SAN BRUNO MOUNTAIN HABITAT CONSERVATION PLAN

1997 ACTIVITIES REPORT

Revised February 1, 1998

Endangered Species Permit PRT 2-9818

Prepared for
San Mateo County and
the U.S. Fish and Wildlife Service

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INTRODUCTION

This report describes biological and development related activities which took place on San Bruno Mountain under Endangered Species Act Section 10(a) Permit PRT 2-9818 for the 1997 Calendar year. It provides information on the relative population status of the butterflies of concern, exotic species control work, and development activities. Anyone interested in reviewing field data or other information collected by Thomas Reid Associates should contact Patrick Kobernus at (650) 327-0429 or Roman Gankin at (650) 363-1826.

1. STATUS OF SPECIES OF CONCERN

a. Mission Blue Butterfly (*Icaricia icarioides missionensis*)

Methodology

Annual monitoring of the population status of the butterflies of concern on San Bruno Mountain is carried out using the following method. Transects are walked by experienced field biologists and data is recorded on data logs and topography maps. At the end of the field season the data is tabulated and non productive transects eliminated. The tabulated data for 1997 is contained in Appendix A. A butterfly sightings per hour figure is derived by dividing the total number of hours spent on transects by the total number of butterfly observations made. A sightings per hour figure can be calculated for each colony by using data from those colonies only (see Appendix A, page A-7).

Using a standard formula derived in 1982 (see Appendix A, page A-7, for explanation of formula), the sightings per hour data is used to determine relative population size for the entire population as well as for each colony. The numerical results are input into a computer graph spreadsheet and the data is depicted in graph form (see Figure 2). The distribution data is input directly from the field maps into a computer map of San Bruno Mountain. The resultant butterfly distribution map is contained in Figure 1. Note all figures are included at the end of the report.

Data Analysis

A total of 78 person hours were spent monitoring the adult population of Mission blue on San Bruno Mountain in 1997. During this time, 256 Mission blue butterflies were documented (see Figure 1 for the locations of each sighting). Observations were scattered throughout the Mountain with several sightings noted in the West Peak area above Colma, on the Northeast Ridge, and in the Buckeye Canyon/ Transmission Line Ridge area (Appendix A).

Analysis of the total number of Mission blue butterflies observed during the 78 hours of monitoring provided a figure of 3.3 sightings per hour for all survey areas; which is down from last year's 4.1 sightings per hour. Figure 2 shows the relative population size for Mission blue on San Bruno Mountain in 1997. The relative population size is the result of the sightings per hour figure for a given area multiplied by the number of hectares of that area. The relative population size of Mission blue

showed an increase in observations per hour for the Guadalupe Hills and Radio Ridge in 1997, while the Southeast Ridge and the Saddle showed a decrease.

Table 1 below provides the monthly total of Mission blue butterflies observed from 1989 to 1997. Hours spent observing butterflies has decreased in recent years thereby causing monthly totals to drop. However butterfly sightings per hour, which is a better indication of butterfly relative population size, has fluctuated year to year as shown in Figure 2.

The 1997 butterfly flight season was shortened by a dry, warm spring which resulted in an earlier flowering period for the butterfly host plants. Only 2.4 inches of rain fell in the months of February through June on the Mountain in 1997, whereas in 1996, 14.9 inches were recorded during these same months. Mission blue observations peaked in April this year, in contrast to other years when observations peaked in May, or were more evenly spread between April, May, and sometimes June. South slope areas (reflected in the Southeast Ridge population category) were foggier and windier than normal this year which limited adult flight and thus reduced observations in this area. In contrast, the Guadalupe Hills had several clear, low wind weather days during the spring and early summer, and thus there was more active adult flight with corresponding higher butterfly observations over 1996 (Figure 2).

Figure 1 shows many sightings on the slopes above Colma (known as the West Peak area). There were 39 Mission blue adults observed here on May 14th in 3.75 hours of monitoring. The weather was optimal that day with a 70 degree F temperature and calm winds. A single one hour visit to Pointe Pacific yielded five adult observations on another optimum weather day. In contrast, Juncus Ravine on the southslope of the Mountain, received only 3 short visits at the very start of the flight season (3/6, 3/13, and 3/22), and only eight observations were recorded.

TABLE 1
MONTHLY TOTALS OF MISSION BLUE ADULTS

	MARCH	APRIL	MAY	JUNE	JULY	TOTAL
1989	26	202	445	51	1	725
1990	28	236	268	76	0	608
1991	0	182	93	158	0	433
1992	19	191	356	107	0	673
1993	0	144	154	15	7	320
1994	14	210	90	13	0	327
1995	0	75	124	2	5	206
1996	0	213	87	12	0	312
1997	11	172	69	4	0	256

b. Callippe Silverspot Butterfly (*Speyeria callippe callippe*)

The callippe silverspot was listed as an endangered species by the U.S. Fish and Wildlife Service in December 1997. Under the HCP, the callippe has always received the same level of protection, monitoring, and enhancement as the Mission blue. In 1997, the same methods used to monitor and assess relative population size for Mission blue were used for the callippe (see Appendix A).

Analysis

The locations of the 404 callippe adults observed in 1997 are shown in Figure 3. Figure 4 shows the relative population size of the callippe silverspot for years 1981-1997. Table 2 provides a breakdown of adult observations by month.

The relative population of the callippe on San Bruno Mountain was high for the second year in a row, in comparison to the two preceding years, even though significantly less adults were observed. The number of sightings per monitoring hour was relatively high in both 1996 and 1997 (9.4 s/h and 8.8 s/h respectively). In 1996, 296 adults were observed in 31.5 hours of surveying and in 1997, 404 callippe were observed in 46 hours of surveying. In contrast, in 1995 there were 7.7 S/H (454 adults in 58.75 hours).

Observations were scattered throughout the callippe's range on the Mountain with several sightings documented on the slopes adjacent to Owl Canyon, on and around Callippe Hill on the Northeast Ridge, on the Southeast Ridge above Brisbane, in Cow Trough Ravine on the south slope, and along GCP above the Linda Vista and Bay Ridge development projects (Appendix A).

The number of callippes sighted per monitoring hour in the Guadalupe Hills in 1997 was 9.9 individuals. In contrast, 5.6 callippes were sighted per hour in 1996. For the Southeast Ridge the sightings per hour figure was 8.0, dropping from the 15.8 figure in 1996. The lower number of callippes observed on the south slope this year is thought to be partially due to cooler temperatures and foggier weather this year than last (see Mission blue analysis). However, callippes are stronger flyers than Mission blues, can tolerate windier conditions, and would be expected to be less impacted by the poor weather than the Mission blues. The combination of limited flight days and early senescence of the Viola probably reduced callippe numbers this year. As a result of the limited good weather days, some areas on the south slope, such as Juncus Ravine, were not adequately surveyed. To compensate for limited observation days in poor weather years such as 1997, in the future additional butterfly surveyors will be deployed on good weather days to cover the Mountain more thoroughly.

TABLE 2
MONTHLY TOTALS OF CALLIPPE SILVERSPOT ADULTS

	MAY	JUNE	JULY	AUGUST	TOTAL
1989	461	789	127	0	1377
1990	191	610	52	0	853
1991	0	611	314	2	927
1992	915	440	3	0	1358
1993	503	469	24	0	996
1994	22	461	124	0	607
1995	38	306	110	0	454
1996	132	160	4	0	296
1997	358	44	0	0	404*

*(2 callippes observed in April not shown)

c. San Bruno Elfin (*Incisalia mossii bayensis*)

The locations of the 27 adult San Bruno elfin butterflies observed in 1997 are shown in Figure 5. See Table 3 for a breakdown of adult observations by month. Larval observations are also included in Figure 5; there were 39 total larvae observed at three locations. A tally of the 1997 San Bruno elfin field data is included in Appendix A.

TABLE 3
MONTHLY TOTALS OF SAN BRUNO ELFIN ADULTS

	FEBRUARY	MARCH	APRIL	TOTAL
1989	0	164	21	185
1990	0	161	1	162
1991	13	63	10	86
1992	38	202	3	243
1993	0	149	3	152
1994	0	56	3	59
1995	0	13	0	13
1996	0	30	0	30
1997	0	26	0	27

On San Bruno Mountain, the San Bruno elfin appears to be recovering slowly from the very wet spring of 1995, when only 13 adults were observed. In 1997, 27 elfin adults were observed. Most of the elfin in 1997 were observed on the ridge between Owl and Buckeye Canyons (6), in the Summit area (7), and up slope of Manzanita Dike (11).

There was a corresponding significant reduction in the population of San Bruno elfin butterflies on National Park lands at Milagra Ridge in Pacifica. Only two adults were observed on Milagra Ridge from 1995-1997 (pers. comm. Bob Wright, NPS).

In May 1997 a total of 39 elfin larvae were observed on San Bruno Mountain -- 25 at the ridge between Owl and Buckeye Canyons, and 14 on the slopes south and east of the Quarry. Larval searches were not conducted at the other elfin colonies in 1997.

Although no specific studies of what factors influence the population of this species are available, San Bruno Mountain data suggests that the population decreases when there are long periods of wet and inclement weather during the adult flight season (late February and March). Unusually wet weather during the flight period of the elfin reduces opportunities for flight and thus minimizes courtship and mating opportunities. San Bruno Mountain supports the largest known population of San Bruno elfin butterflies. The relatively low number of observations of this species during the past three years on the Mountain and corresponding low numbers observed at other population sites, may warrant a special study of this species throughout its range by the US Fish and Wildlife Service.

Conclusions

Development allowed under the HCP has reduced the amount of habitat for the Mission blue and callippe silverspot butterflies by approximately 5-10% in the past 15 years, while habitat for the San Bruno elfin butterfly is completely protected under the HCP. Within the protected areas, the existing habitat for all three butterfly species has stayed relatively consistent and some marginal habitat areas have been improved from aggressive weed control efforts. Weed control efforts have increased in scope in recent years due to an increase in the annual budget for restoration work, and assistance from volunteers of the Friends of San Bruno Mountain.

The annual fluctuations in the relative population sizes of all three endangered butterflies appear to be attributable to: 1) natural population fluctuations of the butterflies and their host plants due to weather conditions, 2) daily weather conditions at time of survey, and 3) reduction in grassland habitat from natural succession of coastal scrub vegetation.

Weather conditions are likely to effect butterfly populations by effecting the quality and abundance of food resources (larval host and nectar plants), the timing of host plant flowering period and butterfly flight season, and rates of mortality through predation and parasitism. At this time, these sources of variability are not well understood. It is hypothesized that very wet weather during critical life stages of the butterflies negatively impacts the butterflies through drowning of larvae, increased

susceptibility to fungal parasites, and prevention of adult flight (and mating).

Small changes in temperature and wind can cause the butterflies to stay down in the brush, or to come out for feeding and mating. Although it is established that the butterflies typically fly during low wind (<10-15 mph), and warm (60-90° F) temperatures, the localized "windiness" and temperature (solar exposure) of each particular location on the Mountain can vary day to day (and hour to hour). The number of butterfly observations recorded at each site are affected by this, and it is difficult to standardize the butterfly monitoring to account for this level of microclimatic variation at each location.

Native coastal scrub tends to expand into grassland habitat in the absence of fire (where appropriate soil and microclimate conditions exist). Although weed control efforts have reduced the amount of exotic shrubs such as gorse and French broom on the Mountain, the influence of natural brush succession on the amount of grassland butterfly habitat has not been investigated since the inception of the HCP. A program of controlled burning or grazing may be needed to protect butterfly habitat from losses due to native brush succession.

For 1998, the butterfly monitoring program will be modified to include the documentation of detailed weather data on butterfly monitoring days and better standardization of survey time in each subregion of the Mountain. The new system will still use the random-walk survey method so as to allow comparison with previous years' data, but also will incorporate set transects. The set transects will provide more detailed information in certain areas and possibly allow SBM data to be compared with Mission blue data collected by the National Park Association at Milagra Ridge and the Marin Headlands.

Also in 1998-- if funding is available-- a study will be conducted to investigate whether natural brush succession is reducing the amount of grassland habitat on the Mountain and thus reducing available butterfly habitat.

d. Bay Checkerspot Butterfly (*Euphydryas editha bayensis*)

No bay checkerspot butterflies (larvae or adults) were observed on San Bruno Mountain by field crew while conducting biological activities and overseeing development activities in 1997.

e. San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*)

No San Francisco garter snakes (SFGS) were observed on San Bruno Mountain by field crew while conducting biological activities and overseeing development activities in 1997.

f. Plants of Concern

Diablo rockrose (*Helianthella castanea)* and all manzanita species (*Arctostaphylos sp.*) were visually evaluated on San Bruno Mountain in 1997, and their populations appear to be stable. No other monitoring for plants of concern was conducted in 1997.

The suppression of wildfires on the Mountain could potentially be having a harmful effect on some sensitive plant species, particularly the manzanitas. Many species of manzanitas only germinate after fires. The effects of controlled burning on certain plants, especially the manzanitas, needs to be better understood in order to develop an appropriate management strategy for these species. If funding is available in fiscal year 1998-99, a detailed management plan for sensitive plant species will be developed.

g. Bird List for San Bruno Mountain

In 1997 Doug Allshouse and Herb Brandt of the Friends of San Bruno Mountain updated the list of bird species known from the saddle and west side of San Bruno Mountain. The list is contained in Appendix B. Lion Baumgartner of TRA is working on updating the bird list for the entire Mountain.

Eucalyptus forest, grassland, and coastal scrub habitats are all found in abundance on the Mountain, while coastal riparian and oak woodland habitat is restricted to the larger drainages (Owl Canyon, Buckeye Canyon, and Colma Creek). The combination of these habitats provides structural diversity to support many bird species.

Bird populations on the Mountain are influenced by weather patterns, presence of feral cats, and plant community changes due to ongoing restoration work. For instance the removal of the eucalyptus forest has impacted some bird species, but restoration of the area with native grass and scrub communities will benefit other species. A volunteer adoption program has removed many feral cats from the Park this year which should have a beneficial impact on birds on the Mountain.

2. EXOTIC PEST PLANT CONTROL ACTIVITIES

Exotic pest plant control activities are being conducted to protect, enhance, and restore the grassland and coastal scrub habitat on San Bruno Mountain. Primary emphasis is placed on controlling exotic infestations that are invading or threatening to invade habitat of the three endangered butterflies.

a. 1997 Exotic Pest Plant Treatment Summary

Currently there are 35-40 exotic pest plant species that exist on San Bruno Mountain. As a rule, hand control methods are used to control low density infestations, while high density infestations (gorse, broom, fennel, and eucalyptus) are controlled using herbicides.

The following plant species received hand and/or herbicide treatment in 1997.

Acacia sp. (Acacia)
Carduus pychnocephalus (Italian thistle)
Carpobrotus edulis (hottentot fig, iceplant)
Centranthus ruber (red valerian)
Cirsium vulgare (bull thistle)
Conium maculatum (poison hemlock)
Cortaderia jubata (pampas grass)
Cotoneaster sp. (Cotoneaster)
Cytissus striatus (Portuguese broom)
Erechtites arguta (New Zealand fireweed)
Erodium cicutarium
Eucalyptus globulus (blue gum tree)
Foeniculum vulgare (fennel)
Genista monspessulana (French broom)
Hedera helix (English Ivy)
Hirschfeldia incana (mustard)
Holcus lanatus (velvet grass)
Hypocheris radicata
Lactuca virosa (wild lettuce)
Lactuca serriola (prickly lettuce)
Lobularia maritima (Lobularia)
Myoporum laetum (Myoporum)
Picris echiodes (bristly ox-tongue)
Pinus radiata (Monterey Pine)
Pyrocantha crenato-serrata (Pyrocantha)
Rubus discolor (Himalaya blackberry)
Scabiosa atropurpurea
Senecio mikeniodes (German Ivy)
Silybum marianum (milk thistle)
Ulex europaeus (gorse)

TRA maintains daily record sheets for all exotic pest plant work conducted on the Mountain. For hand control work an accounting of the number of all plants removed is recorded and for herbicide work the estimated acres treated is recorded. In 1997, over 66,400 exotic pest plants were removed by hand and approximately 70 acres of pest plant infestations were treated with herbicides (Appendix C). Figure 6 shows a generalized view of the locations where hand and herbicide control work was conducted.

The number of plants removed by hand decreased this year from last (from 205,000 to 66,400 plants). Approximately the same number of hours of hand work were completed both years. The reduced number of plants removed in 1997 reflects a much lower number of seedlings removed by TRA biologist Lion Baumgartner. Volunteers of the Friends of San Bruno Mountain and Bay Area Mountain Watch have also been active in removing weeds from the Mountain.

The number of acres of exotic pest plant infestations treated with herbicide increased significantly over last year, making 1997 the most productive year to date in treating weed infestations on the Mountain. This was due to the addition of three separate cooperative agreements between the County and adjacent landowners to treat large infestations of gorse and broom that spanned park and adjacent private or city owned properties: 1) The Daly City/ North Saddle Gorse project (7 acres treated); 2) The Guadalupe Valley Quarry broom project (2 acres treated); and 3) the Brisbane Transmission Line Ridge broom project (4.5 acres treated). These cooperative projects are an important component in the overall weed control project on the Mountain. Exotic pest plant infestations located on lands adjacent to conserved habitat provide a constant source of seed that spreads back into the habitat and compounds weed control efforts within the HCP area.

b. Exotics Control Strategy and Future Goals

Treatment of individual exotic plant infestations are prioritized as follows:

Priority 1: Small patches of exotics within native habitat

Priority 2: Small patches of exotics at the periphery of native habitat

Priority 3: Edges of large exotic infestations threatening native habitat

Priority 4: Large exotic infestations

Under the HCP, all Priority 1 infestations are treated using hand removal techniques. Priority 2 infestations are treated using both hand and herbicide techniques, and Priority 3 and 4 infestations are exclusively treated using herbicides.

For the past three years, herbicide treatment has consisted of spraying the targeted species with an herbicide solution containing either 2% Garlon 4® or 2% Roundup® depending upon the species targeted. These herbicides are used due to their high effectiveness, low toxicity rating, and short half-life in the soil. Herbicide is applied one to two times per year in suitable weather (low wind, low humidity) for maximum plant uptake. The plants are left to die and decay in place, a process that takes from one to five years, depending upon the size of the plants.

Gorse and broom seedlings are highly responsive to fire or disturbance of any kind. This approach has been effective at reducing seedlings and allowing the native plant community to come back on its own. In areas near homes (within 150 feet) where fire danger and herbicide overspray is a potential problem, plants such as gorse are cut and removed and the stumps are sprayed with a small amount of herbicide.

An assessment of the aerial extent of gorse in the saddle was presented in the 1996 annual report. There were approximately 106 acres of high density gorse at that time. Although an assessment was not conducted for the 1997 report, work in the north saddle has reduced this figure to approximately 95 to 100 acres. Most of the gorse control work conducted on the Mountain in 1997 was directed toward treating seedlings, resprouts and partial kill plants within the 300 acre area of the east saddle that has been treated in the past few years.

A wildfire in July 1995 burned much of the north side of the saddle resulting in an explosion of gorse seedlings (over 2.5 years later) in areas previously treated and controlled for gorse (sites 43 and 44). The gorse seedlings in these sites will be treated in 1998. It is hoped that the burn will have depleted much of the seed bank from this area, and will allow more complete control to be achieved. Controlled burning is potentially an important tool for flushing out the seed bank of fire-adapted weed species such as gorse and French broom. Combined with herbicide or hand control follow-up, controlled burning could decrease long-term maintenance costs for areas such as the saddle.

In accordance with the 1996 San Bruno Mountain HCP Five Year Strategic Plan, exotic pest plant control work has expanded into different areas of the Mountain in recent years. Infestations on Callippe Hill, Radio Ridge, Buckeye Canyon, and portions of the Saddle have been targeted and brought under control. Because maintenance of all areas previously controlled will continue to be a priority over treatment of new infestations, expansion of treatment into new areas will take time. High priorities for expanded exotics control work include: 1) the Southeast Ridge and South slope areas where fennel and pampas grass are a continuing problem, and 2) areas on the south side of the Brisbane industrial park where French and Portuguese broom infestations have expanded.

Sources of additional funding will be sought again in 1998 to supplement the HCP budget and provide for expanded exotics control work on the Mountain. For more information, refer to the 1996 San Bruno Mountain HCP Five Year Strategic Plan, which provides a comprehensive breakdown of habitat management goals under different funding scenarios.

c. Gorse Treatment Plots

In the fall of 1995, an experiment to investigate native plant recovery in herbicide-treated gorse areas was conducted in the Saddle area. A detailed analysis of the results of the experiment will be conducted in 1998.

d. Eucalyptus Removal and Native Plant Restoration

Through a coordinated effort between San Mateo County and Thomas Reid Associates, approximately 63 acres of mature eucalyptus forest were clear-cut from several areas of the Mountain in the spring of 1995. The trees were cut to provide corridors and restore habitat for the three endangered butterflies on the Mountain, as well as increase habitat for other native wildlife species.

The 63 acres are spread out over the Mountain and are broken up into seven different restoration units (Figure 7). The restoration units are Dairy Ravine (22.4 acres), Pacific Nursery (21 acres), Wax Myrtle Ravine (6.4 acres), Hoffman Street (5 acres), Botanic Garden (4 acres -- within the Dairy Ravine site), Colma Creek (4.8 acres), and April Brook (3.6 acres).

The eucalyptus removal restoration program is a combined effort between Paul Kephart of Rana Creek Ranch, Thomas Reid Associates, and the Friends of San Bruno Mountain. Detailed restoration plans for each site are described in the 1996 San Bruno Mountain Restoration Plan prepared by Paul Kephart. Habitat types being restored include mixed grassland, northern coastal scrub, and central coast riparian scrub. The plant list for each site was prepared based on the composition of adjacent native flora at each site. Plants to be used include the larval host plants and adult nectar plants of the Mission blue butterfly, the San Bruno elfin butterfly, and the callippe silverspot butterfly, as well as many other native grasses, herbs, and shrubs found on the Mountain.

1997 Summary of Restoration work

Restoration work in the 1997 year focused on eucalyptus stump treatment, control of eucalyptus seedlings and other exotic weeds at all sites (except Pacific Nursery), and continued replanting at the Colma Creek and Botanic Garden sites. For the second year in a row, aggressive weed control was conducted on approximately 19 acres of former eucalyptus forest. Colma Creek received approximately 600 new native plants and the Botanic Garden was planted with approximately 6500 plants, all by volunteers.

For the third year in a row, controlled burning was done to remove eucalyptus debris from the restoration sites. The burns remove piles of eucalyptus debris that are a combination of wood left by the loggers and regrowth cut by restoration crews. In 1997, the Rana Creek Ranch restoration crew spent several days preparing the Dairy Ravine and Wax Myrtle Ravine sites for burning. The April Brook and Colma Creek sites are essentially clear of eucalyptus debris from prior burns occurring in the last two years. Work at these sites consisted of mowing and replanting.

