Appendix B

San Bruno Mountain Habitat Management Plan 2007

San Bruno Mountain Habitat Management Plan 2007

September 2007

Prepared in Support of the
San Bruno Mountain Habitat Conservation Plan

San Mateo County Parks Department

LIST OF PREPARERS

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Clockwise from bottom left: San Bruno elfin butterfly larvae; mission blue butterfly; Southeast Ridge grasslands, San Bruno Mountain; Viola pedunculata, (host plant for the callippe silverspot butterfly); callippe silverspot butterfly.
Photos by Patrick Kobernus and Victoria Harris.

SAN BRUNO MOUNTAIN HABITAT MANAGEMENT PLAN 2007

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EXECUTIVE SUMMARY

San Bruno Mountain is an island of natural open space hosting a unique assemblage of plants and animals. The Mountain is ecologically rich with nine native plant community types including large areas of native coastal grasslands, coastal scrub, riparian scrub, and oak woodlands. Three federally listed endangered butterflies — the mission blue, callippe silverspot, and San Bruno elfin — and a variety of rare plants, are present within the San Bruno Mountain Habitat Conservation Plan (HCP) area. Though the butterflies are rare in other parts of their range these species continue to be locally abundant within the Mountain's grasslands. The conservation and management of the Mountain's grassland habitat is thus critical for the listed butterflies. Habitat for another special status species, the bay checkerspot butterfly (federally threatened) is also present on San Bruno Mountain. Though this species has not been recorded on San Bruno Mountain since 1984, grassland habitat for this species is still present.

The purpose of the 2007 Habitat Management Plan is to provide a management and monitoring plan for the protection and management of: a) the habitat of the mission blue, callippe silverspot, San Bruno elfin and bay checkerspot butterflies, and b) the overall native ecosystem of San Bruno Mountain. This Habitat Management Plan is an implementation plan for the management and monitoring activities authorized in the HCP and is based on lessons learned from habitat management activities conducted over the past 25 years. These efforts have protected the core habitat areas (comprising approximately 1,290 acres) of the mission blue, callippe silverspot, and San Bruno elfin butterfly populations from being overtaken by weed infestations. These efforts however have focused on the highest priority invasive species and current management and funding are incapable of controlling all invasive species that are present on the Mountain. Though the habitat of the San Bruno elfin butterfly was not impacted by development activities authorized through the HCP, the habitat management programs funded through the HCP and described in this plan include management of this species' habitat because it overlaps with portions of the habitat of the mission blue and callippe silverspot butterflies.

The San Bruno Mountain HCP provided a mechanism by which approximately 2,750 acres would be protected and managed as conserved habitat, approximately 360 acres would be developed, and approximately 270 acres would be temporarily disturbed through development activities and restored to native habitat. While restoration of lands disturbed through development activities is an important component of the HCP, it is the management of the undisturbed conserved habitat (approximately 80% of which was protected on San Bruno Mountain) that is the key to reasonably insuring the survival of the endangered species. "Reliance on preservation rather than restoration" is one of the Guiding Principles of the SBM HCP (Volume One, San Bruno Mountain HCP, 1982), and continued management of the conserved areas is the most important component of HCP management.

The San Bruno Mountain HCP provides a funding mechanism to protect and manage habitat for the mission blue, callippe silverspot and San Bruno elfin butterflies on San Bruno Mountain. The HCP currently provides funding that is used to address the highest priority threats to the endangered species habitat. In addition to the HCP-funded management, several grant funded habitat management and restoration projects have been conducted on San Bruno Mountain within the last 10 years (Figure 22). These projects have fostered more community involvement on the Mountain and have resulted in the removal of significant stands of invasive species. These projects are described in more detail within the San Bruno Mountain HCP Annual Reports (http://www.traenviro.com/sanbruno/sbmhcp.htm).

Most (approximately 60%) of the annual HCP budget is used for managing the conserved habitat on San Bruno Mountain, whereas the remaining portions of the budget are used for administration, habitat restoration, and monitoring the endangered species. Managing the conserved habitat has consisted of using hand control, herbicide and mowing to protect the native plant communities and endangered species habitat from being overtaken by invasive weeds. Restoration work has consisted of creating 'habitat islands' through replanting of the endangered butterflies' host and nectar plants in suitable locations. In the past 5 years (2003 – 2007) approximately 6% of the annual HCP budget has been used to create and manage habitat restoration islands. Additional restoration work is conducted through developer funded and grant funded restoration projects on the Mountain. Though a relatively low amount of funding has been allocated for the creation of habitat, the restoration sites provide additional habitat for the mission blue butterfly and potentially buffer the population from fluctuations due to habitat changes within the conservation area (e.g., coastal scrub succession). Creating habitat islands also provides potential educational opportunities for volunteers.

While habitat islands have been created for the mission blue butterfly, and can be created for the San Bruno elfin butterfly, it is unknown if the habitat island approach is appropriate for the callippe silverspot butterfly. The callippe relies on much larger areas (minimum of several acres) that consist of large colonies (i.e. several hundred plants or more) of its host plant *Viola pedunculata* in combination with topographic high points. Due to the high cost and difficulty of propagating viola, restoration of callippe habitat at this time s likely better served through large scale brush removal that opens up grassland habitat and allows for natural recruitment of viola.

An analysis of mission blue and callippe silverspot butterfly data recorded from 1982-2000 showed that their populations are stable in overall distribution on San Bruno Mountain. Specific areas within the conserved habitat however have shown significant negative trends in butterfly occupancy (Longcore 2004). The areas where negative trends were identified are primarily within grassland areas that have succeeded to native coastal scrub on lower elevation north-facing slopes within the Northeast Ridge, Carter-Martin area, Devil's Arroyo, the Saddle, Owl and Buckeye Canyons, Dairy and Wax Myrtle Ravines, and Reservoir Hill management units. From aerial ortho-photographic analysis, it has been determined that the amount of grassland within the conserved habitat on the Mountain decreased by an estimated 122 acres (8.6%) over a 22-year period between 1982 and 2004.

While the core endangered species' habitat on the Mountain has been protected from invasive species over the span of the HCP, the success of this work has been attenuated by the observed landscape level changes that are occurring from: 1) the expansion of coastal scrub over grassland areas, especially on north-facing slopes; and 2) the influx and expansion of herbaceous and grass weeds within the native grasslands, especially on dryer and lower elevation slopes.

In 1982, the San Bruno Mountain HCP identified the need to control the expansion of invasive species and native brush because it was concluded at that time that both processes were occurring at a relatively high rate. The HCP documented a significant expansion of coastal scrub and corresponding loss of grasslands (approximately 541 acres) between 1932 and 1981 on San Bruno Mountain (HCP Vol.1, Biological Program). In addition to coastal scrub succession, the invasive species gorse (*Ulex europaeus*) and blue gum eucalyptus (*Eucalyptus globulus*) were estimated to have expanded by 282 and 82 acres respectively during this 49-year time period; (note: the expansion of other woody invasive species such as French broom (*Genista monspessulana*), Portuguese broom (*Cytisus striatus*) and a variety of other weeds were not calculated). Based on the threats from both native and invasive brush it was estimated that in the absence of management, the mission blue and callippe silverspot butterflies could be

extirpated from the Mountain within 5 – 20 decades due to the expected loss of their grassland habitat (HCP Vol. 1, Impact on Species).

Since 1982, a management and monitoring program funded through the HCP has been carried out for 25 years with a focus on invasive species control. Invasive species were identified in the HCP as the most serious threat to the endangered species' habitat due to their high rate of spread and severe ecological impacts. Invasives species control during the period 1982 – 2007 focused on woody invasive species and has controlled and reversed the expansion of gorse, blue gum eucalyptus, French broom, Portuguese broom, and Monterey pine (*Pinus radiata*).

Management efforts over the span of the HCP have reduced gorse by approximately 290 acres (80% reduction) and eucalyptus by approximately 45 acres (30% reduction) within the conserved habitat areas (Figures 18 and 19).

While the HCP management has focused on invasive species, brush control of native coastal scrub has not been implemented on the Mountain except on a very limited basis. This is due to several factors:

- Lack of available funding and/or in-kind services (i.e., equipment and crews) to address both coastal scrub succession and invasive species management;
- Air quality regulations that have restricted available opportunities for conducting controlled burns;
- Lack of maintained fire breaks, and decreased fire break management in recent decades by fire management agencies (CDF);
- Lack of grazing infrastructure (i.e., fencing, water system) that would allow testing and reintroduction of grazing to maintain fire breaks and/or reduce brush and invasive species;
- Listing of the callippe silverspot butterfly as an Endangered Species by the US Fish and Wildlife Service (USFWS) in 1997. The callippe listing requires the Plan Operator (San Mateo County) to obtain take authorization from the USFWS prior to conducting any brush control activities that could impact the species.

The 2007 Habitat Management Plan proposes to continue the current habitat management methods, and proposes the utilization of additional methods (e.g., grazing, burning and mowing, on a more comprehensive scale in order to protect and maintain the endangered species habitat more effectively. By utilizing the additional tools of mowing, grazing and burning, the emphasis of the program would shift from an exclusive focus on 'control of invasive species' to a focus on 'changing the grassland conditions' (i.e. excessive thatch and nitrogen buildup) that favor invasive species and brush expansion on San Bruno Mountain. Implementation of this program on a broad scale while continuing current habitat management programs would require the acquisition of substantial additional funding.

The 2007 Habitat Management Plan is the result of extensive research and communications with experts in the fields of habitat management and endangered species monitoring. In addition, the Habitat Management Plan incorporates information obtained through analysis of over 20 years of butterfly monitoring data and invasive species management on San Bruno Mountain, as well as aerial photographic analysis of vegetation communities on San Bruno Mountain between the years 1946 and 2006. The Plan incorporates input received through

discussions with habitat management and restoration contractors working on San Bruno Mountain, and public comments received at five San Bruno Mountain workshops held in 2003 and 2004. In addition, the Plan has been revised based on comments received in 2006 and 2007 from US Fish and Wildlife Service Senior Biologists Jesse Wild and Craig Aubrey, the San Bruno Mountain Technical Advisory Committee, Brookfield Homes Corporation, San Mateo County Parks Division, and from peer reviews of the Plan by Alan Launer with the Center for Conservation Biology at Stanford University; David Boyd, Ecologist with California State Parks; and Lori Campbell, Research Wildlife Biologist with the USDA Forest Service. The Plan also incorporates recommendations from the US Fish and Wildlife Service Biological Opinion dated April 7, 2006 on the proposed Implementation and Amendment of the San Bruno Mountain HCP.

The Plan consists of the following changes to habitat management and monitoring, dependant upon available funding, which are designed to follow the HCP biological goals and objectives for management and monitoring, and utilize an adaptive management approach consistent with the Fish and Wildlife Service's Five Point Policy:

1) Restructure the habitat management units into a system of 13 management units based on natural transitions in vegetation, roads, and borders consistent with grassland boundaries and previous management and monitoring work (Appendix B).

2) Implement a program for testing grazing to control brush and enhancing native grasslands. If test results are positive, implement a Stewardship Grazing Program for the Mountain.

3) Significantly expand the current brush control program using hand crews such as CDF prison crews, and/or mechanical methods within non-sensitive habitat areas.

4) Expand the invasive species control program to address invasives on a broader level, using hand control and mowing to control invasive herb and grass species.

5) Expand the effectiveness monitoring program to include monitoring for nitrogen deposition and native species diversity.

6) Create and fund a Volunteer Coordinator position to oversee volunteer-based weed control and restoration programs.

7) Provide annual funding for emergency response to new invasive species infestations.

8) Expand the biological monitoring program to provide both relative population and distribution data for the callippe silverspot, mission blue, and San Bruno elfin butterflies, with the ability to incorporate trained volunteers to assist with the monitoring.

9) Monitor rare plant populations on San Bruno Mountain on a 3-year cycle (current monitoring frequency is approximately every 5 years), and conduct enhancement measures to protect and expand these populations.

10) Develop an ongoing and sustainable supply of native plants for restoration projects through agreements with local native plant nurseries and/or development of a native plant nursery on San Bruno Mountain.

11) Create and maintain additional endangered butterfly restoration sites (habitat islands), if

additional funding is secured and recommended by the TAC and approved by the HCP Trust.

The Mountain has been divided into four priority categories for management purposes, as shown in Figure 1 and described below.

Priority 1: (1,292 acres)

This management area includes all core habitat for the mission blue, callippe silverspot butterfly, San Bruno elfin and bay checkerspot butterflies on San Bruno Mountain, and currently consists of approximately 30% coastal scrub, and 70% grassland. This management area has been consistently managed over the span of the HCP, though management cannot be conducted thoroughly throughout the 1292 acres on an annual basis due to limitations in funding. Management of the endangered species habitat has been accomplished within most of the unit by prioritizing management areas based on habitat value, and modifying work areas annually based on the changing distribution of invasive species.

Priority 2: (495 acres)

This management area includes less important habitat areas located on the periphery of the core habitat areas. It consists of 1) all additional grassland habitat on the Mountain that provide habitat for the mission blue, callippe silverspot, and/or bay checkerspot butterflies; and 2) all grassland areas that have converted to coastal scrub over the span of the HCP and/or provide important movement corridors for the listed butterflies.

Priority 3: (884 acres)

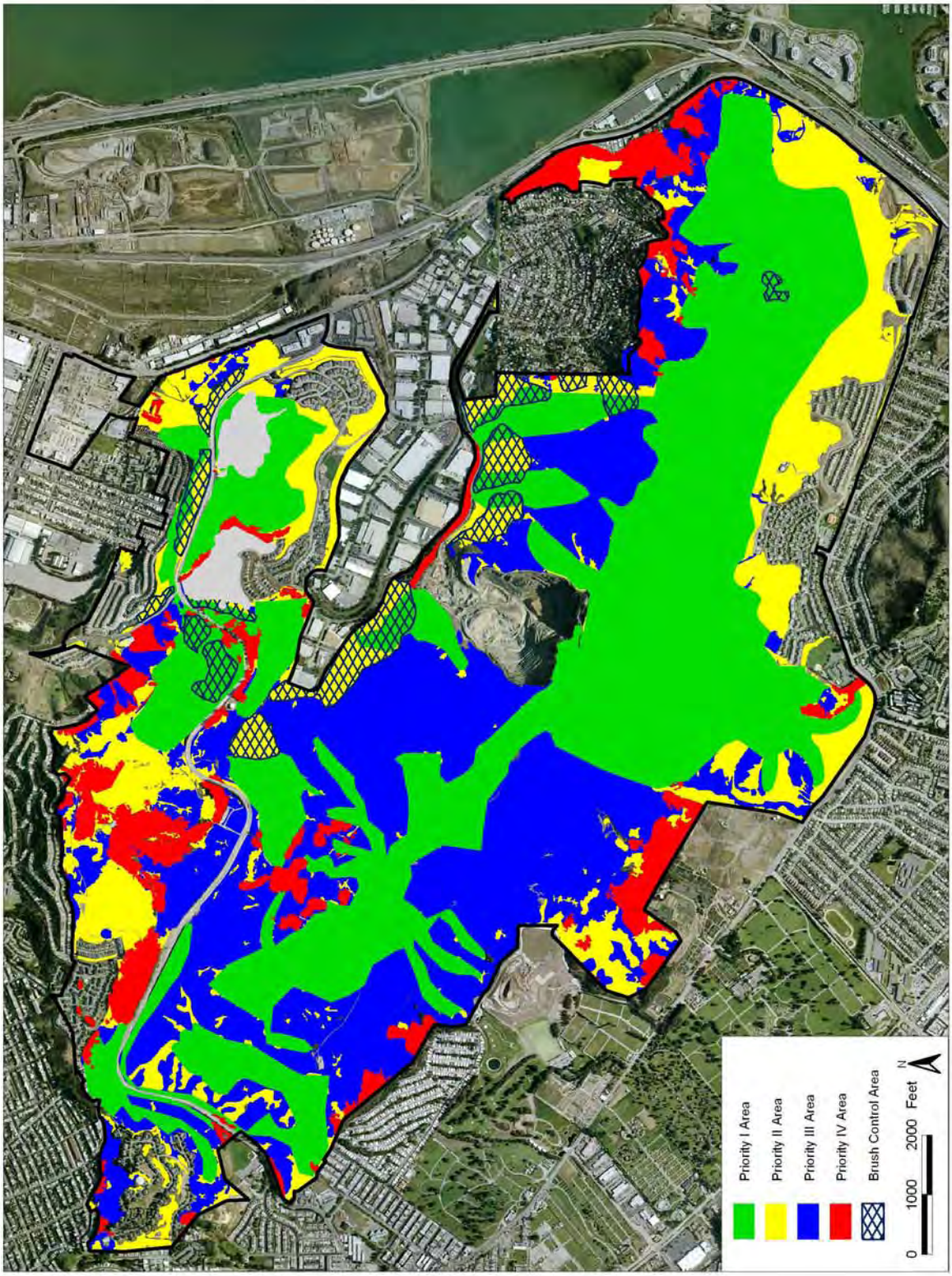
This management areas includes primarily dense stands of coastal scrub and woodland plant communities. It includes: 1) all additional coastal scrub habitat not within Priority 1; and 2) and all native oak woodlands and riparian areas on San Bruno Mountain. These areas are primarily located on the western half of the Mountain and on north- facing slopes where fog and/or brush communities limit occurrence of the butterflies. These areas generally do not support listed butterfly species however pockets of grassland butterfly habitat are present within some coastal scrub habitat. Coastal scrub is a plant community that depends on infrequent fire for regeneration and overall plant community health. Treatment of the coastal scrub within this unit utilizing the additional tools of grazing, mowing, and/or burning would require a significant increase in funding. Although butterfly habitat is limited within this management area (and it is therefore a lower management priority) this area would benefit from more frequent burning to maintain the health of this plant community.

