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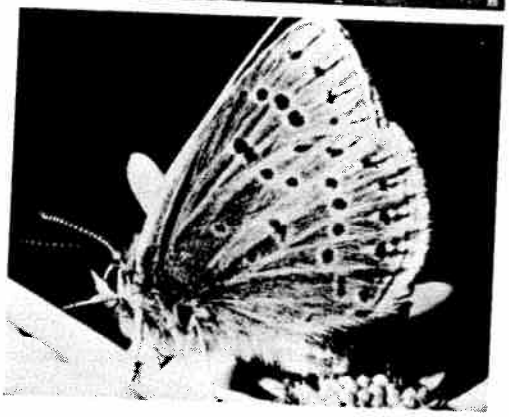

Recovery Plan

San Bruno Elfin & Mission Blue Butterflies

Recovery Plan for the

San Bruno Elfin and Mission Blue Butterflies

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U.S. Fish and Wildlife Service

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Appproved: Robert E. Gilmore
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THIS IS THE COMPLETED RECOVERY PLAN FOR THE SAN BRUNO ELFIN AND MISSION BLUE BUTTERFLIES. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE ON OCTOBER 10, 1984. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVAL OF COOPERATING AGENCIES AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS INVOLVED IN PLAN FORMULATION. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

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San Bruno Elfin and Mission Blue Butterflies

Recovery Plan Executive Summary

1. Point or condition when species can be considered recovered.

San Bruno elfin butterfly: when secure, self-sustaining colonies are established on Milagra Ridge, Montara Mountain and Whiting Ridge and when current colonies on San Bruno Mountain are secure and expanding.

Mission blue butterfly: when secure, self-sustaining colonies are established on Twin Peaks and Ft. Baker and when current colonies on San Bruno Mountain are secure and expanding.

2. What must be done to reach recovery?

Habitats must be secured by easements, agreements or other strategies. Also, habitats must be enhanced.

3. What specifically must be done to meet needs of #2?

Tasks are set forth to secure essential habitat areas. Tasks to determine the amount and quality of habitat necessary to maintain colonies are discussed. Interim measures of habitat enhancement, such as removal of exotic plants and toxic substances, are proposed.

4. What management/maintenance needs have been identified to keep species recovered?

Management plans will be developed for all areas. Annual surveys of butterflies, their habitats and threats are proposed. Extensive public education and law enforcement efforts are also proposed.

ACKNOWLEDGEMENTS

THIS PLAN HAS BEEN PREPARED UNDER CONTRACT TO DR. RICHARD A. ARNOLD (DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA 94720) IN COOPERATION WITH DR. JACK E. WILLIAMS (SACRAMENTO ENDANGERED SPECIES OFFICE, U.S. FISH AND WILDLIFE SERVICE, 2800 COTTAGE WAY, ROOM E-1823, SACRAMENTO, CALIFORNIA 95825). THE ASSISTANCE OF DR. LARRY L. ENG, CALIFORNIA DEPARTMENT OF FISH AND GAME, IS GRATEFULLY ACKNOWLEDGED. COVER ILLUSTRATION OF SAN BRUNO MOUNTAIN IS COURTESY OF THE XERCES SOCIETY. COVER PHOTOGRAPH OF THE MISSION BLUE BUTTERFLY IS COURTESY OF EDWARD S. ROSS.

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PART I. INTRODUCTION

Brief Overview

At one time, the San Bruno elfin (*Callophrys mossii bayensis*) and Mission blue butterflies [*Plebejus (Icaricia) icarioides missionensis*] probably occurred on hill tops and ridges throughout much of northern San Mateo County to the San Francisco Peninsula and northward to southern Marin County. Urbanization of this region has reduced the range of both species of butterflies to relicts of their former abundance except at San Bruno Mountain in northern San Mateo County, which still provides suitable habitat for at least seven colonies of San Bruno elfin butterfly and almost all extant Mission blue butterfly colonies. Other colonies of the San Bruno elfin butterfly occur on Milagra Ridge, Montara Mountain, Peak Mountain and Whiting Ridge in San Mateo County. In addition to San Bruno Mountain, the Mission blue butterfly exists on Twin Peaks in San Francisco and at Ft. Baker in Marin County. The reduced range of these butterflies and continued threats to remaining colonies resulted in the determination in 1976 by the Department of the Interior that the San Bruno elfin and Mission blue butterflies were endangered (*Federal Register* 41:22041-22043).

San Bruno Mountain provides most of the remaining hilly chaparral and grassland habitats formerly characteristic of San Francisco and the northern peninsula. In addition to providing habitat for most remaining colonies of San Bruno elfin and Mission blue butterflies,

San Bruno Mountain serves as a refugium for three other Lepidoptera that are candidates for Federal listing as endangered or threatened species; 12 plants recognized by the California Native Plant Society and other organizations as rare or endangered species; and possibly the San Francisco garter snake (Thamnophis sirtalis tetrataenia), which was listed as a Federal endangered species in 1967. Although some of these fauna and flora can still be found at other localities scattered throughout the San Francisco Bay area, most have major populations on San Bruno Mountain. A combination of proposed housing, commercial and recreational developments threaten the perpetuity of these unique organisms and their habitats.

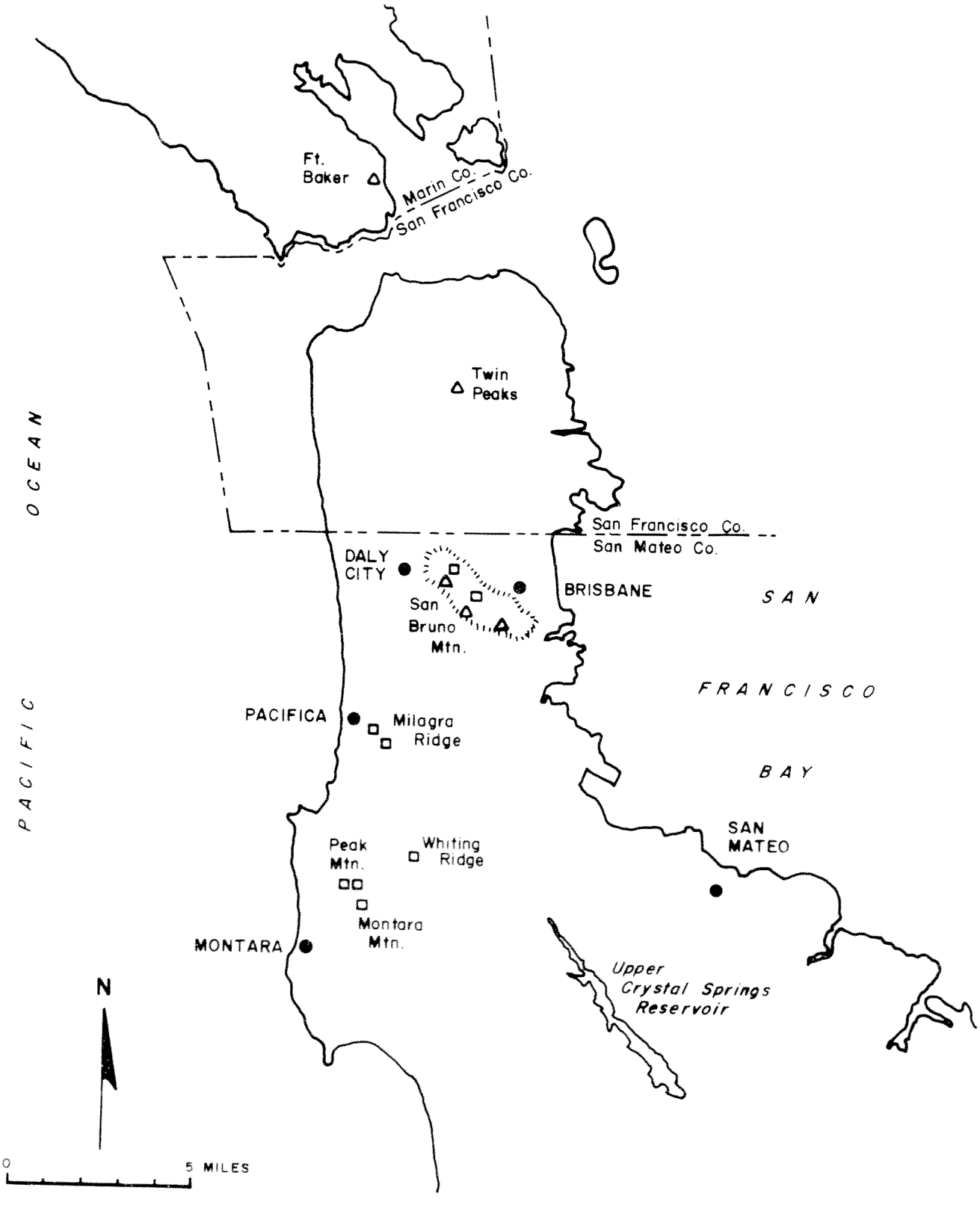
One purpose of the Endangered Species Act of 1973, as amended, is "to provide a means whereby the ecosystems upon which Endangered species and Threatened species depend may be conserved." This plan addresses the recovery needs of the Mission blue and San Bruno elfin butterflies, and discusses their life histories and requirements for survival as well as describing characteristics of their remnant habitats. A comprehensive plan is outlined to maintain the endangered species through protection of their habitats. Because the two butterflies occur at other sites in the San Francisco Bay area, similar concerns of habitat protection, management, and rehabilitation also apply at these sites.

Location of Habitats

San Bruno Mountain lies immediately south of San Francisco, in northern San Mateo County, California (Figure 1). It is the northernmost extension of the Santa Cruz Mountains. The property is bordered by the following municipalities: South San Francisco on the south, Brisbane on the east, Colma on the southwest, and Daly City on the northwest (Figure 2). Today the mountain comprises about 1,465 ha (3620 acres): 692 ha (1710 acres) are owned by the San Mateo County Parks and Recreation Department, 121 ha (298 acres) by the California State Parks Foundation, about 390 ha (963 acres) by Visitacion Associates, a San Francisco Development company; 60 ha (148 acres) by Quarry Products, Inc., 9 ha (22 acres) by Telecommunication Properties and Watson Communications Corp., 24 ha (60 acres) by three school districts, and 169 ha (418 acres) by utility companies and private individuals, plus numerous commercial, agricultural, and private developments on the flanks of the mountain that occupy about 354 ha (875 acres). McClintock et al. (1968) identified the location of pertinent geographic areas on the mountain.

The remaining habitats of the San Bruno elfin butterfly are also in San Mateo County, but have been less studied than San Bruno Mountain. Milagra Ridge is approximately 6.4 km (4 miles) southwest of San Bruno Mountain. Montara Mountain and the adjacent Whiting Ridge and Peak Mountain are approximately 6.4 km (4 miles) further south (Figure 1).

Figure 1. Map of the San Francisco Peninsula region showing localities of the San Bruno elfin (□) and Mission blue (△) butterflies.



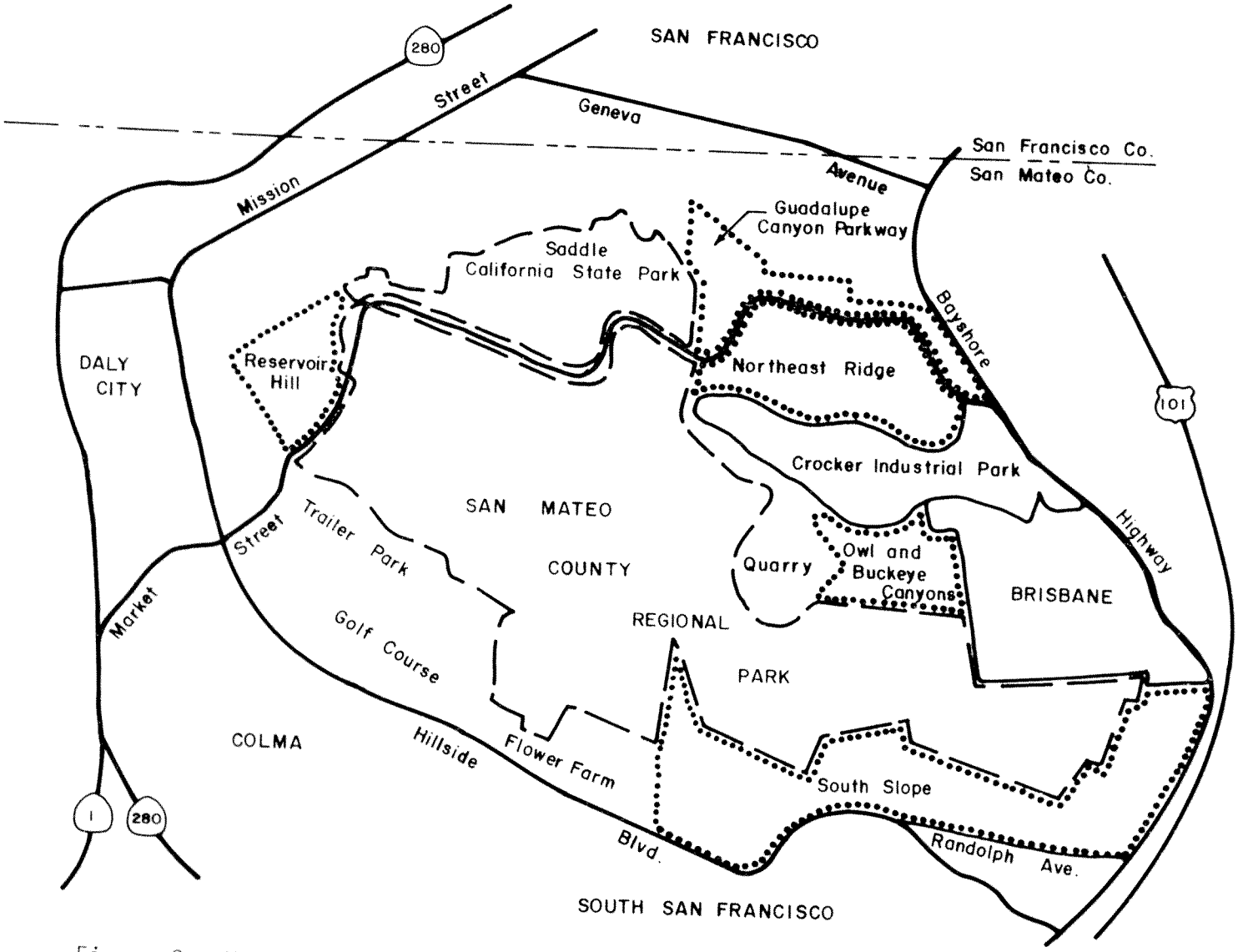


Figure 2. Map of San Bruno Mountain and adjacent environs, showing boundaries of land ownership by various parties and local place names. Areas delineated by dotted lines are proposed for development by Visitacion Association or Quarry Products or other private landowners.

