

Serpentine Endemic Rare Plants

Climate Change Vulnerability
and Adaptation Strategies for the
Golden Gate Biosphere Region



Species Description

Serpentine endemic rare plants are uniquely adapted to serpentine soils derived from the weathering of ultramafic rocks such as serpentinite and peridotite. Serpentine soils influence the diversity of plants that can flourish there as they are typically deficient in nutrients and harbor high concentrations of elements such as magnesium and iron, and a variety of heavy metals. Serpentine soils in the Golden Gate Biosphere (GGB) region support many rare and endemic plants, including Presidio manzanita (*Arctostaphylos montana* ssp. *ravenii*), Presidio clarkia (*Clarkia franciscana*), Marin western flax (*Hesperolinon congestum*), and fountain thistle (*Cirsium fontinale* var. *fontinale*). The North Coast range (which encompasses most of the GGB region), in particular, exhibits significantly elevated occurrences of serpentine endemic species, with 127 serpentine endemic taxa identified in this area.

Species Vulnerability - Moderate

Sensitivity & Exposure - Moderate

Projected Changes	Trend
Air temperature	▲ Increase
Precipitation	▲▼ Varies
Drought	▲ Increase
Wildfire	▲ Increase

Potential Impacts:

- Reduced plant growth due to elevated moisture stress threatens reproduction and survival
- Increased establishment of invasive/non-serpentine species
- Disrupted timing of life cycle events (e.g., seed production) for some species due to increased drought
- Potential for increased germination and flowering as well as species richness and forb cover if wildfire frequency increases modestly, though very frequent fire could have negative impacts

Non-climate stressors may interact with climate stressors and disturbance regimes:

- *Invasive species* can lead to displacement of rare native species and impact ecosystem structure, soil chemistry, and community productivity
- *Nitrogen deposition* from urban areas and vehicles promotes the growth of invasive annual grasses and weeds, threatening biodiversity
- *Fire exclusion* may increase litter, leading to the decline of forb species by limiting light availability



Serpentine endemic rare plants are sensitive to climate changes and disturbances that impact plant growth, nitrogen deposition, invasive species introductions and establishment, and habitat fragmentation and availability of refugia.

Species Vulnerability - Moderate

Adaptive Capacity - Moderate

Intrinsic factors (i.e., inherent characteristics) that enhance or undermine adaptive capacity:

Enhance:

- Exhibits adaptations to harsh soil chemistry and environmental extremes
- Well-adapted to periodic fire events and harsh growing conditions

Undermine:

- Slow recovery after disturbances due to low soil nutrients that limit recolonization
- Constrained distribution and limited connectivity due to naturally-fragmented habitats

Extrinsic factors (i.e., management potential) that enhance or undermine adaptive capacity:

Enhance:

- Good regulatory support for conservation due to the presence of endangered species

Undermine:

- Need for increased financial support for management



Although they are resistant to many environmental stressors, human disturbances may impede the ability of serpentine endemic rare plants to recover from the impacts of climate change, particularly given their naturally-fragmented habitats.



Marin dwarf flax, Tom Hilton, Flickr (CC BY 2.0)



Franciscan manzanita, Shelley Estelle/Presidio Trust, Flickr (CC BY 2.0)

Adaptation Strategies & Actions

Adaptation strategies can reduce climate change vulnerability of a given ecosystem or species by addressing any or all of the three components of vulnerability (i.e., by reducing sensitivity, reducing exposure, and/or increasing adaptive capacity). The table below presents examples of adaptation strategies and actions, which fall within five categories, or approaches: Resistance/Resilience **(R)**, Acceptance **(A)**, Direct/Response **(D)**, Knowledge **(K)**, and Collaboration **(C)**. *Please note that the strategies and actions provided here should not be considered a checklist or plan, but rather as a set of examples for land managers to consider for further study when developing site- or species-specific actions.*

Adaptation Strategies	Adaptation Actions
Prevent the introduction and establishment of invasive species and remove existing populations	<ul style="list-style-type: none"> Remove non-native annual grasses and other invasive plant species using a variety of treatments (e.g., prescribed fire, mowing, hand pulling, herbicides) (R)
Increase seed collection and plant propagation of native species	<ul style="list-style-type: none"> Carry out a seed bank study to better understand population dynamics and where additions may or may not be needed (K) Collect and store seed from serpentine species for future use in restoration and planting programs (R) Provide grants and seed for nurseries to study propagation techniques and develop production programs under stringent pathogen prevention Best Management Practices (BMPs) (K)
Move at-risk species to locations that are expected to provide habitat	<ul style="list-style-type: none"> Establish in appropriate locations that are currently unoccupied by rare species and are expected to remain suitable or are degraded and could be restored (R)
Promote awareness of and appreciation for serpentine ecosystems and associated species	<ul style="list-style-type: none"> Increase education and outreach on serpentine habitats and the endemic species they harbor, as well as human uses that may harm serpentine endemics (e.g., trampling) (C)

Adaptation strategies and actions suggested by individual stakeholders (not discussed during the December 2023 adaptation workshop).



Tiburon mariposa lily, Tom Hilton, Flickr (CC BY 2.0)



Photo Presidio clarkia, Tom Hilton, Flickr (CC BY 2.0)