

Recovery Plan Revision for San Bruno Elfin Butterfly (*Callophrys mossii bayensis*) and Mission Blue Butterfly (*Icaricia icariodes missionensis*)
[\[Click here to view document\]](#)

Original Approved: October 10, 1984
Original Prepared by: USFWS Portland

DRAFT AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for this species since the recovery plan was completed. In this recovery plan modification, we will reference the current criteria, document the proposed criteria amendments and information we considered in drafting proposed criteria amendments, and add species-specific recovery actions designed to aid in the recovery. The proposed criteria amendments are shown as an appendix that supplements the recovery plan, superseding only pages 43-46 (Part II: Recovery Outline and Prime Objective in the Step-down Outline) of the recovery plan.

For
U.S. Fish and Wildlife Service
Region 8
Sacramento, California

December 2018

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Regional Director, Pacific Southwest Region, Region 8,
U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXXXX

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

This draft amendment was prepared by the Sacramento Fish and Wildlife Office (SFWO) of the U.S. Fish and Wildlife Service (Service) and will be peer reviewed in accordance with the OMB Peer Review Bulletin following the publication of the Notice of Availability. We used information from our files, survey information and reports from monitoring and population augmentations at various localities of the species, and communication with species experts. Communication with species experts and information from monitoring reports were our primary sources used in this amendment. We developed the amended recovery criteria using the concepts described in the Species Status Assessment (SSA) framework (Service 2016), and framed the criteria in terms of the current threats to each species that are attributable to the Endangered Species Act's five listing factors. While a full SSA is beyond the scope of this recovery plan revision, the Service used the SSA framework to consider what species need to maintain viability by characterizing the status of the species in terms of its resiliency, representation, and redundancy (Wolf *et al.* 2015).

Resiliency

Resiliency describes the ability of populations to withstand stochastic events (arising from random factors). We can measure resiliency based on metrics of population health (*e.g.* population growth, numbers of individuals, demographic factors, etc.). Highly resilient populations are better able to withstand disturbances such as random fluctuations in reproductive rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

Representation

Representation describes the ability of a species to adapt to changing environmental conditions. Representation can be measured by the breadth of genetic or environmental diversity within and among populations and gauges the probability that a species is capable of adapting to environmental changes. The more representation, or diversity, a species has, the more capable it is to adapting to changes (natural or human-caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the species' geographical range.

Redundancy

Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations across the range of the species, as well as each population's resiliency, distribution, and connectivity, redundancy gauges the probability that the species has a margin of safety to withstand or the ability to bounce back from catastrophic events (such as a rare destructive natural event).

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list." Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995))

and a Government Accountability Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five delisting factors.

Recovery Criteria

See previous version of criteria in the original recovery plan on pages 43-45. [\[Click here to view document\]](#)

Synthesis

Overview

San Bruno elfin butterflies and mission blue butterflies are both small diurnally active and univoltine (one generation each year) butterflies. San Bruno elfin butterfly courtship, mating and reproduction are all carried out in the immediate space around the only known larval host plant, stonecrop (*Sedum spathulifolium*), within coastal grassland and low scrub of north-facing slopes within the fog belt where the larval host plant grows. Typical habitat for mission blue butterfly is coastal scrubland and grassland vegetation that contains at least one of the three larval host plants: silver lupine (*Lupinus albifrons*), manycolored lupine (*L. varicolor*), and summer lupine (*L. formosus*). Adults have also been observed using yellow bush lupine (*L. arboreus*) for reproductive activities (Crooker *in litt.* 2018). Adults feed on a variety of nectar flowers, but do not tend to wander far from areas containing the larval host plants.

Spatial Distribution

The San Bruno elfin butterfly is restricted to San Mateo County. Here we use metapopulations to describe the spatial distribution. A metapopulation of San Bruno elfin butterflies is defined as a population of populations, referred to here as colonies. Sites occupied by San Bruno elfin butterflies and containing both host and nectar plants must be separated from each other by at least 100 m to count as separate colonies, but must be within 800 m of each other to facilitate connectivity. Distances within and between colonies are based on the average and maximum recorded distance of movements by San Bruno elfin butterflies (Arnold 1983, Service 1984). San Bruno elfin butterfly metapopulations occur on San Bruno Mountain, the Montara Mountain region, and Milagra Ridge. The original recovery plan refers to colonies in the Montara Mountain area at Whiting Ridge and Peak Ridge. The Montara Mountain region is now known to include colonies along the Bay Ridge Trail in the San Francisco Peninsula Watershed (SFPW; Service 2010a) and in Rancho Corral de Tierra (Bennett and Russo 2016a).