In October 1997, the cities of Brisbane, South San Francisco, and San Mateo County donated heavy equipment and operators for a one day bulldozer "rodeo" to help with clearing eucalyptus debris. Heavy eucalyptus debris and eucalyptus stumps were dug out and piled for burning. In addition, new areas were cleared within the Botanic Garden and later replanted with native plants on Restoration Day. South San Francisco donated one more day of follow-up work to pile eucalyptus debris for burning.

City of South San Francisco Public Works heavy equipment operator (Dan Canfield) pushing eucalyptus debris into piles for burning.

Unfortunately, the dense areas of eucalyptus regrowth in Wax Myrtle Ravine could not be worked on with the equipment provided, due to the hazards of working on steep slopes and running into hidden stumps.

In the coming year (and subsequent years ahead) eucalyptus regrowth control will continue to be a priority, however, more emphasis will be placed on managing cleared areas through mowing and other methods, and on replanting open areas with native plants.

San Bruno Mountain Botanic Garden

Botanic Garden, January 1998

Establishment of the San Bruno Mountain Botanic Garden began in 1996 with intensive land clearing which included eucalyptus regrowth control, stump grinding, and site grading on a 1.5 acre area. The Garden is being planted by the Friends of San Bruno Mountain who initiated the project and have taken on the responsibility of managing the Garden.

In October 1996, approximately 2000 plants were planted by volunteers on the first annual Restoration Day celebration. Due to sufficient rainfall and great care provided by the Friends group, plant survival at the Garden has been good.

In 1997, the Botanic Garden was expanded by 2.5 acres to 4 acres total. The new area was mowed, and eucalyptus regrowth, German Ivy, English ivy, gorse, and Himalaya berry were treated with herbicides. A large area that was heavily infested with German ivy and large eucalyptus stumps was cleared on Rodeo Day, and later replanted with several hundred native plants on Restoration Day. The Friends group continues to monitor the site and to remove weeds by hand as needed.

The second annual San Bruno Mountain Restoration Day took place in November 1997. The event was organized by Paul Kephart of Rana Creek Ranch and the Friends of San Bruno Mountain. The event drew 75 volunteers, including several students from Jefferson High School, who planted over 1000 native plants in the Garden (see Appendix D for plant list). Plants were grown by Log Cabin Ranch. Lunch and dinner was provided, and the event included speakers, a photo contest, and a California Native Plant sale to benefit the Friends group.

Volunteers of the Friends of San Bruno Mountain weeding and planting in the Garden.

An additional 5500 plants have been planted by the Friends group since Restoration Day, with approximately 1400 more slated to go in before spring.

Wax Myrtle Ravine

The removal of the eucalyptus trees in Wax Myrtle Ravine was done to open up a dispersal corridor for the callippe between the Saddle and Wax Myrtle Ravine (Figure 7; Area C). The upper slopes of Wax Myrtle Ravine along Guadalupe Canyon Parkway and the swale to the south of the Ravine will continue to receive restoration work, however at this juncture,

due to the high cost of treatment and other restoration priorities, it appears likely that the lower sections of Wax Myrtle Ravine will return to eucalyptus forest.

The upper slopes which have supported small numbers of Mission blue butterflies in the past will continue to receive stump treatment, eucalyptus regrowth control work, debris piling and clean-up, and eventual replanting. The lower areas within the drainages are extremely difficult to access and are thus rated as low priority for restoration in the near future.

In 1997, approximately 3 acres in Wax Myrtle Ravine (total area 6.4 acres) received eucalyptus regrowth control, gorse control, and debris piling work.

April Brook

The April Brook site (3.6 acres) is cooler and moister than areas typically associated with the Mission blue or callippe silverspot butterflies. Eucalyptus stumps and regrowth, English ivy, German ivy, and other exotics were treated with herbicides in 1996. Continued exotics control and monitoring will be necessary in this area until all new seedlings and resprouts are eliminated. As the site has good potential for natural recolonization by native coastal scrub habitat, replanting efforts can be reduced here.

In 1997, April Brook was mowed to reduce the biomass and to expose exotic weeds such as Poison hemlock (*Conium maculatum*), German ivy, English ivy, and other exotics. Herbicide treatment of these weeds followed closely. Today April Brook appears to have the ability to restore itself as the adjacent coastal scrub expands into the site. Additional eucalyptus regrowth was also treated and appears to be well in hand at this point. Additional replanting may be done in the open areas cleared of weeds.

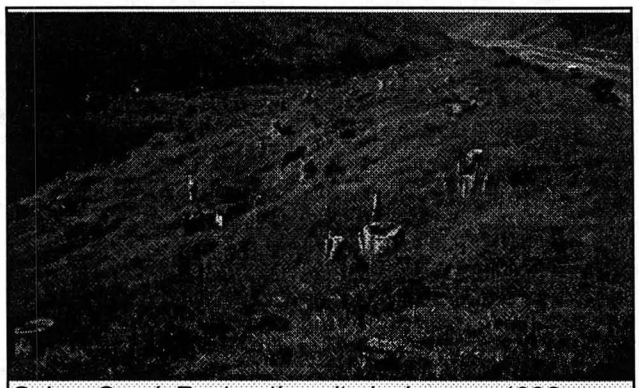
Colma Creek

This site (4.8 acres) was the first to receive restoration work in the winter of 1995-96. It has received three years of annual to semi-annual eucalyptus regrowth control. The area was planted with approximately 8500 native coastal scrub and grassland plants in January and February 1996. In January 1998, an additional 600 native plants were installed.

Colma Creek Restoration site in December 1995.

There are approximately 70 varied lupines *(Lupinus variicolor)* plants (a Mission blue larval food plant) scattered throughout the site. Forty-five of these were planted in 1997; the other 25 are mature plants that naturally colonized the site after a thorough burn in 1995 that removed eucalyptus debris.

Mission blue butterflies are consistently recorded on a grassland slope to the east of the site adjacent to Guadalupe Canyon Parkway (Figure 7; Area A). Future plantings should include summer lupine *(Lupinus formosus)* since this is the preferred larval food plant at the nearby Mission blue colony. It seems likely that the Mission blue will colonize the Colma Creek site when additional host plants are established in the open trail and grassland areas. Annual weeds dominated much of the site immediately after clearing work, but since that time the native plant population appears to be expanding. The site will continue to be monitored for invasion by weedy species and weed control will be done as necessary.



Colma Creek Restoration site in January 1998.

Dairy Ravine

A stand of eucalyptus trees occupying the Dairy Ravine site, (and a portion of the Wax Myrtle site), separated two sub-populations of San Bruno elfin butterflies (one near Fern Rock at the base of Dairy Ravine, and the other on rocky outcrops in upper Dairy Ravine). The removal of the eucalyptus trees was done to provide connectivity between the two apparently separate populations of San Bruno elfin, as well as provide more habitat for the callippe silverspot, (Figure 7; Area B). The callippe is found on the slopes east of Dairy Ravine and in the Saddle.

Dairy Ravine Restoration site (upper slopes), December 1997.

This area has had extensive amounts of eucalyptus debris, eucalyptus regrowth, and gorse seedlings. Approximately 10 acres of eucalyptus regrowth were controlled at the Dairy Ravine site in fall 1996. In 1997, herbicide stump treatment and regrowth control was conducted on approximately 12.5 acres, and approximately 2 acres of Himalaya blackberry, German ivy, and English ivy received herbicide treatment.

Mowing was carried out on a 1 to 2 acre portion of the site adjacent to the Botanic Garden. Over 100 varied lupines have colonized road cut areas of the site. As control is gained over the eucalyptus, Himalaya berry and other exotics, replanting will be done to augment areas where host plants have colonized.

Hoffman site

The Hoffman site (5 acres) has less eucalyptus debris than most sites and contains more open areas between tree stumps. Much of the area has been colonized by annual grasses. There is a substantial colony of Mission blue butterflies along a road cut on the slope above the Hoffman site (Figure 7; Area D). The thin-soiled steep slopes and road cuts on the site are potentially good habitat for Mission blues.

The Hoffman site is currently receiving eucalyptus stump and regrowth control with initial treatment expected to be completed in January 1998. Much more debris removal and eucalyptus regrowth control will be required. In February 1998, sixth-graders at Pollicitos Middle School will plant approximately 30 varied lupines at the site. The lupines were propagated in their classroom.

Pacific Nursery

Extensive eucalyptus regrowth, eucalyptus debris, and other exotic pest plants litter this 21 acre site. The site is dominated by moist, loose, almost sandy soils which are not appropriate for the establishment of habitat for the endangered butterflies. However, along the transmission line ridge to the east of the site there are patches of lupines that support a colony of Mission blue butterflies and there are occasional sightings of callippe silverspots in this area (Area E; figure 8). The area of the site just below the lupine patches can be restored with additional lupine plants thus expanding the colony of Mission blues.

However, at this time, due to the high cost to restore this area, difficulty of access, and the limitations of the HCP budget, it appears likely that most or all of this site will return to eucalyptus forest.

3. Development Activities

Take of habitat for the Mission blue butterfly on San Bruno Mountain was authorized under the Endangered Species Act Section 10(a) Permit PRT 2-9818. Figure 8 shows the land status of parcels as of December 1997. The following development related activities took place which may have resulted in the take of the Mission blue butterfly in 1996.

* The Northeast Ridge project (A.P. 1-07) continued home building in the Phase 1 area and many of the completed homes have become occupied.

* The Terrabay project site (2-04) continued home construction and new residents moved in.

* The final home construction phase of Bay Ridge (1-01) in Daly City is in progress and is expected to be completed in 1998.

No other development activities took place in 1997. The 1998 San Bruno Mountain HCP Operating Program is included as Appendix E to this report.

REFERENCES

Wright, Bob. Site Stewardship Coordinator for Golden Gate National Recreation Area, National Park Service. Personal Communication, 1997.

Study Participants

Annual Report Prepared by: Victoria Harris, Patrick Kobernus, and Adrienne Rain of Thomas Reid Associates

1997 Thomas Reid Associates Field Crew: Mike Forbert, Maria "Alvin" Baggett, and Lion Baumgartner.

Habitat Manager: Roman Gankin, San Mateo County Planning Division

Special thanks for their help and cooperation to:

San Mateo County Department of Parks and Recreation
Patrick Sanchez
Ron Weaver
Marc Selesnow
Ron Cardoza

Paul Kephart and Rana Creek Habitat Restoration

The Friends of San Bruno Mountain
Louis and Kathy Manus
Douglas Allshouse
Herb Brandt, and all the volunteers

City of South San Francisco Public Works Department
City of Brisbane Public Works Department
San Mateo County Department of Public Works

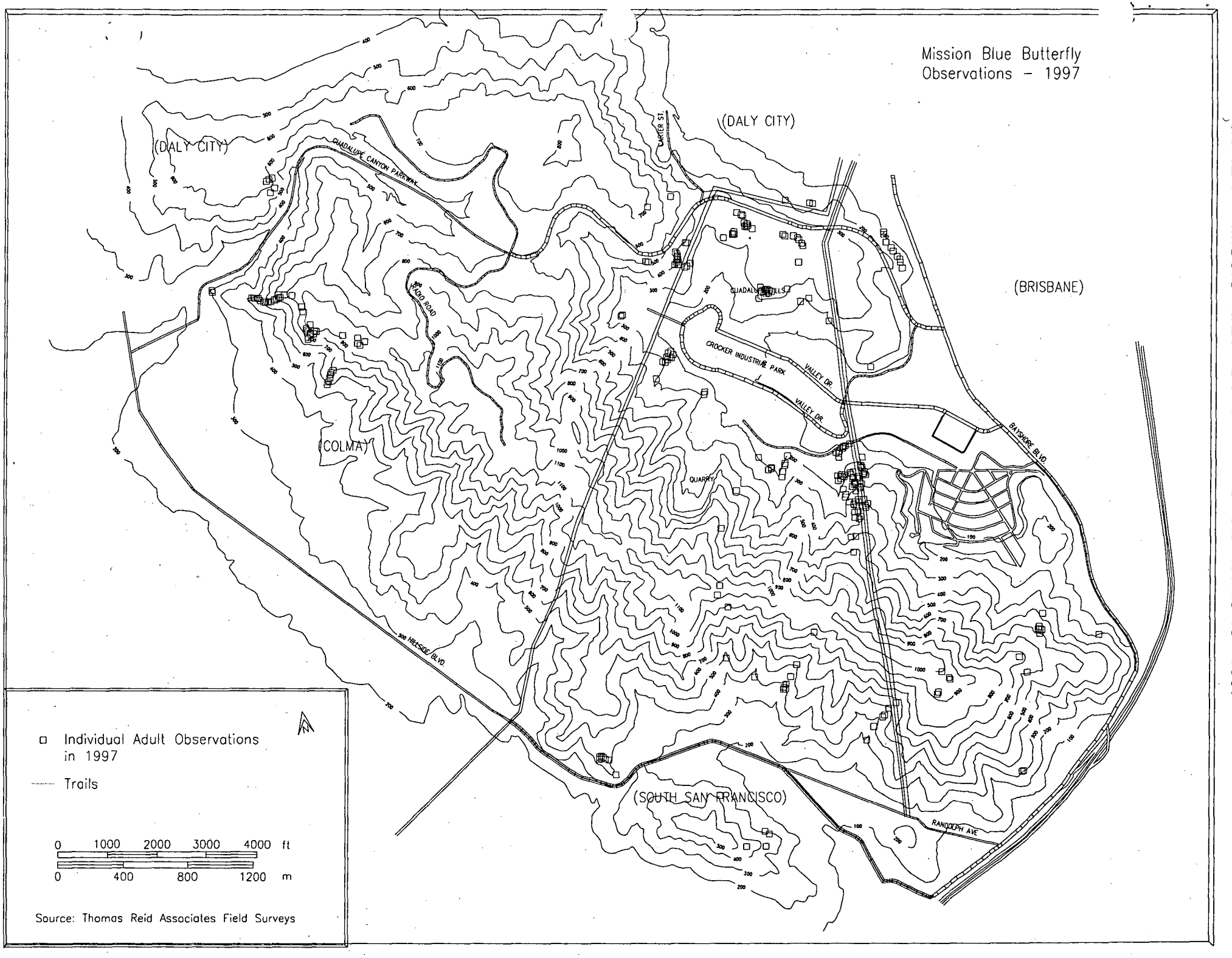


FIGURE 1 — MISSION BLUE BUTTERFLY OBSERVATIONS - 1997

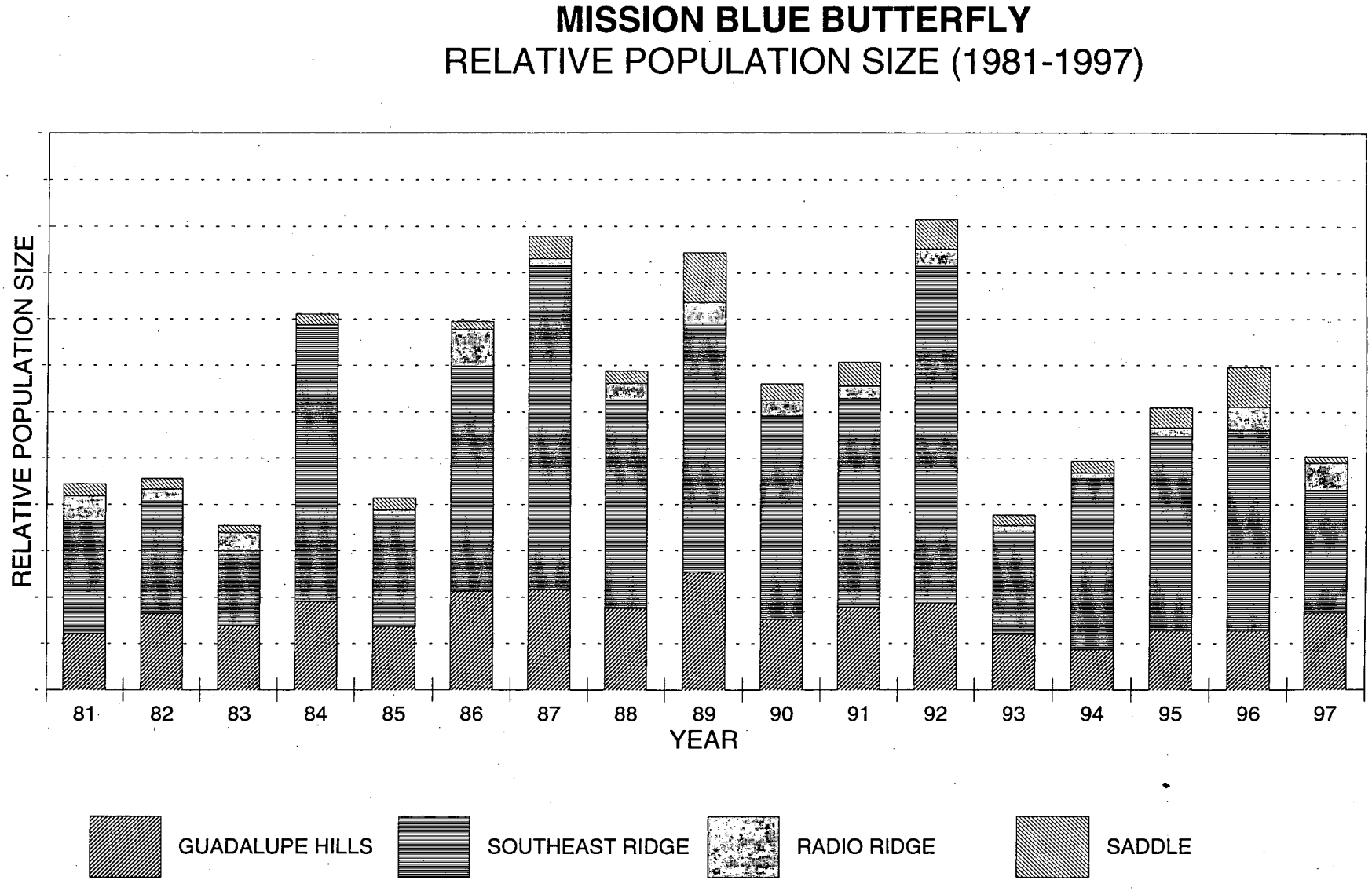


FIGURE 2 — MISSION BLUE BUTTERFLY:RELATIVE POPULATION SIZE (1981-97)

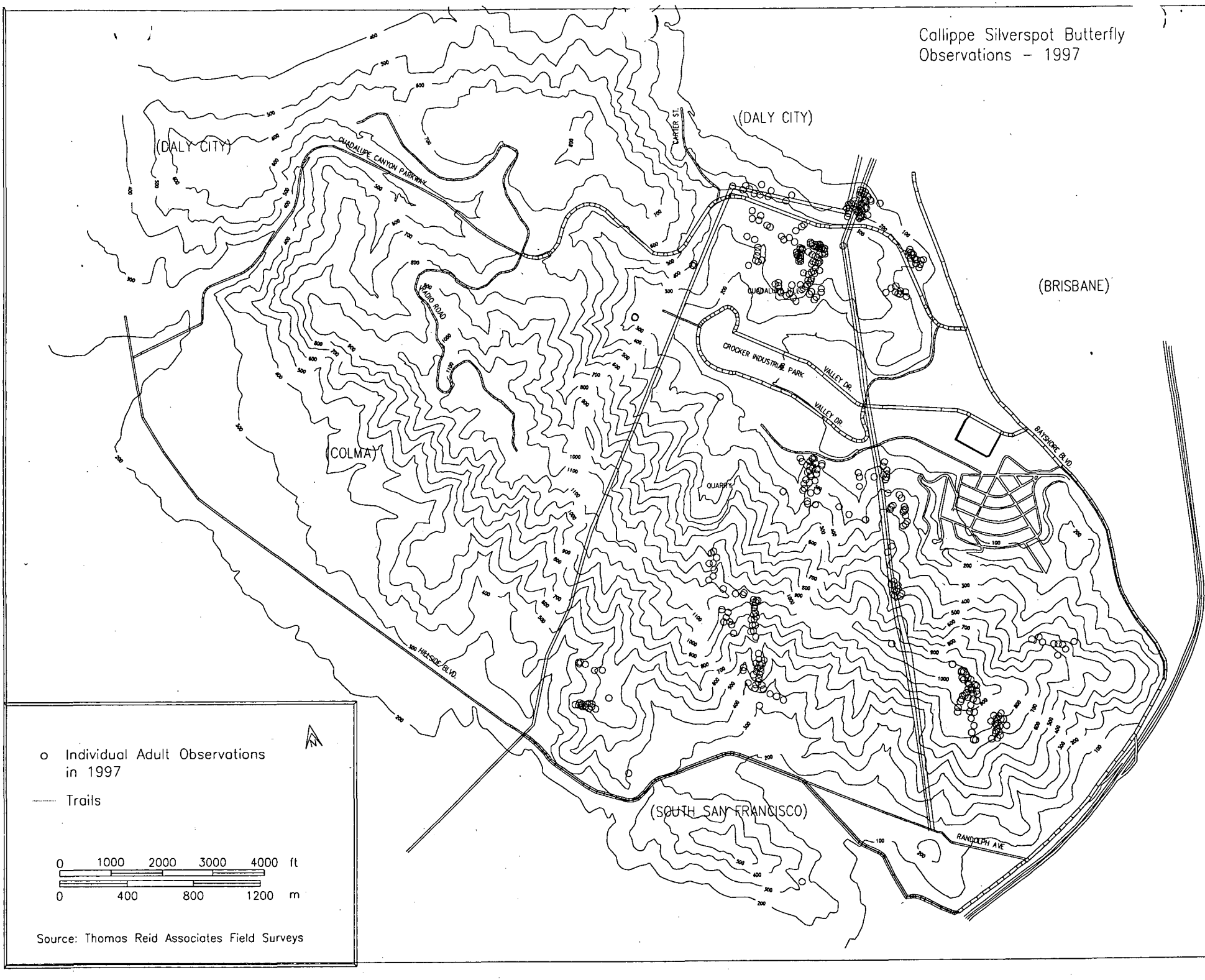


FIGURE 3 — CALLIPPE SILVERSPOT BUTTERFLY OBSERVATIONS - 1997

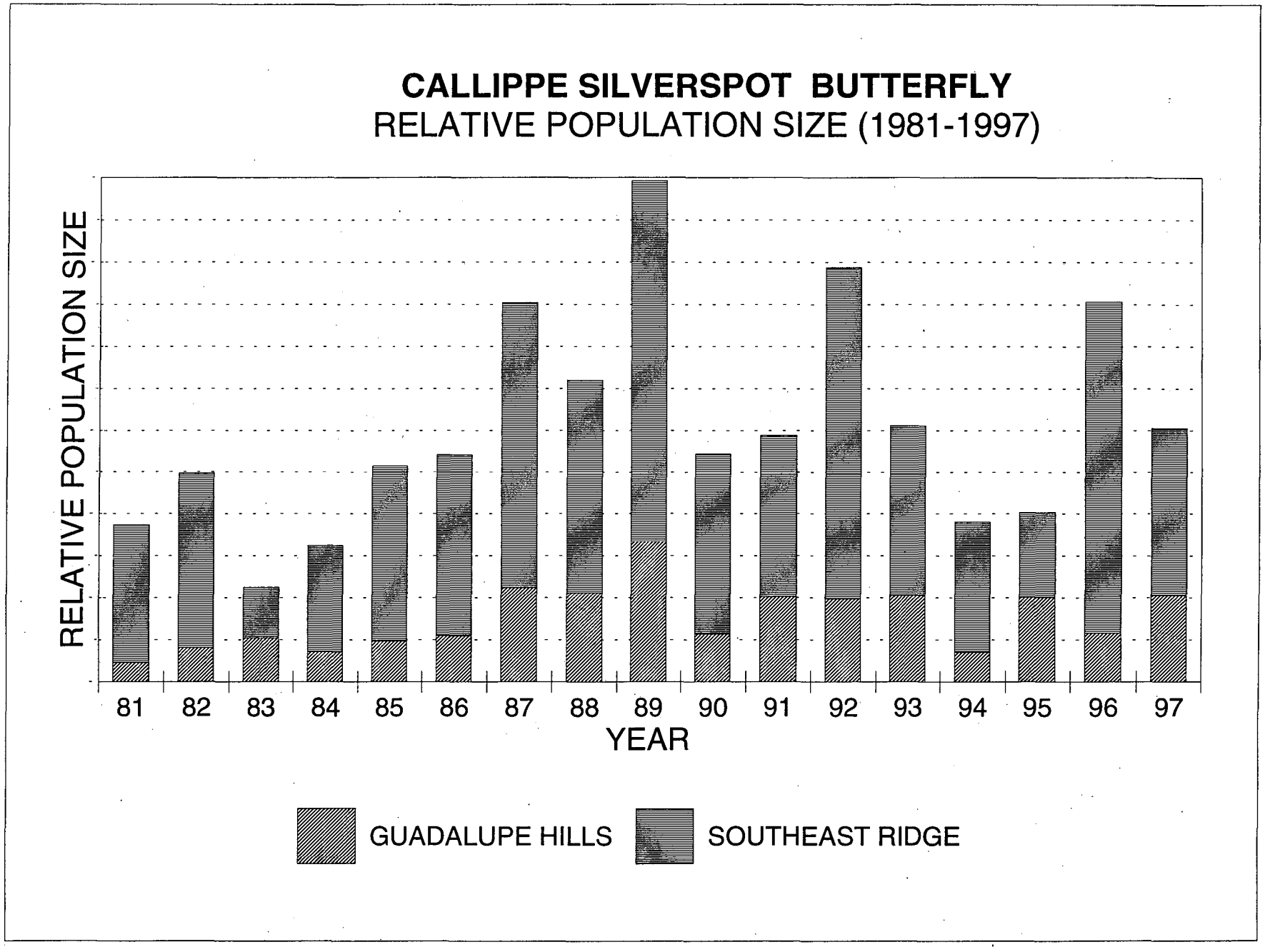


FIGURE 4 - CALLIPPE SILVERSPOT BUTTERFLY: RELATIVE POP. SIZE (1981-97)

