

## Climate Change Vulnerability Index Report

*Damasonium californicum* (Fringed water-plantain)

Date: 19 October 2021

Synonym: *Machaerocarpus californicus*

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington

Heritage Rank: G4/S1

Index Result: Moderately Vulnerable

Confidence: Very High

### Climate Change Vulnerability Index Scores

| <b>Section A: Local Climate</b>                                  | <b>Severity</b>               | <b>Scope (% of range)</b>      |
|--|-------------------------------|--------------------------------|
| 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              | 0                              |
|  | -0.074 to -0.096              | 0                              |
|  | -0.051 to -0.073              | 0                              |
|  | -0.028 to -0.050              | 100                            |
|  | >-0.028                       | 0                              |
| <b>Section B: Indirect Exposure to Climate Change</b>            |                               | <b>Effect on Vulnerability</b> |
| 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                        |
| <b>Section C: Sensitivity and Adaptive Capacity</b>              |                               |                                |
| 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                |                               | 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                        |
| 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 |
| <b>Section D: Documented or Modeled Response</b>                         |         |
| 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 three confirmed occurrences of *Damasonium californicum* in Washington (100%) all occur near the Columbia River in Klickitat County in areas with a

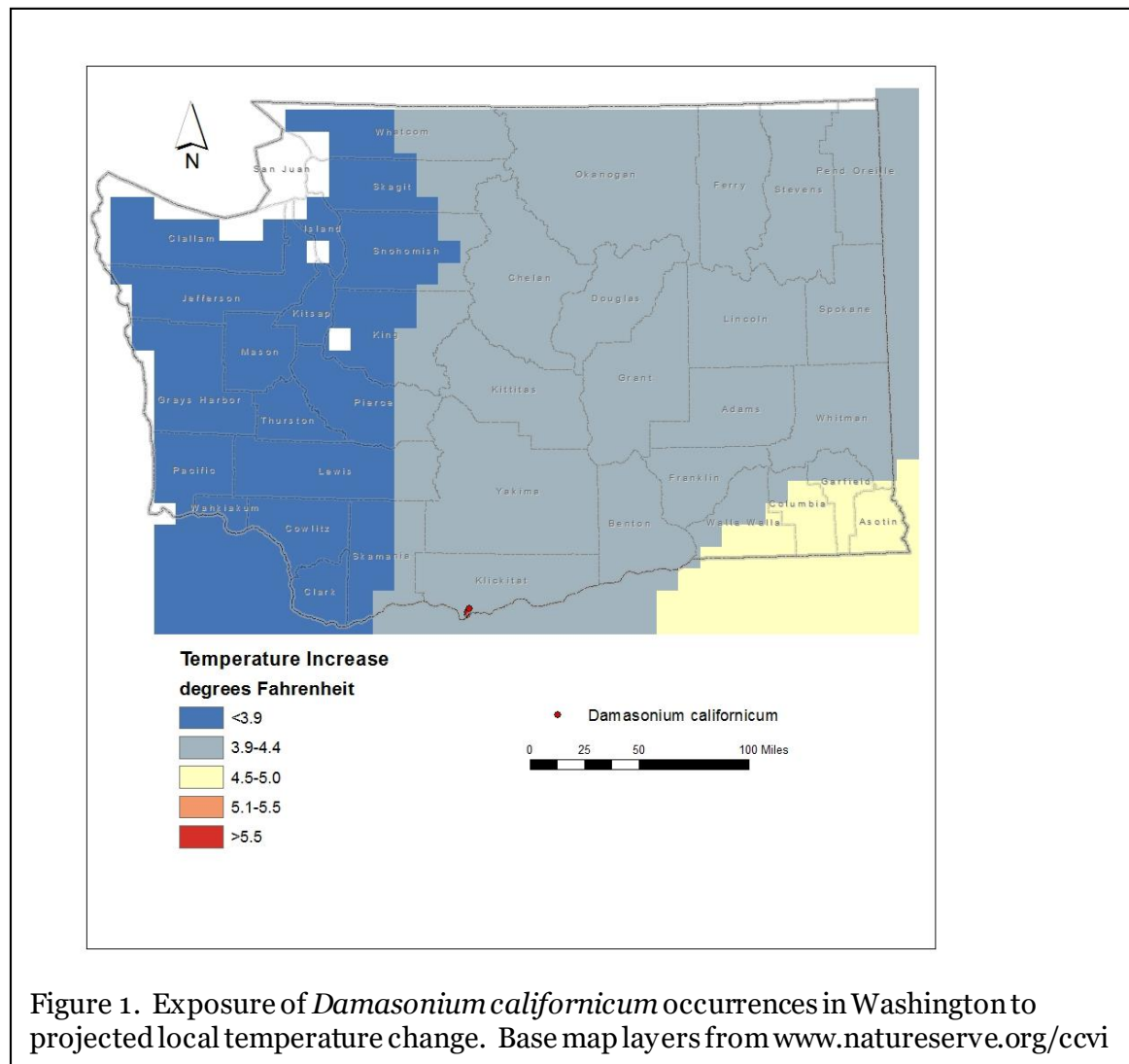


Figure 1. Exposure of *Damasonium californicum* occurrences in Washington to projected local temperature change. Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

projected temperature increase of 3.9-4.4° F (Figure 1). Additional reports from Okanogan and Pierce counties need confirmation and are not included in this analysis.

A2. Hamon AET:PET Moisture Metric: All of the occurrences of *Damasonium californicum* in Washington (100%) 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 -0.028 to -0.050 (Figure 2).