Priority 4: (248 acres)

This management area has significant dense infestations of invasive species including eucalyptus forest, gorse and French broom. These infestations are expensive to eradicate and do not pose a significant threat to native habitats and/or to the butterflies of concern as long as they are controlled from spreading into Priority 1, 2, and 3 areas. Some of the Priority 4 areas could be restored to butterfly habitat and would be suitable for stand-alone restoration projects. Management of these areas and efforts to restore these areas are not a high priority use of HCP funds due to the high cost of conducting such work, and the long-term commitment required to obtain results. This Plan recommends that the control of these areas be pursued through grant funds or other sources of funding whenever possible. For example, the gorse control project

located in the central Saddle has been implemented under a Coastal Conservancy grant since 2002, and has expended $330,000 to control 49 acres of gorse over a 5-year period.

Figure 1. Priority I, II, III and IV Management Areas on San Bruno Mountain



Treatment of Priority areas 1, 2, and 3 on a broad scale utilizing the tools of grazing and/or burning supplemented by hand control, herbicide, and mowing would require a significant increase in funding. Without an increase in funding, the Priority 1 management area would continue to be managed with a focus on the highest priority invasive species threats using hand control, herbicide, and mowing.

This Plan establishes goals and objectives for implementation of the San Bruno Mountain HCP (Table 1) with a prime goal of maintaining a range of 1,200 – 1,800 acres of grassland on San Bruno Mountain. A range of grassland acreage is suggested as a management goal since plant communities are dynamic and fluctuate over time due to climatic and biotic factors as well as from habitat management activities. The low end of this goal is based on the current extent of grassland habitat (estimated at 1287 acres in 2004), which has been shown to support stable populations of mission blue, callippe silverspot, and San Bruno elfin butterflies. The high end of the goal (1,800 acres) is consistent with the level of grassland present on San Bruno Mountain in 1981, prior to development impacts and coastal scrub succession over the past 25 years.

Between 1982 and 2004, San Bruno Mountain lost an estimated 122 acres (8.6%) of grassland habitat primarily as a result of coastal scrub succession within the HCP conservation area. The areas that have decreased in grassland extent include areas on the Northeast Ridge, Carter-Martin, Buckeye & Owl Canyons, Devil's Arroyo, Saddle, Dairy and Wax Myrtle Ravines, and Reservoir Hill. The decrease in grassland in these areas does not appear to have impacted the overall stability of the butterfly populations at this time. Reclaiming these areas through control of coastal scrub vegetation would likely benefit the butterfly populations.

Coastal scrub vegetation only becomes a threat to butterfly habitat when it reaches a high density and overtakes important butterfly host and nectar plant habitat within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. For these reasons, management of coastal scrub succession should be focused on reduction rather than eradication. In contrast, invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures, and therefore control and eradication of invasive species should be pursued whenever feasible. In most cases, invasive plant species provide few resources for native wildlife species. Exceptions to this are species such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativus*) and pin-cushion plant (*Scabiosa purpurea)*, which are utilized frequently as nectar sources by mission blues and callippes. Due to the invasiveness of these species and the availability of a wide variety of native plant species as nectar sources for the butterflies, control of these invasive species is conducted.

It should be expected that butterfly habitat on San Bruno Mountain is not static and the habitat fluctuates both spatially and temporally within areas where suitable soils and slope exposures are present. Over the course of a single year habitat areas can significantly decline in quality while others may increase. For example in the El Nino year of 1998, a significant large-scale decline occurred to mission blue habitat where silver lupine (*Lupinus albifrons var. collinus*) was the dominant host plant species. This was due to a fungal infestation brought on by excessive rainfall which caused significant dieback to silver lupines. A similar dieback of silver lupine and decline in Mission blue numbers was observed in 1998 by the National Park Service in the Golden Gate National Recreation Area. In areas on San Bruno Mountain where summer lupine (*Lupinus formosus var. formosus*) plants were the dominant host plant, mission blue observations were not impacted and may have slightly increased. It is therefore important to provide as much potential habitat as possible to buffer the species from occasional large-scale

declines in habitat quality that occur independent and outside the control of the Habitat Manager.

To meet the goal of maintaining 1,200 – 1,800 acres of grassland habitat this Plan recommends that all Priority 1, 2 and 3 areas be managed. The actual activities undertaken will be determined on an annual basis, based on the availability of funds, in work programs determined and approved by the HCP Trustees in consultation with the Habitat Manager, County of San Mateo, and the Technical Advisory Committee. Utilizing an adaptive management approach the activities in the work programs will address needs identified through the Plan's monitoring program. It is recommended that this Habitat Management Plan be used as a working document and the Plan and its implementation be reviewed and adapted as necessary as recommended by the TAC and approved by the HCP Trust. Past management efforts have focused on controlling the most invasive plant species within the core habitat areas (now identified as Priority 1 areas). This approach should be continued because covering all of the Priority 1 areas (approximately 1,290 acres), will provide reasonable assurance that the listed species will be protected in perpetuity. If additional funding is acquired the program should be expanded to implement invasive species control and brush control on a more broad scale within the Priority 1 areas, and begin actively managing all of the Priority 2 and 3 areas.

If supplemental funding is acquired, grazing will be tested for the first 3-5 years of the plan and if results show a significant benefit to the butterfly species, this tool would be expanded along with the tools of mowing, herbicide and hand control as supportive techniques. Grazing and/or mowing could also be used to provide fuel buffers between wildland and urban interface areas so that controlled burning may become a more reliable management tool in the future. During the experimental phase, no more than 15% of the grasslands of San Bruno Mountain (between 100 and 200 acres) would be grazed. In addition, once an effective management strategy is developed utilizing grazing and/or burning, no more than 50% (approximately 600 acres) of the Priority 1 management area would be treated on an annual basis.

While biological and habitat monitoring are important for tracking the status of the butterfly species of concern, the relationship between habitat quality and butterfly presence is well established. If funds become extremely limited in the future, it is recommended that the monitoring portion of the budget be reduced or eliminated so that the vegetation management programs could be funded to the fullest extent possible within the Priority 1 management area. This change would require the approval of the HCP Trust and the USFWS.

I. INTRODUCTION

The San Bruno Mountain Habitat Management Plan is the implementation plan for executing the goals and objectives of the San Bruno Mountain HCP. The Plan provides a detailed description of recommended habitat management activities for San Bruno Mountain. The Plan also provides estimated costs for different management activities that are intended to maintain the ecological communities on San Bruno Mountain, with special emphasis on the endangered butterflies and their grassland habitat.

San Mateo County and the cities of South San Francisco, Brisbane, and Daly City are the permittees responsible for implementing the HCP under permit from the US Fish and Wildlife Service. San Mateo County Parks Division is the HCP Plan Operator and is responsible to the permittees for managing and monitoring the conserved habitat and the endangered species within the San Bruno Mountain HCP. The County recognizes the need to maintain recreation values and public access in the park and reconciles these uses with habitat management, restoration, and butterfly monitoring programs.

Other agencies that have responsibilities on San Bruno Mountain include the City of Colma, the California Department of Fish and Game, the California Department of Forestry and Fire Protection, and California State Parks. In addition PG&E, San Francisco PUC, and many private landowners within the Brisbane Acres area are participants to the HCP. Through the Site Activity Permit process, the principle oversight mechanism for managing activities on the Mountain, there are opportunities to minimize habitat impacts from road and utility maintenance operations and other activities as well as enhancing habitat areas through reseeding, replanting, and invasive species control.

A. Purpose of 2007 Habitat Management Plan

The purpose of the 2007 Habitat Management Plan is to provide effective guidance for the management and monitoring of: a) the habitat of the mission blue, callippe silverspot, and San Bruno elfin butterflies, and b) the overall native ecosystem of San Bruno Mountain. The Habitat Management Plan provides a strategic plan for implementation of the management and monitoring programs of the San Bruno Mountain Habitat Conservation Plan. It includes biological goals and objectives and provides an implementation and adaptive management program to meet the goals and objectives, consistent with US Fish and Wildlife Service's 5-Point Policy for Reviewing Habitat Conservation Plans.

The amended San Bruno Mountain HCP goals and objectives (Table 1) includes goals directed towards protecting and restoring habitat on San Bruno Mountain by controlling invasive plant species, reversing the trend of coastal scrub succession and replanting native plant species, including the host and nectar plants for the mission blue and callippe silverspot butterflies. Though no habitat for the federally endangered San Bruno elfin butterfly was taken by development activities approved through the San Bruno Mountain HCP, the HCP conservation area encompasses the habitat of the San Bruno elfin butterfly and the management programs described in this Plan pertain to this species as well. In addition, the bay checkerspot butterfly (*Euphydras editha bayensis*), a federally threatened species once present on San Bruno Mountain, is also addressed in this Plan. The bay checkerspot butterfly has not been observed on San Bruno Mountain since a wildfire burned through its habitat in the early 1980's. The species habitat is still present on San Bruno Mountain and has been designated as Critical Habitat by the USFWS. Goals and objectives are also provided for the bay checkerspot

butterfly, and the habitat management conducted through this Plan would also benefit this species' habitat.

The Habitat Management Plan provides details on methods, proposed work areas, and expected costs to meet these goals. Important functions of the Plan include:

1) Prioritization of the work program to direct available HCP funding to highest priority habitat areas;

2) Detailed descriptions of high and low priority habitat areas to facilitate procuring separate funding for stand-alone projects;

3) Descriptions of herbicide, hand control, grazing, mowing, burning and other techniques to manage the San Bruno Mountain ecosystem.

B. Technical Advisory Committee

The HCP specifies that a Technical Advisory Committee (TAC) provide assistance in the reporting of the biological program (research, monitoring and habitat enhancement), and report on the Plan's scientific effectiveness and costs (HCP, Vol. 1, 1982). A TAC was initially formed to assist in the implementation of the HCP in 1982, and provided guidance on developing invasive species control strategies for the first few years of the plan.

The TAC was reformed in 2006 following the recommendations of the HCP Trust. The committee is currently chaired by the Director of San Mateo County Parks and participants include staff from the County (Plan Operator and Habitat Manager), weed control and restoration sub-contractors, and representatives of volunteer groups that are active on the Mountain (i.e., California Native Plant Society (CNPS), Heart of the Mountain, Friends of San Bruno Mountain and San Bruno Mountain Watch).

The TAC meets quarterly to review and recommend to the HCP Trustees annual and long-term management plans, review contractors proposed scopes of work, and initiate research to meet HCP goals. The TAC has reviewed this Habitat Management Plan and will provide ongoing review of current habitat management programs. Adaptations to the Habitat Management Plan will be made based on recommendations of the TAC and approved by the HCP Trust.

II. HABITAT MANAGEMENT PLAN GOALS AND OBJECTIVES

The SBM HCP is a results-based Habitat Conservation Plan with stated goals and objectives. The goals and objectives are both habitat-based and species-based. Monitoring includes measuring both the quantity and quality of habitat over time, and species monitoring includes monitoring the relative abundance and distribution of the callippe silverspot, mission blue, and San Bruno elfin butterflies over time.

A variety of prescriptions are described in this plan to meet the goals and objectives that relate to habitat management. Maintaining flexibility through adaptive management in applying these prescriptions is an integral component of the habitat management program.

A. Grassland Habitat and Endangered Species Goals

Goals, objectives and success criteria for each of the federally listed butterflies on San Bruno Mountain and for the overall management of the San Bruno Mountain ecosystem are stated in Table 1. Goals, objectives and success criteria for the mission blue and callippe silverspot butterflies are identical and focus on the protection of a sufficient quantity and quality of grassland to support the endangered species. Protection of sufficient densities of host plants and nectar plants within the grasslands is vital toward the long term protection of the species. Monitoring of a) the butterflies' habitat quantity; b) habitat quality; and c) populations over time is therefore necessary for tracking the status of the objectives listed in Table 1.

Goals, objectives and success criteria for the San Bruno elfin and bay checkerspot butterflies differ due to different habitat distributions and regulatory requirements for these species. Habitat for the San Bruno elfin on San Bruno Mountain has been protected within existing park lands since 1976, and this species was not impacted by HCP-approved developments. The bay checkerspot butterfly is no longer present on San Bruno Mountain, and based on its historical distribution, it also was not impacted by HCP-approved developments. The management that is recommended in this Plan is intended to both meet the goals and objectives for each species listed in Table 1, as well as benefit the overall ecosystem that supports these species.

A goal of maintaining 1,200 –1,800 acres of grassland on San Bruno Mountain is established. A range of acreage is used as the management goal since plant communities are dynamic and fluctuate over time, due to climatic and biotic factors as well as from habitat management activities. The low end of this goal is based on the current extent of grassland habitat which has been shown to support stable populations of mission blue and callippe silverspot butterflies. The current estimate of grasslands on the Mountain is 1,287 acres (estimated in 2004). The high end of the goal (1,800 acres) is consistent with the level of grassland present on San Bruno Mountain in 1981, prior to development impacts and coastal scrub succession over the past 25 years.

Though the historical amount of grassland in the late 19th and early 20th century was higher than 1,800 acres on San Bruno Mountain, it should be understood that this was the result of farming, grazing and burning practices that were focused on creating large open areas for cattle foraging and farming; and during this period, riparian and coastal scrub habitats were cleared with little regard for species and habitats within these communities. Historic land practices focused almost exclusively on creating open grasslands, whereas current management (due to the lack of controls on the expansion of brush) has inadvertently created conditions that have favored coastal scrub. Management instead should be focused on maintaining a range of grasslands and brush that is allowed to fluctuate within limits, (i.e., a 'dynamic equilibrium') to insure both

the protection of the habitat of the endangered species as well as protection of the native coastal scrub and woodland communities on the Mountain.

The goal of 1,200 –1,800 acres assumes that the low end of the range (i.e., 1,200 acres) is sufficient to reasonably protect the endangered species from extirpation. This is based on a study conducted in 2004 on callippe silverspot and mission blue trends of butterfly occupancy on San Bruno Mountain (Longcore, 2004). This study utilizing 20 years of HCP butterfly monitoring data, determined that the butterflies' distribution has overall remained stable on the Mountain over the span of the HCP. HCP butterfly monitoring data also has not detected any declining trends in occupancy for the mission blue, callippe silverspots and San Bruno elfins over the course of the HCP in spite of losses of habitat to development (331 acres) and losses of conserved grassland habitat to coastal scrub succession (122 acres). The resilience of the butterfly populations is likely due to the continued presence of a sufficient quantity and quality of habitat for each species as a result of habitat conservation and on-going management.

While a development of an extinction risk model is ideal, the development of such a model would require extensive data collection utilizing mark and recapture techniques combined with physical habitat data to provide a thorough understanding of population dynamics of each species. Habitat quality parameters (e.g., density of host plants, invasive species, nectar plants, and hilltopping habitat for callippe) would need to be specified within the model. Creation of such a model would allow for the estimation of a minimum grassland acreage that would support a minimum viable population for each of the butterfly species. Though this data is not available, extinction probabilities for mission blue and callippe silverspot were calculated in the Endangered Species San Bruno Mountain Biological Study 1980 – 1981 (TRA, 1982), which formed the basis of the understanding of the species at that time. Based on the estimated size of the butterfly populations in 1982, and the documented rates of brush expansion on the Mountain, it was estimated that without management to control brush (native and nonnative), the endangered species would likely be extirpated from San Bruno Mountain within 5 to 20 decades (TRA 1982).

The grassland habitat of the endangered species is threatened by a combination of native brush and invasive species and active management is required to protect the habitat. Management must vary depending on the types of terrain and plant species present. Grasslands vary significantly from slope to slope, and region to region on San Bruno Mountain. Grassland areas located on steeper slopes and along the San Bruno Mountain main ridgeline tend to be of higher quality in native species composition than grasslands on lower elevation slopes. Due to higher moisture levels and less disturbance, north-facing and fog-influenced grasslands tend to have higher densities of closely overlapping native bunchgrasses and are more resilient to infestations of weedy grasses and forbs. In contrast south-facing grasslands tend to have more open ground where weeds can get established easier.

Coastal scrub vegetation only becomes a threat to the endangered species habitat when it overtakes important butterfly host and nectar plants within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. For these reasons management of coastal scrub succession should be focused on reduction rather than eradication.

Based on observed proportions of coastal scrub and grassland within core (Priority 1) butterfly habitat areas on San Bruno Mountain, a minimum success criterion for control of coastal scrub is established at 70% control within all grasslands on San Bruno Mountain. This includes areas

that have succeeded to coastal scrub over the 25-year span of the HCP (i.e., 122 acres), and were identified as areas of concern due to declining trends in butterfly occupancy.

In contrast, invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures. Some of these species however such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativus*), and pin-cushion plant (*Scabiosa purpurea)*, are utilized frequently as nectar sources by mission blues and callippes. Due to the invasiveness of these species, and the availability of a wide variety of native plant species as nectar sources for the butterflies, control of these invasive species is conducted. This work needs to be conducted prior to the flowering period of the species to avoid impacts to the endangered butterflies.