Mission blue butterflies occur in metapopulations throughout Marin, San Francisco, and San Mateo Counties. A metapopulation of mission blue butterflies is defined as a population of populations. Previous publications use both the terms “population” and “colony” (e.g., Service 2010a), but we use “population” here because the mission blue butterflies are not concentrated in discrete, persistent patches like the San Bruno elfin colonies. Sites occupied by mission blue butterflies and containing both host and nectar plants must be separated from each other by at least 500 m to count as separate populations. Populations must have a maximum nearest-neighbor distance of 2.5 km, or be connected by stepping stones of suitable habitat with both host and nectar plants that are no more than 1 km apart. Separation distance between populations

was chosen because most mission blue butterflies traveled less than 500 m during a mark-recapture study, while maximum nearest-neighbor distance is based on a documented dispersal event of 2.5 km by a female (Thomas Reid Associates 1982). Stepping stone habitat distance is based on similar requirements for the closely related Fender's blue butterfly (*Icaricia icarioides fenderi*) (Service 2010b).

At the time of its listing in 1976, only two locations with populations of mission blue butterflies were known: Twin Peaks in San Francisco County and San Bruno Mountain in San Mateo County. The original recovery plan also included a population in the Marin Headlands at Fort Baker in Marin County. Since then, additional populations have been located in San Mateo and Marin Counties (Service 2010a). In the Marin Headlands, additional populations have been located west and north of Fort Baker (Coast Ridge Ecology 2017) as far north as Oakwood Valley (Arnold and Lindzey 2003). In San Mateo County, several metapopulations consisting of distinct populations extend from Milagra Ridge through Sweeney Ridge and south through the SFPW (Service 2010a, Coast Ridge Ecology 2018). Mission blue butterflies were last seen at Sweeney Ridge in 1987 and are believed to be extirpated from that location (Bennett and Russo 2016b). Additional observations of butterflies matching the mission blue butterfly phenotype have also been reported in both Marin and San Mateo Counties, including to the north and west of Oakwood Valley in Marin County (Bennett pers. comm. 2018, Wang 2018) and at Montara Mountain and Scarpet Peak in San Mateo County (Arnold *in litt.* 2013).

Because there are no geographic barriers to movement defining the northern and southern limits of its range, hybridization zones may occur between the closely related mission blue butterfly and the pardalis blue butterfly (*I. i. pardalis*). The mission blue and pardalis blue butterfly subspecies are differentiated by phenotypic characteristics (Arnold and Lindzey 2003, Shapiro and Manolis 2007), although it is unclear if the differences in characters between the two subspecies are a result of genetic, environmental, or other factors. Oakwood Valley in Marin County has been proposed as a northern hybrid zone (Service 2010a). Phenotypes resembling each subspecies, as well as intermediate phenotypes, have been documented in this location, with most observations more closely matching the mission blue butterfly phenotype (Arnold and Lindzey 2003). Similarly, phenotypic observations suggest that butterflies matching the mission blue butterfly phenotype occur in the SFPW (Arnold *in litt.* 2018). Historically, pardalis blue butterfly specimens have been collected from the SFPW (Steiner 1990), but mission blue butterflies have been monitored in this region intermittently since 1977 and annually since 2001 (except for 2002; Arnold *in litt.* 2018, Service 2010a, Coast Ridge Ecology 2018). For now, we consider Oakwood Valley to be the northern hybrid zone and the SFPW to be the southern hybrid zone and the spatial distribution to include populations as described above (Service 2010a), with the caveat that photographs of butterflies with intermediate phenotypes or more closely resembling the pardalis blue butterfly originate from Marin, San Francisco, and San Mateo Counties (Arnold and Lindzey 2003).