Like San Bruno Mountain, Milagra Ridge is largely surrounded by urbanized area. San Bruno elfin butterfly habitat is mostly located in Milagra Ridge County Park, which is just northeast of Pacifica.

Colonies of San Bruno elfin butterflies on Montara Mountain are known to include: 1) a relatively large colony on the northwest facing edge of the mountain at 274-366 m (900-1,200 ft) elevation, 2) a smaller colony approximately 1 km (0.6 mi) farther up the northwest slope at 445 m (1,460 ft) elevation, 3) two small colonies on Peak Mountain at 549 m (1,800 ft) elevation, and 4) another small colony occurs on the southwest-facing slope of Whiting Ridge at 244-330 m (800-1,080 ft) elevation. The Montara Mountain area remains poorly surveyed and could harbor additional San Bruno elfin butterfly colonies.

Mission blue butterfly colonies outside of San Bruno Mountain are located at Twin Peaks in the Mission District of San Francisco and at Ft. Baker. Ft. Baker is located near the north end of the Golden Gate Bridge in the Golden Gate National Recreation Area.

Physiography

San Bruno Mountain consists of 2 parallel ridges extending northwestwardly from Sierra Point at the edge of San Francisco Bay, approximately 6.7 km (4 mi) to San Diego Avenue in San Francisco. The southern or main (sometimes referred to as the Southeast Ridge) ridge of San Bruno Mountain proper, attains a maximum elevation of 401 m

(1,314 ft.). Much of the main ridge exceeds 274 m (900 ft.) and is characterized by steep canyons and rocky outcrops. In contrast, the northern ridge or Crocker Hills (sometimes referred to as the Guadalupe Hills), consists primarily of a series of gently rolling hills with a summit of 259 m (850 ft.). Guadalupe Valley bisects the ridges over one-half of their length.

McClintock et al. (1968) discussed geological features of the mountain and noted that most ridges are composed of late Cretaceous (100 million years before present) dark greenish-gray graywacke of the Franciscan Formation. Two small patches of serpentine occur on the main ridge. A large sand formation formerly was located in Colma Canyon, a site now occupied by Guadalupe Canyon Parkway, homes, and the Kennedy Elementary School. Sand-mining, trailer park construction, and landfill operations have nearly eliminated a second sand deposit on the western flank of the mountain near the town of Colma.

There is little variation in soil type, but considerable variation in soil depth (McClintock et al. 1968). A thin soil layer is characteristic of the numerous steep slopes, whereas a thicker soil layer has formed on more gentle slopes. The mountain contains three major drainage units, the Colma Creek basin, the Guadalupe Canyon basin, and Paradise Valley basin. In addition, several intermittent creeks and springs are present in various canyons.

Milagra Ridge extends for approximately 2 km (1.2 mi) in a northwest-southeast direction, nearly reaching the Pacific coast north

of Pacifica. The ridge is steep-sloped and achieves an elevation of 213 m (700 ft). The Milagra Ridge County Park occupies most of the ridge and protects it from urban development.

Montara Mountain extends in a northwest to southeast orientation for approximately 9 km (5.6 mi) from San Pedro Mountain along the coast to Frenchman's Creek. Several peaks extend along the rugged mountain, with the highest point, Scarper Peak, reaching 593 m (1,944 ft). Two small colonies of San Bruno elfin occur on Peak Mountain, a high point near the northwestern portion of Montara Mountain, at 549 m (1,800 ft) elevation. Whiting Ridge is a major extension of the mountain that spreads for about 2.5 km (1.6 mi) northeast of North Peak. The elfin colony on Whiting Ridge occurs on a steep, southeast-facing slope. Much of the Montara Mountain habitat occurs in the San Francisco State Fish and Game Refuge and is therefore protected. Little information is available on soil conditions of the mountain.

Twin Peaks is surrounded by the City of San Francisco. Their high elevation (281 m, 922 ft) makes them a prominent landmark in the peninsula area.

The Mission blue butterfly colony at Ft. Baker is located along the cliffs near the northern end of the Golden Gate Bridge. Topography is steep as the cliffs rise from the Pacific Ocean.

Climate

Marked seasonal and diurnal weather patterns characterize the climate of peaks and mountains in the peninsula area. The Pacific high pressure weather system effectively prevents rain during the summer and then breaks down during winter, which allows northern Pacific storms to enter California. Nearly all precipitation in the area is associated with these storms. Spring and summer weather is relatively cool, windy and cloudy. Maximum summer temperatures average less than 21°C (70°F) (Duckworth and Perkins 1968). Winter temperatures seldom fall below freezing and frequently rise as high as 16°C (60°F).

Wind velocity varies greatly because of irregularities in the terrain. However, a diurnal cycle is generally evident, with winds increasing to a maximum in early to mid-afternoon and decreasing at night. In assigning place names to plant collection sites on San Bruno Mountain, McClintock et al. (1968) called one promontory Kamchatka Point because of the strong winds and bleak weather they experienced there. Several plant taxa growing at exposed sites on the mountain are represented by severely stunted individuals or populations.

A westerly sea breeze is evident in summer and creates an advection fog along much of coastal California. This extensive blanket of fog covers primarily the western slopes of mountains and ridges, while the eastern portions are sunny. Fog moderates temperature and provides extra moisture for vegetation. For San Mateo County and the peninsula area, annual precipitation increases with greater elevation of the

land surface. Precipitation ranges from about 38.1 cm (15 in) at sea level to 127.0 cm (50 in) at elevations above 61 m (200 ft) (San Mateo County 1968).

Rainfall annually averages about 55.9 cm (22 in) on San Bruno Mountain (Duckworth and Perkins 1968) and occurs primarily between November and April. Precipitation decreases from northwest to southeast on the mountain, with southern slopes receiving an average of 10.2 cm (4 in) less per year than northern slopes (Duckworth and Perkins 1968). The vegetation reflects this difference in precipitation as well as exposure, with northern and western slopes generally supporting more mesic chaparral plants, whereas southern and eastern slopes exhibit a more xeric grassland flora.

Precipitation from fog drip on San Bruno Mountain may amount to as much as 0.9 cm (0.3 in) per day and 50.8 cm (20 in) per year (Duckworth and Perkins 1968). Grassland is the primary vegetation type in areas beyond the daily fog-belt, while chaparral dominates the fog-belt region.

History

Presently, forms of recreation, such as off-road vehicle (ORV) use, hiking, photography and nature observation, are the primary activities occurring on most remaining San Bruno elfin and Mission blue butterfly habitats. Until recently, livestock grazing was the principal activity at many areas. During the late-1800's and early to mid-1900's, large ranchos were subdivided, thus reducing cattle

ranching and setting the stage for subsequent development of cities and other urban areas. Such ownership changes are illustrated below for the San Bruno Mountain area.

The original land-grant designation for San Bruno Mountain was known as Canada de Guadalupe, Visitacion y Rodeo Viejo, or more commonly as Visitacion Rancho. The Mexican land-grant was made in the 1830's to Jacob P. Leese, a naturalized Mexican citizen. Portions of the property were later traded or sold. By 1872, the largest holdings reposed in the ownership of the Visitacion Land Company, and these were acquired in 1884 by Charles Crocker. When Crocker's estate was distributed in 1891, his lands passed to the Crocker Estate Company and later to the Crocker Land Company, a subsidiary of Foremost-McKesson. Amfac, Inc. and Foremost-McKesson have entered into an equal partnership called Visitacion Associates, which is responsible for planning and securing the required approvals for present development plans on San Bruno Mountain. Commercial, private and agricultural developments have gradually taken over the flanks of the mountain, reducing the amount of open space to about 1,376 ha (3,400 acres).

San Bruno Elfin Butterfly

Past and Current Distribution and Reasons for Decline

Although the San Bruno elfin butterfly (Callophrys mossii bayensis Brown) inhabits the outskirts of San Francisco, a region studied by entomologists for over a century, it was not discovered until 1962 (Brown 1969, Emmel and Ferris 1972). Today 14 colonies are known, all restricted to the coastal mountains of northern San Mateo County. San Bruno Mountain harbors 7 colonies, while the Montara Mountain area harbors at least 5 colonies, and Milagra Ridge at least 2. In the Montara Mountain area, colonies are located on Whiting Ridge, Peak Mountain and two parcels on the western edge of the area. Specific localities are shown in Appendix A. These colonies range in size from about 0.15 - 8.0 ha. All are located in the fog-belt on steep, north-facing slopes. Direct sunlight is minimal on these slopes, thus moisture is conserved and the larval foodplant, stonecrop (Sedum spathulifolium Hooker), grows in abundance (Emmel and Ferris 1972, Arnold 1978). Additional colonies may occur near Montara Mountain and Crystal Springs Reservoir but the rugged terrain and inaccessibility of the area have prevented a thorough search of this region.

Historically, the coastal montane slopes inhabited by the San Bruno elfin butterfly in San Mateo County have suffered moderate habitat alteration. Some habitat loss has occurred on San Bruno Mountain through quarrying, roadcuts, grazing, and construction of communications facilities. Colonies on Montara Mountain, Milagra

Ridge and Whiting Ridge are found on steep slopes. Most of these colonies occur on Federal or City of San Francisco lands. Based on the numerous herbaria records for Sedum spathulifolium in San Francisco, the butterfly may have previously inhabited several sites long since destroyed by urbanization or irreversibly altered by exotic plantings of iceplant (Mesembryanthemum), eucalyptus (Eucalyptus), and other landscape species. Today the remaining colonies in San Mateo County are threatened with loss of habitat from commercial development, proposed road construction, county park development, and quarrying.

Herbaria records indicated that Sedum spathulifolium occured in several other localities in Alameda, Contra Costa, Marin, and San Mateo Counties. These sites were visited but only two additional colonies of the San Bruno elfin butterfly were discovered, both in San Mateo County (Arnold 1978). Other colonies of Callophrys mossii, which phenotypically resemble other races, were found in Contra Costa and Marin Counties (Arnold 1980, 1983). No colonies were found in Alameda County.

Life History

The information presented in this and subsequent sections summarizes research results of Arnold (1978, 1980, 1983).

Flight Period. - Callophrys mossii bayensis is univoltine, i.e., it has one generation per year. Adults fly from late-February to mid-April, although the peak in adult emergence is usually during the last two weeks in March. The primary nectar resource is Lomatium utriculatum (Nuttall) Coulter and Rose (Apiaceae). Numerous other plants serve as secondary nectar resources.

Oviposition. - Oviposition occurs throughout March and early April. The white, oblate, spheroid eggs are laid primarily on the foliage of the larval foodplant, Sedum spathulifolium.

Larvae. - Under lab conditions larvae emerged in 5 to 7 days. First and second instar larvae bore into the smaller, more succulent leaves of the S. spathulifolium rosettes. They are voracious feeders and form small channels in the leaves. Larvae are dichromatic, either red or yellow.

By the time the third instar is attained in the field, the S. spathulifolium has sprouted flowering stalks that are beginning to bloom. Third instar larvae crawl up the flowering stalks and feed until they mature on the flowerheads, especially on the gynoecium (i.e., female portions of the flower). In the laboratory, larvae will feed on foliage as well as the flowers. Under field conditions, larval development is generally completed by late May or early June.

