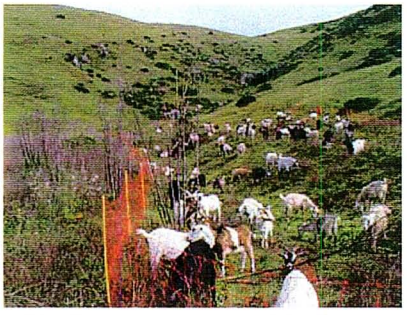
SAN BRUNO MOUNTAIN
HABITAT CONSERVATION PLAN



Year 2003 Activities Report
For Endangered Species Permit PRT-2-9818

Submitted to the
United States Fish and Wildlife Service
By the
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Cover photo: (Clockwise from upper left) Goat grazing in Juncus Ravine (March 2003), Viola pedunculata regrowth in Southeast Ridge August 2002 burn area, Lupine growing in Dairy Ravine habitat island, July 2003 Wax Myrtle Ravine burn.

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GLOSSARY

ANOVA - A statistical procedure called Analysis of Variance. ANOVA allows us to test whether the mean (or average) for butterfly abundance for a given year or on a given transect is statistically different than another year or transect. The procedure will allow us to determine if our sampling efforts are sufficient to detect relative changes in MB/CS/SBE abundance between years and between transects.

Callippe Amendment - An Amendment to the San Bruno Mountain Habitat Conservation Plan. The purpose of the Callippe Amendment is to:

- Add the endangered Callippe silverspot butterfly, listed in 1997, hitherto a species of concern on San Bruno Mountain, to the Endangered Species Act (ESA) section 10(a)(1)(B) permit for incidental take, and appropriate conservation, monitoring, and funding measures.
- To reflect changes and new information regarding covered species status, habitat preservation, habitat restoration techniques, and changes in federal statute, regulation and policy governing HCPs that have occurred since 1983.
- To assess the effect of the HCP on the recently designated Bay Checkerspot butterfly critical habitat (2001).
- To add specificity to timelines and management goals for the conserved lands in the HCP.
- To assess the extent of the non-native species invasion and natural succession and its effect on the Callippe silverspot, Mission blue, and San Bruno elfin, and their habitat; include measures to address these effects.
- To address funding issues for the HCP.

Correlation - Tests for a relationship between two variables.

Endangered - any species which is in danger of extinction throughout all or a significant portion of its range, other than a species of the class Insecta determined by the Secretary to constitute a pest whose protection under the provision of this Act would prevent an overwhelming and overriding risk to man", (Federal Endangered Species Act, 1973).

Endangered Species Act - means the Federal Endangered Species Act (ESA) of 1973, as amended, 16 U.S.C. Sections 1531-1543. The State of California also has an endangered species act which is referred to as the California Endangered Species Act (CESA).

Exotics, or exotic pest plants - species which have been introduced into local habitat from outside the United States and which often become pests, outcompeting native species.

Fixed transects - Permanently marked transects that are surveyed year after year. provide a means to compare butterfly observations from year to year at specific locations using standard statistical procedures. .

Fixed points - Permanently marked points that are surveyed year after year.

Habitat Conservation Plan - the San Bruno Mountain Area Habitat Conservation Plan as adopted by the County Board of Supervisors on September 14, 1982 (Resolution No. 43770). Synonym: HCP.

Habitat Islands – small areas of native habitat established in restoration sites. Native plantings are installed in relatively small islands where weeds can be controlled more easily. This approach cuts down on the area where maintenance is required. A recommended size for planting islands is from 0.1 - 0.25 acres.

Host plant - particular species of vegetation required by butterflies as an energy source for survival in the first stages of development, on which the adults will oviposit. For Mission Blue: the three *Lupinus* species; for Callippe: *Viola pedunculata*; for Elfin: *Sedum spathulifolium*.

Incidental observation - A butterfly observed outside of the transect (or point survey area) or in the transect (or point) vicinity during travel between survey areas is recorded as an incidental observation.

Management - treatment afforded portions of SBM to enhance or protect existing habitat or to reclaim habitat lost to construction or other disturbance.

Monitoring - the task, undertaken by the Plan Operator of regular observation of biological processes, development and conservation activities on San Bruno Mountain; the purpose is to assure compliance with the plan, and to measure the success of its implementation.

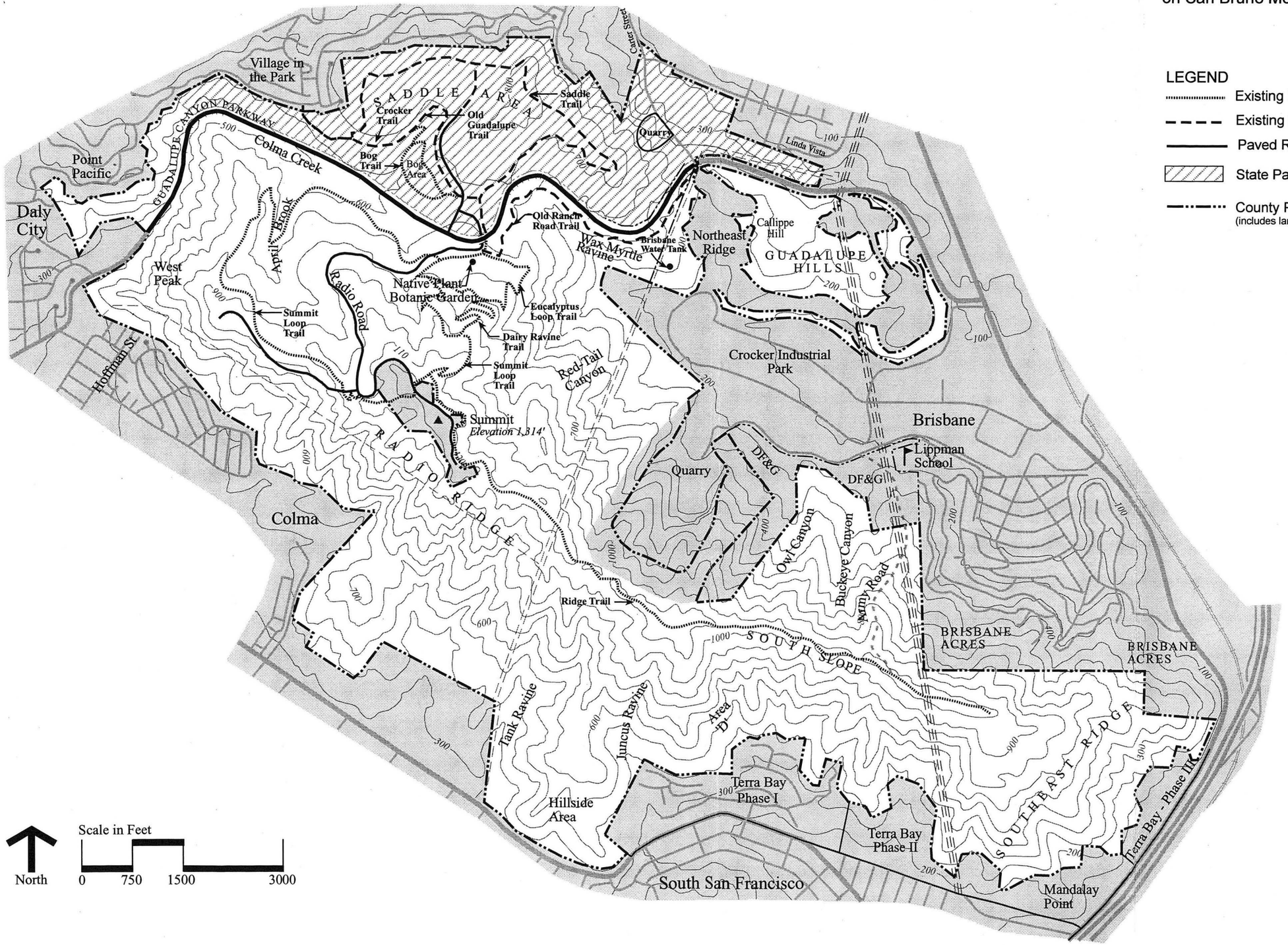
Prescribed burn - The process of burning an area of land in order to kill certain plant species and to favor the growth of others. Prescribed burns are also used to reduce fuel loads. The burn must be conducted during weather conditions optimizing temperature, humidity, and wind speed for burn efficiency and safety.

Regression - A line of best fit used to define the relationship between two variables.

Section 10a - a section of the Endangered Species Act which authorizes the Secretary of the Interior to permit, under such terms and conditions as he may prescribe, any act otherwise prohibited by Section 9 of the Act. The acts may be permitted for scientific purposes, or to enhance the propagation or survival of the affected species (16 U.S.C. Section 1539).

Wandering transects or surveys - Routes that cover large areas (up to a mile) of the mountain and are monitored typically 1-2 times during the flight season. The wandering transects are not standardized routes, but rather the surveyor walks and records butterflies as they are encountered. The wandering transects provide distribution data and allow monitors to check the status of butterfly habitat in remote areas of the park. Since 1982 over 20,000 butterfly observations have been recorded on wandering transects (San Bruno Mountain Ecological Database).

Map of Location Names on San Bruno Mountain



SUMMARY

In 2003, a variety of habitat management work was conducted on San Bruno Mountain to satisfy the requirements of the USFWS Incidental Take Permit (PRT 2-9818). This work included monitoring sensitive species, conducting exotics control work and habitat restoration, monitoring development activities, and coordinating with volunteer groups and oversight agencies (USFWS, CDFG).

Covered Species Population Status and Take

Under the San Bruno Mountain Habitat Conservation Plan, the primary emphasis of the biological monitoring is to evaluate the status of the populations of the endangered butterflies occurring on the Mountain. Fixed transect and point data for the Mission blue (MB), Callippe silverspot (CS), and San Bruno elfin (SBE) butterflies were analyzed using Analysis of Variance (ANOVA).

Butterfly abundance observations were low in 2003 compared to previous years (Figure 2, page 38; Figure 10, page 46; Figure 14 page 50). Although observations were significantly lower than the peak years (2000 for MB, and 2001 for SBE and CS), statistical analysis (ANOVA) for each species show that this does not represent a significant decrease in butterfly abundance based on the year to year variation for the last six years of data collected for MB and SBE and last four years of CS data. A minimum of seven years of data collection is necessary before it will begin to be possible to determine if there is a trend in butterfly abundance.

Currently 20 years of MB and CS wandering survey data is being analyzed by Travis Longcore, Conservation Biologist with the University of Southern California, using spatial analysis techniques and a new software called PRESENCE. Results will be presented in the forthcoming HCP (Callippe) Amendment and in the 2004 San Bruno Mountain HCP annual report.. Although the wandering survey method is no longer being used as much, since the fixed points and transects were installed, past wandering data will be important for focusing restoration efforts on areas that have historically provided MB or CS habitat and that should be targeted for habitat restoration.

As of 2003, 300 acres of San Bruno Mountain have been developed. This is approximately 75% of the total development originally allowed under the HCP. Grading has yet to begin on an additional 105 acres. Approximately 80 acres have been graded and are subject to restoration activities. A report documenting the status of restoration work at each of the development areas will be submitted to the County and USFWS as part of the Callippe Amendment (Amendment to the HCP).

With the implementation of the HCP, take of MB butterfly habitat on San Bruno Mountain was authorized under the Endangered Species Act Section 10(a)(1)(B) Permit. Approximately 14% of the total MB habitat is allowed to be taken by development. As of 2003, 9% of this take has already occurred. Future take will be limited by the Callippe Amendment to only 2%, resulting in less take of MB habitat than was originally authorized. In 2003 development related activity which may have resulted in take of the MB occurred

during the grading of 14 acres for "the Pointe" neighborhood of Mandalay Pointe (Administrative Parcel 2-04). Approximately 400 lupines were known to be in the 1/4 acre of MB habitat that was destroyed.

Although take of 8% of Callippe habitat is allowable under the HCP, no take of CS occurred or was authorized in 2003. Since the listing of the CS in 1997, take of the CS or it's habitat (*Viola pedunculata*) either through development, routine maintenance, and/or restoration work is no longer authorized under the Habitat Conservation Plan. Preconstruction surveys were done to ensure that no *Viola* was growing in the areas to be graded by Western Pacific Housing and Myers Development. An amendment to the HCP is currently being developed under oversight by the USFWS to add CS to the take permit.

Each year efforts are made to update maps of the rare plants on San Bruno Mountain. The San Francisco lessingia, *(Lessingia germanorum germanorum)* occurs in the vicinity of the Mountain and was mapped in 2003 (Figure 19, page 55).

Exotic Pest Plant Control and Habitat Restoration

In 2003, 110 acres of exotic plants were treated with herbicides and hand control (Figure 20, page 56; Appendix B, page 76). This level of effort is consistent with the 114 acres of exotics that were treated in 2002. In 2003, approximately 50 acres of gorse, fennel, blue gum Eucalyptus, French broom, and Portuguese broom, and 36 acres of other assorted weeds were treated with herbicide in 2003. The greatest herbicide efforts went into removing fennel from the western part of the Ridge Trail and into removing both fennel and Eucalyptus from Wax Myrtle Ravine (MAP, page vi). Hand removal methods resulted in the removal of exotics from approximately 22 acres. This includes the control of gorse, blue gum Eucalyptus, French broom and fennel as well as 13 acres of assorted weeds. 2003 handwork focused on fennel removal behind Hillside School and along Old Ranch Road, and French broom removal in Red Tail Canyon and Wax Myrtle Ravine.

Currently there are 49 exotic pest plant species that are treated on San Bruno Mountain. When exotic control work first began under the HCP, only three species were targeted for removal (gorse, French broom and Eucalyptus). Four exotic species were treated for the first time in 2003; fox-glove *(Digitalis* sp.), ehrharta (*Ehrharta longiflora*), licorice plant (*Helichrysum petiolare*), and purple loosestrife (*Lythrum salicaria*).

Habitat restoration work conducted by Shelterbelt Builders focused on the maintenance of seven habitat islands in the Colma Creek, Dairy Ravine and the Saddle areas (Appendix C, page 79). They also controlled weeds in the April Brook and Colma Creek areas and along Guadalupe Canyon Parkway.

Volunteers continued their respective exotics control and/or restoration work in 2003 Active groups include the Friends of San Bruno Mountain, California Native Plant Society, Bay Area Mountain Watch, and Pointe Pacific Homeowners Association.

Two vegetation management tools were implemented in 2003, grazing and prescribed burning. Funding for a pilot grazing project was approved by the HCP Trustees in January

2003. The grazing experiment utilizes both goats and sheep, and incorporates mowing treatments in different seasons and areas. Preliminary results are included as Appendix E (page 87).

A prescribed 4-acre burn in Wax Myrtle Ravine on July 8, 2003 jumped control lines and burned 72.5 acres. Fortunately, there was no damage to lives or property from the fire. The uncontrolled fire burned through large areas of gorse and Eucalyptus, and the fire created an unusually large scale opportunity for restoration of native habitats on the Mountain. Eucalyptus regrowth and gorse were controlled in the ravine in 2003, and two documents, a revegetation and erosion control plan and a restoration plan, were prepared for the ravine. The re-vegetation and erosion control plan has been prepared and the planting of several thousand plants in Wax Myrtle Ravine is scheduled for February 2004 (Appendix D, page 84). The restoration plan is an amendment to the *175-Acres Enhancement Plan for San Bruno Mountain* (County of San Mateo, 2002) and is currently being reviewed by San Mateo County.

INTRODUCTION

This report describes biological and development related activities which took place on San Bruno Mountain under Endangered Species Act Section 10(a)(1)(B) Permit PRT 2-9818 for the 2003 calendar year. It provides information on the status of the butterflies of concern, habitat restoration, work on exotic species control, and development activities. The locations of restoration, exotics control, and development sites are referenced by place name. A map of place names on San Bruno Mountain is located after the Glossary on page vi. Butterfly transects and points are referred to by number and locations can be found in Figures 1, 9, and 13 (pages 37, 45, and 49, respectively). Figures and appendices containing data collected in 2003 are located at the end of the report and can be located by page number. Anyone interested in reviewing field data or other information collected by Thomas Reid Associates should contact Wendy Knight at (650) 327-0429 (ext. 92), Casey Stewman (650) 327-0429 (ext. 94) or Sam Herzberg, Park Planner with the San Mateo County Parks and Recreation Division at (650) 363-1823. Previous reports and data are also available on-line at http://www.traenviro.com/sanbruno.

1. STATUS OF SPECIES OF CONCERN

Two monitoring methods were used in 2003 to assess the status of the endangered Mission blue and Callippe silverspot butterflies of San Bruno Mountain: fixed transects established in 1998 (2000 for Callippe silverspot), and wandering transects which have been used since 1982. The endangered San Bruno elfin was monitored during the adult flight season at fixed points that were established in 1998. Larvae counts were conducted later in the season for San Bruno elfin larvae at these same points.

Wandering transects are routes that cover large areas (up to a mile) of the mountain and are monitored typically 1-2 times during the flight season. The wandering transects are not standardized routes, but rather the surveyor walks and records butterflies as they are encountered. The wandering transects provide distribution data and allow monitors to check the status of butterfly habitat in remote areas of the park. Since 1982 over 20,000 butterfly observations have been recorded on wandering transects (San Bruno Mountain Ecological Database).

Because wandering surveys are not done along set routes year after year, analysis using standard statistical methods is difficult. The wandering transect data may, however, be useful in tracking changes in butterfly distribution over time, which may be correlated with changes in habitat quality. Currently 20 years of wandering transect data is being analyzed by Travis Longcore, Conservation Biologist with the University of Southern California, using spatial analysis techniques and a new software called PRESENCE. Results will be presented in the forthcoming HCP (Callippe) Amendment and in the 2004 San Bruno Mountain HCP annual report.

In contrast to wandering surveys, fixed transect surveys provide a means to compare butterfly observations from year to year at specific locations using standard statistical procedures. Using fixed transect data it is possible to relate the abundance of butterfly observations to the status of the butterfly population as a whole.

Fixed transect locations were not chosen randomly but were placed in habitat areas where higher butterfly densities could be observed. Locations were selected with a variety of slope exposures, host plant types, and soil conditions (i.e. road cuts, ravines, and natural slopes) in an attempt to provide a sample distribution that is representative of the overall population. Even within high quality habitat locations, it is sometimes difficult to observe enough butterflies for statistical comparison. For this reason, it was necessary to locate fixed transects only in areas of high quality habitat.

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

MB butterflies use three larval host plants: *Lupinus albifrons collinus, Lupinus formosus formosus* and *Lupinus variicolor*. Early (March, April) flying MB butterflies are associated with *L. albifrons*, and late (May, June) flying MBs are associated with *L. formosus*. *Lupinus variicolor* is used less frequently. Typically, MB butterflies begin adult flight in March, are most abundant in April, and observations begin to drop off by late May or early June. The timing and duration of the flight season is also influenced by microclimate. MB colonies on the warmer, dryer south-facing slopes of the Mountain begin and end their flight season earlier than colonies on the cooler north-facing slopes.

Methods

The 19 fixed transects that were surveyed in 2003 are 50-meters long and permanently marked in the field (Figure 1, page 37). Each transect is surveyed for 2 ½ minutes. Efforts are made to monitor each transect every 7-10 days (the average adult life span for MB) during the flight season. All transects are surveyed during warm, calm weather. Efforts are made to complete an observation cycle (a survey of all 19 transects) within one to two days. After each transect is surveyed, average wind speed (1 minute average) and air temperature are recorded. Only transect visits that had temperatures greater than or equal to 18^0 C and wind speeds less than or equal to 5.0 mph were used in the analysis. All butterflies observed outside of the transect or in the transect vicinity during travel between transects are recorded as incidental observations.

In order to compare data across years and transects, we calculated a statistic that is the mean number of MB observed per transect. For example, for annual comparisons, we divided the total number of MB observed on a fixed transect in one year by the total number of visits to that transect in that same year. This gave us a mean number of MB observations for each transect. The transect means for an entire year were then averaged to calculate the mean number of MB observed in one year. This was done for each of the six years.

Results

There were a total of 95 MB observed on the fixed transects in 2003 (Figure 1, page 37; Appendix A, Table A-1, page 57). Nineteen of these observations were excluded from statistical analysis since they occurred outside of weather parameters or were found at transects that were surveyed twice in one week. For the years that we have data (1998-2003), 2003 has the lowest mean number of MB observed per transect (Figure 2, page 38). For more detailed analyses see the MB Fixed Transects: Six Year Data Analysis (1998-2003) section that follows on page 9.

The first MB butterflies were observed on March 21 at transect 17. The last MB of the season was observed on June 16, during a wandering survey of the Juncus Ravine/Hillside area). The butterflies may have been flying at least a few days prior to and after these observations. 2003 had a very long flight season compared to flight season data from 1998-2003 (Table 1, page 6).

Across the six years of data, the flight season generally begins in late March to mid-April (Figure 3, page 39; Table 1, page 6). In 2003 the flight season began exceptionally early, in mid-March. The length of the flight season varies, yet the core flight season appears to occur between mid April and the end of May. We did not detect a mid-flight season peak in MB abundance in 2003. The same was true for the last six years of flight season data (Figure 3, page 39). The low MB abundance numbers observed in mid-season are possibly due to bad weather conditions which limited the number of transects that were surveyed and perhaps influenced the survivorship of adults and the rate of larvae metamorphosis.

Table 1. Mission blue flight season start and end dates: 1998-2003

Year	Date first MB observed	Date fixed transect surveys began	Date of last MB observation	Approximate length of flight season (Days)
1998	April 10	April 16	June 26	77
1999	April 16	April 16	June 23	68
2000	March 30	April 11	June 1	63
2001	April 12	April 18	June 8	57
2002	April 15	April 15	July 2	78
2003	March 21	March 21	June 16	87

The highest mean MB numbers in 2003 were observed at both *L. albifrons* (transect 17 - West Peak, transect 25 - Saddle) and *L. formosus* (transect 5 - Owl Canyon) transects (Figure 4, page 40). This differs from 2002 data which recorded the highest numbers of MBs as occurring at transects 5 (Owl Canyon. *L. formosus*), 22 (Northeast Ridge Water Tank, *L. formosus*), and 24 (Linda Vista, *L. albifrons/ L. formosus*). All of the transects are located in conserved park areas with the exception of transect 24, which is in restored habitat adjacent to the Linda Vista development (MAP, page vi). MB have been recorded at this restoration site in three out of the last four years.

On any given transect, there was significant variation between years for the number of MB that we observed. This variation occurs for all transects whether they are *L. albifrons* or *L. formosus* dominated transects (Figure 5, page 41; Figure 6, page 42). For example, *L. albifrons* transect 23 had the second greatest number of MB observed in 2000, but in 2002 and 2003 we observed zero MB.

Status of *Lupinus albifrons* transects

In 2003, MB observations increased from 2002 on many of the *Lupinus albifrons* transects (transects 7, 17, 25, 26 and 28, Figure 5, page 41). Numbers decreased at transects 2, 6,13 and 24. Average MB numbers at transect 27 stayed the same. There were no MB butterflies observed at transects 18 and 23. Transect 18 has not had MB observations in the last 3 years. One MB was, however, seen near transect 18 along the road to the ranger station during a wandering survey of the West Peak area. Transect 23 is located on the Northeast Ridge, downslope of the Brisbane Water Tank (MAP, page vi). Due to weather limitations, transect 14 was not surveyed this year, but MB wandering surveys did reveal that MB are present in the area. *L. albifrons* appeared healthy this year. Therefore the decline in average MB numbers per transect this year was not due to hostplant health. The cause for the low MB observation numbers in 2003 may be due to heavy late spring rainfall (4.3 inches in April, see Rainfall and MB Abundance discussion on page 8).

Status of *Lupinus formosus* transects

MB were observed at all *L. formosus* transects this year except transects 4 and 12 (Figure 6, page 42). Transect 4 is located in Devil's Arroyo and has much fewer lupines than the other transects. Growth of weedy exotics such as *Vicia sativa*, coastal scrub succession, and off road vehicle damage in 2002 have impacted this site. MB observations at transect 4 have been low since surveys began in 1998. Prior to 2002, transect 4 had not had a MB observation since 1999. In early 2003, scrub and shrubby exotics were cleared in a large swath around the transect. Despite these efforts and an increase in survey effort (7 visits), no MB were observed in 2003. This site will be targeted for increased exotics control and habitat island restoration in 2004. Transect 12 is located upslope of the Terrabay Phase I development, and was partially mowed by restoration crews working for Terrabay in 2000. Since that time the lupines have recovered. However, despite an increase in 2003 survey effort (7 visits), MB have not been observed at transect 12 since 2001. Thatch build up, increasing dominance by European annual grasses, and coastal scrub succession may be resulting in a decline of *L. formosus* plants at colonies such as 4 and 12. The periodic disturbance associated with burning and grazing may be the stimulation necessary to revitalize these "disturbance loving" lupine colonies.

Transect 3 is the only *L. formosus* transect that shows an increase in MB abundance in 2003. This transect is located on a San Francisco Water Department (SFWD) roadway easement. This roadway was re-graveled in 2001 during replacement of a water pipeline. The majority of the lupines on the road were lost and this resulted in a major impact to this small MB colony. Although the colony shows signs of recovery, MB abundance at this transect is still low compared to peak 2000 numbers and even 1998 (a similar low abundance year to 2003). A restoration plan was developed by TRA and Shelterbelt Builders to replace the habitat in an appropriate location off of the roadway. Plantings will be kept within the 40' wide easement along the road. The planting area locations were flagged in January 2004, and pre-treatment of the site will occur in February. In March 2004, Shelterbelt will plant 600 lupine host plants, nectar plants, and native grasses in the area. If successful, this effort will provide a net increase in MB habitat compared to before the roadway was re-graveled.

Rainfall and MB Abundance

2002-2003 was a moderately wet year with approximately 27 inches of fall and winter rainfall and abundant late spring (the second highest rainfall month, 4 inches, occurred in April) rain (Table 2, page 8). December was extremely wet with 10.75 inches. However, the months of January and February 2003 were unusually dry.

Rainfall for the transect monitoring years 1998-2003 is shown in Figure 7 (page 43). The figure shows a pattern of moderate to heavy rainfall during the months of January, February, and March for the rain years of 98-99, 99-00, and 00-01. These years had the highest numbers of MB observations per transect. 1997-98 (El Nino year), 2001-02, and 2002-03 deviate from this pattern and had lower numbers of MB observations per transect. The data appears to support the conclusion reached in 2002 that extreme weather years (either a very wet spring, or a very dry spring) cause a decline in MB abundance.

Table 2. Weather data for San Bruno Mountain: 1997-98 — 2002-03. Average high daily temperature and rainfall shown by month. Data was recorded at the County park entrance. T= Average temperature in Fahrenheit. R= Rainfall in inches. The two wettest months for each year are shown in **bold** type. Data shown is for the weather year which is recorded from July of one year, to June of the next year.

Temp.	97-98	98-99	99-00	00-01	01-02	02-03
	T	T	T	T	T	T
July	66.6	66.5	64.9	62.7	70	72.1*
Aug	69.1	68.5	65.5	65.7	65	72.4*
Sep	72.4	67.6	66.3	73.7	70	74*
Oct	64.9	65.9	68.4	61.0	68	69.7*
Nov	59.8	56.2	59.1	54.7	60	64.8*
Dec	53.2	50.7	55.6	56.0	52	57.9*
Jan	54.5	52.2	53.8	52	51	57
Feb	52.3	52.0	54.7	53.3	57	56
Mar	56.4	53.4	57.9	59.2	57	59
Apr	58.6	57.9	60.7	56.5	58	57
May	59.8	57.0	71.7	67.6	63	64
Jun	63.6	62.0	65.7	68.2	67	66

Rain	97-98	98-99	99-00	00-01	01-02	02-03
	R	R	R	R	R	R
July	0.29	0.31	0.05	0.23	0.26	0*
Aug	0.86	0.18	0.47	1.80	0.44	0*
Sep	0.12	0.35	0.50	0.46	0.51	0*
Oct	1.08	0.51	0.61	3.21	0.56	0*
Nov	6.94	4.29	2.57	1.40	**5.75**	2.95*
Dec	4.06	1.61	0.68	1.16	**12.55**	**10.75***
Jan	**14.6**	**5.63**	**7.23**	**5.01**	2.44	2.09
Feb	**16.1**	**7.57**	**10.7**	**7.43**	3.14	3.16
Mar	3.03	3.42	2.92	2.04	2.97	2.37
Apr	3.23	2.77	2.21	2.34	0.72	**4.31**
May	4.91	0.39	1.81	0.19	1.02	0.66
Jun	0.46	0.44	0.37	0.25	0.27	0.13
Total	55.7	27.5	30.1	25.5	31	26.42

*** Data were not available from the County and were taken from NOAA's San Francisco Airport (SFO) weather station. Temperature data from SFO appears to be 2-3° F warmer for the months January through May and 6-7°F warmer for June through December compared weather recorded at the Park entrance. Rainfall data from SFO appears to be 0.03-1.2 inches lower for the months January through May and 0.13-0.26 inches lower for June through December. As of December 2003, weather data is no longer being collected at the Park and will need to come from this NOAA weather station.**

MB Fixed Transects: Six Year Data Analysis (1998-2003)

MB fixed transect data was analyzed using a statistical procedure called Analysis of Variance (ANOVA). ANOVA allows us to test whether the mean (or average) for MB abundance for a given year or on a given transect is statistically different than another year or transect. The last six years of transect data (1998-2003) were analyzed. The procedure will allow us to determine if our sampling efforts are sufficient to detect relative changes in MB abundance between years and between transects.

ANOVAs for variation in MB abundance between years and transect were performed using data culled with the following criteria:

1. Incidentals were omitted.
2. Transects that had temperatures less than 18° C, and average wind speeds greater than 5.0 mph were omitted.
3. For transects that were surveyed twice in one week (spaced less than 4 days apart), the survey with the least # of MB observations was omitted.
4. Transects that were visited in 4 or less years were omitted (Transects # 8,9,10,11,14,15,16,19,20).
5. Transects that recorded 0 butterflies in 4,5,or 6 of the years were omitted (#12).
6. Formosus transects (1, 1.1, 3, 4, 5, 12, 21, 22) visited before first MB observation were omitted.

The analyses show that both year and transect are significant predictors for the number of MB observed (2-factor ANOVA) (Appendix A, Table A-2, page 60). Year was the strongest predictor of MB abundance (F-Statistic = 6.6161, $p<0.0001$). Transect was also a significant factor (F-Statistic = 4.97, $p<0.0001$). Therefore the relative quality of transects for MB changed from year to year.