Threats

Threats to the San Bruno elfin and mission blue butterflies can be categorized according to the five listing factors defined in section 4 of the Endangered Species Act. At the time of listing, threats to both species were centered on destruction, modification, or curtailment of habitat

through private development (Factor A). Because the majority of the butterfly metapopulations are on publicly protected lands, suburban development and habitat fragmentation are no longer considered an imminent threat to the species, although populations on private land are still at risk of habitat loss from development (Service 2010a). Ownership of lands occupied by San Bruno elfin and mission blue butterflies is summarized in the 5-year review (Service 2010a), with the exception of Rancho Corral de Tierra which is managed by the Golden Gate National Recreation Area (GGNRA) through the National Park Service (NPS).

The 2010 5-year review provided an updated assessment of threats for both the San Bruno elfin and mission blue butterflies (Service 2010a), all of which are still current. For mission blue butterflies, habitat degradation via encroachment of coastal chaparral, coastal scrub succession, and non-native grasses and associated thatch build-up is now considered the most serious threat (Factor E; Service 2010a). At San Bruno Mountain, historically home to the largest metapopulation of mission blue butterflies, grassland acreage has decreased from 1419 acres to an estimated 1180 acres because of encroachment or succession since the Habitat Conservation Plan (HCP) was approved in 1983 (Weiss *et al.* 2015). The San Bruno Mountain Habitat Management Plan estimated that grassland habitat was being converted to coastal scrub at a rate of 5 acres/year (TRA Environmental Sciences 2007). Public infrastructure projects (Factor A) are the most serious current threat to the San Bruno elfin butterfly, and also threaten the mission blue butterfly (Service 2010a). Additional threats to both species identified in the previous status review (Service 2010a) but that are new since the original recovery plan was published include: poaching (Factor B); parasitism of larvae (Factor C), potentially exacerbated by the presence of the Argentine ant which has the potential to disrupt the facultative myrmecophile (an animal that lives with ants) relationship between the butterflies and native ants; small population size (Factor E); and climate change (Factor E). Updated threats to the San Bruno elfin include non-native plants and grazing (Factor E), both listed in the original recovery plan for the mission blue butterfly but updated in the 2010 5-year review to include the San Bruno elfin butterfly as well.

Another major threat recognized in the status review for the mission blue butterfly is a fungal pathogen (*Colletotrichum lupini*) that primarily infects the host plant silver lupine (Factor A). The fungal pathogen has resulted in massive die-offs of silver lupine, especially in El Niño years. Following population declines correlated with the fungal pathogen, population augmentation of mission blue butterflies to Twin Peaks began in 2009 and to Milagra Ridge in 2017, with translocations moving butterflies from San Bruno Mountain to the populations being augmented (Wayne *et al.* 2009, GGNRA 2018).

Several threats have been recognized since publication of the last 5-year review. Herbicide use (Factor E) poses a potential threat to both species if used in proximity to occupied habitat (*e.g.* Varela *et al.* 2008, Service 2009). Vole herbivory (Factor A) threatens the host plants of the mission blue butterfly, with herbivory in some years causing severe declines in available lupine (Arechiga pers. comm. 2018, O'Brien pers. comm. 2018, Wayne pers. comm. 2018). Population monitoring may pose a threat to San Bruno elfin butterflies because of the potential for monitors to inadvertently damage habitat and/or host plants (Factor B)(Bennett and Russo 2016a, Arechiga pers. comm. 2018).

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the Act are no longer necessary and the San Bruno elfin butterfly or mission blue butterfly may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists). Downlisting is the reclassification of a species from an endangered species to a threatened species. The term “endangered species” means any species (species, sub-species, or distinct population segment) which is in danger of extinction throughout all or a significant portion of its range. The term “threatened species” means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made “solely on the basis of the best scientific and commercial data available.” Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when we would anticipate that an analysis of the species’ status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan, which triggers rulemaking. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

Although the original recovery plan contains primary and secondary objectives and states when reclassification can be considered, it does not contain objective, measurable recovery criteria. Because the original objectives do not clearly define the terms “secure”, “colonies”, and “self-sustaining”, we are not carrying over any of the objectives verbatim in this revision.

