CALLIPPE SILVERSPOT BUTTERFLY

Speyeria callippe callippe
USFWS: Endangered
CDFG: None

Species Account
Background

Status and Description. The Callippe silverspot butterfly (*Speyeria callippe callippe*) was federally listed as endangered on December 5, 1997 (62 FR 64306). A member of the brush foot family (Nympahlidae), the species (*S. callippe*) was described and named in 1852 by J.A. Boisduval from specimens collected in June by Pierre Lorquin in San Francisco, California (dos Passos and Grey 1947; Anonymous 1980).

The Callippe silverspot (*S. c. callippe*) is a relatively large butterfly with a wingspan of approximately 2-2.5 inches (Anonymous 1980; Black and Vaughan 2005). The upper wings are a dull yellowish-brown with a sooty coloration at their base and extensive black spots and lines. The under side of the wings are brown, orange-brown, and tan with black lines and distinctive black and silver spots (Black and Vaughan 2005).

Taxonomic Remarks. *S. c. callippe* is one of 16 recognized subspecies within the much wider ranging *S. callippe.* Similar to other species within the genus *Speyeria*, *S. callippe* exhibits considerable phenotypic variability throughout its range (western North America), hence the recognition of 16 subspecies (dos Passos 1964; Miller and Brown 1981). Morphological variation between subspecies was speculated by several researchers to be clinal (a gradient of continuous variation in phenotypic or genetic characters) (Hovanitz 1941, 1943; Howe 1975; Moeck 1957 and Sette 1962 as cited in Arnold 1985). A cline can result when natural selection favors different genotypes in different environments and there is gene flow (migration) between them. For the subspecies *callippe callippe*, it has been speculated that the darker coloration, a distinguishing characteristic, is an adaptation to living in foggy areas (such as San Francisco and southwestern Solano County) enabling them to warm up more quickly on foggy days. In this case, the environmental change occurs gradually, rather than suddenly. Correspondingly, character changes that distinguish the subspecies also occur gradually, making exact geographic divides between the subspecies arbitrary (Anonymous 1980).

Western Solano County is an area of overlap and intergradation of the characters that distinguish three subspecies: *callippe callippe*, *callippe comstocki*, and *callippe liliana* (Noss et al. 2002). The darker color morph, representative of *callippe callippe*, occurs less frequently among populations from southwestern Solano County than those from San Bruno Mountain (San Mateo County) and more frequently than it occurs among populations of the other subspecies (*callippe*

comstocki and *callippe liliana*). Based on the higher frequency of the darker color morph and visual similarity of silverspot butterflies the western hills of Solano County, the USFWS treats these populations as the listed subspecies *callippe callippe* at least until additional taxonomic work proves otherwise (USFWS 1999).

Range. *S. c. callippe* was only known from 14 populations in the San Francisco Bay Region. Their historic range included the Inner Coast Range on the eastern shore of the San Francisco Bay from northwestern Contra Costa County south to the Castro Valley area in Alameda County. On the west side of the Bay, it ranged from San Francisco south to the vicinity of La Honda in San Mateo County. Currently, extant colonies are known only from San Bruno Mountain in San Mateo County, a city park in the Oakland Hills in Alameda County and the hills between Vallejo and Cordelia in Solano County. It is currently only known from 7 CNDDB records on San Bruno Mountain in San Mateo County (CNDDB 2008), and from a few non CNDDB records in Solano County (Murphy and Wiess 1990).

Occurrence in the Plan Area. In Solano County, the Callippe silverspot butterfly (*Speyeria callippe callippe*) is primarily associated with grasslands within the southwestern hills of the Inner Coast Range, primarily in the Tri-City/County Planning area. Suitable grassland habitat, containing ridgelines and hilltops, also occur in the Potrero Hills region of the Valley Floor; however, there are no records for this species in this area. The status, distribution and population levels of the Callippe silverspot in Solano County, is largely unknown. As mentioned above, the darker color morph, representative of *callippe callippe*, has been documented in the hills between Vallejo and Cordelia, but may be hybridized with other subspecies. Additional potential areas of concern include Nelson Hill in Cordelia, and the Rockville Hills area, although there are currently no records from these areas.