Third and fourth instar larvae are tended by ants (Formicidae). At least 9 ant species tend the larvae, and each species appears to tend

primarily one larval color morph. As evidenced by laboratory rearings without ants, the larvae are facultative myrmecophiles (i.e., tending ants are not required for the butterfly's larvae to complete their development). Histological and scanning electron microscopy studies (Arnold, unpublished data) revealed that the larvae possess a honeydew secreting gland near the posterior of the abdomen. The ants presumably provide larvae protection from parasitoids and/or predators. Tending ants use their antennae to tap a larva's head and elicit a drop of honeydew which the ants imbibe. Field and laboratory observations demonstrated that an ant may tend a given larva for as long as 3 hours, although most encounters lasted for periods of 3 to 35 minutes.

Pupation. - Pupation occurs among the loose soil and litter of the S. spathulifolium roots. Initially, the pupae are pink, but soon transform to a chocolate-brown color. The pupal stage lasts from June until the following March.

Mortality Factors. - Despite their symbiotic association with ants, a high frequency of the mature larvae were parasitized by a tachinid fly, Aplomya theclarum (Scudder). Parasitization rates might be higher if ants did not tend to larvae. Such a situation was recently reported for another lycaenid, Glaucopsyche lygdamus palosverdensis (Doubleday) (Pierce and Mead 1981).

Population Biology Studies

Six colonies on San Bruno Mountain have been studied using a combination of capture-recapture, life table, and stage-frequency analysis techniques during 1977 to 1982. For further details on these studies consult Arnold (1978, 1980, 1981a, 1983). Coastal chaparral with an influx of bunch grassland formed the dominant vegetation at all study sites. Arnold (1980) listed the plants collected at these sites.

Daily sampling for capture-recapture studies was initiated between 0830 and 1000 PST and terminated between 1330 and 1500 PST. The sampling periods were: 14 to 26 March 1977, 9 to 25 March 1978, and 4 to 25 March 1979. Data collected from these studies were used to calculate daily population numbers, lifespan (residency), vagility parameters, sex ratios, dispersion, and home ranges. A synopsis of the studies conducted at 2 study sites, a) radio towers near summit and b) above the quarry is presented.

During the 3 capture-recapture studies, 479 males and 340 females were marked. The 1977 study was initiated when males were common, but terminated before females outnumbered males in the daily sample totals. In 1978 and 1979, the studies included nearly the entire flight season for both sexes. Data from laboratory rearings provide evidence that the sex ratio is near 1:1 (289 males: 251 females, or 54%:46%).

Daily population numbers were estimated using the Jolly-Seber (Jolly 1965) and Manly-Parr (Manly and Parr 1968) stochastic models. At the radio towers site in 1977, combined male and female daily population estimates ranged from 31 to 277, with 4 daily estimates greater than 156 individuals and 4 less than 110. Total estimated population size in 1977 was 1088 adults. In 1978, daily estimates for the gravel pit site ranged from 8 to 103, with 5 daily estimates greater than 45 individuals and 10 less than 34. Total estimated population size during 1978 was 401 adults. Daily estimates for 1979 at the gravel pit ranged from 22 to 247, with 7 daily totals greater than 65 individuals and 7 less than 52. Total estimated adult population size was 726 adults. Data from 1980, 1981, and 1982 studies have not yet been analyzed.

Mean expected residencies (i.e., "lifespans") indicate that males (range of means for various samples 3.1 to 8.3 days) generally lived slightly longer than females (range of means for various samples 2.5 to 10.8 days). Both sexes are equally vagile. Mean total distance 5 butterflies moved over all capture events ranged from 40.2 to 51.7 m for female samples and 45.9 to 53.4 m for males. Males tended to perch more than females and therefore would be expected to fly shorter distances. Less than 20% of all recaptured individuals flew over 70 m. The maximum observed individual movement within a particular colony for males was 250 m and for females was 224 m during 1977-1979 studies. During 1981 and 1982, several colonies were sampled simultaneously and a maximum movement of about 800 m between two colonies was detected (Arnold, unpublished data).

Mission Blue Butterfly

Past and Current Distribution and Reasons for Decline

The Mission blue butterfly, Plebejus (Icaricia) icarioides missionensis, was described by William Hovanitz in 1937 from specimens collected on Twin Peaks in the Mission District of San Francisco. Only a small colony remains at the type locality today. Continued loss of habitat from residential development threatens this colony. Another problem is trampling of the habitat by tourists visiting Twin Peaks. Robert Langston (pers. comm.) discovered a colony at Ft. Baker in Marin County ca. 1970, but the colony site was not located during a 1977 to 1979 survey (Arnold 1980). However, adults, eggs and larvae of missionensis were found at Ft. Baker during 1980 to 1982 (Arnold, unpublished data), suggesting that the proper areas were not searched during 1977 to 1979. Except for the above, all colonies of missionensis occur on San Bruno Mountain, where the butterfly inhabits approximately 810 ha (1500 acres) of grassland. Here the butterfly has suffered loss of habitat from industrialization, urbanization, agriculture, quarrying, and enchroachment of exotic plant species, notably gorse (Ulex europaeus).

Life History

Most of the information in this and subsequent sections summarizing research is derived from Arnold (1978, 1980, 1983).

Flight Period. - The Mission blue butterfly is univoltine. The adult flight period is from late-March to mid-June. The timing of adult emergence is probably related to a complex interaction of several factors, e.g., microclimate, degree of exposure, foodplant phenology, etc. On San Bruno Mountain, discrete populations of missionensis emerge at different times. For instance, populations near the mountain's peak and on western and southern-facing slopes generally are the first to emerge annually. These are followed by populations on the Northeast Ridge and main ridge. Owl and Buckeye Canyon populations are the last to emerge, probably due to the northern exposure and intermittent creeks, which keep the canyons cooler and moister than other areas on the mountain.

Oviposition. - Three perennial lupine species, Lupinus albifrons Bentham ex Lindley, L. formosus Green, and L. variicolor Steudel, serve as larval foodplants for missionensis on San Bruno Mountain. Herbaria records indicate that these Lupinus grew at several other localities in Alameda, Contra Costa, Marin, San Francisco, and San Mateo Counties. These localities were visited during 1977 to 1980, but no new colonies of missionensis were discovered.

Oviposition occurs throughout the adult lifespan. Single eggs are generally deposited on leaves, stems, flowers and seed pods of the host Lupinus. Occasionally, several eggs are deposited on a single whorl of leaflets. The majority of eggs are laid on new growth, particularly the upper surface of leaflets. Under laboratory

conditions, eggs hatch in 4 to 7 days. Downey (1957) noted that eclosion (i.e., larvae hatch) occurred in 6 to 10 days under field conditions.

Larvae. - First and second instar larvae feed on mesophyll of the host Lupinus. About 3 weeks after eclosion, the second instar larvae begin an obligate diapause. Most diapausing larvae can be found in the litter at the base of Lupinus plants. The following spring, larvae break diapause and resume feeding. Cessation of diapause varies widely, even among sibling larvae. Under laboratory conditions, this period may be as great as one month. This protracted cessation of diapause and the variation in microclimates on the mountain explains why newly emerged adults can be observed throughout an 8 to 10 week period.

Mature and penultimate (i.e., next-to-last) instar larvae are tended by ants (Formicidae), primarily Prenolepis imparis (Say). Formica lasicides Em. was found tending missionensis larvae on Twin Peaks (Downey 1957). The Mission blue butterfly is a facultative myrmecophile. Presumably, ants protect the developing larvae from parasitoids and predators in return for honeydew secreted by the larvae.

Pupation. - Laboratory reared larvae pupated on or near the base of Lupinus rather than in the ground or ant nests as suggested by Downey (1957) for other P. icarioides races. In the field, pupae were found in the dried leaf litter at the base of several plants including Lupinus.

Mortality Factors. - Approximately 35% of field collected eggs were parasitized by an unidentified Encyrtid wasp. A large proportion of 2nd instar larvae expire from desiccation and unknown factors during their lengthy diapause. Third and fourth instars are parasitized by either a Tachinid fly or a Braconid wasp. Rodents may be the principal predators of both larvae and pupae, because the remains of a few larvae and pupae were found at entrances to their burrows.

Population Biology Studies

Five capture-recapture studies were conducted during 1977 to 1979 at 3 sites, on the Northeast Ridge and in Owl and Buckeye Canyons. Because the Mission blue butterfly occurs at very low density throughout most of its natural habitat, studies were performed at a high density site (a roadcut along Guadalupe Canyon Parkway on the Northeast Ridge) to maximize the numbers of adults handled. The results of these studies indicate population parameters in an unusually favorable environment and should not be used to draw direct inferences about the butterfly in most of its natural grassland habitat.

On the Northeast Ridge and adjacent to Guadalupe Canyon Parkway, 4 patches of habitat were marked into grids containing 16 m by 16 m quadrats, for a total of 80 quadrats. The area enclosed was 2.0 ha and contained the most dense stands of larval and adult foodplants. Daily sampling began between 0830 and 1000 PDT and ended between 1430 and 1700 PDT. Sampling periods were 20 May to 7 June 1977, 13 May to 2 June 1978, and 21 May to 12 June 1979. All days were not sampled within each period.

During 3 capture-recapture studies at Northeast Ridge, 349 males and 296 females were marked. In each study the number of males marked and recaptured were greater than females. Observed and estimated deviations from a 1:1 ratio probably resulted from phenological and behavioral differences between the sexes, because laboratory rearings indicate the sex ratio is nearer 1:1.

The 1977 daily total population estimates ranged from 10 to 116, with 3 daily estimates greater than 76 individuals, and 7 less than 58. Total population size during the 19-day study at the site was estimated at 460 adults.

Daily estimates for 1978 ranged from 4 to 78, with 3 daily estimates greater than 66 individuals, and 15 estimates less than 42. Total adult population size during the 21-day study was estimated at 508 individuals. In 1979, daily population estimates fluctuated between 6 and 114, with 4 daily estimates greater than 64 individuals, and 13 estimates less than 54. Total population size during the 23-day study was 548 adults.

In 1981, San Mateo County sponsored a biological study of the Mission Blue throughout its entire range on San Bruno Mountain. This study estimated the average daily population size over the entire mountain at 1,200 individuals throughout a 70-day sampling period (Thomas Reid Associates 1982). It should be noted that the study area for this estimate consisted of almost 800 ha, while Arnold's estimates for 1977 to 1979 were for a 2 ha study site on the Northeast Ridge.

During Arnold's studies, nearly 1.5 times as many individuals were marked in 1977 during 11 sampling days, than in either 1978 (18 sampling days) or 1979 (19 days), indicating an overall decline in population numbers. This trend is confirmed by life table and stage-frequency analyses (Arnold, unpublished data), and is positively correlated with a decreasing biomass of Lupinus. Senescence, succession, and increased weed cover have reduced the lupine biomass at the Northeast Ridge study site.

Mean expected residence times ("lifespan") indicated that females (7.3 to 8.9 days) lived slightly longer than males (6.4 to 10.0 days), although in some samples the mean expected residencies for males were greater.

Males and females flew approximately equal distances and distances/unit time. Average total distance values ranged from 28.7 m to 40.2 m, with maximum observed movements of 154 m for males and 162 m for females. Most individual movements averaged less than 64 m. These figures probably underestimate adult movements under natural grassland conditions where inter-patch distances of Lupinus are greater than at the Northeast Ridge study site. In the 1981 county study adults were observed to move as far as 2,500 m, although most movements were less than 600 m (Thomas Reid Associates 1982).

In 1978 and 1979, Arnold marked 164 adults at Owl and Buckeye Canyons, which are approximately 1.4 air km south of Northeast Ridge. Crocker Industrial Park forms a barrier between Owl and Buckeye Canyons and

Northeast Ridge, extending about 0.7 km. No exchange of adults between Owl and Buckeye Canyons and Northeast Ridge was detected (Arnold 1980, 1983; Thomas Reid Associates 1982). It is doubtful that adults actively cross Crocker Industrial Park. Passive dispersal might occur in the form of occasional wind-blown individuals. Because the prevailing winds blow from west to east rather than north to south, even this form of dispersal is unlikely. If any active dispersal exists, individuals probably fly around the perimeter of the industrial park, where there is a nearly continuous corridor of grassland habitat. This corridor was not rigorously sampled. Because Lupinus patches frequently are separated by 100 m or more in the grassland, and missionensis adults are probably more mobile than observed, dispersal via stepping-stone patches of habitat is possible. The county's study in 1981 detected that a limited number of individuals (4/1486 marked) transferred between major demographic units of the mission blue on San Bruno Mountain (Thomas Reid Associates 1982).

Other Organisms of Concern

San Bruno Mountain and other existing habitats of the San Bruno elfin and Mission blue butterflies provide refugia for a large number of organisms endemic to the hilly chaparral and grassland communities that formerly were abundant in the San Francisco Bay area. Fourteen plants on San Bruno Mountain, Montara Mountain and Milagra Ridge, are candidates for listing as endangered or threatened and are recognized as rare and endangered species by the California Native Plant Society (Gankin 1977a, b; Powell 1974; Smith 1981; Smith et al. 1980) (Table 1). San Bruno Mountain also provides habitat for three Lepidoptera that are candidates for listing as endangered or threatened: the Callippe silverspot butterfly [Speyeria callippe callippe (Bdv.)], Bay checkerspot butterfly (Euphydryas editha bayensis Sternitsky), and San Francisco tree lupine moth (Grapholita edwardsiana Kft.). The mountain may also provide habitat for the endangered San Francisco garter snake (Thamnophis sirtalis tetrataenia).