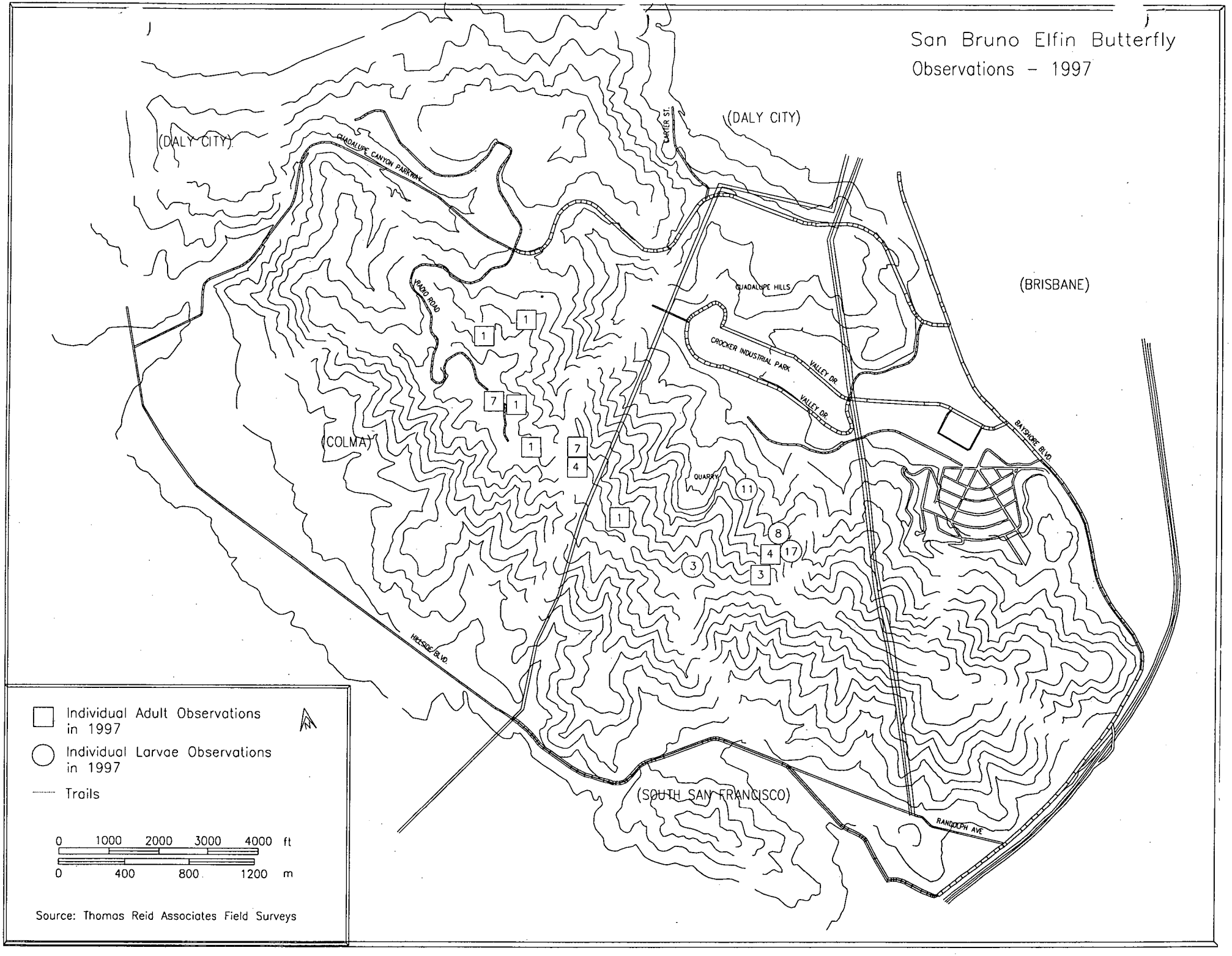


FIGURE 5 — SAN BRUNO ELFIN BUTTERFLY OBSERVATIONS - 1997

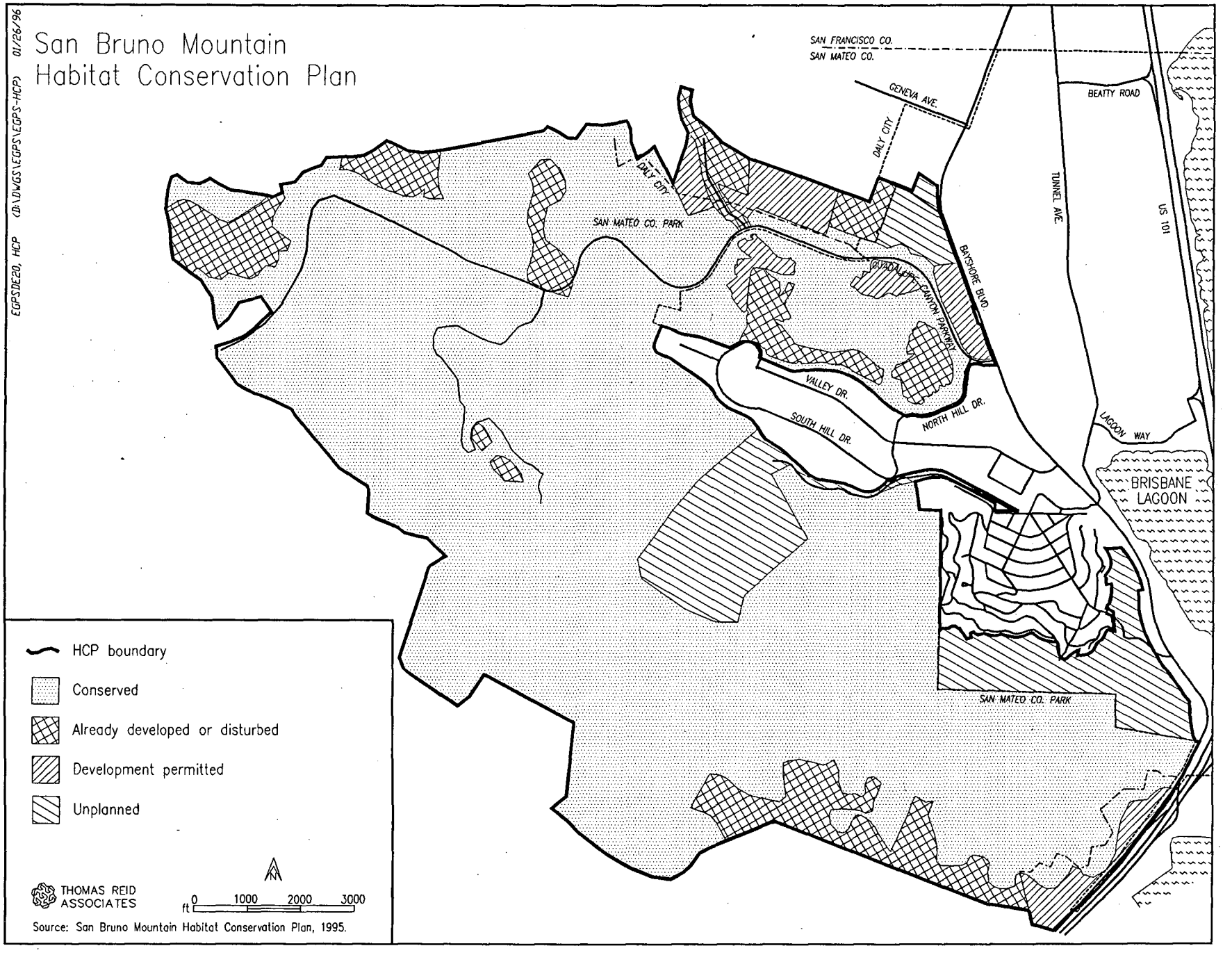


FIGURE 8 — 1997 PARCEL STATUS

APPENDIX A
1997 BUTTERFLY FIELD DATA SUMMARY

MISSION BLUE BUTTERFLY
FIELD DATA SUMMARY --1997
ALL AREAS

DATE	LOCATION	ELAPSED TIME	NUMBER OBSERVED	WEATHER CONDITIONS
306	SE Ridge - Hillside	.25	1	Temp: ? Wind: ?
309	SE Ridge - Owl Cyn. and Subridge	1	0	Temp: ? Wind: ?
313	SE Ridge - Hillside	1	1	Temp: 60's Wind: calm
313	GH - North Hill	1	1	Temp: 60's Wind: windy
322	SE Ridge - Hillside	.5	6	Temp: sunny Wind: 5-10 mph
328	SE Ridge - Owl Canyon	.25	2	Temp: 60's Wind: windy
404	Saddle	1	2	Temp: 69 Wind: Calm to 5 mph
404	GH - Northeast Ridge: Water Tank	2.25	4	Temp: 60's Wind: windy
405	Saddle- Pt. Pacific	1	5	Temp: 71 Wind: calm to 5 mph
405	GH - Arnold Slope	6.25	23	Temp: high 60's - low 70's Wind: Calm
406	SE Ridge- SE Ridge	1.75	4	Temp: ? Wind: ?
407	SE Ridge - Cow Trough Ravine	3	2	Temp: 60's Wind: windy
409	SE Ridge - Southslope / Ridge Trail	5.5	8	Temp: 60's Wind: windy
410	SE Ridge - Southslope	3	6	Temp: 60's Wind: windy
411	GH - Northeast Ridge Water Tank	1.5	5	Temp: 60's Wind: 10-15 mph
414	Radio Ridge - West Peak	3.75	39	Temp: 70 Wind: Calm
415	Radio Ridge - West Peak	1	3	Temp: 70's Wind: Calm

DATE	LOCATION	ELAPSED TIME	NUMBER OBSERVED	WEATHER CONDITIONS
415	Saddle	.5	0	Temp: 78 Wind: Calm
416	SE Ridge - Devil's Arroyo	1.75	1	Temp: ? Wind: windy
417	SE Ridge - Red tail Canyon/ Brisbane Water Tank	2.25	3	Temp: 60's Wind: windy
418	GH - Arnold Slope	.5	4	Temp: 50's-60's Wind: ? (rained in afternoon)
424	GH- Northeast Ridge: Water Tank	2	4	Temp: sunny Wind: windy
425	SE Ridge- Buckeye Cyn. and Trans. Line Ridge	5	19	Temp: 70's Wind: calm
425	SE Ridge - Buckeye Cyn./Trans. Line Ridge	1.75	11	Temp: 71 Wind: Calm
430	SE Ridge - Buckeye Cyn./Trans. Line Ridge	7	29	Temp: 90's Wind: calm to windy
501	GH - Callippe Hill	.25	6	Temp: ? Wind: 5 - 10 mph
502	SE Ridge - Quarry road	2	4	Temp: 60's Wind: 10-20 mph
505	GH - Northeast Ridge: Water Tank	.75	6	Temp: ? Wind: ?
505	GH - Northeast Ridge: SFWD road	.5	8	Temp: low 70's Wind: 10 mph
507	SE Ridge - Hill west of Quarry	.5	9	Temp: upper 60's, low 70's Wind: windy
508	SE Ridge - Brisbane Acres	2.75	4	Temp: 80's Wind: 10 - 20 mph
509	SE Ridge - Southeast Ridge	1.25	5	Temp: Upper 60's - low 70's Wind: 5 - 10 mph
513	SE Ridge - Owl Canyon	.75	3	Temp: low 70's Wind: windy
513	SE Ridge - Southslope	1	0	Temp: 70's Wind: windy
514	GH - Northeast Ridge: Callippe Hill	1.75	2	Temp: 70's Wind: 5- 20 mph

DATE	LOCATION	ELAPSED TIME	NUMBER OBSERVED	WEATHER CONDITIONS
515	Saddle	1.25	0	Temp: 69 Wind: <5 mph
516	Radio Ridge - West Peak	1.5	1	Temp: 90's Wind: Calm
516	SE Ridge - Cow Trough Ravine	1.75	0	Temp: 80's Wind: up to 15 mph
518	GH - Northeast Ridge: Deadman's gulch	.75	5	Temp: upper 70's Wind: light wind
519	SE Ridge - lower Devil's Arroyo	.25	1	Temp: ? Wind: ?
522	SE Ridge - lower Owl Cyn.	1.25	4	Temp: 70's Wind: off and on
526	GH - Northeast Ridge: BayRidge / Linda Vista	.5	3	Temp: 66 Wind: 5 - 10 mph
527	Saddle - Saddle	1	0	Temp: 77 Wind: < 5 mph
527	SE Ridge - Trans. Line Ridge	1.75	5	Temp: 70's Wind: light breeze
529	GH - Southeast Ridge	.5	1	Temp: 70's Wind: <5 mph
529	SE Ridge - Brisbane Acres	.5	2	Temp: 80's Wind: windy
602	GH - Northeast Ridge SFWD road	.25	1	Temp: 76 Wind: calm - 5 mph
605	GH - Northeast Ridge: Callippe Hill, Water Tank, Arnold Slope	.5	3	Temp: 70's Wind: 10-20 mph
TOTAL	ALL AREAS	78.0000	256	3.3 = Sightings Per Hour

CALLIPPE SILVERSPOT BUTTERFLY
FIELD DATA SUMMARY -- 1997
ALL AREAS

DATE	LOCATION	ELAPSED TIME	NUMBER OBSERVED	WEATHER CONDITIONS
425	SE Ridge - Owl Cyn/ Buckeye Cyn.	.5	2	Temp: 70's Wind: calm to breezy
501	GH - Callippe Hill	3.75	61	Temp: ? Wind: calm to breezy
505	GH - Northeast Ridge Water Tank	.25	3	Temp:? Wind: windy
507	SE Ridge - Hill west of Quarry	4	2	Temp: 70's Wind: windy
508	SE Ridge - Brisbane Acres	.25	2	Temp: Hot Wind: 10-20 mph
509	SE Ridge - Southeast Ridge	4	56	Temp: 70's Wind: ?
513	SE Ridge - Cow Trough Ravine	.25	2	Temp: low 70's Wind: windy
513	SE Ridge - Owl Canyon	1.75	19	Temp: low 70's Wind: windy
514	GH - Callippe Hill	3.75	43	Temp: 70's Wind: 5 - 20 mph
515	SE Ridge - Hillside	1.75	21	Temp: 70's Wind: windy
516	SE Ridge - Cow Trough Ravine and above Quarry	3.25	60	Temp: 80's Wind: 5 - 15 mph
522	SE Ridge - Owl Cyn.	1	9	Temp: 70's Wind: calm to breezy
526	GH - Carter / Linda Vista	2.5	53	Temp: 66 Wind: 5 - 10 mph
527	SE Ridge - Trans. Line Ridge	2	20	Temp: ? Wind: ?
527	GH - Saddle	1	0	Temp: 77 Wind: <5 mph
529	SE Ridge - Brisbane Acres	1	7	Temp: 80's Wind: windy
602	GH - Northeast Ridge SFWD area	1.25	20	Temp: 76 Wind: < 5 mph

DATE	LOCATION	ELAPSED TIME	NUMBER OBSERVED	WEATHER CONDITIONS
605	GH - Callippe Hill/ Arnold slope	.75	0	Temp: 70's Wind: 10-20 mph
606	SE Ridge - Buckeye Cyn./Trans. Line Ridge	3	13	Temp: 70's Wind: up to 15 mph
614	GH - Carter / Linda Vista / Arnold slope	3.5	0	Temp: ? Wind: ?
615	SE Ridge - Buckeye Cyn.	2	1	Temp: 70's Wind: wind to 15 mph
615	SE Ridge - Dairy Ravine	1	0	Temp: 70's Wind: 10-20 mph
623	SE Ridge - Buckeye Cyn.	1.5	4	Temp: 70's Wind: ?
623	GH - Callippe Hill	2	6	Temp: 70's Wind: ?
TOTAL	ALL AREAS	46.000	404	= 8.8 Sightings Per Hour

1996 SAN BRUNO ELFIN SEASON SUMMARY

ADULTS

3/07	00, Lion, Dairy Ravine Trail
3/09	00, Lion, subridge between Owl and Buckeye Canyons
3/10	05, Lion, sunny, warm, upper 60's, Summit
3/10	01, Lion, sunny, warm, upper 60's, Ridge trail above Quarry
3/18	01, Lion, sunny, warm, 60's, Summit
3/20	06, Lion, sunny, warm, upper 60's, subridge between Owl and Buckeye Canyons
3/21	11, Lion, cloudy, warm, upper 60's, upslope from Manzanita Dike
3/21	00, Lion, April Brook area
3/22	02, Lion, sunny, warm, 50's - 60's, Summit
3/23	00, Patrick, Temp: 74, wind: calm, old Quarry area in Colma Canyon
3/24	01, Patrick, Temp: 77, wind <5 mph, Dairy Ravine Trail
3/24	00, Patrick, Temp: 74, wind <5 mph, April Brook Area
3/27	00, Lion, Owl Canyon
3/28	00, Lion, sunny, breezy, Owl Canyon
3/29	00, Patrick, Temp: 84, wind: calm, Fern rock area
4/16	00, Lion, Devil's Arroyo
TOTAL	27 adults observed on 13 days

LARVAE

5/13	25, subridge between Owl and Buckeye Canyon
5/16	03, Ridge trail above Quarry
5/22	11, west slope of Owl Canyon
TOTAL	39 larvae observed on 3 days

Formula for Determining Relative Population Size

The productivity ratio, the ratio of sightings to hours spent, is the measure of density. Density is expressed as sightings/hour (S/H). The productivity ratio is directly proportional to density, related by a constant. The Area (A) of grassland in the colony is the measure of the total resource in a colony. The product of density (sightings/hour) times Area yields a measure of the insects present. The actual value of the product has no direct meaning -- it is related to the true number of insects by an unspecified constant. However, if the product for the various colonies is summed and the product for one colony is expressed as a percentage of the total, then the unspecified constant cancels out. The result is a valid estimate of the proportion of all insects in the colony.

For the Mission blue, the productivity ratio formula was applied to the 1997 butterfly counts for the following regional categories. All conserved habitat is included within these regional categories.

Colony	**Sightings per Hour**	**Area** (hectares)	**A x S/H**	**% of Population**
Guadalupe Hills	4.0	207	828.0	32.9%
Southeast Ridge	2.65	500	1325.0	52.6%
Radio Ridge	6.38	46	293.0	11.6%
Saddle	1.47	48	71.0	2.8%

For the callippe, the productivity ratio formula was applied to the 1997 butterfly counts for the following regional categories. All conserved habitat is included within these regional categories.

