Climate Change Vulnerability Index Report

Draba cana (Lanceleaved draba)

Date: 14 September 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G5/S1

Index Result: Extremely 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	80
	<3.9° F (2.2°C) warmer	20
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	80
	-0.074 to -0.096	20
	-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 B: Indirect Exposure to Climate Change		
1. Dispersal and movements		Somewhat Increase
2ai Change in historical thermal niche		Increase
2aii. Change in physiological thermal niche		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		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		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		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/Somewhat Increase
6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D: Documented or Modeled Response	
D1. Documented response to recent climate change	Unknown
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: Four of the five occurrences of *Draba cana* in Washington (80%) are found in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1). One historical population from Clallam County (20%) is from an area with a projected temperature increase of <3.9 ˚ F.

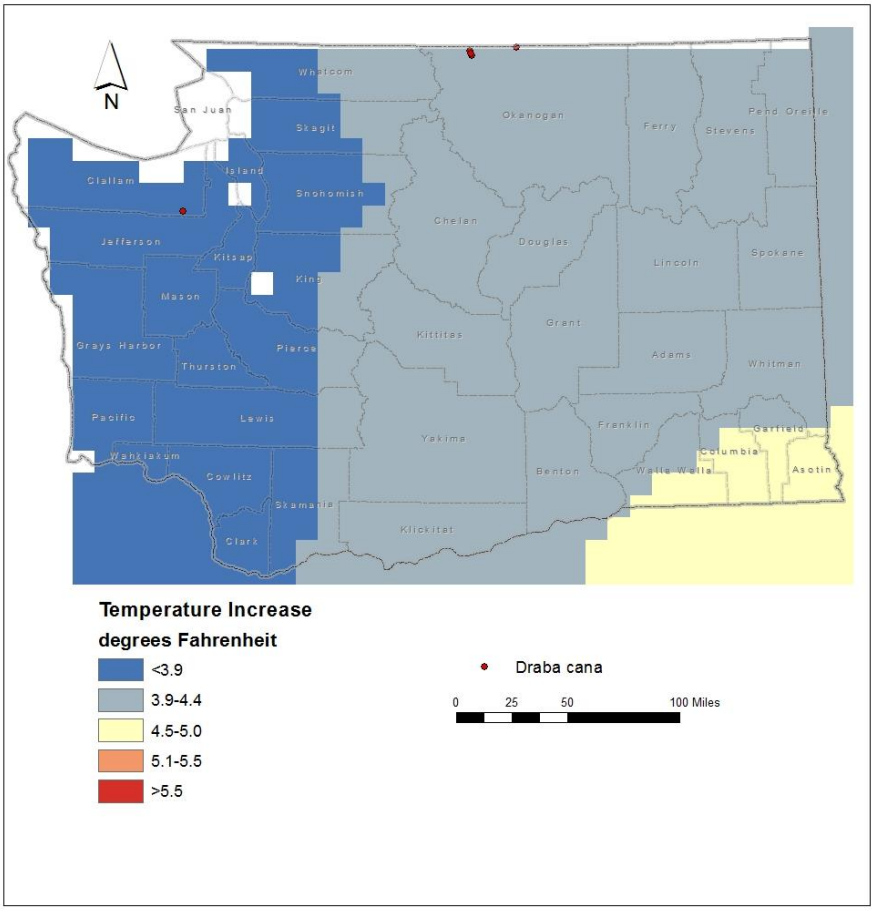

Figure 1. Exposure of *Draba cana* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Four of the five occurrences (80%) of *Draba cana* 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 additional historical population (20%) is from an area with a projected decrease of -0.074 to -0.096.