A goal of 90% control is established for invasive species. Though complete control of all invasive species is an unlikely probability, focused efforts on the most invasive species threats should be directed toward attaining 90% control or better. Control of invasive species is still the highest priority due to the threats these species pose to the endangered species and the overall ecosystem on San Bruno Mountain.

Table 1. Goals, Objectives and Success Criteria for the Mission Blue, Callippe Silverspot, San Bruno Elfin and Bay Checkerspot Butterflies on San Bruno Mountain.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 1. Maintain or expand a self-sustaining and viable mission blue population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
1.1 Maintain a sufficient quantity and quality of conserved habitat for MB on SBM, which supports a viable and stable population of mission blue butterflies over time.	1.1 Objective is met when: a) the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres, b) invasive species are 90% controlled[1] and coastal scrub is 70% controlled within all grassland habitats[2], c) grasslands on SBM are consistently providing suitable host and nectar plant habitat for MB, d) grasslands on SBM are comprised of a significant and diverse native plant species component[3]; and e) the relative abundance and/or the distribution of mission blue butterflies show no statistically significant declining trend over time.

[1] The 90% criterion applies to all major invasive species that form monoculture stands that overtake native grassland habitat for the mission blue and callippe silverspot butterflies. These invasive species include woody invasive species such as gorse, French broom, Portuguese broom, Eucalyptus spp., among others, as well as herbaceous invasive species such as poison hemlock, Bermuda buttercup, and cape ivy. Invasive species not subject to the 90% control criteria include invasive grasses such as rattlesnake grass and herbaceous invasive species such as English plantain. These species are less of a threat to the butterflies of concern, and are more difficult to control due to their ubiquitous distribution on San Bruno Mountain. These species are still considered a high priority for control; however their control will depend on the ability of habitat managers to utilize additional tools such as grazing and/or burning on a consistent basis.

[2] The 70% criteria for coastal scrub control within mission blue and callippe silverspot habitat is a mountain-wide criterion, and should be adaptively implemented based on slope exposure, elevation, fog influence, and other factors such as the value of coastal scrub to native and special status species. For example, for south facing grasslands a 90% criterion may be the appropriate objective for control of coastal scrub, whereas for north facing slopes a 50% criterion may be a more appropriate objective.

[3] The significant and diverse plant species component shall be determined through monitoring data, which will establish a target percent cover threshold for native plant species within the grasslands of San Bruno Mountain. This threshold will be determined through analysis of grassland monitoring data collected and analyzed by the Habitat Manager, and reviewed by the TAC.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
1.2 Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat.	1.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for improving grassland habitat, and these tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.
1.3 Restore MB colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites (habitat islands) with MB host and nectar plants where appropriate conditions exist.	1.3 Objective is met when habitat restoration activities successfully restore an estimated amount of habitat that is equal in proportion or greater to the amount of mission blue habitat that has been lost within the Conserved Habitat areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for invasive species and 70% controlled for coastal scrub; b) have MB host and nectar plants established and maintained at densities that provide high quality mission blue habitat, as specified in the Butterfly Habitat Restoration Guidelines (Appendix A); and c) MB presence has been recorded for 5 consecutive survey years within each restoration site.
1.4 Ensure that the restoration of habitat in graded and developed areas (HCP “temporarily disturbed conserved habitat”) is maintained to established restoration standards prior to acceptance by the Plan Operator.	1.4 Objective is met when areas to be dedicated to the HCP conserved habitat area are: a) 90% controlled for invasive species for a minimum of 5 years; b) 70% controlled of coastal scrub; and c) have established restoration sites that meet the Butterfly Habitat Restoration guidelines (Appendix A).
1.5 Ensure that habitat easements in undisturbed areas (HCP “preserved habitat”) are being sufficiently maintained to provide suitable habitat for mission blue prior to acceptance by the Plan Operator.	1.5 Objective is met when areas to be dedicated as HCP “preserved habitat” are 90% controlled for invasive plants and 70% controlled for coastal scrub, and --if suitable MB habitat is present-- these areas continue to provide suitable habitat for MB.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
1.6 Maintain data on MB relative abundance and/or distribution of MB on San Bruno Mountain.	1.6 Objective is met when MB butterfly monitoring data allows for year-to-year comparison and detection of trends over time. Monitoring data may utilize presence/absence and/or relative abundance methods for comparison across years. Host and nectar plants shall also be surveyed at MB transects on the same schedule as the butterfly surveys. This will enable managers to monitor the status of MB habitat, and draw correlations between habitat changes and MB numbers.
1.7 Monitor for mission blue butterfly at restoration sites.	1.7 Add proportion of MB restored areas to butterfly monitoring survey scheme and consistently monitor over time.
1.8 Monitor quantity and quality of grassland habitat that supports mission blue butterflies.	1.8 Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters[4] that provide a data set for detecting changes over time.

[4] Monitoring parameters shall be determined and established by the Habitat Manager and reviewed by the San Bruno Mountain TAC.

CALLIPPE SILVERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 2. Maintain or expand a self-sustaining and viable callippe silverspot population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
2.1 Maintain a sufficient quantity and quality of conserved habitat for CS on SBM, which supports a viable and stable population of callippe silverspot butterflies over time.	2.1 Objective is met when: a) the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres; b) invasive species are 90% controlled and coastal scrub is 70% controlled within all grassland habitats; c) grasslands on SBM are consistently providing suitable host and nectar plant habitat for CS; d) grasslands on SBM are comprised of a significant and diverse native plant species component; and e) the relative abundance and/or the distribution of callippe silverspot butterflies show no statistically significant declining trend over time.
2.2 Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat.	2.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for improving grassland habitat, and these tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.
2.3 Restore CS colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites with CS host and nectar plants where appropriate conditions exist.	2.3 Objective is met when habitat restoration activities successfully restore an estimated amount of habitat that is equal in proportion or greater to the amount of callippe silverspot habitat that has been lost within the Conserved Habitat areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for invasive species and 70% controlled for coastal scrub; b) have CS host and nectar plants established and maintained at densities that provide high quality callippe silverspot habitat, as specified in the Butterfly Habitat Restoration Guidelines (Appendix A); and c) CS presence has been recorded for 5 consecutive survey years within each restoration site.

CALLIPPE SILVERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
2.4 Ensure that the restoration of habitat in graded and developed areas (HCP "temporarily disturbed conserved habitat") is maintained to established restoration standards prior to acceptance by the Plan Operator.	2.4 Objective is met when areas to be dedicated to the HCP conserved habitat area are: a) 90% controlled for invasive species for a minimum of 5 years; b) 70% controlled of coastal scrub; and c) have established restoration sites that meet the Butterfly Habitat Restoration guidelines (Appendix A).
2.5 Ensure that habitat easements in undisturbed areas (HCP "preserved habitat") are being sufficiently maintained to provide suitable habitat for callippe silverspot prior to acceptance by the Plan Operator.	2.5 Objective is met when areas to be dedicated as HCP "preserved habitat" are 90% controlled for invasive plants and 70% controlled for coastal scrub, and --if suitable CS habitat is present-- these areas continue to provide suitable habitat for CS.
2.6 Maintain data on CS relative abundance and/or distribution of CS on San Bruno Mountain.	2.6 Objective is met when CS butterfly monitoring data allows for year-to-year comparison and detection of trends over time. Monitoring data may utilize presence/absence and/or relative abundance methods for comparison across years. Host and nectar plants shall also be surveyed at CS transects on the same schedule as the butterfly surveys. This will enable managers to monitor the status of CS habitat, and draw correlations between habitat changes and CS numbers.
2.7 Monitor for callippe silverspot butterfly at restoration sites.	2.7 Add proportion of CS restored areas to butterfly monitoring survey scheme and consistently monitor over time.
2.8 Monitor quantity and quality of grassland habitat that supports callippe silverspot butterflies.	2.8 Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters that provide a data set for detecting changes over time.

SAN BRUNO ELFIN BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 3. Maintain or expand a self-sustaining and viable San Bruno elfin population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
3.1 Maintain existing quantity and quality of conserved habitat for SBE on SBM.	3.1 Objective is met when the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres, and invasive species and coastal scrub succession are controlled to the extent that SBE habitat on SBM is providing a consistent level of SBE occupancy over time.
3.2 Apply vegetation management tools (e.g., grazing, burning, mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat, and identify and reduce factors that reduce that quality.	3.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for specific problems and these tools are implemented effectively on a regular basis.
3.3 Restore SBE colonies to areas on SBM where the population has declined due to natural succession and/or invasive species, and create restoration sites (habitat islands) with SBE host and nectar plants, where appropriate conditions exist.	3.3 SBE host and nectar plants shall be planted at suitable restoration sites at established densities. Plants shall be monitored for survival and replaced if necessary. Site shall be controlled for invasive species and coastal scrub succession. Objective is met when site supports suitable SBE habitat and when SBE presence is recorded for 5 consecutive survey years within each restoration site.
3.4 Maintain data on SBE relative abundance and/or distribution and status of SBE habitat on San Bruno Mountain.	3.4 Host and nectar plants shall be surveyed at SBE points/transects on the same schedule as the SBE larvae surveys. This will enable managers to monitor the status of SBE habitat, and draw correlations between plant resources and SBE numbers.
3.5 Monitor status of restoration sites, and SBE utilization.	3.5 Add restored areas to point survey scheme.

BAY CHECKERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 4. Maintain distribution and abundance of bay checkerspot butterfly host and nectar plants so that reintroduction can occur in the future if deemed appropriate by regulating agencies and the Plan Operator.	
OBJECTIVE:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
4.1 Maintain distribution maps for bay checkerspot host and nectar plants. These maps should be updated at least once every five years.	4.1 Identify and characterize potential bay checkerspot butterfly habitat. Objective is met when maps are kept updated and complete and can be used to track the status of potential habitat.
4.2 Consider the habitat and reproductive requirements of bay checkerspot host plants when planning landscape-wide vegetation management. Apply vegetation management tools (e.g., grazing, burning, mowing) that sustain high quality bay checkerspot habitat and identify and reduce factors that reduce that quality.	4.2 Objective is met when it is determined which tool and/or tools is best used to address the management concerns of bay checkerspot butterfly habitat and these tools are implemented effectively and on a regular basis.

B. Performance Indicators and Adaptive Management

Adaptive Management has been a key strategy in the implementation of the HCP since its inception in 1982. Based on changing conditions, emphasis of the management has shifted from the control of a few highly invasive woody plant species (i.e. gorse, eucalyptus, pampas grass and French broom) to inclusion of over 40 invasive woody, herbaceous and grass weeds. In addition, the butterfly monitoring program has been adapted from a wandering transect design to a fixed transect design based on peer reviews of the program. It is likely that in the future there will be new invasive species that will require management on San Bruno Mountain, new and more effective tools for managing habitat, and perhaps even new species discoveries (and/or reclassifications of existing species) that will add to the list of sensitive species on the Mountain.

A key component of adaptive management involves testing and experimentation. Results of experiments conducted on gorse and eucalyptus in the 1990's led to an effective control program that has significantly reduced the size and rate of spread of these species. To manage invasive species and coastal scrub succession more effectively, habitat management may require utilizing techniques such as cattle grazing that have not been tested and monitored on San Bruno Mountain. Additional funding would be required for both the testing and implementation of such programs. If additional funds can be secured, a portion of these funds will be allocated each year to test, monitor and retest techniques to determine their impact prior to broad scale application. Early testing and evaluation is critical to the long-term success of habitat management.

The spread of new arrivals of invasive species, such as plant and/or insect pests could threaten the endangered species through disruption of their life cycle or the life cycle of their host plants. To deal with changing conditions on San Bruno Mountain due to the introduction of new invasive species, or new information showing a dangerous expansion of existing invasive plants or insect pests, the management program for San Bruno Mountain needs to be adaptable. Based on recommendations from the TAC and the USFWS, and with the approval of the HCP Trust, the Habitat Manager will reprioritize funds and resources to address changing conditions on the Mountain as needed.

Table 2 shows the methods and process of evaluating the effectiveness of management efforts and the adaptive management approach for remedial action when performance indicators are not met.

Table 2. Performance Indicators and Adaptive Management for Monitoring Effectiveness of Habitat Management Plan Objectives

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Maintain a sufficient quantity and quality of conserved habitat for listed butterflies on SBM, which supports a viable and stable population of butterflies over time	a) Acreage of grassland	The amount of grassland on SBM is maintained within a range of 1,200 – 1,800 acres	Measure using digital ortho-photos and field correction every 5 years	Reassess and modify invasive species and coastal scrub succession control program
	b) Acreage of invasive species and coastal scrub within grasslands	90% control of invasive species and 70% control of coastal scrub within grassland habitats	Measure using digital ortho-photos and field correction every 5 years	Reassess and modify invasive species and coastal scrub succession control program
	c) Quality of butterfly habitat within grasslands	Grasslands on SBM are consistently providing suitable habitat for butterflies	Monitor distribution of host and nectar plants through GPS mapping or other suitable methods on San Bruno Mountain every 5 years.	Consider options to increase the density of butterfly host and nectar plants, such as outplanting
	d) Percent cover of native plant species within grasslands	Grasslands on SBM are comprised of a significant and diverse native plant species component	Measure with habitat monitoring techniques	Reassess and modify invasive species and coastal scrub succession control program and consider outplanting of native species.
	e) Butterfly abundance and distribution	The relative abundance and/or the distribution of butterflies show no statistically significant declining trend over time	Determined though the butterfly monitoring program	Evaluate potential sources for butterfly decline and base remedial actions on findings
Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance to sustain and improve the quality of the native grassland habitat	Tool use and efficiency within grassland habitat	Tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.	Measured through monitoring programs established for management tool application projects	Reevaluate and modify management tool application projects

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Restore butterfly colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites (habitat islands) with butterfly host and nectar plants where appropriate exist	a) Acreage of newly created habitat (either restoration of previously occupied habitat or creation of habitat islands); b) percent cover of invasive species and coastal scrub within these areas; c) percent cover of butterfly host and nectar plants within these areas; and d) butterfly presence within these areas	Restoration of an estimated amount of habitat that is equal in proportion or greater to the amount of butterfly habitat that has been lost within the conserved areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for invasive species and 70% controlled for coastal scrub; b) have butterfly host and nectar plants installed and maintained at densities that provide high quality butterfly habitat; and c) butterfly presence has been recorded for 5 consecutive survey years within each restoration site.	Measured through GPS mapping, individual plant counts within restoration sites, and butterfly monitoring	Reevaluate and modify butterfly restoration efforts
Ensure that the restoration of habitat in graded and developed areas (HCP "temporarily disturbed conserved habitat") is restored to established restoration standards prior to acceptance by the Plan Operator	Percent cover of invasive species, percent cover of coastal scrub -- and where suitable conditions exist -- presence of mission blue and/or callippe silverspot butterfly habitat	Areas are: a) 90% controlled for invasive species; and b) 70% controlled for coastal scrub for a minimum of 5 years. Where suitable conditions exist, sites should have mission blue and callippe silverspot habitat that meets established restoration guidelines (Appendix A).	Measured through GPS mapping and qualitative assessment of the restoration sites	Increase oversight of restoration work by Plan Operator and extend period prior to acceptance
Ensure that habitat easements in undisturbed areas (HCP "preserved habitat") are being sufficiently maintained to provide suitable habitat for butterflies prior to acceptance by the Plan Operator	Percent cover of invasive species, percent cover of coastal scrub -- and where suitable conditions exist -- presence of mission blue and/or callippe silverspot butterfly habitat	Areas are: a) 90% controlled for invasive species; and b) 70% controlled for coastal scrub for a minimum of 5 years. Where suitable conditions exist, sites should have mission blue and callippe silverspot habitat that meets established restoration guidelines (Appendix A).	Measured through GPS mapping and qualitative assessment of the butterfly habitat	Increase oversight of restoration work by Plan Operator and extend period prior to acceptance

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Maintain data on butterfly relative abundance and/or distribution of butterflies on San Bruno Mountain	Butterfly abundance and /or distribution data	Butterfly data is consistently collected, stored, and analyzed, and allows for year-to-year comparison and detection of relative abundance trends over time, and effectively guides management decision-making.	Determined though the butterfly monitoring program. Data needs to be robust enough to detect trends in the butterflies' relative abundance to guide decision making.	Revise data collection methods to allow for desired analysis
Monitor for butterflies at restoration sites	Butterfly abundance and /or distribution data	Butterfly data is consistently collected, stored, and analyzed, and allows for year-to-year comparison and detection of relative abundance trends over time, and effectively guides management decision-making. Add proportion of butterfly restored areas to butterfly monitoring program and consistently monitor over time	Evaluation of butterfly monitoring data through statistical power analysis, and peer review of butterfly monitoring program every five years.	Modify butterfly monitoring design to improve data collection and analysis.
Monitor quantity and quality of grassland habitat that supports butterflies	Habitat quality evaluation techniques and data.	Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters that provide a data set for detecting changes over time.	Evaluation of habitat monitoring data through statistical power analysis, and peer review of habitat monitoring program every five years.	Modify habitat monitoring design to improve data collection and analysis.

III. HISTORICAL BACKGROUND

The San Bruno Mountain ecosystem has evolved over time under the influence of grazing animals, fire and humans for thousands of years. Grazing animals, including Pleistocene herbivores no longer present, are likely to have grazed on San Bruno Mountain and had a strong influence over the vegetation composition of native plant communities (Edwards 1992).