Colony	**Sightings per Hour**	**Area** (hectares)	**A x S/H**	**% of Population**
Guadalupe Hills	9.92	207	2053.0	33.9%
Southeast Ridge	8.00	500	4000.0	66.1%

SPECIES	Breeds	Wntr	Sprg	Sumr	Fall
Bunting, Lazuli	?		u	u	r
Bushtit	b	c	c	c	c
Chickadee, Chestnut-backed		c	c	c	c
Cowbird, Brown-headed	b		u	u	
Creeper, Brown		r	u		u
Crossbill, Red		cs			
Crow, American		r	r	r	r
Dove, Mourning	b	c	c	c	c
Dove, Rock (pigeon)		u	u	u	u
Eagle, Bald			x		x
Eagle, Golden			x		x
Falcon, Prairie			r		r
Finch, House	b	c	c	c	c
Finch, Purple	b	c	c	c	c
Flicker, Northern					
Red-shafted	b	c	c	c	c
Yellow-shafted			cs		
Flycatcher, Ash-throated			r		r
Flycatcher, Gray			x		
Flycatcher, Hammond's			x		
Flycatcher, Olive-sided	b		c	c	fc
Flycatcher, Pacific-Slope	?		fc	fc	fc
Flycatcher, Willow					r
Gnatcatcher, Blue-gray	b	r	r	r	r
Goldfinch, American	b		fc	c	c
Goldfinch, Lawrence's			cs		cs
Goldfinch, Lesser	b		fc	c	c
Grosbeak, Black-headed			u	r	u
Grosbeak, Rose-breasted			x		
Harrier, Northern	b		fc	fc	fc
Hawk, Cooper's			u	r	u
Hawk, Red-shouldered			r		r
Hawk, Red-tailed	b		c	c	c
Hawk, Sharp-shinned		r	u	r	u
Hummingbird, Allen's	b		c	c	
Hummingbird, Anna's	b	c	c	c	c
Hummingbird, Rufous	b		r	r	
Jay, Scrub	b	u	fc	fc	u
Jay, Stellar's			x		
Junco, Dark-eyed	b	c	c	c	c
Kestral, American	b	fc	fc	fc	fc
Killdeer		r	r	r	r
Kingbird, Western			r		
Kinglet, Golden-crowned		c	u		c
Kinglet, Ruby-crowned		c	fc		c
Kite, Black-shouldered		u	r	r	u
Lark, Horned	?	r	r	r	r
Meadowlark, Western		c	fc		c
Mallard			x		
Merlin			r		r
Mockingbird, Northern	b		c	c	c
Nuthatch, Pygmy				r	r
Nuthatch, Red-breasted		r	r		r
Oriole, Northern	b		fc	fc	
Osprey			r		r
Owl, Barn		u	u	u	u
Owl, Burrowing		r	r	r	r
Owl, Great-horned	b	u	u	u	u
Owl, Northern Saw-whet			x		
Phoebe, Black		u	r		r
Phoebe, Say's		u	u		u
Pigeon, Band-tailed		u	u		u
Poorwill, Common					x
Quail, California	b	c	c	c	c
Raven, Common	b	c	c	c	c
Redstart, American			x		

SPECIES	Breeds	Wntr	Sprg	Sumr	Fall
Robin, American	b	c	c	c	c
Sapsucker, Red-breasted			r		r
Shrike, Loggerhead			r	r	r
Sisken, Pine		x	x	fc	r
Snipe, Common		cs			
Sparrow, Chipping			cs		
Sparrow, Fox		c	fc		c
Sparrow, Golden-crowned		c	fc		c
Sparrow, Lark			cs		
Sparrow, Lincoln's		u	r		u
Sparrow, Sage			x		x
Sparrow, Savannah		u	u	u	u
Sparrow, Song	b	c	c	c	c
Sparrow, White-crowned	b	c	c	c	c
Sparrow, White-throated		cs			cs
Starling, European	b	c	c	c	c
Swallow, Barn	b		c	c	u
Swallow, Cliff	b		c	c	u
Swallow, Northern Rough-winged				r	r
Swallow, Tree			r		r
Swallow, Violet-green			r		r
Swift, Black			r		r
Swift,Vaux's			r		r
Swift, White-throated	?	x	u	u	u
Tanager, Western			r	r	fc
Thrasher, California			x		
Thrush, Hermit		c	c	r	c
Thrush, Swainson's	b		c	c	r
Thrush, Varied		u	r		r
Towhee, Brown	b	u	u	u	u
Towhee, Green-tailed				x	x
Towhee, Spotted	b	c	c	c	c
Vireo, Hutton's	b	c	c	c	c
Vireo, Solitary			r		r
Vireo, Warbling			u	u	u
Vulture, Turkey			fc	fc	fc
Warbler, Black-throated Gray			r		r
Warbler, Hermit			r		r
Warbler, MacGillivary's			r		r
Warbler, Nashville			cs		
Warbler, Orange-crowned	b		c	c	fc
Warbler, Palm			x		
Warbler, Townsend's		u	u	x	u
Warbler, Wilson's	b		c	c	u
Warbler, Yellow			u		u
Waxwing, Cedar		fc	fc		u
Waxwing, Bohemian		r			
Woodpecker, Downy	?	u	u	u	u
Wood-Pewee, Western	?		u	u	u
Wren, Bewick's	b	c	c	c	c
Wren, Rock	?	r	r	r	r
Wren, Winter	b	c	c	c	c
Wrentit	b	c	c	c	c
Yellowthroat, Common	b	r	c	c	fc
*- single sighting					
*Bunting, Painted			x		
*Warbler, Black-throated Blue					x
*Warbler, Chestnut-sided					x

San Bruno Mountain Bird Checklist

Compiled by "Mac" McCormick 1993, revised by Herb Brandt and Doug Allshouse, Dec. 1997.

Abundance Code:

c- common	cs- casual
fc- fairly common	x- accidental
u- uncommon	b- breeds in park
r- rare	?- suspected breeder

APPENDIX C — NUMBERS OF EXOTIC PEST PLANTS REMOVED BY HAND WORK ON SBM IN 1997

Area		UE	EG	GM	CS	FV	LV	PE	Other[2]
Radio Rd./ Summit	W					10	201		12
	H	99		1688					492
Ridge Trail	W					455	606		129
	H								4
GCP	W			5		7185	111	617	684
	H	9	63	18	38	1333			645
Saddle	W			45	1	1614	61	506	10
	H	18			8				11
NE Ridge/ Water Tank	W			3		2531	13	138	8
	H		75	807	781		3		460
Carter / Martin	W	22				5722	452	2564	79
	H	172		3	13		20		43
Callippe Hill	W		1			11519	168	719	31
	H		43	141	516	1209	3,2		263
Arnold Slope	W					1851			
	H				8				67
Buckeye Canyon	W					1037			16
	H			76					29
Owl/Buckeye subridge	W					516	79	139	
	H			42					1073
Brisbane Acres	W					3225	76		
	H			10					12
Terrabay/ South slope	W					1187	9	17	6
	H								

Area		UE	EG	GM	CS	FV	LV	PE	Other[2]
Juncus Ravine/ Hillside	W					5252	303	595	177
	H		275						18
Tank Ravine	W					2703	393	565	310
	H								2
Pointe Pacific	W					200			104
	H		420	66					313
Totals		320	877	2904	1365	47549	2527	5860	4998
Grand Total									**66,400**

1. W = Plants removed with weed wrench or maddox. H = Plants removed by hand pulling. Categories represented are: **UE**: *Ulex europaeus* (gorse), **EG**: *Eucalyptus globulus* (blue-gum tree), **GM**: *Genista monspessulana* (French broom), **CS**: *Cytissus striatus* (Portuguese broom), **FV**: *Foeniculum vulgare* (fennel) , **LV**: *Lactuca virosa* (wild lettuce), and **PE**: *Picris echiodes* (bristly ox-tongue).
2. Other category includes 22 additional weed species receiving hand control.

APPENDIX C -- ACREAGES OF EXOTIC SPECIES TREATED WITH HERBICIDE IN 1997

Area	Gorse (UE)	Euc. (EG)	F.Broom (GM)	P.Broom (CS)	Fennel (FV)	Other [1]
Saddle- Unit I						
Low density	3.0	0.1				
Saddle- Unit II						
Low density	2.25					
Saddle- Unit III						
High density	1.0					
Med. density	0.5					
Low density	2.0		2.25	0.1		0.1
Saddle- Bog Trail & Park Entrance Area						
High density						0.25
Medium density	0.1					0.35
Low density	1.75					0.1
Saddle- Park Boundary Gorse Project and Burn area						
High density	7.25					
Low density	0.25					
Radio Rd./Summit						
Low density	0.1					
Ridge Trail						
Low density						0.25
Bitter Cherry Ridge						
Low density	2.0					0.1
Dairy Ravine						
High density		3.5				

Area	Gorse (UE)	Euc. (EG)	F.Broom (GM)	P.Broom (CS)	Fennel (FV)	Other [1]
Med. density		4.75				1.5
Low density		4.25				0.5
Botanic Garden						
Low density		2.0				
April Brook						
Low density		2.5				
Colma Creek						
Low density		1.0				
Hoffman Site						
High density		1.0				
Hill West of Quarry						
Low density				1.5		
NE Ridge / Water Tank Area						
Low density						0.25
Wax Myrtle Ravine						
High density		2.25				
Med. density		2.5				
Low density	0.35					
GCP						
Med. density						0.5
Low density	0.25					0.25
Arnold Slope						
High density					0.25	
Brisbane Acres / Brisbane Water Tank						
Med. density			1.5			
Low density			1.25			

Area	Gorse (UE)	Euc. (EG)	F.Broom (GM)	P.Broom (CS)	Fennel (FV)	Other [1]
Brisbane/ Trans. Line Ridge boundary area						
High density			4.5			
Owl Canyon- /Quarry						
High density			2.5			
Linda Vista Area						
High density			2.5			
Low density			0.25			0.25
Tank Ravine						
Low density					1.0	
Juncus Ravine						
High density					2.5	
Med. density					0.75	
Low density					0.25	0.25
Totals	**20.8**	**23.9**	**14.75**	**1.6**	**4.75**	**4.65**
Grand Total						**70.45**

High density = >50% cover, Medium density = 25-50% cover, Low density = <25% cover. Density and acreages were visually estimated in field. Categories represented are: UE: *Ulex europaeus* (gorse), EG: *Eucalyptus globulus* (blue-gum tree), GM: *Genista monspessulana* (French broom), CS: *Cytissus striatus* (Portuguese broom), FV: *Foeniculum vulgare* (fennel). 1.Other category includes German ivy, English ivy, cotoneaster, pampas grass, Monterey pine, iceplant, (*Carpobrotus edulis*), and Echium.

Appendix D

Rana Creek Habitat Restoration

YGCIC Native Nursery				
San Bruno Mountain				
Botanic Garden				
			Rana	Rana
Quantity	Plant Name	Collection Site	Unit Price	Total Price
98	Achillea millefolium	Pedro Pt.	$ 1.05	$ 102.90
3	Anaphalis margaritaceae	Mt. Davidson	$ 3.15	$ 9.45
16	Artemisia californica	Pedro Pt.	$ 2.10	$ 33.60
34	Aster chilensis	San Bruno Mtn.	$ 1.05	$ 35.70
32	Aster chilensis	McLaren	$ 2.10	$ 67.20
2	Calystegia purpurata	Glen Canyon	$ 3.15	$ 6.30
2	Ceanothus thyrsiflorus	San Bruno Mtn.	$ 3.15	$ 6.30
3	Cornus sericea	Montara Mtn.	$ 3.15	$ 9.45
49	Elymus glaucus	San Bruno Mtn.	$ 1.05	$ 51.45
49	Festuca californica	San Bruno Mtn.	$ 1.05	$ 51.45
42	Festuca rubra	San Bruno Mtn.	$ 1.05	$ 44.10
30	Fragaria vesca	Mt. Davidson	$ 1.05	$ 31.50
97	Grindelia sp.	San Bruno Mtn.	$ 1.05	$ 101.85
32	Grindelia sp.	San Bruno Mtn.	$ 2.10	$ 67.20
49	Iris douglasiana	Twin Peaks	$ 1.05	$ 51.45
80	Juncus patens	Montara Mtn.	$ 2.10	$ 168.00
16	Lonicera hispidula vacillans	Montara Mtn.	$ 2.15	$ 34.44
10	Lonicera involucrata ledebourii	San Bruno Mtn.	$ 3.15	$ 31.50
2	Lupinus albifrons	Twin Peaks	$ 3.68	$ 7.35
16	Monardella villosa franciscana	GC,BW,MD	$ 2.15	$ 34.44
1	Myrica californica	Montara Mtn.	$ 3.15	$ 3.15
49	Nasella lepida	Pedro Pt.	$ 1.05	$ 51.45
73	Nasella pulchra	Pedro Pt.	$ 1.05	$ 76.65
6	Ribes sanguineum glutinosum	Brotherhood Way	$ 3.15	$ 18.90
32	Rubus parviflorus	Montara Mtn.	$ 2.10	$ 67.20
16	Rubus ursinius	San Bruno Mtn.	$ 2.10	$ 33.60
18	Rubus salicifolius	Twin Peaks	$ 1.05	$ 18.90
10	Salvia spathacea	San Bruno Mtn.	$ 3.15	$ 31.50
3	Sambucus racemosa	Pedro Pt.	$ 3.15	$ 9.45
43	Scrophularia californica	San Bruno Mtn.	$ 1.05	$ 45.15
25	Silene scouleri grandis	Bayview	$ 1.05	$ 26.25
21	Silene verecunda verecunda	Mt. Davidson	$ 1.05	$ 22.05
49	Solidago sp.	San Bruno Mtn.	$ 1.05	$ 51.45
16	Tellima grandiflora	Glen Canyon	$ 2.10	$ 33.60
1024	Sub Total			$ 1,434.93
	Sales Tax			104.03
	Grand Total			$ 1,538.96

Rana Creek Habitat Restoration

1997 cnps Plant Sale				
Species	Size	Quantity	Total	
Acaena pinnatifida californica	4"	13	$	37.54
Achillea millefolium	4"	20	$	58.28
Anaphalis margaritacea	gallon	7	$	28.49
Angelica hendersonii	4"	3	$	8.75
Arabis blepharophylla	4"	8	$	23.10
Aster chilensis	4"	3	$	8.66
Baccharis piluraris	4"	25	$	72.85
Berberis pinnata	4"	1	$	2.89
Berula erecta	4"	14	$	40.43
Bromus carinatus carinatus	4"	32	$	92.40
Calamagrostis nutkaensis	4"	11	$	31.76
Ceanothus thyrsiflorus	gallon	1	$	4.07
Cornus sericea	gallon	5	$	20.35
Deschampsia caespitosa holciformis	rose	22	$	34.65
Dudleya farinosa	4"	7	$	20.21
Elymus glaucus	4"	14	$	40.43
Erigeron glaucus	4"	27	$	77.96
Eriophyllum staechadifolium	4"	40	$	116.55
Festuca californica	4"	3	$	8.66
Festuca rubra	4"	2	$	5.78
Fragaria chiloensis	4"	24	$	69.30
Fragaria vesca	4"	28	$	80.85
Grindelia sp.	4"	18	$	51.98
Heracleum lanatum	4"	7	$	20.21
Horkelia californica	4"	24	$	69.30
Iris douglasiana	4"	48	$	138.60
Juncus occidentalis	4"	15	$	43.31
Juncus patens	4"	8	$	23.10
Lathyrus vestitus vestitus	4"	8	$	23.10
Lupinus albifrons	gallon	9	$	25.99
Marah oreganus	gallon	2	$	8.14
Melica californica	4"	16	$	46.20
Melica imperfecta	4"	2	$	5.78
Mimulus aurantiacus	4"	4	$	11.66
Mimulus guttatus	4"	10	$	28.88
Monardella villosa franciscana	4"	10	$	29.14
Nasella lepida	rose	49	$	77.18
Oenothera elata hookerii	4"	12	$	34.65
Polygonum paronychia	4"	12	$	34.65
Plantago subnuda	4"	16	$	46.20
Potentilla glandulosa	4"	12	$	34.65
Prunus ificifolia	gallon	10	$	40.69
Rosa parviflorus	4"	21	$	60.64
Rubus ursinus	4"	10	$	28.88

Rana Creek Habitat Restoration

Species	Size	Quantity	Total	
Salix lasiolepis	gallon	11	$	44.76
Salvia spathacea	4"	6	$	22.05
Satureja douglasii	4"	3	$	8.66
Scrophularia californica	4"	11	$	32.06
Sidalcea malvaeflora	4"	1	$	2.89
Silene scouleri grandis	4"	7	$	20.40
Silene verecunda verecunda	4"	7	$	20.40
Sisyrinchium bellum	4"	10	$	28.88
Solanum umbelliferum	4"	6	$	17.33
Solidago sp.	4"	9	$	25.99
Stachys ajugoides rigida	4"	21	$	60.64
Urtica dioica gracilis	4"	8	$	12.60
Sub Total		733	$	2,063.48
Sales Tax				149.60
Grand Total			$	2,213.08

Rana Creek Habitat Restoration	Rana Creek Habitat Restoration			
Plants Delivered to				
San Bruno Mountain				
Botanic Garden on 12/11/97				
Quantity	Plant Name	Size	Unit Price	Total Price
617	Eriogonum latifolia	Cone	$ 0.40	$ 246.80
62	Brickellia californica	Cone	$ 0.40	$ 24.80
35	Salvia spathacea	Cone	$ 0.40	$ 14.00
201	Arabis glabra	Cone	$ 0.40	$ 80.40
645	Acaena pinnatifida californica	Cone	$ 0.40	$ 258.00
265	Mondarella villosa	Cone	$ 0.40	$ 106.00
294	Lupinus varicolor	Cone	$ 0.40	$ 117.60
98	Koeleria murcanthe	Cone	$ 0.40	$ 39.20
77	Eriophyllum staech.	Cone	$ 0.40	$ 30.80
490	Achillea mil.	Cone	$ 0.40	$ 196.00
320	Achillea mil.	Plug	$ 0.05	$ 16.00
124	Dechampsia caesp.	4"	$ 0.25	$ 31.00
3228	Sub Totals			$ 1,160.60
Plants delivered to San Bruno Mountain				
on 1/6/98:				
Quantity	Plant Name	Size	Unit Price	Total Price
1974	Achillea millefolium	Cone	$ 0.40	$ 789.60
774	Festuca californica	Cone	$ 0.40	$ 309.60
726	Elymus glaucus	Cone	$ 0.40	$ 290.40
480	Eriogonum latifolia	Cone	$ 0.40	$ 192.00
613	Prunella vulgaris	Cone	$ 0.40	$ 245.20
15	Villosa americana	Cone	$ 0.40	$ 6.00
2	Horkelia californica	Cone	$ 0.40	$ 0.80
2	Chlorogalum pomeridianum	Cone	$ 0.40	$ 0.80
42	Lathyrus vestitus	Cone	$ 0.40	$ 16.80
10	Festuca idahoensis	Cone	$ 0.40	$ 4.00
15	Festuca rubra	Cone	$ 0.40	$ 6.00
102	Heracleum lanatum	Plug	$ 0.05	$ 5.10
114	Lomatium dasycarpum	Plug	$ 0.05	$ 5.70
80	Sedum spathifolia	4"	$ 0.25	$ 20.00
49	Sedum spathifolia	Rose Pot	$ 0.25	$ 12.25
24	Dudleya	4"	$ 0.25	$ 6.00
14	Trifolium wildenovii	Cone	$ 0.40	$ 5.60
39	Sidalcea malviflora	Cone	$ 0.40	$ 15.60
41	Silene californica	Cone	$ 0.40	$ 16.40
42	Erysimum	Cone	$ 0.40	$ 16.80
152	Festuca idahoensis	4"	$ 0.25	$ 38.00
5310	Sub Totals			$ 2,002.65
8538	Total Plants			$ 3,163.25
	Sales Tax			229.34
	Grand Total			$ 3,392.59

APPENDIX E
OPERATING PROGRAM BY ADMINISTRATIVE PARCEL -- 1998

Administrative Parcel	Species Monitoring	Exotics Control	Revege-tation	Planning Assistance *
GUADALUPE HILLS (1)				
01 Linda Vista III (Bay Ridge)	X	X	X	X
02 Carter St.	X	X		
03 Rio Verde Heights	X			X
04 Levinson Property	X			
05 Brisbane Office Park	X			
06 Parcel Z	X			X
07 Northeast Ridge Project	X	X	X	X
08 Guadalupe Valley West	X	X		
09 State Park	X	X	X	X
10 Guadalupe Canyon Pkwy.	X	X		X
11 PG&E Transmission Lines	X			X
12 PG&E Fee	X			
13 Water Pipelines	X			X
14 Linda Vista I	X	X		
15 Water Tank				
16 Parcel V	X	X		
SOUTHEAST RIDGE (2)				
01 Quarry	X	X	X	X
02 Owl and Buckeye Canyons	X	X	X	
03 Brisbane Acres	X			X
04 Terrabay Project	X	X	X	X
05 County Park	X	X		X
06 Hillside School				
07 PG&E Transmission Lines	X	X		X
08 Juncus Ravine	X	X		
09 Water Pipelines	X			
10 Fire Breaks	X			
RADIO RIDGE (3)				
01 Telecommunications Site	X	X		X
02 County Park	X	X	X	X
03 Guadalupe Canyon Pkwy.	X	X		
04 PG&E Transmission Lines	X		X	X
SADDLE (4)				
01 Pointe Pacific	X	X		
02 Village-in-the-Park		X		
03 South Hills Estates		X		
04 State Park	X	X	X	X
05 Guadalupe Canyon Pkwy.	X	X		X
06 Water Tanks				

* Includes monitoring of construction, project design review, and HCP compliance review

San Bruno Mountain Habitat Conservation Plan

Five Year Strategic Plan

November 1996

REVISED DRAFT

Prepared for:

San Bruno Mountain Habitat Conservation Plan Trustees

Prepared by:

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San Bruno Mountain Five Year Strategic Plan

Purpose of Plan

At the July 1996 meeting of the San Bruno Mountain Habitat Conservation Plan Trustees, the Trustees requested that the County of San Mateo and its contractor, Thomas Reid Associates, develop a 5 year strategic plan for San Bruno Mountain. The plan is intended to outline a strategy for habitat management of San Bruno Mountain for the next five years, and to provide different management scenarios of varying land management intensity that can be evaluated based on cost and expected effectiveness.

This 5-year plan is based on experience of working on the Mountain since 1980, and updates the Exotic Species Management Plan drafted in 1992. The plan addresses the broad objectives set forth in the San Bruno Mountain Area Habitat Conservation Plan. The primary emphasis of this plan is on maintenance and restoration of the grassland plant community on San Bruno Mountain. This community is the type habitat for the endangered Mission blue butterfly and the proposed endangered Callippe silverspot butterfly. The endangered San Bruno Elfin butterfly's type habitat is rocky outcrops within coastal scrub habitat. Coastal scrub and riparian habitats on San Bruno Mountain will also continue to receive habitat maintenance and restoration efforts, but are a lesser priority because these habitats are not as threatened by exotic plant infestations.

San Mateo County is the HCP Plan Operator and is responsible for the maintenance and restoration of the native ecosystems on San Bruno Mountain for the purpose of protecting rare plant and animal species, and protecting the integrity of the ecosystem as a whole. The County recognizes the need to maintain recreation values and public access in the park and to reconcile human uses in the park with habitat restoration and butterfly monitoring programs.

Other agencies have responsibilities on San Bruno Mountain, notably the Cities of Brisbane, Daly City and South San Francisco and the California Department of Fish and Game, owners of Owl and Buckeye Canyons. The strategic plan focuses on the land in the County Park which is the core of the HCP conservation area. The plan recognizes opportunities to coordinate with other agencies.

Volunteer groups have emerged as important contributors. Volunteer activities have focused to date on three locations. The main parking lot area and future botanic garden area (by Friends of San Bruno Mountain), the California Department of Fish and Game property (by Bay Area Mountain Watch), and Pointe Pacific Property (by Pointe Pacific Homeowners Association). Results from these activities have been successful and very encouraging. As the volunteer base for these organizations builds, there is the potential for expansion of volunteer activities into other habitat areas of the Mountain which will increase the effectiveness of habitat maintenance and restoration efforts. Volunteer organizations do not have the capability of conducting large scale habitat maintenance or restoration -- this work will remain the responsibility of the County. The County will continue to coordinate with volunteer organizations as their programs develop.

