Climate Change Vulnerability Index Report

Coptis asplenifolia (Spleenwort-leaved goldthread)

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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	0
	3.9-4.4° F (2.2-2.4°C) warmer	14.3
	<3.9° F (2.2°C) warmer	85.7
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to -0.096	100
	-0.051 to -0.073	0
	-0.028 to -0.050	0
	>-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		Increase
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		Somewhat Increase
2c. Dependence on specific disturbance regime		Neutral
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		Somewhat Increase
4f. Sensitivity to competition from native or non-native species		Neutral/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 7 occurrences of *Coptis aspleniifolia* in Washington (85.7%) occur in areas with a projected temperature increase of < 3.9˚ F (Figure 1). One other population (14.3%) is from an area with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

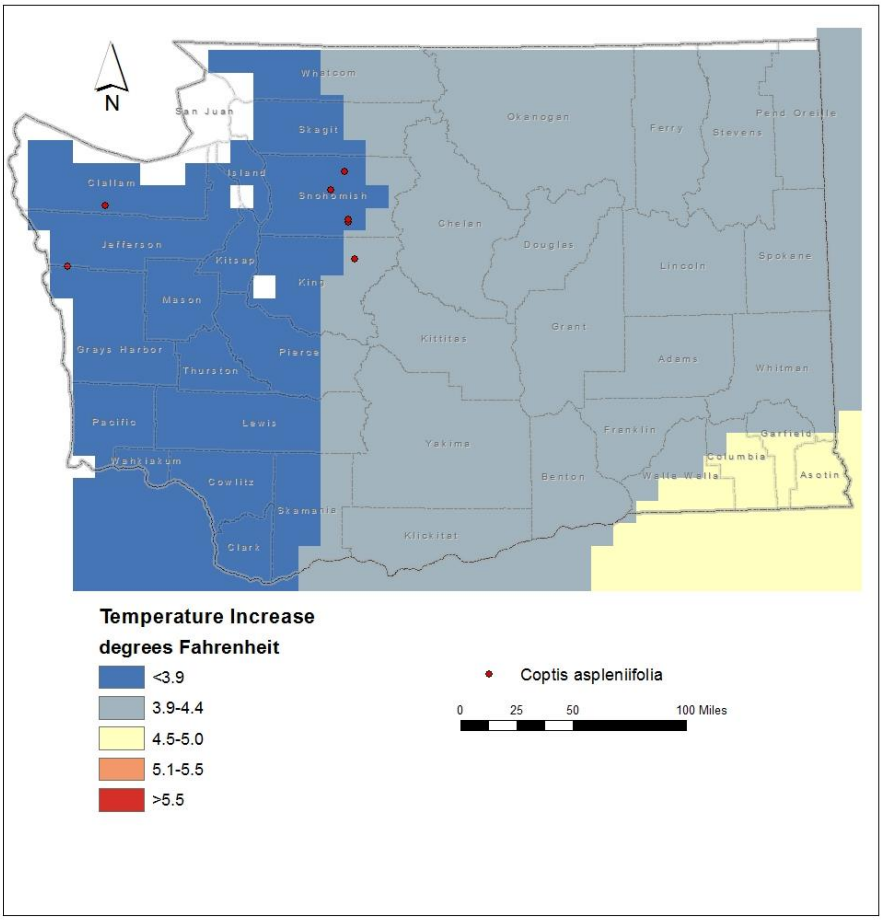

Figure 1. Exposure of *Coptis aspleniifolia* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: All 7 occurrences (100%) of *Coptis aspleniifolia* 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).