Habitats and Vegetation

Historically, six plant communities were found on or adjacent to San Bruno Mountain. Today only two communities remain largely intact. Grassland extends over the largest portion of the mountain, including most of the Crocker Hills, Northeast Ridge, and southeastern slopes of the main ridge. Coastal scrub is predominant on the western portion of the main ridge and saddle region. A small stand of woodland vegetation lies in a canyon near Brisbane. Similarly, a limited

Table 1. Rare plants of San Bruno Mountain, Montara Mountain and Milagra Ridge. Status as a U.S. Fish and Wildlife Service candidate for listing as endangered or threatened is noted (1980 Federal Register 45:82480-82569).

Species	Family	Distribution	USFWS[1]
Arabis blepharophylla	Cruciferae	Santa Cruz Co. to Sonoma Co.	2
Arctostaphylos imbricata	Ericaceae	endemic to San Bruno Mtn.	1
Arctostaphylos montarensis	Ericaceae	San Bruno and Montara Mtns.	1
Arctostaphylos pacifica	Ericaceae	endemic to San Bruno Mtn.	1
Dichondra donelliana	Convolvulaceae	Bay area including San Bruno Mtn.	-
Erysimum franciscanum	Cruciferae	San Mateo and San Francisco Cos.	2
Grindelia maritima	Compositae	San Francisco area including San Bruno Mtn.	1
Helianthella castanea	Asteraceae	Sierra Pt. and possibly San Bruno Mtn.	1
Lavatera assurgentiflora[2]	Malvaceae	Channel Islands and San Bruno Mtn.	1
Orthocarpus floribundus	Scrophulariaceae	San Mateo Co. to Marin Co.	1

Table 1 (cont.)

Species	Family	Distribution	USFWS[1]
Pentachaeta bellidiflora	Compositae	Santa Cruz Co. to Marin Co.	1
Silene verecunda	Caryophyllaceae	Santa Cruz Co. to San Francisco Co.	1
Tanacetum camphoratum	Asteraceae	Coastal dunes and San Bruno Mtn.	2
Lupinus eximius	Fabaceae	Montara Mtn.	1

[1] 1 = biological information sufficient to support listing, 2 = may warrant listing but further information is required

[2] Population on San Bruno Mountain is introduced

amount of riparian habitat, including several intermittent creeks and one small wetland area, occur on the mountain. Remnants of the salt-marsh community can be observed at Pt. San Bruno and Sierra Pt. Sand dunes were formerly prevalent along the northern, southern and western boundaries of the mountain. Several small, stabilized dune remnants still exist on the saddle and western perimeter of the main ridge.

In their flora of San Bruno Mountain, McClintock et al. (1968) recorded 542 vascular plant taxa, including 384 native and 158 introduced species. Analysis of the floral distributional patterns reveals that approximately 33% of the flora is confined to California, another 22% to the Pacific Coast, 9% to North America, and 5% have Holarctic distributions (McClintock, pers. comm.). Most of the introduced plants are from other temperate regions, but a few are from South Africa [notably iceplant, (Mesembryanthemum sp.)].

San Bruno Mountain is the geographic distributional limit of a few native species (McClintock et al. 1968; McClintock, pers. comm.). For instance, pipe vine [Aristolochia californica Torrey (Aristolochiaceae)], endemic to northern California, has its southernmost locality on San Bruno Mountain. Huckleberry [Vaccinium arbuscula (Gray) Merriam (Ericaceae)], known from forested and montane areas of the Sierra Nevada and Rocky Mountains north to British Columbia, has a disjunct population on the mountain. False lily-of-the-valley [Maianthemum dilatatum (Wood) Nelson & Macbride],

which occurs in eastern Asia and western North America, reaches its southernmost American distribution in San Mateo County.

Community Ecology

The grasslands and to a lesser degree the coastal scrub habitat are disclimax ecosystems, i.e., maintenance and regeneration of the plants characteristic of these ecosystems are dependent upon irregular perturbation processes that preclude normal succession. The larval and adult foodplants for the butterflies and the moth, as well as many of the endemic and rare plants, are dependent upon natural disturbance processes such as rock-slides, mud-slides, and fires to establish their seedlings. Thus preservation of these species requires not only sufficient tracts of natural habitat but also maintenance of the natural disturbance factors which operate on patches of vegetation.

Public ownership of habitat does not necessarily imply that complex natural processes necessary for maintenance of the habitat and species will continue to operate. Perhaps the greatest threat to endemic fauna and flora is ecological change, whether natural or human-induced. Ecosystems are dynamic, fluctuating through time in structure, composition and areal extent. Dynamics are initiated by environmental fluctuation, natural disturbance, species senescence, or other intra-community characteristics. Successions are initiated in some cases or reverted to earlier stages in others. Species may be adapted to temporal patterns as well as spatial gradients.

Change is nature's constant in the various ecosystems on San Bruno Mountain. The first step in resource management is to understand the dynamics of these natural systems and their interacting elements. It was noted that their larval foodplants, Sedum spathulifolium, Viola pedunculata, and 4 species of Lupinus, all are poor competitors and require some form of natural perturbation to establish seedlings. The situation is perhaps most dramatic for Grapholita edwardsiana and its larval foodplant, Lupinus arboreus. On dynamic dune systems, winds constantly shift the sand and secondarily redeposit it creating new mounds. Lupinus arboreus rapidly colonizes these newly opened sand sites and can form rather dense stands within a few years after their creation. However, as other plant species colonize the area, they eventually outcompete the lupine populations. As succession progresses, the lupines gradually die out and are replaced by later successional stage species. In large, natural dune systems, the wind continually creates new pockets of redeposited aeolian sand, so the cycle continues. On small dune remnants, such as those at San Bruno Mountain, the habitat island is so small that no reservior of sand exists. After a site is colonized, it is only a matter of time before later successional stage plants choke out the lupine. Grapholita edwardsiana colonies have been so fragmented by urbanization that intensive management will be required to simulate nature's dynamic perturbation processes necessary for maintenance of the remaining populations.

Similarly, the Lupinus larval foodplants for the Mission blue butterfly are dependent upon natural perturbations to establish seedlings. Under natural grassland conditions, adults of the Mission blue butterfly are widely distributed but occur at a relatively low density (less than 5 adults/ha). Lupinus albifrons, L. formosus, and L. variicolor are also widely dispersed at low densities. The Lupinus larval foodplants of P. i. missionensis are "pioneer" species, i.e., they grow best in areas of recent localized disturbance or in early stages of grassland succession. Patchily distributed dense colonies of these Lupinus are found at sites of natural disturbances (e.g., rodent burrows, mud or rock slides, fire, etc.) throughout the grassland. Adult Mission blue butterfly numbers are markedly higher at these sites. But these colonies eventually senesce as other later successional plants and weeds invade these sites, unless an irregular disturbance regime occurs to permit the Lupinus to propagate.

A roadcut adjacent to Guadalupe Canyon Parkway on the Northeast Ridge served as the study site for capture-recapture, life table, and stage-frequency analysis studies (Arnold 1980, unpublished data). Along this road, which was built in the mid-1960's, dense colonies of L. albifrons have become established. Many of these colonies are now senescent or in competition with other plants. Management techniques such as intermittent scraping or chaining of the roadcut would be required to maintain these colonies. Also, colonies at roadcuts or sites of natural disturbance are ephemeral in relation to the long-term existence of P. i. missionensis, i.e., lupines rapidly become established and in the course of 5 to 50 years they senesce and

disappear. Because areas of dense lupine patches normally vary in space and time, artificial maintenance of one or more particular sites of a comparable age and successional stage may alter the dynamic relationship between lupine patch formation and Mission blue colonization ability.

Under historic conditions, perturbations operate, thereby permitting localized aggregations of Lupinus and the butterfly to establish. On San Bruno Mountain, these colonies are of various ages, i.e., at recently disturbed sites, lupine seedlings and yearlings are established but there are few P. i. missionensis; several dense colonies of the butterfly and lupine ranging in size from 0.3 to 20.0 ha exist; and there are senescent lupine stands that support dwindling numbers of the butterfly. Thus the disturbance processes that allow for colonization of lupine, and subsequently the butterfly, are dynamic, and each colony is dynamic and short-lived. Thus, the butterflies opportunistically utilize localized dense patches of lupine as long as they exist, but as these patches later decline in quality or suitability, the butterflies move to newly created lupine patches. Although it is conceivable that the butterfly could be maintained via intensive and costly management along roadcuts or other dense colonies, this strategy may be inadvisable because of an increased likelihood of disease, predation, or behavior modification. Recovery actions should instead focus on understanding and reducing factors that limit populations within the remaining natural habitat for the species. The ephemeral nature of localized, high

density colonies of lupines and the butterfly may be an important factor in the evolution and long-term survival of P. i. missionensis.

Fire is an important natural perturbation on San Bruno Mountain. Many of the chaparral plants (e.g., Arctostaphylos pacifica, Baccharis, Ceanothus, Monardella, Rhamnus, Vaccinium, etc.) stump sprout after fire or otherwise regenerate themselves (McClintock et al. 1968). Other species, for example Arctostaphylos imbricata and A. montarensis, readily establish seedlings after fire. Many grassland species are also fire adapted. Here periodic fires are needed to reduce the biomass of brush and open up sites for seedling establishment. The three Lupinus foodplants of the Mission blue butterfly are opportunistic invaders and move into areas after fires.

Most fires on San Bruno Mountain presently occur in the summer and fall, a time when larval foodplants for the butterflies have finished their vegetative growth. At this time the butterflies are either pupae or early instar lavae diapausing in the dried leaf litter. If the fuel load is low, a grassland fire is relatively "cool" because the flames burn through an area swiftly and a thin layer of duff is sufficient insulation to protect many pupae and diapausing larvae from burning. Under natural conditions, fires would occur on the average of every few years and burn a large area, probably several hundred acres per occurrence. However in recent years, the frequency of fires has increased (California State Division of Forestry, pers. comm.). A network of fire trails and quick response time by fire fighters have resulted in most of the recent fires on the mountain burning less than

12 ha (25 acres). Despite their adaptations to fire, many of the plants and animals may not be able to survive the increased frequency of fires. Also, the distribution of fires on the mountain has in recent years become more localized. Today most fires occur on slopes at the mountain's perimeter in grassland habitat and are contained before moving into the chaparral or burning large areas within the grassland. The absence of fires within the same general area has permitted an increased fuel load to accumulate in some chapparal and grassland sites. Thus a fire in these areas will be "hotter" and potentially more damaging to wildlife and plants.

As further development of the mountain is realized, additional changes in fire ecology will undoubtedly occur. Development will significantly reduce the amount of habitat available for the endangered and endemic organisms. Thus a 12 ha fire would burn a considerably larger proportion of the remaining habitat. With houses and more people in the area, the frequency of fires will likely increase. Also, fires may occur at times of the year when organisms are least able to survive them. More residents on the mountain will result in quicker reporting of fires, thus less acreage of the mountain may burn. Residents might not tolerate controlled burns, a probable management technique. Thus reduction of fire frequency could lead to further alteration of the vegetation and threaten the survival of the endangered and endemic organisms.

Minimum areas to sustain butterfly or plant populations and their habitats are difficult to estimate. Observed estimates of the range

of movement of the species are 1 to 20 acres. These estimates are not necessarily representative of minimum areas needed to sustain the species. Both of the endangered butterflies on San Bruno Mountain have suffered loss of habitat. The essential habitat of other species of concern may also have been reduced. Today the mountain is a biological island of habitat, with urbanization rather than natural habitat as the surrounding landscape. Although Callophrys mossii bayensis and Plebejus icarioides missionensis inhabit only about 300 ha and 800 ha respectively on San Bruno Mountain, it would be misleading to imply that these currently occupied habitats are alone adequate for the perpetuity of these taxa. Endogenous as well as exogenous factors are important in creating and maintaining these patches of habitat. Largescale development may irreversibly alter the natural patch dynamics and perturbation processes through further fragmentation of the site.

Thus expensive and labor intensive management practices would probably be necessary to maintain these taxa and their habitats. Although small colonies of these taxa could probably persist for several years, the increased likelihood of catastrophe suggests that their persistence might be considerably less than if no development occurred.

Nearest populations of the San Bruno elfin and Mission blue butterflies, which could serve as recolonization sources for San Bruno Mountain colonies, are more distant than the longest movements observed during capture-recapture studies. Natural extinction of

localized populations frequently occurs in the Bay checkerspot butterfly, followed by recolonization from neighboring colonies (Ehrlich et al. 1980), and is an important process in the long-term maintenance of populations of this butterfly. A similar situation probably exists for the Mission blue butterfly, San Bruno elfin butterfly, and perhaps other species of concern. Thus it is important to maintain the maximum area of undeveloped habitat for these taxa on San Bruno Mountain because recolonization from more distant populations seems an unlikely process for the reestablishment of locally extinct populations on San Bruno Mountain.