Associated Covered and Special Mamagement Species. The primary species that will incur additional benefits from this conservation strategy is the California red-legged frog. However, all other species associated with the Inner Coast Range Natural Community will benefit from this conservation strategy to varying degrees.

Narrative Conceptual Model

This section provides a preliminary narrative conceptual model for the Callippe silverspot butterfly. This model will be used to guide the conservation and management programs. Following concepts developed by Atkinson et al. (2004), the essential ecological processes, habitat variables and anthropogenic threats, described in the model, are considered pressures. Pressures are agents that either promote or inhibit change in the state of the environment (Atkinson et al. 2004). Similar to the conceptual models from previous sections, this model is divided up into three categories, lifecycle and biology, land use practices and the consequences of land use practices.

Life Cycle and Biology. The adult flight period is from mid May to the end of July, depending on environmental conditions. The females lay eggs on the dried stems and leaves of the larval host plant, Johnny jump-up (*Viola pedunculata*; also known as wild pansy or wild violet). After hatching, the larvae (caterpillar) immediately spin a silk pad on which they remain through the summer and into the winter. After the late winter rains have begun and the wild violet plants have started to grow, the larvae become active and feed on the new plant growth. Following this activity, the larvae, which are

dark-colored and have branched spines covering their backs, soon pupate and then emerge as adult butterflies in May and June. The adult individuals then only live for approximately 3 weeks.

Breeding and Courtship behavior. The adult butterflies are strong fliers and to encounter mates, males wait at the tops of hills for female butterflies. To search for females, the males fly back and forth over the tops of the hills. Once a female arrives at the top of a hill, courtship and then mating occurs. After mating the female flies in search of host plants for oviposition and the male waits for another female. This behavior is called hilltopping and is a mechanism by which the males and females find each other for the purpose of reproduction.

An assessment of long term (1982 to 2000) butterfly monitoring data for San Bruno Mountain confirmed the importance of topographic relief for Callippe silverspot (Longcore et al. 2004). Males were in slightly greater proportion within the 25-m buffer ridgeline zones (41.2% vs. 37.8%) while females were present in slightly lower proportion than observed in the population (34.6% vs. 40.6%). The percentage Callippe silverspot butterflies of unknown sex was greater within ridgeline buffers than in the population as a whole (24.2% vs. 21.4%). These results are consistent with the observation that male Callippe silverspot butterfly use hilltops more than females. Other areas on San Bruno Mountain with concentrated use were in areas with abundant nectar sources and larval host plants.

Courtship seems to entail a joint flight by the male and female in which they fly in an ascending or spiral fashion or an otherwise circular flight pattern. Copulation is initiated in the air, perched on a shrub or grass, or on the ground. Copulation was observed to last from 4 minutes to over an hour (TRA 1982). At the end of copulation, the pair either separate and fly off or fly off together and then separate. Along with the spermatophore, packet containing the sperm, the male leaves a plug that hardens and provides a barrier to additional insemination by other males.

Oviposition Behavior and Locations. Callippe silverspot butterflies have been observed to lay eggs on the drying remains of violet or on bare ground or vegetation near the violet including dry grass, dry filaree (*Erodium* spp.), or other mixed plant debris. On San Bruno Mountain, the eggs were usually laid within three inches of a violet, but none were observed to be laid directly on the violets (TRA 1982). TRA (1982) provides the following account of the typical oviposition behavior of the Callippe silverspot butterfly.

> *"The gravid female slowly searches a suitable site through a series of low (2 inches to 1 foot) erratic but determined Ahopping@ flights. She lands repeatedly on the ground, walking and crawling between, over, and under shrubs, grasses, and weeds, as well as exploring patches of soil and holes in the ground. She often trembles in a distinctive manner, walking about deliberately and repeatedly probing the substrate with her abdomen. She may not deposit an egg in this location before continuing with her search. The buff colored eggs are laid singly, and are always somewhat hidden under plant debris so that they are difficult to find. Sunning, pumping and/or resting may also occur during this sequence, but nectaring was never observed during an egg laying sequence."*

Eggs and Larvae. Once the eggs are laid, they take approximately a week to hatch. After hatching, the larvae eat their egg shells, spin a silken pad on which they rest, and then enter into a long summer and winter diapause. The highest mortality rate occurs during this time. In the

spring, when the violets begin to produce new growth and flower, the first instar larvae exit their diapause and begin to feed. At first they feed on the violet petals and later various other parts of the plant. Feeding occurs in the late afternoon and evening to avoid daytime predation. During the day they crawl off of the violets. The larvae go through five instars before pupating in May. The pupal stage lasts about two weeks (Arnold 1981).