For the last six years of transect monitoring, 2000 was by far the best year with the greatest number of butterflies observed per transect (1.67, Table 3, page 10). Further tests reveal that it was the extraordinarily high abundance of MB in 2000 that drove the overall result that year was a significant factor in the ANOVA (Scheffe Post-Hoc tests). The year 2000 was significantly different than all other years, but none of the other years were significantly differently from one another.

Although 2003 had the lowest number of MB observations to date, 2003 was not significantly lower than 1998, 1999, 2001, or 2002. Even though it may appear that the population is on a downward trend since 2000, data from 1998 and 1999 show that this level of MB occurrence is within the range of variation observed in the last 6 years. The exceptionally good year in 2000 may represent a natural high due to cyclic population processes. Continued survey effort in conjunction with vegetation and climate analyses may provide more clues as to why some years are better than others for MB.

There was significant variation in the survey effort between years. For example, in 1998 there were 39 total transects surveyed and in 2003 there were 121. 2000 and 2001 had similar total transect visits, but 2000 had over twice as many butterfly observations. In 2003, the survey effort was increased two to three times over what was done in previous years, yet the MB observations were the lowest recorded in the six years of monitoring (0.61 MB/transect,

Figure 2, page 38; Table 3, page 10). We suggest that in future years, transects should continue to be surveyed at the increased effort level of 2003 and that future effort should concentrate on surveying approximately 100 transects per season.

The current sampling scheme is at a level that can detect differences between both years and transects. Variation in butterfly numbers between transects is likely to be strongly related to the variation in host plant density (habitat quality) between transects. Year to year variation at each transect is likely to be related to weather factors for that year which influence reproductive success, development, and predation. In the future, we suggest that vegetation sampling be included in our annual monitoring efforts, and that analysis continue to consider climate data.

Table 3. **Mean number of Mission blue observations per transect for the years 1998-2003.**

Year	Mean MB/ Transect	Total Number of Transect Surveys
1998	0.75	39
1999	0.82	59
2000	1.67	76
2001	0.78	69
2002	0.84	46
2003	0.61	121

MB Wandering Surveys

In 2003 wandering surveys were done in the Saddle, Tank Ravine/Hillside, West Peak/April Brook, South slope - Area D Landslide, Pointe Pacific, and Village in the Park areas (Appendix A, Table A-2, page 60). We recorded the location of each adult butterfly, including incidental MB observations that occurred during CS fixed transect monitoring (Figure 8, page 44). A total of 163 MB butterflies were observed in the 26.25-hour monitoring period (this is summed over 10 individual wandering surveys).

Since the implementation of the MB fixed transect system in 1998, less time has been spent on the wandering surveys than in previous years. While wandering data provides information on the presence of MB in areas that are not regularly visited, the data is not standardized in a way that is comparable between years. However, since fixed transect monitoring is focused on a relatively small portion of the Mountain, wandering data from the past 22 years continues to provide a valuable record of where MB habitat has occurred and where it would be reasonable to expect grassland restoration efforts to be successful. This is particularly useful in areas that have been invaded by exotics or coastal scrub. We are currently treating some of these invaded areas using mowing, burning or herbicides techniques in an effort to restore MB habitat. Past wandering data will be important for focusing restoration efforts on areas that have historically provided MB habitat and that should be targeted for MB habitat restoration.

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

CS rely on the host plant *Viola pedunculata*. The CS flight season in the last to occur of the three monitored butterflies on SBM. Adults typically fly from mid-May to mid-July.

Methods

Twelve fixed transects were established for CS in spring 2000 (Figure 9, page 45). These vary from 470 to 2180 meters in length and are permanently marked in the field. Transects are surveyed frequently during the flight season. Ideally, each transect is monitored every 14 days during warm, calm weather. However, in practice, transects were surveyed more frequently in order to take advantage of weather conditions suitable for CS flight. Efforts are made to complete an observation cycle (a survey of all twelve transects) within one to two days. All butterflies observed outside of the transect or in the transect vicinity during travel between transects are recorded as incidental observations.

CS are stronger flyers than MB, and they are active during a wider range of weather conditions. Although weather conditions certainly affect the probability of observing CS in flight, we surveyed on days when weather conditions were favorable for butterfly observations. Since this decision was somewhat subjective, we collected data on wind speed and temperature for each of our transects and ran a regression using four years of this data. These analyses show that wind speed ($p=0.11$, $F=2.65$) and temperature ($p=0.42$, $F=0.63$) are not significantly correlated with the probability of observing CS in flight (the number of CS sightings per hour). Therefore, we did not throw out any of our transect data based on wind speed and temperature and performed further statistical analyses with the assumption of homogeneous variation between our observations.

CS transects are longer and of variable length in comparison to the MB transects, and for this reason a sightings per hour (S/H) statistic is used rather than the average number of butterflies observed on the transect. To calculate this S/H, we record the start and stop time for each transect. We then divide the number of CS observed for a particular transect by the number of minutes it took to survey the transect. S/H is used to compare CS observations among transects. For each year, the average of the CS S/H for all transects was taken and used to compare relative CS abundance between years.

Results

In 2003, the fixed CS transects were monitored from May 12 to July 14, and a total of 311 CS were observed (Figure 9, page 45; Appendix A, Table A-4, page 62). The first CS observation occurred on May 9, on Callippe Hill during a MB transect survey (MAP, page vi). The last CS observations were on July 14 on CS transects 7 and 9 (Ridge Trail and Owl Canyon, respectively). CS may have been flying at least a few days prior to and after these recorded observations. The length of the flight season was about average compared to 1998-2003 data (Table 4, page 12). 2003 was similar in length to the years 2000 and 2002, and in that the flight season came to a close in mid-July, whereas 2001 extended into August.

The fixed transect locations and CS butterfly occurrences in 2003 are shown in Figure 9 (page 45). For the years that we have data, 2003 has the lowest mean CS S/H observed across all transects per year (Figure 10, page 46). However, this does not represent a

significant decrease in CS abundance based on the year to year variation observed over the last four years. For more detailed analyses, see the CS Fixed Transects: Four Year Data Analysis (2000-2003) section that follows on page 13.

On any given transect, there was significant variation between years for the number of CS/hour that we observed on that transect (Figure 11, page 47). For example, transect 11 had the greatest CS S/H observed in 2001 (by a margin of over 40 S/H), but in 2002, it had only the sixth greatest S/H (out of twelve transects)..

For 2003, the highest CS S/H observations were recorded on transect 3 (Northeast Ridge), on transect 11 (summit of the Southeast Ridge), and along transect 7 (Ridge Trail). The transects with the lowest S/H observations include transect 1 (Dairy Ravine), transect 2 (Saddle), and transect 9 (Owl Canyon).

Across the six years of fixed transect data, the flight season generally begins in mid-May (Figure 12, page 48; Table 4, page 12). Although according to the fixed transect data, the 2000 flight season appears to have begun exceptionally late (June 1), CS were actually observed earlier on wandering transects on May 18, so using the start of fixed transect data as the beginning of the flight season may be misleading for some years (Table 4, page 12). This delay in the initiation of surveys is likely to be due to foggy weather which is unsuitable for surveying and is often a problem during the summer and the CS flight season. Another factor is that in some years there may be a competition for survey effort since MB are often still flying, ie. during late MB or early CS seasons. The timing of the flight season appears to occur fairly consistently across years between mid May and early July. Our data did not indicate a mid-flight season peak in CS abundance in 2003. However, by plotting a trendline over the last four years of data, it appears that the peak flight season occurs around June 9.

Table 4. Callippe silverspot flight season start and end dates: 1998-2003.

Year	Date first CS observed	Date fixed transect surveys began	Date of last CS observation	Approximate length of flight season (Days)
1998	May 31	NA	July 15	42
1999	June 3	NA	July 22	49
2000	May 18	June 1	July 14	57
2001	April 4*	May 21	August 4	122
2002	May 8	May 17	July 9	62
2003	May 9	May 12	July 9	61

*Second CS sighting in 2001 occurred on May 8.

Rainfall and CS abundance

A cursory comparison of weather data for the CS flight season for the four years of monitoring showed that the year with the highest CS S/H (2001) was also the lowest rain year since 1998 (Figure 7, page 43; Table 2, page 8). A closer examination of weather factors including

degree days, could provide some useful correlations. However, more years of CS data may be necessary.

CS Fixed Transects: Four Year Data Analysis (2000-2003)

Four years of CS fixed transect data was analyzed using ANOVA. Analyses for variation in CS abundance between year and transect were performed using data culled with the following criteria:

1. Incidentals were omitted.
2. For transects that were surveyed twice in one week (spaced less than 4 days apart), the survey with the least # of CS/hour observations was deleted.

The ANOVAs show that both year (ANOVA, $F=7.7816$, $p<0.0001$) and transect (ANOVA, $F=4.5181$, $p=0.0001$) are significant predictors for the number of CS S/H (2-factor ANOVA; Appendix A, Table A-5, page 66). Year was the strongest predictor of CS S/H (F-Statistic = 7.7816, $p<0.0001$). Transect was also a significant factor (F-Statistic = 4.5181, $p<0.0001$). Therefore the relative quality of transects for CS changed from year to year.

For the last four years of transect monitoring, 2001 had the highest CS S/H values and was significantly greater than 2000 ($p=0.003$), 2002 ($p=0.06$), and 2003 ($p<0.0001$). 2002 had the second highest S/H, however, 2002 was not significantly different than 2000 and 2003,($p=0.7378$ and $p=0.4164$, respectively, Figure 10, page 46). As with MB, the 2003 survey effort was greater (61 transects) than 2000, 2001, 2002 (41, 42, 44 transects, respectively). However, the difference is not as pronounced in the CS data and we suggest that in future years transects should continue to be surveyed a total of at least 60 times (five surveys per transect).

Although 2003 had the lowest number of CS S/H to date, 2003 was not significantly lower than 2000 or 2002. Therefore, although it may appear that the population has been demonstrating a downward trend since 2001, data from 2000 show that this level of S/H is within the range of variation observed in the last four years. The exceptionally good year in 2001 may represent a natural high due to cyclic population processes. Continued survey effort in conjunction with vegetation and climate analyses may provide more clues as to why some years are better for CS.

CS Wandering Surveys

In 2003 wandering surveys were done on the southern ridges of the Southeast Ridge, the Saddle and the Hillside areas (Figure 8, page 44). A total of 32 CS adults were observed in 3.2 hours of monitoring (also includes incidentals observed on MB transects (Appendix A, Table A-3, page 61).

Since the implementation of the CS fixed transect system in 2000, less time has been spent on the wandering surveys than in previous years. This is true for 2003 when 31 hours, 38 minutes were spent on fixed transects compared to 3.2 hours for wandering surveys. This change is largely due to the fact that CS fixed transects currently cover a significant portion of the overall habitat for CS and were established in areas where wandering surveys were once conducted. Nevertheless, wandering survey data continues

to provide useful information on CS distribution and allows us to survey areas of the Mountain that are rarely visited.

i. Management Implications for Mission Blue and Callippe Silverspot

For MB, 2000 was found to be a significantly good year for the butterflies relative to the five other years for which we have fixed transect data; 1998 ($p=0.033$), 1999 ($p=0.097$), 2001 ($p=0.011$), 2002 ($p=0.083$), and 2003 ($p<0.0001$). For CS however, 2001 was found to be the best year and it was significantly better than 2000 ($p=0.003$), 2002 ($p=0.004$) and 2003 ($p<0.0001$). The two species are separate in both the timing of their life cycle and their habitat requirements, so it is not surprising to see that a good year for the MB is not necessarily a good year for CS, and vice-versa.

For the MB, to determine trends, we ask the question "Is the MB population increasing or decreasing". For this we would need to establish a correlation or regression. For correlations, 8 years is the minimum number before correlations across years would become significant, so continued monitoring will be necessary to address this (C. Knight pers. comm.). Mean MB abundance has decreased since 2000. But this abundance has decreased to a level that is within the variation that has been observed in the last six years of data. 2001 and 2002 both had more MB than 1998 and 1999, and 2003 numbers are only slightly lower than in 1998. 2003 MB abundance is not significantly lower than any of the previous years except for the high year of 2000. If we were to omit the year 2000 from the analysis, we would conclude that the population is stable.

For the CS, we ask the same question: "Is the CS population increasing or decreasing". Again, we do not have enough years of data to determine a trend. All we can say is that there has been variation from year to year, and for our four years of data, 2001 was the best year. Although 2003 has the lowest CS S/H, 2003 is not significantly worse than 2000 or 2002.

Though we are not able to establish trends at this point, the fixed transect system may provide this opportunity in the future. This was not possible with prior monitoring methods (i.e. wandering surveys only). For management purposes, the transect system is providing a data set to statistically evaluate the butterfly populations and provide information to the habitat manager and supervising agencies (USFWS).

An analysis based on three years of MB fixed transect data was conducted by Steven Courtney (SEI, 2002). He concluded that the current fixed transect system did not have enough statistical power, and could not predict trends in the MB population that would be useful on a timescale to allow habitat managers to perceive a precipitous decline in the population. Courtney recommend redesigning the monitoring program to a presence/absence system, instead of attempting to identify population trends. In his assessment, Courtney used only three years of data and did not standardize the data using weather parameters. Before abandoning the transect system, we suggest that Courtney conduct another power analysis using six years of MB data that has been standardized for weather.

In order to satisfy the HCP requirements for monitoring, we recommend that both a transect monitoring system (such as what is currently in place) and a presence/absence system (based on Courtney's recommendations) be used. The San Bruno Mountain Habitat Conservation Plan, Biological Program (County of San Mateo, 1982, page III-20) states that (1) "the monitoring should allow the Plan Operator (San Mateo County) to determine whether the populations are essentially stable in numbers, decreasing, increasing or fluctuating" and (2) "whether the distribution of the animals is shifting". These statements suggest that a transect or other similar system should be used to monitor population trends, and a presence/absence system (butterflies and/or host plants) should be employed to monitor the distribution of the butterflies and how management may impact the distribution of the butterflies in areas not intercepted by the transects. In the past the wandering surveys have been utilized to monitor the distribution of the butterflies, and this system may provide more comparable data with some modifications to the program.

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

SBE are closely associated with their host plant, *Sedum spathufolium*. SBE occur where there are high densities of Sedum and in areas that are protected from the wind. Northeast to northwest aspect also favor SBE adults and larvae. SBE are the first of the three monitored butterfly species to emerge and their flight season is typically between early March and mid-April.

Adult Survey Methods

In 1998, 21 fixed monitoring points for San Bruno elfin (SBE) were installed on San Bruno Mountain (Figure 13, page 49). Each point is permanently marked in the field. Surveys are conducted at each point for 5 minutes. Points are surveyed as frequently during the flight season as weather conditions permit. All points are surveyed during warm, calm weather. Efforts are made to complete an observation cycle (in 2003 a survey of all 17 points) within one to two days. Average wind speed (1 minute average) and air temperature are recorded. Only transect visits that had temperatures greater than or equal to 14°C and wind speeds less
than or equal to 7.0 mph were used in the analysis. All butterflies observed in the vicinity of the observation point during travel between points are recorded as incidental observations.

Results - Adults

The first adult SBE observations were recorded on March 4. Peak observations were recorded on March 21. The last recorded adult SBE observations were on April 7. SBE were likely flying a few days prior to and after the recorded observations. The length of the flight season was about average compared to data from 1998-2003 (Table 5, page 16).

In 2003, a total of 25 adult SBE butterflies were observed at the points, and 18 incidentals were observed between points (Figure 13, page 49; Appendix A, Table A-6, page 67). For the six years that we have data, 2003 has the lowest mean number of adult SBE observed per point (Figure 14, page 50). Although 2003 SBE numbers are lower than those observed in the previous two years, numbers are still within the range that we have seen before, therefore we may be seeing a cyclical pattern that is only recognizable when a

long-term data set has been developed. For more detailed analyses, see the SBE Fixed Points: Six Year Data Analysis (1998-2003) section that follows on page 17.

Across the six years of data, the flight season generally begins in early to mid March (Figure 15, page 51; Table 5, page 16). In 1999 the flight season was exceptionally late and began in late March. The length of the flight season varies and in most years SBE surveys overlap with the beginning of the MB flight season. Since survey effort tends to switch to MB surveys in early April, survey effort at the tail end of the SBE flight season is often less consistent. However, the date of first SBE observation is generally fairly accurate since point checks and surveys are often done prior to the first SBE sighting. The trendline indicates that the average peak flight across the past six years has occurred on March 19.

Table 5. San Bruno elfin flight season start and end dates: 1998-2003.

Year	Date first SBE observed	Date fixed point surveys began	Date of last SBE observation	Approximate length of flight season (Days)
1998	February 20	February 20	March 30	39
1999	March 28	early March	April 14+	17
2000	March 1	March 1	April 3	33
2001	March 13	February 15	March 27	14
2002	March 4	February 28	April 22	49
2003	March 4	February 18	April 7	34

+ Fresh SBE were observed on April 14. Therefore, the 1999 flight season was a minimum of 17 days.

At any given survey point, there was significant variation between years for the number of SBE that we observed at that point (Figure 16, page 52). For example, point 5.1 was tied for the third best performing point in 2001. But in 2002 it was the 10th best point. In 2003, point 5.1 was tied for the second best performing point (although total numbers were lower in 2003). Overall, in 2003 SBE abundance was greater at only three points compared to 2002 (points 5.1, 8, and 9).

Rainfall and SBE Abundance

A cursory comparison of weather data for the SBE flight season for the six years of monitoring showed that the year with the highest mean SBE observations (2001) was also the lowest rain year since 1998 (Figure 7, page 43; Table 2, page 8). A closer examination of weather factors including degree days, could provide some useful correlations. However, more years of SBE data will be necessary.

SBE Fixed Points: Six Year Data Analysis (1998-2003)

For our six years of adult SBE fixed point data, ANOVAs for variation in SBE abundance between years and point were performed using data culled with the following criteria (Appendix A, Table A-7, page 69):

1. Incidentals were omitted
2. For points that were surveyed twice in one week (spaced less than 4 days apart), the survey with the least # of SBE or worse weather conditions was omitted.
3. Only points that had temperatures greater than or equal to 14 degrees C, and average wind speeds equal to or less than 7.0 mph were considered in the analysis.
4. Surveys done before the first elfin sighting were omitted.
5. Days on which only one point was surveyed, or that fall late in the season, and have no SBE observations were omitted. These surveys are intended to check if SBE are still flying late in the season.
6. Points that were surveyed in only 1 year were omitted (Points 1, 4, 21).

Analysis shows that both year and point number are significant indicators of SBE abundance. 2001 was found to be significantly better than all other years (1998 ($p=0.073$), 1999 ($p<0.001$), 2000 ($p=0.007$), 2003 ($p<0.001$)), except for 2002, which had the second highest mean SBE observations (Appendix A, Table A-8, page 75). Although numbers decreased in 2003, they are not significantly lower than the year other than the peak year (2001). Additional years of data are necessary to reveal if the population is declining or if we are observing a natural fluctuation in population numbers.

Point to point variation in SBE numbers is likely to be strongly correlated to host plant density. However, since the numbers of SBE observed is so low and so many point surveys result in zero SBE, increasing survey frequency will also increase the opportunity to observe a SBE. It may not be worth it, however, to increase surveys for SBE adults since it is possible to count larvae instead. Larvae counts may be able to provide a more reliable portrait of point to point variation in SBE numbers.

Larvae survey methods

In 2003, one-time larvae counts were done at 8 points. Counts are conducted within a 25-meter radius around each point. Since larvae are closely associated with their hostplant *Sedum spathulifolium*, each plant is searched.

Results for larvae counts

In 2003, surveys were conducted on May 28, 29, and 30. A total of 336 SBE larvae were observed at eight points (Figure 13, page 49; Appendix A, Table A-6, page 67). 2003 numbers are similar to the 330 larvae that were observed in 2002. A minimum of 8 points have been surveyed for larvae every year since 1998, however these have not always been the same 8 points. Within 2003 and between the last four years, there was variation between points for the mean number of SBE that we counted (Figure 17, page 53). For the points that have been surveyed in common over the past four years, there is a weak positive correlation between larvae number and adult number (Figure 18, page 54). This correlation is not significant; the mean number of adults observed at a point does not predict the number of larvae that will be counted later in the season at that same point. Similarly, the number of larvae counted at a point is not related to the mean number of

adults that were observed at that point earlier in the season. With more data, this correlation could become stronger. It may also be more meaningful in future years if mean larvae counts are used instead of single counts.

Discussion for larvae counts

The larvae counts are helpful in monitoring the abundance and distribution of SBE because they can provide confirmation of SBE presence and abundance at points where no adults have been observed. There were many points at which no SBE adults were observed in 2003.

Since survey effort varied among points, Table 6 (page 19) identifies points at which SBE numbers may be declining and points at which more survey effort should be allocated in 2004. Points 12, 14, 15, and 22 had no adult SBE observations this year, yet taking into account the low numbers of SBE adults observed throughout the season, this is not worrisome when it is clear that these points were only surveyed once in 2003. Points 16, 17, and 19 were surveyed twice with no adult SBE occurrences. Points 5, 10, and 20 were surveyed three times and no adult SBE were found.

Based on the adult data alone, it would appear that SBE numbers may be declining at points that were surveyed 2 or 3 times during the flight season and that had no SBE adult observations in 2002 or 2003. However, SBE larvae were found at all points at which larvae counts were conducted, including points that had zero adult observations. This indicates that larvae counts are a better method with which to confirm SBE presence and distribution when no adults are observed at a point. Conducting larvae counts at all points that have no adult observations in 2004 or that have not had adult SBE observations in the last three years, would provide instructive data on whether SBE are still present.

Table 6. SBE points with no 2003 adult observations shown with larvae count results.

Points with zero SBE observations	SBE adults surveyed 1 time in 2003	2 times	3 times	0 SBE in last 2 years	2003 larvae counts
5			X		NA
10			X		NA
12	X				NA
14	X			X	NA
15	X			X	45
16		X		X	21
17		X			55
19		X			26
20			X	X	NA
22	X			X	NA

i. Management Implications for San Bruno elfin

The last 3 years of larvae counts have consisted of single counts at each of eight points. This method is sufficient to verify SBE presence and distribution, however, is not appropriate for estimating relative population abundance for comparison between years. If USFWS determines that adult surveys should be replaced by SBE larvae surveys, methods should be changed to allow for larvae counts to be repeated at least 3 times at each point. Each set of counts should be completed on the same day and within the shortest possible time span to reduce temporal variation between points. This would be possible with the availability of a large crew of biologists and volunteers over a 3 or 4 day period. An additional benefit of larvae surveys is that they can be conducted under a variety of weather conditions. But since it is not yet understood how changes in weather impact larvae activity, conducting counts at several points at once and recording weather data would be desirable.

d. Butterfly Monitoring Conclusions

There is a continued need for butterfly monitoring of MB, CS and SBE on the Mountain. Although we currently do not have enough years of data, we are getting closer to the time when we will have enough fixed transect/point data to be able to do cross year trend analysis. This type of analysis would enable us to corroborate any perceived decline in increase in numbers of butterflies through statistical analysis. It would lend credence to what we perceive in the field or in the data as a decline. Statistical analysis on eight and

more years of data may show us with reasonable certainty whether a decline or increase in butterfly abundance is a significant change on the Mountain.

i. Monitoring Logistics

Unique conditions on San Bruno Mountain can make the logistics of monitoring difficult. The following conditions should be taken into consideration when contemplating changes to the monitoring program.

1) Summertime fog and wind decrease the number of available weather windows for monitoring, and survey visits cannot be scheduled more than 1-2 days in advance because of weather variability. In the past, the transect and wandering surveys have been scheduled with an attempt to monitor only one time during the lifespan period (every 7-10 days for the MB butterfly, and every 2-3 weeks for the CS) so as to minimize double counting of individuals. However, since weather windows are unpredictable, we have included data from surveys done no less than 4 days apart. Therefore we must assume that variation between cohorts within years is insignificant for our purposes of comparing the differences between years.

2) Flexibility to work when the weather dictates (weekends, holidays) is sometimes necessary to be able to obtain consistent data.

3) Monitoring begins in the early spring (with SBE) and extends into mid-late summer (with CS) and hiking the steep terrain repeatedly makes it a physically challenging job.

4) The three butterfly monitoring seasons often overlap with each other for several weeks. This stretches the ability of field crews to get through all the necessary transects, especially when weather windows are tight.

ii. Monitoring Recommendations for 2004

1) Maintain the number of MB fixed transect surveys at 100 visits to make comparisons between years more statistically robust and also to make better comparisons between transects so we can better monitor the quality of MB habitat.

2) Maintain the number of CS fixed transect visits at a minimum of 5 per season for each transect. This will make comparisons between years more statistically robust and also enable better comparisons between transects so we can better monitor the quality of CS habitat.

3) For all butterflies, space the transect visits evenly across the entire flight season to ensure a consistent sampling effort and to better characterize the flight season.

4) When necessary, monitor MB and CS transects less than 6 days apart to take advantage of good weather windows.

5) Make it a priority to complete an entire set of MB, SBE, or CS fixed surveys within 1-2 days.

6) Consider establishing a presence/absence butterfly (and/or host plant) monitoring system based on Steve Courtney's recommendations. This may allow us to evaluate management impacts (i.e. succession, grazing, restoration) in areas that are not intercepted by the transects. A standardized method of conducting the wandering surveys could also be used for this purpose.

7) Place new MB transects (or presence/absence monitoring points) in Colma Creek, Dairy Ravine and in the Saddle habitat restoration islands as host plants become well established. Colma Creek islands will be ready for monitoring points in 2004.

8) Investigate the possible correlation between degree-days and butterfly abundance and length of flight season for MB, CS, and SBE.

9) Protect transects (particularly MB transects 4 and 24) from encroachment by exotic and coastal scrub vegetation.

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

A small population of Bay checkerspot butterflies was present on San Bruno Mountain (near the summit) up until the mid-1980's. This species has not been observed in the 20 years since. 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 2003. In October 2000, the U.S. Fish and Wildlife Service proposed critical habitat for the Bay checkerspot butterfly. The USFWS issued a Final Rule on the critical habitat designation in April 2001. The critical habitat designation includes the historic Bay checkerspot habitat on San Bruno Mountain. This habitat must be taken into account when planning mowing, burning, or grazing events.

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

The San Francisco garter snake was identified in the San Bruno Mountain HCP (1982) as having potential habitat on San Bruno Mountain. No San Francisco garter snakes (SFGS) were observed on the Mountain by field crew while conducting biological activities and overseeing development activities in 2003. There have been no confirmed observations of SFGS on San Bruno Mountain in the 22 years of the HCP monitoring program. Based on the lack of ponds and other aquatic habitats, this species is unlikely to be present.

g. California Red-legged Frog (*Rana aurora draytonii*)

The California red-legged frog (CRLF) shares similar aquatic habitat with SFGS. Though it was not identified as a sensitive species at the time of the HCP, CLRF has since been listed as a federally threatened species. No California red-legged frogs (CRLF) were observed on San Bruno Mountain by field crew while conducting biological activities and overseeing development activities in 2003. There have been no confirmed observations of CRLF on San Bruno Mountain in the 22 years of the HCP monitoring program. Based on the lack of ponds and other aquatic habitats on San Bruno Mountain, it is unlikely this species would be present.

h. Plants of Concern

Several rare and listed plant species are found on San Bruno Mountain, and TRA has been working on creating updated maps for these species in GIS format. The location of the federally listed endangered species, San Francisco lessingia (*Lessingia germanorum germanorum*) was mapped in 2003 (Figure 19, page 55). The Lessingia is known from only five occurrences, one on San Bruno Mountain and four occurrences on the Presidio in San Francisco. This species is not actually found within the HCP area, rather, it is located on a sandy ridge just west of the Pointe Pacific housing project within a city park in Daly City. In addition to its federal status, this species is also listed as CE (State listed, endangered) and CNPS 1B.

The San Francisco Bay spineflower (*Chorizanthe cuspidata cuspidata*) is a CNPS 1B species. It occurs within the Lessingia area on San Bruno Mountain and was not mapped separately. This species is more widespread than the *Lessingia* and is found throughout the Bay Area (CNPS Inventory 2001).

i. San Bruno Mountain Community Resources

Cooperative Website and Data Resources

A cooperative website for San Bruno Mountain was developed by TRA in 2001 and is found at http://www.traenviro.com/sanbruno. This site serves as a center for information, announcements, contacts, references, and mapping resources for San Bruno Mountain. It is used by volunteers, professionals, government employees, and members of the public who are involved in preservation, restoration, biological monitoring, and planning at San Bruno Mountain. The site also includes postings of recent SBM management reports that have been prepared by TRA.

Workshops for Callippe Amendment

A total of six workshops are being held as part of the process of soliciting input from USFWS, SBM stakeholders and the community regarding the Callippe Amendment. The first two meetings were held on November 20, 2003 and January 27, 2004 and covered the background of the HCP and Callippe Amendment, biological issues and funding. Future

meetings will be held on the third Tuesday of each month for the next four months beginning in February. The meeting topics will include presentations on butterfly monitoring methods and results, exotic plant distribution, handwork and herbicide methods, and the SBM 5-year plan.

2. VEGETATION MANAGEMENT AND RESTORATION

a. San Bruno Mountain Five Year Plan

The habitat management program of the San Bruno Mountain HCP follows the objectives set forth in the 1996 San Bruno Mountain HCP Five Year Strategic Plan. The five-year plan provides a comprehensive breakdown of habitat management goals under different funding scenarios. The specific objectives for exotics control are set forth in the medium-level funding scenario in the (1996-2001) plan. The 1996-2001 plan focused on exotic weed control, and expanded the previous program to cover most of San Bruno Mountain. This was necessary as invasive species such as fennel (*Foeniculum vulgare*), French broom (*Genista monspessulana*), and Portuguese broom (*Cytisus striatus*) were expanding into butterfly habitat areas on the South Slope, Brisbane Acres, and the slopes above the Crocker Industrial Park. Prior to 1996, control efforts were focused primarily on the Saddle, Radio Ridge, Northeast Ridge and in Owl and Buckeye Canyons.

The framework for a new expanded five-year plan for 2004-2009 is currently in preparation. Because the five-year plan needs to be written in conjunction with the Callippe Amendment, and because it took several years to get funding for the Amendment, preparation of the five-year plan has been delayed. The plan will address the following activities: 1) Exotics Control, 2) Sensitive Species Population Monitoring and Mapping, 3) Habitat Restoration, 4) Development Mitigation, and 5) Public Participation.

b. Exotics Control

The primary focus of habitat management since the inception of the HCP has been control of exotic weed infestations through hand removal, mechanical removal, and herbicide treatment. Due to the large area of the Mountain that is controlled for exotics (approximately 2800 acres) and the number of exotic species, infestations must be prioritized based on their threat to sensitive habitat areas.