Threats to Survival

Today, San Bruno Mountain is an island of habitat encompassed by a sea of urbanization. Wholesale destruction of the mountain was prevented because it has been in a single private ownership since the 1880's and also due to its topography, which is dominated by steep slopes and canyons. Nonetheless, human activities have substantially altered the natural vegetation and topography of San Bruno Mountain. Habitat loss has resulted from, roadway, utility, home, industrial and commercial construction, rock and sand quarrying, livestock grazing, invasion of exotic species, groundwater diversion, off-road vehicle (ORV) activity and changes in fire size and frequency.

Livestock grazing has occurred on San Bruno Mountain since the Mexican land-grant acquisition. This activity has encouraged the growth of weedy annuals and other exotic plants in the grasslands and reduced

the amount of chaparral. The transition from native perennial bunch grasses to introduced annuals is attributed to grazing and to an increased frequency of fires. McClintock et al. (1968) noted that 24 of the 50 grass species identified from San Bruno Mountain grasslands were exotics. Among the remaining native grasses were 3 perennials endemic to California, 7 species (including 6 perennials) with ranges extending just north or south of the state's boundaries, and 11 species limited to the Pacific Coast (McClintock, pers. comm.).

Although much of the mountain's physiography has remained intact, major exceptions include the town of Brisbane, located at the eastern end of the main ridge, the large rock quarry located midway on the north side of the main ridge, and the sand quarry-landfill in Colma on the southwestern flank of the mountain. Presumably the area occupied by Brisbane formerly supported populations of the Mission blue butterfly. A major colony of the San Bruno elfin butterfly was destroyed by expansion of the rock quarry in 1978. This excavation, operated by Quarry Products Inc., also usurped habitat for the Mission blue butterfly. Several smaller rock quarries lie abandoned around the base of the mountain.

Crocker Industrial Park, consisting of 136 ha (335 acres) and lying on the floor of Guadalupe Valley, destroyed habitat for the Mission blue butterfly. About 9 ha (22 acres) along the main ridge of San Bruno Mountain have been developed as an antenna "farm" with transmission towers for several Bay area radio and television stations (Watson Communications Corporation). Construction and maintenance activities

have adversely affected the habitat of both endangered butterflies, plus several of the rare plants.

Approximately 158 exotic plant species now reside on the mountain, comprising nearly 30% of the entire flora (McClintock et al. 1968). Many of the exotics are aggressive and noxious plants, especially 3 species of Cytisus (broom), Eucalyptus globulus, Ulex europaeus L. (gorse), and Mesembryanthemum edule L. (iceplant). Numerous fire and utility trails plus roadways have opened pathways for establishment of many exotic species now firmly entrenched on the mountain.

Today, proposed housing and commercial developments on the Northeast Ridge, south slope area of the main ridge at South San Francisco, and Reservoir Hill at Daly City could destroy or irreversably alter approximately 272 ha (671 acres) of existing habitat for rare Lepidoptera, including the Mission blue butterfly. Additionally, county park development, if ill-planned, could adversely impact the San Bruno elfin and Mission blue butterflies. The use permit granted by San Mateo County for the rock quarry expires in five years and can be renewed for another five years. At the end of that time, the quarry is scheduled to close. A reclamation plan for the property is being reviewed by San Mateo County. It emphasizes the need for revegetation of excavated areas with native plants (M. Carpenter, pers. comm.).

Preservation Efforts

Concerned local citizens have strived for years to preserve much of San Bruno Mountain in a near-natural state. But due to the proximity of San Francisco, San Bruno Mountain is very valuable real estate. Homes first dotted the mountain's landscape when Visitacion City (now Brisbane) was conceived to serve as a temporary residence for those displaced by the 1906 San Francisco earthquake and fire. Perhaps the most elaborate scheme to develop the mountain occurred in the 1950's when airport planners proposed to use the mountain as landfill in the Bay to create the new San Francisco airport. In 1971, Crocker Land Co. unveiled a plan to introduce 51,000 residents on the mountain. This original plan was denied by county officials.

In November 1972, a Charter Amendment was passed by the electorate of San Mateo County to provide funds for acquisition and development of park lands over a 10-year period on San Bruno Mountain. A lengthy process of site evaluation, environmental impact reports and negotiations culminated in 1978 with the acquisition of 692 ha (1710 acres) on the northwest portion of the main ridge. A combination purchase and donation by Visitacion Associates to California State Parks Foundation resulted in the acquisition of 121 ha (298 acres) of the Saddle. Responsibility for management of this parcel belongs to the San Mateo County Parks and Recreation Department. As noted earlier, most of the remaining undeveloped area on the mountain is owned by Visitacion Associates and other private land owners, who have proposed several housing developments within the range of the Mission blue butterfly.

During 1980, the San Bruno Mountain Steering Committee was formed to investigate issues surrounding the potential private developments as they relate to rare plant and animal species on the mountain. The Steering Committee was composed of representatives from the landowners, developers, County of San Mateo, nearby city governments, California Department of Fish and Game, U.S. Fish and Wildlife Service, and California Department of Forestry. The purpose of the Steering Committee was to develop a Habitat Conservation Plan (HCP) for the San Bruno Mountain area that would address the conflict between housing construction and endangered species in a manner that would provide for the protection of the species. Implementation of the HCP is designed to allow private and public developments on the mountain to proceed in a way that minimizes the adverse effects on endangered species. Further, the long-term purpose of the HCP is the conservation and enhancement of all species of concern including the Mission blue and San Bruno elfin butterflies. Because of the anticipated long-term benefit of the HCP on the Mission blue butterfly, the U.S. Fish and Wildlife Service has issued a permit under Section 10(a) of the Endangered Species Act to allow incidental take (i.e., harassment or killing) of this endangered species. The U.S. Fish and Wildlife Service is authorized to issue such a permit under the Endangered Species Act if taking will ultimately enhance the prospects for survival of a species. In this way, development of portions of the mountain could proceed, but in a manner that would be of long-term benefit to the Mission blue butterfly.

The San Bruno elfin butterfly occurs at higher elevation areas on San Bruno Mountain that are not included in the proposed developments but are largely privately owned and subject to housing development pressures. It is the intent of the HCP that the developments will not result in the take (i.e., harrassment or killing) of any San Bruno elfin butterflies [San Bruno Mountain Habitat Conservation Plan Steering Committee (SBMHCPSC) 1982].

Prior to development of the HCP, San Mateo County hired an environmental consulting firm, Thomas Reid Associates of Palo Alto, to determine the population size and structure of Callippe silverspot and Mission blue butterflies on San Bruno Mountain. The results of this investigation (Reid et al. 1980) and the earlier work of Arnold (1980, 1981b, and reported herein) formed the biological basis upon which the Steering Committee developed the HCP.

Initially, the HCP will allow the loss of 14% of the Mission blue butterfly habitat on the mountain (SBMHCPSC 1982). The HCP proposes to eventually reclaim approximately one-quarter of this amount after construction. To offset the 14% loss, the HCP calls for private owners to convey 324 ha (800 acres) of private land to the San Mateo County Parks and Recreation Department. Thus, 81% of the open space present in 1982 would be in public ownership (SBMHCPSC 1982). Development, as provided for in the HCP, would occur on 11% (149 ha, 468 acres) of the remaining open space. No plans exist for the remaining 8% open space. The developers will also be required to

contribute funds for the preservation and maintenance of remaining habitat. According to the HCP, funds will be raised through initial contributions followed by levies on the property after development.

PART II. RECOVERY

Objectives

The primary objective of this Recovery Plan for the San Bruno Elfin and Mission Blue Butterflies is to maintain and enhance existing populations of these endangered species throughout their range. Reclassification of the San Bruno elfin butterfly to threatened can be considered when secure, self-sustaining colonies of this species are established and/or reestablished on Milagra Ridge, Montara Mountain, Peak Mountain and Whiting Ridge and when 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. 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 Ft. Baker (one colony at each site) and when existing colonies on San Bruno Mountain (as noted in the HCP*) are secure. Colony size and dynamics necessary for a

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* Thomas Reid Associates (1983) divided the Mission blue population on San Bruno Mountain into 4 colonies: Guadalupe Hills, Southeast Ridge, Radio Ridge and Reservoir Hill. Interbreeding among individuals of the colonies now has been demonstrated and, therefore, the 4 colonies are often considered as a single population.

population to be self-sustaining in perpetuity will be determined for both species. Delisting of these species will be contingent upon protection, maintenance, and/or expansion of current colonies and establishment of additional colonies.

Population segments of these butterflies will probably remain small in size and distant from potential recolonization sources. Thus they will continue to be vulnerable to extirpation by natural catastrophe, disease, parasitism or pollution. Such populations or colonies will need to be enhanced to insure long-term survival.

Secondary objectives of the recovery plan are to rehabilitate ecosystems that have been altered by exotic plant introductions, ORV activity or urbanization. Inadequate implementation of this plan, especially the habitat protection and management phases, will result in further loss and alteration of habitat and increased threats to the survival of the species of concern.

This plan identifies known essential requirements for the perpetuation and recovery of the San Bruno elfin and Mission blue butterflies. It proposes a comprehensive array of short- and long-term activities to meet these objectives. These actions are directed at the autecologies of Federally listed endangered species and synecologies of their respective habitats. These protection, management and rehabilitation activities will also benefit the species of concern as well as numerous other wildlife and plant species not specifically mentioned

in this plan, and enhance opportunities for public awareness of these conservation issues. The costs for necessary actions may be shared between a number of complementary projects and agencies.

Step-down Outline

Prime Objective: The primary objective of the Recovery Plan for the San Bruno Elfin and Mission Blue Butterflies is to protect, maintain and enhance existing populations of these endangered species throughout their range. Reclassification of the San Bruno elfin butterfly to threatened can be considered when secure, self-sustaining colonies of this species are established and/or reestablished on Milagra Ridge, Montara Mountain, Peak Mountain and Whiting Ridge and when 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. 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 Ft. Baker (one colony at each site) and when colonies on San Bruno Mountain (as noted in the HCP) are secure. Colony size and dynamics necessary for a population to be self-sustaining in perpetuity will be determined for both species. Delisting of these species will be contingent upon protection, maintenance and/or expansion of current colonies and establishment of additional colonies.

1. Protect essential habitat of the San Bruno elfin and Mission blue butterflies.

11. Secure essential habitat on San Bruno Mountain through cooperative agreements, easements or other protection strategies.

    111. San Mateo County Parks and Recreation Department.

    112. California State Parks Foundation.

    113. Quarry Products, Inc.

    114. Visitacion Associates.

    115. Telecommunication Properties - Watson Communications Corporation

    116. Pacific Gas and Electric.

    117. Bank of America.

    118. City of Brisbane.

    119. Daly City.

12. Secure essential habitat outside San Bruno Mountain through cooperative agreements, easements or other protection strategies.

    121. San Mateo County Parks and Recreation Department - Milagra Ridge.

    122. City of San Francisco - Twin Peaks.

    123. California Department of Fish and Game - San Francisco State Fish and Game Refuge (Montara Mountain area).

    124. U.S. Government, General Services Administration - Milagra Ridge.

    125. U.S. Army - Ft. Baker.

    126. Private property owners - Montara Mountain, Peak Mountain, Whiting Ridge and Milagra Ridge.

2. Prevent further degradation of habitat and enhance habitat when possible.
   21. Minimize use of herbicides, insecticides and other toxic substances.
   22. Control ORV activity.
   23. Remove exotic weeds.
   24. Transplant selected native flora.
   25. Improve seedling establishment of native flora.
3. Develop and implement management plans for existing colonies of San Bruno elfin and Mission blue butterflies.
   31. Gather additional information on bionomics.
      311. Inventory butterflies and their foodplants for baseline data.
      312. Conduct annual surveys of butterflies, and their foodplants and degree of threats.
      313. Determine synecological relationships.
      314. Determine biological requirements of larval and adult foodplants.
      315. Investigate biology of tending ant species.
      316. Identify perturbation processes.
   32. Determine population and habitat criteria necessary for reclassifying the butterflies to threatened and eventually delisting.
      321. Determine necessary sizes of colonies.
      322. Determine necessary habitat quality and quantity.
   33. Evaluate data and develop long-term management plans.

331. San Bruno elfin and Mission blue butterflies on San Bruno Mountain.

332. San Bruno elfin butterfly on Milagra Ridge, Montara Mountain, Peak Mountain and Whiting Ridge.

333. Mission blue butterfly on Twin Peaks and Ft. Baker.

4. Reestablish San Bruno elfin and Mission blue butterflies in restored or rehabilitated habitat within their historical ranges.

41. Select potential sites.

42. Secure selected sites through cooperative agreements, easements or other protective strategies.

43. Restore selected habitat sites.

431. Remove exotic or otherwise unwanted fauna or flora and other deleterious materials.

432. Introduce necessary biological components.

44. Obtain butterflies and reintroduce into restored sites.

5. Increase public awareness of San Bruno elfin and Mission blue butterflies and their habitats.

51. Prepare TV and radio spot programs.

52. Prepare and distribute brochures and audio-visual programs on preservation and recovery.

6. Enforce laws and regulations to protect the San Bruno elfin and Mission blue butterflies and their habitats.

61. Enforce Federal regulations.

62. Enforce State regulations.

63. Enforce County zoning and growth restriction ordinances.

64. Enforce City regulations and ordinances.

65. Evaluate effectiveness of current regulations and propose necessary revisions or new regulations.

Narrative

1. Protect essential habitat of the San Bruno elfin and Mission blue butterflies.

Essential habitat for both butterflies must be secured. Protection of these areas is a high priority and necessary to prevent further declines in distribution and abundance of the San Bruno elfin and Mission blue butterflies.