Contents

This plan has four parts:

1) Habitat Protection and Restoration Techniques

The most important goal of exotics control and restoration work is the enhancement and restoration of grassland habitat for the rare butterflies on the Mountain. This priority reflects the role of the HCP in mitigating impacts of development on grassland habitat. Secondary to this is enhancement and restoration of other native plant communities, such as coastal scrub and riparian habitats. To develop native grassland habitat where it does not exist, either in exotic shrublands or native coastal scrub habitat, a number of techniques can be utilized either alone or in combination. Techniques include hand removal, herbicide application, burning, grazing, mechanical clearing and mowing. With the exception of grazing, all of these techniques have been used on San Bruno Mountain. The current focus of large-scale exotics control is herbicide application and hand removal of perennial exotic plants. Other techniques such as mowing, grazing, and burning will suppress exotic annuals as well as perennials. The timing of implementation of these selected management tools is critical to the success of grassland habitat creation.

a) Hand and Herbicide

Table 1 shows the present treatment method for the major exotic pest plants on San Bruno Mountain. Herbicide control is done on high density exotic plant infestations, while hand work is used on low density infestations. Hand work is also used in remote locations of the park where access is difficult for herbicide crews.

Most exotic pest plant infestations that are treated with herbicide are treated once a year by foliar spraying. Spraying is done year round with the same results. The initial treatment usually has a 95% kill rate followed up with routine maintenance every six to twelve months for up to three years. The majority of the originally sprayed plants will decay to skeletons in one to three years. The remaining skeletons and duff can be burned to initiate propagation of seeds that still exist in the soil. The use of herbicide is a continuous process for a number of years to control seedlings. Hand removal of seedlings is used when the population is greatly reduced.

Currently, it costs approximately $1000/ acre to apply initial spray treatments on medium to high density infestations for most exotic species. Spraying eucalyptus stumps is more expensive due to the greater cost of the more concentrated herbicide and runs approximately $1250-$1500 per acre, depending upon stump density. Annual follow-up work is essential to control all infestations. The next one to two years require about one-half the initial spray time, and the following two to four years after this require approximately one-quarter the initial spray time. Table 2 gives a generalized cost estimate for exotics control and restoration work on a per acre basis.

Hand removal is done with a maddox, weed-wrench, or by hand pulling. Pulling out the whole plant, roots and all, is essential for control of most weedy exotic plants. Hand work is most effective in the winter and spring when soils are moist. Hand removal initial costs range from $25 to $400/acre depending on the density of the infestation. Annual maintenance work follows the same schedule as herbicide control work.

Table 1
Major exotic pest plants on San Bruno Mountain and current treatment methods for each (1996)

Exotic Pest Plant Species	Area[1] (acres)	Treatment
Eucalyptus *Eucalyptus spp.*	140	Trees are clearcut and removed. Stumps are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide in cottonseed oil with a coloring agent. The herbicide is sprayed on cut stumps shortly after felling. The herbicide is applied to the phloem and cambian layers where it is quickly absorbed. If the cut stumps are older than 48 hours, the outside of the bark is frilled with an axe and the live tissue is sprayed.
Gorse *Ulex europaeus*	95	Gorse is treated by foliar spraying year round with 2% Garlon 4 herbicide that includes an acidifier and coloring agent. Hand removal of seedlings is done when the population is greatly reduced.
Fennel *Foeniculum vulgare*	90	Fennel is controlled with a 2% Garlon 4 herbicide that includes an acidifier and coloring agent. The plants are treated by basal foliar spray during the months of April and May prior to seed formation.
French Broom *Genista monspessulana*	50	French Broom is controlled with a 2% Roundup Ultra (Glyphosate) herbicide that includes an acidifier, tackifier, and a coloring agent. The plants are treated by foliar spraying year round with the same results. Hand removal of seedlings is done when the population is greatly reduced
Striatus Broom *Cytisus striatus*	25	Striatus Broom is controlled with a 2% Garlon 4 herbicide that includes an acidifier and coloring agent. The plants are treated by foliar spraying year round with the same results. Hand removal of seedlings is done when the population is greatly reduced.
Pampas grass *Cortaderia jubata*	20	Pampas grass is treated with 2% Round-up (or Rodeo) herbicide that contains an acidifier, tackifier, and coloring agent. Treated primarily in summer months before seed formation, but can be treated year round.

Exotic Pest Plant Species	Area[1] (acres)	Treatment
English Ivy and German Ivy *Hedera helix & Senecio mikanoides*	7	English and German ivies are controlled with 2% Garlon 4 herbicide that includes an acidifier and controlling agent. The plants can be treated by foliar spraying year round with the same results. A second application is done 3 to 6 months after the initial treatment. The entire site must be sprayed with herbicide to ensure no runners are missed.
Monterey Pine *Pinus radiata*	5	Monterey pine trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.
Monterey Cypress *Cupressus macrocarpa*	4	Monterey cypress trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.
Poison Hemlock *Conium maculatum*	3	Poison hemlock is controlled with 2% Garlon 4 herbicide that includes an acidifier and coloring agent. The plants are treated by foliar spraying during the months of April and May.
Iceplant (Hottentot fig) *Carpobrotus edulis*	3	Iceplant is treated with 1.5% or 2% Round-up (or Rodeo) herbicide that contains an acidifier, tackifer, and a coloring agent. Plants are treated year round.
Cotoneaster *Cotoneaster spp.*	<1	Cotoneaster is cut at the base with a pruning or chain saw. The stumps are treated with 50% Garlon 4 and 50% cottonseed oil with a coloring agent. The herbicide is sprayed on cut stumps within 30 minutes of cutting.
Echium *Echium pinanana*	<1	Echium is treated with a 50% Garlon and 50% cottonseed oil mixture. Plants are cut and the stumps are sprayed. Treatment is done in the fall when the plants are more visible.
Estimated total acres	**444**	

1. Acres of exotics were estimated from low altitude aerial photographs and visual estimates in field.

Table 2
Generalized Cost for Exotic Species Control and Restoration Work (from infestation stage to native plant community)

Exotics Control

Exotic infestation	Year	Cost/Acre
Medium density exotic plant infestation (Gorse, Broom, others)	**1** (initial spray)	$1,000
	2	$500
	3 through 5	$750 @($250/yr)
	6 through 10	$500 @($100/yr)
	Total Cost per Acre	**$2,750**

Restoration of Eucalyptus Cut Areas

Exotic infestation	Year	Cost/Acre
Eucalyptus Forest	**1** (initial spray/ soil prep/ & revegetation)	*$2,800
	2 through 6 Use of mowing, grazing, burning, hand removal, or herbicide work alone or in combination	$2,500 @ ($500/ yr)
	Total Cost per Acre	**$5,300**

* Assuming no cost for tree removal or chainsaw work to control woody regrowth. Based on preliminary results from 1995 and 1996 restoration work, (Paul Kephart).

b) Grazing

Grazing has yet to be used on San Bruno Mountain for habitat enhancement purposes. In the past when San Bruno Mountain was used extensively for ranching, grassland habitat was more abundant. In recent times grazing has not been considered as a viable option due to the labor intensity of livestock management, and due to the potential damage to native vegetation. When properly managed grazing may be a cost effective method of controlling exotic species and increasing grassland habitat. In the case of gorse, livestock will not graze on the mature shrubs and therefore grazing is only useful in controlling seedlings in areas already cleared of adult plants. Grazing would have a high initial cost of $900/ acre to develop infrastructure, but would decrease each subsequent year and level off at $400/ acre or lower, depending on the economic value of the rangeland.

c) Burning

Controlled burning reduces fire hazard, decreases native scrub and exotic species coverage, and increases grassland habitat. It is also an excellent way to prepare areas for replanting. Research by TRA and others has shown that exotic species such as gorse and french broom regenerate strongly after burning, and that post-burn control of seedlings is paramount to gaining control. Areas with high-density gorse that were burned in the mid-1980's and were not followed up with herbicide treatment have returned to gorse, while burned areas that were followed up with herbicide treatment have since been recolonized by native shrubs and grassland habitat.

Time-of-year influences vegetation response to burning. Research by Tom Parker of San Francisco State University and others has shown that burning in the winter tends to favor exotic plants rather than native plants. Our native flora is adapted to a late summer/fall burning regime. Controlled burning could also have a beneficial impact upon certain rare plants on the Mountain, such as the San Bruno Mountain manzanita. Controlled burning costs range from $450 to $650/ acre.

Work on San Bruno Mountain is restricted by air quality regulations and summer burns are not allowed. TRA plans to work with San Mateo County Parks, the California Department of Forestry, and Bay Area Air Quality Management in coordinating controlled burns on San Bruno Mountain.

d) Mowing

Mowing can be used to depress woody and weedy exotic species in the same manner as grazing and burning. Annual exotics such as certain grasses and herbs have not received treatment efforts due to their lower threat to habitat areas, and their pervasiveness on the Mountain. Mowing during the spring before they have had a chance to out compete native grasses is a technique that has shown to be successful. Mowing can be done with a tractor mower for large areas, or with a weed-eater for small areas. Mowing costs approximately $400/acre with a tractor mower, and $750/acre for weed-eating.

e) Replanting methods

In addition to exotics control work, restoration requires site preparation and replanting. For specific details on restoration work see San Bruno Mountain Restoration Plan 1996, (Paul Kephart). A cost estimate per acre for habitat restoration of Eucalyptus-cut areas from infestation stage to native plant community is provided based on preliminary results from the 1996 restoration work (see Table 2).

2) Distribution of exotic plant species on San Bruno Mountain

The current distribution of the major exotic pest plants on the Mountain is shown in Maps 1 through 4. The mapped infestations display only the dominant vegetation

type within each infestation and only infestations over one-quarter acre in size were mapped. The estimated acreages for the major exotic pest plants on the Mountain are shown in Table 1.

The exotic plant infestations are primarily located around the periphery of the Mountain, adjacent to developed areas. The exotic pest plants tend to colonize disturbed roadside areas and then over time move upslope into the habitat areas of the Mountain. Our control efforts have focused on maintaining the upslope habitat areas first, and then working downslope to control the source areas.

The present priority strategy was established in the 1992 Exotic Species Control Program. This strategy utilizes holistic range management techniques, and has markedly increased our effectiveness in controlling exotic pest plant infestations. The priority system is as follows:

Priority 1: Control of small outlying infestations within or near butterfly habitat
Priority 2: Control of boundaries of large infestations
Priority 3: Control of large infestations

Each area is treated using this priority strategy until an area is completely controlled. After two or more years of treatment to control an area, then annual monitoring is conducted to insure the area stays weed-free. The methodology for evaluating habitat maintenance and restoration activities on San Bruno Mountain is shown in Appendix 3.

Exotic infestations that are overlapping or threatening to invade known butterfly colonies are considered priority one. Map 5 shows the current spatial relationship between exotic plant infestations and butterfly distributions. The 1990 and 1991 butterfly population data was used to give a representation of butterfly locations on the Mountain. Areas where butterfly distributions are threatened by exotic pest plant infestations include locations on Northeast Ridge, South Slope, Saddle, and Southeast Slope.

The exotics control strategy has been successful at maintaining sensitive habitat areas free of weeds and at reducing the coverage of gorse in the saddle. However, large infestations of fennel, striatus broom, and other exotics along the periphery of the Mountain have been expanding in recent years. Substantial portions of these infestations are on private land in the jurisdictions of neighboring cities. Some infestations are currently being controlled by private landowners, but most are not.

Map 6 shows the spatial relationship between the exotics and the property boundaries on the Mountain. Table 3 lists the landowners of the properties that are shown on Map 6. Many of these areas have significant exotic plant infestations and these are the sources for the exotic infestations found further up the Mountain. It is imperative that these source areas be controlled in conjunction with work in the habitat areas, if we are to be successful in controlling exotic plants on the Mountain.

Over the next five years, San Mateo County will step up efforts to coordinate with

local landowners and cities to control exotics on their properties as required in the HCP, whilst expanding our control efforts into the HCP habitat areas that are adjacent to these properties.

Table 3
Surrounding Properties with Exotic Species Infestations*

(The infestations on these properties surrounding the HCP area have either already spread to the HCP area or have the potential to spread to the HCP area.)

Property	Exotic Species	Total Area (ac)
Brisbane Acres (various landowners)	French broom	24
Terrabay	Fennel, Pampas grass	15
Southern Hills Estates (various homeowners)	Gorse	10
*Guadalupe Quarry	French broom	9
City of Brisbane	French broom, Pampas grass	7
Levinson property Carter/Martin area	Fennel	3
Pacific Nursery	Silver dollar eucalyptus	2
Colma landfill	Pampas grass	2
*Northeast Ridge	Fennel, Striatus broom	2
Brisbane office park	Pampas grass	2
Total		**66**

*The Northeast ridge and Guadalupe Quarry (California Rock and Asphalt) have made significant progress on controlling french broom on their properties.

3) Projection of Next Five Years of Habitat Management (1997-2001)

To help guide habitat management efforts on the Mountain, it is necessary to understand and estimate the rate of exotic plant expansion. Diagram 1 (page 11) illustrates the expansion rate of a hypothetical exotic plant infestation using an expansion rate of 10 feet/ year from edge of infestation. Two geometric shapes are illustrated, a circle and a thin rectangle. Both shapes begin as one acre sized infestations. The circle has a low perimeter to area ratio, while the thin rectangle has a much higher perimeter to area ratio. The circle increases from one acre to 2.0 acres in 5 years and to 3.4 acres in 10 years. The thin rectangle increases it's size much faster, going from one acre to 3.3 acres in 5 years, and to 6.1 acres in 10 years. The thin rectangle has expanded by 6 times its original size, while the circle has expanded by only 3 times over the same period of time.

We can expect the rate of expansion of infestations on the Mountain to be closer to the maximum, since most infestations have complex shapes with large perimeter to area ratios. These take the form of either thin rows, or small scattered clumps that coalesce with time. The expansion rate would be high at first as perimeter is great and area is small, but as the infestation grows and coalesces with other infestations the perimeter/ area ratio drops and the rate of expansion decreases.

Records for gorse on San Bruno Mountain show an estimated increase of 282 acres over a 49 year period. This is consistent with a 4% increase in area per year for a thin rectangle starting at 50 acres (500 feet by 4,530 feet). This rate of increase is also consistent with the rate of expansion found for fennel. Beatty and Licari (1992) found that fennel expanded by approximately 3 meters per year from edge of infestation, which is about a 4.5% increase in area per year for an infestation with the same rectangle shape and dimensions.

Using the derived expansion rate and the thin rectangle shape and applying it to the present 304 acres of exotics on the Mountain (excluding eucalyptus) gives a predictive estimate of what the expansion of exotics would be on San Bruno Mountain. Table 4 uses this expansion rate to predict acreages of exotic plants by 2001 under three different management scenarios. Diagram 2 (page 12) shows the information in graphical form. The estimate is based solely on documented expansion rates of exotic plants. A more precise predictive model would require inclusion of variables such as weather, seed disbursal, and habitat types.

Table 4
Projected Acres of Exotic Pest Plants by 2001[1] Under Three Management Scenarios

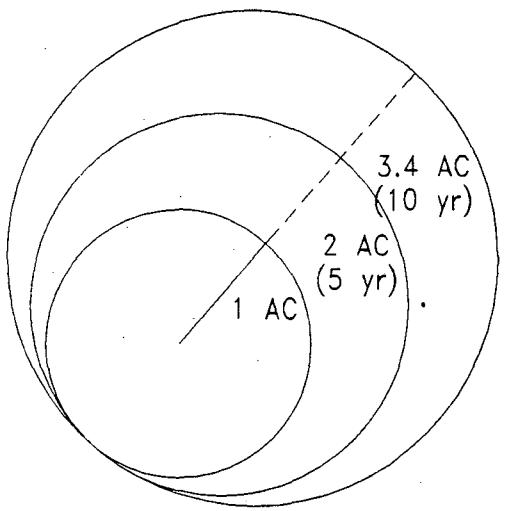
Exotics Management	Control Effort and Funding Level			
	No Funding	**1) Low (50% Decrease)**	**2) Medium (Current Level)**	**3) High (50% Increase)**
Re-establishment of currently maintained areas	400[2]	0	0	0
Expansion/ reduction of untreated infestations[3]	370	370	285	201
Re-establishment of Eucalyptus cut areas	52	30	0	0
Grand total	822	400	287	201

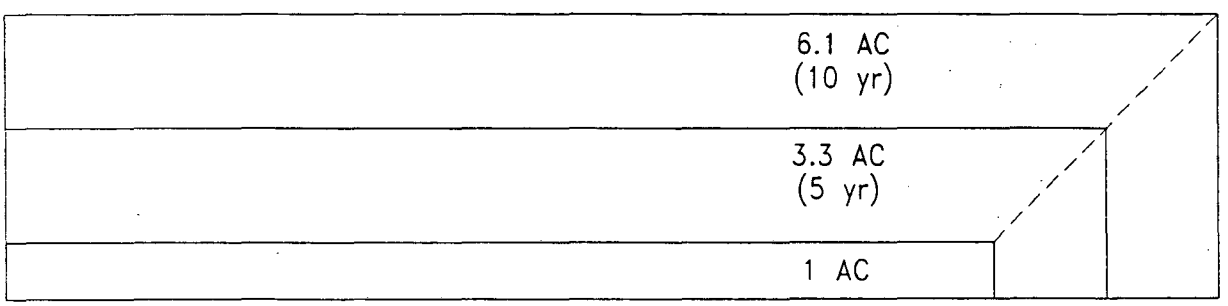
1 Rate of 4% annual growth is used to calculate exotic plant expansion; uncut eucalyptus not included.

2 Approximately 400 acres of exotic pest plants receive maintenance work every year. This area is a priority to maintain under all funding levels. It is assumed that under no funding it would return to exotic pest plants by 2001.

3 This calculation is derived from subtracting the acres controlled from the expansion of exotics annually over a 5 year period.

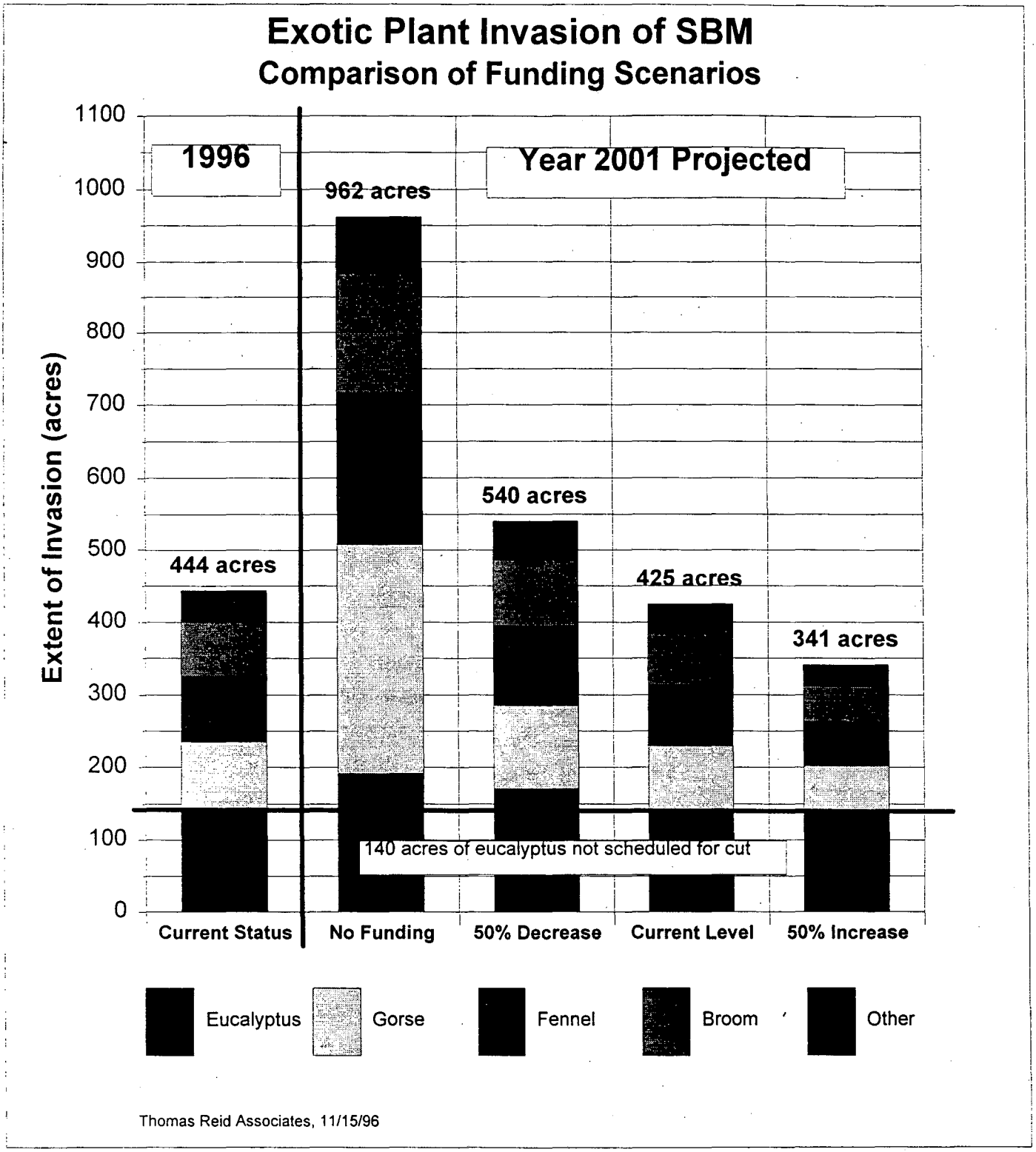
Diagram 1. Effect of geometric shape on expansion rate of exotic plant infestations. Hypothetical expansion with a constant growth rate of 10 feet per year from edge of infestation is shown after 5 and 10 years.





Source: Thomas Reid Associates. 10/96.

Diagram 2. Exotic Pest Plant Invasion of San Bruno Mountain: Projected Size of Infestations Based on Funding Scenarios.



Using the present methods of exotics control, a projected work scope with goals is given for the low, medium, and high management scenarios. No further eucalyptus cutting is proposed in any of the scenarios.[1]

a) Low (50% decrease in funding)

A 50% decrease in funding would decrease the current budget of $110,000 for exotics control and habitat restoration to approximately $55,000. This would necessitate abandonment of large scale exotics control and restoration and focus on maintaining areas already under control or restored. Under this scenario, the Southslope eucalyptus areas would not be restored and would return to eucalyptus forest. Fennel would likely continue to expand on the Southslope of the Mountain. Striatus broom would likely expand further up the hillsides on the northslope above the Brisbane Industrial Park. Areas such as Radio Ridge, Saddle, and Northeast Ridge would be maintained at their present level, and only the eucalyptus areas along Guadalupe Canyon Parkway (33 acres) would be restored. The specific goals for exotics control under this scenario are described below.

Gorse

1) Control gorse Mountain-wide to keep new colonies of gorse from becoming established.