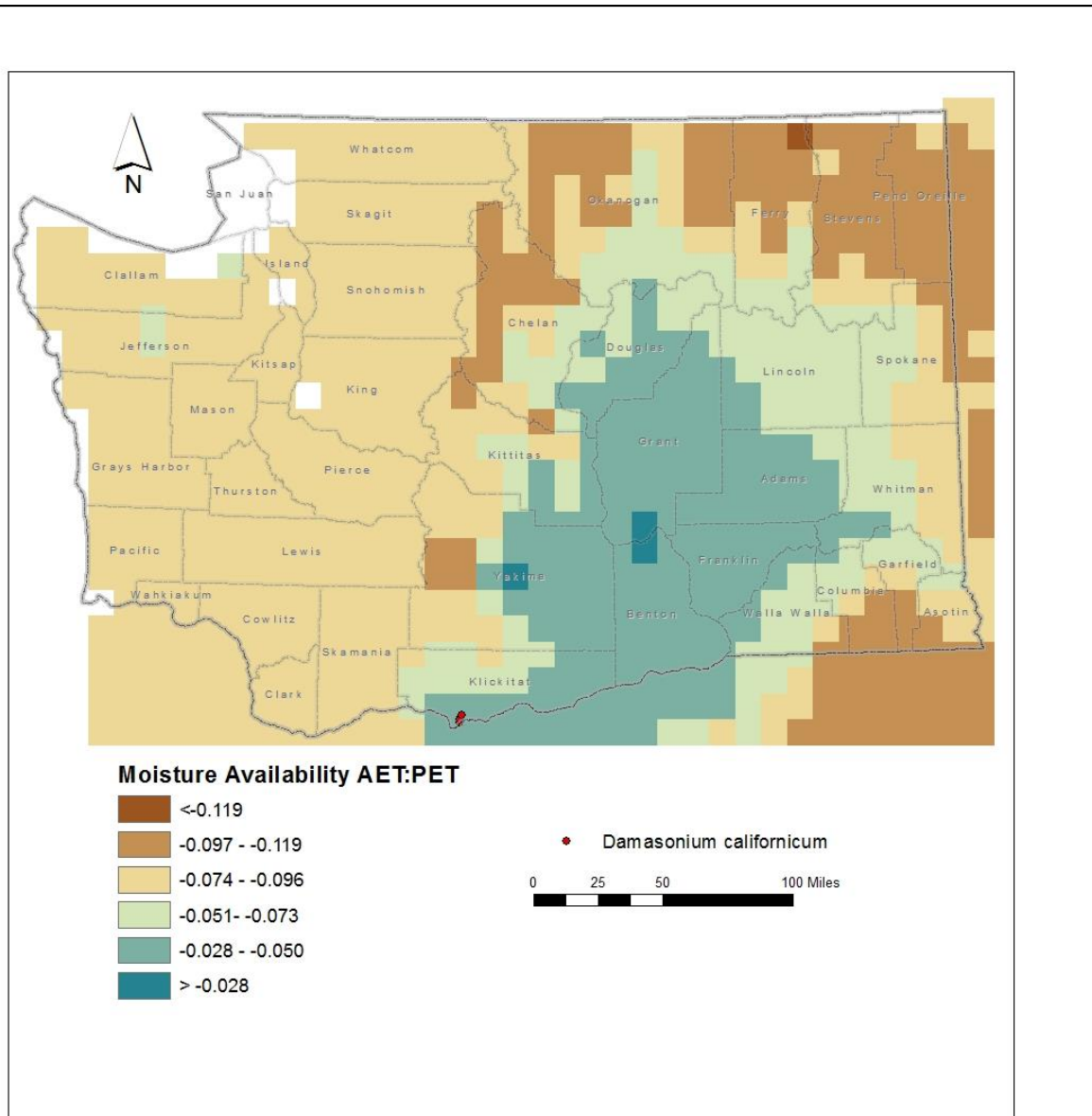


Figure 2. Exposure of *Damasonium californicum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from [www.natureserve.org/cvii](http://www.natureserve.org/cvii)

## Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.

Washington occurrences of *Damasonium californicum* are found at 200-235 feet (60-72 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.

In Washington, *Damasonium californicum* occurs in shallow, mud-lined ponds in depressions in basalt bedrock associated with *Erythranthe guttata* (yellow monkeyflower), *Veronica* (veronica), *Juncus* (rush), *Alisma plantago-aquatica* (European water-plantain), *Downingia yina* (showy downingia), and *Ranunculus aquatilis* (white water crowfoot) (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is part of the North American Arid West Emergent Marsh ecological system (Rocchio and Crawford 2015). Populations in Klickitat County are isolated from each other by 1-2 miles (1.5-3.3 km) of unoccupied and unsuitable upland habitat that creates a partial barrier to dispersal.

B2b. Anthropogenic barriers: Neutral.

The range of *Damasonium californicum* in Washington is bisected by roads and other human infrastructure, but dispersal is more constrained by the naturally patchy distribution of suitable shallow pond habitat.

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

## Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Neutral.

*Damasonium californicum* produces star-like whorls of flat, 1-seeded achenes, each with a long, pointed beak. Fruits may be transported by water or stuck to fur or feathers of animals. Dispersal distances may vary, but the species has the potential for moderate to long-distance dispersal (over 1 km) via animal vectors.

C2ai. Historical thermal niche: Neutral.

Figure 3 depicts the distribution of *Damasonium californicum* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 (“historical thermal niche”). All three 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 shallow pond habitat of *Damasonium californicum* is associated with depressions in basalt bedrock that may be a cold air drainage. The proximity of these sites to the Columbia River may also expose them to strong winds that have a cooling effect. These sites are likely to be impacted by temperature increases associated with climate change.

