

**Enhance habitat for GGNRA Mission blue butterfly
through habitat disturbance actions**

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Abstract

The federally endangered Mission blue butterfly (*Icaricia icarioides missionensis*) occurs in coastal prairie grasslands that occur primarily within Golden Gate National Recreation Area (GGNRA). The mission blue relies on a few species of disturbance associated lupine as host plants. To date, management of the mission blue has focused on removal of invasive plants and outplanting lupines, which has been variably successful and expensive. In addition, coastal scrub is encroaching into many grasslands in the park due to an altered disturbance regime, precluding lupines. We propose to introduce a variety of disturbance treatments to mission blue habitat to test mechanisms for expanding the distribution of lupine host plants and populations, increasing their health and vigor, and, thereby improving and expanding available habitat for the mission blue.

Introduction

a) Problem Statement

Populations of the federally endangered Mission blue butterfly (*Icaricia icarioides missionensis*) are now found in only a few locations around the San Francisco Bay area in California: at the Marin Headlands and Fort Baker (GGNRA/Marin County), Alta Avenue and Oakwood Valley (GGNRA/Marin County) and the Skyline ridges (GGNRA/Milagra and Sweeney in San Mateo County) within GGNRA, and San Bruno Mountain (San Mateo County) and possibly Twin Peaks (San Francisco County) outside of GGNRA. The historical distribution of the species probably encompassed much of the coastal scrub/grassland habitat of the northern San Francisco peninsula and Marin County. The GGNRA now manages the only habitat for this species in Marin County. In San Mateo County, San Mateo County Parks manages the only other significant population of Mission blues.

With alterations of natural (e.g. tule elk) and anthropogenic (e.g. Native American burning and ranching) sources of disturbance that have historically maintained grasslands in this area, coastal scrub has become established in many of these areas. The lupine host plants that Mission blues depend typically do not grow in areas dominated by coastal scrub. In addition, GGNRA's typical methods of habitat restoration for Mission blues have been primarily invasive plant removal and outplanting lupines. The invasive plant removal has not been effective in getting lupines to establish or regenerate. The outplanting has not been terribly successful in many areas and is expensive to implement.

With this project, we will restore disturbance back into the system, to determine if it is effective in restoring Mission blue butterfly habitat. We would use the results of this study to try and implement disturbance on larger scales to benefit Mission blues and maintain grassland patches and the biodiversity they support. If disturbance proves effective, it may prove a more cost effective way to restore Mission blue butterfly habitat.

b) Background

Causes for the decline of Mission blues are listed as urbanization, encroachment of exotic species and trampling, per the Recovery Plan for the species (USFWS 1984). The extant populations are fragmented: the butterflies are unable to span the distances between each of the larger locations in Marin, San Francisco, and San Mateo counties, and are often unable to cross from one habitat patch to another within a particular site due to lack of suitable host and nectar plants, leaving little chance of dispersal between populations which may be leading to genetic isolation. The main threats to the population within the GGNRA are the spread of exotic plants, trampling, a native pathogenic fungus that periodically kills off large amounts of lupine, and loss of disturbance processes that maintain early successional, disturbance-dependent communities such as grasslands where lupines are known to thrive.

However, natural disturbance factors at Milagra Ridge and other areas of Mission blue habitat have changed radically over the past 250 years. Most coastal grasslands experienced occasional low to moderate intensity fires - primarily set by the Coast Miwok and Ohlone people who inhabited this area. These fires were more common in grassland and scrub ecotones, and resulted in increased food production from grasses, forbs, tubers, and bulbs. Following settlement by Euro American settlers, burning continued until the late 1800s. At the same time, the natural grazers and browsers - tule elk - were reduced and eventually extirpated from the area, to be replaced by cattle and horses which would have browsed shrubs and helped maintain the grasslands. As urbanization of the San Francisco Bay Area continued, sites became more isolated and the activities on these sites became much more limiting, resulting in loss of both fire and grazing effects (GGNRA Fire Management Plan, 2005).