11. Secure essential habitat on San Bruno Mountain through cooperative agreements, easements or other protection strategies.

The San Bruno Mountain Habitat Conservation Plan provides security for much of the essential habitat for Mission blue and San Bruno elfin butterflies on the mountain. Results of the Habitat Conservation Plan should be analyzed and any additional protection that is needed should be pursued.

111. San Mateo County Parks and Recreation Department.

Additional long-term agreements should be secured with the County, as necessary.

112. California State Parks Foundation.

Additional long-term agreements should be secured with the State, as necessary.

113. Quarry Products, Inc.

Additional long-term agreements should be secured with Quarry Products, as necessary.

114. Visitacion Associates.

Additional long-term agreements should be secured with Visitacion Associates, as necessary.

115. Telecommunication Properties - Watson Communications Corporation.

Additional long-term agreements should be secured with Telecommunication Properties - Watson Communications Corporation, as necessary.

116. Pacific Gas and Electric.

Additional long-term agreements should be secured with Pacific Gas and Electric, as necessary.

117. Bank of America.

Additional long-term agreements should be secured with Bank of America, as necessary.

118. City of Brisbane.

An agreement with the City of Brisbane addressing the permit process for private developments is needed.

119. Daly City.

An agreement with Daly City addressing the permit process for private developments is needed.

12. Secure essential habitat outside San Bruno Mountain through cooperative agreements, easements or other protection strategies.

Management agreements, conservation easements, memoranda of understanding or acquisition will be necessary to protect essential habitat on Milagra Ridge, Ft. Baker, Twin Peaks, Montara Mountain, Peak Mountain and Whiting Ridge.

121. San Mateo County Parks and Recreation Department - Milagra Ridge.

Protection of County lands on Milagra Ridge should be pursued by the most appropriate method.

122. City of San Francisco - Twin Peaks.

Protection of City lands in the Twin Peaks area should be pursued by the most appropriate method. Protection of this habitat is a high priority because it is one of only two colonies of Mission blue butterflies outside San Bruno Mountain.

123. California Department of Fish and Game - San Francisco State Fish and Game Refuge (Montara Mountain area).

Protection of State lands in the San Francisco State Fish and Game Refuge should be pursued by the most appropriate method.

124. U.S. Government, General Services Administration - Milagra Ridge.

Protection of Federal lands on Milagra Ridge should be pursued by the most appropriate method.

125. U.S. Army - Ft. Baker.

Protection of Army lands at Ft. Baker should be pursued by the most appropriate method. Along with the Twin Peaks site, protection of Mission blue butterfly habitat at Ft. Baker is a high priority because of the very limited amount of habitat available to the species outside San Bruno Mountain.

126. Private property owners - Montara Mountain, Peak Mountain, Whiting Ridge and Milagra Ridge.

Protection of habitat on private property on Montara Mountain, Peak Mountain, Milagra Ridge and Whiting Ridge should be pursued by the most appropriate method.

2. Prevent further degradation of habitat and enhance habitat when possible.

Until long-term management plans are developed and implemented, several measures that will reduce habitat degradation and enhance existing habitat are proposed. On San Bruno Mountain, these actions are addressed in the HCP.

21. Minimize use of herbicides, insecticides and other toxic substances.

The use of toxic substances within the essential habitat of San Bruno elfin and Mission blue butterflies should be prohibited or minimized. Physical removal of unwanted flora is preferred.

22. Control ORV activity.

Off-road vehicle activity should be curtailed or prohibited within essential habitat.

23. Remove exotic weeds.

Several exotic plant species, especially Ulex europaeus, Mesembryanthemum, Cytisus, Cortaderia selloana, Cupressus macrocarpa, Eucalyptus globulus, and various landscape species should be removed. Because eucalyptus and cypress trees are attractive features in a park, containment rather than elimination may be an acceptable management practice. However, the other shrubs and herbs are noxious and extremely

aggressive, and should be eradicated swiftly. Baseline data on the most cost-effective and biologically compatible eradication techniques are needed.

24. Transplant selected native flora.

Plants native to San Bruno Mountain should be used to replace the exotic plant species.

25. Improve seedling establishment of native flora.

A vigorous population of foodplants is vital to maintenance of the butterfly colonies. Seedling establishment of foodplants and other native plants can be enhanced by removal of exotic species and debris as well as cessation of deleterious habitat management practices.

3. Develop and implement management plans for existing colonies of San Bruno elfin and Mission blue butterflies.

The long-term survival of these butterflies depends on protection of essential habitat as well as maintenance and enhancement of colonies. Management plans are needed to successfully complete maintenance and enhancement procedures for existing colonies.

31. Gather additional information on bionomics.

Additional biological information is necessary to develop optimal management plans.

311. Inventory butterflies and their foodplants for baseline data.

Although information concerning the distribution of the butterflies and their foodplants are available and given herein, these data should be updated and detailed maps developed showing the butterflies precise range and the range of the foodplants.

312. Conduct annual surveys of butterflies, their foodplants and degree of threats.

The status of the butterflies and their foodplants should be monitored on a regular basis and results incorporated into baseline survey maps (task 311). Threats to the butterflies and their habitats should be reviewed and documented annually.

313. Determine synecological relationships.

Additional information on climatic and geologic factors are needed. Preliminary climatic studies (Duckworth and Perkins 1968) have been performed, but more detailed accounts are needed to adequately understand the interactions of these species, their habitats and physical environments.

314. Determine biological requirements of larval and adult foodplants.

Factors limiting the distribution and abundance of

foodplants should be determined so that management objectives aimed at improving foodplant status can be developed.

315. Investigate biology of tending ant species.

Tending ants may be of critical importance in reducing levels of predation and parasitism on larval butterflies. The biological requirements and roles of the tending ant species should be investigated.

316. Identify perturbation processes.

The role of perturbation processes in the establishment and maintenance of larval and adult foodplants should be identified.

32. Determine population and habitat criteria necessary for reclassifying the butterflies to threatened and evenually delisting.

Although the numbers of colonies necessary to reclassify both butterflies to threatened status are suggested in the Prime Objective, colony size and habitat area necessary to insure the long-term survival of these populations are unknown.

321. Determine necessary sizes of colonies.

The sizes of colonies necessary to allow long-term survival of the species and to allow individuals from a nearby population to reestablish any colony that is

extirpated by natural or man-induced processes should be determined.

322. Determine necessary habitat quality and quantity.

The amount and quality of habitat necessary for long-term survival of a colony should be determined.

33. Evaluate data and develop long-term management plans.

Data from the above studies should be used to develop management plans. The San Bruno Mountain Habitat Conservation Plan (HCP) represents one model for long-term management plans that may be desirable elsewhere in the ranges of the species.

331. San Bruno elfin and Mission blue butterflies on San Mountain.

A long-term management plan should be developed for all colonies of both butterflies on San Bruno Mountain. It is believed that the HCP will adequately fulfill this task.

332. San Bruno elfin butterfly on Milagra Ridge, Montara Mountain, Peak Mountain, and Whiting Ridge.

Long-term, management plans should be developed for remaining colonies of the San Bruno elfin butterfly off San Bruno Mountain.

333. Mission blue butterfly on Twin Peaks and Ft. Baker. Long-term management plans should be developed for colonies of the Mission blue butterfly off San Bruno Mountain.

4. Reestablish San Bruno elfin and Mission blue butterflies in restored or rehabilitated habitat within their historical ranges. Colonies of both endangered butterflies have been destroyed by loss of natural habitat. Such colonies should be identified and analyzed for potential recolonization efforts.

41. Select potential sites.

Former colony sites on and off San Bruno Mountain should be investigated. For example, rock quarrying operations by Quarry Products, Inc., destroyed one colony of the elfin butterfly in 1978 and seriously damaged another. Adjacent colonies of the Mission blue butterfly were also affected. A reclamation plan for the quarry should include provisions for reestablishment of the chaparral vegetation at higher elevations (e.g., greater than 100 m), and grassland at lower elevations. In addition, implementation of the HCP should result in some restored and/or rehabitated habitat that would be available for both butterflies.

42. Secure selected sites through cooperative agreements, easements or other protective strategies.

After recolonization sites are identified, the habitat should be secured by the most appropriate method.

43. Restore selected habitat sites.

Once the sites have been secured, habitat restoration can begin.

431. Remove exotic or otherwise unwanted fauna or flora and other deleterious materials.

Exotic flora that would compete with larval or adult foodplants should be removed.

432. Introduce necessary biological components.

Native vegetation, including larval and adult foodplants, and any other important biological components (e.g., ants) should be introduced.

44. Obtain butterflies and reintroduce into restored sites.

If recolonization does not occur naturally, butterflies from a nearby colony should be reintroduced. If natural colonies are greatly depleted, propagation of captive individuals will be necessary to obtain stock for reintroduction.

5. Increase public awareness of San Bruno elfin and Mission blue butterflies and their habitats.

Efforts to preserve the endangered species and unique habitats could be greatly facilitated by educational activities that better inform the public of the species and their values.

51. Prepare TV and radio spot programs.

Spot programs on local radio and TV stations could enhance public awareness of remaining areas of natural habitat and their values.

52. Prepare and distribute brochures and audio-visual programs on preservation and recovery.

The County park on San Bruno Mountain will eventually have an interpretive museum and ranger station. Audio-visual displays on the natural history and ecology of the biota should form an integral part of the museum's educational program. Rangers would lead interpretive tours of the mountain. Brochures discussing the status and preservation efforts for both species throughout their range should be prepared and distributed.

6. Enforce laws and regulations to protect the San Bruno elfin and Mission blue butterflies and their habitats.

Existing laws and regulations which protect the endangered species and their habitats should be enforced at all sites.

61. Enforce Federal regulations.

The Endangered Species Act and other applicable Federal regulations should be strictly enforced.

62. Enforce State regulations.

Applicable State regulations should be strictly enforced.

63. Enforce County zoning and growth restriction ordinances.

Applicable County ordinances and provisions of the HCP should be strictly enforced.

64. Enforce City regulations and ordinances.

Applicable local ordinances should be strictly enforced.

65. Evaluate effectiveness of current regulations and propose necessary revisions or new regulations.

Existing regulations should be analyzed every two years to determine their effectiveness in preserving the endangered butterflies and their habitats. If additional regulations or revisions of existing regulations are deemed advisable, they should be expeditiously proposed.

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PART III. IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows, is a summary of scheduled actions and costs for the San Bruno elfin and Mission blue butterflies recovery program. It is a guide to meet the objectives of the Recovery Plan for the San Bruno Elfin and Mission Blue Butterflies, as elaborated upon in Part II, Narrative. This schedule indicates the general category for implementation (I = information gathering, M = management, A = acquisition, O = other), recovery plan tasks, corresponding action outline numbers, task priorities, duration of the tasks, which agencies are responsible to perform these tasks, and lastly, the estimated costs to perform them. Implementing Part III is the <u>action</u> of the recovery plan, that when accomplished, should bring about the recovery of the endangered butterflies and protection of their habitats.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law Enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

1 = an action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

2 = an action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

3 = all other actions necessary to provide for full recovery of the species.