Habitat Requirements. The Callippe silverspot butterfly habitat requirements are larval food plants (violet or Johnny jump-up), adult nectar plants, and hill tops. These three habitat components need to be relatively close to each other to support Callippe silverspot butterflies. The known butterfly sites within the Plan Area consist of an aggregation of dense patches or stands of Johnny-jump-up interspersed with grassland vegetation and typically occur along ridgelines of the steeper hill slopes. The known or suspected breeding areas contain dense stands of the host plant over approximately a 40-acre area.

In these known areas, the violets grow at a density that varies from a high of approximately 25 percent cover to less than one percent cover. On San Bruno Mountain, assessments of violet stands over the 18 years of monitoring on the Northeast Ridge, have documented that the range of host plant densities was approximately 500 - 1500 plants per acre (plants equals clumps that appear to be individual units from above) (Korbernus 2003). Presumably, the density of violet has to be relatively high to support Callippe silverspot butterflies. Some violet plants are large enough to support the herbivory of one caterpillar while others are too small and would be consumed by the caterpillar. In addition, caterpillars feed at night and leave the plant during the day such that they may feed on adjacent plants on subsequent nights. Stands that support one violet in a square meter are probably too sparse to support populations of Callippe silverspot butterflies, but large plants may support an occasional larva. More importantly, smaller more isolated patches may be important in dispersal and connectivity between core breeding sites.

Eggs and Larvae Habitat. The larval host plant, Johnny Jump-up, provides the substrate on which eggs are laid and also provides the necessary food for the developing larvae. Johnny Jump-up is a low-growing plant with yellow flowers which blooms from early January through April. By mid-summer, the flowers and the leaves are dried up and difficult to either find or identify. Johnny Jump-up can be found in a diversity of grassland types throughout the state, but in Solano County the densest stands occur on shallow, rocky or thin soils where the annual introduced grasses are less dense (S. Forman pers. obs.); however, this correlation has not been observed throughout the plants range. For example, LSA Associates (1981), in a study on San Bruno Mountain, did not find any strong relationships between the abundance of the violet and total soil depth, total soil moisture storage capacity or the soil moisture storage capacity in the top nine inches, soil acidity, or clay content. In addition, this study found no relationships between micro climatic measurements and violet distribution. Additional studies by Thomas Reid Associates (1982) found no correlation between the violet's cover, size, and insect damage with grass height, exposure, slope, and occurrence of other plant species (TRA 1982).

Adult Habitat. The Callippe silverspot butterfly is flexible in its nectaring requirements. It is able to change from one suitable flower to another depending on availability. A wide variety of plants are used for nectaring, including native and exotic species although members of the Asteraceae are preferred. The most frequently used nectar plants on San Bruno

Mountain included thistles (*Cirsium* spp.), Italian thistle (*Carduus* spp.), milk thistle (*Silybum* spp.), and coyote mint (*Monardella villosa*) (TRA 1982). Nectaring time varies throughout the day and is affected by weather conditions. Under average conditions nectaring takes place all day, but on hot days, it is reduced while the silverspots remain in shady areas. During windy or cold weather, nectaring is greatly reduced. The butterflies nectar in conjunction with a variety of activities such as hilltopping, traveling, and sunning. They do not, however, nectar while laying eggs.

Dispersal Habitat. The Callippe silverspot is a relatively large butterfly and is a strong flyer. Their flight is usually low to the ground (1-3 meters above the ground or brush), fast and direct (from one place to another as opposed to erratic or a non-directional, wandering flight that zig-zags, goes between and around shrubs, or returns to the location where the flight started). Thomas Reid Associates conducted a mark-recapture study of Callippe silverspot butterflies on San Bruno Mountain (TRA 1982) and found that approximately 95% of the recaptures were made within 4,000 feet of the first capture. Eight males and 4 females, 5 and 6% of the marked population, traversed distances between 4,800 and 7,400 feet and 4,600 and 6,200, respectively. Based on these results, they concluded that movement between colonies is more than enough to consider the San Bruno Mountain population a genetically cohesive unit (TRA 1982). They exhibit a preference for relatively clear corridors, unobstructed with bushes, shrubs, buildings or any other vertical projections. Major and minor barriers to movement include large residential areas, dense plantings of tall trees, major roads (four lanes or more), burned areas and dense brush or scattered trees.