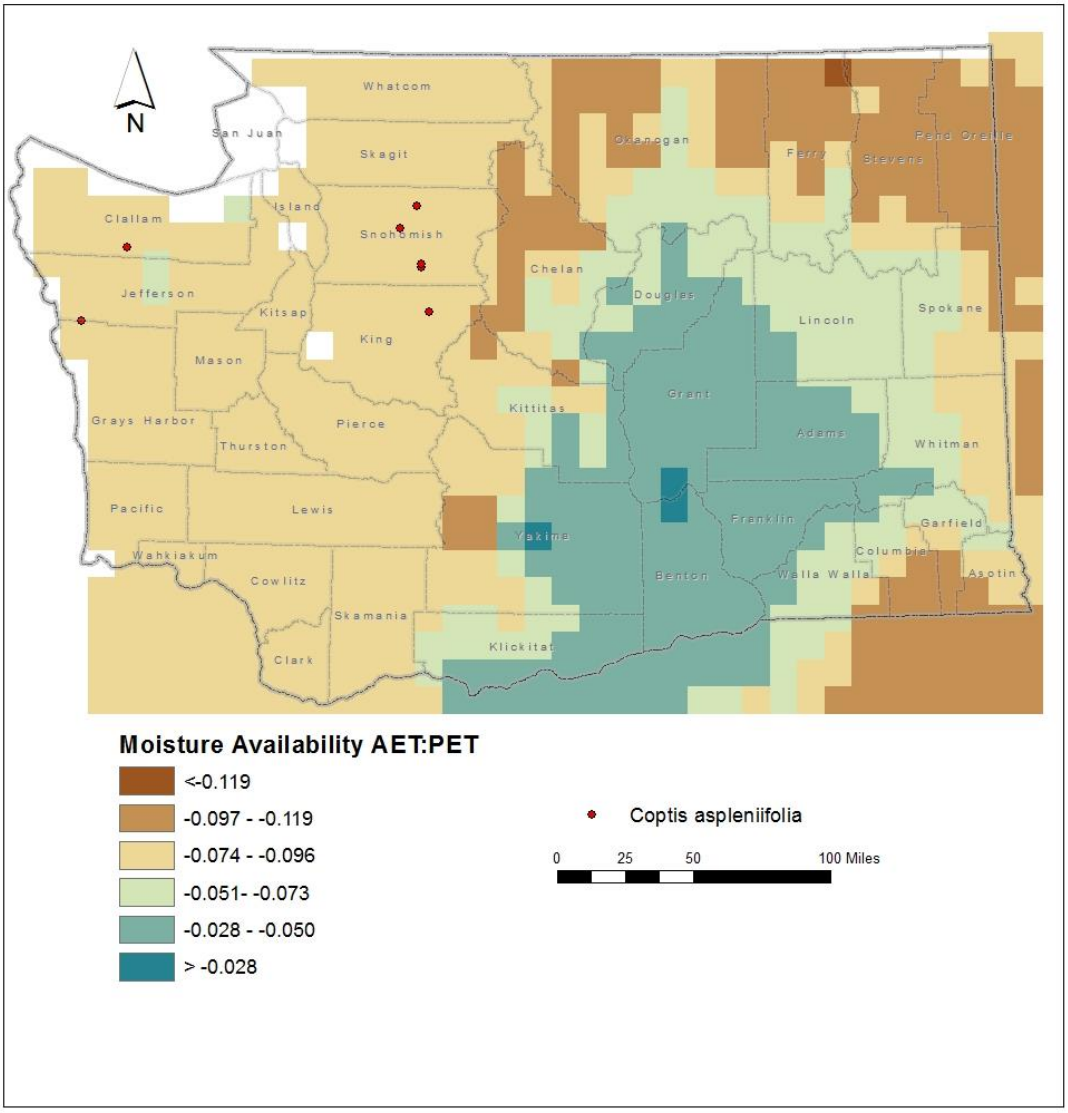

Figure 2. Exposure of *Coptis aspleniifolia* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Coptis aspleniifolia* are found at 100-3040 feet (30-930 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
In Washington, *Coptis aspleniifolia* occurs primarily in moist depressions, streambanks, or shady lower slopes in old growth forested wetlands of western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*) or silver fir (*Abies amabilis*) (Camp and Gamon 2011, Washington Natural Heritage Program 2021). This habitat is part of the North Pacific Lowland Riparian Forest & Shrubland and North Pacific Mesic Western Hemlock-Silver Fir Forest ecological systems (Rocchio and Crawford 2015). Populations within the North Cascades and Olympic Mountains are isolated by 1.7-30 miles (50 km) of potential (though patchy) habitat. These two main population centers are separated from each other by 100 miles (161 km) of mostly unsuitable habitat, which includes the Puget Sound, Puget Trough, and the Seattle-Tacoma metropolitan area. Dispersal between the two mountain ranges is probably minimal due to a lack of potential habitat.