Over the previous several thousand years, native grasslands were likely maintained by herds of native grazing animals such as Tule elk (*Cervus elaphus nannodes*), occasional wildfire and intentional burning by Native American Indians. Native Americans are likely to have conducted burning on San Bruno Mountain for centuries and possibly longer, to encourage the growth of forbs harvested for food (Keeley 2002). With the coming of Europeans in the late 1700's and the arrival of domesticated livestock, the Mountain was cleared for ranching and farming and was grazed by cattle. For the next two centuries, domesticated grazing animals had replaced native grazing animals in maintaining grasslands, while fire was still being utilized to clear brush.

In the building booms of the 1940's, 50's and 60's, the periphery of San Bruno Mountain gradually grew into the cities of Brisbane, Daly City, Colma, and South San Francisco. By the 1970's, San Bruno Mountain had become one of the largest open space areas surrounded by urbanization in the United States. Most of this land was privately owned and was planned for development. However through purchases and donations of parkland to the State (400 acres) and the County of San Mateo (1600 acres), and the conservation of 800 acres through the HCP, approximately 80% of San Bruno Mountain was set aside as protected open space by 1982. In addition, the California Department of Fish and Game purchased 91 acres in Owl and Buckeye Canyons, and protected 15 additional acres within this parcel from development[5].

The creation and expansion of the park created large grassland areas that needed to be protected from the expansion of brush and woodland communities. By the late 20th Century however, native grazing animals had been eliminated and the practices of cattle grazing and regular burning on the Mountain had been eliminated or drastically reduced. These practices had maintained much of the lower elevation and eastern slopes of the Mountain as open grasslands. While the disturbance caused by grazing and burning was beneficial in keeping grasslands open, these practices also allowed invasive species to colonize and spread on the Mountain.

The Mountain today contains large areas of native and non-native grasslands, coastal scrub, and oak woodlands (Figure 4). Three federally listed endangered butterflies, the mission blue, callippe silverspot, and San Bruno elfin, and a variety of rare plants are present within the San Bruno Mountain HCP. Though the butterfly species are rare in other parts of their range, these species continue to be locally abundant on San Bruno Mountain. One federally threatened species, the bay checkerspot butterfly, has been extirpated from the Mountain since the mid-1980's. Habitat for this species is limited to a narrow portion of the summit of the Mountain, and is designated as Critical Habitat by the US Fish and Wildlife Service (Figure 9).

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[5] 76 acres within Owl and Buckeye Canyons were protected through the HCP, and the purchase of this property by CDFG protected an additional 15 acres (91 acres total). This land is managed by the HCP Habitat Manager and through volunteer activities by San Bruno Mountain Watch.

Over the past 25 years, management of the Mountain's ecosystem has been focused on the removal of invasive plant species through hand control, mowing, and herbicide, and the major processes that have shaped the flora of San Bruno Mountain –- grazing and fire —are largely absent today. Wildfires are extinguished before burning substantial acreages to protect local communities, resulting in only approximately 20 – 50 acres burned annually. Prescribed burning has been implemented as a management tool only minimally over the span of the HCP due to fire hazard and air pollution concerns. Grazing has been limited to one pilot grazing experiment in 2002/2003 that covered six acres, and grazing has not been implemented on a large scale due to funding constraints, environmental concerns and the lack of grazing infrastructure (water and fencing) on the Mountain.

A. Invasive Species and Brush Succession

Native grassland is vulnerable to invasive species and brush succession due to its low height and competitive disadvantage to faster growing and/or taller grass, herbs, and shrubs. The process of type conversion from grassland to brush and invasive species is not specific to San Bruno Mountain. It has been occurring for decades throughout California and elsewhere (McBride, J., and H. F. Heady 1968; McBride, J. 1974). This process combined with the loss of grasslands to development has resulted in California native grasslands as being identified as one of the 21 most endangered ecosystems in the United States (PIRG, 1997).

While the current management has been successful in controlling invasive species, the elimination of grazing, burning and other forms of disturbance has resulted in an acceleration of coastal scrub succession and a corresponding loss of grasslands.

In 1982, the HCP documented the loss of grassland on the Mountain due to the expansion of invasives and natural succession, and warned of the potential extinction of the rare butterflies if these processes were not controlled.

> "In 1932 in the San Bruno Mountain area, there was more than four times as much grassland as non-grassland; (whereas) in 1981 the proportions are nearly equal." -- Volume One, San Bruno Mountain HCP, 1982.

> "It is clear that existing biological processes, unchecked, will dramatically reduce the area of grassland habitat in the near future so that the dominant aspect of the Mountain will be brush and exotics". --Volume One, San Bruno Mountain HCP, 1982.

In 1932, most of San Bruno Mountain was covered by grassland due to the intensive ranching and farming practices that had been on-going for several decades. These practices had tipped the balance of the ecological communities well towards grassland. However by 1981, this had changed dramatically due to the cessation of grazing and the suppression of fires beginning in the 1960's.

In 1981, the level of grassland prior to HCP-approved development on San Bruno Mountain was 1,740 acres (calculated from HCP Vol. 1, 1982). Of that grassland, 331 acres has been developed as allowed through the HCP. The amount of protected grassland remaining after development within the conservation areas was estimated to be 1,409 acres. The current estimate of grassland (1287 acres as of 2004) within the conserved habitat area on San Bruno Mountain represents a loss of 122 acres (8.6%) of grassland to coastal scrub succession over the span of the HCP.

Much of the focus of vegetation management since the inception of the HCP has been on control of woody and herbaceous weed species through hand, mechanical, and herbicide methods. During the past 25 years, succession of grassland to coastal scrub has occurred in the Reservoir Hill area, the Carter-Martin area, Owl and Buckeye Canyons, the eastern Saddle, and the north-facing slopes above the Brisbane Industrial Park. The lack of any grazing and/or consistent prescribed burning on the Mountain has allowed native coastal scrub to expand and overtake grassland areas, especially on lower elevation north-facing slopes

This loss of grassland indicates that the current vegetation management program needs to be modified to counteract this process. Approximately 5 acres of grassland are converting to coastal scrub per year, and it is anticipated that this process will continue. Over time, this rate would decline as some areas of the Mountain are resilient to coastal scrub succession, (e.g., areas with thin soils on rocky outcrops, ridgelines and very dry exposures on south-facing exposures). However without reintroduction of a disturbance regime that is commensurate with the level of disturbance the native grasslands evolved with, the grasslands are expected to continue to decrease in area.

Coastal scrub vegetation only becomes a threat to butterfly habitat when it reaches a high density and overtakes important butterfly host and nectar plant habitat within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. Coastal scrub also provides shade and greater soil moisture retention for host plants (i.e., *Viola pedunculata* and *Sedum spathulifolium*), and may provide protection of adult and larval stages of the butterflies from predators. Coastal scrub also provides important foraging and nesting habitat for a wide range of native wildlife species. For all of these reasons, management of coastal scrub succession should be focused on control rather than eradication of this important plant community.

B. Habitat Conservation Plan Overview

The Habitat Management Plan applies to conserved habitat within the HCP plan area that is part of the San Bruno Mountain State and County Park, including land that has been dedicated and accepted by the County of San Mateo. Lands that are currently under private ownership, but are required to be dedicated to the conservation area and eventually come under County ownership are also subject to this Habitat Management Plan. Figure 2 shows all conserved habitat and developments as of 2007. These acreages are described in Table 3. Acreages shown are approximated and are slightly different than acreages reported in the original HCP, due to the development of more accurate methods of calculation (i.e. GIS) since 1982.

Figure 2. Conserved Habitat and Development on San Bruno Mountain as of 2007

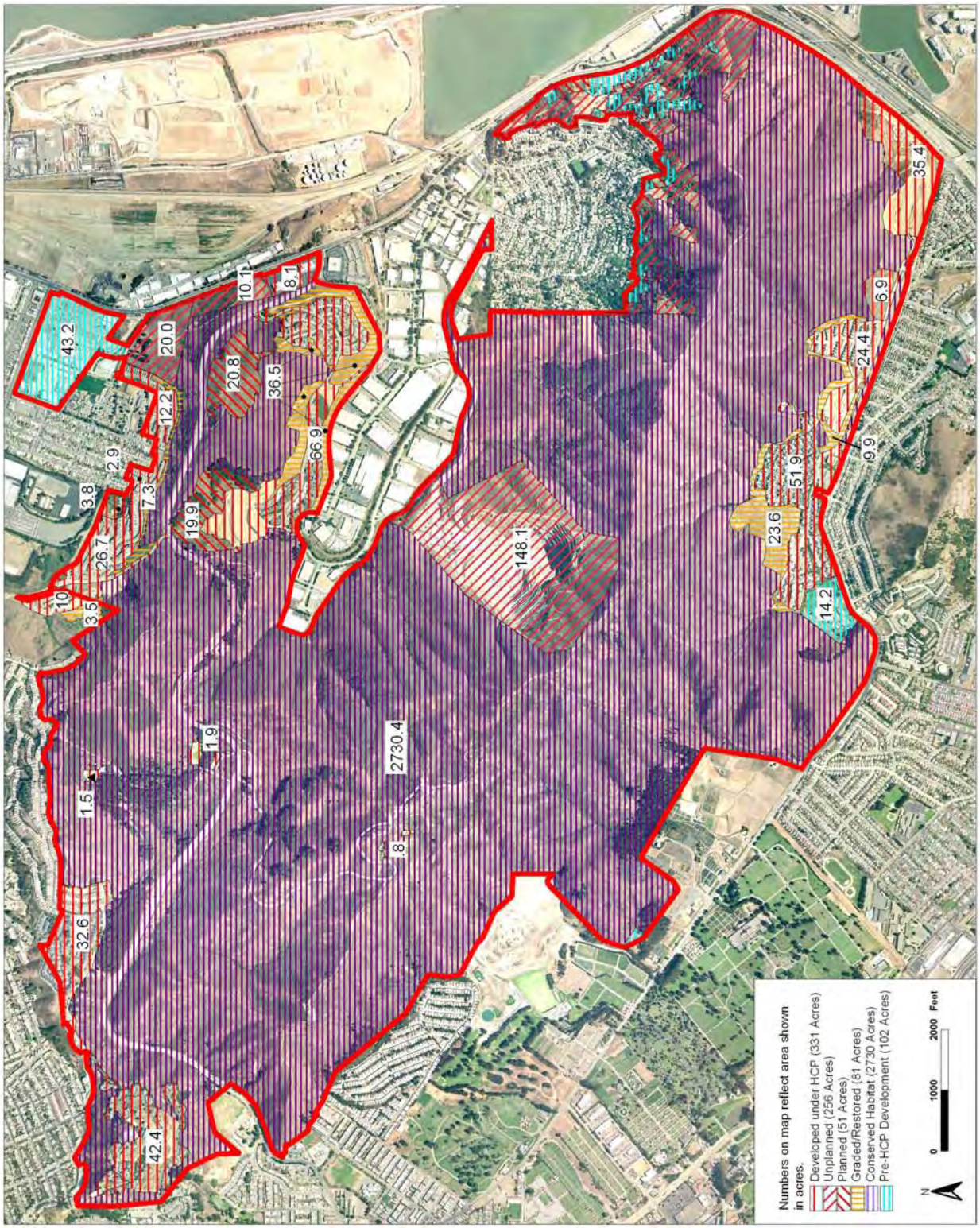


Table 3. Acreages of HCP Conserved Habitat and Development on San Bruno Mountain, September 2007.

Category	Acres	Percentage of HCP Area	Notes
Conserved Habitat	2727	79.1%	Includes lands donated and purchased prior to the HCP, and included in HCP Conservation Area, and Conserved Habitat that is still in dedication process. Total conserved habitat is expected to exceed original HCP calculation of conserved habitat by at least 100 acres due to 1) reduced development plans on the Southeast Ridge and Northeast Ridge, 2) additional lands being purchased for conservation through other land agreements.
Developed Areas	331	9.6%	Includes all areas currently developed as approved through the HCP as of 2007.
Unplanned areas	256	7.4%	Unplanned areas do not have developments or conservation dedications planned at this time (2007). Brisbane Acres was comprised of 154 acres of unplanned parcels in 1982. 42 acres have been purchased as open space by the City of Brisbane through grant assistance, and approximately 16 acres have become planned parcels as of 2007. Conservation of a minimum of 40% of unplanned parcels in Brisbane Acres administrative parcel is required by the HCP. Guadalupe Quarry (148 acres) is an unplanned parcel and is included in the total. Approximately 85 acres of the quarry are disturbed from mining operations, and 73 acres are undisturbed habitat areas located on the east, south, and west. Total reflects subtraction of 42 acres of open space that were purchased by the City of Brisbane, as of 2007.

Category	**Acres**	**Percentage of HCP Area**	**Notes**
Areas temporarily disturbed through grading due to slope stabilization requirements.	81	2.3%	Includes all areas, as of 2007, that have been graded due to temporary disturbance. Most of these areas are required to be restored and dedicated to the HCP conservation Area.
Additional Planned Development Areas	51	1.4%	Pending City, County, and/or USFWS approval. Acreage shown assumes 1989 Approved VTM for the Northeast Ridge included in total. The modified Brookfield homes proposal (2007 VTM) would reduce development by 20 acres in the planned development areas, and these acres would be added to the conservation area.
Total	3,446	99.8%	Total percentage is slightly off due to rounding. Total acres calculated in the 1982 HCP was 3,537. Approximately 100 acres were included in this total that were developed prior to the HCP (Figure 2).

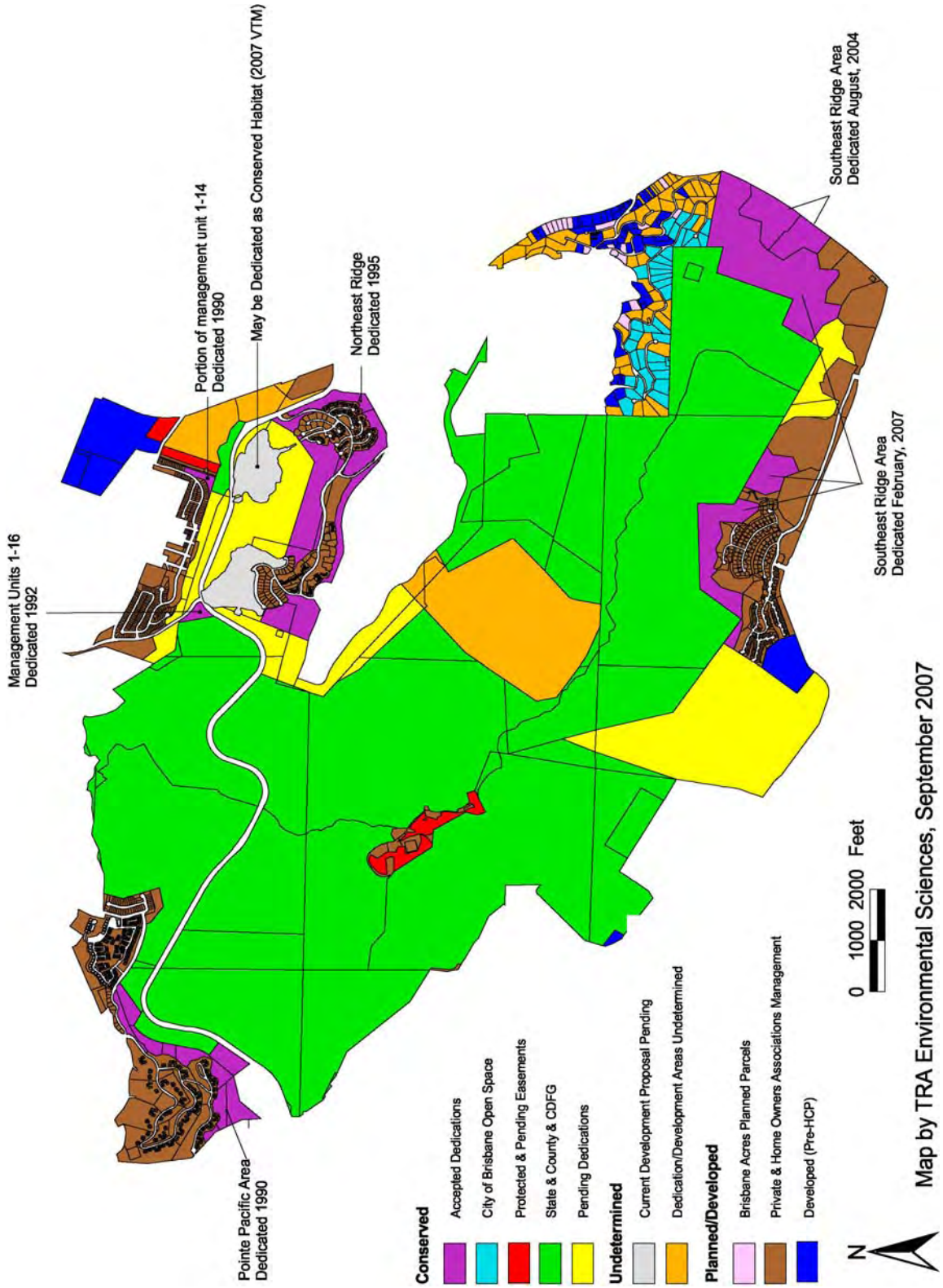
The conservation area consists of lands already dedicated to the park or in the process of dedication. Parcels designated as unplanned do not have development proposals at this time and are subject to habitat conservation requirements of the HCP (TRA, 1982, HCP Vol. II). Figure 3 shows the status of all HCP parcels as of 2007.