In the GGNRA, Mission blue butterfly habitat now tends to be in marginal grasslands located on thin, rocky and sandy soils where scrub species are somewhat excluded. The lupine host plants are resourceful, growing in rocky rubble and on sand dunes where their root systems may reach a depth of 20 feet. These lupines obtain nitrogen from the atmosphere with the help of Rhizobium bacteria which convert atmospheric nitrogen into organic compounds through nitrogen fixation. In return the lupine serves as a host that supplies energy-rich carbon compounds to the bacteria. Healthy regenerating lupine patches are found along road cuts and shoulders, in abandoned quarries, slumps, recently burned areas, and alongside trails. In contrast, lupine patches within mature grassland communities are declining in size, extent, and vigor.

Mission blue butterfly management within the Golden Gate National Recreation Area GGNRA has focused on maintaining and increasing the native perennial lupine host plant populations of silver lupine (*Lupinus albifrons*), summer lupine (*L. formosus*) and Lindley varied lupine (*L. variicolor*) by two means: invasive plant species removal and outplanting lupine host plants. During past park outplanting efforts, various problems have been encountered. Despite the typically vigorous nature of most lupine species in wildland settings, mortality rates of propagated seedlings of silver-leaf lupine - while still in the nursery - have ranged from 30-50%, up to 98-100%. Similarly, the survival of

seedlings that have been outplanted into the field have been highly variable, ranging from 30-70% (Gerlich, 2004). Propagation and planting is very expensive and time-consuming due to the costs of each of its components: seed collection, propagation, planting, watering, and follow-up weed control. Similarly, results from direct seeding of lupine plants have been disappointing: of 240 lupine seeds scarified and directly seeded at Milagra Ridge, only 7 germinated seedlings survived after 6 months. Given the expense and inconsistent results of these efforts, protection and enhancement of existing lupine plants and populations needs to be a higher priority.

The park has had many successes in invasive plant removal, in part funded through NRPP Natural Resources Management and Fee Demonstration projects, and strongly supported by the Golden Gate National Parks Conservancy (GGNPC). However, just as invasive non-native plants can successfully compete with native lupine host plants, so can native species such as coyote brush and California sagebrush. Since the mid-1990s, anecdotal observations by staff from the NPS and GGNPC Site Stewardship Program - one of the partner organizations for GGNRA - indicate that scrub cover at Milagra ridge in San Mateo county has been increasing. Because the mission blue butterfly depends on lupine plants, and because native scrub has been documented in the literature to encroach into grasslands, staff became concerned that an increase in scrub might lead to a decrease in mission blue host plants, and ultimately have negative consequences for the mission blue butterfly. This has been the case at San Bruno Mountain, where the scrub has been documented as increasing; butterfly populations have decreased (Kobernus, Pers. Comm. 2006). Coastal scrub encroachment has been well-documented at Milagra Ridge with a combination of long-term photo monitoring points and transects for mission blue butterflies that include vegetation data. These data show an overall increase in shrub density and cover, and a decrease in numbers of host plants and numbers of seedlings. In every transect where scrub increased, lupine decreased, whereas on transects where scrub decreased, lupine increased. This pattern of plant senescence without reproduction may also be an early indication of the affect of climate change, which is important to recognize (and isolate from the other environmental factors) as we work toward recovery of the species.

In addition, as the quantity of lupine host plants has declined over the years, the quality of these host plants has also declined. Caterpillars across all lepidopteron families have been shown to survive and grow more vigorously on younger host plants (Stamp and Casey, 1993). Staff have speculated that lupine populations at park mission blue sites are aging without being replaced by younger plants, leading to the need for promoting recruits - not just to replace older plants that may die, but to invigorate the mission blue populations by providing younger, nutrient-rich mission blue larval food sources. Interestingly, the lupine population that supports the most abundant mission blues in GGNRA - at Milagra Ridge - not only has the highest lupine cover, but also the greatest number of first-year seedlings as compared to other populations. Current fire policy for GGNRA allows for prescribed burns; other fire starts are suppressed (GGNRA FMP 2005).