B2b. Anthropogenic barriers: Neutral.
The montane forest wetland habitat of *Coptis aspleniifolia* in Washington is restricted to the western Olympic Range and Northern Cascades. Intervening sites include extensive areas of human development in the greater Seattle-Tacoma metropolitan area and second growth forested lands in montane foothills and valleys. These anthropogenic barriers are similar to those already in place due to a lack of intervening natural habitat.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.
Coptis aspleniifolia produces 6-10 dry fruits (follicles) per flower head that split open along the upper side at maturity to expose 5-10 seeds. The fruit acts as a "splash cup" in which the impact of raindrops landing on the fruit causes seeds to bounce short distances (up to 1 m) (Pojar 1974, Willson and Anderson 2007). Secondary dispersal by foraging insects or rodents may transport seeds further, though likely less than 100 m.

C2ai. Historical thermal niche: Increase.
Figure 3 depicts the distribution of *Coptis aspleniifolia* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Four of the 7 known occurrences in the state (57.1%) are found in areas that have experienced small (37-47˚F/20.8-26.3˚C) temperature variation during the past 50 years and are considered at increased vulnerability to climate change (Young et al. 2016). Two occurrences (28.6%) are from areas that have had very small variation in temperature (<37˚F/20.8˚C) over the same period and are at greatly increased vulnerability to climate change. One other occurrence (14.3%) is from an area with slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation and is at somewhat increased vulnerability to climate change.