PART III. IMPLEMENTATION SCHEDULE

General Category	Task	Task Number	Priority	Duration of Tasks (Yrs.)	Cooperating Agencies FWS Region	FWS Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments
PROTECT ESSENTIAL HABITAT ON SAN BRUNO MOUNTAIN:											
A7	Secure essential habitat on San Bruno Mountain through cooperative agreements, easements or other protection strategies	11	1	Ongoing	1	SE	SMC* CDFG Brisbane Visitation Associates et al.	To Be Determined			Includes tasks 111-119. Habitat Conservation Plan accomplishes this task. Amendment to the HCP may be necessary or additional long-term management plans may be required in the future.
SECURE ESSENTIAL HABITAT OUTSIDE SAN BRUNO MOUNTAIN:											
A7	San Mateo County Parks and Recreation Department - Milagra Ridge	121	2	1	1	SE*	CDFG SMC		0.5 0.5 1		Costs for implementing tasks 121-126 are largely administrative.
A7	City of San Francisco-Twin Peaks	122	1	1	1	SE	CSF*	1 1			
A7	California Department of Fish and Game - San Francisco State Fish and Game Refuge (Montara Mountain area)	123	2	1	1	SE	CDFG*		0.5 1		
A7	U.S. Government, General Services Administration - Milagra Ridge	124	2	1	1	SE*			1		

General Category	Task	Task Number	Priority	Duration of Tasks (Yrs.)	Cooperating Agencies FWS Region	FWS Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments
A7	U.S. Army - Ft. Baker	125	1	1	1	SE*		1			
							USA	1			
A7	Private property owners - Montara Mountain, Peak Mountain, Whiting Ridge and Milagra Ridge.	126	2	1	1	SE				1	
							CDFG			1	
							SMC*			1	
PREVENT FURTHER DEGRADATION OF HABITAT AND ENHANCE HABITAT:											
M3	Minimize use of herbicides, insecticides and other toxic substances	21	1	Ongoing			CDFG*	1	1	1	For tasks 21-25: County is lead agency on San Bruno Mountain, City of San Francisco is lead agency on Twin Peaks and CDFG is lead agency on other lands.
							SMC*	1	1	1	
							CSF*	1	1	1	
M3	Control ORV activity	22	1	Ongoing			CDFG*	1	1	1	
							SMC*	1	1	1	
M3	Remove exotic weeds	23	1	Ongoing			SMC*	1	1	1	
							CDFG*	1	1	1	
M3	Transplant selected native flora	24	2	Continuous			CDFG*		5	5	
M3	Improve seedling establishment of native flora	25	2	Continuous			CDFG*		3	2	
GATHER ADDITIONAL INFORMATION ON BIONOMICS:											
I1	Inventory butterflies and their foodplants	311	3	1	1	SE			2		
							CDFG*		2		

General Category	Task	Task Number	Priority	Duration of Tasks (Yrs.)	Cooperating Agencies FWS Region	FWS Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments
I1	Conduct annual surveys of butterflies, their foodplants and degree of threat	312	3	Continuous	1	SE	CDFG*			2 2	Task begins FY 3.
I3	Determine synecological relationships	313	3	2	1	SE	CDFG*			2 3	Tasks to be completed in FY 4.
I3	Determine biological requirements of larval and adult foodplants	314	3	2	1	SE	CDFG*		2 3	2 3	
I14	Investigate biology of tending ant species	315	3	2	1	SE*	CDFG			2 2	Task to be completed in FY 4.
I14	Identify perturbation processes	316	3	2	1	SE*	CDFG		2 1	2 1	
DETERMINE POPULATION AND HABITAT CRITERIA NECESSARY FOR RECLASSIFYING THE BUTTERFLIES:											
I6	Determine necessary sizes of colonies	321	3	2	1	SE*	CDFG			3 2	Task to be completed in FY 4.
I3	Determine necessary habitat quality and quantity	322	3	2	1	SE*	CDFG			3 2	Task to be completed in FY 4.
EVALUATE DATA AND DEVELOP LONG-TERM MANAGEMENT PLANS:											
M7	San Bruno elfin and Mission blue butterflies on San Bruno Mountain	331	2	Ongoing	1	SE	CDFG SMC*	0.5 0.5 0.5	0.5 0.5 0.5	0.5 0.5 0.5	The HCP may require modifications as implementation proceeds.

General Category	Task	Task Number	Priority	Duration of Tasks (Yrs.)	Cooperating Agencies FWS Region	FWS Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments
M7	San Bruno elfin butterfly on Montara Mountain, Peak Mountain, Whiting Ridge and Milagra Ridge	332	3	1	1	SE*				2	
							CDFG			2	
							SMC			2	
M7	Mission blue butterfly on Twin Peaks and Ft. Baker	333	2	1	1	SE*				1	
							CDFG			2	
							CSF			2.5	
							USA			0.5	
REESTABLISH SAN BRUNO ELFIN AND MISSION BLUE BUTTERFLIES IN RESTORED AND REHABILITATED HABITAT:											
M2	Select potential sites	41	3	1	1	SE*				1	
							CDFG			1	
A7	Secure selected sites through cooperative easements or other protective strategies	42	3	1	1	SE*					Task is to be completed in FY 4. Cost to be determined.
M3	Restore habitat sites	43	3	1	1	SE*					Task to be completed in FY 5. Cost to be Determined. Includes 431 and 432.
							CDFG				
M3	Obtain butterflies and reintroduce into restored sites	44	3	2	1	SE*					Task to be completed in FY 7. Cost to be determined.
							CDGF				
INCREASE PUBLIC AWARENESS:											
01	Prepare TV and radio spot programs	51	3	2	1	SE*			3	3	

General Category	Task	Task Number	Priority	Duration of Tasks (Yrs.)	Cooperating Agencies FWS Region	FWS Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments
01	Prepare and distribute brochures and audio-visual programs on preservation and recovery	52	3	2			SMC*		2	2	
ENFORCE LAWS AND REGULATIONS:											
02	Enforce Federal regulations	61	1	Continuous	1	LE*		1	1	1	
02	Enforce State regulations	62	1	Continuous			CDFG*	1	1	1	
02	Enforce County zoning and growth restriction ordinances	63	1	Ongoing			SMC*	3	3	3	
02	Enforce City regulations and ordinances	64	1	Continuous			City of Brisbane	0.5	0.5	0.5	
							Daly City	0.5	0.5	0.5	
							City of S. San Francisco	0.5	0.5	0.5	
02	Evaluate effectiveness of current regulations and propose necessary revisions or new regulations	65	2	Ongoing	1	SE*		0.5	0.5	0.5	
							CDFG	0.5	0.5	0.5	

* = lead agency
Ongoing = task currently underway and will continue from year to year
Continuous = when funding becomes available, task will continue from year to year
Abbreviations are as follows:
SE = U.S. Fish and Wildlife Service (Endangered Species Program)
LE = U.S. Fish and Wildlife Service (Law Enforcement)
CDFG = California Department of Fish and Game
SMC = San Mateo County
CSF = City of San Francisco
USA = U.S. Army

APPENDIX A

Figure Legends

Figure 3. Essential habitat for San Bruno elfin butterfly on San Bruno Mountain.

Figure 4. Essential habitat for San Bruno elfin butterfly on Milagra Ridge.

Figure 5. Essential habitat for San Bruno elfin butterfly in the Montara Mountain area.

Figure 6. Essential habitat for Mission blue butterfly on San Bruno Mountain.

Figure 7. Essential habitat for Mission blue butterfly on Twin Peaks.

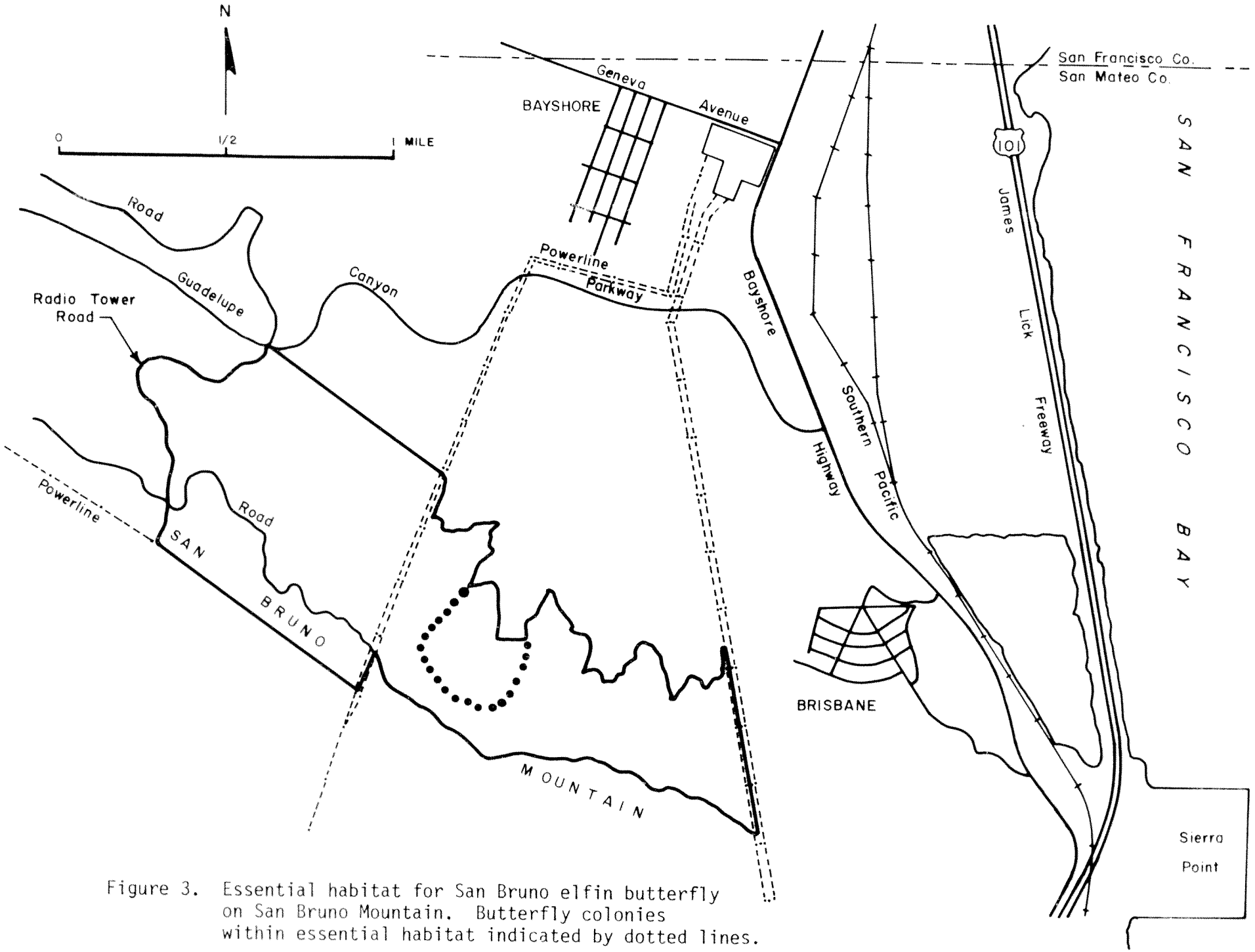

Figure 3. Essential habitat for San Bruno elfin butterfly on San Bruno Mountain. Butterfly colonies within essential habitat indicated by dotted lines.

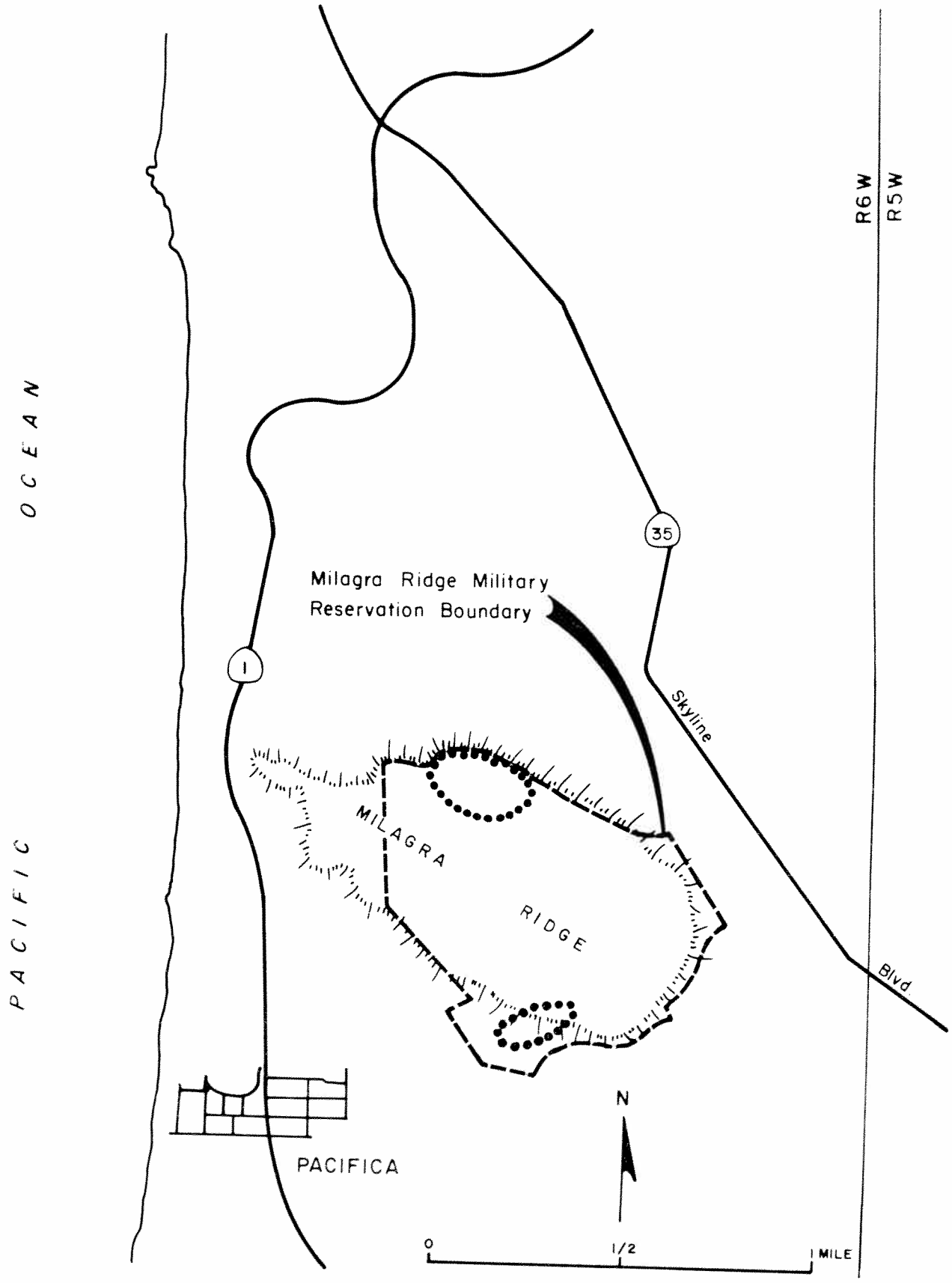

Figure 4. Essential habitat for San Bruno elfin butterfly on Milagra Ridge. Butterfly colonies within essential habitat indicated by dotted lines.

