulnerable to displacement by plants associated with wet meadows of riparian shrublands or woodlands (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. *Spartina pectinata* is a polyploid with three cytotypes: tetraploid ($4x = 40$), hexaploid ($6x = 60$) and octoploid ($8x = 80$) (Graves et a. 2016). Studies in the Midwest have detected high genome sizes between populations (Kim et al. 2010). Populations from Washington and the Pacific Northwest are somewhat disjunct from the core of the species' range (Barkworth 2003) and are likely to have less genetic diversity due to genetic drift or founder effects.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral.
Range-wide, *Spartina pectinata* has high genetic diversity due to its ability to cross-pollinate over long distances and its multiple ploidy levels (see section C5a).

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.
Three populations of *Spartina pectinata* in Washington have not been relocated in more than 40 years and are historical or possibly extirpated. Across the Northwest, the range of this species has decreased due to habitat destruction (Roché et al. 2019).

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

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