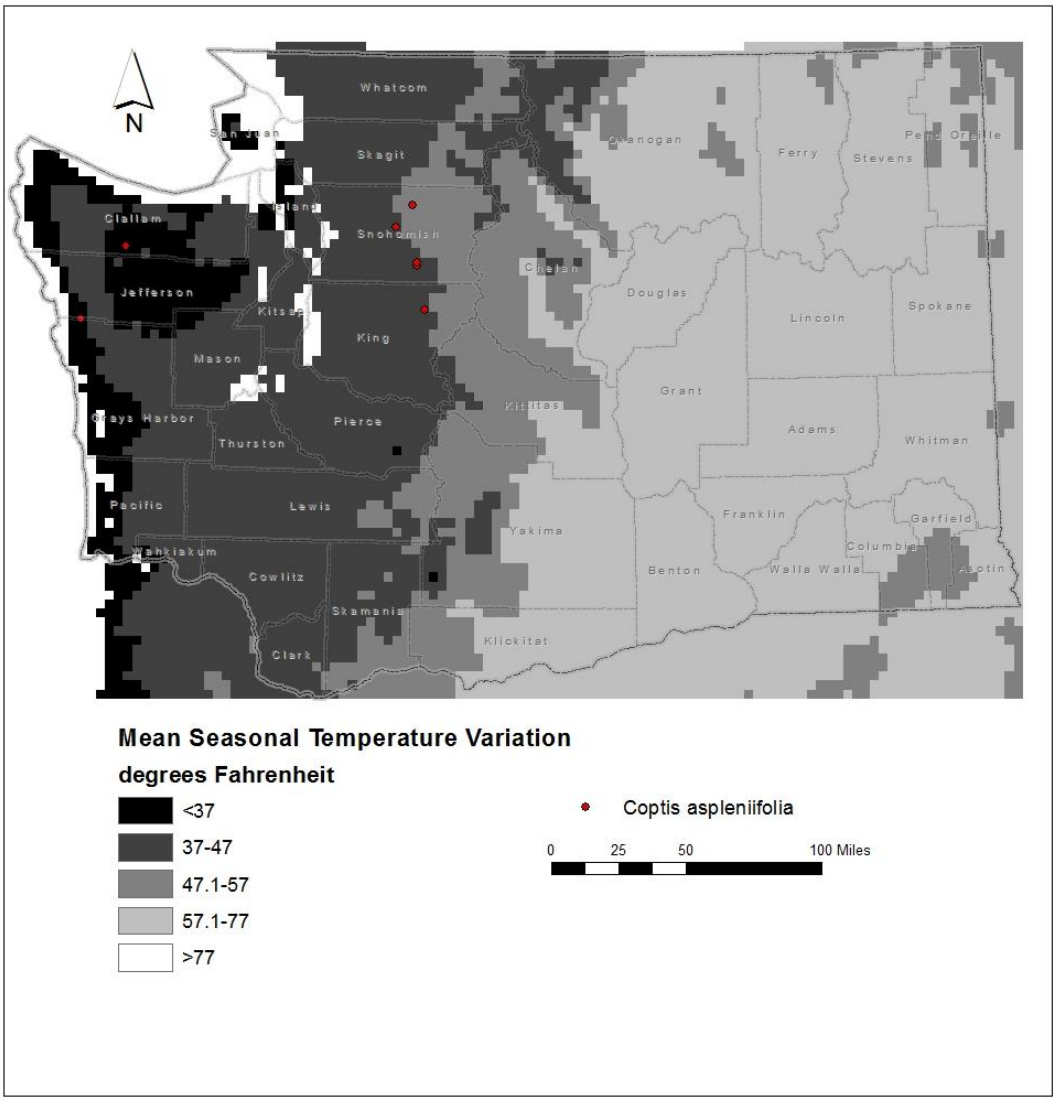

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Coptis aspleniifolia* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
Populations of *Coptis aspleniifolia* in Washington are found mostly along streambanks or lower slopes of forested areas that have cold air drainage during the growing season and could be adversely impacted by warming temperatures.

C2bi. Historical hydrological niche: Neutral.
All of the known populations of *Coptis aspleniifolia* in Washington are found in areas that have experienced greater than average precipitation variation in the past 50 years (>40 inches/1016

mm) (Figure 4). According to Young et al. (2016), these occurrences are neutral for climate change.