Temporarily disturbed lands within the HCP conservation area are subject to the guidelines for restoration of butterfly habitat (Appendix A). The purpose of the restoration guidelines is to aid those conducting restoration in meeting butterfly habitat restoration goals of the HCP. Some slopes disturbed through slope stabilization requirements are located adjacent to the developments are not within the HCP conservation area. These areas are managed by the Homeowners Association of each development.

Conserved areas protected through other mechanisms include areas purchased and managed by City of Brisbane as conserved open space (42 acres), areas purchased by the Trust for Public Land such as the Preservation Parcel on Southeast Ridge (26 acres), and areas purchased by California Department of Fish and Game (15 additional acres conserved).

The 2007 Habitat Management Plan focuses only on the land within the HCP plan area. However control of invasive species would be enhanced by management efforts on both sides of the HCP boundary, and this is critical toward the long-term success of invasive species control on San Bruno Mountain. One example of control efforts being conducted on both sides of the HCP boundary is the northern Saddle area where gorse control is conducted by the Habitat Manager on HCP lands, and the City of Daly City has instituted a mandatory gorse control ordinance on adjacent landowners. The HCP Habitat Manager will need to continue work with adjacent landowners to achieve the desired objectives of the HCP.

Figure 3. San Bruno Mountain HCP Parcels



IV. VEGETATION TYPES, ENDANGERED SPECIES AND THREATS

A. Vegetation Types and Plant Communities

Figure 4 shows a map of the general vegetation types on the Mountain. Within these broad categories are nine native plant communities and three invasive plant communities. Plant communities are assemblages of plant species that occur together in the same area. They are defined by species composition and relative abundance. The vegetative community descriptions generally follow the classification system provided in *A Flora of the San Bruno Mountains* (McClintock et al, 1991) while nomenclature follows the Jepson Manual (Hickman, 1996). A comparison to the more modern and nationally recognized classification presented in Sawyer and Keeler-Wolf's *A Manual of California Vegetation* (MCV), (1995) is also included.

There are a variety of important native plant communities on San Bruno Mountain and within these plant communities there is significant variation in dominant species and overall species composition. Three types of grassland communities provide habitat for the endangered species (Valley Needlegrass Grassland, Coastal Prairie and Non-native Grasslands). Rocky outcrops are included within grassland communities.

Native Plant Communities

<u>1. Valley Needlegrass Grassland</u>

MCV Classification: Purple Needlegrass Series

Purple needlegrass (*Nassella pulchra*) is a dominant or important species in this grassland community. Associated grass species include foothill needlegrass (*Nassella lepida*), California fescue (*Festuca californica*), California melic (*Melica californica*), and blue wildrye (*Elymus glaucus*). Associated wildflower species include coast iris (*Iris longipetala*), soap plant (*Chlorogalum pomeridianum*) and a rare perennial sunflower species, Diablo helianthella (*Helianthella castanea*). These grasslands represent an important component of habitat for the rare butterfly species on the Mountain because of the higher proportion of native host and nectar plants found in them.

<u>2. Coastal Terrace Prairie</u>

MCV Classification: Pacific Reedgrass Series, California Oatgrass Series, Tufted Hairgrass Series

Coastal prairies dominated by Pacific reedgrass (*Calamagrostis nutkaensis*), California oatgrass (*Danthonia californica*), or tufted hairgrass (*Deschampsia caespitosa*) are a limited but integral component of the plan area. Good examples of this community are located on Kamchatcka Point and April Brook. Associated species include bracken fern (*Pteridium aquilinum*), red fescue (*Festuca rubra*), California fescue, and Idaho fescue (*Festuca idahoensis*). These grasslands represent an important component of habitat for the rare butterfly species on the Mountain because of the higher proportion of native host and nectar plants found in and around them.

3. Valley Wild Rye Grassland

MCV Classification: Creeping Ryegrass Series

Creeping ryegrass (*Leymus triticoides*) dominates in riparian grasslands and mesic grassland slopes. Examples of this community include localities on the Northeast Ridge, Southeast Ridge Preservation Parcel and the base of Wax Myrtle Ravine. Associated species include California brome (*Bromus californica*), blue wildrye and annual invasives such as wild oats (*Avena barbata*). This grassland type typically does not support the butterflies of concern because soils are too moist for host plant survival.

4. Coast Live Oak Woodland

MCV Classification: Coast Live Oak Series

Woodland communities dominated by coast live oak (*Quercus agrifolia*) typically occur on steeper, north to east-facing slopes in Buckeye and Owl Canyons and above the City of Brisbane. Associated shrub species include California coffeeberry (*Rhamnus californica*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), and California bay (*Umbellularia californica*). The growth-form of these trees is typically low and shrubby due to the maritime influence.

5. Northern Coastal Scrub

MCV Classification: Coyote Brush Series, California Sagebrush Series

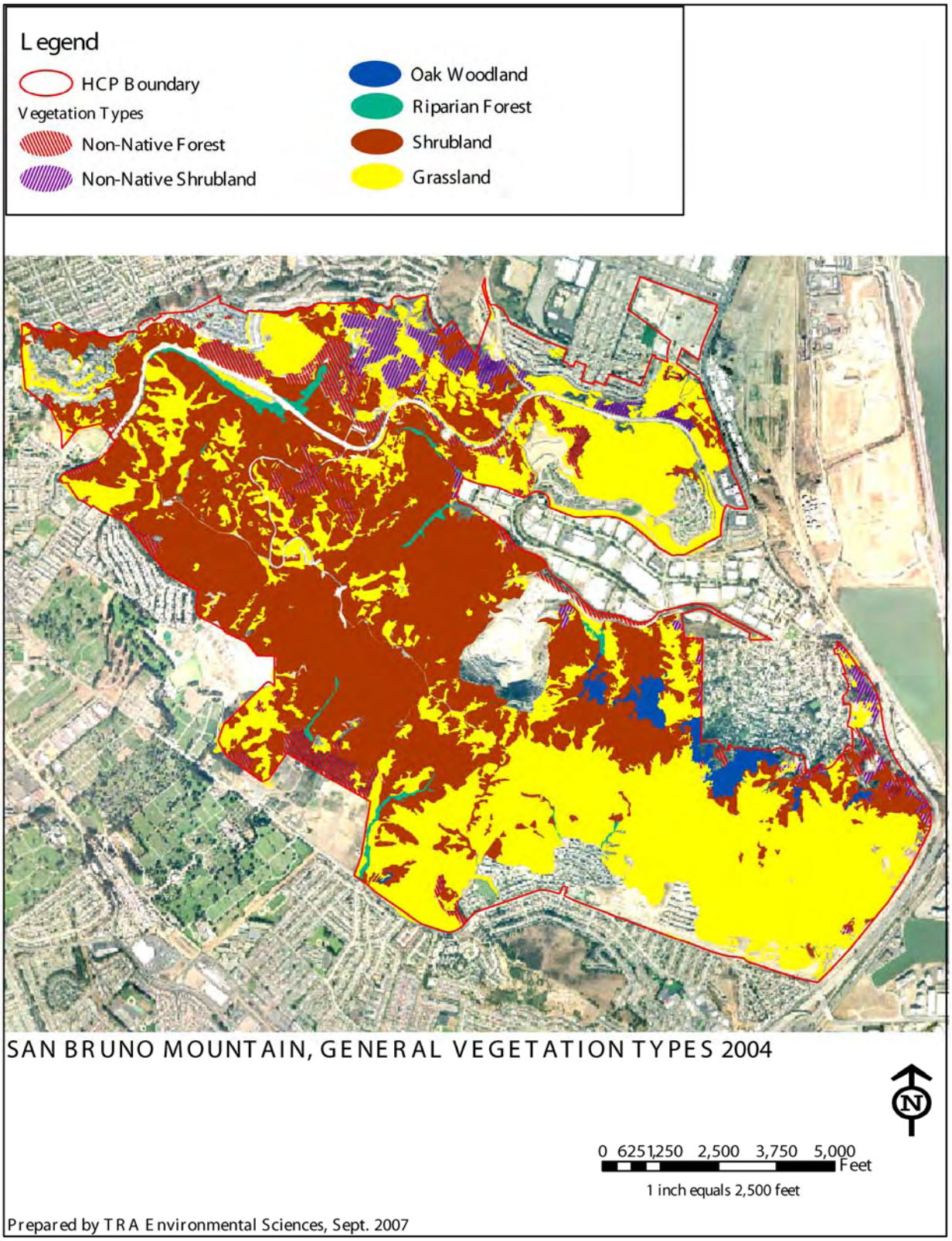
This shrub community is common in many locations on San Bruno Mountain and is dominated by stands of coyote brush (*Baccharis pilularis*) and California sagebrush (*Artemisia californica*). Subdominants include sticky monkeyflower (*Mimulus aurantiacus*) and poison-oak. Associated shrub species include pearly everlasting (*Anaphalis margariticea*), hazelnut (*Corylus cornuta*), oceanspray (*Holodiscus discolor*), seaside woolly sunflower (*Eriophyllum staechadifolium*) and California blackberry (*Rubus ursinus*).

6. Central Coast Riparian Scrub

MCV Classification: Arroyo Willow Series, Sitka Willow Series

This riparian scrub and forest community occurs along creeks and wet ravines and is dominated by stands of arroyo willow (*Salix lasiolepis*), Sitka willow (*Salix sitchensis*) and California wax myrtle (*Myrica californica*). Associated species include American dogwood (*Cornus sericea* ssp. *sericea*), red elderberry (*Sambucus racemosa*), California blackberry, water parsnip (*Oenanthe sarmentosa*), lady fern (*Athyrium filix-femina*), and cow parsnip (*Heracleum lanatum*).

Figure 4. San Bruno Mountain General Vegetation Types



7. Central Dune Scrub

MCV Classification: Yellow Bush Lupine Series

This dune habitat is only known from the dune habitats west of Pointe Pacific and these habitats are largely outside of the plan area. These sand dune communities are dominated by yellow bush lupine (*Lupinus arboreus*) and blue beach lupine (*Lupinus chamissonis*). Associated plants include sandmat (*Cardionema ramosissimum*), mock heather (*Ericameria ericoides*), evening primrose (*Camissonia strigulosa*, *C. micrantha*) and two rare annual herb species, San Francisco lessingia (*Lessingia germanorum*) and San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*).

8. Blue Blossom Chaparral

MCV Classification: Blue Blossom Series

This shrub community is dominated by blue blossom (*Ceanothus thyrsiflorus*). Associated shrub species include black huckleberry (*Vaccinium ovatum*), coyote brush, toyon, and poison-oak. Large stands of this community occur on the north east-facing slopes below the upper parking lot at the head of the Ridge Trail (Devil's Arroyo). Previous to the last hot fire that occurred in this area in 1964, the north-facing slope below the summit contained only small patches and remnants of blue blossom. A component of this chaparral type includes stands of maritime chaparral dominated by manzanita species such as San Bruno Mountain Manzanita (*Arctostaphylos imbricata imbricata*), Montara Manzanita (*A. montaraensis*), and bearberry (*A. uva-ursi*).

9. Freshwater Marsh & Seeps

MCV Classification: Sedge Series

Wetland marshes and seeps dominated by sedge and/or rush species make up this herbaceous plant community. Dominant rush species include Pacific bog rush (*Juncus effusus*), Baltic rush (*Juncus balticus*), and brown-headed rush (*Juncus phaeocephalus*) while dominant sedge species include slough sedge (*Carex obnupta*), dense sedge (*Carex densa*), and Santa Barbara sedge (*Carex barbarae*). Associated species include fringe cup (*Tellima grandiflora*) and monkeyflower (*Mimulus guttatus*).

Invasive Vegetation Types

10. Broom/Gorse Shrubland

MCV Classification: Broom Series

This community is dominated by non-native legume shrub species such as French broom, gorse, Portuguese broom, and Scotch broom (*Cytisus scoparius*). Though significant portions of infestations of these species have been controlled, there are dense stands of these species remaining on the periphery of the Plan area.

11. Eucalyptus Forest

MCV Classification: Eucalyptus Series

Stands of Eucalyptus (Gum) trees dominate significant portions of the periphery of the plan area. The most prevalent and widespread of the species represented include blue gum and Silver Mountain Gum (*Eucalyptus pulverulenta*). Other non-native trees associated with these communities and occurring elsewhere on the Mountain include Monterey Cypress, acacia (*Acacia* spp.), and Monterey Pine.

12. Non-Native Grasslands

MCV Classification: California Annual Grassland Series, Introduced Perennial Grassland Series

Grasslands dominated by non-native annual or perennial grasslands have become an increasing concern throughout significant portions of the plan area, especially the northeast and southeast ridges. Dominant species include wild oat, ripgut brome (*Bromus diandrus*), velvet grass, Kikiyu grass (*Pennisetum clandestinum*) and Italian ryegrass (*Lolium multiflorum*). Associated non-native forb species are a significant component of this community and dominate the landscape in places. These species include mustards (*Brassica* spp., *Hirschfeldia incana*), wild radish (*Raphanus sativus*), filaree (*Erodium* spp.), sow thistle (*Sonchus oleraceus*), hairy cat's ear (*Hypochaeris radicata*), sheep sorrel (*Rumex acetosella*) and Bermuda buttercup. Though the endangered species are found in non-native grasslands and utilize some non-native species for nectaring, they generally prefer higher quality native grasslands due to the presence of associated native species that are low growing and do not overtake the butterfly host plants.

B. Endangered Butterfly Species

The mission blue, callippe silverspot, and San Bruno elfin butterflies require grassland habitats that support their larval host plants and nectar plants. All three butterflies overlap with one another in distribution, but also are found separately on the Mountain due to the different habitat requirements of their host plants as well as behavioral preferences for different topographic features.

Butterfly habitat on San Bruno Mountain is not static, and the habitat fluctuates both spatially and temporally, within areas where suitable soils and slope exposures are present. Over the course of a single year some habitat areas decline in quality while others increase. For example in the El Nino year of 1998, a significant large-scale decline in habitat quality occurred to mission blue habitat where silver lupine (*Lupinus albifrons var. collinus*) was the dominant host plant species. This resulted in a significant decline in mission blue colonies that utilized silver lupine on San Bruno Mountain (a similar decline occurred to mission blue colonies in the Golden Gate National Recreation Area). In areas on San Bruno Mountain where summer lupine (*Lupinus formosus var. formosus*) plants were the dominant host plant, mission blue observations were not impacted, and may have slightly increased. It is therefore important to provide as much potential habitat as possible to buffer the species from infrequent large-scale declines in habitat quality that occur independent and outside the control of the Habitat Manager.

Within the San Francisco Bay region, San Bruno Mountain provides the largest and most actively conserved and managed habitat area for the callippe silverspot and San Bruno elfin butterflies, and the second largest area for mission blue. Most other sites for each of these

species are either much smaller in size, have less habitat, and/or are not actively managed or monitored on a regular interval. Exceptions to this are Milagra Ridge and Sweeney Ridge in Pacifica and the Marin headlands in the Golden Gate National Recreation Area, where the National Park Service has been monitoring mission blues for several years. Habitat is managed at the Marin headlands (9,600 acres), and Sweeney Ridge (1,200 acres) and monitoring is currently conducted at Milagra Ridge (230 acres). Mission blue butterfly numbers at Milagra are currently stable (Merkle, pers. comm.); however, there are concerns about the long-term viability of this population (Lindzey 2006). Invasive species control is conducted within these sites, but they are not managed for coastal scrub succession at this time (Merkle, pers. comm.).

The callippe silverspot butterfly is found in grassland habitats in the East Bay (Pleasanton Ridge) and the North Bay (Vallejo area), and a Recovery Plan for the callippe silverspot is in process (Longcore, pers. comm.). The San Bruno elfin butterfly is found in a few isolated habitat locations on Milagra Ridge and on Montara Mountain in western San Mateo County. No monitoring information is available for these sites.

Mission Blue

The mission blue butterfly is the most widespread of the endangered butterfly species on the Mountain, and its distribution corresponds closely to the distribution of its host plants. Figure 5 shows a generalized map of mission blue habitat based on grassland extent. (Mission blue host plants have not been mapped on a mountain-wide basis on San Bruno Mountain since 1981; mission blues are limited primarily to areas where their host plants and nectar plants are concentrated. Figure 6 shows the distribution of mission blue and callippe silverspot butterfly observations recorded annually on San Bruno Mountain from 1982 to 2001.

The host plants for the mission blue butterfly are three perennial lupines: silver lupine (*Lupinus albifrons* var*. collinus*), summer lupine *(L. formosus* var*. formosus)*, and varied lupine (*L. variicolor*). Mission blues use a variety of native and nonnative species for nectaring (especially thistles) that are found throughout the grassland and coastal scrub plant communities (Appendix C). Mission blues have been found to move up to approximately 0.25 miles between habitat patches (Thomas Reid Associates, 1981) however the species is likely to move further, during multiple movements between habitat areas. It is unlikely that mission blues are capable of immigrating or emigrating from San Bruno Mountain due to the urbanization barriers surrounding the Mountain.