Fire. Fire is recognized as a major force shaping the ecology of California grasslands (D'Antonio 2000). Fire reduces the amount of thatch left by introduced annual grasses and can promote the growth of native plants (TRA 1982). Periodic fires are an important factor in maintaining the grassland and coastal prairie habitat of the Callippe silverspot butterfly (D'Antonio and Vitousek. 1992). Without fire or grazing, succession may eliminate the foodplants of the larvae of this butterfly (Orsak 1980, Hammond and McCorkle 1984). However, the immediate affects of fire on Callippe silverspot butterfly populations is not well known. Fire was implicated in the extirpation of a population of bay checkerspot butterflies (*Euphydryas editha bayensis*) in the mid 1980's from San Bruno Mountain (USFWS 1998) but it is unknown how this fire affected the Callippe silverspot population. Experiments need to be conducted to determine whether controlled burning of limited areas of habitat at particular times of year would benefit butterfly populations.

Land Use Practices. The land use practices or primary pressures that directly affect either, adversely or beneficially, Callippe silverspot butterflies in Solano County are: urbanization, intensive agriculture, cultivated grassland/dry-land farming and livestock grazing. Vineyard development on hillsides could result in loss of habitat in the future. Off-road vehicle use, un-controlled off-trail foot and equestrian traffic, inappropriate levels of livestock grazing, and invasive exotic vegetation all pose a minor threat to the Callippe silverspot butterfly. These activities could harass, injure, or kill individuals by trampling or crushing the early life stages, the foodplants of the larvae, or the adult=s nectar sources.

Urbanization. Urbanization results in direct habitat loss and fragmentation of remaining populations and habitat. For example, the Callippe silverspot butterfly was known historically from 14 sites in San Mateo, Alameda, Sonoma, and Solano counties and is now only known from

the San Bruno Mountain area, the Tri-Cities/County area of Solano County, possibly a few scattered sites in the Oakland/Berkleley/Hayward hills, and a disjunct population in the Sears Point area of Sonoma County. A number of the populations in the Oakland Hills are probably extirpated due to urbanization and fragmentation (Arnold 1981).

Intensive Agriculture. Intensive agriculture is not yet resulting in the conversion of Callippe silverspot habitat; nevertheless, the development of vineyards is a potential threat to the colonies in the Tri-cities/County area of Solano County. The secondary affect of intensive agriculture is pesticide drift. Silverspot butterfly larvae are extremely sensitive to pesticides, and even the accumulation of runoff in the soil after spraying has proven lethal to the larvae of members of the genus *Speyeria* (Mattoon et al. 1971). Drift or runoff from vineyards adjacent to habitat is therefore a concern for the Callippe silverspot butterfly.

Cultivated Grassland/Dry-land Farming. The Callippe silverspot butterfly is not currently known from areas that are cultivated. Nevertheless, these areas could have been habitat for the Callippe silverspot prior to cultivation, if the larval host and adult nectar plants, were present. The direct effects of cultivation are the destruction of the larval host plant, adult nectar plants and possibly direct killing of larvae and pupae.

Livestock Grazing. Livestock grazing may have both beneficial and detrimental effects on the caterpillar host plant, Johnny jump-up and the adult nectar plants. Johnny jump-up only grows in areas where the grasses are short during the beginning of spring and thatch is low. The violets themselves are low and cattle would not eat them but sheep would. Grazing patches of violets that result in a reduction of thatch and grass height would be of benefit to the violets and Callippe silverspot butterflies. If violets are growing in sparse grassland composed of native plants, grazing should be done carefully in order to not convert the native grassland to grassland dominated by non-native species. It is the non-native species that can out-compete the violets.