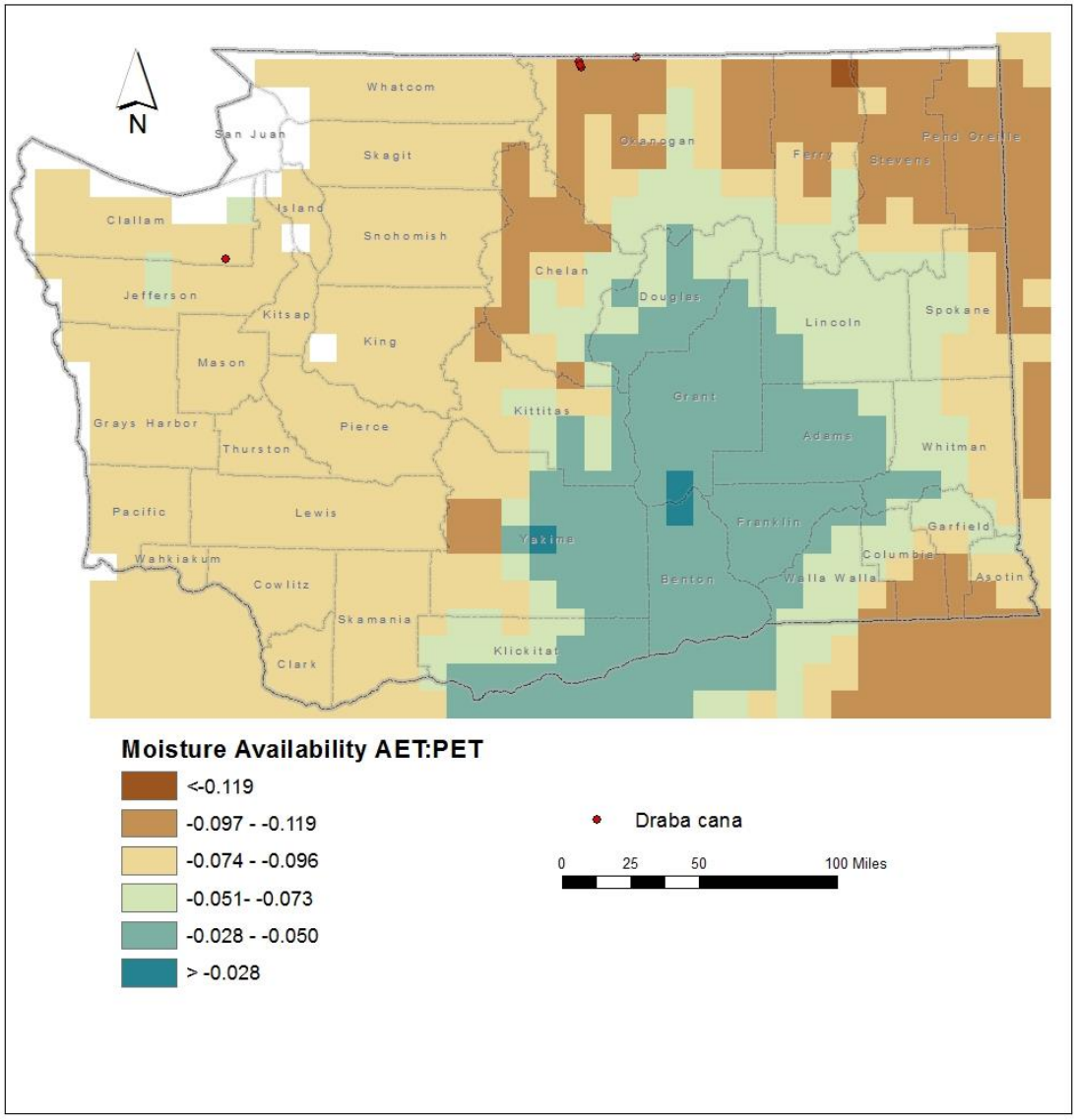

Figure 2. Exposure of *Draba cana* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Draba cana* are found at 5900-7800 feet (1800-2375 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
Draba cana occurs on dry, rocky, south-facing alpine or upper subalpine slopes on sandy-loam soils in cushion plant or dry meadow communities (Camp and Gamon 2011; Washington Natural Heritage Program 2021). This habitat is part of the Rocky Mountain Alpine Bedrock and Scree and Rocky Mountain Alpine Dwarf-Shrubland, Fell-Field, and Turf ecological systems (Rocchio and Crawford 2015). Populations in the Okanogan Plateau of north-central Washington are separated from each other by 0.8-20 miles (1.5-32 km) of unoccupied and unsuitable habitat in valleys or broad basins. A single historical occurrence in the Olympic Range is disjunct by 145 miles (235 km) of mostly unsuitable habitat that presents a significant barrier to gene flow.