Protection from wind appears to be an important habitat component for mission blues, and often the species is detected on the leeward side of slopes, or within protected roadcut areas where suitable densities of host plants are present.

Mission blues utilize silver lupine and summer lupine as their primary host plants, and utilize varied color lupine less frequently on San Bruno Mountain. Silver lupine is the most widespread host plant species on the Mountain, and grows within dry habitats such as south and east-facing native and non-native grasslands, roadcuts, rock outcrops, fire breaks, ridgelines, erosion rills, and landslide scars. Summer lupine also grows within disturbed soil conditions, and colonizes roadways and landslide scars that are located in more mesic areas, where soils are typically deeper and/or more sandy. Varied color lupine grows in grasslands and along disturbed roadsides, typically within mesic exposures, and is commonly found within north and west facing grasslands. Varied color lupine tends to be utilized by mission blues when found in large patches and/or plant sizes, or when found in proximity to silver and/or summer lupine plants (perhaps indicating a suitable microclimate is present).

Figure 5. Distribution of Mission Blue Habitat on San Bruno Mountain (Based on Grassland Extent)

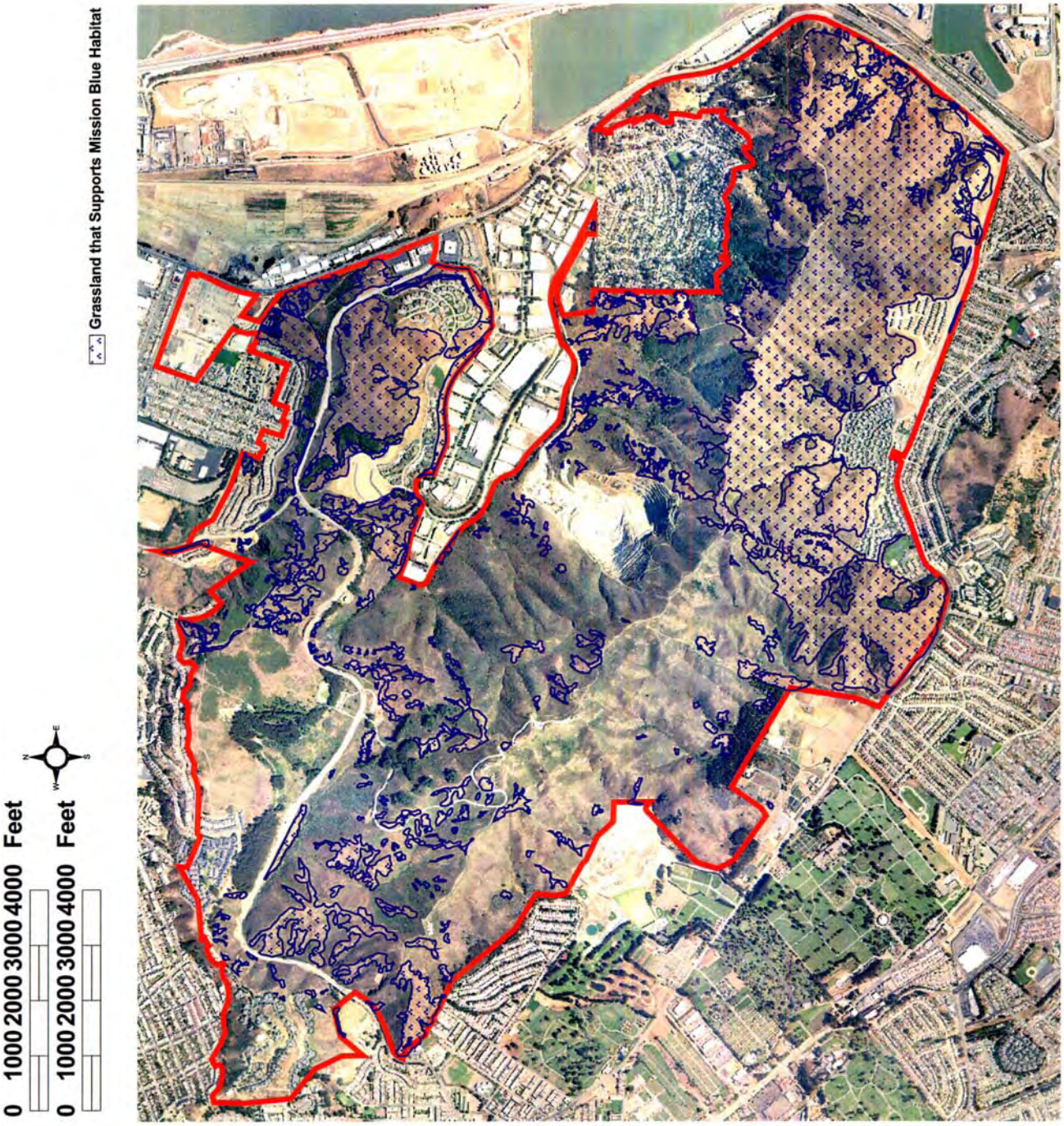
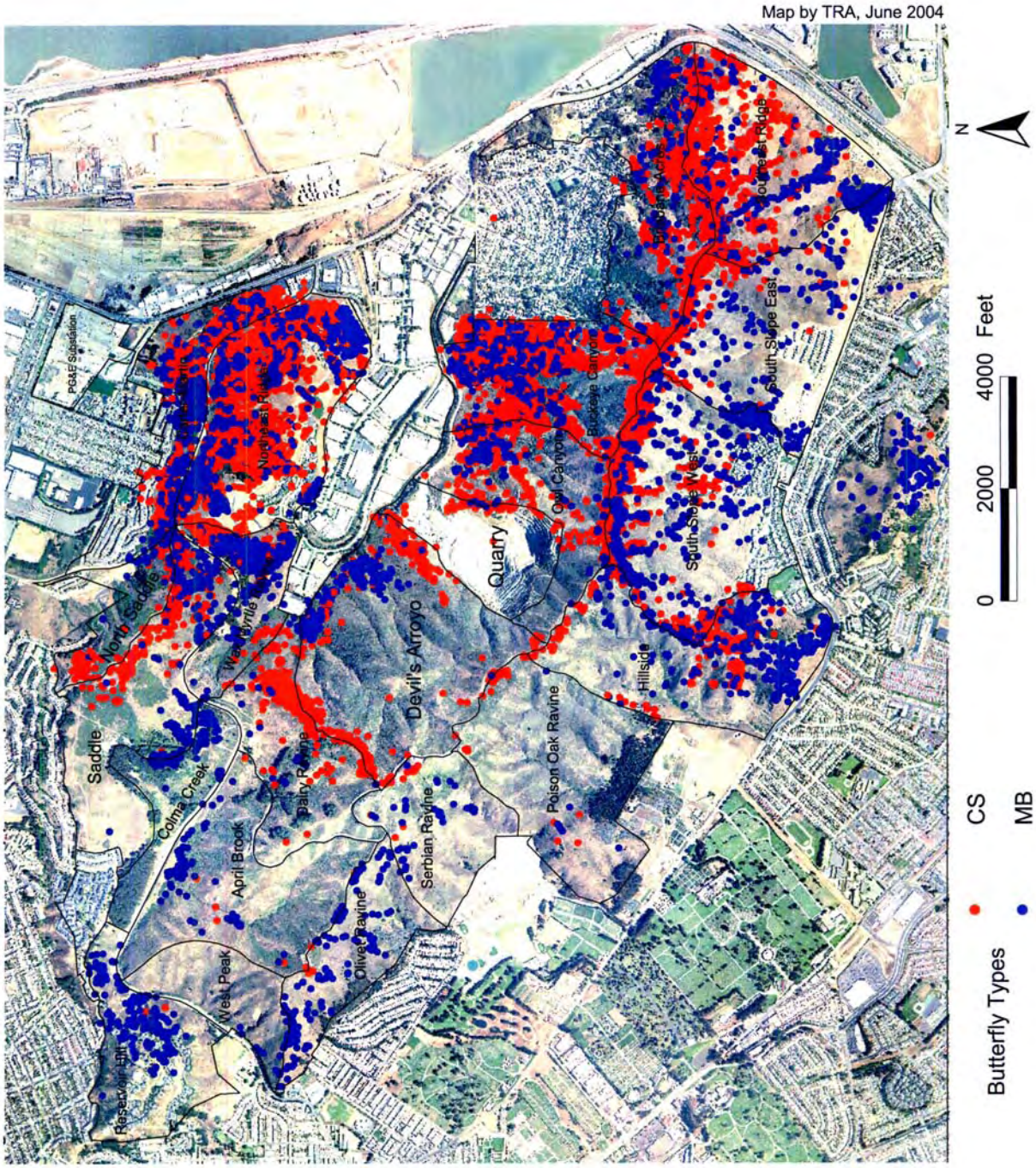


Figure 6. Mission Blue and Callippe Silverspot Distribution on San Bruno Mountain (1982 - 2000)



Callippe Silverspot

The callippe silverspot distribution is similar to that of the mission blue, however the callippe is less frequently observed on the west side of the Mountain (Figures 6). Habitat for the callippe is shown in Figure 7. Viola pedunculata, the host plant for the callippe, is predominately found within mesic to dry open grasslands on both north and south-facing slopes. Viola can also be found on disturbed roadcuts, and along the boundaries between grassland and scrub under partial shade of taller plants. Ridgelines and hilltops within grassland habitats are an important habitat component for this butterfly species, because callippes utilizes these features for mate selection. Callippe silverspots use a variety of native and nonnative species for nectaring (especially thistles) that are found throughout the grassland and coastal scrub plant communities (Appendix C). The species has been shown to move up to approximately 0.75 miles between habitat patches (Thomas Reid Associates, 1981), but likely can move further in multiple movements. Callippe silverspots are capable of immigrating or emigrating from San Bruno Mountain to two adjacent open space areas, Sign Hill and McClaren Park, (both are within 0.25 miles of San Bruno Mountain State and County Park). Both of these parks have extremely limited habitat for callippe at the present time. It is likely that urbanization barriers preclude the callippe from immigrating or emigrating beyond these two adjacent parks.

Due to their larger size and stronger flying ability than mission blues, callippes are not as sensitive to strong winds. Often this species is detected along ridgelines and hilltops in high densities, sometimes during windy conditions (>10 mph average).

San Bruno Elfin

The host plant for the San Bruno elfin butterfly, Pacific stonecrop (*Sedum spathulifolium*), is predominately found in native grassland patches and rocky outcrops, on north-facing slopes above 500 feet elevation. Sedum often grows along transition areas between scrub and grassland. San Bruno elfins use a variety of nectar plants limited to the upper elevation grasslands and scrub on the Mountain (Appendix C). This species has been documented to move at least 0.15 mile between habitat patches (Arnold, 1983), and can likely move much further over the course of multiple flight movements.

San Bruno elfin habitat is located within north-facing grasslands that are highly influenced by summertime fog. Figure 8 shows the distribution of San Bruno elfin habitat on San Bruno Mountain. Coastal scrub plant species are common within San Bruno elfin habitat, and this community type is utilized frequently for nectaring and perching by San Bruno elfins.

Bay Checkerspot

The bay checkerspot butterfly, a federally Threatened butterfly, was observed to be present within a linear band of habitat 0.8 kilometers in length along the summit of San Bruno Mountain up until the mid-1980's. The combination of an extremely small population size, drought, wildfire, and possibly collecting appears to have brought about the extirpation of bay checkerspot butterflies on the Mountain, as no individuals have been observed on San Bruno Mountain since 1984. The host plants for this species, California plantain (*Plantago erecta*) and owl's clover (*Castilleja densiflora*) are still found in relative abundance in coastal prairie and grassland on San Bruno Mountain.

The USFWS designated Critical Habitat for this species on San Bruno Mountain in 2001. The acreage defined by the Service is located on the eastern half of the Mountain, and is located above the 500 foot elevation contour (Figure 9). San Bruno Mountain represents the most

northerly part of the subspecies' former range on the San Francisco peninsula and has reasonably good conditions to support the species. The San Bruno Mountain unit is considered as an essential supporting element of the San Mateo metapopulation, and a backup to the Edgewood and Jasper Ridge populations (USFWS 2001).

Figure 7. Distribution of Callippe Silverspot Habitat on San Bruno Mountain (Based on Grassland Extent)