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
Priority 4:	Large exotic infestations

As a general rule, all Priority 1 and 2 infestations are treated using hand removal or back-pack spray techniques. Priority 3 and 4 infestations are treated using a truck mounted herbicide spray rig (in combination with mechanical clearing (mowing) of vegetation in some cases).

Herbicide treatment has consisted of spraying targeted species with an herbicide solution containing either Garlon 4® or Roundup®. These herbicides are used due to their high effectiveness, low toxicity rating, and short half-life in the soil. Garlon 4® herbicide is the preferred chemical since it does not harm monocots (grasses). 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 decay in place, a process that takes from one to five years,

depending upon the size of the plants. In sensitive areas (near butterfly habitat and within 150 feet of private property) mature stands of exotic plants are removed by chainsaw or mowing, followed by seedling and stump herbicide treatment.

2003 Exotic Pest Plant Treatment Summary

Exotic pest plant control activities are conducted to protect, enhance, and restore the native vegetation communities on San Bruno Mountain. Currently there are 49 exotic pest plant species that are controlled on San Bruno Mountain. Exotics of primary concern and that receive the most control work include gorse, French broom, Portuguese broom, fennel, Eucalyptus, Himalaya blackberry, Cotoneaster, Cape ivy, English ivy, and iceplant.

The following plant species currently receive exotics control work on San Bruno Mountain: The species in bold print were newly treated in 2003.

Acacia sp. (Acacia)
Avena spp. (wild oat)
Briza maxima (rattlesnake grass)
Bromus hordeaceus (soft chess)
Carduus pycnocephalus (Italian thistle)
Carpobrotus edulis (hottentot fig, iceplant)
Centaurea calcitrapa (purple star thistle)
Centaurea melitensis (Napa thistle)
Centranthus ruber (red valerian)
Chenopodium album (lamb's quarter)
Cirsium vulgare (bull thistle)
Conium maculatum (poison hemlock)
Cortaderia jubata (pampas grass)
Cotoneaster sp. (Cotoneaster)
Cupressus macrocarpa (Monterey cypress)
Cytisus striatus (Portuguese broom)
Delairea odorata (Cape ivy)
***Digitalis* sp. (fox-glove)**
Erechtites arguta (New Zealand fireweed)
***Ehrharta longiflora* (Ehrharta)**
Erodium cicutarium
Eucalyptus globulus (blue gum tree)
Foeniculum vulgare (fennel)
Genista monspessulana (French broom)
Hedera helix (English ivy)
***Helichrysum petiolare* (licorice plant)**
Hirschfeldia incana (mustard)
Holcus lanatus (velvet grass)
Hypochaeris radicata (hairy cat's ear)
Lactuca serriola (prickly lettuce)
Lactuca virosa (wild lettuce)
Leucanthemum vulgare (ox-eye daisy)
Lobularia maritima (Lobularia)
Lolium multiflorum (Italian wild rye)
***Lythrum salicaria* (purple loosestrife)**
Myoporum laetum (Myoporum)
Oxalis pes caprae (Bermuda buttercup)
Phalaris stenoptera (Harding grass)
Picris echioides (bristly ox-tongue)
Pinus radiata (Monterey pine)
Pyrocantha crenato-serrata (Pyrocantha)
Raphanus raphanistrum (wild radish)
Rubus crispus (curly dock)
Rubus discolor (Himalaya blackberry)
Rumex acetosella (sheep sorrel)
Scabiosa atropurpurea
Silybum marianum (milk thistle)
Solanum sp. (nightshade)
Ulex europaeus (gorse)

West Coast Wildlands, subcontractor to TRA, maintains daily record sheets for all exotic pest plant work conducted on the Mountain. For both herbicide and hand control work the treatment area is recorded and mapped in acres on the daily record sheet (Appendix B, Tables B-1 and B-2, pages 76 and 77). In the past year, approximately 50 acres of gorse, fennel, blue gum Eucalyptus, French broom, and Portuguese broom plants were controlled with herbicides, and approximately 36 acres of assorted weeds were also sprayed (Figure 20, page 56). The greatest herbicide efforts went into removing fennel from the western

end of the Ridge Trail and into removing both fennel and Eucalyptus from Wax Myrtle Ravine. Hand removal methods resulted in the removal of exotics on approximately 22 acres. Gorse, blue gum Eucalyptus, French broom and fennel, were controlled as well as 13 acres of assorted weeds. 2003 handwork focused on fennel removal behind Hillside School and along Old Ranch Road and French broom removal in Red Tail Canyon and Wax Myrtle Ravine.

Summary of new exotics controlled in 2003

- A single *Helichrysum petiolare* (Licorice plant) bush was found in late September 2003. It was growing in the middle of a dense, continuous patch of gorse above the Carter Street Quarry on San Bruno Mtn County & State Park property. This plant is often an ornamental escapee from someone's home. It was treated with Garlon 4 @ 2%.

- *Lythrum salicaria* (purple loosestrife) was observed on the Crocker trail, near the Bog, by the San Mateo County Weed Management team in October 2003. The infestation was hand pulled with a followup of Garlon 4 @ 2%. As of January 6, 2004, the plants are beginning to exhibit new leaf growth. This plant is located in a drainage and needs to be treated with an aquatic herbicide. The vines are also heavily entwined with California blackberry, making removal by hand very labor intensive. West Coast Wildlands will re-spray after the leaves are larger to increase translocation of the herbicide.

- *Ehrharta longiflora* was found by Friends of San Bruno Mountain volunteers, along the V-ditches at Wax Myrtle Ravine after the July 8, burn. It was removed by hand with follow-up treatments of Roundup Pro @ 2%. The non-natives within the area are treated once a month and the site is monitored for any new Ehrharta observations. The Ehrharta on Radio Road has been treated since 2002 and control in this area has been added to West Coast Wildland's scope of work.

- *Digitalis* sp. (fox-glove) was observed along the Ridge trail. Four plants were pulled while the flowers were just forming. As of January 11, 2004, no new plants have been observed. This spot will be monitored in the future.

- *Leucanthemum vulgare* (ox-eye daisy) has been treated at Dairy Ravine, Wax Myrtle Ravine, and April Brook since 2002. 2003 saw a five-fold increase of the plant at Dairy Ravine. So far ox-eye daisy has not returned to the lower section of Wax Myrtle Ravine after the fire. The April Brook infestation is currently under control.

General observations on status of some exotics on the Mountain (West Coast Wildlands)
In general work in 2003 focused on maintaining or reducing the original stands of exotic plants and trying to incorporate the more aggressive new species into the work effort.

- The main non-native grasses found in the perennial grassland butterfly habitat are *B. maxima, Avena spp.* and *L. multiflorum.* Mowing is used at certain butterfly habitat sites to control these grasses.

- Gorse maintenance in the Saddle is ongoing and remains necessary since seedlings continue to emerge years after the mature stand has been controlled.

- Bermuda buttercup is quickly moving through Tank Ravine and other parts of the mountain despite efforts to control it. This plant has the ability to devastate complete areas leaving bare spots after seed production and die-off. This opens up the area for new invasives.

- Mustard, wild radish, and bristly ox-tongue abundance along the eastern end of the Ridge Trail (Southeast Ridge) has been increasing. On the other hand, French broom is almost gone from the area.

Additional Exotics Control Work

Shelterbelt Builders, subcontractor to TRA, conducted annual weed control work to prepare and maintain planting island sites in the Saddle, Colma Creek, and Dairy Ravine. They are also mowing in April Brook to control the spread of poison hemlock (*Conium maculatum*). See Appendix C (page 79) for a summary report on the habitat restoration activities conducted by Shelterbelt on San Bruno Mountain in 2003.

In addition to exotics control work on County parklands, West Coast Wildlands controls the exotics on six parcels of Myers Development Co. property within Phase II/III of Terra Bay (including the Preservation Parcel) and at the Tank & Juncus Ravine property. Management and restoration plans have been prepared for these areas (Knapp 2001; Forbert 2001). They also control gorse on the slopes above the Carter Street Quarry Development and extending to the Ridge Development owned by Standard Pacific Homes (MAP, page vi). They will be planting grasses and forbs around the east end of the gorse treatment area.

The volunteer group San Bruno Mountain Watch focused its 2003 stewardship efforts on exotics control of the lower reaches of Buckeye Canyon, including the ridge east of the Canyon and areas adjacent to Lipman School in Brisbane. The following exotic species were removed from these areas; black mustard (*Brassica nigra*), hemlock (*Conium maculatum*), bristly ox-tongue (*Carduus pycnocephalus*), broom (*Genista monspessulana*), cotoneaster (*Cotoneaster* sp.), pincushion flower (*Scabiosa purpurea*), Himalayan blackberry (*Rubus discolor*) and bull thistle (*Cirsium vulgare*). In addition, since the Wax Myrtle Ravine fire in July 2003, volunteers put in approximately 350 hours of invasive plant removal in this area, focusing on gorse (*Ulex europaeus*) and some of the above species. Total volunteer time for 2003 was roughly 500 hours.

Other areas on San Bruno Mountain receiving exotics control work are the Botanic Garden and bog area by the Friends of San Bruno Mountain; the headwaters of Colma Creek area in the Saddle by Heart of the Mountain (California Native Plant Society); and Bermuda buttercup and orchard grass control at Point Pacific by the Point Pacific Homeowners Association.

c. Restoration of Habitat

Early attempts at large scale planting on San Bruno Mountain were difficult to maintain and monitor, due to the large influx of weeds. As a result, a strategy of creating small high quality habitat islands has been developed and has proven to be successful in Eucalyptus cut areas, former gorse patches, and on development slopes. This approach has been implemented in several areas of the Mountain. Restoration of MB habitat has been successful in several locations (Colma Creek, Terrabay, Linda Vista, NE Ridge). However CS habitat has not been restored due to a lack of understanding in how to successfully propagate and maintain *Viola* plantings. In 2001 and 2002, restoration work conducted by PG&E was very successful in establishing *Viola* at transmission tower sites on the NE Ridge and Army Road. Their methods are now being shared with other restoration contractors on the Mountain and in 2003 the Friends of San Bruno Mountain have had modest success with *Viola* emerging from dormancy. With continued maintenance of the planting islands and continued creation of additional planting islands each year, it should be possible to restore (and likely surpass in time) the amount of butterfly habitat taken by development through the HCP (According to the SBM HCP Volume I, a total of approximately 14% of MB habitat and 8% of CS habitat was planned for take by development.).

Restoration guidelines for MB and CS

HCP funded restoration work in the form of weed control, erosion control, and planting has been ongoing on the mountain since the mid-1980's. The primary goal of the restoration work is the establishment of high quality habitat for the MB and CS butterflies. Because the HCP does not specify what is required for successful restoration, *Habitat Restoration Guidelines for MB and CS* were produced in November 2000 by TRA to address some of the previous problems and assist restoration professionals with accomplishing the habitat restoration goals of the HCP. The guidelines include suggested methods on how to select appropriate restoration sites, recommended host plant densities to support the endangered butterflies, and propagation methods. They are to be used in conjunction with the *Standards for Acceptance of any Dedicated Lands by the County of San Mateo in Accordance with the San Bruno Mountain Area Habitat Conservation Plan*, prepared by Roman Gankin (in *San Mateo County Parks Draft Master Plan, Appendix 1*).

Eucalyptus-cut areas

In 1995, 63 acres of Eucalyptus trees were clear-cut on San Bruno Mountain. The 63 acres are broken up into five different restoration units: Dairy Ravine (22.4 acres), Wax Myrtle Ravine (6.4 acres), Hoffman Street (5 acres), Colma Creek (4.8 acres), and April Brook (3.6 acres). The Botanic Garden site (4 acres) is within the Dairy Ravine site and is managed by the Friends of San Bruno Mountain.

The goals of the Eucalyptus removal and native habitat restoration on San Bruno Mountain are: 1) to provide corridors and restored grassland habitat for the three endangered butterflies on the Mountain (MB, CS, and SBE), and 2) to restore native habitats for other native wildlife species.

Since the time of the initial Eucalyptus cutting, restoration work has been done on approximately 54 acres (Dairy Ravine, Botanic Garden, April Brook, Colma Creek, Hoffman Street, and Wax Myrtle Ravine). Restoration work was initiated in the rest of Wax Myrtle Ravine in 2003 in the form of a 4-acre controlled burn which turned into a 72.5 acre wildfire and cleared out the accumulated Eucalyptus slash and regrowth and large stands of exotics. Funding was provided for debris removal and for preparation of both the burn and restoration plans through a Coastal Conservancy grant. The Wax Myrtle Ravine restoration plan, also known as the "amended plan for the 175-acre enhancement area", has been prepared by TRA and is currently under review with San Mateo County. It will be posted to the SBM Cooperative Website upon completion. An erosion control and revegetation plan has also been developed by TRA and will be implemented this winter by Shelterbelt for an area in Wax Myrtle Ravine experiencing sediment loss, slides and slumps (Appendix D, page 84). This plan will significantly help erosion problems in the ravine and in getting native species re-established where the Eucalyptus/Gorse and slash were piled until recently.

After the burn, West Coast Wildlands conducted herbicide work and hand pulling to prevent exotics from sprouting and re-establishing. Eucalyptus tree stump sprouts were the first to be treated, followed by Ehrharta, fennel, Himalayan blackberry, gorse stump re-growth, poison hemlock, bristly ox-tongue, pampas grass, French broom and nightshade. In addition, wild lettuce, mustard, Cape ivy, lambs quarter, curly dock and sheep sorrel are resprouting and are being treated with herbicides.

The nightshade, poison hemlock and bristly ox-tongue have been the most aggressive invaders to the Wax Myrtle Ravine burn site (West Coast Wildlands, pers. comm.). The removal of the Eucalyptus slash throughout the Ravine has really increased access to the whole area and has made treating the exotics easier. West Coast Wildlands is currently walking the burn site once every 2-4 weeks to remove or spray emerging non-natives before they produce seeds. Five photo stations have been established in the upper and middle burn areas.

Habitat Islands and Restoration activities

Since 1995, seven habitat restoration islands have been created within former Eucalyptus and gorse sites. These sites are located in the Botanic Garden (2 islands), Colma Creek (2 islands), and Dairy Ravine (2 islands), and the Saddle (1 island). In 2003, one new planting island was added in Dairy Ravine and one was added in the Botanic Garden. These islands were planted with *L. formosus* and *L. albifrons*. See Appendix C (page 79) for a summary report on the habitat restoration activities conducted by Shelterbelt on San Bruno Mountain in 2003. The Botanic garden is managed by the Friends of San Bruno Mountain, and the Colma Creek, Dairy Ravine, and Saddle sites are managed by TRA and Shelterbelt Builders. To date, two habitat islands have had confirmed presence of the endangered butterflies (MB at Colma Creek, and SBE butterfly at Botanic Garden).

In 2003, West Coast Wildlands planted 5000 native perennial grasses in three planting islands at Tank and Juncus Ravine, an area being controlled for Bermuda buttercup. This land belongs to Myers Development The first planting (500 *Bromus carinatus* and 500 *Nassella pulcra)* suffered <10% mortality. An additional 600 plugsof each grass species

were planted in December 2003, and another 4000 will be planted throughout the 164 acre property.

Other Restoration Islands in Park Areas and Volunteer Site Stewardship Activities

- Heart of the Mountain, CNPS. The California Native Plant Society formed a group to do volunteer work specifically on San Bruno Mountain ("Heart of the Mountain"). The group has conducted weed control, erosion control, and replanting in the headwaters of Colma Creek, and has conducted public outreach activities since 1999. In 2003, Mary Petrilli passed the leadership of this group on to Joe Cannon. In the past year the program supervised over 960 hours of volunteer help restoring native plant habitat by removing invasives, gathering seed and outplanting native plants. Work is focused on restoring habitat upstream of previous work areas in the headwaters of Colma Creek.

- Friends of San Bruno Mountain: The Friends of San Bruno Mountain (FSBM) have been active on San Bruno Mountain since 1995 conducting weed control, replanting and public outreach activities. They have created butterfly habitat islands within the Botanic Garden, where they have successfully established habitat for the SBE butterfly. In January 2003, 100 *L. formosus* plants were planted on the eastern hillock of the garden to provide habitat for the MB butterfly.

  FSBM operate a nursery in South San Francisco for the purpose of supplying butterfly host plants and other native species for restoration projects on the Mountain. They are currently working to supply grasses for Tank Ravine, and plants for hillside and riparian restoration in Wax Myrtle Ravine and along San Bruno Creek. They plan to almost triple the amount of nursery space in the upcoming year.

  In addition, FSBM is working to propogate *Viola pedunculata* from seed that can be planted in habitat islands on the Mountain. Previous efforts have failed when *Viola* did not survive the dormant period. In 2003, they planted 250 plants and experimented with providing moisture to the bottom of the pots during dormancy in an effort to assimilate a more natural condition. As of January 2004, the results have been encouraging with about 10% of the plants emerging from dormancy.

- San Bruno Mountain Watch focused its 2003 stewardship efforts on exotic control in the lower reaches of Buckeye Canyon, including the ridge east of the Canyon, areas adjacent to Lipman School in Brisbane, and Wax Myrtle Ravine.

- Pointe Pacific Patrick MacNamara and volunteers from the Pointe Pacific Homeowners Association Habitat Committee have been conducting invasive plant control for several years within and around their development. A goal of the group is to establish corridors between the Pointe Pacific development and the County Park through which Mission blues can expand their habitat. Over the last several years, the group has planted and maintained 20-30 native plant islands. These islands have been planted with *Lupinus albifrons*, *Phacelia californica*, and *Fescue*

idahoensis. In 2003, the group successfully propogated *Eriogonum latifolium* (coastal buckwheat) and will add these plants to the islands. MB were recorded utilizing Lupines within these plant islands in 2003. The volunteers are continuing to control orchard grass *(Dactylis glomerata)* and Bermuda buttercup (*Oxalis pes-caprae*).

d. Grazing and Burning

Grazing

Since the cessation of livestock grazing in the early 1960's and the more efficient prevention of fires since that time, the native prairie grassland has been threatened by the expansion of coastal scrub, and the influx of weeds. A stewardship grazing plan was written for the Mountain in April 2002 (D. Amme, 2002), and funding for a pilot grazing project was approved by the HCP Trustees in January 2003. This study will be used to determine how to best utilize grazing to enhance and restore native grasslands on San Bruno Mountain. Mowing may also be a useful tool in areas where slopes are accessible. The grazing experiment began in March 2003, with 120 goats and repeat grazing occurred in July with 470 goats. The grazing experiment also incorporated mowing treatments in different seasons and areas. Preliminary results are included as Appendix E (page 87).

2003 Prescribed burn

On July 8, 2003, a prescribed burn was conducted to remove Eucalyptus debris in Wax Myrtle Ravine. This prescribed burn was identified as the only feasible way to remove Eucalyptus slash within the ravine left behind by a past logging operation in 1995 (Wax Myrtle Ravine Restoration Plan, 2002). Phase I of the prescribed burn intended to burn a 4-acre area within the headwaters of the ravine, however, the fire escaped control lines and burned the entire ravine and additional slopes to the northeast (72.5 acres total).

The fire burned over grassland, coastal scrub, Eucalyptus (*Eucalyptus globulus*) forest, and dense patches of gorse (*Ulex europeaus*) and other invasive species. Both Eucalyptus and gorse are highly invasive species, and if left untreated will return and likely expand into new areas opened up by the fire. An erosion control and revegetation plan (Appendix D, page 84) was prepared and will be implemented beginning in February 2004.

The unintended extent of the burn required that the 175-Acres Enhancement Plan for San Bruno Mountain (County of San Mateo, November 2002), written to direct habitat restoration, exotics control, and trail restoration between 2002-2004, be amended to address the restoration of this additional area. The portion of Wax Myrtle Ravine that is within the original 175-acre enhancement plan area is approximately 10 acres. In December 2003, an amended Enhancement Plan was prepared by TRA. This amended restoration plan is focused upon restoring the area of Wax Myrtle Ravine and adjacent slopes to the east that burned on July 8, 2003. The restoration plan is currently being reviewed by the County and will be posted on the SBM Cooperative Website upon completion.

Planned burn

A controlled burn has been planned for the Juncus Ravine/Tank Ravine area since 2001. The goals of the burn are to conduct training for fire crews, reduce invasive species, and reinvigorate native plant species. The burn is scheduled to occur in summer 2004, if appropriate weather conditions can be met and California Department of Forestry can provide necessary support at that time.

Past burn

An uncontrolled burn occurred on the Southeast Ridge in August, 2002. The 18-acre burn burned a large patch of grassland containing CS habitat. The burn may provide important information for the use of burning on San Bruno Mountain. A report addressing the burn, monitoring methods, and burn policy of the HCP was completed in 2003 (dated 2002). The report is entitled *"Fire and Fire Suppression Policy Report"* and is available on the SBM Cooperative Website.

3. DEVELOPMENT ACTIVITIES

As of 2003, 300 acres of San Bruno Mountain have been developed. This is approximately 75% of the total development originally allowed under the HCP. Grading has yet to begin on an additional 105 acres. Approximately 80 acres have been graded and are subject to restoration activities. A report documenting the status of restoration work at each of the development areas will be submitted to the County and USFWS as part of the Callippe Amendment.

With the implementation of the HCP, take of MB butterfly habitat on San Bruno Mountain was authorized under the Endangered Species Act Section 10(a)(1)(B) Permit. Approximately 14% of the total MB habitat is allowed to be taken by development. As of 2003, 9% of this take has already occurred. Future take will be limited by the Callippe Amendment to only 2%, resulting in less take of MB habitat than was originally authorized. In 2003, development related activity which may have resulted in take of the MB occurred in the Mandalay Pointe (Phase 2 area) of the Terrabay project area (Administrative Parcel 2-04) during grading by Western Pacific Housing of approximately 13 acres for the 70 paired housing units and grading of one acre by Myers Development for the condo high rise site. Approximately 1/4 acre of MB habitat (consisting of 400 lupines) was destroyed by this grading.

Although take of 8% of Callippe habitat is allowable under the HCP, no take of CS occurred or was authorized in 2003. Since the listing of the CS in 1997, take of the CS or it's habitat (*Viola pedunculata*) either through development, routine maintenance, and/or restoration work is no longer authorized under the Habitat Conservation Plan. Preconstruction surveys were done to ensure that no *Viola* was growing in the areas to be graded by Western Pacific Housing and Myers Development. An amendment to the HCP is currently being developed under oversight by the USFWS to add CS to the take permit.

The 2004 San Bruno Mountain HCP Operating Program is included as Appendix F (page 98) to this report. A separate report documenting the status of restoration work at each of the development areas will be submitted to the USFWS as part of the Callippe Amendment.

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All documents/ resources available on-line at http://www.traenviro.com/sanbruno/ *or from County of San Mateo Parks and Recreation Division.*

Personal Communications:

Mike Forbert, West Coast Wildlands. Communications re: Exotics control

Charley Knight, California Polytechnic State University. Communications re: MB, CS, SBE data analysis.

Travis Longcore, Urban Wildlands Group. Communications re: CS monitoring

STUDY PARTICIPANTS

Annual report prepared by: Wendy Knight, Patrick Kobernus, Sharon Komarow, Casey Stewman, Victoria Harris and Tom Reid of Thomas Reid Associates

2003 Thomas Reid Associates Field Crew: Wendy Knight, Patrick Kobernus, Sharon Komarow, Eben Polk, Casey Stewman.

County Coordinators for San Bruno Habitat Conservation Plan: Sam Herzberg and Roman Gankin

TRA Subconsultants and Area of Expertise:

Exotic Pest Plant Control: West Coast Wildlands, Michael Forbert, Supervisor
Native Plant Restoration: Shelterbelt Builders, Inc. Mark Heath, Supervisor

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Pointe Pacific Homeowners Association
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Intern: Lillian Haney

FIGURE 1

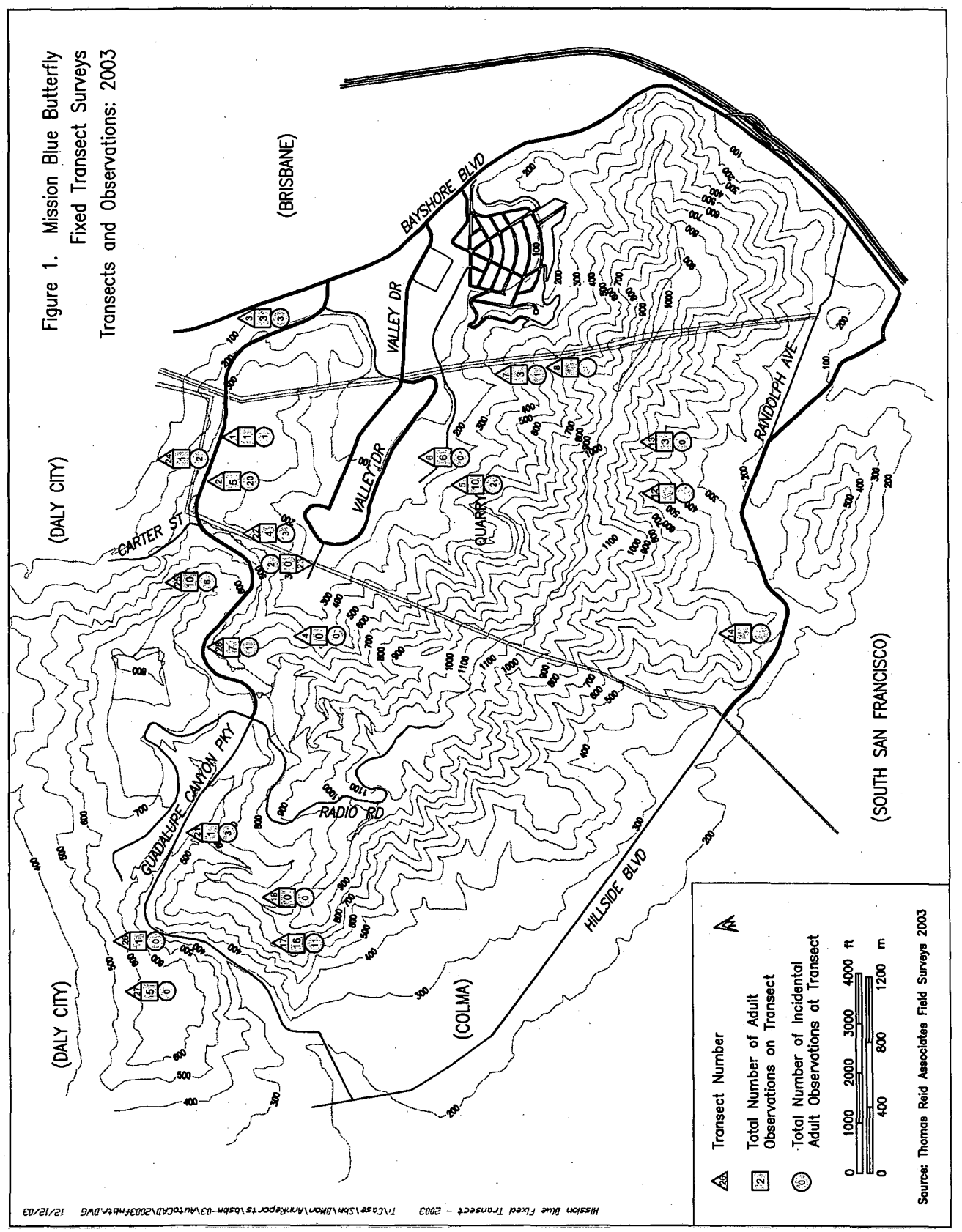
Figure 1. Mission Blue Butterfly Fixed Transect Surveys Transects and Observations: 2003
(DALY CITY)
(BRISBANE)
(COLMA)
(SOUTH SAN FRANCISCO)
BAYSHORE BLVD
VALLEY DR
CARTER ST
QUARRY
RANDOLPH AVE
GUADALUPE CANYON PKY
RADIO RD
HILLSIDE BLVD
Transect Number
Total Number of Adult Observations on Transect
Total Number of Incidental Adult Observations at Transect
0 1000 2000 3000 4000 ft
0 400 800 1200 m
Source: Thomas Reid Associates Field Surveys 2003
Mission Blue Fixed Transect - 2003 T:\Case\SBM\BMon\AnnReports\bsbm-03\AutoCAD\2003fmbtr.dwg 12/12/03

FIGURE 2

Figure 2. Mission blue transects: Mean number of observations per year: 1998-2003