Livestock grazing could threaten the Callippe silverspot butterfly if it occurs at harmful levels, such that the vegetation is overgrazed and the food plants and nectar sources of these butterflies are eliminated or greatly reduced in abundance. The species of grazing animal is important because sheep will feed on the violet while cattle may not eat the violet because of its low-growing habit. Grazing animals can also trample the larval food plants and adult nectar sources.

Butterfly Collectors. The adult Callippe silverspot butterfly is highly prized by insect collectors and commercial trade has been documented for the Callippe silverspot butterfly, as well as for other rare butterflies. Although no studies specifically document the impact of the removal of individuals on natural populations of this species, the USFWS considers the Callippe silverspot to be vulnerable to impacts from collection due to their isolated, possibly small populations. Prior to listing, butterfly collectors were observed on San Bruno Mountain collecting Callippe silverspot butterflies. Collection of females dispersing from a colony may also reduce the probability that new colonies will be founded. Collectors pose a threat because they may be unable to recognize when they are depleting butterfly colonies below the thresholds of survival or recovery, especially when they lack appropriate biological training or when they visit the area for a short period of time.

Consequences of Land Use Practices. The consequences of the above land use practices (i.e. secondary pressures) on Callippe silverspot butterflies in Solano County are:

Habitat Loss and Fragmentation. The Callippe silverspot butterfly is vulnerable to the effects of habitat fragmentation. Subdivision of natural land into smaller blocks of suitable habitat is often the result of human activities such as urban development, road construction, fire management policies, and inappropriate livestock grazing practices. Large residential areas are a nearly total barrier because Callippe silverspot butterflies do not fly beyond the first lots at the edge of habitat areas (TRA 1982). Further reduction of population size and genetic interchange among populations through isolation, genetic drift, and inbreeding depression, may result in less vigorous and adaptable populations of the Callippe silverspot butterfly. Small isolated populations are vulnerable to extinction from random fluctuations in population size or variations in population characteristics (e.g., sex ratios) caused by annual weather patterns, food availability, and other factors. Because most of the populations of this species are isolated from other conspecific populations, natural recolonization from other populations is unlikely or impossible, and the vulnerability of each population to natural events is high.

Non-native Species. The invasion of California's native grassland and coastal prairie by alien plants has adversely affected the native flora and fauna. Numerous non-native species have invaded these plant communities (Heady 1988, Heady *et al.* 1988). Introduced alien plants, such as various nonnative annual grasses, iceplant (*Carprobrotus* spp.), gum trees (*Eucalyptus* spp.), and gorse (*Ulex europaeus*), often out-compete and supplant native vegetation. The lower slopes of the site supporting the Callippe silverspot butterfly by the rest stop along Highway 80 in Vallejo are dominated by mustard (*Brassica* sp.) and poison hemlock (*Conium maculatum*), two non-native species. In the absence of control and eradication programs, invasive alien plants may eliminate the remaining native plants, including the host plants of the Callippe silverspot butterfly. Adequate levels of *Viola* species are especially critical for the long term survival of populations of silverspot butterflies.

Highways. The Callippe silverspot butterfly is a strong flyer, nevertheless, wide areas of pavement or forested areas, or rows of trees, pose an impediment to the dispersal of Callippe silverspot butterflies. Callippe silverspot butterflies rarely cross areas that are not habitat.

Chemical Contaminants. Contaminants such as pesticides, heavy metals, and other air pollutants can affect larval development, potentially leading to malformations, increased susceptibility to disease and death. The use of insecticides would threaten the Callippe silverspot butterfly if use occurred in proximity to occupied habitat. Silverspot butterfly larvae are extremely sensitive to pesticides, and even the accumulation of runoff in the soil after spraying has proven lethal to the larvae of members of the genus *Speyeria* (Mattoon *et al.* 1971). Drift or runoff from vineyards adjacent to habitat is therefore a concern for the Callippe silverspot butterfly.

Data Gaps, Uncertainties and Assumptions

The data gaps, uncertainties and assumptions for the Callippe silverspot butterfly include:

Population Genetics. There is no information available concerning the relatedness between subspecies and whether or not the morphological characters that distinguish subspecies correspond to distinct genetic lineages. In addition, it is unknown whether the silverspot butterflies, resembling the Callippe subspecies within Solano County, are genetically more closely related to *Callippe Callippe* than to *Callippe comstocki* or *Callippe liliana.* Further research is needed on the phylogeography of this species.