B2b. Anthropogenic barriers: Neutral.
The alpine and subalpine habitat of *Draba cana* in Washington is located primarily on high peaks in the Okanogan Plateau and in the northeast Olympic Range. These areas are mostly unimpacted by human development and barriers.

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

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Somewhat Increase.
Draba cana produces 20-50 small seeds (each 0.6-1 mm wide) in dry silicle fruits that dehisce at maturity to release the seeds passively (Hitchcock and Cronquist 1964). The seeds lack wings, hooks, barbs, or other structures to facilitate dispersal by animals, but due to their small size could be transported by strong winds up to 1,000 meters. Secondary dispersal by foraging animals once seeds land on the ground is also possible.

C2ai. Historical thermal niche: Increase.
Figure 3 depicts the distribution of *Draba cana* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). Four of the five known occurrences in the state (80%) are found in areas that have experienced small variation (37-47˚F/20.8-26.3˚C) in temperature in the past 50 years and are considered at increased vulnerability to climate change. One population (20%) is from an area of slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation over the same period and is at somewhat increased vulnerability to climate change (Young et al. 2016).

C2aii. Physiological thermal niche: Increase.
The subalpine and alpine rocky ridge, cushion plant, and dry meadow habitat of *Draba cana* is exposed to high winds and cold temperatures during the flowering season and highly vulnerable to temperature increases from climate change.