2) Maintain all areas already under control. This includes Bitter Cherry Ridge, the eastern and western portions of the Saddle, portions of Wax Myrtle Ravine, Northeast Ridge, and Radio Ridge.

Eucalyptus

1) Keep all existing eucalyptus groves from expanding by removing pioneer sprouts on the periphery of groves.

2) Continue eucalyptus regrowth control in restoration areas along Guadalupe Canyon Parkway only (33 acres), and manage the area to provide a minimum 15 acres of butterfly habitat.

Broom

1) Control French and striatus broom Mountain-wide to keep new colonies from becoming established.

2) Maintain all broom areas already under control. This includes: the Saddle, the Northeast Ridge, Buckeye Canyon and Radio Ridge.

Fennel

1) Maintain all areas already under control. This includes: the Saddle, Northeast Ridge, portions of Tank Ravine and Juncus Ravine, and Radio Ridge.

[1] No further eucalyptus cutting can be done without prior approval from the City of Brisbane.

Other Exotics

1) Control all pampas grass and cotoneaster Mountain-wide.

2) Control all isolated patches of German Ivy and English Ivy, and in areas where it is escaping from eucalyptus forested areas, (i.e. Radio ridge, Saddle bog area).

b) Medium (current funding level)

The current habitat management program is based on the last 14 years of experience in working on the Mountain. Since resources are not available to attack all of the exotic plant infestations on the Mountain at once, a strategy of phased exotics control on large infestations, while doing only maintenance efforts in others has evolved. This program has had effective results. However while the program has been effective at controlling and reducing the amount of gorse and other exotics on Radio Ridge, Saddle, and Northeast Ridge, other areas such as Southslope and the hillsides south of the Brisbane Industrial Park have shown an increase in exotic plant coverage.

The scenario presented here focuses more efforts on the expanding fennel and striatus broom infestations in the areas indicated above. In exchange, gorse in the saddle would receive primarily maintenance work. Exotics control within the eucalyptus cut areas is given a higher priority than others, since the success of restoration efforts is dependant upon controlling regrowth before the areas return to eucalyptus forest, or become infested with other exotic plants.

In the present fiscal year, (1996-97) approximately $110,000 will be spent on exotics control and habitat restoration on San Bruno Mountain. Approximately $60,000 is for restoration of the eucalyptus cut areas, and the remaining $50,000 is for exotics control on the rest of the Mountain. This increased budget will have to be sustained for at least the next five years if all of the eucalyptus cut areas are to be restored while conducting control work on other exotic infestations on the Mountain.

The specific goals for exotics control under this scenario are described below.

Gorse

1) Control gorse Mountain-wide to keep new colonies of gorse from becoming established.

2) Maintain all areas already under control. This includes: Bitter Cherry Ridge, the eastern and western portions of the Saddle, portions of Wax Myrtle Ravine, and the Northeast Ridge.

3) Control all gorse within and adjacent to any of the eucalyptus restoration areas.

Eucalyptus

1) Keep all existing eucalyptus groves from expanding by removing pioneer sprouts on the periphery of groves.

2) Control eucalyptus regrowth in all eucalyptus cut areas (63 acres total). For areas not immediately planned for replanting, control of regrowth will require consistent assistance from County Park staff, work furlough, and/or volunteer crews in 1997 and 1998.

3) Remove eucalyptus debris either by burning and/or hauling from cut areas at Wax Myrtle Ravine and behind Pacific Nursery.

4) Complete initial phases and follow up of replanting in eucalyptus cut areas along Guadalupe Canyon Parkway, and conduct initial phases of replanting in eucalyptus cut areas on Southslope.

5) Manage eucalyptus cut areas through burning, grazing, and /or mowing to provide a) a minimum of 15 acres of grassland habitat in eucalyptus cut areas along Guadalupe Canyon Parkway, and b) a minimum of 10 acres of grassland habitat on southslope areas. The remaining areas will be restored to coastal scrub and riparian habitats.

Broom (Cytisus and Genista spp.)

1) Control french and striatus broom Mountain-wide to keep new colonies from becoming established.

2) Maintain all broom areas already under control. This includes: the Saddle, the Northeast Ridge and Buckeye Canyon.

3) Control french broom above Brisbane Acres water tank and all isolated infestations along transmission line ridge.

4) Control french broom in butterfly habitat behind the homes in the Carter/ Martin area.

5) Control all low density striatus broom on south side of Brisbane Industrial Park

6) Control low and high density striatus broom on north side of Brisbane Industrial Park.

Fennel

1) Control fennel Mountain-wide to keep new colonies from becoming established.

2) Maintain all areas already under control. This includes: the Saddle, areas on Northeast Ridge, portions of Tank Ravine and Juncus Ravine on Southslope.

3) Control remaining fennel infestations on Northeast ridge that have not received treatment.

4) Control scattered fennel infestations on southslope within butterfly habitat.

Other Exotics

1) Control all pampas grass and cotoneaster Mountain-wide.

2) Control all isolated patches of German Ivy and English Ivy, and in areas where it is escaping from eucalyptus forested areas, (i.e. Radio ridge, Saddle bog area).

c) High (50 % increase in funding)

A 50% budget increase would translate into approximately $55,000 in more money for exotics control and restoration. The additional funding would provide for the hiring of either temporary labor crews, or two more full-time exotics control field technicians. The $55,000 is broken up as follows:

- $15,000 for gorse control
- $20,000 for eucalyptus control,
- $10,000 for broom control
- $10,000 for fennel control.

This scenario includes all of the goals listed under the Medium funding scenario (current funding program), plus the additional goals described below.

Gorse

A $15,000 budget increase would allow for control work to be done on an additional 15-20 acres of gorse.

a) Burn and spray the gorse in Unit IV, specifically sites 26 and 27 on the southeast side of the saddle, and sites 5 and 7 on the west (Day Camp Area). These two areas comprise approximately 1/3 of the remaining gorse in the Saddle (excluding the gorse on the steep slopes uphill from Carter Street).
(or)

b) Conduct initial spraying on remaining gorse infestation in Wax Myrtle Ravine
(or)

c) Conduct initial, phased spraying of Saddle/Daly City Park boundary area.
(or)

d) Conduct spraying of gorse burn area

Eucalyptus

A $20,000 budget increase would allow for control work to be accelerated in the eucalyptus cut restoration areas.

Conduct herbicide and hand control of regrowth in eucalyptus cut areas behind Pacific Nursery and Hoffman Street.

Broom

A $10,000 budget increase would allow for control work to be done on an additional 10-15 acres of broom.

a) Conduct initial, phased spraying and hand removal of low and high density striatus broom on south side of Brisbane Industrial Park,
(or)

b) Conduct initial phased spraying and hand removal of french broom in Owl Canyon (Fish & Game Property). This effort would add to already existing TRA control work on French broom adjacent to Quarry and Bay Area Mountain Watch volunteer efforts on Broom control in Owl Canyon.

Fennel

A $10,000 budget increase would allow for control work to be done on an additional 10-15 acres of fennel.

a) Conduct initial, phased control on large fennel infestations on Southeast slope
(or)

b) Conduct initial, phased control on large fennel infestations on Southslope
(or)

c) Conduct initial and follow-up control on the large fennel infestation upslope of George's Welding in Daly City.
(or))

d) Conduct initial, phased control on fennel on cut slopes north of Guadalupe Canyon Parkway in the Carter/Martin area

Long Range Goals

If the current funding level continues for another five years and the eucalyptus areas have been restored to a maintenance level of work, it is estimated that the budget could be cut by 25% after 2001. It is estimated that by keeping 75% of the current budget, this will provide for additional money for a heightened work effort to control all of the gorse and broom on the Mountain (estimated 140 acres, 1996), and the fennel (estimated 90 acres, 1996) within the next 10 years. This estimate of fifteen years (by 2011) to have control over nearly all major exotic pest plant infestations on San Bruno Mountain is predicated on the following assumptions:

1) The 75-100% of the current annual budget could be maintained for fifteen years;

2) No new exotic pest species become widespread on the Mountain; and

3) Exotics control and restoration is carried out concurrently by developers and other property owners on most private properties on the Mountain.

4) BIOLOGICAL MONITORING PROGRAM

Chapter III, Volume One of the San Bruno Mountain HCP describes the monitoring protocol for the rare butterflies (see Appendix 2).

a) Ongoing Biological Monitoring

From 1982 through 1996, Thomas Reid Associates has monitored the distribution of the San Bruno elfin, mission blue, and callippe silverspot butterflies every year throughout San Bruno Mountain. San Bruno elfin surveys were conducted both at the adult stage and at the larval stage. The mission blue and callippe were surveyed during their adult stage only. The bay checkerspot was monitored until 1985, when the population became extirpated on San Bruno Mountain. Results of the monitoring studies are described in the Annual Activities Reports for each monitoring year.

The monitoring method for the butterflies of concern has been the same since 1982. Typically two field biologists are employed between April 1 and August 1 each year. This is the prime flight season for the mission blue and callippe. Only one biologist is employed during March when the San Bruno elfin is in adult flight. To avoid duplicated transects, the two biologists are given different areas of the Mountain to monitor. There are a simple set of rules guiding the decision as to where and when to monitor. These are:

1. The transects must be walked during the appropriate flight season of the targeted butterfly.

2. Temperatures must be over 60 degrees F., with never more than moderate winds.

3. A specific transect must never be surveyed more often than once a week.

4. To avoid duplicate counting of individuals, only butterflies observed in the direction of forward travel are counted.

The biologists must keep an accurate record of all survey information, including location of transect, start and finish times, weather, location of each observation, sex, condition, behavior, other butterfly species observed, and other pertinent information. Each butterfly observation is plotted in the computer and a computerized map of the whole mountain is generated. These maps, which depict distribution and abundance, are included in the annual activities reports.

The data collected each year provides an ongoing indication of the changes in distribution of butterflies on San Bruno Mountain, and provides information on the relative abundance of butterflies from year to year.

Due to the large size of the study area more intensive methods of monitoring have not been used. For instance, both at Milagra Ridge in Pacifica and the Marin Headlands in Marin County, the National Park Service (NPS) carries out monitoring studies of the mission blue butterfly each year (beginning in 1994). Biologists at the NPS decided to establish pre-set transects at each area. They use these as a basis of measuring changes in relative abundance of butterfly populations. Transect surveys consist of having an observer walk a pre-set transect for a pre-determined length of time, noting the number of butterflies observed during the allotted time. At the Marin Headlands, a 100 meter transect is walked in five minutes (refer to Rashbrook and Cushman, 1996).

At San Bruno Mountain, assessing the overall distribution of butterflies on the Mountain is more critical than knowing the relative abundance in specific areas. In addition, our random transect data provides adequate information to obtain relative abundance data on a colony wide basis.

Data from the past 15 years indicate that the populations of the butterflies of concern (except the Bay checkerspot) on San Bruno Mountain appear to be stable. The entire population of the San Bruno elfin is protected from disturbance on San Bruno Mountain, therefore development allowed under the HCP has had little, if any, impact on this butterfly. The mission blue population has been subject to habitat loss from development, however, re-establishment of its host plant lupines has been successful in many areas and expansion into restored habitat has been documented (at Terrabay and Carter Street). The callippe silverspot is currently being subject to the biggest impact on its population from the development of the Northeast Ridge project. It is too early to assess the overall impact of major development on this species.

b) Future Studies

The HCP discusses periodic assessment of the distribution of butterfly larval food plants. This has not been done on a mountain-wide scale since the 1981 large-scale biological study. Within the next five years the general distribution of the three lupines used by the mission blue and the California golden violet used by the callippe should be mapped throughout the Mountain. This information can be compared with the data collected in 1981 to determine if major changes have occurred.

There are other populations of the butterflies of concern in the Bay Area. Some of these populations are subject to formal monitoring studies and some are not. For instance the NPS populations are subject to monitoring studies, while the population of the mission blue at Twin Peaks in San Francisco is, to our knowledge, not monitored. Within the next five years, the Habitat Manager should encourage and participate in a workshop aimed at assessing the overall population status of the butterflies of concern throughout the Bay Area. Strategies to reintroduce populations at sites which have declined from sites which have increased should be discussed. A sharing of knowledge

should take place on such topics as: results of habitat enhancement activities, monitoring techniques, data gaps, etc. San Francisco State University could solicit interest in such a workshop and assist with planning. There must be a strong commitment from the USFWS to make such a workshop happen.

c) Monitoring Other Species

Monitoring of rare plant species has taken place on the Mountain over the past 15 years. Monitoring data have shown that none of the rare plants known from within the HCP Area of the Mountain have suffered any significant declines over the past 15 years, and some of the populations have increased. Continued monitoring of rare plant populations should take place over the next five years.

Recently, the USFWS has indicated that the San Bruno Mountain manzanita, a species proposed for listing as an endangered species, may benefit from periodic controlled burns. Fire is needed to stimulate seed growth and plant germination in many species of manzanita. A carefully executed controlled burn around designated manzanita populations should be carried out in the next five years. This activity should be coordinated with staff from the USFWS.

d) Summary of Species Monitoring

1. Continue monitoring butterflies and plants as have done in the past years.

2. Map distribution of butterfly host plants and compare with 1981 data.

3. Assist with the organization of a workshop to discuss the overall status of populations of and management activities for the endangered butterflies.

4. Conduct a controlled burn to increase germination success of San Bruno Mountain manzanita.

References

Beatty, S.W., and D.L. Licari, 1992. Invasion of fennel into shrub communities on Santa Cruz Island, California. Madrono 39:54-66.

County of San Mateo, 1982. San Bruno Mountain Area Habitat Conservation Plan. Prepared by Thomas Reid Associates.

Appendix 1. Review of Past Five Years of Habitat Management (1992-1996)

The following section is an evaluation of the 5 year goals set in the 1992 Exotic Species Management Plan (ESMP). Many of the goals listed below have been achieved, yet will require annual maintenance work to maintain areas brought under control.

a) Gorse

Goal 1 ***Control of the gorse population at Bitter Cherry Ridge by removal of all mature plants and annual seedling control.***

Goal achieved. All of the mature gorse plants on Bitter Cherry Ridge are in various stages of decomposition. A small number of gorse seedlings have continued to come up at this location for the past few years, and these are controlled on an annual basis.

Goal 2 ***Control of the gorse in Wax Myrtle Ravine by removal of mature plants and annual seedling control.***

Goal partially achieved. Mature gorse plants on the south side of Wax Myrtle Ravine and upslope of Fern Rock have been controlled and are in various stages of decomposition. Annual treatment of gorse seedlings in this area is still necessary. Dense infestations of gorse still exist on the north side of the ravine and on the slopes at the base of the ravine near Brisbane Industrial Park. The eucalyptus-cut area at the headwaters of the ravine has extensive gorse seedlings that will need to be controlled as part of the restoration of this area.

Goal 3 ***Control of any other gorse found south of Guadalupe Canyon Parkway, including continual removal of seedlings in the former gorse areas along Radio Road.***

Goal partially achieved. Gorse has been essentially controlled in areas south of Guadalupe Canyon Parkway, with the exception of the large infestations on the slopes bordering the Brisbane Industrial Park, and the dense patch within the Dairy Ravine restoration area. Gorse plants are found occasionally on Radio Ridge, and this area needs annual maintenance to keep it under control.

Goal 4 ***Maintenance of the gorse-free area of the Saddle west of the Day Camp and south of the Saddle Trail.***

Goal achieved. This area has been maintained essentially gorse-free.

Goal 5 ***Reduction and maintenance of the gorse density in the eastern third of the Saddle to a level sparse enough to allow habitat restoration.***

Goal achieved. Approximately 40 acres of low to high density gorse has been controlled in the eastern third of the saddle. The mature gorse plants in this area are in various stages of decomposition. The area needs annual treatment for gorse seedlings. The gorse is now at a level sparse enough to allow for habitat restoration (i.e. soil preparation and re-planting). However no habitat restoration is planned for this area. Vegetation plots set up in the saddle last year will provide data regarding the percentage of native/exotic plant recolonization of this area which will help determine the necessity for replanting.

Goal 6 ***Maintenance of gorse density in the central third of the Saddle at a height and density not exceeding those recorded in 1992.***

Goal partially achieved. The gorse in the central third of the Saddle has been reduced through treatment of the boundaries of sites 15, 25, 16, and 17. However the interior of this gorse infestation has become more dense.

Goal 7 ***Development of a protocol for habitat restoration in the Saddle, through research and experimentation on restoration methods.***

Goal achieved. An experiment was set up in winter of 1994-95 to test the effectiveness of different grassland restoration methods. Plots were planted with either native grass plugs, native grass seeds, sterile wheat seeds, or left unplanted. No maintenance of the restoration plots was conducted.

The results of this experiment were that plug planting was more effective at establishing a native plant colony than direct seeding or natural recolonization. However the native grass establishment appeared to be successful only in plots that had thin, rocky soils. Non-native grasses appeared to dominate all other plots where moderate to deep soils existed, and gorse seedlings were high in virtually all plots. The restoration protocol based on this research is as follows:

1) Plug plantings are the preferable method for native grass restoration.

2) Only native grass species that are appropriate for the given soil conditions of the site should be planted.

3) Non-native grasses should be controlled (either by mowing in the spring, or use of another effective method).

4) Gorse seedlings should be controlled by hand or herbicide.

b) Eucalyptus

Due to prohibitively high removal costs, the goals set for eucalyptus removal in the 1992 ESMP were limited to removal of a few small stands of eucalyptus and maintaining existing stands from expanding. The logging of 63 acres of eucalyptus trees (approximately 30 % of all eucalyptus forest on the Mountain) in 1995 well exceeded these goals.

Goal 1 ***Creation and maintenance of corridors for butterfly movement through the eucalyptus stands along Guadalupe Canyon Parkway just west of Carter Street.***

Goal partially achieved. The stand referred to is actually due south of Carter Street, on the south side of Guadalupe Canyon Parkway. A 1 acre portion of this stand was cut in 1992, and stumps were treated with herbicide. Significant regrowth has occurred on some of these stumps and these need to be re-treated. The expense of having the trees cut by a tree service company was prohibitively expensive, and eucalyptus removal by this mechanism was not pursued further.

Goal 2 ***Removal of eucalyptus on the north side of Guadalupe Canyon Parkway east of the Picnic Area, except for selected aesthetically pleasing trees.***

Goal partially achieved. The westernmost grove in site 35 of the saddle was cut in 1992. Eucalyptus debris at this site needs to be burned or hauled off to allow for native plants to recover on the site. The two stands near the junction of Carter street and Guadalupe Canyon Parkway were not cut.

Goal 3 ***Containment of the grove within the Eucalyptus Loop Trail at southern and eastern boundaries formed by the trail itself on the south and the old fire road on the east.***

Goal achieved. Most of this grove was logged in 1995 and the area is currently being controlled for eucalyptus regrowth.

Goal 4 ***Containment of existing groves of mature trees (including pines) along the north rim of the Saddle, and removal of outlying small trees.***

Goal achieved. This area has been maintained, and will continue to require maintenance as long as the groves are there.

Goal 5 ***Containment of existing groves of mature trees (including cypress) between the Picnic Area and the Day Camp; removal of trees south of the Bog Trail and the western portion of Old Guadalupe Trail (except for selected aesthetically significant trees).***

Goal achieved. Annual hand removal of eucalyptus pioneers (seedlings and saplings) has been done to contain the groves in all of these areas.

Goal 6 ***Removal of eucalyptus in Wax Myrtle Ravine and containment along the Old Ranch Road Trail.***

Goal achieved. All of the eucalyptus trees have been logged in Wax Myrtle Ravine, and control of regrowth is planned to begin in the winter of 1996/97. Annual hand removal of eucalyptus pioneers has been done to contain the groves along Old Ranch Road. Annual containment work is necessary as long as the groves are there.

Goal 7 ***Monitoring of eucalyptus groves along Radio Road and west Guadalupe Canyon Parkway, and groves bordering developed areas of Brisbane and Daly City, for possible control activity if becoming invasive.***

Goal partially achieved. In 1995, approximately 33 acres of eucalyptus forest were cut along Guadalupe Canyon Parkway, and approximately 30 acres were cut above Hillside Boulevard. Regrowth has been treated on approximately 20 acres of the clear-cut area along the Parkway as of fall 1996, through coordinated efforts by County Park staff, Paul Kephart's crews, and TRA. Treatment of the eucalyptus regrowth at the clear-cut areas above Hillside Boulevard is not planned for until 1998-99. Until then, regrowth needs to be controlled. Annual hand removal of eucalyptus pioneers has been done to contain the groves along Radio Road, and most of the groves above Brisbane and Daly City.

c) Broom (Cytisus and Genista spp.)

Goal 1 ***Control of small populations in the Saddle area by removal of mature plants and annual seedling control.***

Goal achieved. No significant broom infestations are found in the saddle any longer. Annual seedling removal is necessary in a few areas to maintain this.

Goal 2 ***Continued seedling control along Radio Road***

Goal achieved. Seedlings have been controlled annually along Radio Road. Continued monitoring will be necessary to maintain this.

Goal 3 ***Treatment of broom in conjunction with gorse control activities in Wax Myrtle Ravine and around Crocker Industrial Park.***

Goal partially achieved. The french broom in Wax Myrtle Ravine adjacent to Guadalupe Canyon Parkway has not received treatment. This infestation is planned to receive treatment as part of the restoration of the eucalyptus cut area in Wax Myrtle Ravine in winter 1996-97. The striatus broom infestations on the north side of the Crocker Industrial Park, and on the hill west of the Quarry received initial treatment in 1995, however there is extensive striatus broom infestations on the south side of Crocker Industrial Park that have yet to receive treatment.

Goal 4 ***Continued hand control in Buckeye Canyon and coordination with the California Department of Fish & Game in developing an exotics management program for their ecological reserve.***

Goal partially achieved. Hand control has continued in Buckeye Canyon, both by TRA and Bay Area Mountain Watch volunteers. In addition, herbicide and hand control work was done on broom infestations on transmission line ridge to the east of the Canyon. The large infestation to the west of Owl Canyon that borders Guadalupe Valley Quarry is presently under treatment. California Department of Fish and Game has given permission for TRA to treat this infestation. Presently CDFG has not developed a plan to control the exotics on their ecological reserve.

Goal 5 ***Coordination with the owners and developers of the Northeast Ridge to control broom on their project site.***

Goal achieved. All of the broom on the Northeast Ridge properties has essentially been controlled, with the exception of the striatus broom on the north side of the industrial park. Annual monitoring of the areas for seedlings will need to continue.

d) Fennel

Fennel has become an increasing threat to butterfly habitat over the past ten years. It has expanded significantly in grassland habitat areas on the Northeast Ridge, and on Southslope. Control efforts have made significant progress on the Northeast Ridge, while only a few areas on Southslope have received treatment (Juncus and Tank Ravines).

Goal 1 ***Development of a protocol for fennel control through experimentation with control methods in high priority areas.***

Goal achieved. An effective control method for fennel has been developed (see Table 1), and has been in use since 1994.

Goal 2 ***Control of small populations north of Guadalupe Canyon Parkway in the east Saddle area.***

Goal achieved. This area has been controlled annually by hand removal. Continued monitoring will be necessary to maintain this.