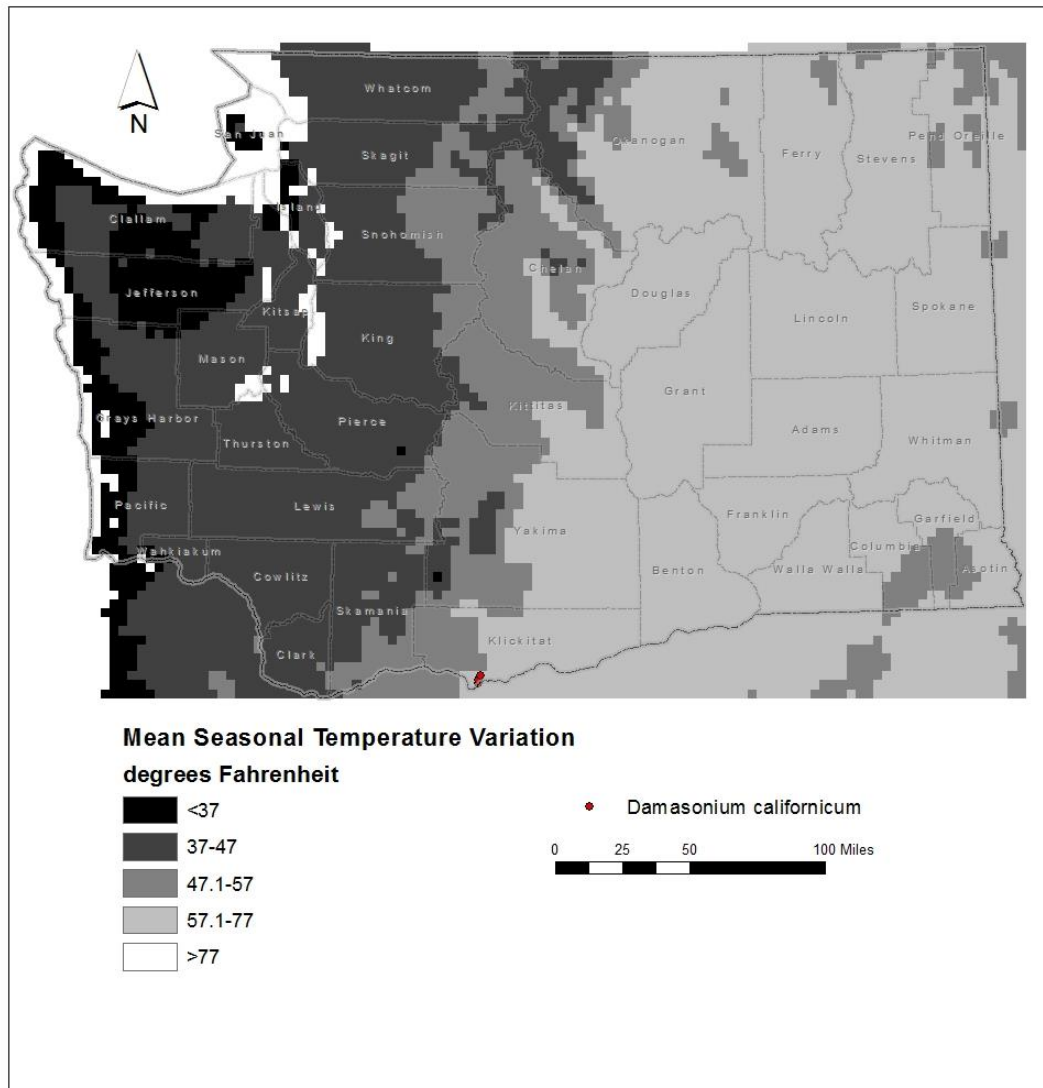


Figure 3. Historical thermal niche (exposure to past temperature variations) of *Damasonium californicum* occurrences in Washington. Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

C2bi. Historical hydrological niche: Somewhat Increase.

All of the known populations of *Damasonium californicum* in Washington (100%) are found in areas that have experienced slightly lower than average precipitation variation in the past 50 years (11-20 inches/255-508 mm) (Figure 4). According to Young et al. (2016), these occurrences are at somewhat increased vulnerability from climate change.