Rodent Control. Rodents have a large effect on the turn over of grassland soils. This has implications for mineral cycling in grassland ecosystems. Rodents also create local areas of disturbance that could be colonized by a variety of plant species. The relationship between rodents and the larval and adult food plants of the Callippe silverspot butterfly should be examined. If violets and the adult nectar plants are dependent on local disturbance for establishing themselves, then rodents may be important for them to maintain suitable densities for the Callippe silverspot butterfly.

Fire. The affects of fire on Callippe silverspot butterfly populations is not well known. Fire was implicated in the extirpation of a population of bay checkerspot butterflies (*Euphydryas editha bayensis*) in the mid 1980's from San Bruno Mountain (USFWS 1998) but it is unknown how this fire affected the Callippe silverspot population. Fire is recognized as a major force shaping the ecology of California grasslands (D'Antonio 2000) and it has been presumed that without fire or grazing, succession may eliminate the foodplants of the larvae of this butterfly (Orsak 1981, Hammond and McCorkle 1984). Experiments need to be conducted to determine whether controlled burning of limited areas of habitat at particular times of year would benefit butterfly populations.

Johnny Jump-up Reproduction and Establishment. Little is known regarding the pollination ecology of Johnny jump-up. Presumably, Johnny jump-up is insect pollinated (species with showy flowers are often pollinated by insects, birds, or other animals). The ability of Johnny jump-up to self-pollinate should also be studied.

The seeds of many species of violets are dispersed and cached by ants and the role of ants in the seed dispersal of Johnny jump-up should be investigated. The factors that affect the germination of the seed of Johnny jump-up should also be investigated including seed dormancy.

The microhabitats utilized by Johnny jump-up should be studied to determine the areas best suited to establish populations of Johnny jump-up. The ability of seedlings to compete with other grassland species should be examined in relation to examining the factors that affect the expansion of populations of Johnny jump-up. These factors should include spring moisture, depth of soil, and associated plant species. The role of grazing in maintaining populations of violets should also be studied.

Buffers. Because limited information exists regarding the structure and dynamics of populations, dispersal and tolerances to disturbance, the buffer distances established in the conservation measures are in some ways arbitrary and based on standard buffer distances associated for other species. These distances should be monitored to determine if they are meeting the conservation needs of the species. In addition, these distances are subject to change based on the results of future research and monitoring efforts on this and similar species.

Current Management and Monitoring Practices. The area that the Monitoring and Adaptive Management Program for the Callippe silverspot butterfly is applicable to falls within the Inner Coast Range Natural Community. Therefore, similar to that described in the Inner Coast Range section, the primary management focus of existing reserves/preserves involves providing opportunities for recreation (primarily hiking, biking and horseback riding in public open spaces) or promotion of agricultural values (Lynch Canyon). Livestock grazing is the primary management tool for most reserves. On public lands, the primary focus of the livestock grazing is wildfire fuel reduction. Limited monitoring of the effects of the current management practices has been conducted and only recently have the Plan Participants begun to develop and adopt specific management plans for such public open space areas. No management specifically for the benefit of Callippe silverspot butterfly populations is being conducted, nor are populations currently being monitored.

Key Monitoring and Adaptive Management Issues from Conceptual Model. The Callippe silverspot (S. c. callippe) is a relatively large butterfly with a wingspan of approximately 2-2.5 inches (Anonymous 1980; Black and Vaughan 2005) and a relatively strong flyer. The adult flight period is from mid May to the end of July, depending on environmental conditions, during which courtship and breeding occurs. To search for females, the males fly back and forth over the tops of the hills a behavior known as "hill-topping" and courtship seems to entail a joint flight by the male and female in which they fly in an ascending or spiral fashion or an otherwise circular flight pattern. Females lay their eggs on the dried stems and leaves of the larval host plant, Johnny jump-up (*Viola pedunculata*; also known as wild pansy or wild violet). Once the eggs are laid, they take approximately a week to hatch. After hatching, the larvae (caterpillar) immediately spin a silk pad on which they remain through the summer and into the winter. After the late winter rains have begun and the wild violet plants have started to grow, the larvae become active and feed on the new plant growth. Following this activity, the larvae, which are dark-colored and have branched spines covering their backs, soon pupate and then emerge as adult butterflies in May and June. The adult individuals then only live for approximately 3 weeks.