We provide both downlisting and delisting criteria for the San Bruno elfin butterfly and mission blue butterfly, which will supersede those included in the 1984 San Bruno Elfin & Mission Blue Butterfly Recovery Plan, as follows:

San Bruno elfin butterfly

Downlisting Recovery Criteria

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Present or threatened destruction, modification, or curtailment of the habitat or range of the San Bruno elfin butterflies due to private development projects no longer poses as serious of a threat to these species as they did at the time of listing (Service 2010a). Public infrastructure development, however, is a serious threat that may destroy, modify, or curtail the habitat or range of the species. Exotic invasive plants and habitat loss due to succession are considered with Factor E in order to be consistent with organization of the five-factor analysis in the 5-year review.

In order to downlist the San Bruno elfin butterfly to threatened status, threats to species' habitat must be reduced. This reduction will have been accomplished if the following have occurred:

- A/1** Sites supporting metapopulations of the San Bruno elfin butterfly across the historic range of the species (see E/1 below), including San Bruno Mountain, Milagra Ridge, and the Montara Mountain region, must be managed to ensure the maintenance of habitat that includes a diversity of nectar plants and the larval host plant *Sedum spathulifolium* and to control threats. Long-term maintenance of the sites must be financially sustainable. Use of herbicides, mowing, burning, or livestock grazing in management should be implemented with appropriate methods and timing to avoid impacts to the butterfly and its nectar and host plants.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Although poaching and damage to habitat during population monitoring are now considered to be threats to the San Bruno elfin butterfly populations, they are unlikely to be a significant factor in population decline and no new recovery criteria have been developed for this factor. However, please see "Site Specific Recovery Actions" for recommendations regarding San Bruno elfin butterfly population monitoring.

FACTOR C: Disease or Predation

Although insect parasitism and rodent predation of larvae are considered threats, they are unlikely to be significant factors in population decline and no new recovery criteria have been developed for this factor.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms is not a current threat. Therefore, no new recovery criteria have been developed for this factor.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

The following other natural or manmade factors that may affect the continued existence of the species: small population size, exotic invasive plants, recreation impacts, climate change, habitat loss due to succession, and pesticide use. Robust and redundant occurrences are needed across the species range to ensure that the species persists in light of these threats. This will have been accomplished when the following have occurred:

- E/1 Sites support metapopulations across the historic range of the species, including San Bruno Mountain, Milagra Ridge, and the Montara Mountain region. San Bruno Mountain must include a minimum of 7 colonies, the Montara Mountain region must include a minimum of 5 colonies (including Peak Mountain and Whiting Ridge), and Milagra Ridge must include a minimum of 2 colonies.¹ Each of these metapopulations must contain an average of at least 30 adults with a stable or increasing population trend for a minimum of 10 years.²
- E/2 Habitat patches in sites supporting colonies in E/1 have a stable or increasing areal extent over the same 10-year period of population growth.³

Delisting Recovery Criteria

The San Bruno elfin butterfly will be considered for delisting⁴ when, in addition to the downlisting criteria:

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

No additional recovery criteria have been established for this factor.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No additional recovery criteria have been established for this factor.

¹ The original recovery plan stated as a primary objective that “Secure, self-sustaining colonies of this species are established and/or re-established on Milagra Ridge, Montara Mountain, Peak Mountain, and Whiting Ridge, and colonies on San Bruno Mountain are secure. Numbers of colonies necessary for reclassification of the San Bruno elfin butterfly to threatened are 7 on San Bruno Mountain, 5 on Montara Mountain (including Peak Mountain and Whiting Ridge), and 2 on Milagra Ridge.” Note that SFPW monitoring includes subpopulations along Whiting Ridge and Fifield Ridge, which were originally lumped with Montara Mountain. Multiple colonies within metapopulations are recommended to ensure redundancy.

² This is the number of adults considered necessary for resiliency in a congener (member of the same genus), the frosted elfin butterfly (*Callophrys irus*)(Service 2018). A stable or increasing population trend over a 10-year period is recommended for another member of the Lycaenidae family, the Fender’s blue butterfly (Service 2010b), and also among other butterfly families (e.g. Behren’s silverspot butterfly *Speyeria zerene behrensii* (Service 2015)).