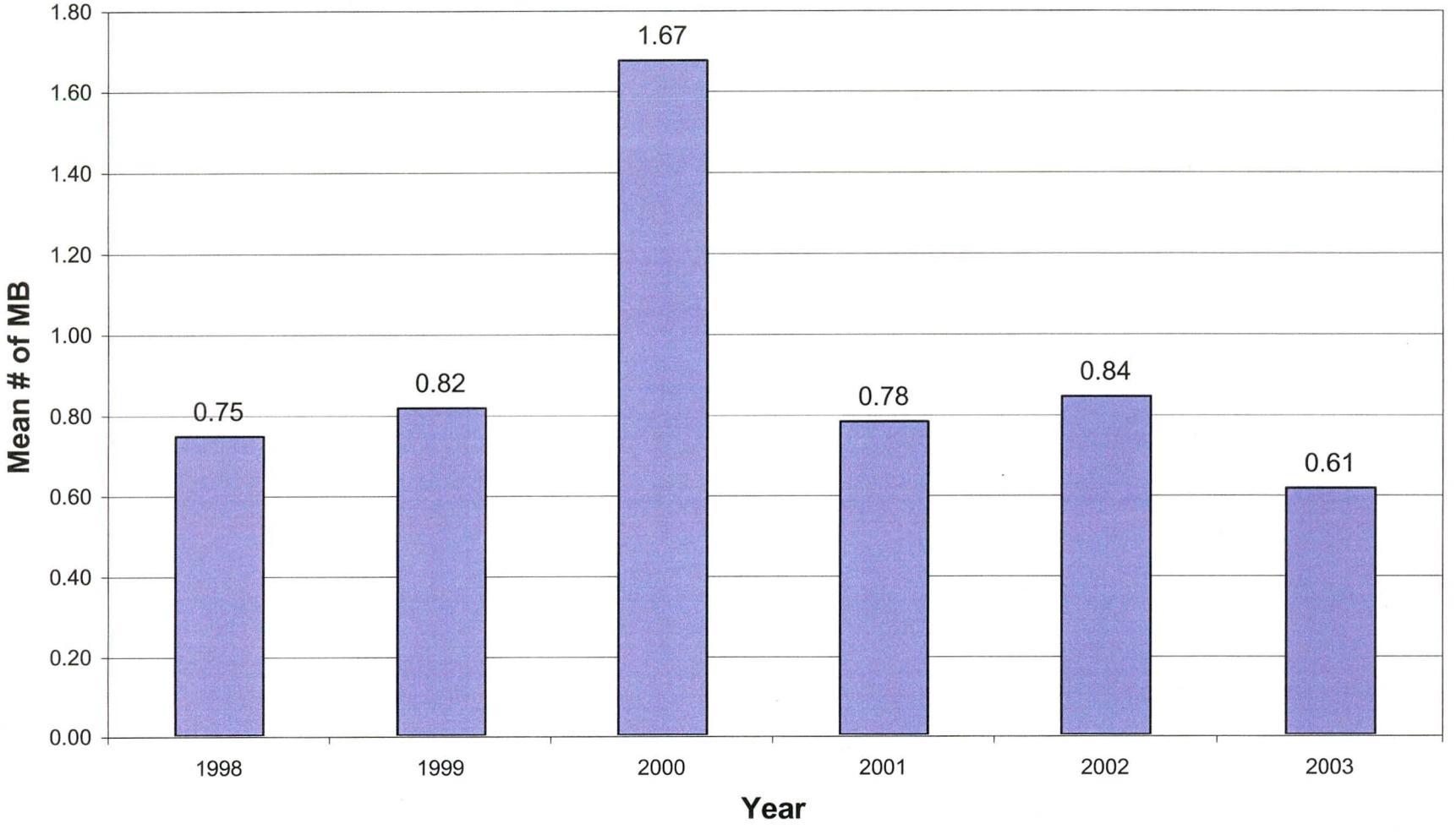

FIGURE 3

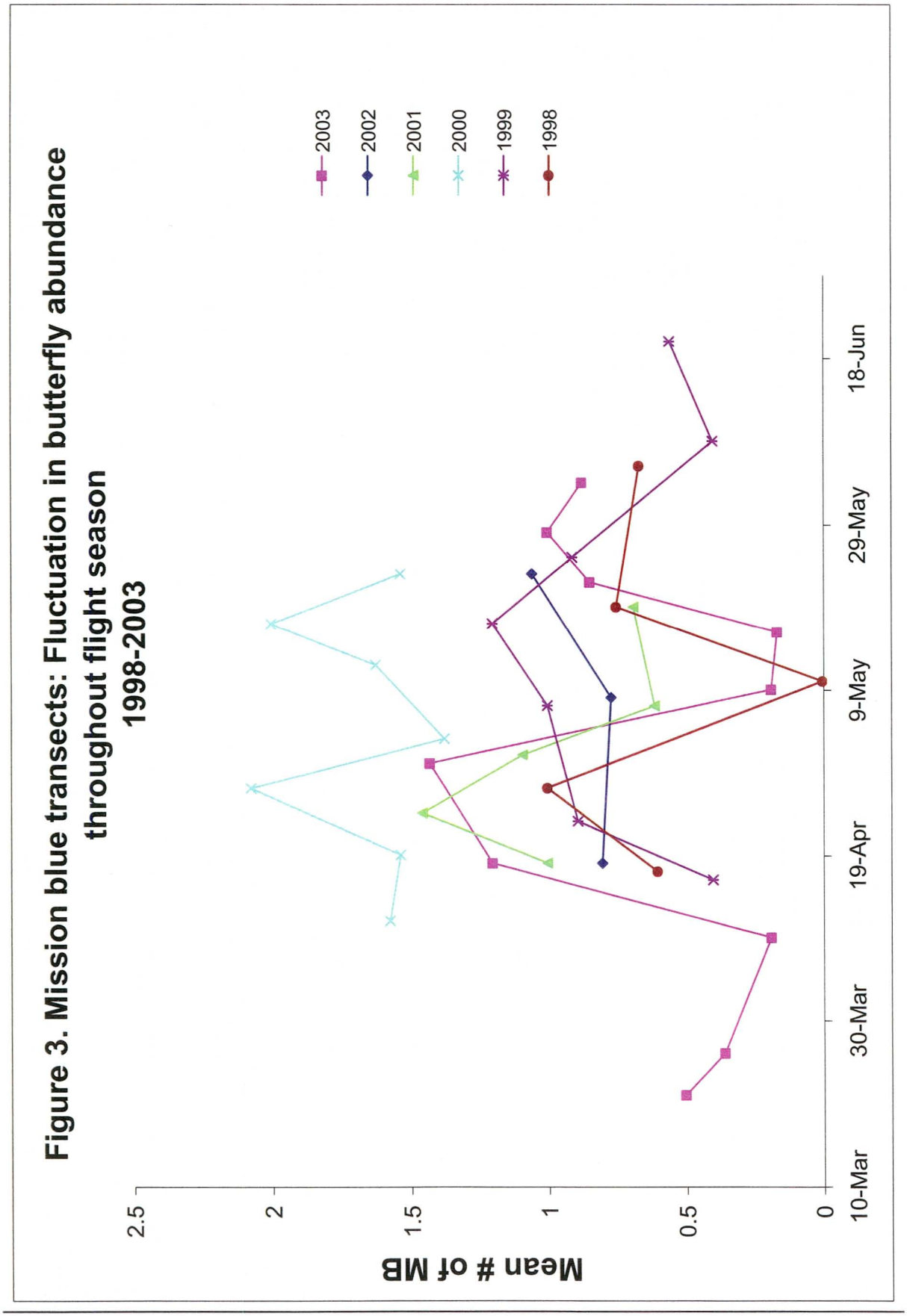
Figure 3. Mission blue transects: Fluctuation in butterfly abundance throughout flight season 1998-2003
2003
2002
2001
2000
1999
1998
Mean # of MB
2.5
2
1.5
1
0.5
0
10-Mar
30-Mar
19-Apr
9-May
29-May
18-Jun

FIGURE 4

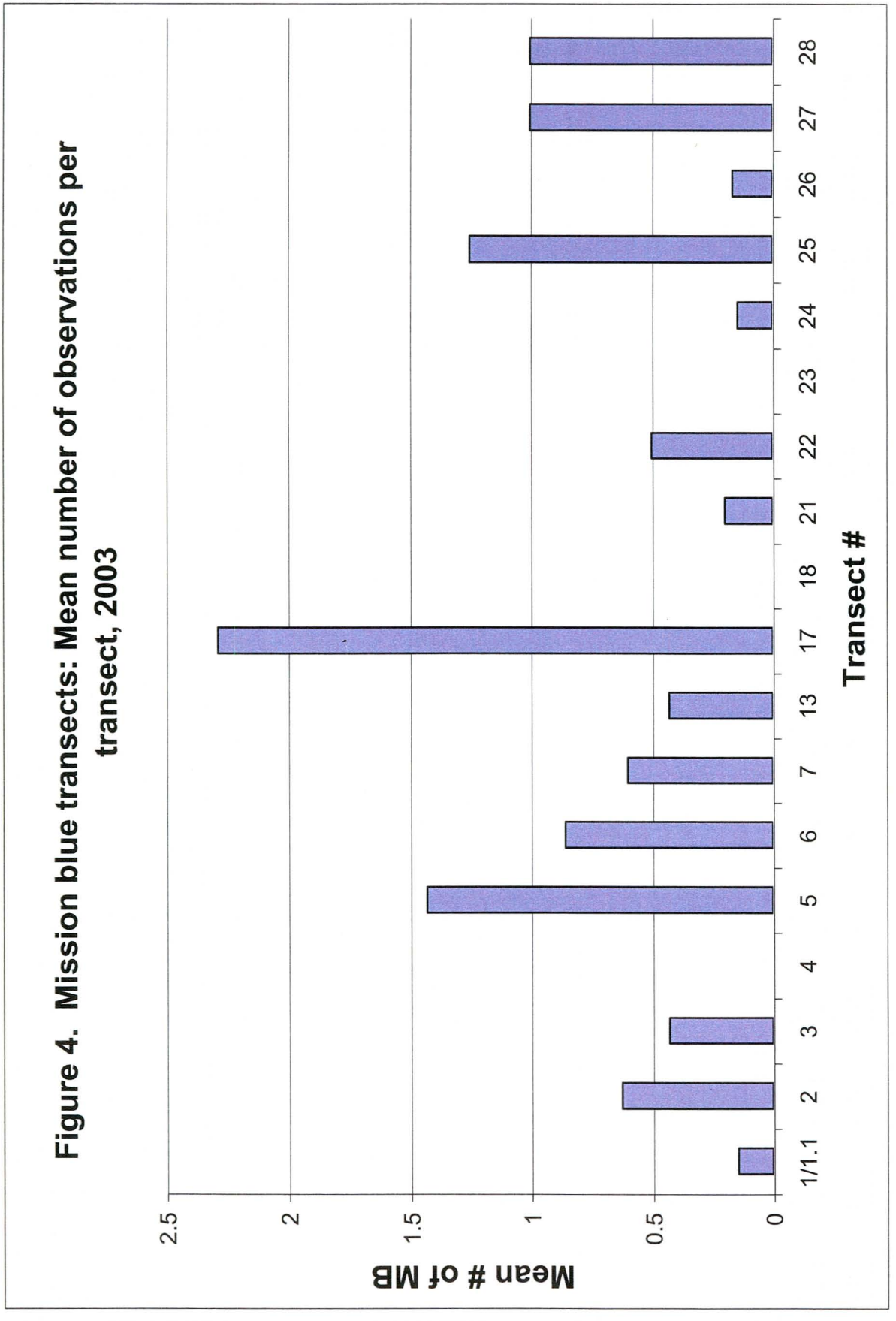
Figure 4. Mission blue transects: Mean number of observations per transect, 2003
Mean # of MB
2.5
2
1.5
1
0.5
0
1/1.1
2
3
4
5
6
7
13
17
18
21
22
23
24
25
26
27
28
Transect #

FIGURE 5

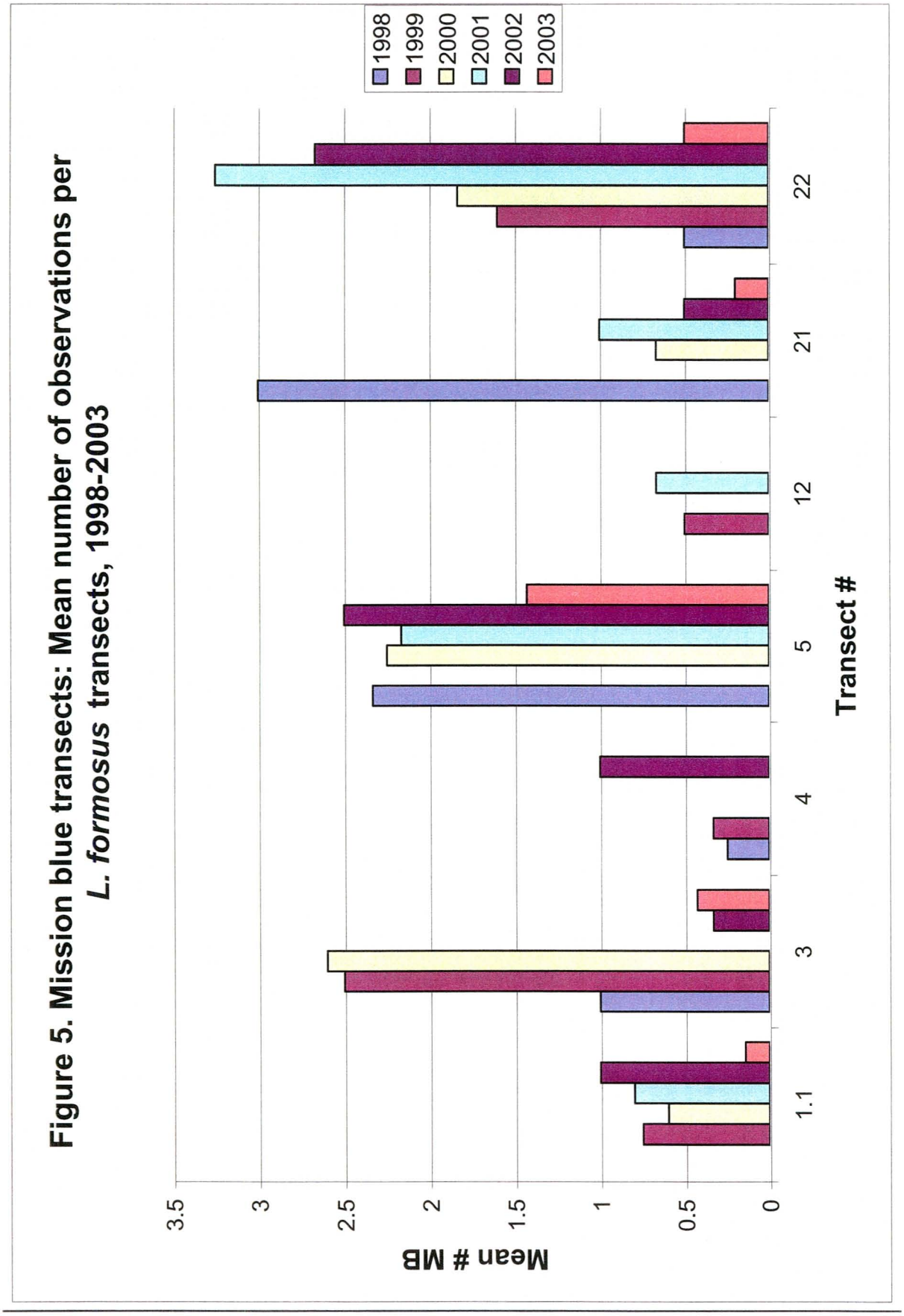

Figure 5. Mission blue transects: Mean number of observations per *L. formosus* transects, 1998-2003

FIGURE 6

Figure 6. Mission blue transects: Mean number of observations per *L. albifrons* transects, 1998-2003

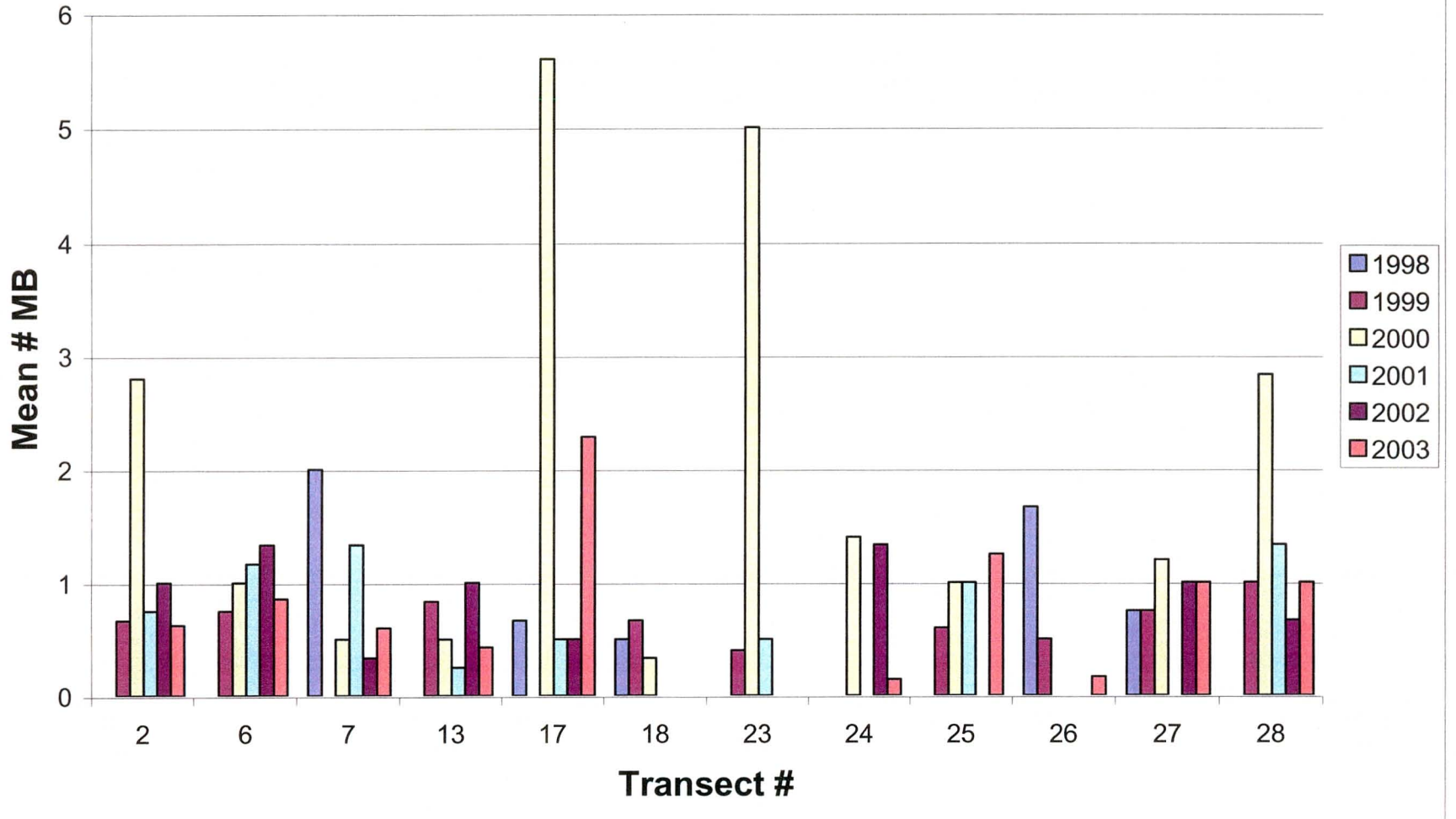

FIGURE 7

Figure 7. Rainfall (by month) on San Bruno Mountain 1997-98-----2002-03 Rain Years

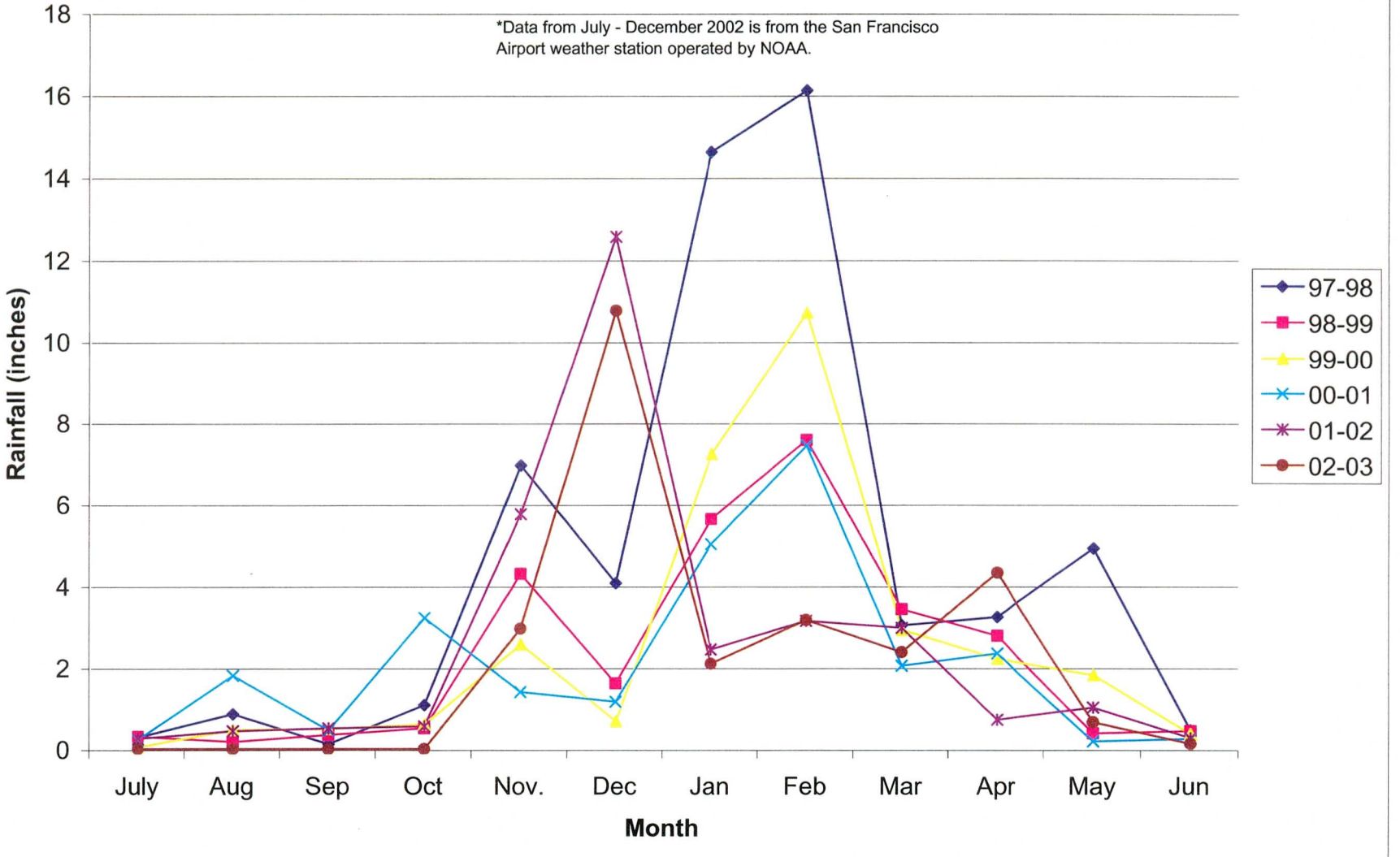

FIGURE 8

Figure 8. Mission Blue and Callippe Silverspot Wandering Surveys and Observations: 2003

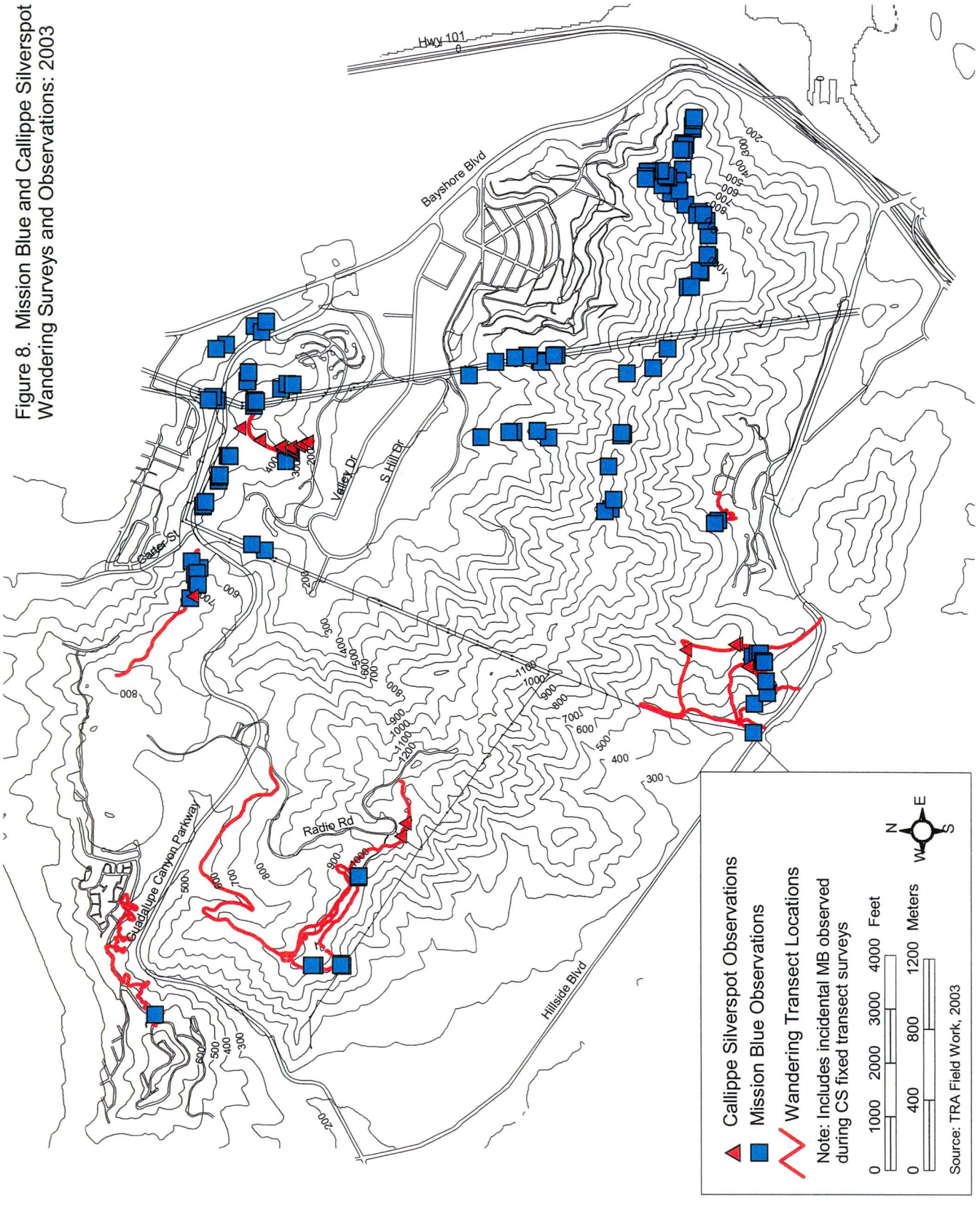

FIGURE 9

Figure 9. Callippe Silverspot Fixed Transects and Observations: 2003

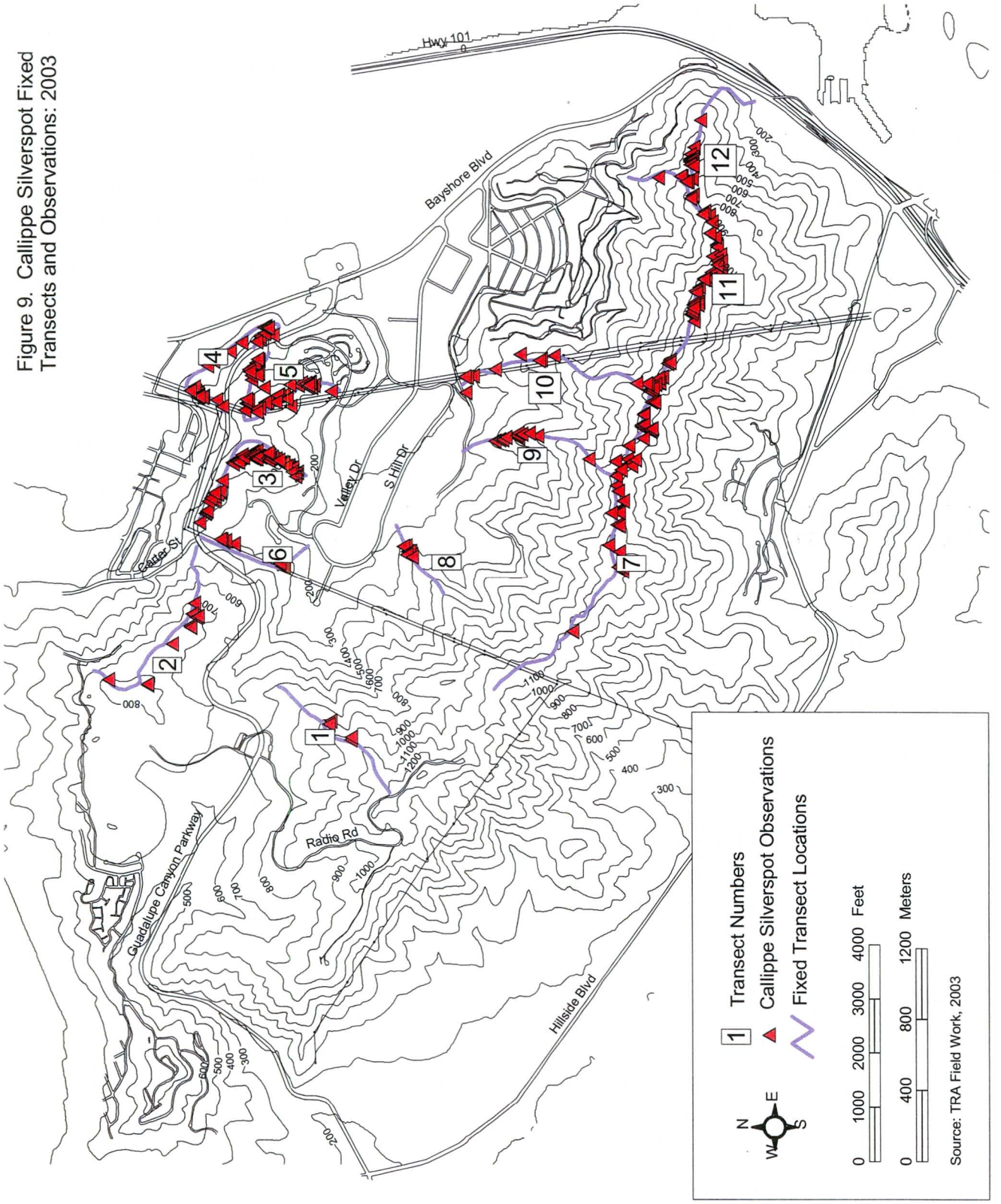

FIGURE 10

Figure 10. Callippe silverspot transects: Mean number of observations per year, 2000-2003