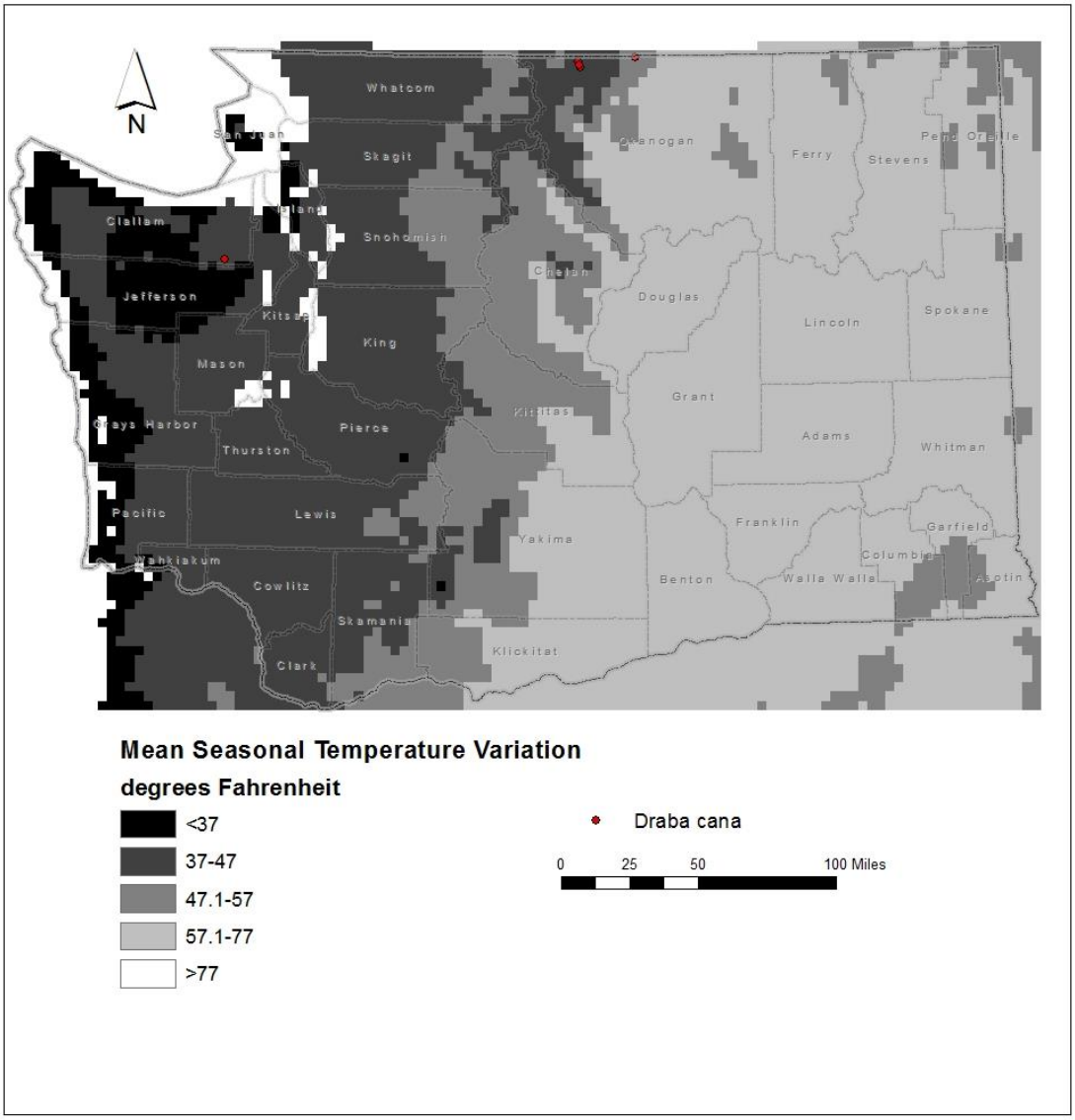

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Draba cana* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.
All of the known populations of *Draba cana* in Washington are found in areas that have experienced average or greater than average precipitation variation in the past 50 years (>20 inches/508 mm) (Figure 4). According to Young et al. (2016), these occurrences are neutral for climate change.