In August 2004 a wildland fire started at GGNRA under Red Flag conditions (especially hot, dry weather with sustained winds), burning 7 acres of grassland and coastal scrub

habitat before it was suppressed. This burn, named the Lateral Fire, occurred within a 17-acre Mission blue habitat restoration project at Fort Baker in Marin County. The fire burned over six patches of lupine host plants, affecting approximately 300 individual plants. Following intensive weed control in the burn area supported through Burned Area Emergency Rehabilitation funds, post-fire monitoring revealed three significant effects on Mission blue habitat: 1) about half of the lupine plants known to host mission blue butterfly larvae survived the fire despite severe scorching and burning; 2) mission blue larvae caterpillars were found on the burned host plants; and 3) an increased number of lupines germinated within the fire area than in adjacent unburned habitat with host plants. Further monitoring in 2006 shows the density and vigor of lupine plants to be higher within the fire area than in the adjacent unburned site. In addition, the extent of fungal mycelium on individual plants within the burn area appear to be reduced, suggesting the fire - although it burned very quickly through these fine fuels - had enough residual heat to effect at least some of the pathogens affecting seeds and seedlings.

Park staff (NPS and GGNPC), the Fish and Wildlife Service, and butterfly experts have supported the idea of testing treatments to evaluate the feasibility of adding disturbance to our current management efforts. Similarly, staff with The Nature Conservancy at Cascade Head in Oregon have begun testing methods of maintaining and restoring disturbance-dependent species using various methods - including prescribed fire and mechanical treatments - within grassland habitat for the Oregon silverspot butterfly.

c) Objectives

1. Promote lupine population growth by testing various disturbance treatments (fire, manual/mechanical scrub removal, soil scraping).
2. Promote self-propagated expansion of existing lupine patches by locating test sites adjacent to existing lupine patches.
3. Promote population-wide Mission blue butterfly benefits by introducing a patchwork mosaic of disturbance treatments throughout Milagra Ridge that will mimic pre-Euro-American disturbance regimes and return selected areas to early successional communities, while allowing natural succession to take place elsewhere on the landscape.
4. Provide cost comparison of these treatment methods with costs of current methods of mission blue habitat enhancement.

d) Environmental Planning

This project will be conducted to avoid direct take of mission blue butterflies. However, treatment locations would occur within areas supporting nectar plants and dispersal corridors. Therefore, the project will be required to go through consultation with the US Fish and Wildlife Service, either through formal Section 7 consultation or a formal letter of concurrence. The USFWS is aware of this proposal and has expressed interest in keeping the project moving through the consultation process. We have initiated

communications with our local USFWS office by sending them the proposal, but have not yet heard back from them.

Depending on the level of consultation needed by USFWS, the park will determine the necessary NEPA compliance level. Similar projects in other areas of the park have been supported with a Categorical Exclusion to NEPA, when conducted in conjunction with an approved burn plan. The project would go through the park's project review process well in advance of implementation.

The shared Fire Management staffs (Fire Ecologist, Fire Education Specialist, and Fuels management specialists) of GGNRA and Point Reyes have offered assistance to facilitate implementation of this project in FY09, and have provided budget input to the proposal to cover seasonal/term staff time needed to complete the burn plan in a timely manner.

e) Principal Project Managers

Sue Fritzke, GGNRA, Supervisory Vegetation Ecologist
Bill Merkle, GGNRA, Acting Chief, Natural Resources
Christina Crooker, GGNPC Site Stewardship Ecologist

Study Implementation Plan

a) Approach and Methods

The Milagra Ridge in San Mateo County of GGNRA supports several patches of *L. albifrons* and *L. variicolor* mission host plants. The site is a habitat island, surrounded by housing developments and other urbanization. As noted above, scrub species have continued to invade the native grassland communities along this ridge, and the mission blue population is declining in all but a few key areas. Due to the isolated nature of Milagra, it is unlikely the site would be recolonized naturally if the mission blue population was extirpated. The site would be suitable for testing the efficacy of using fire and scrub species removal to stimulate lupine establishment and vigor because of the potential for stimulating germination of lupine seeds that have lain dormant in the seed bank as sites have been taken over by coastal scrub species.

Year 1

Experimental plots would be located adjacent to existing lupine patches to maximize chances of having an active seed bank. The experimental plots would not be placed within lupine patches to avoid the potential for direct take of butterflies, but would occur within the habitat for the species as defined by presence of nectar plants and dispersal corridors. The experimental patches would be selected based on proximity to lupine patches known to support butterflies (based on an ongoing monitoring program supported through the GGNPC and NPS). The overall goals would be to improve lupine extent and thus connectivity - to create a corridor to connect patches of lupine that support

butterflies, to provide more of a mosaic of grassland and scrub cover, and to place the plots in such a way as to minimize visual impacts to visitors hiking in the area.