Goal 3 ***Continued seedling control along Radio Road and Ridge Trail.***

Goal achieved. This area has been controlled annually by hand removal. Continued monitoring will be necessary to maintain this.

Goal 4 ***Coordination with the California Department of Fish and Game in developing a control program for fennel in Buckeye Canyon.***

Goal partially achieved. Hand control has continued in Buckeye Canyon, both by TRA and Bay Area Mountain Watch volunteers. Presently CDFG has not developed a plan to control the exotic plants on their ecological reserve.

Goal 5 ***Monitoring of fennel between Guadalupe Canyon Parkway and Crocker Industrial Park (west of the Northeast Ridge Development); increased control efforts if fennel is becoming an increasing threat to the habitat of protected butterflies.***

Goal partially achieved. Low density fennel infestations have been controlled in this area, while the high density fennel infestation has not received treatment.

APPENDIX 2. Habitat Conservation Plan Monitoring Requirements

The San Bruno Mountain Habitat Conservation Plan addresses the task of monitoring in Volume One, Chapter III, page III-19:

Monitoring is the task, undertaken by the Plan Operator of regular observation of biological processes, development and conservation activities on San Bruno Mountain. The categories of processes and activities that will require monitoring include the following:

a. Mitigation - compliance with Plan conditions with respect to development areas.

b. Population status of endangered species (and other species) including status of habitat resources and components vital to endangered species, i.e., host plants, exotic species encroachment.

c. Research and pilot study progress.

d. Conserved habitat enhancement programs.

The purpose of monitoring is to assure the Plan conditions are being met in practice (as opposed to on paper), and to keep an ongoing record of the progress of implementation which will be the basis of period re-evaluation of the Plan and modification of its major activities, as needed. The degree of monitoring will correspond to the intensity of construction work underway and should be structured to provide sufficient information for the ongoing review. Monitoring of initial experimentation will be more intensive than monitoring done after techniques are established. "

On Page III-20 of the HCP, monitoring the status of the endangered species is addressed as follows:

Monitoring the status of endangered species is central to the main purpose of the Habitat Conservation Plan -- to preserve endangered species. The population status information will be a key indicator of the success or failure of the Plan and its component parts. The most cost-effective method to monitor butterfly and host plant populations on a long-term basis is to be found through experimentation guided by the experience of the 1980-81 biological study. The major colonies of the Phase Two Biological Study within conserved habitat as well as private lands to be dedicated to the public as conserved habitat should all be monitored. A special subset of the butterfly monitoring program is the assessment of butterfly utilization of areas where habitat manipulation for enhancement has occurred.

The monitoring should allow the Plan Operator to determine whether the populations are essentially stable in numbers, decreasing, increasing or fluctuating and whether the distribution of animals is shifting with only a small proportion of the effort spent in the mark-release-recapture program in the Biological Study. Trial methods include observation and counting along predetermined transects, possibly with simplified marking to avoid duplicate counting. If an observer walks a straight path, duplicate

observations should be minimal; sometimes during close observation one can get an impression of whether the animals are being counted more than once. During the flight season each area should be surveyed once a week.

Butterfly host plant populations should probably also be monitored since the butterfly populations are very likely to respond to changes in the abundance or quality of their food resources. It is probably sufficient to monitor only the larval food plants because these insects utilize such a wide variety of nectar plants that it is unlikely that nectar plants alone would become limiting.

The host plants may be monitored generally using the sweep method explained in the biological study (see Glossary). Each area should be swept during the blooming seasons and general distribution maps drawn up. It may be feasible to census host plant populations during the course of butterfly censussing. The observer could then also note insect utilization of host plant in different areas. Where more detailed information is required, the traditional methods of censussing by transect or quadrant may be employed.

Other species of concern should also be monitored - both for effects caused by HCP activities, and to find out more about their population and distribution on San Bruno Mountain. Emphasis should be on monitoring the San Bruno Elfin and Bay Checkerspot butterflies, and the Tree Lupine moth. Also further searches for the San Francisco Garter Snake should take place. Finally, the Habitat Manager should be knowledgeable as to the description and habits of the rare plants found on the Mountain, so that detailed mapping of these plants can be made."

APPENDIX 3. Report on Methodology for Evaluating Habitat Management and Restoration Activities on San Bruno Mountain

[Prepared by Thomas Reid Associates and submitted to the San Bruno Mountain Habitat Plan Trustees on March 31, 1996.]

Background

At the San Bruno Mountain Habitat Conservation Plan Board of Trustees meeting in July of 1995, the Trustees required the Habitat Manager, Thomas Reid Associates, to develop an evaluation methodology to measure the effectiveness of TRA's habitat maintenance and restoration activities on San Bruno Mountain. This program was required to be in place by March 31st, 1996.

The Trustees also required a final report summarizing the level of success achieved with respect to each of the exotic pest plant removal tasks set forth in the 1995-96 proposed work scope (Exhibit A), and compare actual performance with the performance objectives set forth in the table of expected results (Exhibit C). That report will be submitted on or before June 15th, 1996.

This report contains the proposed evaluation methodology and baseline data as required by the HCP Trustees.

A 4-measure evaluation program has been instituted which consists of:

1) Native plant cover
2) Index of plant diversity
3) Utilization of the area by sensitive species
4) Estimate of ongoing maintenance requirements (costs)

Site Criteria for Program Application

The purpose of this evaluation program is to measure how effective TRA has been in restoring habitat to areas infested with exotic plants. To obtain meaningful results from this program, it needs to be applied to areas where there is likely to be a discernable and quantifiable change in habitat quality from restoration efforts. This program is being applied to areas that fit the following three criteria:

A) The program should only be applied in areas with the potential to support the rare butterflies. Many habitat areas have 100% cover native plants, and high native plant diversity, yet do not have sensitive species (the rare butterflies) because there is not the appropriate plants or micro-climate to support them.

B) The program needs to be applied to a fairly significantly sized habitat area to include enough butterflies for comparison. It is important to verify whether or not a change in butterfly usage was actually due to habitat manipulation and not just due to random seasonal variability in their distribution.

C) The program should be applied to areas where a significant change in habitat quality is expected from exotic plant removal efforts. The area should have a significantly dense stand of exotic plants because an area with scattered exotic plant infestation will not likely present a problem to butterflies, as long as their nectaring or larval food plants are still present and the microclimate is appropriate for them.

The area that best fits these three criteria is the saddle area of the Mountain. The saddle is several hundred acres in size, has dense stands of exotics (primarily gorse) that have undergone herbicide treatment for several years, and both the mission blue butterfly and the callippe silverspot use the native habitat in this area.

In the future, we will apply the evaluation program to other areas that fit the criteria above. Other potential sites include the Eucalyptus areas south of the Guadalupe Canyon Parkway, and the French broom areas in the hills above Brisbane.

Methodology

1) Overall Change in Native Plant Cover

In the saddle, three types of vegetation exist: gorse, native coastal scrub, and grassland. In areas where the gorse has been treated with herbicide, coastal scrub and grassland species have been observed to take over these areas. The change in percent cover of the gorse over time is indicative in an overall sense with what is happening with the coastal scrub and grassland habitat.

The areal extent of gorse in the saddle was mapped in 1932 by the U.S. Forest Service, and again in 1981 by TRA. During this period, the area heavily infested with gorse was estimated to expand from 52 acres in 1932, to 334 acres in 1981.

The gorse was reassessed this year by TRA using low-altitude aerial photography that was rectified to a base map of the saddle. As of March 1996, the extent of the gorse has been reduced to an estimated 106 acres (Fig.1). 41 acres of live gorse exist in the central part of the saddle, while 65 acres of gorse were burned in an uncontrolled burn in July 1995.

This estimate has not been field-checked completely at the time of this report, however it is expected that the actual acreage of gorse may be slightly lower than our estimate due to the inclusion of pockets of coastal scrub habitat within gorse patches.

2) Index of Native Plant Diversity

In November 1995, an experiment was set up to test for native plant recovery in areas of gorse treatment. 24 quadrats were placed within 3 treatment groups, (8 quadrats per treatment group). The quadrats were located in three areas: 1) Recently sprayed gorse; 2) Gorse sprayed for 2+ years; and 3) Untreated gorse (control).

From observations, gorse takes about 1 month to die after spraying, and 2 years or more to break down, depending on the height of the plant. For this reason, two

treatment groups were used for the sprayed areas, one beginning immediately after spraying, and one in an area that has been sprayed for approximately 2 years. The method used for gorse control is an herbicide solution containing 2 % Garlon4. The herbicide is applied to living plants twice per year in suitable weather (low wind, low humidity) for maximum plant uptake.

Quadrats are 3m x 3m. The 3m x 3m quadrat size was determined by estimating the size of the largest individual shrub and adding 50% to this area (pers. comm. Dr. Carla Boussard, St. Mary's College). Quadrats were randomly placed within a suitable area by laying out 75 m transects and then placing quadrat centers at random spots along the transects using a random number generator. Transect locations were selected within boundary areas between high density gorse and native plants.

Vegetation data collected:

* Percent cover of gorse
* Stage of gorse: (live, part-live, dead-brushy, skeleton)
* Number of gorse plants (adults and seedlings)
* Percent cover of other exotics
* Percent cover of grass species
* Percent cover of native shrubs
* Number of native shrub /herbaceous plants (adults and seedlings)

Percent cover was determined by measuring the distance between the quadrat edge and the points of inflection of the gorse shrub inside the quadrat (5-10 points per quadrat). These points were plotted on graph paper, and percent cover was estimated by summing the squares. Only the canopy shrub layer will be considered in percent cover estimates.

Vegetation data will be recorded every 6 months for two years. Baseline data was recorded at all quadrats in November 1995. Figure 2 shows a representative data sheet. Data will be recorded again in May 1996. Before and after percent cover and species abundance data within each treatment group will be compared using non-parametric statistics.

Photographic documentation sites were established within each treatment group. Baseline photos were taken of each quadrat at beginning of experiment and will be taken every 6 months along with plant species data.

3) Utilization by Sensitive Species

Butterfly surveys have been conducted throughout the Mountain since 1981. Figure 3 shows a comparison in distribution between mission blue butterflies collected from 1981-1986, and mission blues observed from 1988-1995.

In the saddle area north of the main entrance to the park, several more observations of mission blue butterflies were recorded in the 1988-1995 period than in

the 1981-1986 period. Callippe silverspot habitat utilization of the saddle appears to be showing a similar trend over time (not shown), yet not as dramatic as the mission blue. This is expected since the callippe are larger and are found in lower densities than the mission blue are.

At this time it is not conclusive that the increase in observations of mission blues and the callippe's in the saddle are a direct causal result of the habitat maintenance efforts. Natural wandering of individuals, wind patterns, and weather during observation may have influenced this change in distribution. Although population estimates for insects are subject to high variance, the trend of observations suggests an increase in butterfly utilization of these areas. If the maintenance efforts are responsible for this change, we should see a continued increase in habitat utilization as more habitat in the saddle is opened up.

4) Estimate of Ongoing Maintenance Requirements

Herbicide treatment of the saddle area of the Mountain is conducted in four basic treatment units. The acreage and densities of gorse (and associated costs for treatment) is different for each treatment unit. It is evident that the amount of live gorse has visibly decreased over time in the saddle area due to our habitat restoration efforts. This is a direct result of our switching to using Garlon 4 herbicide in 1992.

By comparing low-altitude color aerial photographs taken in 1993 and 1996 the number of acres of gorse that has been killed in the saddle can be quantified. The average cost per acre of gorse killed within each treatment unit will be calculated at the end of the 1996 treatment season. These results will be submitted with the 1995-96 Exotic Pest Plant Expected Results table (Exhibit C) in June 1996.

Schedule

The schedule for data collection for each of the evaluative measures is shown in Table 1.

Table 1. San Bruno Mountain 4-measure Evaluation Program Schedule

Evaluation Measure	Data	Method	Schedule
Relative Cover of Native Species	Aerial extent of Exotic infestations and native habitat	Acreage measurements from rectified low altitude color aerial photography	Bi -annually (every other year-late fall
Index of Native Plant Diversity	Plant species composition and abundance	Species inventory of quadrats in saddle	Semi-annual (late fall and late spring)
Sensitive Species Utilization	Mission blue and callippe silverspot observation data	Butterfly observation surveys	Annually during Butterfly flight season
Maintenance requirements (Cost)	Herbicide and labor costs per unit area	Tabulation of herbicide usage and labor hours	Annually at end of treatment year

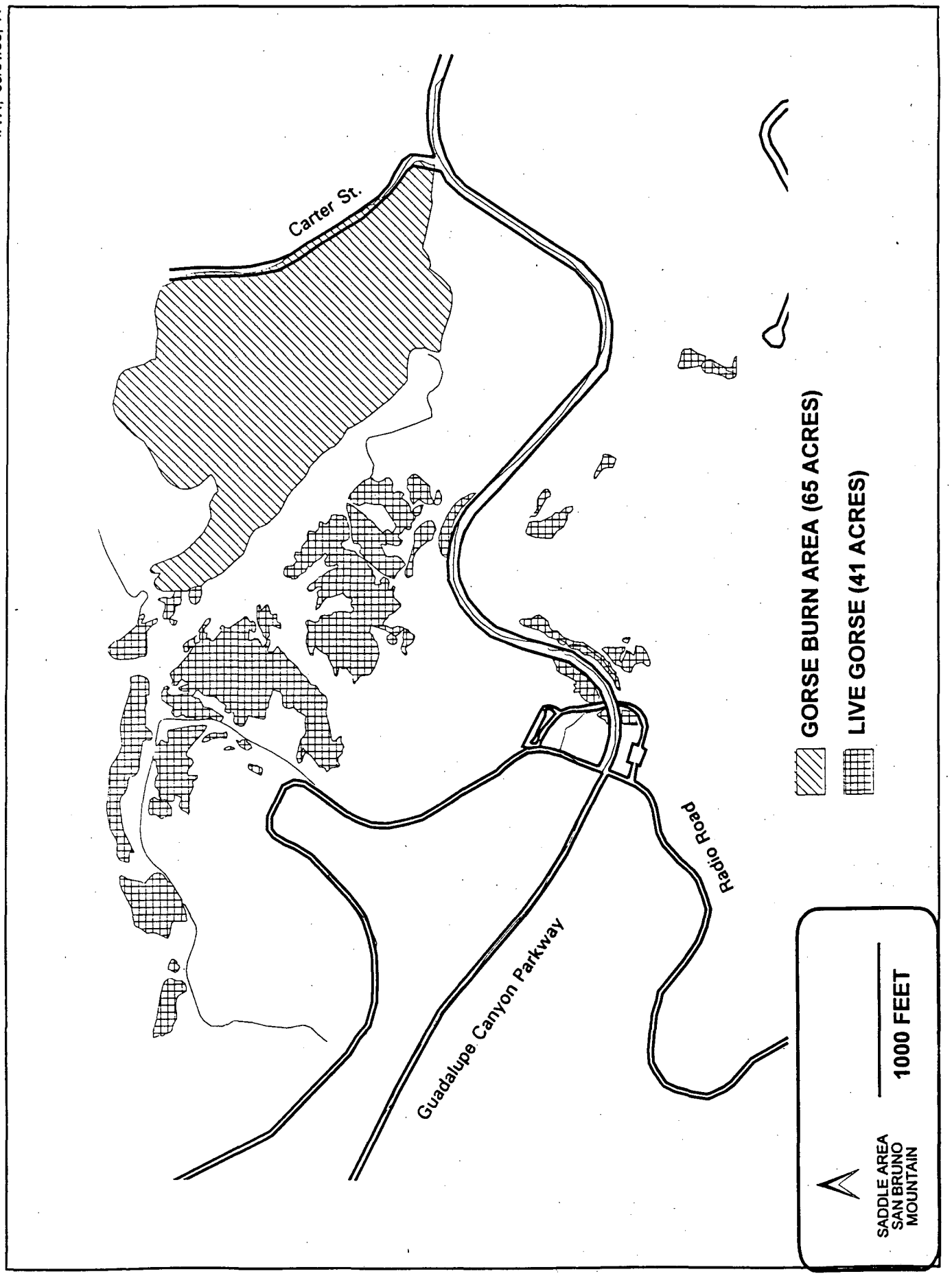


Figure 1. 1996 map of areal extent of gorse on San Bruno Mountain

Figure 2. Plant diversity data sheet

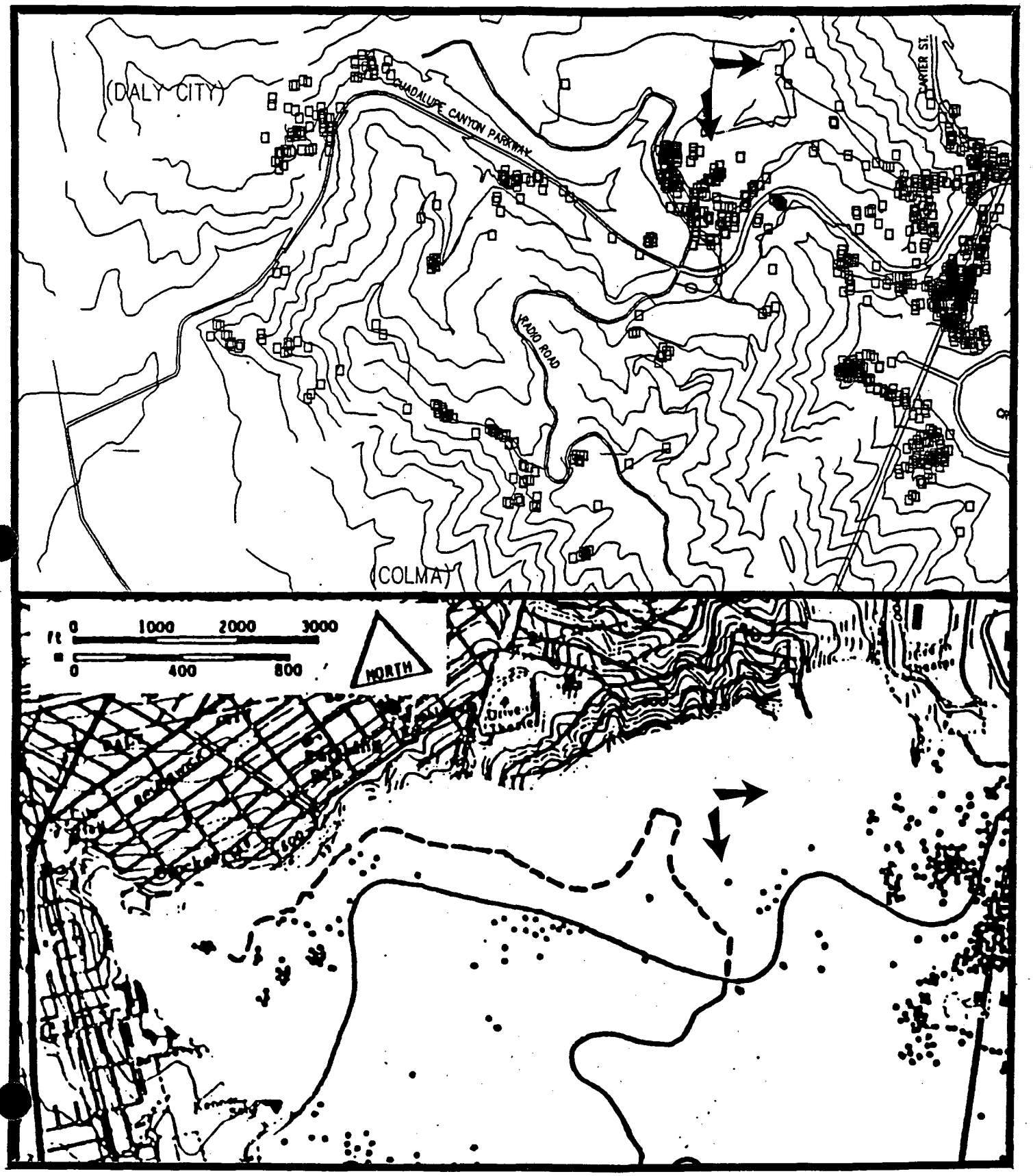
Date: 11/9/95 Treatment: 2
Name: Lisa Transect #: 13
Weather: sunny Quadrat #: 7
Location: CANE Photo Doc. #: ✓

Exotics	T%C	#A	#S	Natives	T%C	#A	#S
1. Gorse (Live)				Poison Oak		6	
2. Gorse (Partial live)				Coyote Brush-prost.			4
3. Gorse (Dead, brushy)				Coyote Brush-upright		7	
4. Gorse (Dead skeleton)				Pearly Everlasting		83	
Bull's Thistle			1	Lizard tail			
Italian Thistle				California Sagebrush			
Eucalyptus globulus				Coffeeberry			
Poison Hemlock				California Blackberry			
Sweet Fennel				Red Elderberry			
Pampas grass				Serviceberry			
Purple Nightshade				Native grass sp.			
Australian Fireweed				Horsetail		1	
New Zealand Fireweed				Wild Rose		3	
Himalaya Blackberry		4					
Exotic grass sp. Velvet & other Bromes							

HHL

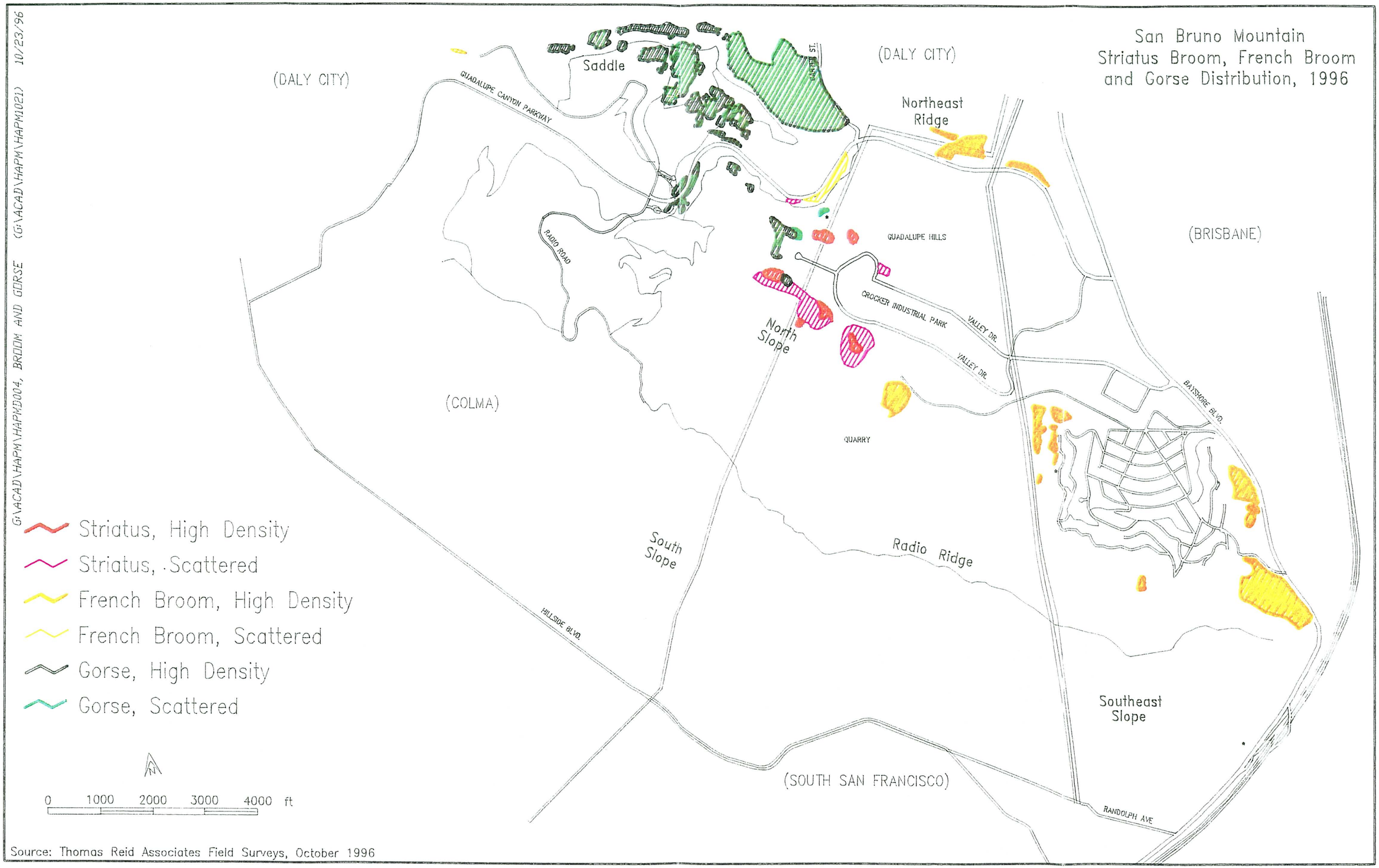
More plants on back of sheet? yes/ no

Figure 3. (Top) Map of mission blue butterfly observations on San Bruno Mountain from 1988-1995, and (Bottom) from 1981-1986. Arrows indicate areas in the saddle where mission blue butterfly observations have increased.