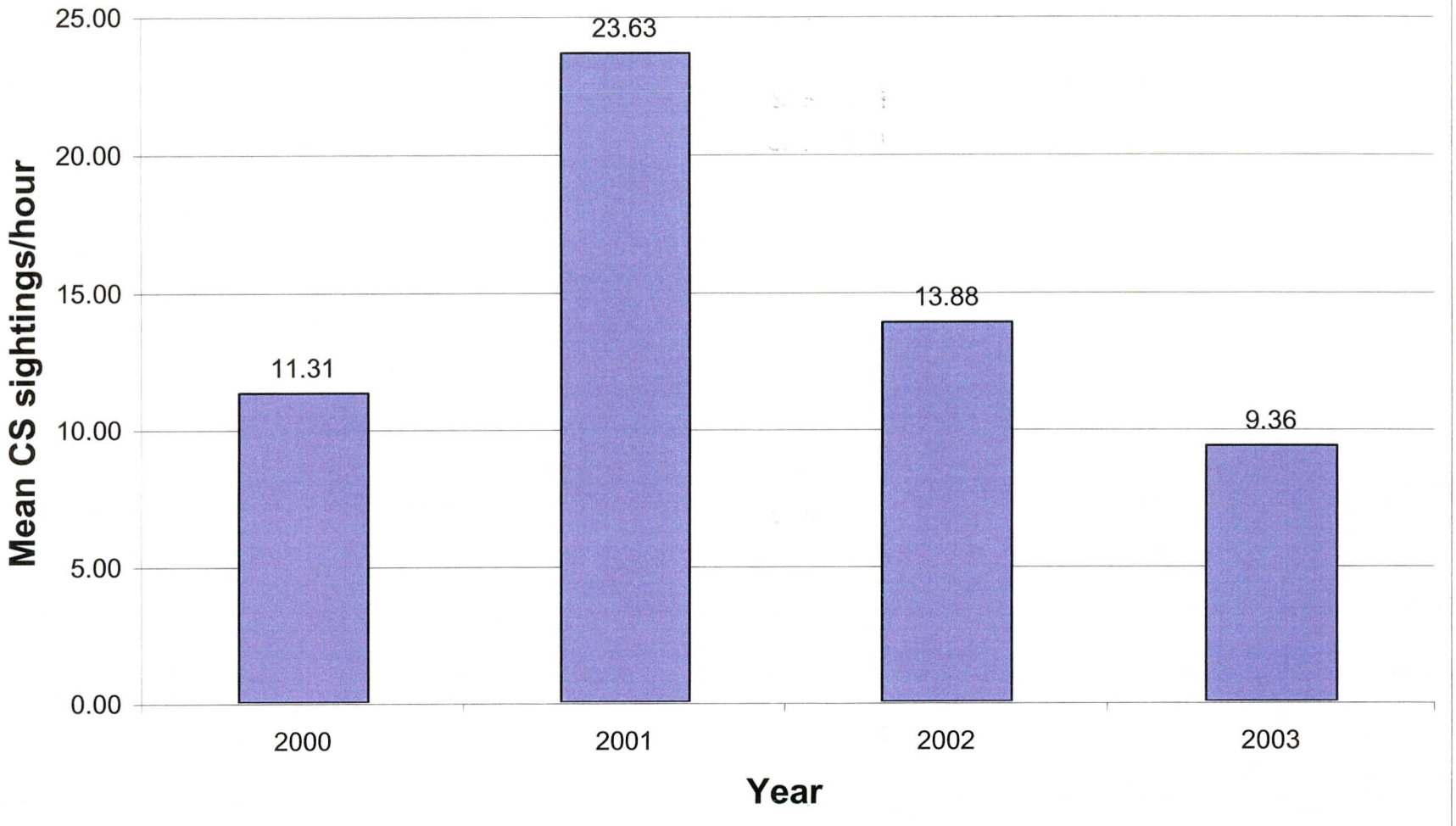

FIGURE 11

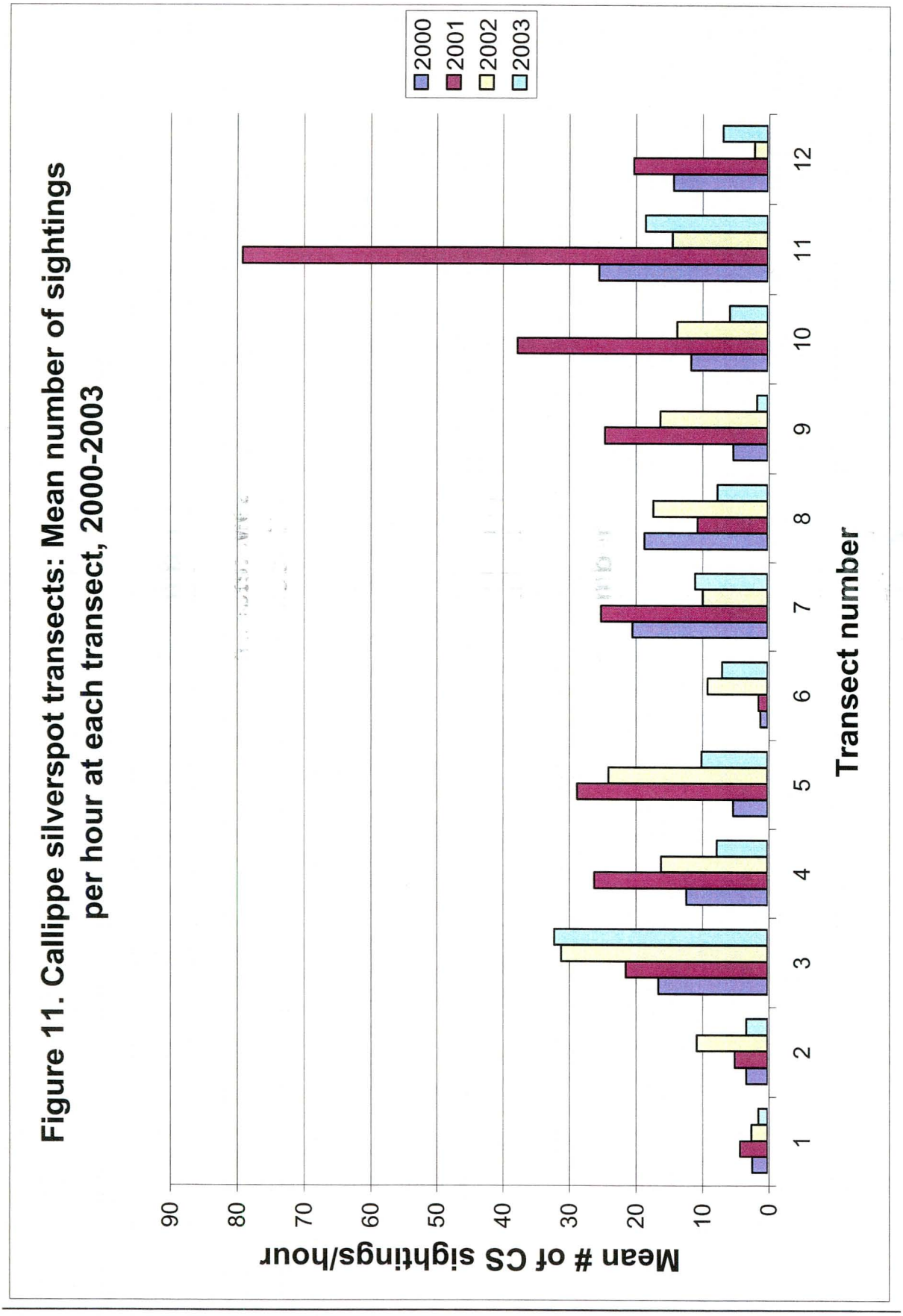

Figure 11. Callippe silverspot transects: Mean number of sightings per hour at each transect, 2000-2003

FIGURE 12

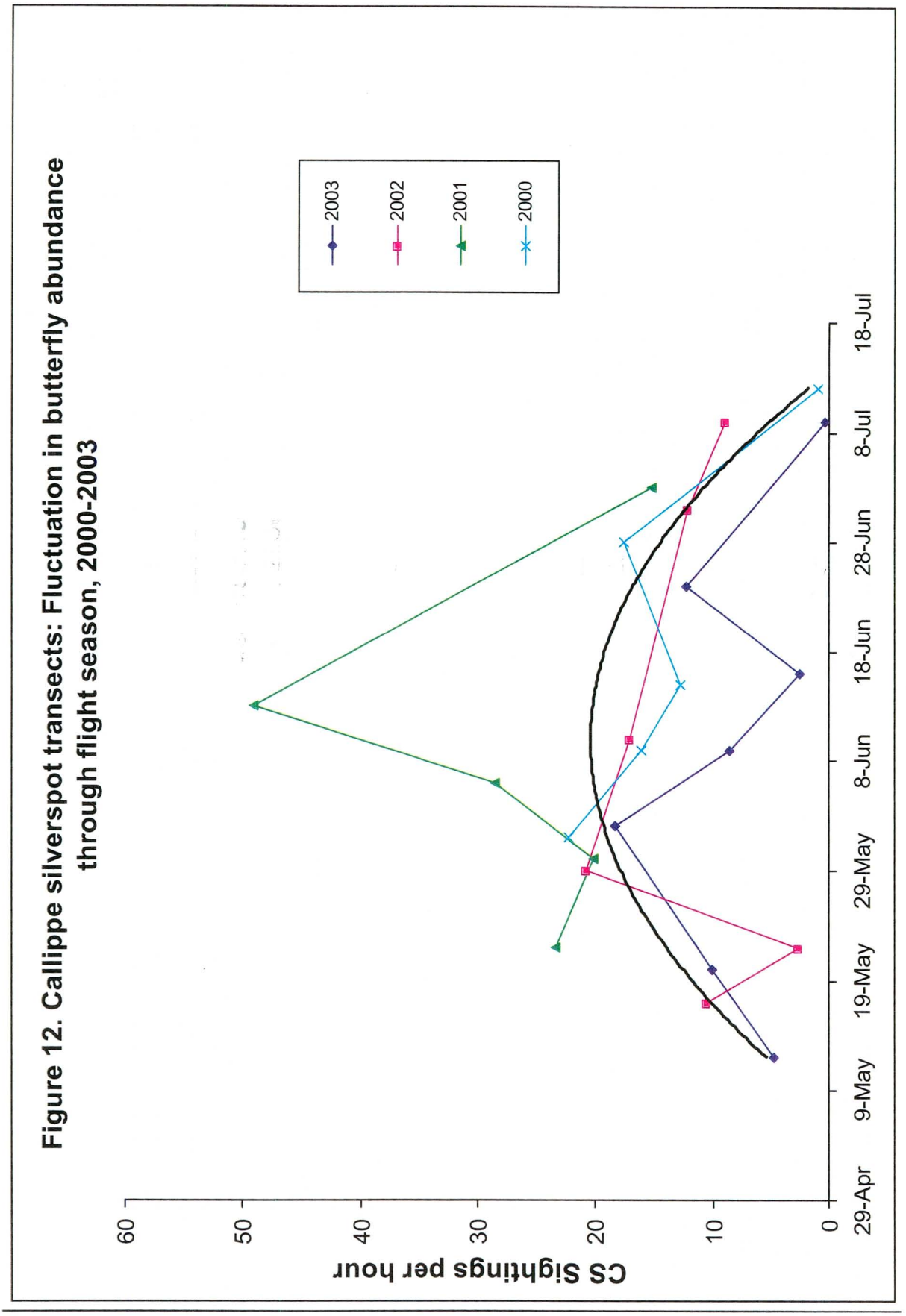

Figure 12. Callippe silverspot transects: Fluctuation in butterfly abundance through flight season, 2000-2003

FIGURE 13

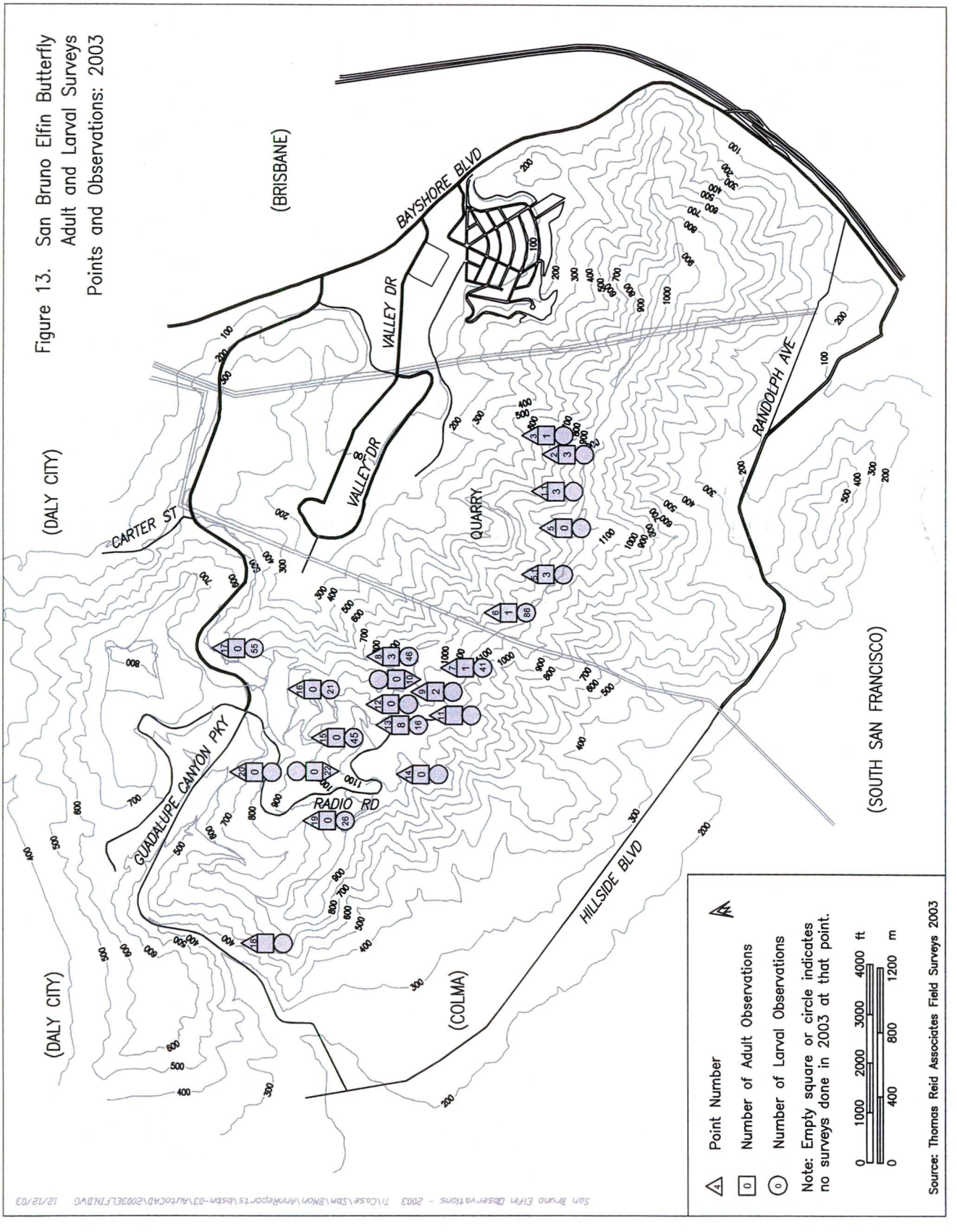
Figure 13. San Bruno Elfin Butterfly
Adult and Larval Surveys
Points and Observations: 2003
(DALY CITY)
(BRISBANE)
(COLMA)
(SOUTH SAN FRANCISCO)
BAYSHORE BLVD
VALLEY DR
CARTER ST
GUADALUPE CANYON PKY
RADIO RD
QUARRY
HILLSIDE BLVD
RANDOLPH AVE
Point Number
Number of Adult Observations
Number of Larval Observations
Note: Empty square or circle indicates no surveys done in 2003 at that point.
0 1000 2000 3000 4000 ft
0 400 800 1200 m
Source: Thomas Reid Associates Field Surveys 2003

FIGURE 14

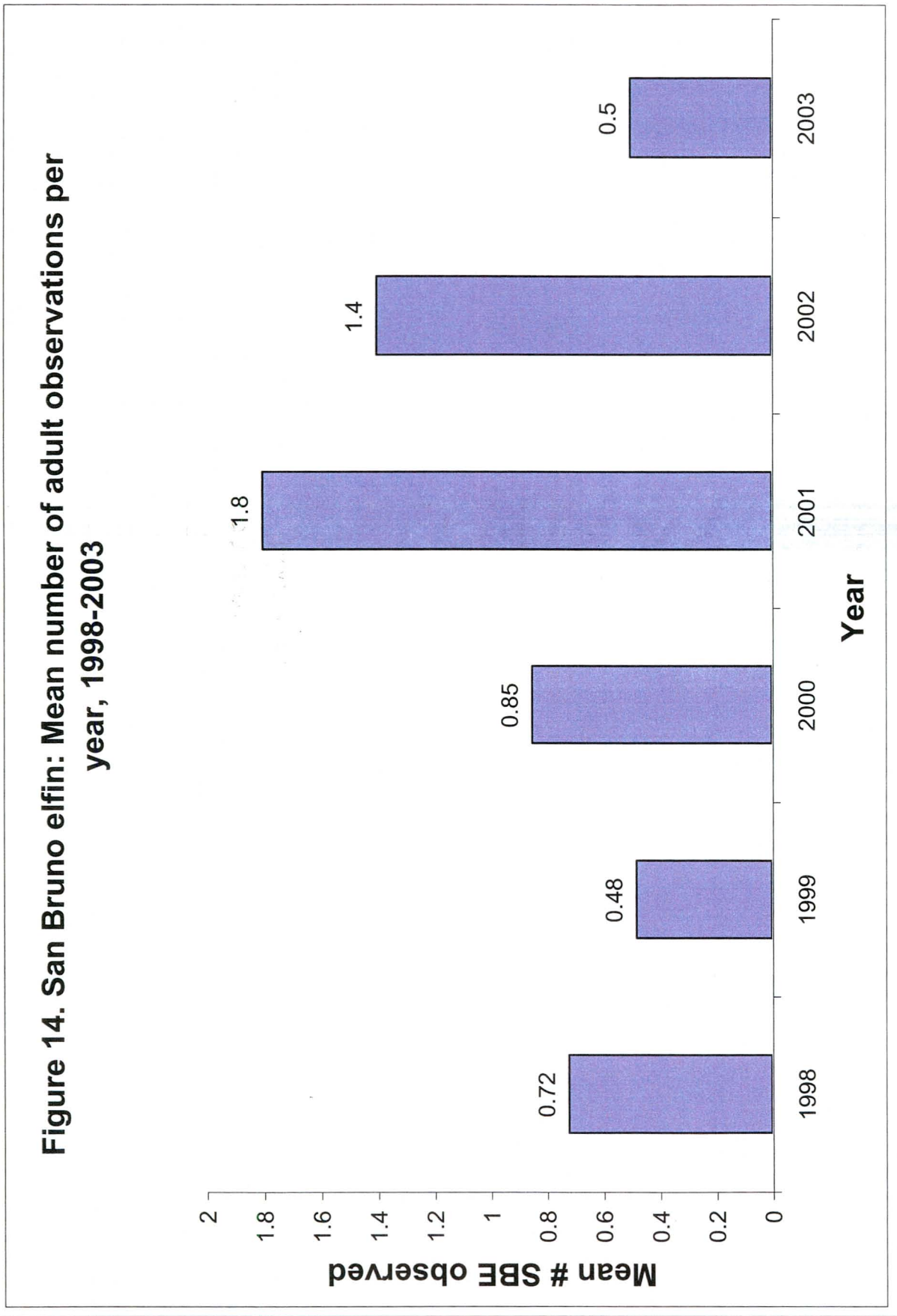
Figure 14. San Bruno elfin: Mean number of adult observations per year, 1998-2003
Mean # SBE observed
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.72
0.48
0.85
1.8
1.4
0.5
1998
1999
2000
2001
2002
2003
Year

FIGURE 15

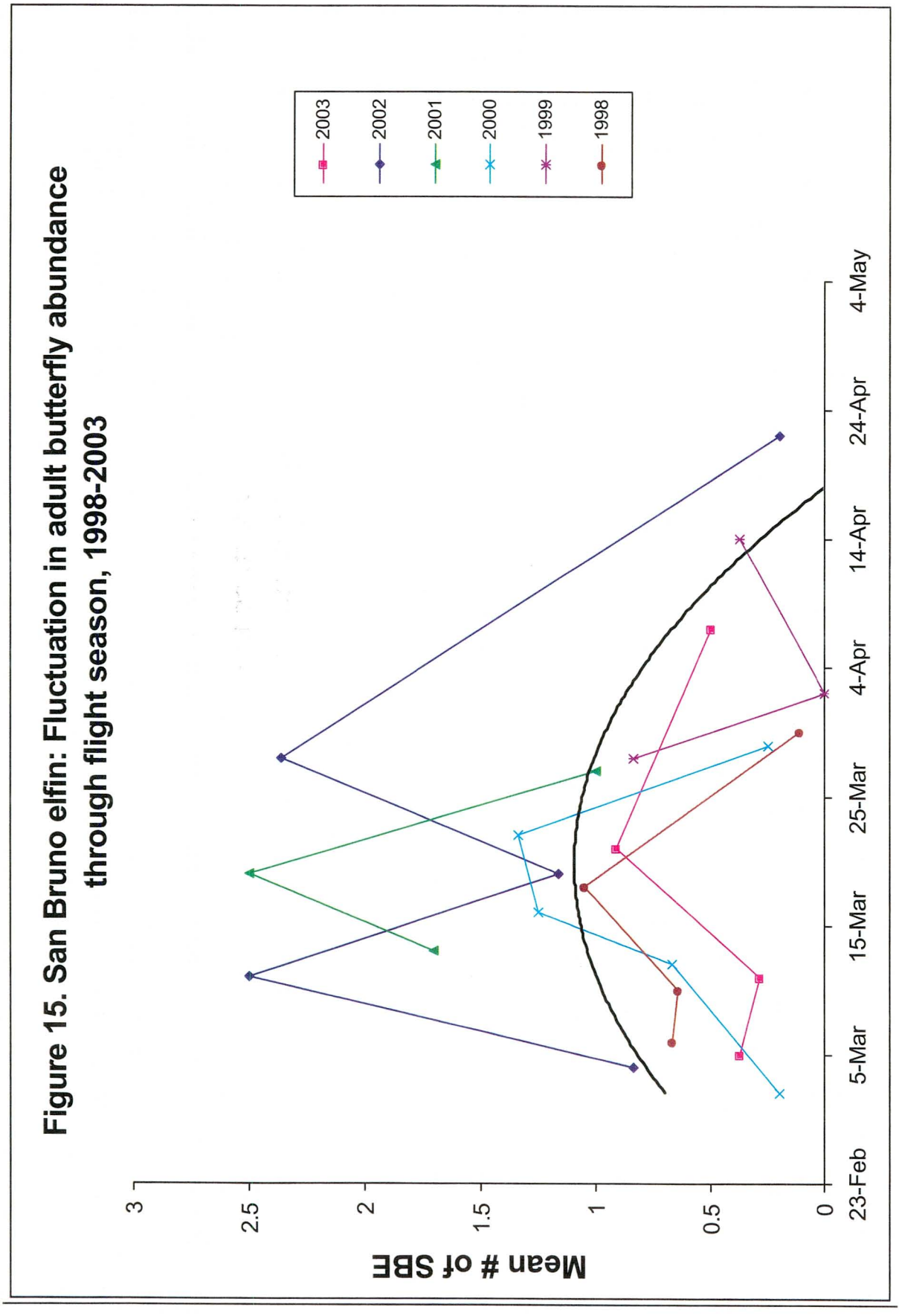

Figure 15. San Bruno elfin: Fluctuation in adult butterfly abundance through flight season, 1998-2003

FIGURE 16

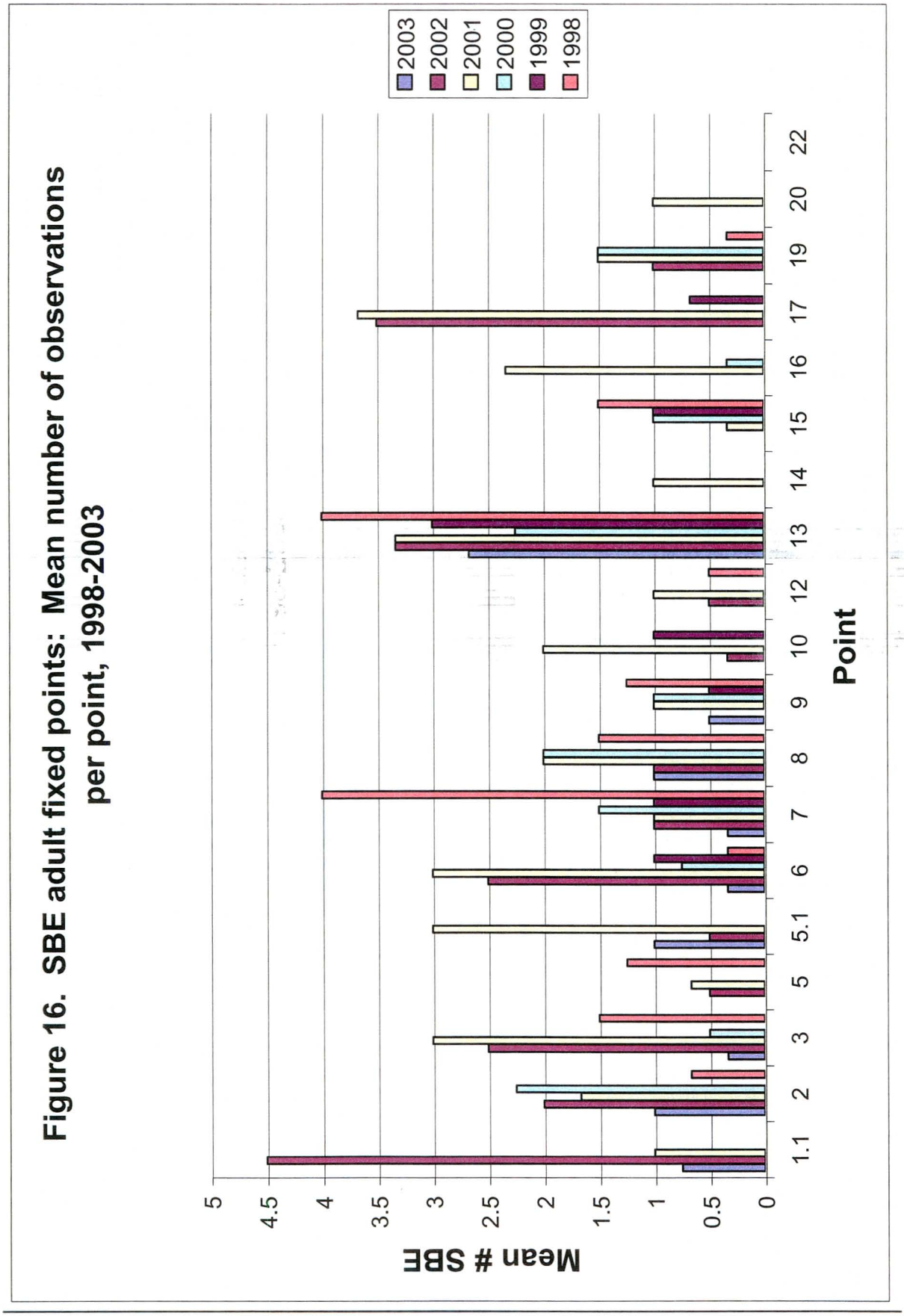

Figure 16. SBE adult fixed points: Mean number of observations per point, 1998-2003

FIGURE 17

Figure 17. SBE larvae counts: Number of larvae at each Point, 2000-2003

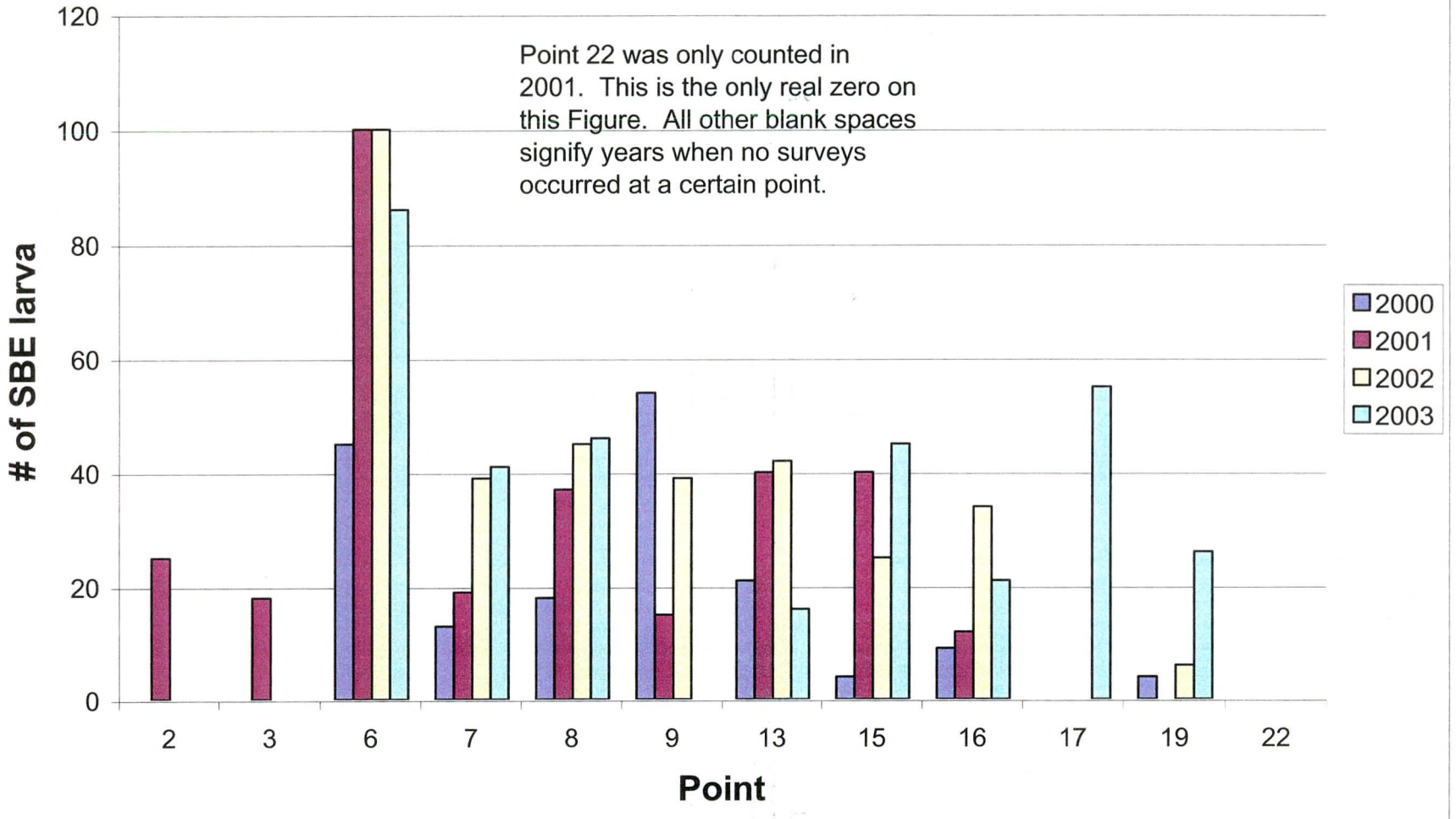

FIGURE 18

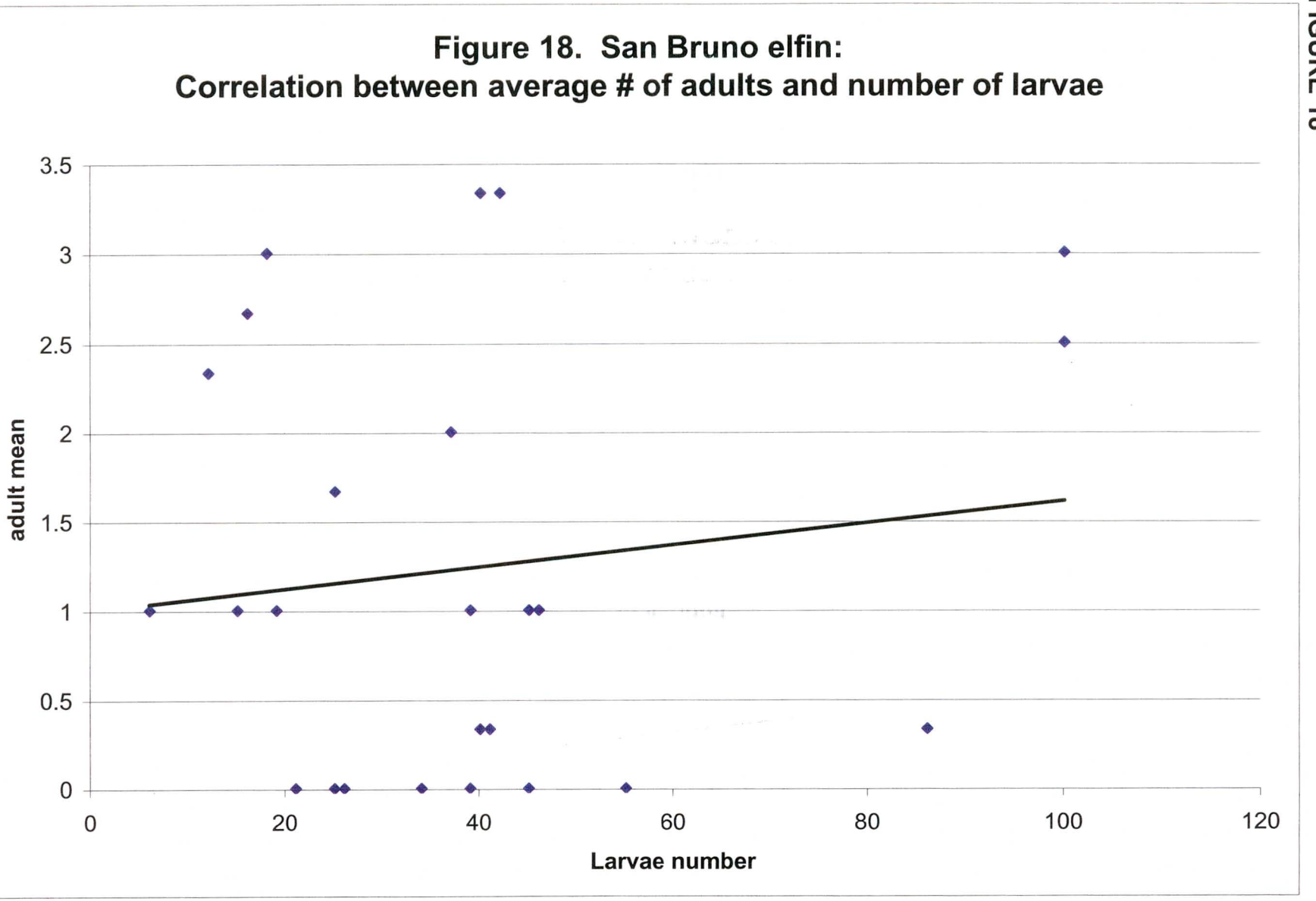
Figure 18. San Bruno elfin:
Correlation between average # of adults and number of larvae
adult mean
3.5
3
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
120
Larvae number