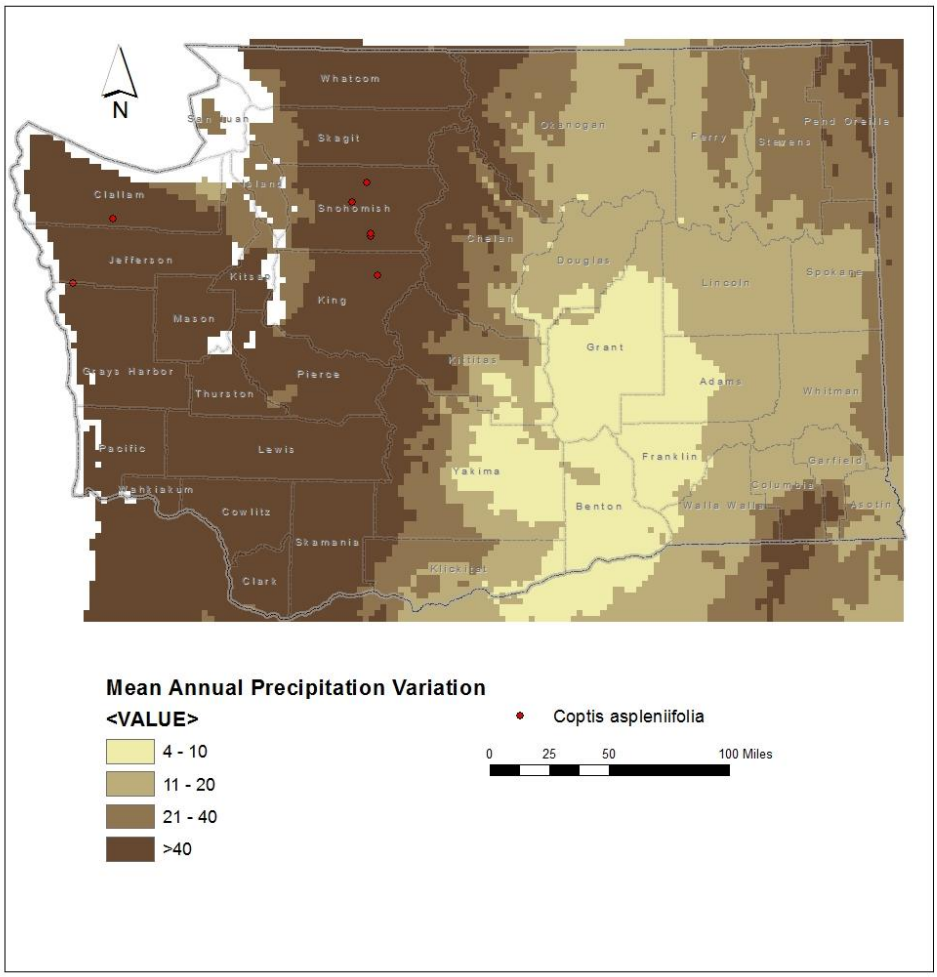

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Coptis aspleniifolia* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is found in habitats with a high water table or associated with perennial water sources. Under project climate change, North Pacific Lowland Riparian Forest and Shrubland sites are likely to experience more drought or lower base flows during the summer due to changes in the amount or timing of precipitation. Streamside populations might also experience more flooding, or changes in the timing of flooding, especially if affected by snowmelt from higher in the watershed (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Some *Coptis aspleniifolia* occurrences in the North Cascades are found in old avalanche chutes or areas where wind throw has created small light gaps. Otherwise, the species does not depend on disturbance events to maintain its swampy forest habitat (Fuentes 2004). Future climate change that would increase drought, lower water tables, and make forest areas more prone to wildfire would be detrimental to these habitats (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Populations of *Coptis aspleniifolia* occur in mountain foothill areas that receive moderate amounts of snow or high levels of winter rainfall. Streamside habitats could be negatively impacted by reduction in the amount of snow at higher elevations or changes in the timing of snowmelt (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.
In the Olympic Peninsula, *Coptis aspleniifolia* is found on outcrops of the Western Olympics lithic assemblage (Oligocene-Eocene marine sedimentary rocks) or glacial outwash and alluvium. Populations from the North Cascades are associated with Cretaceous-Jurassic age marine metasedimentary rocks and granodiorite batholiths (Washington Division of Geology and Earth Resources 2016). These are relatively widespread geologic substrates in the mountains of western Washington.

C4a. Dependence on other species to generate required habitat: Neutral
The montane and foothill swamp forest habitat occupied by *Coptis aspleniifolia* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Based on studies in Alaska, *Coptis aspleniifolia* is visited by a variety of potential pollinators, including at least 8 families of small flies (Diptera) bees (Hymenoptera) and beetles (Coleoptera) (Willson and Anderson 2007).

C4d. Dependence on other species for propagule dispersal: Neutral.
Seeds are dispersed primarily through passive means, facilitated by heavy rainfall (Pojar 1974; Willson and Anderson 2007).

C4e. Sensitivity to pathogens or natural enemies: Somewhat Increase.
Coptis aspleniifolia is browsed by deer (Fuentes 2004) and herbivory is a potential threat to its persistence in Washington (Camp and Gamon 2011).

C4f. Sensitivity to competition from native or non-native species: Neutral/Somewhat Increase.
Coptis aspleniifolia is often found in areas with thick cover of mosses. Competition from other vascular plant species is usually low. Changes in the amount of precipitation or streamflow under projected climate change could reduce the area of swampy forest sites and make them drier and prone to invasion by species adapted to less saturated soils (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 data are available on the genetic diversity of *Coptis aspleniifolia* populations in Washington. Being at the southern edge of its range, Washington populations are likely to have lower overall genetic variation due to inbreeding or founder effects.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral.
Coptis aspleniifolia produces three types of flowers (all staminate, protandrous with stamens maturing before pistils, and protogynous with pistils maturing before stamens) to promote outcrossing (Willson and Anderson 2007). This reproductive system is usually associated with average levels of genetic variation.

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

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No major changes have been detected in the distribution of *Coptis aspleniifolia* in Washington since it was first recorded in the state in 1965 (earlier reports are based on misidentified specimens).

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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