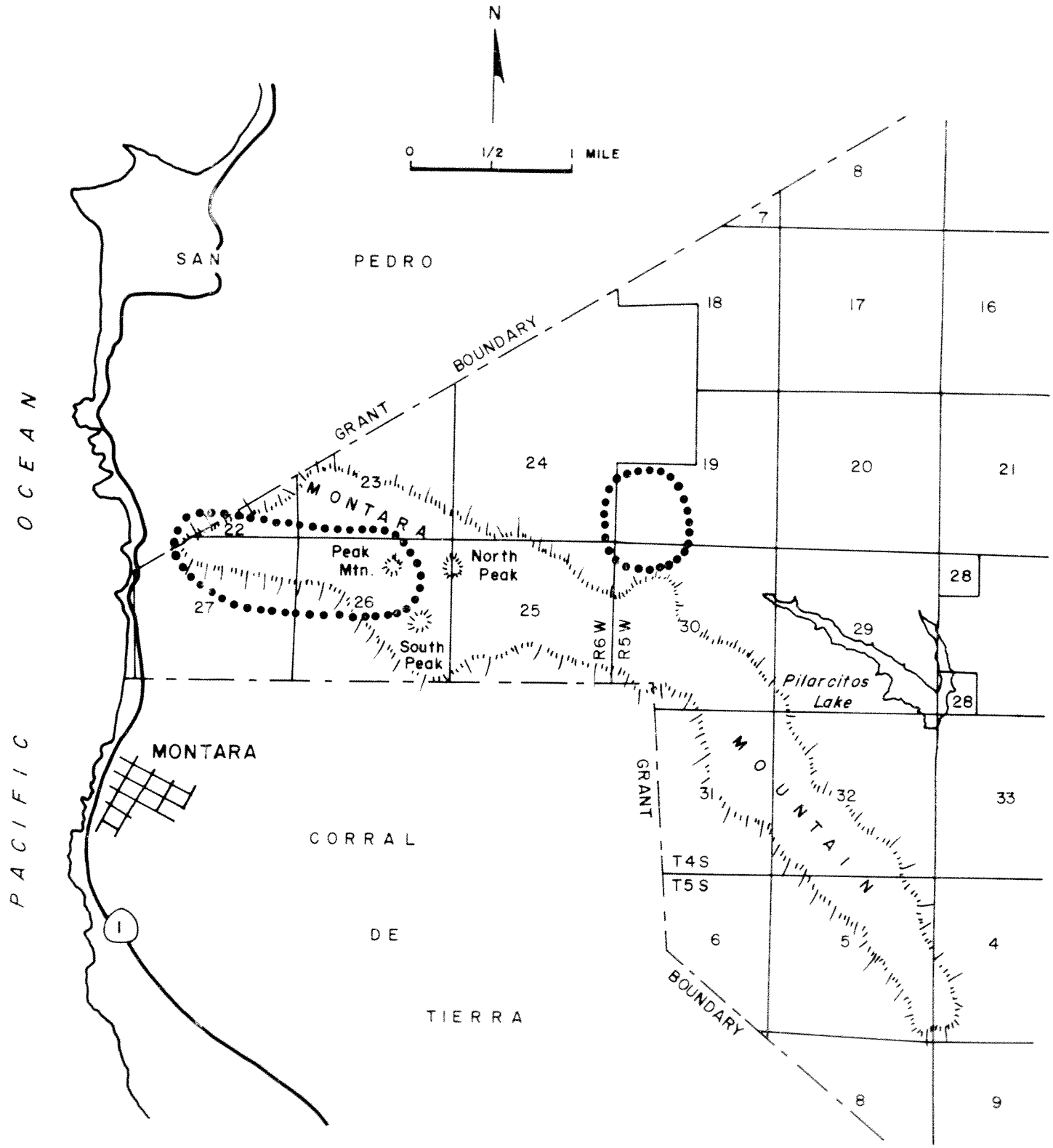

Figure 5. Essential habitat for San Bruno elfin butterfly in the Montara Mountain area. Butterfly colonies within essential habitat indicated by dotted lines.

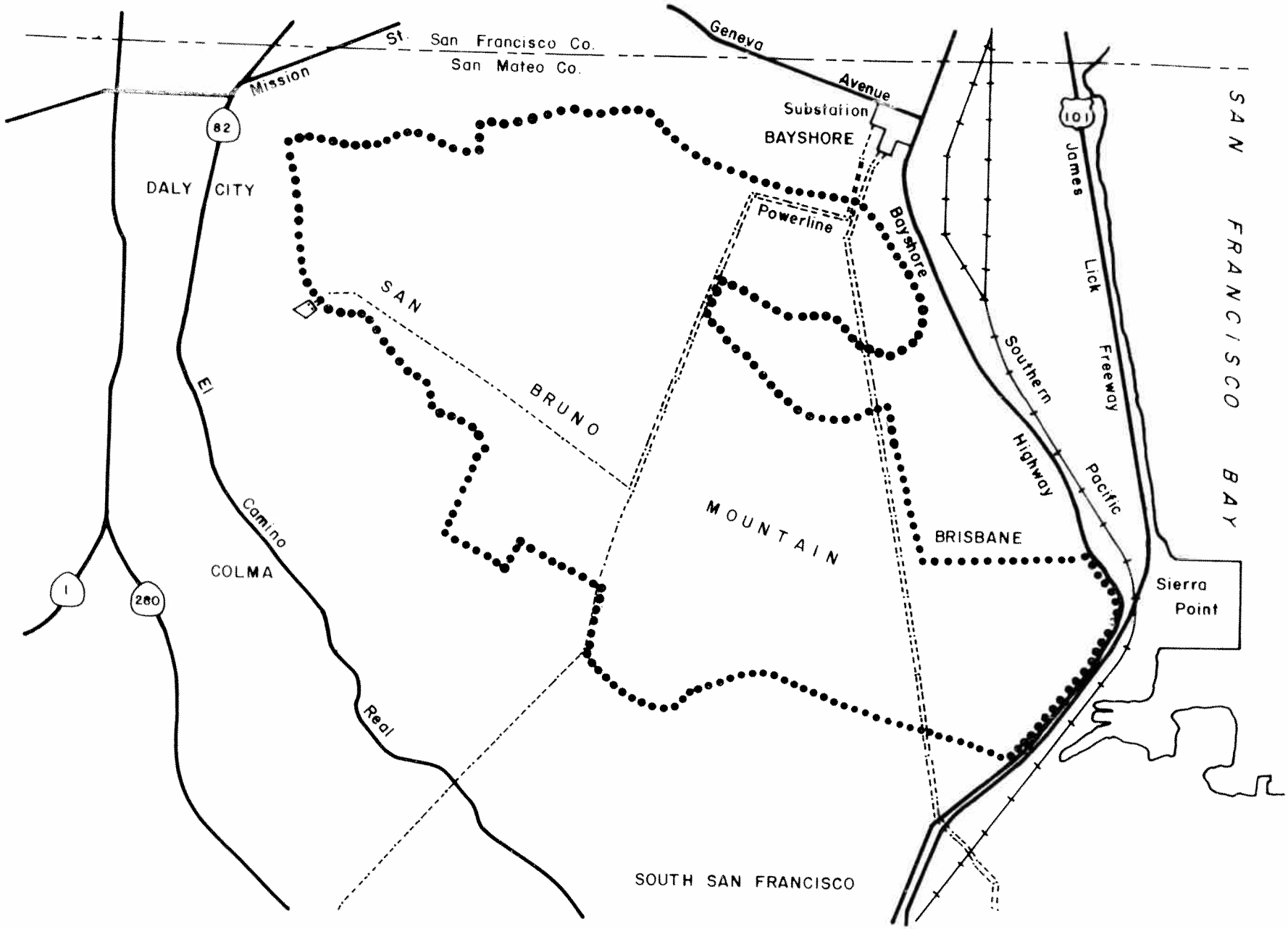

Figure 6. Essential habitat for Mission blue butterfly on San Bruno Mountain. Butterfly colonies within essential habitat are indicated by dotted lines.

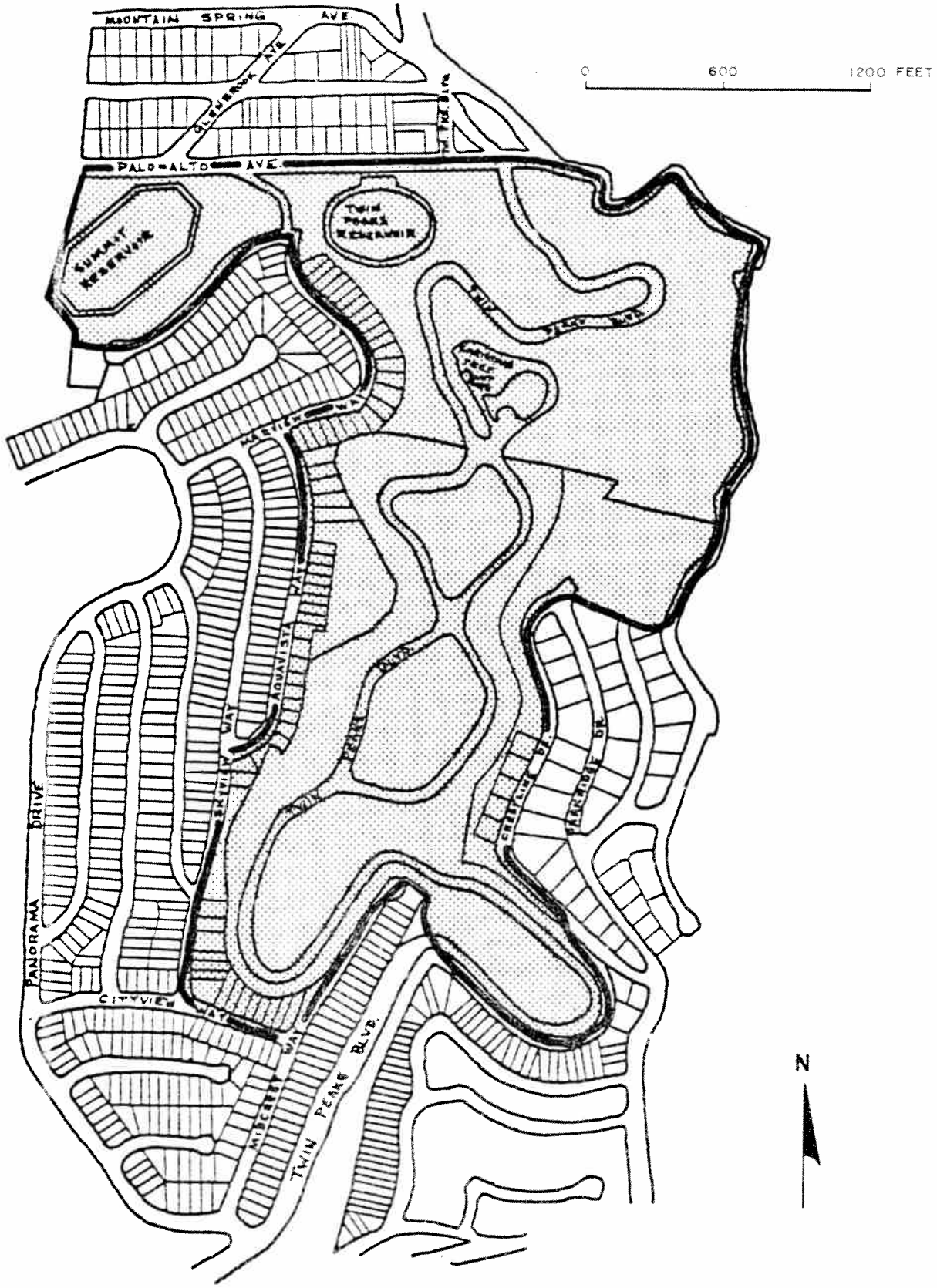

Figure 7. Essential habitat for Mission blue butterfly on Twin Peaks is the shaded area.

APPENDIX B

List of Agencies Asked to Submit Review Comments

Fish and Wildlife Service	Washington, D.C. Portland, OR
California Department of Fish and Game	Sacramento, CA Monterey, CA
California Department of Parks and Recreation	Sacramento, CA
University of California	Berkeley, CA
Department of Environmental Services, County of San Mateo	Redwood City, CA
Pacific Gas and Electric	San Ramon, CA
Bay Area Realty	Colma, CA
Quarry Products, Inc.	Richmond, CA
Telecommunications Properties	Concord, CA
Visitation Associates	San Francisco, CA