FIGURE 19

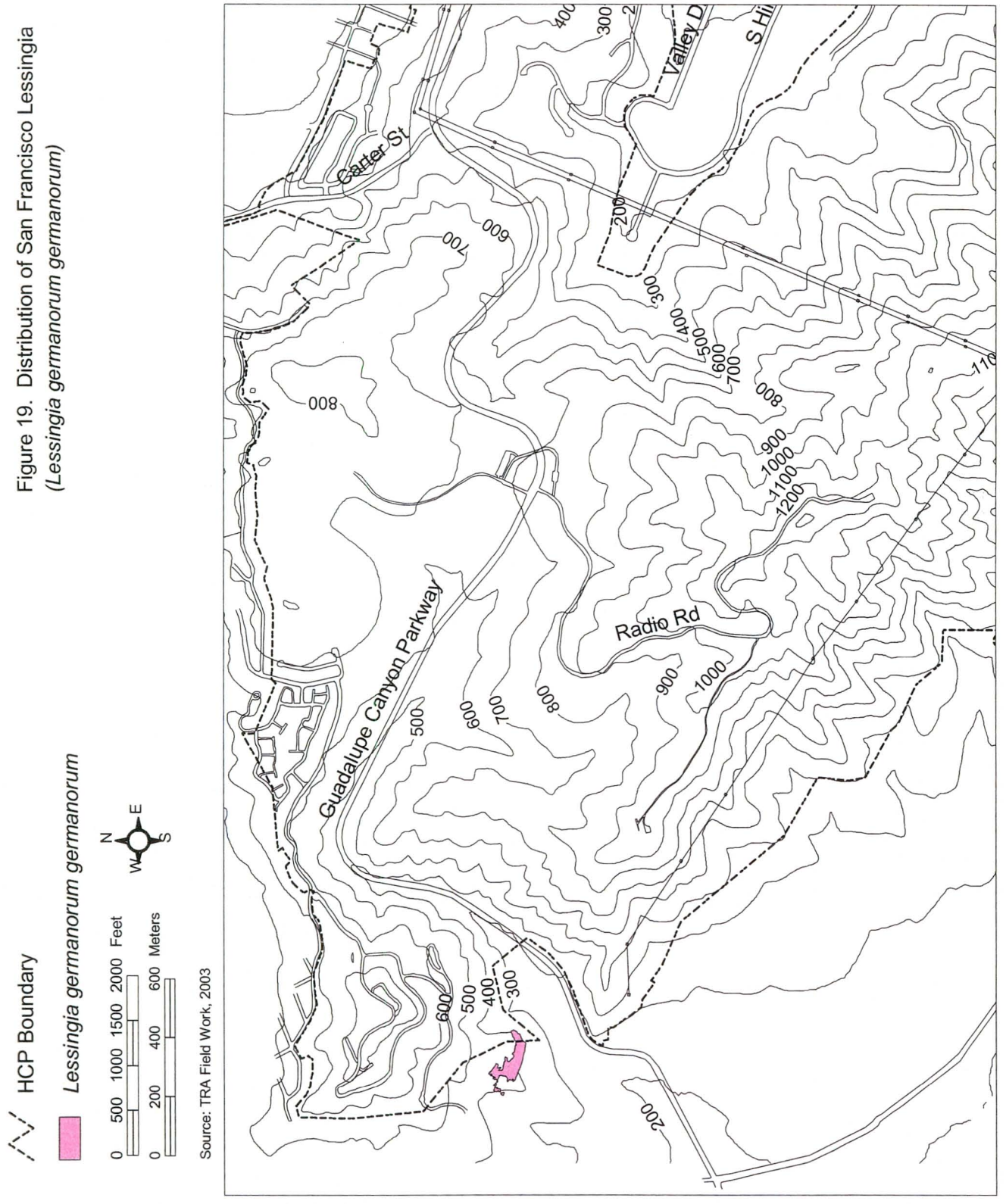

Figure 19. Distribution of San Francisco Lessingia (*Lessingia germanorum germanorum*)

FIGURE 20

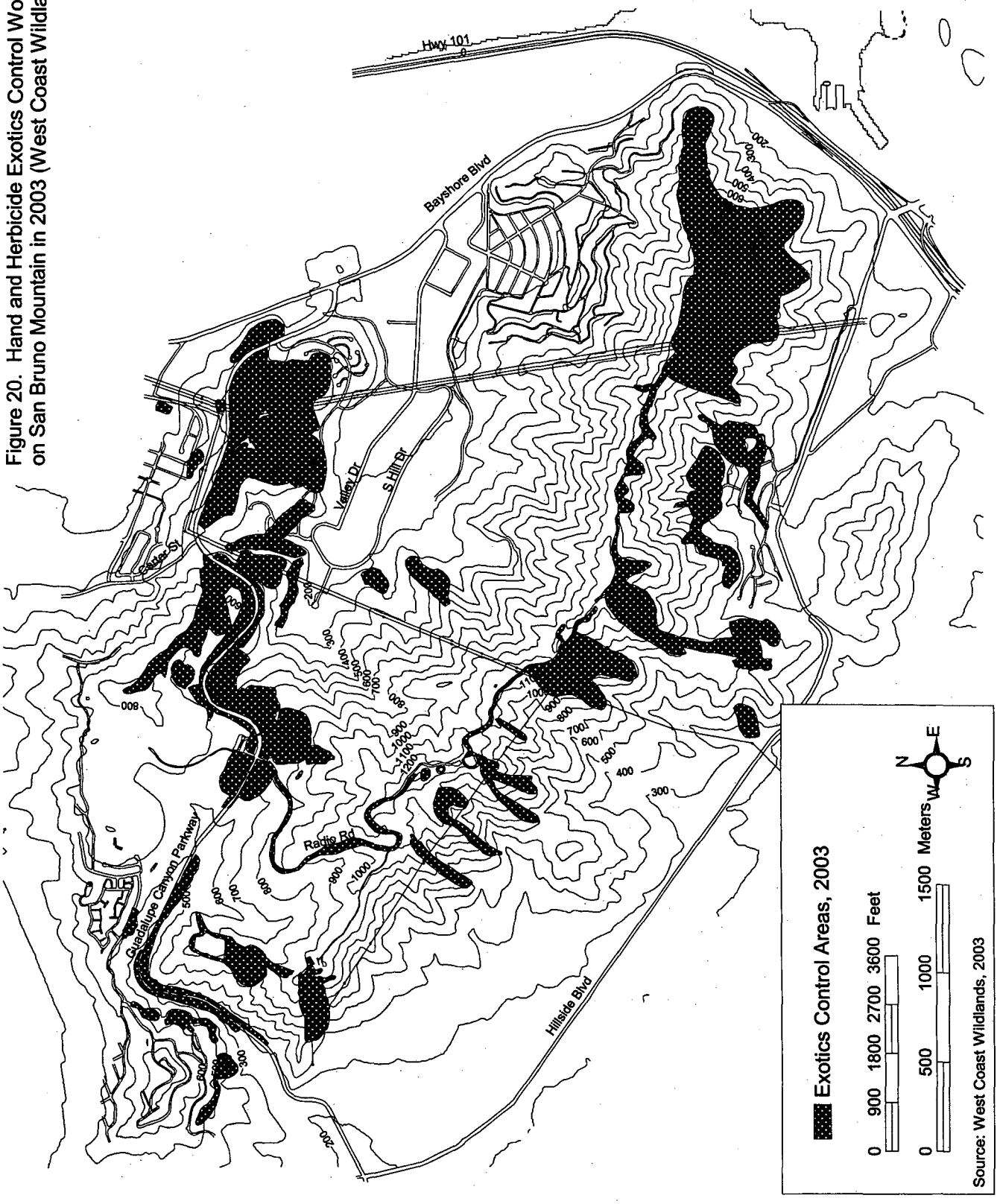

Figure 20. Hand and Herbicide Exotics Control Work on San Bruno Mountain in 2003 (West Coast Wildlands)

TABLE A-1. MISSION BLUE FIXED TRANSECT DATA 2003

The following data has been culled and was used for the ANOVA analysis.

Week	Date	Transect #	# MB	Mean Wind <5mph	Temp > 18C	Start Time
1	21-Mar	17	6	2.8	21.6	11:05
1	21-Mar	18	0	3.7	20.6	10:43
1	25-Mar	1.1	0	1.8	22.1	13:17
1	25-Mar	3	0	1.8	18.5	12:09
1	25-Mar	4	0	1.5	22.1	11:49
1	25-Mar	5	0	2.2	22.8	11:21
1	25-Mar	6	1	0.5	22	11:01
1	25-Mar	7	0	1.1	19.7	10:39
1	25-Mar	13	1	1.7	24.5	13:00
1	25-Mar	26	1	2.3	20	12:10
1	25-Mar	27	1	2	20	12:18
1	25-Mar	28	0	1.7	20.2	15:51
1	27-Mar	2	2	2.4	21.8	11:30
1	27-Mar	22	1	4.6	25.6	10:23
1	27-Mar	23	0	3.1	25.6	10:18
1	27-Mar	25	0	4.9	18.5	10:55
4	9-Apr	1.1	1	4.1	22.1	13:03
4	9-Apr	2	0	0.8	23.2	12:42
4	9-Apr	4	0	2.2	25	13:20
4	9-Apr	17	7	1.3	23.3	10:28
4	9-Apr	18	0	1	21.4	10:11
4	9-Apr	21	0	3.4	19.1	9:54
4	9-Apr	22	0	1.7	21.8	11:24
4	9-Apr	23	0	2	21.2	11:42
4	9-Apr	24	0	1.3	23.9	12:19
4	9-Apr	25	1	2.1	23	11:59
4	9-Apr	28	2	1	24.3	10:52
4	10-Apr	3	0	4.2	19.4	13:44
4	10-Apr	5	0	1.8	19.2	13:20
4	10-Apr	6	0	1.4	27.2	13:08
4	10-Apr	7	0	2	22.1	13:21
4	10-Apr	13	1	3.2	19.2	11:49
5	15-Apr	13	0	2.2	21.3	11:40
5	18-Apr	1.1	0	3.6	20.6	12:37
5	18-Apr	2	1	3	21.3	12:18
5	18-Apr	3	0	3.3	22.8	13:14
5	18-Apr	4	0	1.7	25	13:14
5	18-Apr	5	0	0.5	23.2	13:14
5	18-Apr	6	3	4.5	19.2	13:14
5	18-Apr	18	0	5	20.2	13:14
5	18-Apr	22	0	2.2	21	11:59
5	18-Apr	24	0	4.3	22.2	13:14
5	18-Apr	25	3	3.7	20.9	11:25
5	18-Apr	26	0	3.5	22	13:11
5	18-Apr	27	3	2	22	13:14
5	18-Apr	28	1	0.5	18.2	11:01
5	19-Apr	17	2	5	21.2	13:06
7	30-Apr	1.1	0	1.5	21.1	11:20

- MB 1998 -2003 data continued -						
Week	Date	Transect #	# MB	Mean Wind <5mph	Temp > 18C	Start Time
7	30-Apr	2	1	2.9	18.6	10:30
7	30-Apr	3	0	2.4	25	11:20
7	30-Apr	4	0	1.5	24.2	11:40
7	30-Apr	5	2	1.5	22.8	?
7	30-Apr	6	1	0.8	23.3	11:55
7	30-Apr	7	2	2.2	18.4	12:04
7	30-Apr	13	0	1.6	18.9	12:00
7	30-Apr	21	0	3.2	19	10:40
7	30-Apr	22	1	0.7	19.3	10:01
7	30-Apr	23	0	4.5	18.3	10:05
7	30-Apr	24	0	2.7	22.4	10:50
7	30-Apr	25	1	2.5	18.9	10:28
7	30-Apr	26	0	2.4	18	11:07
8	9-May	1.1	0	1.3	26.2	11:09
8	9-May	2	0	2.2	22.3	11:20
8	9-May	3	1	2.5	22.2	11:38
8	9-May	4	0	2.1	21.5	12:17
8	9-May	5	2	0.8	23.3	12:03
8	9-May	6	0	1.9	22.8	11:52
8	9-May	13	1	3	21.2	12:16
8	9-May	17	1	4.5	20.5	2:10
8	9-May	21	0	3.5	21.5	11:48
8	9-May	22	0	3.1	23.6	10:52
8	9-May	23	0	4.1	19.3	10:42
8	9-May	24	0	2.8	20.3	10:42
8	9-May	25	1	3	18.1	10:23
8	9-May	26	0	4.8	22.8	10:54
8	9-May	27	1	4.2	22.8	10:58
8	9-May	28	0	2.7	19.8	10:27
9	16-May	1.1	0	0.8	24.8	11:30
9	16-May	2	1	3.9	23.3	11:08
9	16-May	3	0	1.5	29.9	11:31
9	16-May	4	0	1.8	26.1	10:56
9	16-May	5	3	3	26.7	10:26
9	16-May	6	1	1.3	22.6	10:17
9	16-May	7	0	1.2	22.4	10:00
9	16-May	13	0	4.2	26.2	12:12
9	16-May	17	0	2.2	26.3	11:58
9	16-May	18	0	1.6	24.3	11:30
9	16-May	21	1	4.5	21.2	10:46
9	16-May	22	1	2.5	22.8	9:52
9	16-May	23	0	3.6	22	0:00
9	16-May	24	1	1.1	24.4	10:47
9	16-May	25	0	3.6	21.7	10:25
9	16-May	28	0	1.7	23.2	11:43
9	17-May	26	0	2.1	22.5	10:24
9	17-May	27	0	3	19	10:33
10	21-May	6	0	1.5	28	11:56
10	21-May	7	1	1.5	28	11:42

- MB 1998 -2003 data continued -						
Week	Date	Transect #	# MB	Mean Wind <5mph	Temp > 18C	Start Time
10	22-May	1.1	0	2.3	19.6	11:42
10	22-May	3	2	3.9	24.3	11:22
10	22-May	4	0	1.4	21.6	9:52
10	22-May	5	3	3	24	11:28
10	23-May	13	0	4.4	24.4	12:08
10	23-May	18	0	4.1	20.2	11:28
10	23-May	21	0	3.9	20	10:33
10	23-May	22	1	4.2	24.9	10:13
10	23-May	23	0	4.3	23	10:20
10	23-May	24	0	2.4	25.5	10:59
10	23-May	28	3	1.7	20.7	12:06
11	27-May	2	0	2.4	31.4	11:11
11	27-May	26	0	4.5	26.9	12:36
11	27-May	27	0	4.5	26.9	12:33
11	28-May	17	0	1.7	21.8	9:40
11	28-May	25	1	1.1	28.2	9:39
12	3-Jun	2	0	1.4	30.2	
12	3-Jun	17	0	3.1	25.2	
12	3-Jun	18	0	3.6	27.4	
12	3-Jun	22	0	2.1	28.3	
12	3-Jun	23	0	2.4	27.3	
12	3-Jun	24	0	4.5	29.3	
12	3-Jun	25	3	2.6	27	
12	3-Jun	28	1	2	28.3	

TABLE A-2. ANOVA TABLE FOR MISSION BLUE ANALYSIS 1998 – 2003

DESIGN

Dependent variables

Name	Code
# MB	#M

Type of analysis: OLS ANOVA

Factors

Name	Code	Nested in	F/R	Kind
Transect #	T#	()	Fix	Disc
Year	Yr	()	Fix	Disc

Partial (Type 3) Sums of Squares

Interactions up to 1 - way

No Modifications

RESULTS

General Results

410 total cases

ANOVA

Analysis of Variance For **# MB**
No Selector

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Const	1	359.649	359.649	225.94	≤ 0.0001
T#	18	142.61	7.92278	4.9772	≤ 0.0001
Yr	5	52.6574	10.5315	6.6161	≤ 0.0001
Error	386	614.435	1.5918		
Total	409	810.351			

Results for factor Yr

Coefficients

Expected Cell Means

Expected Cell Means of: # MB on Yr

Level of Yr	Expected Cell Mean	Cell Count
1998	0.7565	39
1999	0.9311	59
2000	1.635	76
2001	0.8124	69
2002	0.8943	46
2003	0.5956	121

Scheffe Post Hoc Tests

	Difference	std. err.	Prob
1999 - 1998	0.174599	0.2687	0.994658
2000 - 1998	0.878764	0.2509	0.0331965
2000 - 1999	0.704165	0.2299	0.0975337
2001 - 1998	0.055982	0.2563	0.999974
2001 - 1999	-0.118617	0.2374	0.998472
2001 - 2000	-0.822782	0.2128	0.0116171
2002 - 1998	0.137846	0.2763	0.998483
2002 - 1999	-0.0367529	0.2574	0.999997
2002 - 2000	-0.740918	0.2366	0.0834778
2002 - 2001	0.0818643	0.2415	0.999769
2003 - 1998	-0.160894	0.2348	0.993139
2003 - 1999	-0.335493	0.2109	0.771832
2003 - 2000	-1.03966	0.1859	13.5581e-6
2003 - 2001	-0.216876	0.192	0.937153
2003 - 2002	-0.29874	0.2193	0.86839

TABLE A-3. MISSION BLUE AND CALLIPPE SILVERSPOT BUTTERFLY WANDERING SURVEY DATA (and Incidental butterfly observations) – 2003.

DATE	LOCATION	ELAPSED TIME (min)	MB OBSERVED	ELAPSED TIME (min)	CS OBSERVED
3/27	Tank Ravine/ Hillside	128	6		0
4/19	West Peak/ April Brook	102	7		0
4/19	SouthSlope - Area D Landslide	32	2		0
5/13	Northeast Ridge		0	19	10
5/17	Point Pacific	56	1		0
5/17	Village in the Park	43	0		0
5/21	Saddle	24	1	24	1
6/9	Radio Road/April Brook		0	49	2
6/16	Tank Ravine/ Hillside		0	41	3
6/16	Tank Ravine/ Hillside		0	57	1
Several Dates	MB incidentals observed off transect on MB transects		41		
Several Dates	CS Incidentals observed on MB transects			Inc	15
Several dates	MB observed on CS transects during MB flight season	1190	105		
TOTAL	**ALL AREAS**	**26.25 hours**	**163**	**3.17 hours**	32

TABLE A-4. CALLIPPE SILVERSPOT FIXED TRANSECT DATA: 2000- 2003. Data sorted by transect number. Weather data not provided, and not found to be a significant predictor of CS observations.

Year	Week	Date	Transect	#CS	minutes	CS/Hour
2000	3	6/15	1	2	26	4.62
2000	7	7/10	1	0	28	0.00
2001	1	5/23	1	0	24	0.00
2001	2	5/30	1	0	25	0.00
2001	3	6/7	1	7	34	12.35
2001	7	7/3	1	1	14	4.29
2002	2	5/22	1	0	20	0.00
2002	3	5/29	1	0	23	0.00
2002	4	6/10	1	3	25	7.20
2002	8	7/9	1	1	23	2.61
2003	1	5/12	1	0	14	0.00
2003	2	5/20	1	0	36	0.00
2003	4	6/2	1	0	18	0.00
2003	5	6/9	1	4	28	8.57
2003	7	6/24	1	0	18	0.00
2003	9	7/8	1	0	15	0.00
2000	1	6/2	2	3	49	3.67
2000	3	6/14	2	4	40	6.00
2000	7	7/10	2	0	31	0.00
2001	2	5/30	2	1	42	1.43
2001	3	6/7	2	9	40	13.50
2001	7	7/3	2	0	24	0.00
2002	3	5/29	2	11	34	19.41
2002	4	6/11	2	6	36	10.00
2002	8	7/9	2	1	22	2.73
2003	2	5/21	2	5	53	5.66
2003	4	6/3	2	6	50	7.20
2003	7	6/23	2	0	35	0.00
2003	9	7/8	2	0	38	0.00
2000	1	6/2	3	16	32	30.00
2000	2	6/9	3	24	42	34.29
2000	3	6/15	3	3	24	7.50
2000	5	6/29	3	4	29	8.28
2000	7	7/12	3	1	26	2.31
2001	1	5/21	3	6	34	10.59
2001	2	5/30	3	19	21	54.29
2001	4	6/13	3	11	32	20.63
2001	7	7/3	3	0	15	0.00
2002	1	5/17	3	4	28	8.57
2002	3	5/29	3	21	26	48.46
2002	4	6/11	3	14	25	33.60
2002	7	7/1	3	14	25	33.60
2003	1	5/12	3	6	23	15.65
2003	2	5/20	3	31	37	50.27
2003	4	6/3	3	14	41	20.49
2003	7	6/24	3	21	30	42.00
2000	2	6/9	4	15	44	20.45

- CS 2000 -2003 data continued -						
Year	Week	Date	Transect	#CS	minutes	CS/Hour
2000	3	6/16	4	7	32	13.13
2000	7	7/12	4	2	38	3.16
2001	1	5/21	4	5	51	5.88
2001	2	5/30	4	5	39	7.69
2001	4	6/13	4	21	39	32.31
2001	7	7/4	4	40	41	58.54
2002	1	5/17	4	3	33	5.45
2002	3	5/29	4	20	31	38.71
2002	4	6/11	4	8	27	17.78
2002	7	7/1	4	1	26	2.31
2003	1	5/12	4	0	24	0.00
2003	2	5/21	4	1	41	1.46
2003	3	5/27	4	4	23	10.43
2003	4	6/3	4	8	24	20.00
2003	6	6/16	4	3	35	5.14
2003	7	6/24	4	10	36	16.67
2003	9	7/9	4	0	23	0.00
2000	2	6/9	5	4	39	6.15
2000	3	6/16	5	6	35	10.29
2000	5	6/29	5	2	27	4.44
2000	7	7/13	5	0	28	0.00
2001	1	5/21	5	2	51	2.35
2001	2	5/31	5	25	28	53.57
2001	4	6/13	5	5	30	10.00
2001	7	7/4	5	26	32	48.75
2002	1	5/17	5	12	35	20.57
2002	3	5/29	5	32	34	56.47
2002	4	6/11	5	10	36	16.67
2002	7	7/1	5	1	30	2.00
2003	1	5/13	5	8	49	9.80
2003	2	5/21	5	14	41	20.49
2003	3	5/28	5	9	50	10.80
2003	4	6/3	5	10	25	24.00
2003	6	6/16	5	0	32	0.00
2003	7	6/24	5	2	25	4.80
2003	9	7/9	5	0	15	0.00
2000	2	6/9	6	2	36	3.33
2000	3	6/16	6	0	17	0.00
2000	7	7/10	6	0	23	0.00
2001	1	5/21	6	0	23	0.00
2001	2	5/30	6	3	43	4.19
2001	7	7/3	6	0	25	0.00
2002	1	5/17	6	4	32	7.50
2002	3	5/29	6	4	20	12.00
2002	4	6/11	6	7	25	16.80
2002	8	7/9	6	0	10	0.00
2003	2	5/20	6	4	22	10.91
2003	4	6/2	6	10	36	16.67
2003	7	6/24	6	0	31	0.00
2003	9	7/9	6	0	25	0.00

- CS 2000 -2003 data continued -						
Year	Week	Date	Transect	#CS	minutes	CS/Hour
2000	1	6/1	7	14	58	14.48
2000	3	6/14	7	15	51	17.65
2000	5	6/28	7	33	42	47.14
2000	7	7/14	7	1	27	2.22
2001	1	5/22	7	22	46	28.70
2001	3	6/5	7	3	32	5.63
2001	4	6/14	7	53	62	51.29
2001	7	7/3	7	11	45	14.67
2002	3	5/29	7	1	30	2.00
2002	4	6/10	7	5	43	6.98
2002	8	7/9	7	15	44	20.45
2003	1	5/12	7	3	42	4.29
2003	2	5/20	7	10	49	12.24
2003	4	6/2	7	17	49	20.82
2003	7	6/24	7	11	38	17.37
2003	9	7/9	7	0	29	0.00
2000	1	6/1	8	16	22	43.64
2000	3	6/16	8	4	20	12.00
2000	7	7/10	8	0	12	0.00
2001	1	5/23	8	7	52	8.08
2001	3	6/7	8	11	28	23.57
2001	7	7/3	8	0	12	0.00
2002	2	5/23	8	1	13	4.62
2002	3	5/29	8	6	12	30.00
2002	4	6/7	8	7	15	28.00
2002	7	7/2	8	2	19	6.32
2003	1	5/13	8	0	10	0.00
2003	2	5/21	8	0	14	0.00
2003	4	6/2	8	3	14	12.86
2003	7	6/23	8	5	12	25.00
2003	9	7/9	8	0	19	0.00
2000	1	6/1	9	3	32	5.63
2000	3	6/14	9	2	29	4.14
2000	5	6/28	9	9	56	9.64
2000	7	7/14	9	1	49	1.22
2001	1	5/22	9	13	58	13.45
2001	3	6/5	9	54	54	60.00
2001	7	7/3	9	0	27	0.00
2002	2	5/22	9	1	50	1.20
2002	3	5/29	9	9	35	15.43
2002	4	6/10	9	16	42	22.86
2002	7	7/2	9	13	31	25.16
2003	1	5/12	9	1	33	1.82
2003	2	5/20	9	0	37	0.00
2003	7	6/24	9	3	38	4.74
2003	9	7/9	9	0	38	0.00
2000	1	6/1	10	23	60	23.00
2000	3	6/14	10	10	50	12.00
2000	5	6/28	10	5	38	7.89
2000	7	7/10	10	2	37	3.24

- CS 2000 -2003 data continued -						
Year	Week	Date	Transect	#CS	minutes	CS/Hour
2001	1	5/22	10	23	39	35.38
2001	3	6/5	10	19	35	32.57
2001	7	7/3	10	3	4	45.00
2002	2	5/22	10	6	45	8.00
2002	3	5/29	10	11	39	16.92
2002	4	6/10	10	15	35	25.71
2002	7	7/2	10	3	45	4.00
2003	1	5/12	10	0	20	0.00
2003	2	5/20	10	0	29	0.00
2003	4	6/2	10	9	31	17.42
2003	7	6/24	10	6	32	11.25
2003	9	7/9	10	0	20	0.00
2000	1	6/1	11	37	63	35.24
2000	3	6/14	11	16	25	38.40
2000	5	6/28	11	13	28	27.86
2000	7	7/10	11	0	20	0.00
2001	1	5/22	11	100	50	120.00
2001	3	6/5	11	41	46	53.48
2001	4	6/14	11	83	38	131.05
2001	7	7/3	11	5	26	11.54
2002	3	5/29	11	2	29	4.14
2002	4	6/7	11	8	24	20.00
2002	8	7/9	11	6	19	18.95
2003	1	5/12	11	8	30	16.00
2003	2	5/21	11	11	36	18.33
2003	4	6/2	11	16	28	34.29
2003	7	6/24	11	11	31	21.29
2003	9	7/9	11	1	30	2.00
2000	3	6/14	12	17	36	28.33
2000	7	7/10	12	0	31	0.00
2001	1	5/22	12	36	65	33.23
2001	3	6/5	12	43	95	27.16
2001	7	7/3	12	0	29	0.00
2002	2	5/22	12	0	29	0.00
2002	3	5/29	12	5	50	6.00
2002	4	6/10	12	0	36	0.00
2003	1	5/12	12	0	34	0.00
2003	2	5/21	12	0	39	0.00
2003	4	6/2	12	16	35	27.43
2003	7	6/24	12	3	40	4.50
2003	9	7/9	12	1	33	1.82

TABLE A-5. ANOVA TABLE FOR CALLIPPE SILVERSPOT ANALYSIS 2000 – 2003

DESIGN

Dependent variables

Name	Code
CS/Hour	C/H

Type of analysis: OLS ANOVA

Factors

Name	Code	Nested in	F/R	Kind
Year	Yr	()	Fix	Disc
Transect	Trt	()	Fix	Disc

Partial (Type 3) Sums of Squares

Interactions up to 1 - way

No Modifications

RESULTS

General Results

188 total cases

ANOVA

Analysis of Variance For **CS/Hour**
No Selector

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Const	1	39069	39069	145.43	≤ 0.0001
Yr	3	6271.33	2090.44	7.7816	≤ 0.0001
Trt	11	13351	1213.72	4.5181	≤ 0.0001
Error	173	46474.4	268.638		
Total	187	66194.9			

Results for factor Yr

Coefficients

Expected Cell Means

Expected Cell Means of: CS/Hour on Yr

Level of Yr	Expected Cell Mean	Cell Count
2000	10.51	41
2001	24.07	42
2002	14.52	44
2003	9.027	61

Scheffe Post Hoc Tests

	Difference	std. err.	Prob
2001 - 2000	13.565	3.611	0.00349544
2002 - 2000	4.0166	3.572	0.737839
2002 - 2001	-9.54838	3.543	0.0677528
2003 - 2000	-1.48135	3.337	0.977995
2003 - 2001	-15.0463	3.292	189.045e-6
2003 - 2002	-5.49794	3.252	0.416423

TABLE A-6. SAN BRUNO ELFIN ADULT AND LARVAL OBSERVATIONS –2003 BY DATE AND POINT # point/incidental)

Adult Counts								Larval Counts
POINT #	March 5	March 11	March 21	April 7	Total Adults (Points)	TOTAL Adults	Survey visits	LARVAE* (5/29 - 5/31/02)
1.1	0	1	0	2	3	3	4	
1.1 - INC								
2	2	1	N	0	3	3	3	
2 - INC						2		
3	0	0	N	1	1	1	3	
3 - INC						2		
4								
4 - INC								
5	N	0	0	0	0	0	3	
5 - INC						3		
5.1	0		3	0	3	3	3	
5.1 - INC								
6	0	N	1	0	1	1	3	86
6 - INC								
7	0		1	0	1	1	3	41
7 - INC						6		
8	N	0	2	1	3	3	3	46
8 - INC						4		
9	2	0	0	0	2	2	4	
9 - INC								
10	0	0	0		0	0	3	
10 - INC								
11								
11 - INC								
12	0				0	0	1	
12 - INC								

Adult Counts								Larval Counts
POINT #	March 5	March 11	March 21	April 7	Total Adults (Points)	TOTAL Adults	Survey visits	LARVAE* (5/29 - 5/31/02)
13	2		3	3	8	8	3	16
13- INC								
14	0				0	0	1	
14 - INC								
15	0		N		0	0	1	45
15 - INC								
16	0		N	0	0	0	2	21
16 - INC						1		
17	0		N	0	0	0	2	55
17 - INC								
18								
18 - INC								
19	N		0	0	0	0	2	26
19- INC								
20	0		0	0	0	0	3	
20 - INC								
21								
21 - INC								
22	0				0	0	1	
22 - INC								
TOTAL	6	2	10	7	25	43	48	336

*Larvae are counted on one occasion at eight points during the spring each year. All *Sedum spathulifolium* plants (primarily the flower heads) are searched within a 25-meter radius of the points.