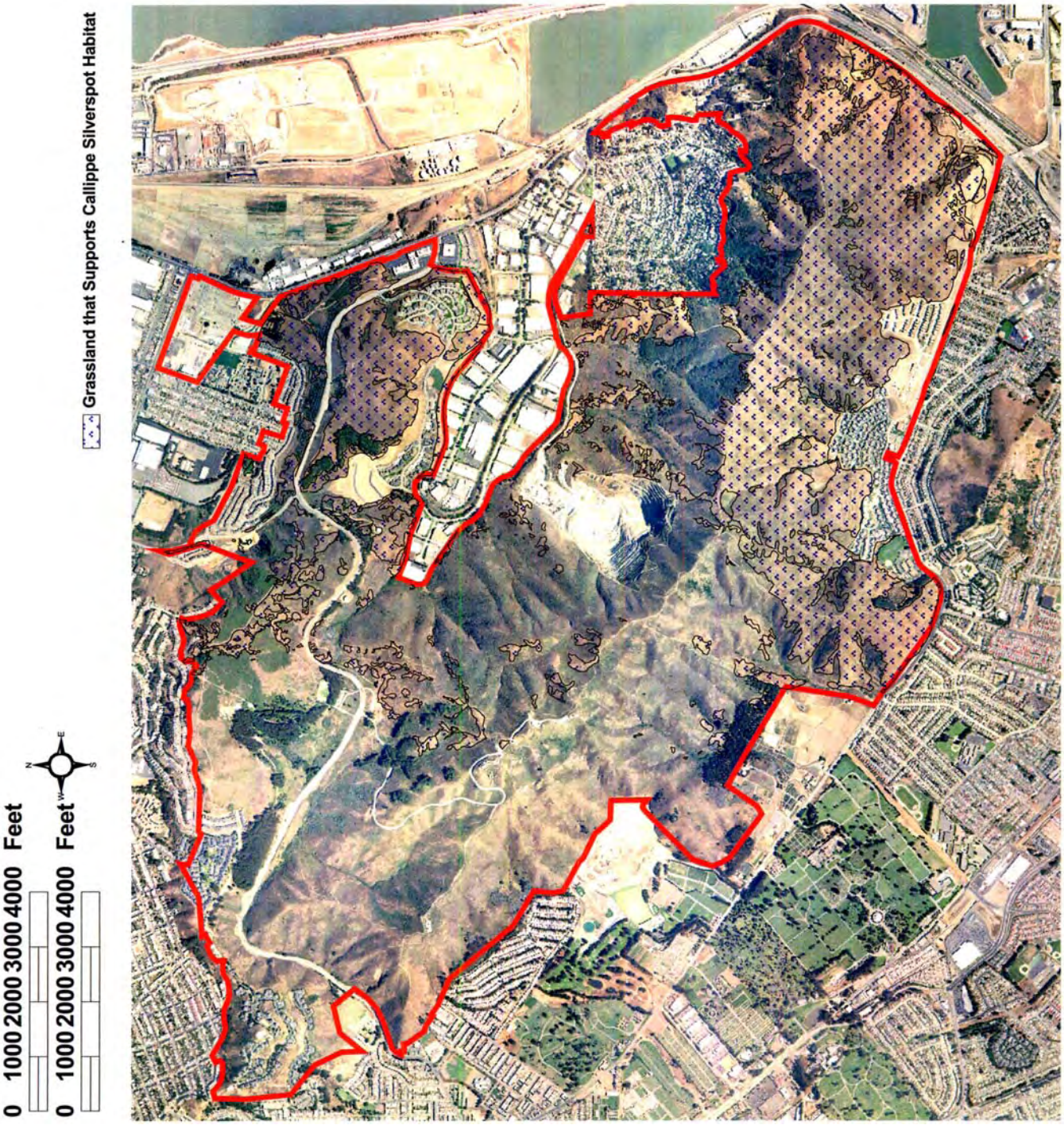


Figure 8. Distribution of the San Bruno Elfin Habitat on San Bruno Mountain

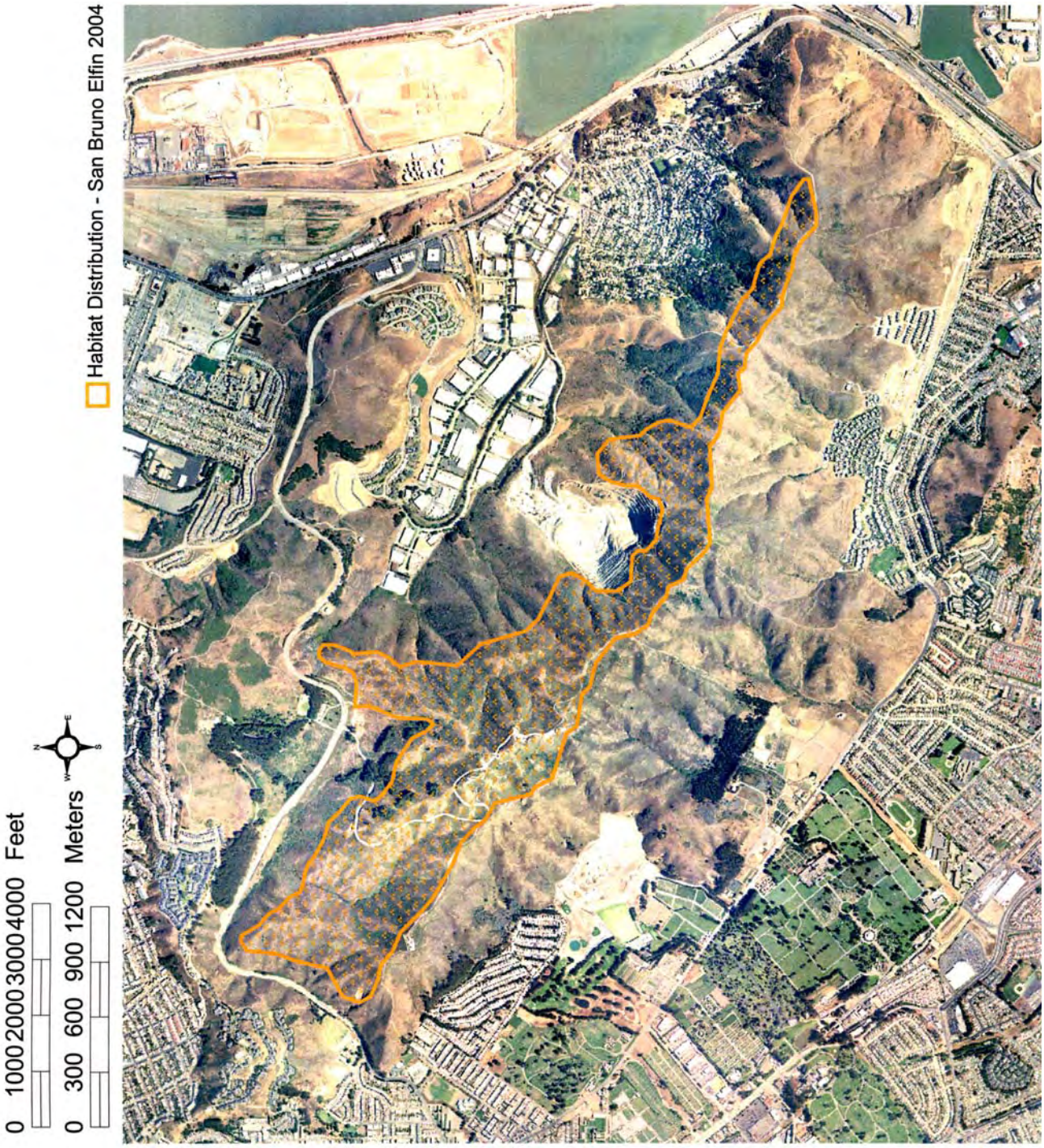
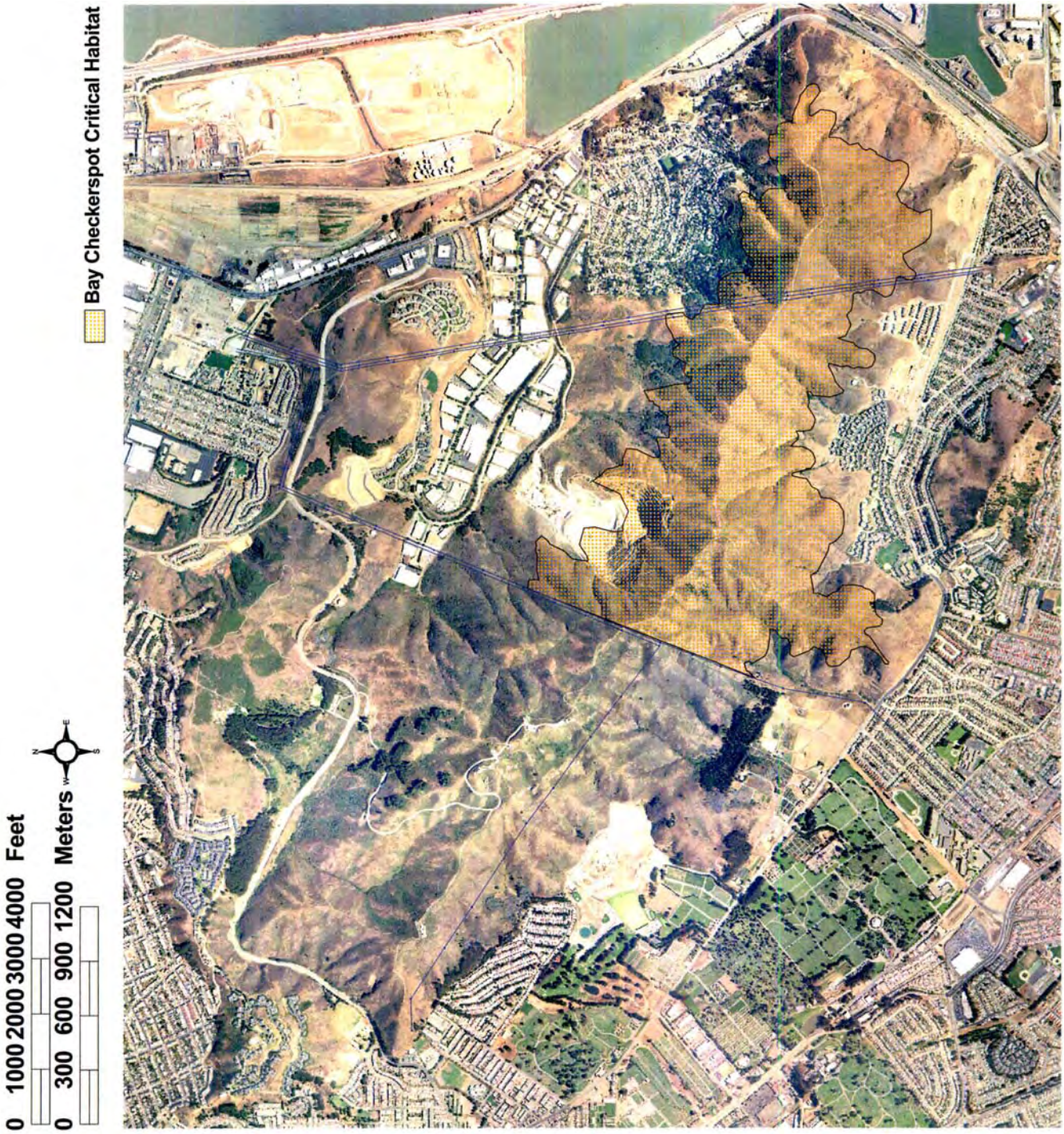


Figure 9. Bay Checkerspot Critical Habitat on San Bruno Mountain



Rare Plants

Rare plant species on San Bruno Mountain include two federal and state endangered species, San Bruno Mountain manzanita (*Arctostaphylos imbricata var. imbricata*) and San Francisco Lessingia (*Lessingia germanorum*), and several California Native Plant Society List 1B species including Montara manzanita (*Arctostaphylos imbricata montaraensis*), Diablo Helianthella (*Helinathella castanea*), San Francisco spineflower (*Chorizanthe cuspidata cuspidata*), and San Francisco campion (*Siliene vercunda verecunda).* For a complete list of rare plant species on San Bruno Mountain see Appendix C. Figures 10, 11, and 12 show the distribution of rare plant species mapped on San Bruno Mountain.

C. Threats to Butterfly Habitat, Rare Plants and Native Plant Communities

Coast Scrub Succession

Portions of Buckeye Canyon, Devil's Arroyo, the Saddle, and other locations (typically north-facing, low elevation slopes) have converted from a mosaic of scrub and grassland to dense coastal scrub over the 25-year span of the HCP. These areas are shown in Figure 1 as brush control areas. In some areas, such as roadside areas along the south side of the Brisbane Industrial Park and the north side of Carter Street in Daly City, a combination of coastal scrub and invasive brush (including gorse, Portuguese broom, and Himalayan blackberry (*Rubus discolor*)) have overtaken grassland areas.

Figure 13 shows an example of brush succession in Buckeye Canyon over the span of the HCP, and Figure 14 shows both butterfly observations and survey routes for mission blue butterfly walked within Buckeye Canyon in the 1980's and again in the 1990's. Habitat in these areas has been overtaken by the expansion of coastal scrub, and the ability to monitor these areas using walking transects has been reduced or eliminated due to the high density of brush.

Coastal scrub can easily overtake grasslands, and the habitat they support for the endangered butterflies, due to the low-growing status of the butterflies' host and nectar plants. All three endangered butterflies also utilize nectar plants within coastal scrub, and utilize shrubs for perching. For this reason, the goal of management should be to control coastal scrub rather than eradicate this plant community.

Figure 10. Distribution of Rare Manzanitas on San Bruno Mountain, 2002

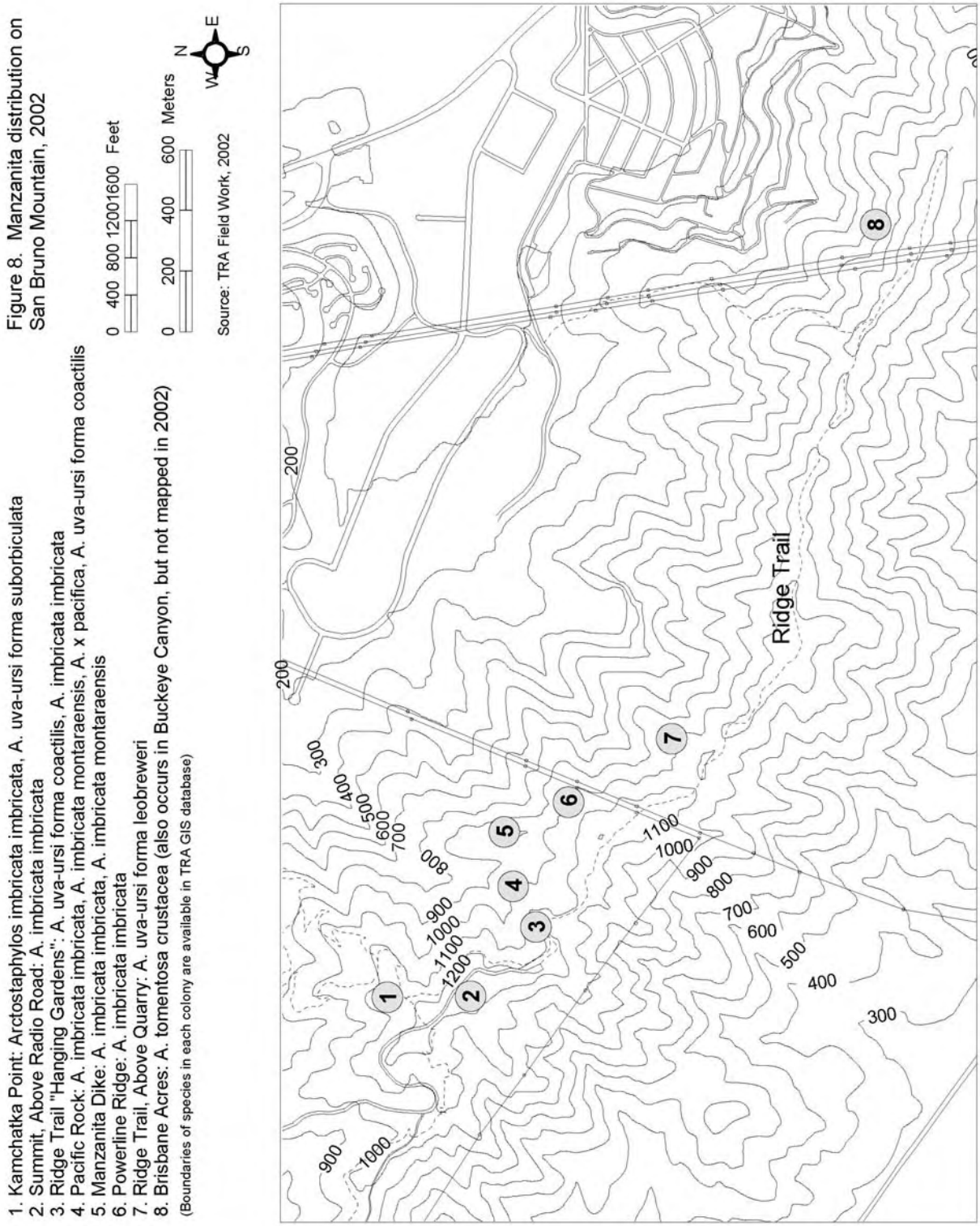


Figure 11. Distribution of Helianthella Castenea and Silene Verecunda on San Bruno Mountain, 2001