The Callippe silverspot butterfly habitat requirements are larval food plants (violet or Johnny jump-up), adult nectar plants, and hill tops. These three habitat components need to be relatively close to each other to support Callippe silverspot butterflies. The known butterfly sites within the plan area consist of large aggregation (roughly 40-acres), of dense patches or stands (densities varying from approximately 25 percent cover to less than one percent cover) of Johnny-jump-up interspersed with grassland vegetation and typically occur along ridgelines of the steeper hill slopes. The Monitoring and Adaptive Management Program for this species will focus on these three habitat requirements with additional emphasis on maintaining large, dense stands of the larval host plant.

The main primary pressures affecting Callippe silverspot butterflies that will be addressed in the Monitoring and Adaptive Management Program include fire, urbanization, livestock grazing and recreation. Fire is recognized as a major force shaping the ecology of California grasslands (D'Antonio 2000) and can be an important management tool. Fire reduces the amount of thatch left by introduced annual grasses and can promote the growth of native plants such as Johnny jump-up and adult nectar plants (TRA 1982). Without fire or grazing, succession may eliminate the foodplants of the larvae of this butterfly (Orsak 1981, Hammond and McCorkle 1984). However, the immediate

affects of fire on Callippe silverspot butterfly populations is not well known. Experiments need to be conducted to determine whether controlled burning of limited areas of habitat at particular times of year would benefit butterfly populations. Implementing prescribed burning is not currently planned at the sites because of the complexity and difficulty in obtaining permissions for the burns, but resource managers will explore opportunities for implementing appropriately-timed controlled burns with local fire control agencies and associated organizations in the future.

Livestock grazing, one of the most manageable pressures that can have both beneficial and detrimental, indirect effects on butterfly populations via direct effects to the larval host plant, Johnny jump-up and the adult nectar plants. Johnny jump-up only grows in areas where the grasses are short during the beginning of spring and thatch is low. Grazing patches of violets that result in a reduction of thatch and grass height would be of benefit to the violets and Callippe silverspot butterflies. If violets are growing in sparse grassland composed of native plants, grazing should be done carefully in order to not convert the native grassland to grassland dominated by non-native species. It is the non-native species that can out-compete the violets. Livestock grazing could threaten the Callippe silverspot butterfly if it occurs at harmful levels, such that the vegetation is overgrazed and the food plants and nectar sources of these butterflies are eliminated or greatly reduced in abundance. The species of grazing animal is important because sheep will feed on the violet while cattle may not eat the violet because of its low-growing habit. Grazing animals can also trample the larval food plants and adult nectar sources.

The consequences of the land use practices (secondary pressures) that will be addressed in the Monitoring and Adaptive Management Program are habitat loss and fragmentation and non-native species. The Callippe silverspot butterfly is vulnerable to the effects of habitat fragmentation. Subdivision of natural land into smaller blocks of suitable habitat is often the result of human activities such as urban development, road construction, fire management policies, and inappropriate livestock grazing practices. Small isolated populations are vulnerable to extinction from random fluctuations in population size or variations in population characteristics (e.g., sex ratios) caused by annual weather patterns, food availability, and other factors. Because most of the populations of this species are isolated from other conspecific populations, natural recolonization from other populations is unlikely or impossible, and the vulnerability of each population to natural events is high.

The invasion of California's native grassland and coastal prairie by non-native plants has adversely affected the native flora and fauna. Numerous non-native species have invaded these plant communities (Heady 1988, Heady et al. 1988). Introduced plants, such as various nonnative annual grasses, iceplant (*Carprobrotus* spp.), gum trees (*Eucalyptus* spp.), and gorse (*Ulex europaeus*), often out-compete and supplant native vegetation including Johnny jump-up and adult nectar plants. The Monitoring and Adaptive Management Program will incorporate control and eradication programs, in order to maintain adequate levels of Johnny jump-up populations, which is critical for the long-term survival of populations of silverspot butterflies.

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