N= No data recorded. Point was visited, but weather was poor (high wind, low temperature, fog) so data was not recorded.

TABLE A-7. SAN BRUNO ELFIN FIXED POINT DATA: 1998- 2003.

Data sorted by fixed point number.

Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
1998	2	9-Mar	1	0	59.7	2.6	
1998	3	18-Mar	1	0	66.3	1.4	
1999	1	29-Mar	1.1	0	20.4	2.4	12:00
2003	1	5-Mar	1.1	0	17.9	0.9	11:30
1999	2	2-Apr	1.1	0	15.5	2.4	12:10
2000	2	11-Mar-00	1.1	0	20.5	4.9	2:12
2001	2	19-Mar	1.1	1	23.9	1.1	12:56
2003	2	11-Mar	1.1	1	15.8	5.2	11:16
2001	3	27-Mar	1.1	1	18.5	-	10:55
2002	3	19-Mar	1.1	4	59.7	0.8	11:40
2003	3	21-Mar	1.1	0	19.5	5.2	12:08
1999	4	14-Apr	1.1	0	21	2.9	11:20
2000	4	22-Mar	1.1	0	23.4	1.8	11:39
2002	4	28-Mar	1.1	5	65.5	1.8	10:59
2000	5	29-Mar	1.1	0	22.7	2.6	12:20
2003	5	7-Apr	1.1	2	20.2	1.3	12:28
1998	1	6-Mar	2	0	58.5		
1999	1	29-Mar	2	0	15.9	4.5	11:10
2000	1	1-Mar	2	2	18.3	2.1	12:10
2001	1	13-Mar	2	1	64.1	4.8	2:27
2003	1	4-Mar	2	2	16.9	3.2	1:22
1998	2	9-Mar	2	0	59.6	2.3	
1999	2	2-Apr	2	0	14.5	4.1	11:20
2000	2	11-Mar	2	2	16.7	3.7	1:15
2001	2	19-Mar	2	3	22.7	4.2	1:13
2003	2	11-Mar	2	1	19.3	4.5	11:33
1998	3	18-Mar	2	2	63.2	1.2	
2001	3	27-Mar	2	1	16.6	1.2	10:08
2002	3	19-Mar	2	1	60.1	2.2	11:58
1999	4	14-Apr	2	0	20	2.6	10:35
2000	4	22-Mar	2	4	20.1	1.5	10:37
2002	4	28-Mar	2	3	65.4	1.8	11:13
2000	5	29-Mar	2	1	18.5	2.1	11:25
2003	5	7-Apr	2	0	20.2	3.9	11:49
1999	1	29-Mar	3	0	17.7	2.3	11:30
2000	1	1-Mar	3	0	18	3.1	12:25
2003	1	4-Mar	3	0	17	5.4	1:41
1998	2	9-Mar	3	1	59.3	2.3	
1999	2	2-Apr	3	0	14.9	2.6	11:35
2000	2	11-Mar	3	2	18.2	4.5	1:37
2001	2	19-Mar	3	5	23.6	3.4	1:30
2003	2	11-Mar	3	0	16.2	4.2	11:47
1998	3	18-Mar	3	2	67.6	2.1	
2001	3	27-Mar	3	1	-	1.7	10:33
2002	3	19-Mar	3	1	65.1	0.6	12:15
1999	4	14-Apr	3	0	19.4	2.5	10:50
2000	4	22-Mar	3	0	21.3	2.3	11:02

- SBE 1998-2003 data continued -							
Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
2002	4	28-Mar	3	4	63.2	2.3	11:47
2000	5	29-Mar	3	0	19.3	0.3	12:00
2003	5	7-Apr	3	1	19.2	4.2	12:04
1998	2	9-Mar	4	1	60.3	1	
1998	3	16-Mar	4	2	63.5	2.5	
1998	1	6-Mar	5	0	59.2		
1999	1	29-Mar	5	0	15.3	2.3	10:45
2000	1	1-Mar	5	0	15.3	1.1	11:20
2001	1	13-Mar	5	0	65.8	4.4	1:45
2002	1	4-Mar	5	0	17.6	2.6	12:18
1998	2	11-Mar	5	3	67.5	0.8	
2000	2	11-Mar	5	0	17.2	2.3	2:35
2001	2	19-Mar	5	2	23.4	1.2	2:08
2003	2	11-Mar	5	0	18.2	2.3	12:17
1998	3	18-Mar	5	2	67.1	3.5	
2001	3	27-Mar	5	0	18.4	3.3	11:15
2002	3	20-Mar	5	0	25.7	1.5	12:15
2003	3	21-Mar	5	0	17.4	2	12:10
1999	4	14-Apr	5	0	19.5	1.8	11:40
2000	4	22-Mar	5	0	20.8	1	12:56
2002	4	27-Mar	5	1	23.7	1.7	12:40
2002	4	28-Mar	5	1	69	1	12:25
1998	5	30-Mar	5	0	57.3	2.5	
2000	5	29-Mar	5	0	22	1.6	12:34
2003	5	7-Apr	5	0	21.1	1.2	12:44
2002	1	4-Mar	5.1	0	20.5	2.6	11:57
2003	1	4-Mar	5.1	0	20.4	5.3	12:26
2001	2	19-Mar	5.1	3	-	-	2:26
2001	3	27-Mar	5.1	3	-	3.2	11:22
2002	3	19-Mar	5.1	2	62.5	4.6	11:16
2003	3	21-Mar	5.1	3	22.6	1.9	11:48
2002	4	28-Mar	5.1	2	63.4	1.5	10:11
2003	5	7-Apr	5.1	0	21.9	1.6	1:01
2002	8	22-Apr	5.1	0	25	2.4	10:56
1998	1	6-Mar	6	1	58.9		
1999	1	28-Mar	6	2	18	4.5	12:50
2000	1	1-Mar	6	0	18.2	2.2	10:35
2002	1	4-Mar	6	1	21	1.1	11:33
2003	1	4-Mar	6	0	14.5	5.9	12:09
2000	2	11-Mar	6	0	20.4	5.9	2:44
2001	2	19-Mar	6	4	-	-	12:35
1998	3	18-Mar	6	0	69.6	6	
2000	3	15-Mar	6	1	22.8	0.7	10:17
2001	3	27-Mar	6	2	-	-	11:05
2002	3	19-Mar	6	4	65	3.7	11:46
2003	3	21-Mar	6	1	16.8	1.7	11:44
1999	4	14-Apr	6	0	24	3.3	12:15
2000	4	22-Mar	6	2	20.8	3.4	11:52
2002	4	27-Mar	6	5	26	1.9	12:17
1998	5	30-Mar	6	0	59.4	7	

- SBE 1998-2003 data continued -							
Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
2003	5	7-Apr	6	0	22.3	1.7	12:44
2002	8	22-Apr	6	0	24.8	1.6	11:13
1999	1	28-Mar	7	2	16.3	5.2	12:00
2003	1	4-Mar	7	0	15.2	6.5	11:13
2001	2	19-Mar	7	3	24.9	0.7	11:44
1998	3	18-Mar	7	4	66.8	3.7	
2000	3	15-Mar	7	2	22.4	1.3	10:41
2001	3	26-Mar	7	0		6.6	11:14
2001	3	27-Mar	7	0	14.3	2.7	10:14
2002	3	19-Mar	7	1	68	6.3	12:06
2003	3	21-Mar	7	1	19.5	1.3	11:08
1999	4	14-Apr	7	0	24.1	4.2	12:50
2000	4	22-Mar	7	1	17.8	4.3	10:26
2002	4	27-Mar	7	2	20.1	6.8	11:05
2003	5	7-Apr	7	0	20.3	3.6	12:22
2002	8	22-Apr	7	0	25.2	3.5	11:34
1998	2	10-Mar	8	1	64.5	6.5	
2001	2	19-Mar	8	3	23.5	2.5	11:59
2003	2	11-Mar	8	0	16.7	5.5	11:20
1998	3	18-Mar	8	2	70.9	2.5	
2000	3	15-Mar	8	2	23.3	1.1	11:00
2001	3	27-Mar	8	1	14.7	2.4	10:30
2002	3	19-Mar	8	1	66	2.4	12:24
2003	3	21-Mar	8	2	21.6	3.4	11:01
2000	4	22-Mar	8	2	18.3	2.7	10:40
2003	5	7-Apr	8	1	20.4	1.7	21:01
2002	8	22-Apr	8	1	26.6	2.9	11:57
1998	1	6-Mar	9	0	60	calm	
1999	1	28-Mar	9	0	14.5	3.7	11:35?
2000	1	3-Mar	9	0	16.4	0.7	10:21
2001	1	13-Mar	9	2	60	3	11:55
2002	1	4-Mar	9	0	19.3	1.7	10:57
2003	1	4-Mar	9	2	15.3	3.3	10:26
1998	2	9-Mar	9	3	59	5.8	
2000	2	11-Mar	9	0	19.3	2.7	12:25
2001	2	19-Mar	9	0	21.1	5.2	2:45
2003	2	11-Mar	9	0	22.1	2.5	10:30
1998	3	18-Mar	9	1	63.8	2.8	
2000	3	17-Mar	9	3	18.7	4.3	1:25
2001	3	27-Mar	9	1	14.7	1.9	9:36
2002	3	19-Mar	9	0	68.2	2.4	12:48
2003	3	21-Mar	9	0	20.6	1.4	10:27
1999	4	14-Apr	9	1	24	1.4	1:55
2000	4	22-Mar	9	1	19	2.7	10:05
2002	4	27-Mar	9	0	19.2	3.4	10:24
1998	5	30-Mar	9	1	64.6	3.3	
2003	5	7-Apr	9	0	17.3	1.6	1:27
2000	1	3-Mar	10	0	18.7	2.3	12:45
2003	1	4-Mar	10	0	15.6	3.3	10:45
1998	2	9-Mar	10	0	59	3.6	

- SBE 1998-2003 data continued -							
Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
2001	2	19-Mar	10	2	20.7	6.3	2:56
2003	2	11-Mar	10	0	18.8	1.1	10:50
1998	3	18-Mar	10	0	67	2.9	
2000	3	17-Mar	10	0	18.4	2.6	1:42
2002	3	19-Mar	10	1	67	0.9	12:59
2003	3	21-Mar	10	0	18.8	2.1	10:32
1999	4	14-Apr	10	1	26	1.4	1:45
2002	4	27-Mar	10	0	23.3	3	10:36
1998	5	30-Mar	10	0	64.8	3.7	
2002	8	22-Apr	10	0	26	3.5	1:00
1998	1	6-Mar	11	0	58.6	4	
1998	2	9-Mar	11	0	61.7	3.9	
1998	3	18-Mar	11	1	65.1	3.3	
1999	4	14-Apr	11	0	24.8	3.4	1:30
2001	1	13-Mar	12	0	65	3?	11:49
2002	1	4-Mar	12	0			10:30
2003	1	6-Mar	12	0	14.3	1.6	10:26
1998	2	9-Mar	12	0	59.2	3.8	
2001	2	19-Mar	12	2	26.8	1.5	11:53
1998	3	18-Mar	12	1	62.9	4	
2001	3	27-Mar	12	1	20	1.6	10:32
2002	3	19-Mar	12	1	64.8	0.7	1:23
1999	4	13-Apr	12	0	72.2	2.9	10:54
1999	1	28-Mar	13	4	16.5	3.3	1:20
2000	1	3-Mar	13	0	15.1	1.2	10:38
2001	1	13-Mar	13	3	67	2	11:32
2002	1	4-Mar	13	4	19.7	0	10:20
2003	1	6-Mar	13	2	15.6	2.1	10:16
2000	2	12-Mar	13	2	14.6	3.8	1:40
2001	2	19-Mar	13	5	26.9	0.8	11:40
1998	3	18-Mar	13	4	68.9	3.9	
2000	3	17-Mar	13	3	14.6	3.6	12:49
2001	3	26-Mar	13	2	14.6	2.2	11:26
2002	3	19-Mar	13	3	55	2	10:25
2003	3	21-Mar	13	3	19.6	1.6	11:32
1999	4	14-Apr	13	2	24	1.8	2:25
2000	4	22-Mar	13	4	18.4	2.8	12:21
2002	4	27-Mar	13	3	22.9	1.1	1:30
2003	5	7-Apr	13	3	22.4	4.2	1:28
2003	1	5-Mar	14	0	16.7	3.6	2:00
1998	2	9-Mar	14	0	61.6	1.5	
2000	2	12-Mar	14	0	14.5	4.7	1:55
2001	2	19-Mar	14	1	28.6	6.5	2:27
1998	3	18-Mar	14	0	65.8	1.6	
2002	3	19-Mar	14	0	73.5	0.5	1:41
1998	5	30-Mar	14	0	61.8	6.7	
1998	1	6-Mar	15	2	65	3	
1999	1	28-Mar	15	0	21.2	6.7	2:25
2000	1	3-Mar	15	0	18.3	1.8	11:00
2001	1	13-Mar	15	0	65	4?	12:36

- SBE 1998-2003 data continued -							
Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
2003	1	5-Mar	15	0	18.5	5.1	12:33
2001	2	19-Mar	15	0	25.1	2.5	12:14
2002	2	11-Mar	15	0	20.7	4.9	11:41
1998	3	18-Mar	15	1	75	2.2	
2000	3	15-Mar	15	2	26.1	2.9	12:02
2001	3	27-Mar	15	1	21.5	5.3	10:49
2002	3	20-Mar	15	0	19.9	3.9	10:25
1999	4	13-Apr	15	2	67.9	0.6	11:36
2000	1	3-Mar	16	0	15.1	1.6	12:50
2001	1	13-Mar	16	2	67	3	12:17
2003	1	6-Mar	16	0	15.3	4.4	11:09
2001	2	19-Mar	16	5	26.5	2.5	1:35
1998	3	18-Mar	16	0	77	4.1	
2000	3	15-Mar	16	1	24.1	4.1	12:10
2001	3	27-Mar	16	0	20.1	3.9	11:44
2002	3	20-Mar	16	0	18.9	1	10:48
1999	4	13-Apr	16	0	67.7	3.7	11:13
2000	4	22-Mar	16	0	15.6	6.5	1:13
1998	5	30-Mar	16	0	57.4	3.4	
2003	5	7-Apr	16	0	16.7	5.6	2:19
1999	1	28-Mar	17	2	18.2	1.7	11:30?
2001	1	13-Mar	17	4	68	3.6	10:45
2003	1	6-Mar	17	0	18.7	3.6	11:25
1999	2	1-Apr	17	0	65	4.4	11:01
2000	2	13-Mar	17	0	15.6	2.5	11:17
2001	2	19-Mar	17	5	28.4	0.9	1:52
2002	2	11-Mar	17	5	19.3	0.5	10:46
1998	3	18-Mar	17	0	70	3.1	
2000	3	15-Mar	17	0	23.6	1.8	11:55
2001	3	27-Mar	17	2	20.5	4.4	12:03
2002	3	20-Mar	17	2	23.4	0.9	10:38
1999	4	15-Apr	17	0	18.3	2.2	9:35
1998	5	30-Mar	17	0	58.6	3.5	
2003	5	7-Apr	17	0	19.8	4.2	2:27
1998	2	10-Mar	18	0	70	1.8	
1999	2	2-Apr	18	0	20.4	2	2:10
1998	3	18-Mar	18	0	64.98	3.3	
1998	1	6-Mar	19	1	62	7	
1999	1	29-Mar	19	0	17.9	6.1	10:55
2001	1	13-Mar	19	3	68	3	1:10
2001	2	19-Mar	19	0	24.4	3.8	12:51
1998	3	18-Mar	19	0	68.5	2.9	
2000	3	15-Mar	19	1	19.9	6.4	1:00
2002	3	19-Mar	19	1	65.4	1.3	1:33
2003	3	21-Mar	19	0	16.3	3.9	11:12
1999	4	13-Apr	19	0	65.1	4.2	12:09
2000	4	22-Mar	19	2	22.4	6.5	12:45
1998	5	30-Mar	19	0	60	3.7	
2003	5	7-Apr	19	0	20.8	6.7	1:56
1999	1	28-Mar	20	0	20.7	6.2	2:10

- SBE 1998-2003 data continued -							
Year	Week	Date	Point #	# SBE	Temp	Wind ave	Time Start
2001	1	13-Mar	20	2	65	3	1:25
2003	1	5-Mar	20	0	16.4	2.6	10:35
1998	2	9-Mar	20	0	62.6	1.4	
2001	2	19-Mar	20	1	26.3	3.1	1:14
1998	3	18-Mar	20	0	68	4.2	
2000	3	17-Mar	20	0	15	2.5	9:30
2001	3	27-Mar	20	0	22.3	5.9	11:27
2002	3	19-Mar	20	0	66	1.6	1:49
2003	3	21-Mar	20	0	18.6	6.1	10:58
1999	4	13-Apr	20	0	66.5	3.5	12:40
2000	4	21-Mar	20	0	22	5.5	3:45
1998	5	30-Mar	20	0	64	4.3	
2003	5	7-Apr	20	0	21.2	3.8	2:07
1998	2	9-Mar	21	0	69.3	3.3	
1998	3	18-Mar	21	0	71	5	
2000	1	3-Mar	22	0	16.6	1.6	11:35
2003	1	6-Mar	22	0	19	2	11:48
2000	3	15-Mar	22	0	23	1.1	12:30
2002	3	20-Mar	22	0	22.7	4.8	13:26

TABLE A-8. ANOVA TABLE FOR SAN BRUNO ELFIN ANALYSIS 1998 – 2003

DESIGN

Dependent variables

Name	Code
# SBE	#S

Type of analysis: OLS ANOVA

Factors

Name	Code	Nested in	F/R	Kind
Point #	P#	( )	Fix	Disc
Year	Yr	( )	Fix	Disc

Partial (Type 3) Sums of Squares

Interactions up to 1 - way

No Modifications

RESULTS

General Results

260 total cases

ANOVA

Analysis of Variance For **# SBE**
No Selector

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Const	1	242.312	242.312	192.8	≤ 0.0001
P#	20	108.666	5.43329	4.3232	≤ 0.0001
Yr	5	52.7582	10.5516	8.3958	≤ 0.0001
Error	234	294.087	1.25678		
Total	259	458.688			

Results for factor Yr

Coefficients

Expected Cell Means

Expected Cell Means of: # SBE on Yr

Level of Yr	Expected Cell Mean	Cell Count
1998	0.8422	45
1999	0.3335	33
2000	0.6623	47
2001	1.632	44
2002	1.199	43
2003	0.3545	48

Scheffe Post Hoc Tests

	Difference	std. err.	Prob
1999 - 1998	-0.508706	0.2636	0.590614
2000 - 1998	-0.179976	0.2444	0.990376
2000 - 1999	0.328731	0.2595	0.90007
2001 - 1998	0.789378	0.2468	0.0730421
2001 - 1999	1.29808	0.2625	282.646e-6
2001 - 2000	0.969353	0.2399	0.00717091
2002 - 1998	0.357127	0.2507	0.844435
2002 - 1999	0.865833	0.267	0.0658455
2002 - 2000	0.537103	0.2416	0.425706
2002 - 2001	-0.432251	0.2437	0.677634
2003 - 1998	-0.487746	0.2433	0.547876
2003 - 1999	0.0209603	0.2589	1
2003 - 2000	-0.30777	0.2328	0.882253
2003 - 2001	-1.27712	0.2367	43.4608e-6
2003 - 2002	-0.844873	0.2372	0.0293412

EXOTIC PEST PLANTS REMOVED BY HAND AND HERBICIDE WORK ON SBM IN 2003

Table B-1. Acres of Exotic Pest Plants Removed by Hand Work on San Bruno Mountain in 2003[1]

Area	UE	EG	GM	FV	Other	Total Acres
Hillside School	0	0	0	0.65	2.35	3.0
Pt. Pacific / Village	0	0	0.2	0.2	1.6	2.0
Dairy Ravine	0	0.2	0	0	1.3	1.5
Wax Myrtle Ravine	0.22	0.22	0.33	0.33	0.9	2.0
Old Ranch Road	0.13	0.13	0.23	0.73	0.53	1.75
Hill West of Quarry	0	0	0.21	0.45	1.34	2.0
Linda Vista / Bay Ridge	0.05	0	0.15	0	0.05	0.25
Callippe Hill / Arnold Slope	0	0.19	0.19	1.69	0.63	2.7
Red Tail Canyon	0	0.3	0.45	0.3	2.7	3.75
Saddle Unit III (sites 26, 3)	0.14	0.14	0.14	0	0.08	0.5
Brisbane Office Park	0	0	0.1425	0.1025	0.13	0.375
SER / Canon Sign	0	0	0	0	0.5	0.5
Kamchatka Ridge	0	0	0	0.1	0.65	0.75
Guadalupe Canyon Parkway	0	0	0.68	0.71	0.36	1.75
Total	**0.54**	**1.18**	**2.723**	**5.263**	**13.12**	**22.825**

1. Plants were removed using weed wrenches, maddox's or by hand pulling. Categories represented are: **UE**: *Ulex europaeus* (gorse), **EG**: *Eucalyptus globulus* (blue-gum tree), **GM**: *Genista monspessulana* (French broom), **FV**: *Foeniculum vulgare* (fennel). Other category includes additional weed species receiving hand control or a combination of several weed species in a given treatment. Other species include bristly ox-tongue (*Picris echioides*), Cape ivy (*Delaeria odorata*), Cotoneaster (*Cotoneaster* sp.), English ivy (*Hedera helix*), Erharta (*Erharta longiflora*), Italian wild rye (*Lolium multiflorum*), Monterey cypress (*Cupressus macrocarpa*), mustard (*Hirschfeldia incana*), Napa thistle (*Centaurea melitensis*), ox-eye daisy (*Leucanthemum vulgare*), Portuguese broom (*Cytisus striatus*), pampas grass (*Cortaderia* sp.), poison hemlock (*Conium maculatum*), soft chess (*Bromus hordeaceus*), wild lettuce (*Lactuca virosa*), wild oat (*Avena* sp.), and wild radish (*Raphanus raphanistrum*).

Table B-2 Acreages of exotic pest plants treated with herbicide at Saddle and Main Mountain areas in 2003.

Area	EG	UE	GM	CS	FV	Other	Total
Hillside School/ Terrabay	0	0	0	0	2.6	0.4	3.0
Water Tank/ Spumoni	0	0.8	1.1	2.35	0.5	0	4.75
Pointe Pacific/Village	0.28	0	0.16	0	0	1.56	2.0
Linda Vista/Bay Ridge	0	0.05	0.2	0	0	0	0.25
Radio Ridge/Summit	0	0.5	0	0	0	0.5	1.0
Ridge Trail - East	0	0	0.5	0	0.58	0.42	1.5
Ridge Trail - West	0	0	0.87	0	1.88	0	2.75
Ridge Trail/West Peak	0	0	0.3	1.4	0.85	1.45	4.0
Ridgelines / Hoffman	0.3	0	0.65	0.3	0.8	3.2	5.25
Colma Creek	0	0	0.19	0	0	0.56	0.75
Guadalupe Cyn Pkwy	0.35	0.3	1.1	0.5	1.25	1.5	5.0
Saddle (Units I, II, III)	0.1	1.75	0.1	1.2	0.5	1.1	4.75
Terrabay	0	0	0	0	3.6	3.9	7.5
SER / Canon Sign	0	0	0.4	0	0.8	4.8	6.0
Tank Ravine	0	0	0.65	0	1.05	2.8	4.5
Dairy Ravine	0.45*	0	0	0	0	0.3	0.75
Callippe Hill / Arnold / NER fenceline	0	0	0.39	0.54	1.34	5.28	7.55
Bitter Cherry	0.45	0.45	0	0	0.45	0.65	2.0
Brisbane Office Park	0	0	0.3	0	0.3	0.275	0.875
Kamchatka Ridge	0	0	0	0	0	0.25	0.25
Wax Myrtle Ravine	9.17*	2.9	0.83	0	1.75	7.6	22.25
Total	**11.1**	**6.75**	**7.74**	**6.29**	**18.3**	**36.55**	**86.675**

*exotics that were treated both manually and chemically.
Categories represented are: EG: *Eucalyptus globulus* (blue-gum tree), UE: *Ulex europaeus* (gorse), GM: *Genista monspessulana* (French broom), CS: *Cytissus striatus* (Portuguese broom), FV: *Foeniculum vulgare* (fennel). Other category includes Bermuda buttercup (*Oxalis pes-caprae*), bristly ox-tongue (*Picris echioides*), Cape ivy (*Delaeria odorata*), Cotoneaster (*Cotoneaster* sp.), curly dock (*Rubus crispus*), English ivy (*Hedera helix*), Erharta (*Erharta*

longiflora), fox-glove (*Digitalis* sp.), Harding grass (*Phalaris stenoptera*), Himalayan blackberry (*Rubus discolor*), ice plant (*Carpodrotus edulis*), Italian thistle (*Carduus pycnocephalus*), Italian wild rye (*Lolium multiflorum*), lamb's quarter (*Chenopodium album*), Monterey cypress (*Cupressus macrocarpa*), mustard (*Hirschfeldia incana*), Napa thistle (*Centaurea melitensis)*, nightshade (*Solanum* sp.), ox-eye daisy (*Leucanthemum vulgare*), pampas grass (*Cortaderia* sp.), poison hemlock (*Conium maculatum*), purple loosestrife (*Lythrum salicaria*), purple star thistle (*Centaurea calcitrapa*), rattlesnake grass (*Briza maxima*), red valerian (*Centranthus ruber*), sheep sorrel (*Rumex acetosella*), wild lettuce (*Lactuca virosa*), and wild radish (*Raphanus raphanistrum*).

2003 Butterfly Island Year End Report

SAN BRUNO MOUNTAIN

January 15, 2004

Prepared by

Mark Heath
Shelterbelt Builders INC
An Open Land Management and Restoration Company
3088 Claremont Avenue
Berkeley, California 94705

2002/03 (Year 4) Island Planting Summary

Colma Creek Watershed

The Colma Creek planting islands established well. Lupine have been observed to be establishing from seed at CC1 and Mission Blue butterfly larvae have been observed at CC2. After excellent survivability of lupine in the first year (1999/2000), we planted additional host and nectar plants at each site in year 2 (2000/2001) and year 3 (2001/2002). Year 4 (2002/2003) required no additional plants, as each island is sufficiently dense with butterfly host and nectar plants. Six species of nectar plants were planted for three years at both sites; they include *Aster chiloensis*, *Cirsium quercetorum*, *Erigeron glaucus*, *Eriogonum latifolium*, *Heterotheca sessiflora*, and *Horkelia californica*. Coast buckweat (*Eriogonum latifolium*) and golden aster (*Heterotheca sessiflora*) established very well at each of the sites.

Colma Creek 1 (CC1): Lower restoration site

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
524	2"/ D16	2	**unknown**	X

***CC1 has been planted with >90% *Lupinus formosus* which is summer dormant perennial. It typically does not emerge from dormancy until February or March. Survivability can not be determined until later in the Spring when plants are visible.**

Colma Creek 2 (CC2): Upper restoration site

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
464	2"/ D16	3	109 *L. albifrons*	23% over 4 years

As in CC1, the *L.formosus* were not visible at the time of monitoring, so true survivability is actually slightly higher.