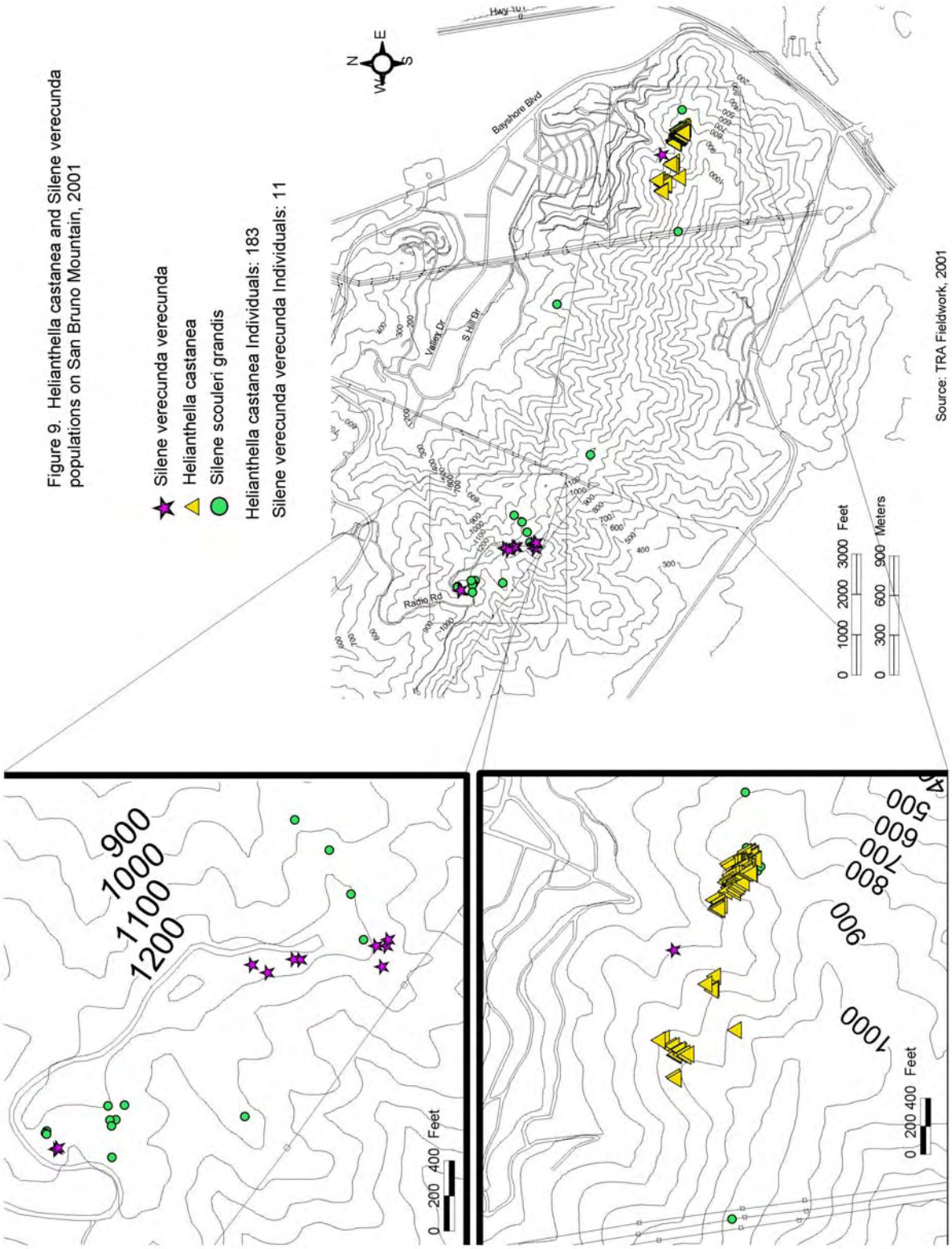


Figure 12. Distribution of Lessingia Germanorum on San Bruno Mountain, 2003

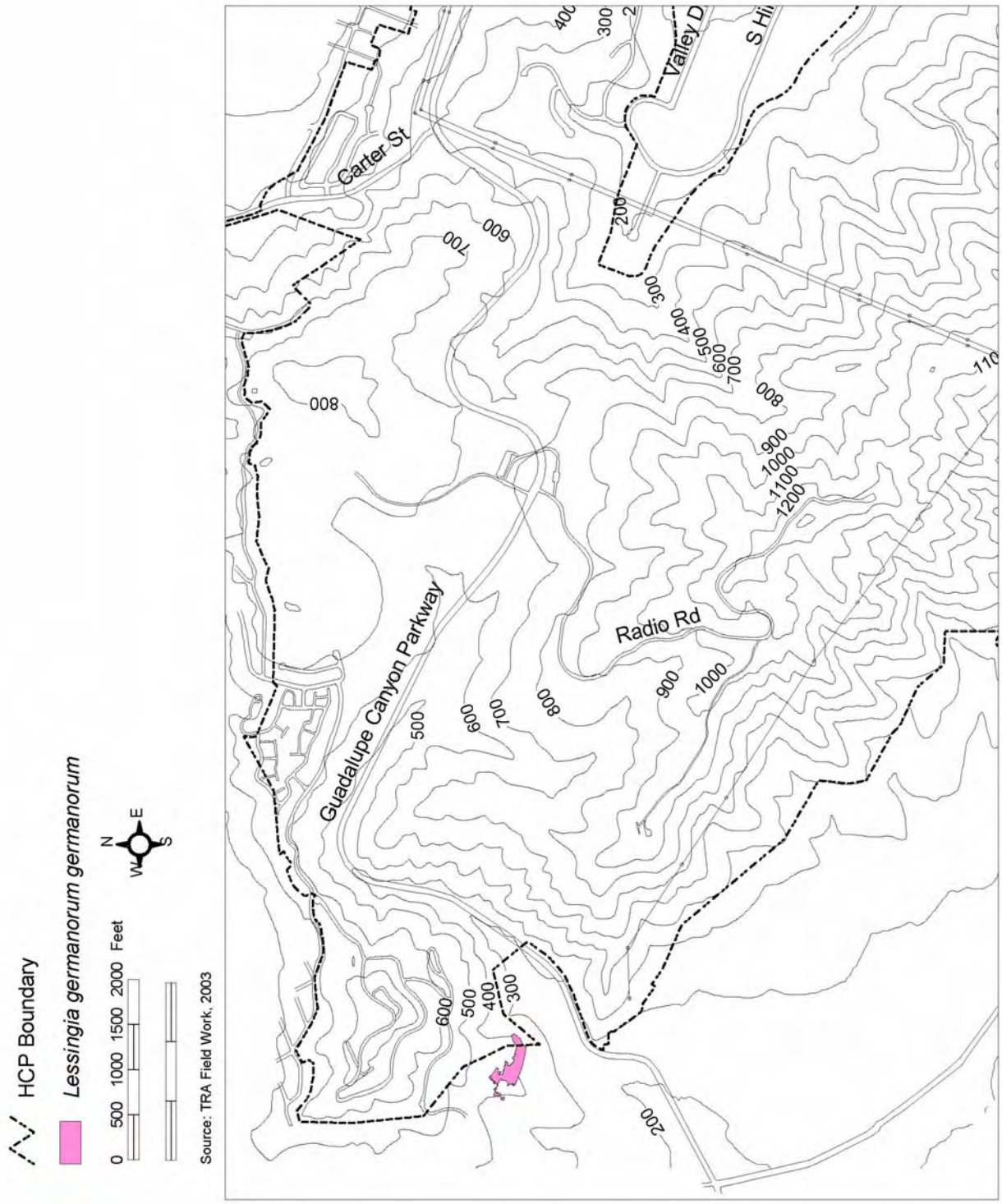
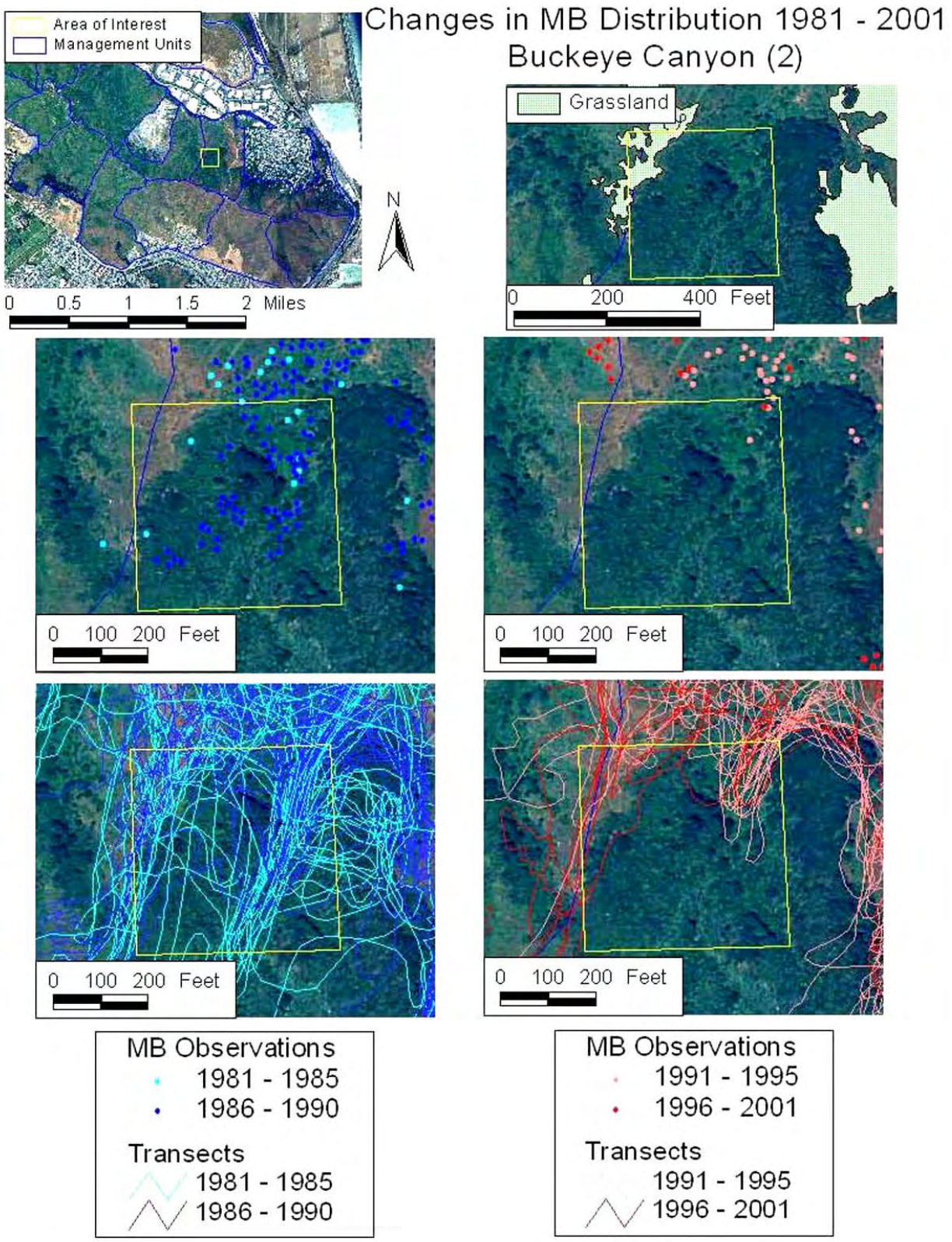


Figure 13. View of Buckeye Canyon and Transmission Line Ridge in 1982 (below), and 2006 (above)

Figure 14. Changes in Mission Blue Distribution



Invasive Plant Species

Figure 15 shows the distribution of invasive plant species on San Bruno Mountain as mapped in 2004. Infestations were mapped using a combination of GPS data and hand drawn polygons on topographic maps in the field. No differentiation was made between high and low density infestations. Due to time and seasonal constraints, not all herbaceous weed infestations were mapped, and invasive grasses were not mapped. A re-mapping of the invasive species on San Bruno Mountain should be conducted on a 5-year rotation.

Invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures, and therefore control and eradication of invasive species should be pursued whenever feasible. In most cases, invasive plant species provide few resources for native wildlife species. Exceptions to this are species such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativa*), and pin-cushion plant (*Scabiosa purpurea)*, which are utilized as nectar sources by the endangered species. Due to the invasive habitat of these species, and the availability of native plant species as nectar sources, control of these invasives is conducted.

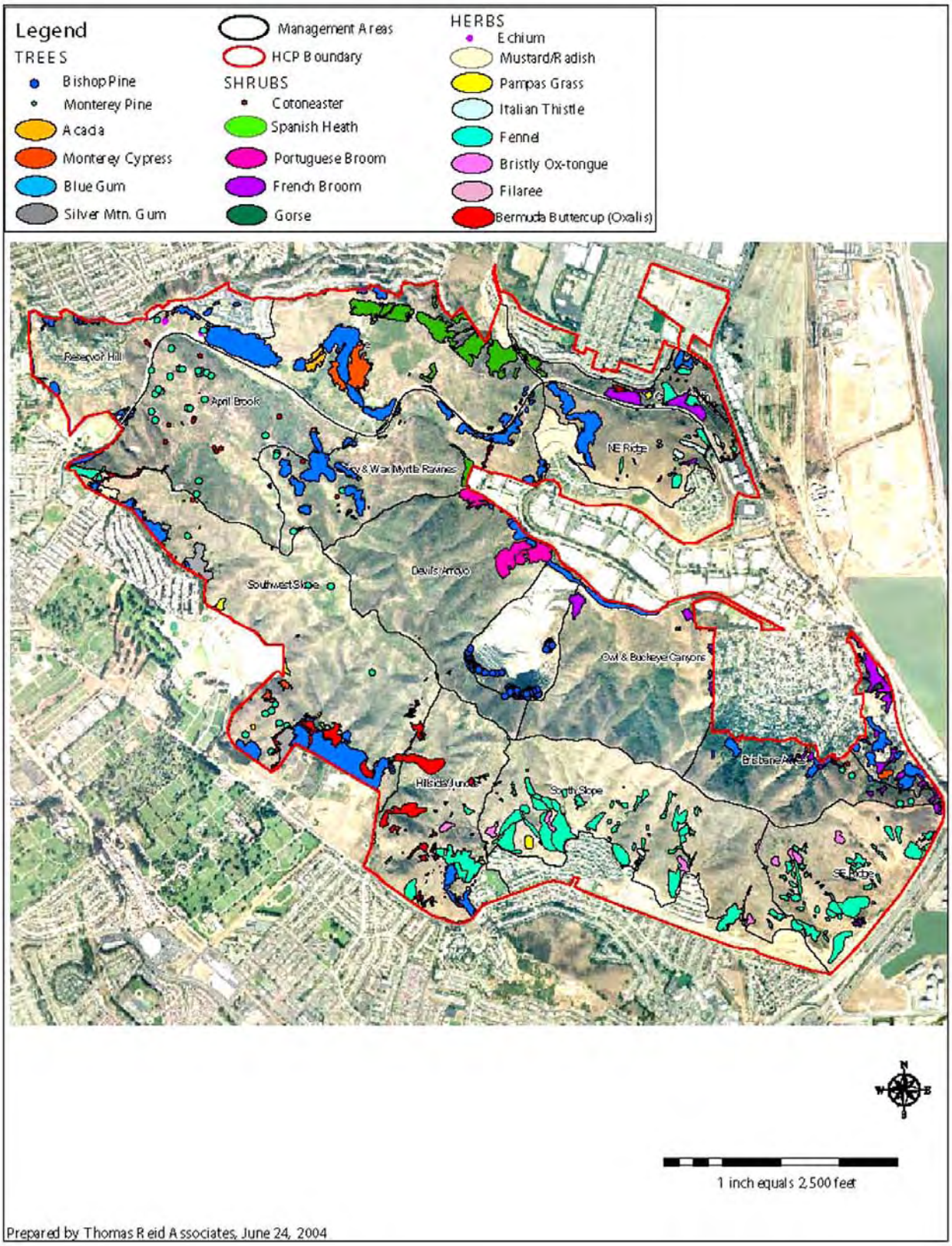
Nitrogen Deposition

Research by Stuart Weiss within serpentine grasslands in the San Francisco Bay Area suggests that anthropomorphic sources of nitrogen are accelerating weed invasions into grasslands (Weiss, S.B. 1999), and this process is potentially accelerating weed invasions and coastal scrub succession on San Bruno Mountain (personal communication, Stuart Weiss). Excess nitrogen in the form of NH4 and NHO3 has been documented as a potential problem throughout California, and especially within urban centers such as Los Angeles, San Diego and the San Francisco Bay Area (Weiss, S.B. 2006). Excess nitrogen deposition within grasslands in the San Francisco Bay Area has been documented at the Kirby Canyon Land Trust in Santa Clara County, and at Edgewood County Park in San Mateo County, approximately 20 miles south of San Bruno Mountain. This phenomenon has also been identified in other urban/parkland grassland ecosystems, such as within the coastal sage scrub habitat of the federally endangered Palos Verdes blue (*Glaucopsyche lygdamus palosverdesensis*) in San Pedro, California (Soil Ecology and Restoration Group, 2004).

Nitrogen that gets deposited on native grasslands behaves like a fertilizer. The more nutrient rich soil is exploited by nonnative weeds, which out-compete the native grasses and herbaceous plants that are adapted to low nutrient conditions. This phenomenon has been well documented in serpentine plant communities which are low in nutrients. Similarly, the ultramafic soils of San Bruno Mountain are also low in nutrients, and the impact from nitrogen deposition is potentially significant.

At Kirby Canyon, cattle grazing has been used effectively to counteract the additional biomass produced through excess nitrogen deposition, and has successfully maintained native grasslands and protected habitat of the federally threatened bay checkerspot butterfly for over 20 years (Peterson, Weiss pers. comm.). Edgewood County Park in San Mateo County has recently begun to use mowing to reduce the biomass of invasive grasses fueled by nitrogen deposition (Ishimaru, ABC-7 News, April 5, 2007). Both of these sites provide critical habitat for the federally threatened bay checkerspot butterfly.

Figure 15. Invasive Plant Species on San Bruno Mountain, 2004



Preliminary estimates based on wind patterns and distance to source areas suggest that approximately 7 KG/ hectare (approximately 6 lbs/acre) of nitrogen are deposited on the slopes of San Bruno Mountain per year (Weiss, pers. comm.). This amount of nitrogen is substantial and would alter vegetation composition over time (Weiss, pers. comm.).

San Bruno Mountain is situated between two highly traveled freeways (Highways 101 and 280), and has extensive urbanization and roads surrounding the park. Prevailing wind patterns and subsequent areas of fog collection on San Bruno Mountain may result in increased nitrogen deposition, as fog may pick up nitrogen (in the form of NH3) as it drifts over Highway 280, before reaching San Bruno Mountain (Weiss. pers. comm.). It is therefore plausible that nitrogen deposition is occurring on San Bruno Mountain, and perhaps at levels that are accelerating invasive species infestations.

Global Warming

Climate models for Northern and Central California suggest that the region will become warmer and possibly wetter, with greater temperature extremes, due to the effects of global warming. This may result in a continuing and accelerated transition from grassland and savannah habitats to forests in the next 70 years (The Wildlife Society, 2004). It is therefore likely that coastal scrub will continue and possibly increase its rate of expansion on San Bruno Mountain if it is not managed. This expansion will predominately occur on north-facing slopes, steep shaded ravines, and on gradual slopes with deeper soils. Steep slopes with thin, rocky soils, and dry south and east-facing slopes are much more resistant to coastal scrub expansion, and these areas are likely to remain grassland despite a warmer and wetter microclimate. Global warming could potentially increase the spread of both native and invasive species that favor warmer and wetter conditions.

Invasive Insect Species

Insect pests that have emerged as a potential problem on San Bruno Mountain include the tussock moth (*Orgyia vetustaz*), and the argentine ant (*Linepithema humile)*. The tussock moth has become naturalized in California, and is commonly found in local native habitats. The tussock moth infested and damaged two San Bruno Mountain Manzanita colonies in 1998. No new infestations or damage caused by the Tussock moth have been identified since the 1998 event.

The Argentine ant (*Linepithema humile*) is a non-native ant that has proliferated in California, especially in wet areas and near human occupation. Argentine ants have been known to decimate native ant populations through competition and aggressive behavior. This may be a concern for mission blue and San Bruno elfin butterflies, which are believed to be facultative myrmecophiles. The butterfly larvae secrete a honeydew substance from an abdominal gland on which the native ants feed. In return, the ants tend to the larvae by helping to protect them from predators and parasites.

California has been infested by numerous colonies of genetically distinct Argentine ants during the last 100 years (Stanford University, 2004). In February 2006, a preliminary study by Jessica Shors, a graduate student at Stanford University, revealed that Argentine ants are present within some of the MB habitat on San Bruno Mountain Information at this time does not suggest that the Argentine ant is a dangerous threat to the sensitive butterflies and their habitat however new information may arise that suggests otherwise. Further study on the possibility that the Argentine ant could impact native ant species, and potentially disrupt the relationship

between mission blue and San Bruno elfin butterflies and native ant species should be investigated.

Loss of Pollinator Species Diversity

See discussion on Bumblebee species in Section VIII.

Potential for Genetic Inbreeding Depression of the Butterfly Populations

It is highly unlikely that mission blues, callippe silverspots, and San Bruno elfins are capable of successfully immigrating to San Bruno Mountain or emigrating to other populations located outside of the Mountain due to significant urbanization barriers surrounding the Mountain. Over time, the San Bruno Mountain butterfly populations could develop reduced viability through genetic isolation, and genetic exchange between other populations of the listed butterflies and San Bruno Mountain should be considered.

Most other protected habitat areas for the listed butterflies are significantly smaller is size than the conserved habitat on San Bruno Mountain (e.g., Twin Peaks and Milagra Ridge for mission blue; Montara Mountain and Milagra Ridge for San Bruno elfin; and Pleasanton Ridge for callippe silverspot). Movement of female butterflies between these locales and San Bruno Mountain may be necessary to insure genetic health of the populations on San Bruno Mountain, and may be vital for the health of these smaller populations. (See section V.B for discussion on genetic exchange program).