³ This criterion helps to protect against scrub encroachment.

⁴ The original recovery plan stated that: “Delisting of these species will be contingent upon protection, maintenance, and/or expansion of current colonies and establishment of additional colonies.”

FACTOR C: Disease or Predation

No additional recovery criteria have been established for this factor.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

No additional recovery criteria have been established for this factor.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

- E/1 The metapopulations at San Bruno Mountain, Milagra Ridge, and the Montara Mountain regions must include on average a minimum of 18, 4, and 7 occupied colonies, respectively, with overall stable or increasing population trends over a 20-year period.
- E/2 Habitat patches in sites supporting colonies in E/1 have a stable or increasing areal extent over the same 20-year period of population growth.⁵

Mission blue butterfly

Downlisting Recovery Criteria

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Although the reduction and fragmentation to habitat is no longer the primary threat to mission blue butterflies, public infrastructure development and private development are current threats to the species. Additionally, a fungal pathogen that primarily affects the host plant silver lupine, and vole herbivory of the host plants, are threats to species habitat. Modification of habitat through coastal scrub succession and non-native grass invasion are considered in Factor E. In order to downlist the mission blue butterfly to threatened status, threats to species' habitat must be reduced. This reduction will have been accomplished if the following have occurred:

- A/1 Sites supporting metapopulations of the mission blue butterfly (see E/1 below) must be managed to ensure the maintenance of habitat that includes host plants and a diversity of nectar plants. Sites shall have in place a management plan approved by the U.S. Fish and Wildlife Service that supports grasslands and controls other threat to the species and its habitat. Long-term maintenance of the sites must be financially sustainable. Management tools including herbicides, mowing, burning, or livestock grazing should be implemented with appropriate methods and timing to avoid impacts to the butterfly and its nectar and host plants.
- A/2 Monitoring must determine that all sites support populations of silver and summer lupine (*Lupinus albifrons* and *L. formosus*), including a variety of size and/or age classes.⁶

⁵ This criterion helps to protect against scrub encroachment.

⁶ Species experts recommended multiple species of lupine as necessary for recovery.

Monitoring over a 15-year period⁷, which includes at least two years that have above average local rainfall⁸, must demonstrate natural recruitment of both lupine species and an average of 250 lupine plants/hectare.⁹ Mission blue butterflies must be documented using both species of lupine.¹⁰

A/3 Suitable habitat has a minimum of 250 nectar plants/hectare.¹¹

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Although poaching is now considered a threat to the mission blue butterfly populations, it is unlikely to be a significant factor in population decline and no new recovery criteria have been developed for this factor. However, we recommend captive breeding to ensure source stock for population augmentation, as discussed below in “Site Specific Recovery Actions.”

FACTOR C: Disease or Predation

Although insect parasitism and rodent predation of larvae are considered threats, they are unlikely to be significant factors in population decline and no new recovery criteria have been developed for this factor.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms is not a current threat. Therefore, no new recovery criteria have been developed for this factor.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

The following other natural or manmade factors that may affect the continued existence of the species: small population size, exotic invasive plants, recreation impacts, climate change, habitat loss due to succession, and pesticide use. Habitat loss due to succession is widely considered the most serious threat to the species. Robust populations are needed across the species range to ensure that the species persists in light of these threats. This will have been accomplished when the following have occurred:

⁷ A 15-year period showing a stable population is recommended for threatened congeners (member of the same genus) Kincaid’s lupine (*Lupinus sulphureus* ssp. *kincaidii*)(Service 2010b) and Tidestrom’s lupine (*L. tidestromii*)(Service 1998).

⁸The criterion specifies at least two years with above average rainfall because the fungal pathogen that threatens silver lupine is most prevalent following wet, El Niño years.

⁹ Recommended lupine cover in the habitat restoration guidelines in the San Bruno Mountain Habitat Management Plan is 2.5% over 0.125 acre or 100 plants in high quality patches, with approximately one high quality patch per acre (TRA Environmental Sciences 2007). This translates to 250 plants/hectare. Maintaining a healthy population of host plants will help to protect against threats posed by non-native grasses.