Six to ten experimental plots would be located around 5 lupine patches per the criteria above. Each plot would have three treatments: a 5 x 15 m burn, a 5 x 15 m scrape plot, and a 5 x 15 m control. The positioning of the three treatments would be varied to make sure adjacent treatments or location adjacent to the lupine patch were not biasing results. These plot sizes were based on the observation that the disturbance area of an old Quarry site was about 75 square meters and that the Quarry supports higher densities of lupine than other areas so it can be inferred that a 75 square m disturbance could produce measurable differences in lupine habitat quality. The total project area to be treated by burning or scraping would be 1,500 square m.

The location of each study plot would be equidistant to the border of the lupine patch. Plots would be placed downslope from the patch to increase the chances of encountering a pre-existing seed bank due to gravitational seed dispersal. Each study plot would contain three subplots: one control and two treatments. The arrangement of these subplots within each study plot would be varied to reduce systematic influencing among the treatments and to control for variation across the slope/patches. Experimental treatments include burning, through use of small controlled burn plots, and soil scraping, which would be done by scraping off the top layer of soil, including scrub, using small heavy equipment.

Year 2

Following initial treatment, the plots would remain untouched for one year. After this incubation period, evaluation would be conducted by NPS and GGNPC staff, to determine the number of new *L. albifrons* or *L. variicolor* seedlings in each plot and the percent cover of invasive weeds. After quantifying invasive weeds, weeds would be controlled by NPS and GGNPC in a manner consistent with GGNRA policies. The amount of time and money that each treatment takes, from planning stages through final weed control would also be recorded.

Year 3

Final evaluation would be conducted by NPS and GGNPC staff, to determine the number of new *L. albifrons* or *L. variicolor* seedlings in each plot and the percent cover of invasive weeds, after which weeds would be removed. Additionally, mission blue larval and adult butterfly activities would be assessed to determine if potential new habitat areas were being inhabited. The amount of time and money that each treatment takes, from planning stages through final weed control would also be recorded.

Following evaluation of these treatments, a larger-scale effort in additional potential habitat areas at Milagra Ridge and other areas of the park would be conducted based on additional site criteria:

1) site sustainability - likelihood of site to remain open/scrub-free based on natural disturbance regimes, wind patterns

2) occurrence of host and nectar plants to sustain mission blue butterfly populations

Data Analysis

Data analysis would be used to assess the following: 1. Determine whether disturbance at the scale proposed in this study increases first and second-year lupine recruitment; 2. Determine whether the type of disturbance effects first and second-year lupine recruitment; 3. Determine if lupine recruitment varies drastically between sites, and therefore if site-specific factors need to be incorporated into further tests; 4. Assess the level of invasive species management necessitated by each disturbance regime; 5. Calculate the amount of time and money each treatment requires.

We would use ANOVA and repeated measures ANOVA analyses to test the first three questions. For questions four and five, we would create a table to compare time and money needed for each treatment.

Interpretive Component

The Fire Education Specialist will develop outreach materials regarding the prescribed fire aspects of the project, for distribution to local communities, interested public, and adjoining fire agencies.

Research and information materials about Mission Blue butterfly management in conjunction with this project will be developed and distributed through the existing NPS Natural Resources Education and Outreach Coordinator and the GGNPC Site Stewardship outreach program to local schools, volunteer groups, and communities, including those involved with long-term stewardship of the Milagra Ridge site.

Tasks, Organization, and Schedule

STAFFING

Year 1

GS-9 Term Part Time biologist to implement evaluation plots and treatments in conjunction with contributed time from Permanent NPS and GGNPC staff.

GS-7 Seasonal Biologist to assist with development of data collection associated with mission blue butterfly population increases.

GS-7 Term Fuels Management Specialist to develop Prescribed burn plan and assist with implementation. Note: Implementation of the burn plots would be done in conjunction with GGNRA and Point Reyes National Seashore Fire Management staff, and under the auspices of an approved burn plan. Pre-treatment and immediate post-treatment monitoring would be conducted by permanent park and GGNPC staff through non-project funds.

Year 2

GS-9 Term Part Time biologist to continue evaluating plots, weeding, and developing outreach materials through the GGNPC Site Stewardship Program and Fire Information staff, project status report in conjunction with contributed time from Permanent NPS and GGNPC staff.