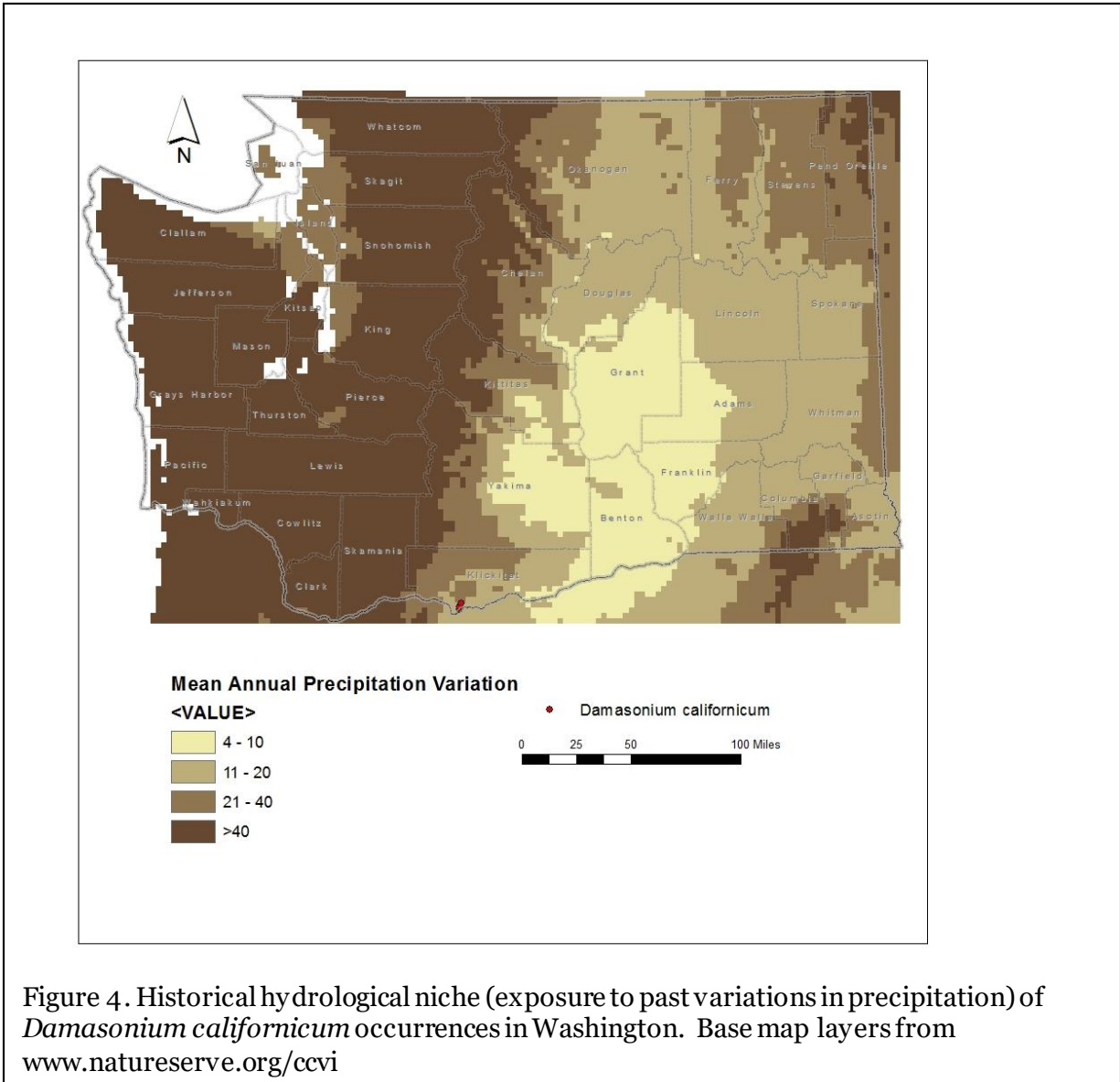


Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Damasonium californicum* occurrences in Washington. Base map layers from [www.natureserve.org/ccvi](http://www.natureserve.org/ccvi)

C2bii. Physiological hydrological niche: Increase.