¹⁰ Using multiple host plants will add to population representation.

¹¹ This is the approximate recommended number of nectar plants in the San Bruno Mountain Habitat Management Plan, which specifies that there should be 100 nectar plants/acre (TRA Environmental Sciences 2007). Nectar flower abundance is also a criterion for the closely related Fender’s blue butterfly (Service 2010b).

- E/1** Metapopulations are maintained or re-established in suitable habitat within the historical range of the species, including at least one metapopulation each in Marin, San Francisco, and San Mateo Counties.¹² At least one metapopulation must be maintained on San Bruno Mountain (San Mateo County) and must contain populations across Guadalupe Hills, Southeast Ridge, Radio Ridge, and Reservoir Hill.¹³ Metapopulations in Marin and San Mateo Counties must contain at least three populations.¹⁴
- E/2** Patches of suitable habitat must be at least 6 hectares (15 acres)¹⁵ to support populations designated in E/1. Suitable habitat patches must have stable or increasing grassland acreage over at least a 25-year period, with management focused on maintaining larger habitat patches. For each site, woody vegetation should make up no more than 15% of the absolute vegetative cover.¹⁶ San Bruno Mountain must have a minimum of 1200 acres of grassland as designated in the Habitat Management Plan (TRA Environmental Sciences 2007).
- E/3** Population viability analysis determines that mission blue butterflies have a 90% probability of persistence over a 25-year period across all three counties of the historic range as referred to in E/1.¹⁷ Probability of persistence may be based on varying numbers of metapopulations or populations within each county.

Delisting Recovery Criteria

All downlisting criteria remain applicable for delisting, and are to be extended to include the populations mentioned in delisting criterion A/1. The mission blue butterfly will be considered for delisting¹⁸ when, in addition to the downlisting criteria:

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

No additional recovery criteria have been established for this factor.

¹² The original recovery plan stated that “*Reclassification of the mission blue butterfly to threatened status can be considered when secure, self-sustaining colonies of this species are established and/or reestablished on Twin Peaks and Fort Baker (one colony at each site) and when colonies on San Bruno Mountain (as noted in the HCP) are secure.* Multiple metapopulations across the species range ensures redundancy.

¹³ These San Bruno locations are mentioned as colony locations necessary for reclassification in the primary objective of the original recovery plan (Service 2010a). San Bruno Mountain is specified within San Mateo County because it is central in the historic range of the species.

¹⁴ Having multiple populations ensures redundancy. Multiple populations are not required in San Francisco County because of the small areal amount of suitable habitat.

¹⁵ This is the minimum patch size for an isolated population to persist in the absence of immigration from other patches in the Fender blue butterfly Recovery Plan, based on a conservative approach to studies showing a minimum patch size of 2-6 hectares (Service 2010b).

¹⁶ Limiting woody vegetation to 15% absolute vegetative cover is part of the habitat quality guidelines for the closely related Fender’s blue butterfly (Service 2010b).

¹⁷ Population viability analysis can be used to determine minimum or average population sizes to ensure persistence. This criteria is modelled after methodology used to develop minimum population sizes necessary for recovery of the closely related Fender’s blue butterfly (*Icaricia icarioides fenderi*)(Service 2010b). This probability of persistence was chosen to ensure resiliency.

¹⁸ The original recovery plan states that “*Delisting of these species will be contingent upon protection, maintenance, and/or expansion of current colonies and establishment of additional colonies.*”

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No additional recovery criteria have been established for this factor.

FACTOR C: Disease or Predation

No additional recovery criteria have been established for this factor.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

No additional recovery criteria have been established for this factor.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

E/1 Metapopulations are maintained or re-established in suitable habitat within the historical range of the species, including at least one additional metapopulation in Marin County¹⁹ and three additional metapopulations in San Mateo County.²⁰

E/2 Population viability analysis determines that mission blue butterflies have a 95% probability of persistence in Marin, San Francisco, and San Mateo Counties over a 100-year period. Probability of persistence may be based on varying numbers of metapopulations or populations.²¹

All classification decisions consider the following five factors: (1) is there a present or threatened destruction, modification, or curtailment of the species' habitat or range; (2) is the species subject to overutilization for commercial, recreational scientific or educational purposes; (3) is disease or predation a factor; (4) are there inadequate existing regulatory mechanisms in place outside the ESA (taking into account the efforts by states and other organizations to protect the species or habitat); and (5) are other natural or manmade factors affecting its continued existence. When delisting or downlisting a species, we first propose the action in the *Federal Register* and seek public comment and peer review. Our final decision is announced in the *Federal Register*.

