Mission Blue Butterfly

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

Species Description

The mission blue butterfly (*Icaricia icariodes missionensis*) is a small, diurnally active, univoltine (one generation per year) butterfly that is one of twelve subspecies of Boisduval's blue butterfly found in western North America. Its life cycle is closely aligned with and highly dependent on three host plant species of lupine that are found in coastal prairie and coastal scrub ecosystems: silver lupine (*Lupinus albifrons)*, summer lupine (*L. formosus*), and many-colored lupine (*L. variicolor*). Mission blue butterflies emerge between March and mid-June, depending on the population and the surrounding topography, with populations in cooler microclimates emerging later than those in warmer areas. The adults feed on the nectar of a variety of grassland plant species. Mission blue butterflies are federally endangered, and within the Golden Gate Biosphere (GGB) region they occur in metapopulations in Marin, San Francisco, and San Mateo Counties.

Species Vulnerability - *High*

Sensitivity & Exposure - *High*

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

Potential Impacts:

- Declines in lupine host species and threats to caterpillar survival as a result of rising temperatures
- Increased host plant dieback due to fungal pathogens as precipitation increases, threatening successful reproduction
- Potential shifts in grassland distribution and/or composition, impacting the availability of host plants and nectar sources
- Negative impacts on dispersal, food access, and mating during strong winds associated with storms
- Reduced germination, re-establishment, and persistence of host plants with climate-driven changes in wildfire regimes

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

- *Recreational/commercial development* has contributed to historic habitat loss, and continues to limit the species range, create barriers to movement, and degrade habitat through trampling
- *Invasive Argentine ants* (*Linepithema humile*) increase parasitism in mission blue butterfly larvae by interrupting the protective function of native ants that care for these larvae
- *Excessive herbivory* by deer and voles causes declines in lupine host plants
- High rates of *atmospheric nitrogen deposition* can facilitate *invasion by exotic annual grasses*, leading to mortality in native host species
- *Fire exclusion* leads to the encroachment of shrubs and trees in coastal scrub and grassland ecosystems, which can shade out and compete with early-successional plants

The mission blue butterfly is sensitive to stressors that affect the health and availability of their lupine host plants, which are impacted by changes in moisture availability, fire regimes, grazing, and competition/displacement by invasive plants, among others.

Species Vulnerability - *High*

Adaptive Capacity - *Low*

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

Enhance:

- Some indication this species can utilize additional host plants
- Variability in emergence and egg laying that may be linked to varying microclimates where populations are distributed

Undermine:

- Restricted in its range
- Habitat loss and fragmentation
- Relatively low reproductive rates and slow recovery from past perturbations

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

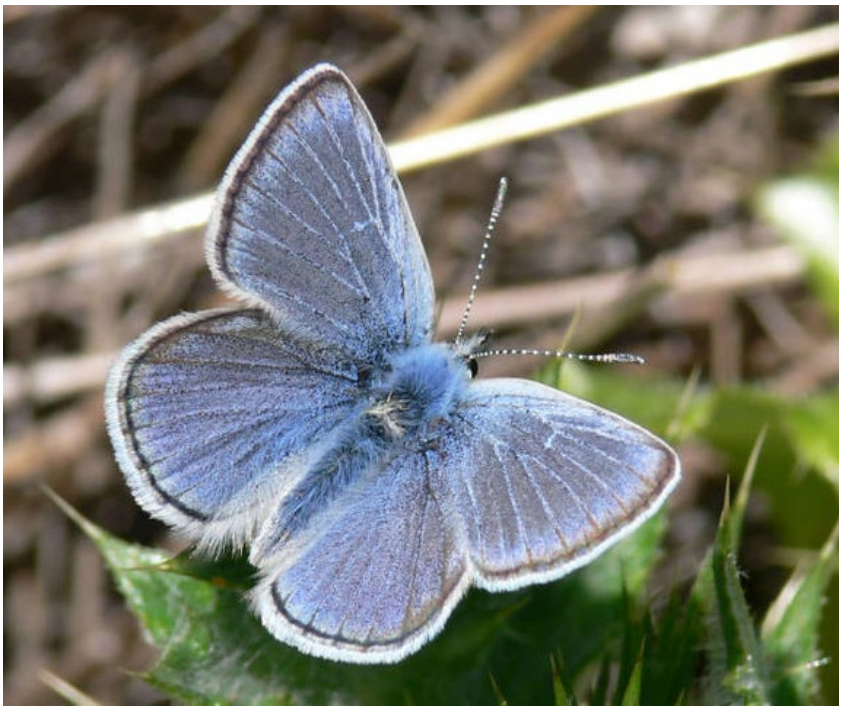
Enhance:

- Active restoration and translocation efforts
- Regulatory protection due to status as a federally-endangered species

Undermine:

- Lupines are relatively difficult to establish and labor-intensive to plant, and restoration has been hampered by nursery pathogen issues

Although mission blue butterflies are protected, continued habitat loss and fragmentation is an ongoing challenge for maintaining the integrity of intact habitat and for restoration of degraded lands.



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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
Improve coordination with the goal of generating shared knowledge	• Standardize and coordinate monitoring across the region **(K/C)** • Sponsor research to investigate whether recovery plan reflects the biology and management needs across its range **(K/C)** • Collaborate to better understand evolutionary and population genetics **(K/C)**
Improve habitat resilience to extreme events (e.g., storms, drought, disease outbreaks)	• Diversify occurrences of host-plant species to buffer against disease-related impacts to any individual lupine species **(R)** • Provide grants and seed for nurseries to study propagation techniques for all three lupine species and develop production programs under stringent pathogen prevention Best Management Practices (BMPs) **(K)** • Implement research to investigate potential treatments for fungal pathogens of lupine host plants **(R/K)**
Improve lupine habitat, especially in the context of missing disturbance regimes	• Control woody vegetation **(R)** • Implement prescribed burning that mimics the historic fire regime and meets mission blue butterfly life history requirements **(R)** • Manage invasives, especially annual grasses and arthropods **(R)** • Create and implement a vegetation monitoring and management strategy that includes monitoring of lupine populations for size, health, and vigor **(R/K)**
Improve habitat connectivity	• Identify occupied, formerly occupied, and potential habitat patches and perform path analysis based on likely butterfly flight path **(K)** • Create dispersal corridors by removing woody vegetation (trees and shrubs) **(R)** • Create habitat patch stepping stones (lupine and/or nectar resources) **(R)**

Adaptation strategies and actions generated through breakout group exercises during the adaptation workshop in December 2023.