GS-7 Seasonal Biologist to assist with implementation of data collection associated with mission blue butterfly population increases.

Year 3

GS-9 Term Part Time biologist to finish evaluating plots and weeding, developing final report with recommendations and updated outreach materials in conjunction with contributed time from Permanent NPS and GGNPC staff.

GS-7 Seasonal Biologist to assist with implementation of data collection associated with mission blue butterfly population increases.

PROJECT SUPPORT

The park will expend \$107,800 per year in base funds on staff time on Mission blue butterfly management (GS-12 vegetation ecologist - 0.2 FTE - \$17,000; GS-12 Wildlife ecologist - 0.2 FTE - \$16,000; GS-11 Park Botanist - 0.1 FTE - \$9,800; GS-9 Natural Resources Specialist - 0.5 FTE - \$33,150; GS-7 Biological Technician - 0.5 FTE - \$26,850) and contracts (\$5,000). It is estimated that 25% (\$26,950/year) will be focused on Milagra Ridge directly contributing to this project.

An additional \$270,200 in mitigation and restoration funds focused on exotic plant removal and host and nectar plant outplanting are provided annually to the NPS to compensate for habitat impacts related to Federal Highways projects, California Department of Transportation, Golden Gate Bridge District projects, and housing developments at Pacifica (adjacent to Milagra Ridge) that occur within or immediately adjacent to mission blue habitat, per USFWS Biological Opinion guidance. Ten percent of these funds (\$27,020/year) will go towards Milagra Ridge directly contributing to this project.

The GGNPC (non-federal) will provide \$105,000 annually for Mission blue habitat enhancement, stewardship and education, and monitoring focused at Milagra Ridge directly contributing to this project .

Volunteer contributions (non-federal) through the GGNPC Site Stewardship programs at Milagra Ridge average over 800 hours annually, which equates to approximately \$12,000 (value based on \$15 per hour).

In addition, the Data Manager (GS-11) for the San Francisco Bay Area I&M Network provides data support for butterfly monitoring, requiring about one week of his time annually (\$1,885).

This means that each year, the park will contribute \$26,950 in staff time and \$27,020 in mitigation and restoration funds for a total park contribution of \$80,850. The GGNPC (non-federal) will contribute \$105,000 annually for a total contribution of \$315,000. Volunteer contributions (non-federal) through the GGNPC Site Stewardship programs at Milagra Ridge will come to \$36,000 over the course of the project. And the Data Manager for the San Francisco Bay Area I&M Network contribution will be \$5,655.

In summary, the park is requesting \$129,000 in NRPP funds, and the park and its partners will be contributing \$518,565. This means the total cost of the project is \$647,565, and the park and its partners will be contributing 80% of the total cost of the project. The non-federal contribution is \$351,000 which is 54% of the total cost of the project.

QA/QC

To be developed.

Budget

BUDGET

Year 1 - \$43,000

GS-9 Term Part Time biologist = \$20,735 (approx. 0.38 FTE)

GS-7 Seasonal biologist = \$4,965 (approx. 0.11 FTE)

GS-7 Term Fuels Management Specialist = \$4,950 (approx. 0.12 FTE)

Contract with Butterfly researcher to develop site-specific research objectives = \$8,500

GSA Vehicle Rental = \$3,200 (8 months at \$400 each month) Note: Milagra Ridge is situated approximately 20 miles from GGNRA headquarters and 28 miles from GGNRA Natural Resources staff offices, necessitating a dedicated vehicle for the duration of the project season.

Equipment, Supplies, and Training = \$650: Digital camera for photo documentation of treatments (\$450); temporary signage materials (\$200)

Year 2 - \$43,000

GS-9 Term Part Time biologist = \$25,235 (approx. 0.44 FTE)

GS-7 seasonal biologist = \$5,115 (approx. 0.11 FTE)

Contract with Butterfly researcher = \$8,500

GSA Vehicle Rental = \$3,200

Training = \$950 - George Wright Society attendance and presentation (\$950)

Year 3 - \$43,000

GS-9 Term Part Time biologist = \$25,635 (approx. 0.44 FTE)

GS-7 seasonal biologist = \$5,265 (approx. 0.11 FTE)

Contract with Butterfly researcher = \$8,500

GSA Vehicle Rental = \$3,200

Supplies = \$400 ? Report printing and development of education outreach materials

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