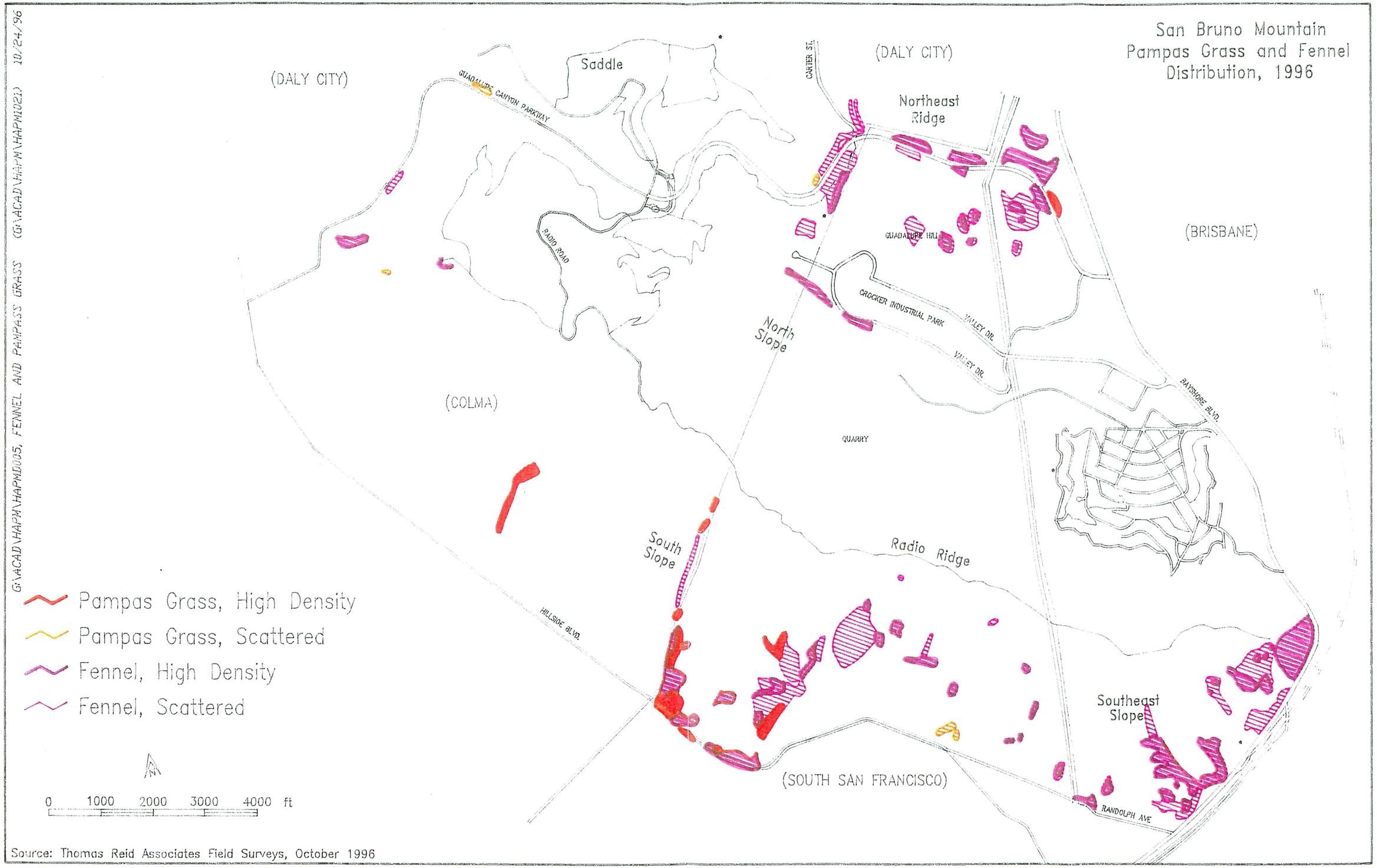
Distribution of gorse, striatus broom, and french broom on San Bruno Mountain, 1996 -- MAP 1

[Infestations were mapped using low altitude color aerial photography or estimated in field]



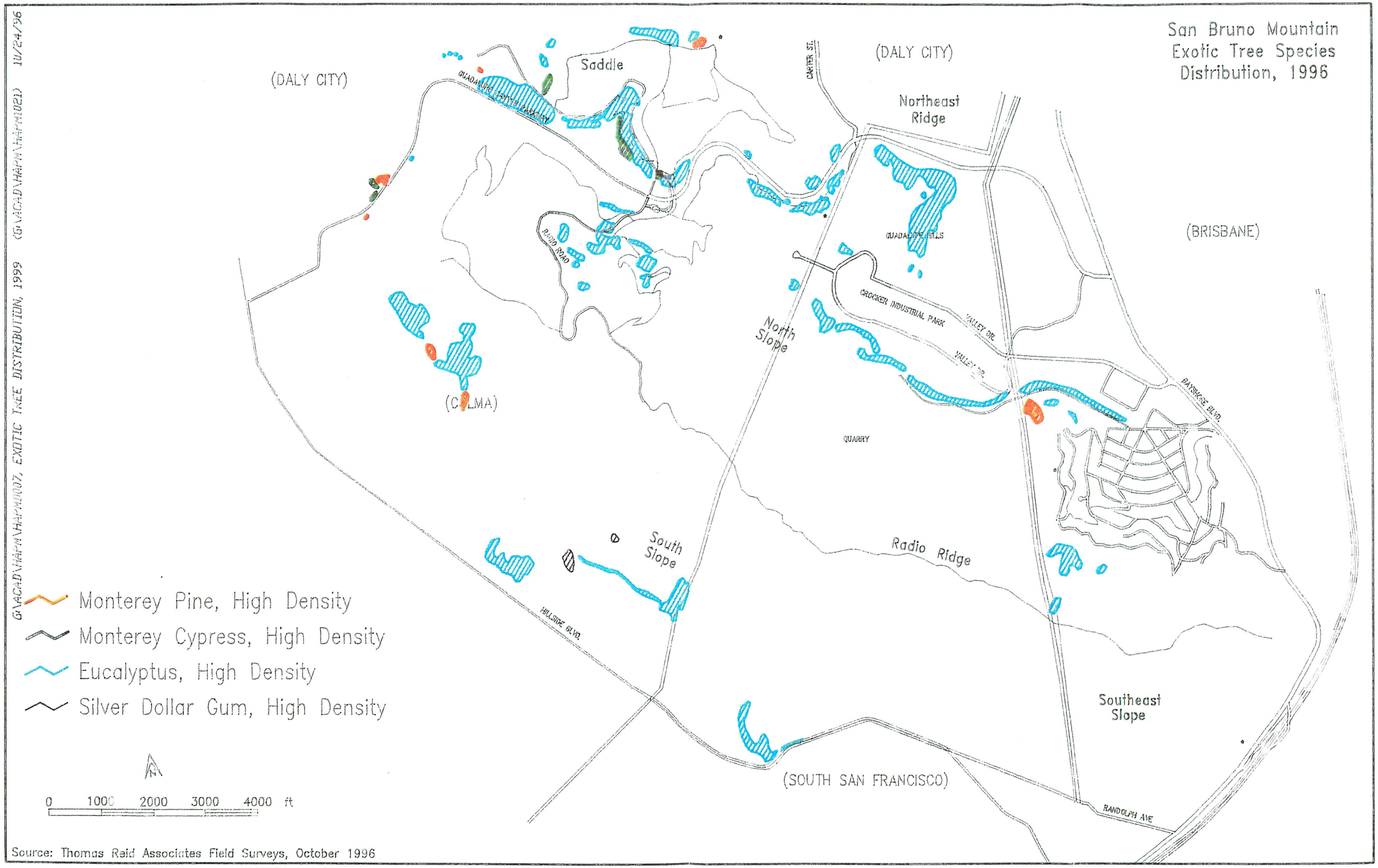
Source: Thomas Reid Associates Field Surveys, October 1996

Distribution of fennel and pampas grass on San Bruno Mountain, 1996 -- MAP 2
[Infestations were mapped using low altitude color aerial photography or estimated in field]



Source: Thomas Reid Associates Field Surveys, October 1996

Distribution of eucalyptus and other exotic tree species on San Bruno Mountain, 1996 -- MAP 3
[Infestations were mapped using low altitude color aerial photography or estimated in field]



Source: Thomas Reid Associates Field Surveys, October 1996

Distribution of miscellaneous exotic plant species on San Bruno Mountain, 1996 -- MAP 4

[Infestations were mapped using low altitude color aerial photography or estimated in field.]

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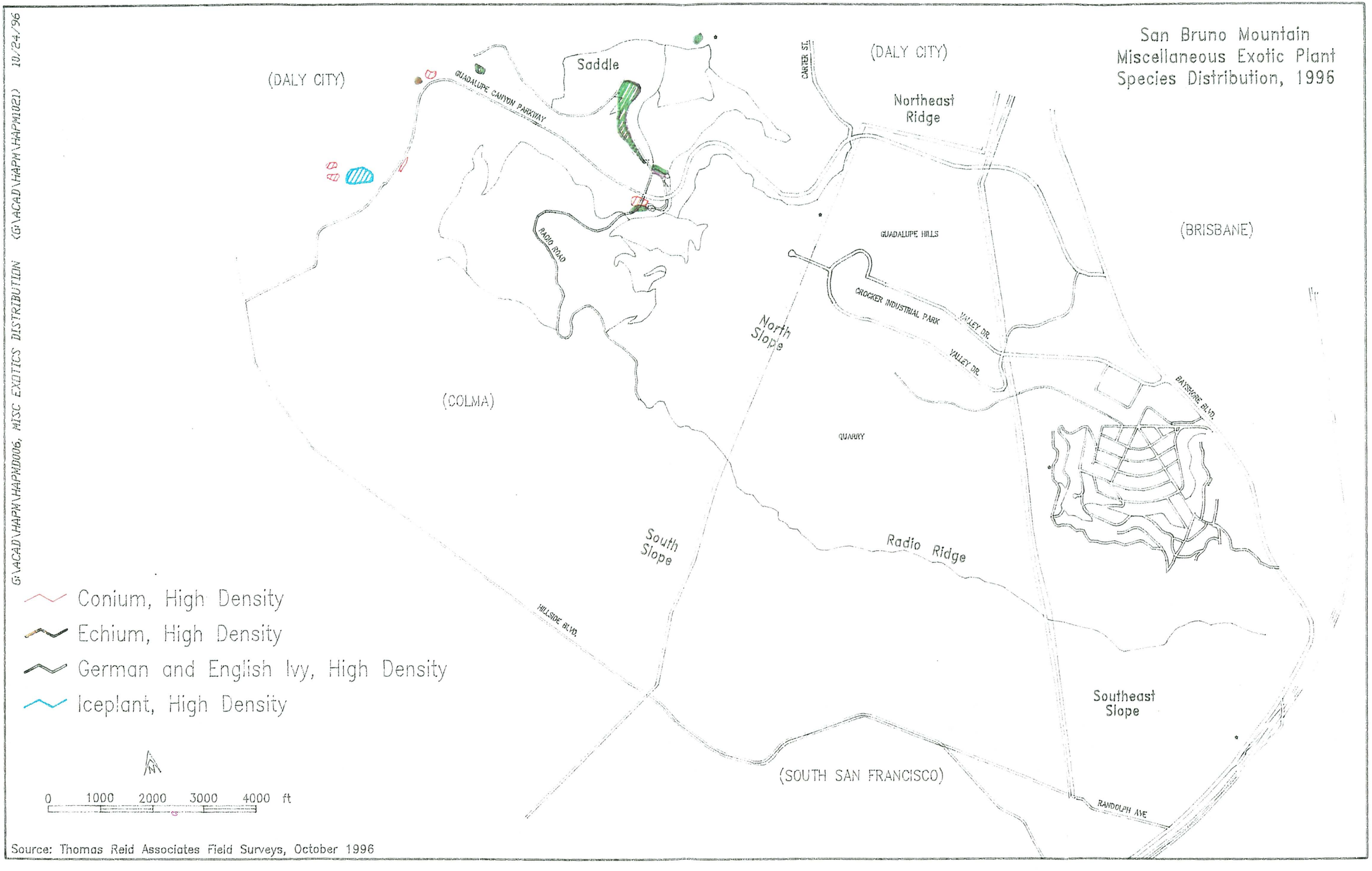
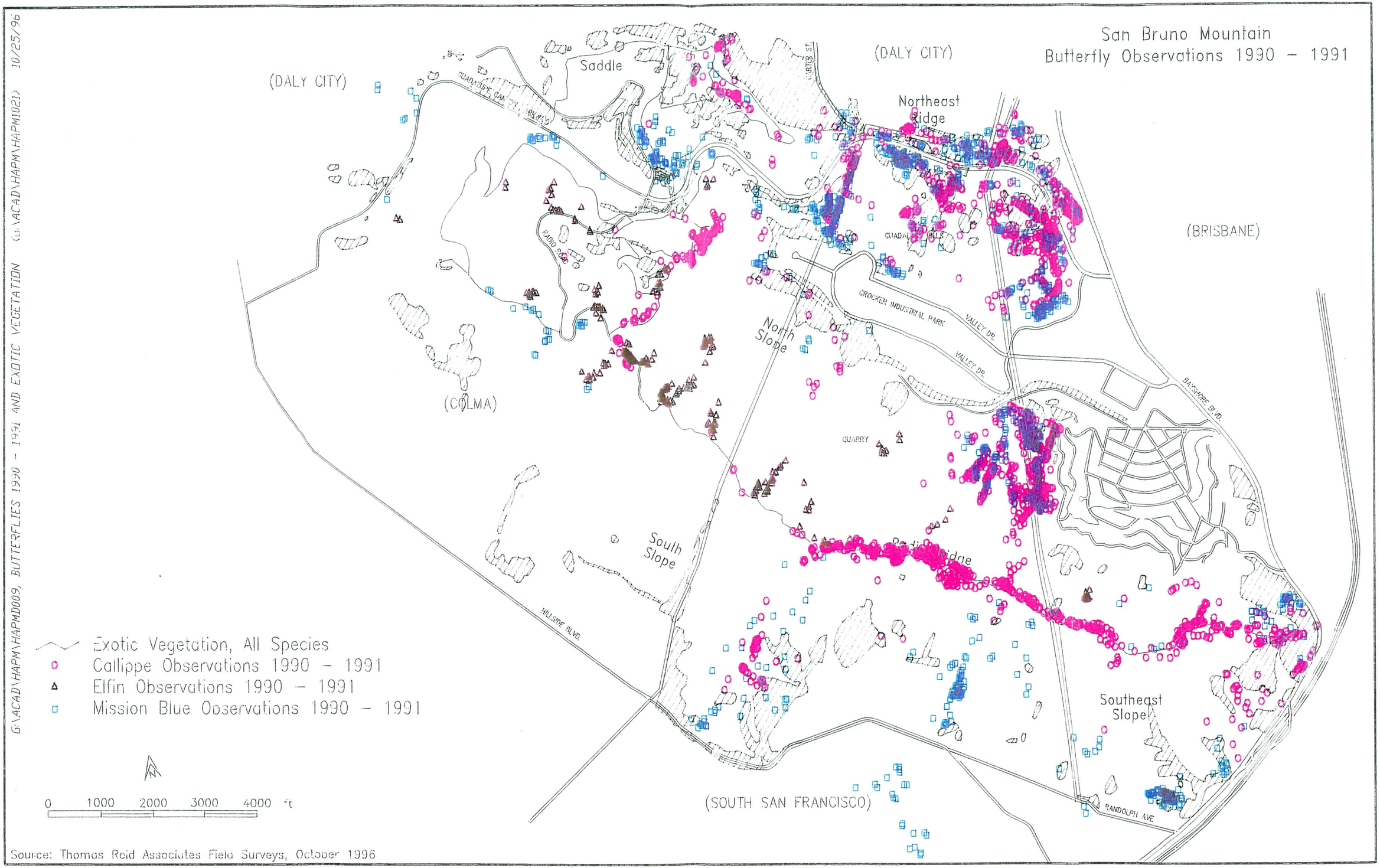


Source: Thomas Reid Associates Field Surveys, October 1996

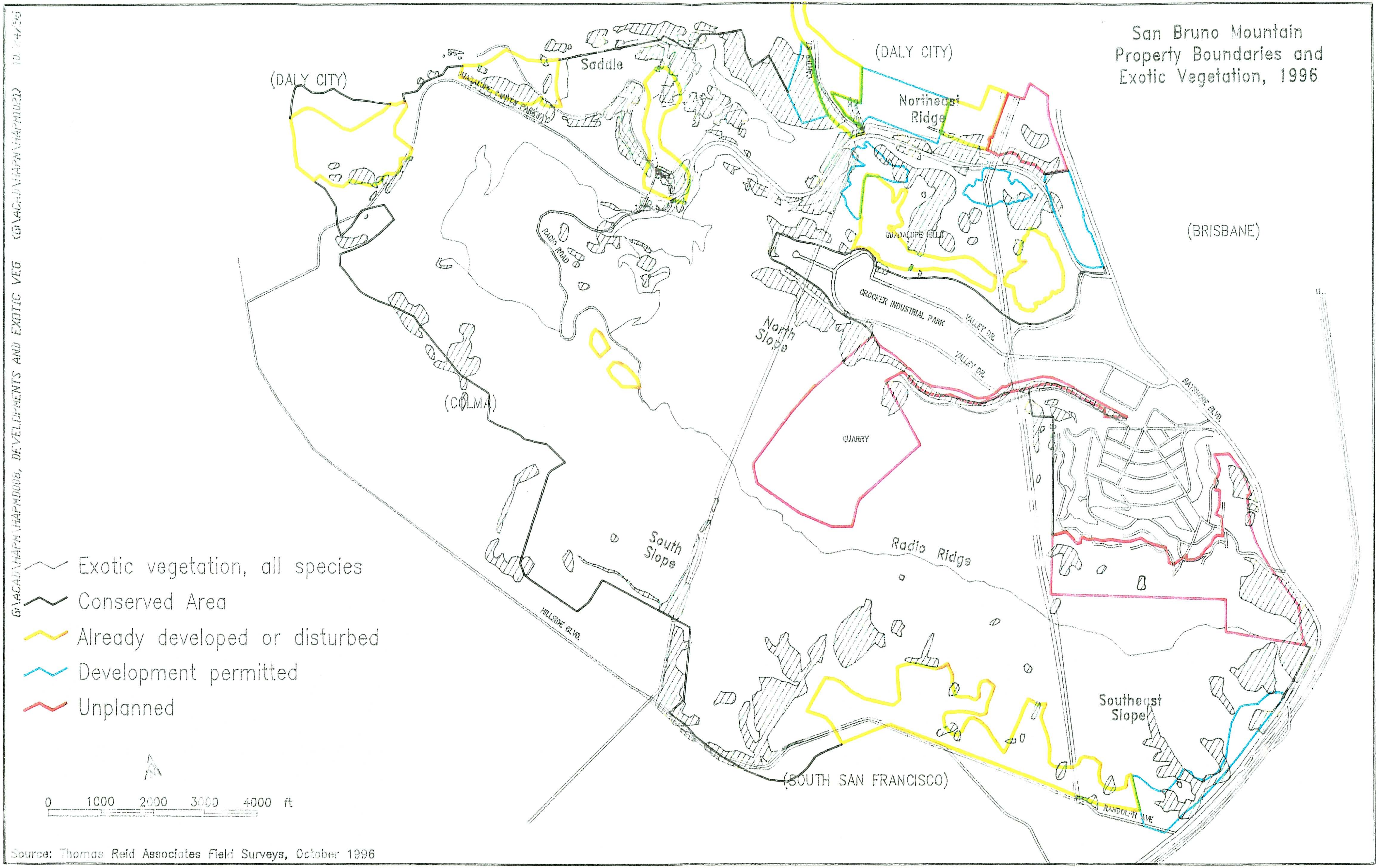
Spatial comparison of butterfly populations and exotic plant species distributions, 1996 -- MAP 5

[Butterfly data shown is from 1990 and 1991 surveys. Overlapping areas are highest priority for control work.]



Source: Thomas Reid Associates Field Surveys, October 1996

Spatial comparison of property boundaries and exotic plant species distributions, 1996 -- **MAP 6**



San Bruno Mountain
Property Boundaries and
Exotic Vegetation, 1996
(DALY CITY)
Saddle
(DALY CITY)
Northeast Ridge
(BRISBANE)
CROCKER INDUSTRIAL PARK
VALLEY DR.
North Slope
QUARRY
(COLMA)
South Slope
Radio Ridge
HILLSIDE BLVD.
Southeast Slope
(SOUTH SAN FRANCISCO)
RANDOLPH AVE
Exotic vegetation, all species
Conserved Area
Already developed or disturbed
Development permitted
Unplanned
0 1000 2000 3000 4000 ft
Source: Thomas Reid Associates Field Surveys, October 1996