This species occurs in shallow ponds underlain by basalt bedrock that are maintained by precipitation and a high water table. Changes in the amount and timing of rainfall and increasing temperatures could make these sites vulnerable to prolonged drought and result in a conversion from marsh to wet meadow vegetation (Rocchio and Ramm-Granberg 2017). Groundwater-dependent marshes are also vulnerable if changes in snow deposition or timing of snowmelt reduce water availability in the growing season.

C2c. Dependence on a specific disturbance regime: Neutral.

*Damasonium californicum* occurs in shallow ponds underlain by basalt bedrock. These sites are maintained by sufficient precipitation and groundwater that keeps soils sufficiently saturated to prevent encroachment by species adapted to drier conditions (such as wet meadows

or forests). These sites are not dependent on episodic disturbances, such as fire, though they may benefit from periodic drought to prevent shrubs from being established.

C2d. Dependence on ice or snow-cover habitats: Neutral/Somewhat Increase.

The populations of *Damasonium californicum* in Washington are found in areas with relatively low snow accumulation and mild winter temperatures. Reduced snowpack within the watershed could reduce the amount of groundwater available, which in turn could facilitate conversion of marshlands to wet meadows (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.

*Damasonium californicum* is found primarily in depressions within the Frenchman Springs Member of the Wanapum Basalt, a formation that is widespread in the Columbia Plateau (Washington Division of Geology and Earth Resources 2016).

C4a. Dependence on other species to generate required habitat: Neutral.

The shallow pond habitat occupied by *Damasonium californicum* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.

The specific pollinators of *Damasonium californicum* are poorly known. Vuille (1987) has suggested that moths or other nocturnal insects may be attracted to the white flowers for pollination. Les (2020) notes that *D. californicum* is pollinated by a variety of insects.

C4d. Dependence on other species for propagule dispersal: Neutral.

Fruits have a sharp, pointed beak that may stick into fur or feathers for transport. The fruits are also flattened and might adhere to animals on mud.

C4e. Sensitivity to pathogens or natural enemies: Neutral.

Impacts from pathogens are not known. Foliage and fruits may be eaten by waterfowl (Les 2020), but this is not considered a significant threat.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.

At least one occurrence of *Damasonium californicum* in Washington has high cover of the *Phalaris arundinacea* (reed canary grass), an invasive species. Changes in water availability due to drought, reduced precipitation, or lowered water tables, are likely to result in the conversion of this habitat to meadows, which will lead to increased competition from other native and introduced plant species (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.

Genetic variability is poorly known. *Damasonium* species from Europe have a base chromosome number of  $x = 7$ , but no counts have been completed for *D. californicum* (Les 2020).

C5b. Genetic bottlenecks: Unknown.  
Not known.

C5c. Reproductive System: Neutral.

*Damasonium californicum* is strongly protandrous (stamens mature before the pistils) to promote outcrossing and thus probably has high genetic variability over its full range (Vuille 1987). Populations in Washington occur at the northern limit of the species' range and might be expected to have lower overall genetic variability due to inbreeding, genetic drift, or founder effects.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.  
Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), *Damasonium californicum* has not changed its typical blooming time in the last 40 years.

#### **Section D: Documented or Modeled Response to Climate Change**

D1. Documented response to recent climate change: Neutral.

*Damasonium californicum* was first documented in Washington in 1981 (although an unconfirmed, vegetative specimen was collected in Pierce County in 1973). Of the three verified occurrences, one has not been relocated in the last 20 years despite several attempts. If this population is extirpated, it may be due to habitat destruction rather than a drying climate.

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

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