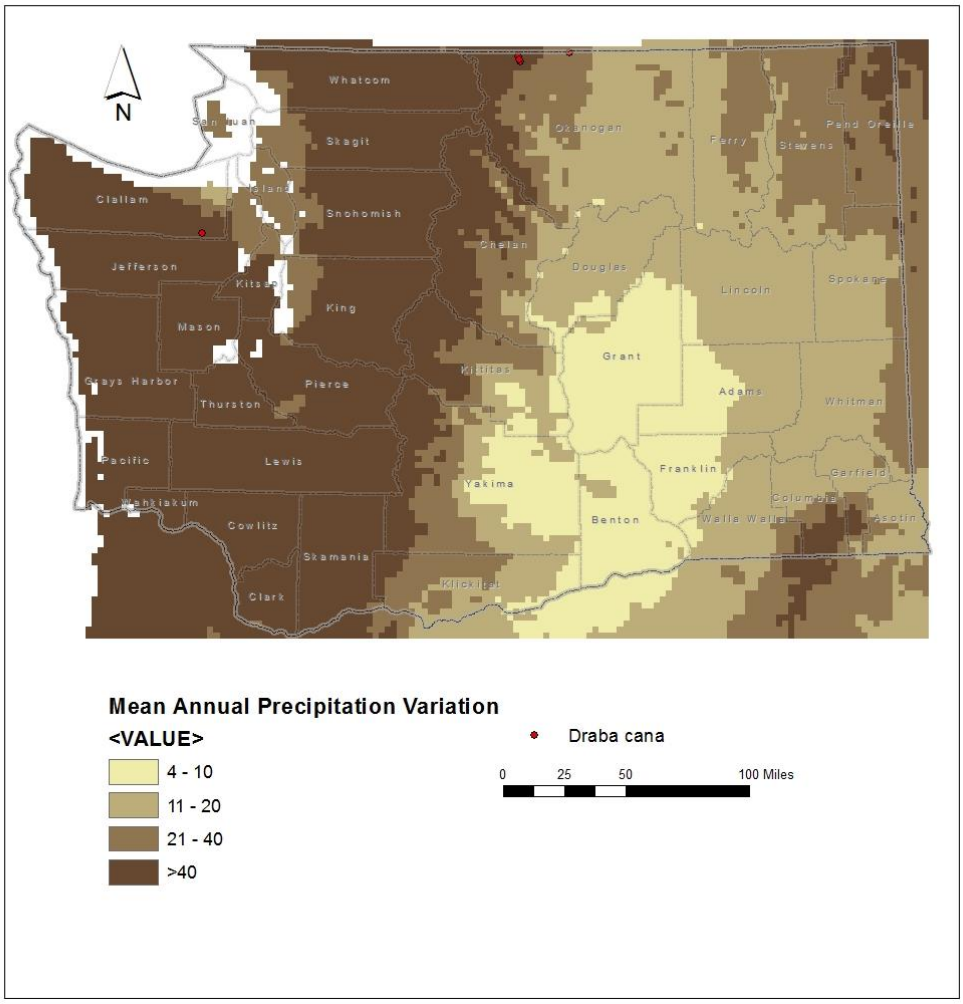

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Draba cana* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is found in habitats that are not associated with perennial water sources or a high water table and so is dependent on winter snow and summer precipitation for its moisture needs. It would be vulnerable to changes in the timing or amount of snow and rainfall or snowmelt due to warming conditions (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Draba cana occurs in alpine or subalpine rock crevices, cushion plant communities, or dry meadows subjected 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: Increase.
The populations of *Draba cana* in Washington are found on rocky alpine or subalpine slopes, dry meadows, or cushion plant communities associated with high winter snow accumulation, although the areas may be free of snow due to evaporation or wind during the growing season. Reduction in the amount of snow or timing of its melt due to climate change would decrease the amount of moisture available through runoff (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Somewhat Increase.
In the Okanogan Plateau, *Draba cana* is found primarily on outcrops of pre-Jurassic granodiorite gneiss of the Quartz Mountain area and tonalitic gneiss of Tillman Mountain. Both of these outcrops are mostly found near the Canadian border. In the Olympic Mountains, *D. cana* is known from Eocene-age uplifted marine sediments found mostly ringing the north and eastern slopes of the range (Washington Division of Geology and Earth Resources 2016).

C4a. Dependence on other species to generate required habitat: Neutral
The alpine talus and tundra habitat occupied by *Draba cana* is maintained largely by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The specific pollinators of *Draba cana* are not known. Self-pollination is common among arctic and alpine species of *Draba* (Brochmann 1992) and may occur in *D. cana*.

C4d. Dependence on other species for propagule dispersal: Neutral.
The small, light-weight seeds of *Draba cana* are released passively and spread by high winds or gravity. Insects or rodents may transport seeds secondarily once they fall on the ground.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Not known, but probably not a limiting factor.

C4f. Sensitivity to competition from native or non-native species: Neutral/Somewhat Increase.
Under present conditions, competition from non-native species is minor, as few introduced plants are adapted to the harsh environmental conditions of the alpine and upper subalpine zones. With warmer and drier conditions under projected climate change, competition could increase from lower elevation plant species that are able to expand their range into formerly unsuitable alpine habitats (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.
Beilstein and Windham (2003) documented that *Draba cana* is a tetraploid with a chromosome count of $2n = 32$. No data are available on genetic variability of Washington populations.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral/Somewhat Increase.
The reproductive biology of *Draba cana* is poorly known. Many arctic and alpine *Draba* taxa reproduce by agamospermy in which fertile seeds are produced without pollination (Brochmann 1992). Due to a lack of genetic intermixing, these species would be expected to have low genetic diversity. Washington populations of *Draba cana* are isolated from other U.S. occurrences in the Rocky Mountains and near the edge of the species' range in Canada and thus likely have lower genetic variability due to inbreeding or founder effects.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on Washington Natural Heritage Program element occurrence data, *Draba cana* has not changed its typical blooming time in recent years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Unknown.
Two of the five documented populations of *Draba cana* in Washington are historical and have not been relocated since the mid 1970s and early 1980s (including the disjunct occurrence from the Olympic Range). Whether these populations are extirpated or have gone undetected is not known. If extirpated, the cause of mortality is not known.

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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