Rationale for Recovery Criteria

We have amended the recovery criteria for the San Bruno elfin butterfly and mission blue butterfly to include objective, measurable downlisting and delisting criteria that incorporate the biodiversity principles of resiliency, redundancy, and representation (Service 2016) and threats addressed under the five factors. The amended criteria were developed based on the Service's

¹⁹ The current range of mission blue butterflies is considered to include populations in the Marin Headlands in addition to Fort Baker, as well as a population in Oakwood Valley (Service 2010a). Observations in other locations (e.g. Tennessee Valley) suggest that other areas in the county may support mission blue butterflies.

²⁰ Mission blue butterflies have been documented in San Mateo County at Milagra Ridge, Sweeney Ridge, and the SFPW, which could all support metapopulations.

²¹ Population viability analysis can be used to determine minimum or average population sizes to ensure persistence. This criteria is modelled after methodology used to develop minimum population sizes necessary for recovery of the closely related Fender's blue butterfly (*Icaricia icarioides fenderi*) (Service 2010b). This probability of persistence was chosen to ensure resiliency.

current understanding of the species needs and requirements. This understanding includes information gathered since the original recovery plan was published, such as more recent information about population status and trends, along with an updated understanding of the threats acting on the species, as summarized in the synthesis above. The criteria presented are based on the reduction of threats to the species, and they include a temporal aspect to ensure that the species are resilient to expected variation within a reasonable time frame.

ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS

Actions identified in the step-down outline in the original recovery plan are still applicable towards meeting these amended recovery criteria. In certain cases, actions may be expanded to include more recently discovered San Bruno elfin butterfly colonies and mission blue butterfly populations.

The actions identified below are those that, based on the best available science, are necessary to bring about the recovery of the listed species in this amendment and ensure their long-term conservation. However, these actions are subject to modification as might be indicated by new findings, changes in species status, and the completion of other recovery actions.

Key to Terms and Acronyms Used in the Recovery Action Narrative and Implementation Schedule:

Priority numbers are defined per Service policy (Service 1983) as:

- Priority 1:** An action that must be taken to prevent extinction or to prevent a species from declining irreversibly.
- Priority 2:** An action that must be taken to prevent a significant decline of the species population/habitat quality or some other significant negative impact short of extinction.
- Priority 3:** All other actions necessary to provide for full recovery of the species.

The priority assigned to each action is specified within parentheses at the end of the description.

The numeric recovery priority system follows that of all Service recovery plans. Because situations change over time, priority numbers must be considered in the context of past and potential future actions at all sites. Therefore, the priority numbers assigned are intended to guide, not to constrain, the allocation of limited conservation resources.

- 1. Establish captive breeding of mission blue butterflies at a captive breeding facility.** This action will assist in the recovery of mission blue butterflies by further protecting existing populations and allowing for population augmentation in an effort to maintain and re-establish self-sustaining populations to persist in the long-term. (Priority 1)
- 2. Conduct a population genetics study of the mission blue butterfly across the proposed**

range. This study will aid in genetic management at the captive breeding facility, and can more clearly define the boundaries of the species range. (Priority 3)

- 3. Conduct population viability analyses for metapopulations of the mission blue butterflies.** This action will assist in the recovery for the species by determining the target populations, minimum populations, or occupancy at each population or metapopulation site needed to achieve recovery criteria. (Priority 3)
- 4. Coordinate among habitat managers and regulatory agencies to establish recommended San Bruno elfin butterfly monitoring protocols.** Concern about damage to host plants and habitat should be considered when determining monitoring activities and frequency. (Priority 3)
- 5. Investigate biology of San Bruno elfin butterflies to guide population estimates.** Studies on oviposition rates and larval survival will help determine how to estimate adult populations from larvae monitoring. (Priority 3)

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