Dairy Ravine

These butterfly island sites are scattered throughout the Dairy Ravine restoration area. The islands with the least amount of weed competition, especially annual grasses, tend to have the best establishment. Dairy Ravine 1 is situated on a saddle with shallow, rocky soils and has become the model for this area of Dairy Ravine. *Aster chiloensis*, *Cirsium quercetorum*, *Erigeron glaucus*, *Eriogonum latifolium*, *Heterotheca sessiflora*, and *Horkelia californica* were all planted at DR1. *Eriogonum* and *Erigeron* have both established very well throughout the island.

Dairy Ravine 2 and 3, which were created in 2000 and 2001, have both been abandoned since annual grass competition was severe and very few lupine were able to establish in these islands. DR 4 (Elfin Ridge) now has very dense stands of *Sedum*, both naturally occurring and planted,

which extends the Elfin butterfly habitat up along the ridge separating Dairy Ravine from Wax Myrtle canyon.

Two new islands were created this year in 2002/03. DR5 was created downslope from DR1. This island , like DR1, has shallow rocky soils along a ridge line with little annual grass competition. DR6 was created in the Friends of San Bruno Mountain Botanical Garden in lower Dairy Ravine. Both islands have performed extremely well with high survivabilities. Two new weed maintenance techniques were incorporated into these islands. Thick rice straw mulch was applied around lupines in DR5 and pre-emergent herbicide was used at DR6. Each method provided excellent annual grass control during the first year establishment period. Unfettered by weeds, plants at each island grew large and many flowered the first summer. Both techniques will continue to be explored with the addition of new islands on the mountain.

Dairy Ravine 1 (DR1)

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
586	2"/ D16	3	148 *L. albifrons*	25% over 4 years

Dairy Ravine 5 (DR5): New Island for 2002

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
311	D16	1	136 *L. formosus*	44% over 2 years

Dairy Ravine 6 (DR6): Friends of San Bruno Mountain Botanical Garden Island

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
100	D16	1	43 *L. formosus*	43% over 2 years

Saddle

After two years of great lupine establishment without much weed competition, annual grasses and other exotic annuals increased at the site. Thick gorse mulch prevented annual establishment for the first two years at this island site, but apparently the site's resistance to weeds is only short-lived. The Spring of 2003 revealed that annual grasses could be problematic at the island. Hand weeding, selective mowing and the additional planting of native perennial grasses will be the short-term solution until the island can establish good native cover.

Native cover is critical for the long term success of this island. For the last two years, we have taken advantage of the lack of invasive grasses to outplant hundreds of native perennial bunch grass plugs. 750 additional grass plugs were installed in 2002/03 to fill in gaps in previous year's planting and seeded areas. The grasses have established very well and we hope to fill-in all bare ground areas with native grasses and herbaceous perennials to support the butterfly host plants.

89 additional lupine were added in 2003/03 to supplement previous year's plantings. The lupine and nectar plants are very robust and grow very quickly in the post-gorse nitrogen enriched soils. *Phacelia californica* and *Eriogonum latifolium* are the two top performing nectar plants at the site. Natural recruitment has been recorded for both species in the second year as well as for the lupine.

Saddle 2 (S2): GCP Saddle island

Total Lupine Planted	Size	Years Planted	Current Surviving Lupine	Survivability
389	D16	2	211	54% over 2 years

Weed management and Stewardship

GCP Site

The GCP site continues to be mowed throughout the Spring growing season. After 3 years of mowing, many annual weeds still remain. The focus continues to be on slowing the establishment of these invasive at the neighboring S2 island.

April Brook Hemlock Control Site

April Brook hemlock was mowed again in the late Spring of 2003. Hemlock is still very persistent at this site and new herbicide or grazing strategies may need to be applied here for complete control. Mowing only helps to curb it's spread down the Colma Creek watershed.

Colma Creek

The restored coastal scrub between CC1 and CC2 continues to mature. Four successive years of weed management have reduced the amount of radish, mustard, hemlock, and thistle on the site. A few more years of weed management will allow the scrub to fill in completely with few dominant weed patches. The reduction of weeds in this area insures the Colma Creek butterfly islands continue to remain free of large competitive exotics.

Upper Wax Myrtle Ravine Re-vegetation and Erosion Control Plan

1/14/04

Presently, there is one area in particular in the Wax Myrtle Ravine Burn Area that has almost no ground cover and needs to be revegetated. This re-vegetation plan will be implemented by Shelterbelt Builders and will significantly help control erosion over the next few winters. Implementation of this plan will be a significant step in the right direction of getting native species re-established where the Eucalyptus/Gorse slash were piled until recently. Plants will be donated to this effort by The Friends of San Bruno Mountain (Doug Allshouse, pers. comm.). This plan does not include plantings on the very rocky slopes because erosion is not much of a concern in these areas.

The loss of sediment moving off the slopes, various slides and slumps taking place on the lower slopes into Wax Myrtle Creek and erosion caused by the culvert drainage that comes down from under Guadalupe Canyon Parkway have all been documented by TRA, West Coast Wildlands and Shelterbelt. Recommendations from these groups have been incorporated into the attached planting plan (Figure 1).

It is anticipated that by planting willows and other riparian trees in and along the streambeds, erosion off the slopes will be slowed and sediments kept from being swept downstream to the Brisbane Sediment Basin. Top soil is a very important commodity on the mountain and takes a long time to replace/rebuild after it is eroded away to bare mineral soils (graywacke/clay in this case). The grass plugs that will be planted on the bare, steeper mid to lower slopes will primarily serve for erosion control rather than an effort to establish grasslands in this area. These grass planting areas overlap with the scrub planting area. The acreages below coincide with the areas depicted in Figure 1, Postburn Revegetation Plan for Wax Myrtle Ravine.

Scrub planting area (3.24 acres): Toyon (*Heteromeles arbutifolia*), Coffeeberry (*Rhamnus californica*), Golden sticky monkeyflower (*Mimulus aurantiacus*), California sagebrush (*Artemisia californica*), and Oceanspray (*Holodiscus discolor*)

500 - 1 gallon/D40 plants installed in the upper canyon of the burn area
Total = $4680

Riparian planting area (1.0 acre): American dogwood (*Cornus sericea* ssp. *sericea*), Arroyo willow (*Salix lasiolepis*), Sitka willow (*Salix sitchensis*) and Pacific waxmyrtle (*Myrica californica*)

30 - riparian trees (1 gallon/D40) and 50 willow stakes installed in the riparian areas of the canyon.
Total = $1440

Wetland/Seep planting area (0.15 acres): *Carex barbarae*, *Juncus patens* and/or Iris-leaved rush (*Juncus xiphioides*) and/or Baltic rush (*Juncus balticus*)

27 – 1 gallon/D40 plants installed in the wetland seep area.
Total = $270

Grass planting area (1.82 acres): Blue wildrye (*Elymus glaucus*) and California brome (*Bromus carinatus*)

2,500 – grass plugs (1× 3 starts) installed in grassland areas.
Total = $2610

Grand total cost for project = $9,000

FIGURE 1

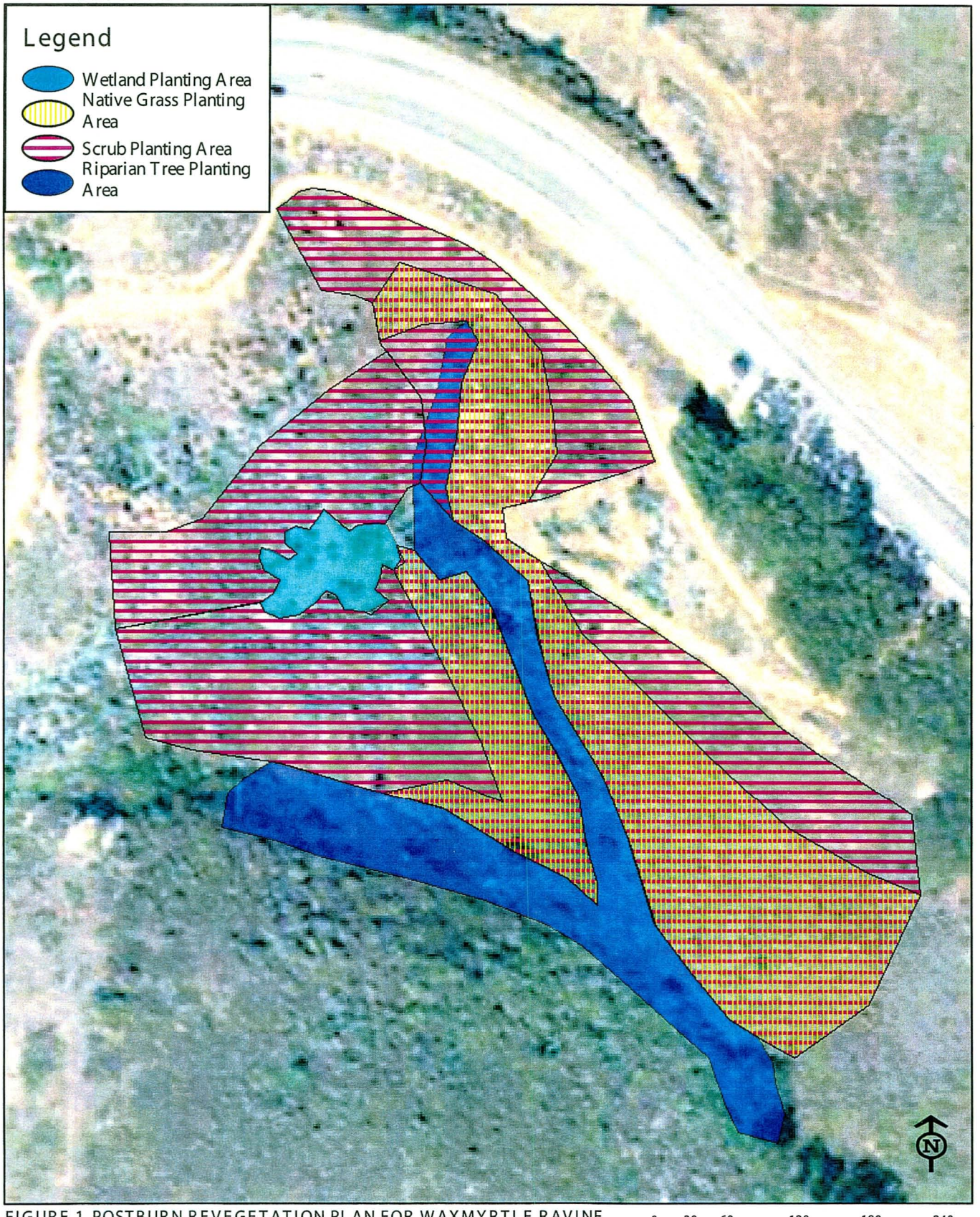

FIGURE 1. POSTBURN REVEGETATION PLAN FOR WAXMYRTLE RAVINE

PREPARED BY THOMAS REID ASSOCIATES, JANUARY 6, 2004

Grazing and Mowing Experiment at Hillside/Juncus Parcel San Bruno Mountain, 2003

Preliminary Results

Prepared by Thomas Reid Associates
January, 2004

SUMMARY

A 3-year pilot grazing and mowing experiment at Hillside/Juncus Parcel on San Bruno Mountain was begun in March, 2003. Baseline data was collected in March, 2003 prior to the grazing and mowing treatments. Preliminary results presented in this report include observation data on the feeding habits of goats, impact to thatch levels, and response of native and non-native species to grazing and mowing. A comparison of before and after data in the grazed, mowed and control plots will be reported in the San Bruno Mountain 2004 Annual Report.

INTRODUCTION

Grazing, mowing, and/or burning have been identified as important tools for vegetation management in managing native grasslands. (Weiss, 2002; Hayes & Holl, 2003; Pollak & Kan, 1998). The grassland plant community on San Bruno Mountain evolved with both grazing and fire, and research in similar grassland communities in California suggests that grazing and fire provide important functions toward the health of this plant community (i.e. nutrient cycling, regeneration of fire adapted species, and biomass removal). Successful management of the grassland plant community on San Bruno Mountain is especially important due to the existence of three endangered butterflies and several sensitive plant species within this habitat.

In 1982 the San Bruno Mountain Habitat Conservation Plan (HCP) was adopted which created approximately 2800 acres of open space on San Bruno Mountain and provided annual funding to manage these lands. Since that time, the vegetation management program on the mountain has primarily relied on the methods of hand and herbicide control work for maintaining the grassland habitat. Reliance on these methods has been partially due to their cost effectiveness and the need to prioritize work on the most serious weed threats. It has also been due to the lack of information available on grazing (specifically goats and sheep) impacts to coastal grasslands, and the difficulty in obtaining the necessary permits and inter-agency cooperation to conduct controlled burns.

Hand and herbicide weed control methods have proven effective at reducing perennial invasive shrubs and trees such as French broom, gorse, and eucalyptus from invading and overtaking grassland habitat on San Bruno Mountain. However, herbaceous weed and grass invaders such as wild oat (*Avena barbata*), Bermuda buttercup (*Oxalis pes-caprae*), and Italian thistle (*Carduus pycnocephala*) are much more prolific, and the ability to treat large areas of these ubiquitous weeds using hand and/or herbicide work is expensive and difficult. In addition, in the absence of burning and grazing, native coastal scrub vegetation has expanded and overtaken grassland habitat. For this reason, the future of vegetation management on San Bruno Mountain is likely to require the use of grazing and burning to help reduce the threat from both herbaceous and grass weeds as well as to limit the expansion of coastal scrub into native grasslands.

In April, 2002, a Stewardship Grazing Plan was written for San Bruno Mountain by David Amme. This plan addresses the vegetation changes that threaten the grassland habitat of the mountain. In March 2003, a 3-year pilot grazing project was initiated on the mountain in the Hillside area/ Juncus Ravine parcel to test the efficacy of grazing as management tool. Both mowing and grazing were incorporated into the experiment to test these methods. The experiment also includes burning, however, a Fall 2003 moratorium on burning by CDF has prevented this portion of the experiment from occurring.

The experiment is located on land owned by Myer's development. This land is planned for dedication to the County park after exotics control work has been completed to the satisfaction the HCP Plan Operator (San Mateo County). This project, as proposed, is a combined project utilizing the funding provided by both the HCP trust fund and Myers Development Corporation to accomplish the mutual goals of each entity. The goals of this program are consistent with the goals of the HCP and the Habitat Restoration Plan for the Juncus Ravine Dedication Parcel (Myers Development Corporation, November 2001). Assistance with data collection has been provided by volunteers with the Friends of San Bruno Mountain.

Project Goals

The goal of the pilot grazing and mowing experiment is to test the efficacy of controlled livestock grazing as a tool to enhance and restore the health and diversity of native grassland plant communities. Specifically, the program will target rank annual grasses and weeds that suppress the diverse native herbaceous and perennial grassland plant community and reverse the encroachment of coastal scrub into grassland areas. The pilot grazing and mowing program includes moving livestock to and from the mountain during one to two seasons a year, as well as the labor and material required to manage the animals full time, move fencing, provide water and supplemental feed. The program includes mowing and grazing treatments, once-a-year monitoring of plant species composition within treatment and control plots, and annual reporting of the results.

Goals

1) Reduce targeted annual weeds;
2) Increase the abundance of native plant species;
3) Reduce/ control expansion of coastal scrub vegetation;
4) Increase the habitat value for the endangered butterflies of San Bruno Mountain.*

The Hillside/ Tank Ravine area is ideal for this experiment because this site has easy access, and has many of the invasive vegetation problems that are facing the rest of the mountain including: 1) extensive infestations of invasive European annual grasses; 2) invasive forbs such as Italian thistle, fennel (*Foeniculum vulgare*) and Bermuda buttercup; and 3) coastal scrub.

Areas with *Viola pedunculata*, the host plant for the endangered Callippe silverspot butterfly, were excluded from the grazing and mowing treatment areas because this species is not currently covered under the HCP take permit for San Bruno Mountain. The experiment includes grassland areas that are similar to Callippe habitat in species composition and exposure, and therefore it is likely that results from the grazing and mowing experiment will be applicable to Callippe silverspot habitat.

Hand and herbicide control work may be incorporated into the treatment areas to determine the best possible combination of methods for controlling exotic species and increasing native plant cover. All work conducted will be recorded and costs determined at the end of the experiment.

METHODS

All areas chosen for the experiment are dominated by ruderal grassland with varying levels of exotic infestations, (except GSCRUB which is a mix of coastal scrub and grassland). Figure 1 shows the location of the treatment plots and monitoring transects on the mountain. Table 1 shows a description of each treatment and control area.

Temporary grazing areas were installed which ranged from approximately 1/4-acre to two acres in size. The animals typically grazed in each paddock for approximately one day, and were moved once the vegetation was taken down to bare earth or nearly so. Prior to grazing on San Bruno Mountain, goats were fed on a diet of alfalfa and brush to prevent the goats from bringing in any new weeds to the Mountain. A shepherd was provided for twenty-four hour supervision of the goats. The goats were moved with cattle dogs into enclosures created with mobile electric fences. Water requirements were met through the use of a mobile water tank and trough.

A herd of 120 goats grazed from March 19 through March 30, 2003. Three months later, 470 goats were brought in to graze the treatment areas again between July 22, and July 27, 2003. (Using a higher number of goats in the second grazing event necessitated keeping the goats in the paddocks for less time). A grazing treatment is planned for the winter of 2003 to treat oxalis areas, and in the following spring and/or summer depending upon the vegetation response and monitoring results in March 2004.

Mow plots included two plots, a single mow plot and a double mow plot. Mow plots were mowed on March 17, 2003 followed by raking on March 20, 2003. The native and non-native grasses were mowed along with the non-native forbs. Native perennials were avoided by flagging before mowing. These included Mission blue butterfly host and nectar plants (i.e. silver lupine *(Lupinus albifrons)*, coast buckwheat *(Eriogonum latifolium)* and checkerbloom *(Sidalcea malviflora)* as well as long-petaled iris (*Iris longipetala)* and Douglas iris (*I. douglasiana*. The double mow plot was mowed and raked again on May 1, 2003. The plots were mowed with string cutters followed by raking with metal bow rakes. The clippings were hauled out and deposited outside of the plots.

Monitoring

The experimental design and monitoring program were determined after research and meetings with County park staff, consultants, and the Friends of San Bruno Mountain in February, 2002. The experiment utilizes a matrix of treatment groups and controls to test each treatment independently. Monitoring transects were established in the grazed plots, in mowed plots and within control areas.

Monitoring data collected prior to the initial grazing and mowing in March 2003 consisted of:
1) percent cover data within quadrats
2) lupine counts on rocky outcrops
3) plant species richness within grazing areas
4) residual dry matter.

Percent cover data was taken within 0.25-meter quadrats placed every 5 meters along a 50 meter transect. Transects were permanently marked within each of the treatment areas (grazing, mowing and control areas) with the exception of GSCRUB). A total of 108 quadrats were inventoried for species and percent cover (data may later be lumped into native and nonnative categories for analysis). Lupine counts were taken at six rocky outcrops (30-foot radius) to measure the number of lupine plants before and after grazing and mowing. Species richness (number of species) within the grazed areas was recorded prior to the grazing experiment. Residual dry matter was measured at random locations within grazed areas and control areas. Data collection will occur once per year in March.

RESULTS (preliminary)

Grazing

Data collection

Residual dry matter, plant percent cover, species richness, and lupine counts were done prior to the goat grazing. This data will be collected again in March 2004 and preliminary comparisons will be reported in the 2004 annual report. It is likely that it may take 2-3 years of treatments before a significant change in plant species composition is observed in the grazed areas (personal communication David Amme).

The residual dry matter (RDM) data that was collected prior to the grazing and mowing treatments was found to be extremely high (Figure 2). This is likely due to the lack of burning and/or grazing in the hillside/Juncus area for the past several years. The high amount of thatch is likely suppressing the growth of native annual and perennial wildflowers. The grazing impact on thatch appeared to be significant, especially after the second grazing episode (personal observation).

Observations

The goats appeared to prefer broadleaf plants (eating flower heads, leaves and stalks). They fed immediately and heavily on brush and herbaceous plants when first introduced into the corrals. Plants favored by the goats included natives and nonnatives alike such as: fennel, coyote brush (*Baccharis pilularis*), soap plant (*Chlorogalum pomeridianum*), Bermuda buttercup, checkerbloom, bristly ox-tongue (*Picris echioides*), mustards (*Brassica sp./Hirschfeldia incana*), common mallow (*Malva sp.*), Italian thistle, sow thistle (*Sonchus sp.*) and vetch (*Vicea sp.*). The goats avoided lupines (*L. albifrons*) at first but later, apparently after more palatable plants were eaten, they ate the lupines as well. In the scrub plot, they appeared to avoid California sagebrush, and this may have been due to the timing of the grazing and the strong oils in the plant during the spring and summer (personal communication, Jared Lewis).

Goats appeared to avoid most grasses, especially rip-gut brome, They did eat some wild oat (*Avena* sp.), primarily focusing on the seed heads. They appeared to partly avoid fillaree (*Erodium botrys*) and wild lettuce (*Lactuca* sp.). They appeared to avoid eucalyptus at first, but did strip the saplings of this species after other plants were depleted. The goats did not eat the woody stems of shrubs.

After the initial grazing and mowing events plants were observed coming back in all corals on April 25, 2003. This included natives and non-natives alike: (soapplant, silver lupine,

checkerbloom, fennel, coast buckwheat, California poppy (*Escholtzia californica*), vetch, oxalis,and Italian thistle). Based on the recovery of the plants after one month it appeared that the initial grazing did not thoroughly kill off any plants. This was good to see for the natives, but the invasives were also rebounding. The most noticeable re-bounders were soapplant of the natives, and fennel for the invasives. Oxalis had also recovered partially after the first grazing event. Thatch levels still appeared to be high in some locations after the first grazing event.

A second more intensive grazing treatment was done in July, 2003 and this included incorporation of native grass seed and hay into the corrals. Native grasses were seeded in during the grazing period so the animals could incorporate the seed with their hooves into the soil. The goats also fed on native grass hay while they were grazing and in this way native seed is incorporated into the soil through the animal droppings (personal communication Jared Lewis).

After the second, more intensive grazing treatment, thatch levels appeared to be much lower. Fennel was observed to be returning to the grazed areas, however after grazing opened up the areas, it makes this plant much easier to see and to spray with herbicide. Preliminary observations suggest that grazing in combination with herbicide and hand work follow up will provide an effective method for reducing invasive species cover.

Mowing

Data collection:

Residual dry matter, plant percent cover, species richness and lupine counts were done prior to the mowing. This data will be collected again in March 2004 and preliminary comparisons will be reported in the 2004 annual report. It is likely that it may take 2-3 years of treatments before a significant change in plant species composition is observed (personal communication David Amme).

Observations:

The mow plots are located upslope of the grazed plots in an area that has a greater dominance of native grasses. Dense stands of California brome (*Bromus carinatus)* are especially evident within the mow plots. Data that is collected will document the change (before and after treatment), and it this change that is the important statistic to compare, rather than comparing the mowed plots directly to the grazed plots.

Perennial natives such as lupines and checkerbloom appeared to be doing well within the mow plots (personal observation). These species were avoided during the mowing application. Grasses such as *Nassella pulchra*, *Mellica californica* and *Bromus carinatus* all produced an abundant amount of seeds within eight weeks following the first mowing. The seeds were collected and propagated and are being planted within the perennial grass planting islands at Tank Ravine. At the double mow plot, the perennial grasses showed seed production later in the year (personal communication Mike Forbert).

Table 1. Grazing, Mowing, and Control Plots Established on San Bruno Mountain in 2003.

Grazing Area, paddocks	Transect	Size	Dates and Duration	Primary target	Notes
1	G3	(0.5 ac)	March 03- 1.5 days July 03 - 1 day	Annual grasses	Top of hill includes R2 (photo point only) and R3 outcrop (not seeded)
2	G1, G2	(1.5 ac)	March-03 - 2 days July 03 - 2 days	Annual grasses, fennel, oxalis	Closest to Hillside Blvd. Includes R1 outcrop seeded with Nassella pulchra and California brome
3 GSCRUB	no transect	(0.7 ac)	March 03 - 2 days July 03 - 2 days	Bacch. pilularis, CA sage-brush	Mixture of scrub and grassland. Vegetation was not heavily grazed after two days of grazing. Seeded with Nassella pulchra, Bromus carinatus, and Elymus glaucus.
4 GOX	G6.1, G6.2	(0.2 ac)	March 03 - 1 day July 03 - 0.5 days	Oxalis	West facing slope with dense oxalis infestation. Area was small, and heavily grazed. Control site on opposite slope. Seeded with Nassella pulchra and Bromus carinatus.
5 GRAV	G5	0.25 ac)	March 03 - 2.25 days July 03 - 0.75 days	Italian thistle, Oxalis, Mustard, radish	Ravine at base of slope, w/ dense exotics. Area received intensive grazing. Opposite side of ravine left ungrazed as control. Seeded with Elymus glaucus and Bromus carinatus.
M1 (single mow plot)	M1	(0.25 ac)	Mowed- weed-wack	Annual grasses	Mowed by WCW crews during same week as grazing. Some natives avoided (lupines, checkerbloom, etc.). No seeding, (seed collection).

Grazing Area, paddocks	Transect	Size	Dates and Duration	Primary target	Notes
M2 (double mow plot)	M2	(0.20 ac)	Mowed-weed-wack	Annual grasses	Mowed by WCW crews during same week as grazing. Includes R4 rocky outcrop, lupine counts for R4 extended partially beyond mowed area (to the west). Partial damage by OHV's, January 2004. No grass seeding.
Control	C5, C6		no treatment	Annual grasses	Control transects upslope within grassland outside of proposed burn area.
Control	C7		no treatment	Italian thistle, Oxalis, Mustard, radish	Control transect for ravine (transect G5).
Control	C8.1, C8.2		no treatment	Oxalis	Control transects on east facing slope with dense oxalis infestation. Control sites for transects G6.1 and G6.2.

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Personal Communications

Jared Lewis, Project Manager, Living Systems, Inc. Santa Cruz, California.

Terri Holleman, Grazing Manager, Goats-R-Us, Orinda, California.

David Amme, Resource Ecologist, El Cerrito, California.

Mike Forbert, Resource Manager, West Coast Wildlands, Pacifica, California.

Figure 1. Grazing and Mowing Monitoring Plots at Hillside Area, San Bruno Mountain, established March, 2003. Control monitoring transects are outside of treatment areas.

Proposed Burn Area

Grazed Areas

Mowed Areas

Monitoring Transects (treatments and controls)

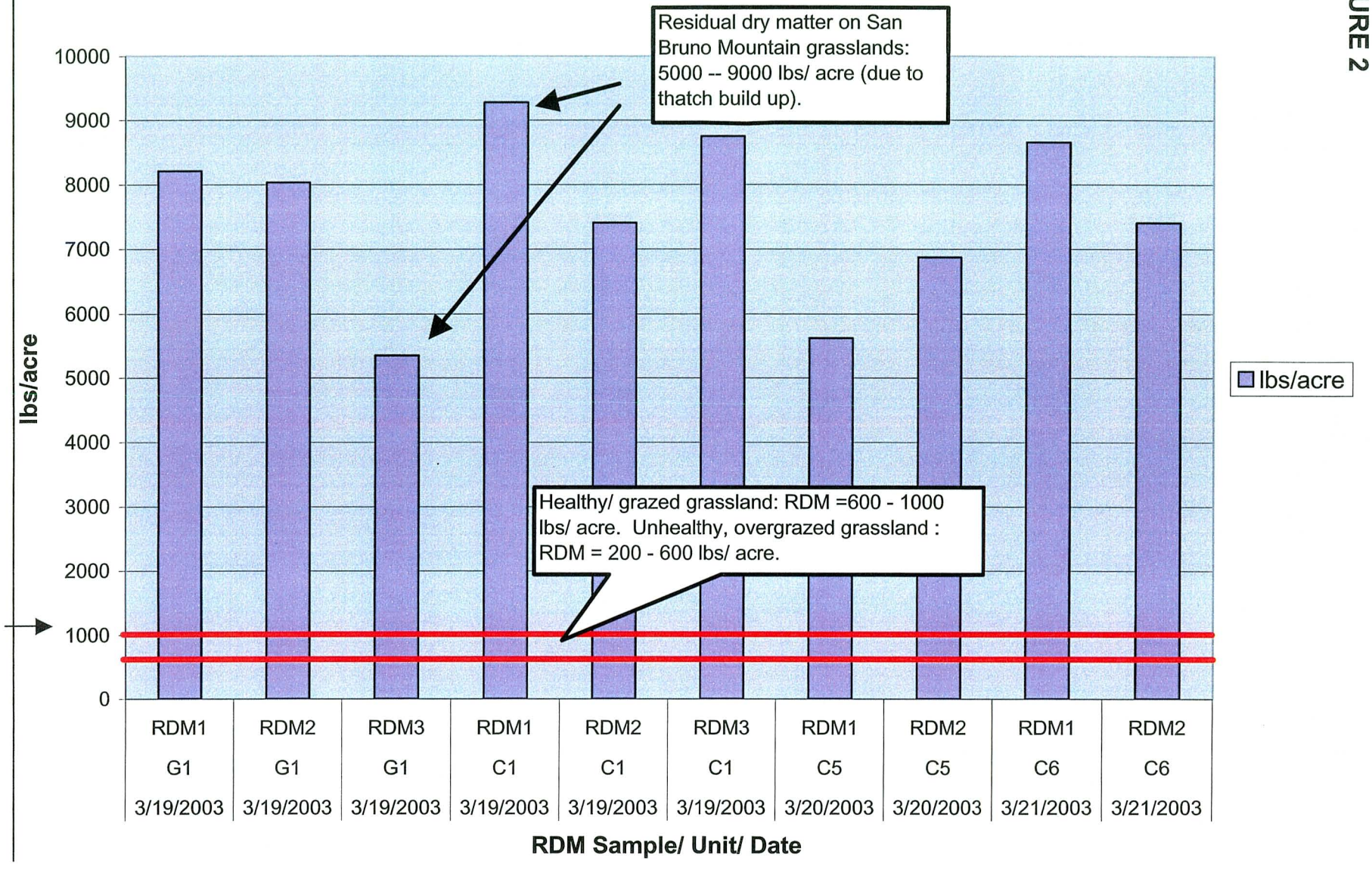
N

Approximate scale 1" = 500'

Map prepared by Thomas Reid Associates, January 2004

FIGURE 2

Figure 2. Residual Dry Matter (RDM) measured in grassland areas at Hillside/ Juncus Ravine area, San Bruno Mountain, March 2003



2004 Operating Program by Administrative Parcel

Administrative Parcel	Species Monitoring	Exotics Control	Revege-tation	*Planning Assistance
GUADALUPE HILLS (1)				
01 Linda Vista III (Bay Ridge)	X	X	X	
02 Carter St.	X	X		
03 Rio Verde Heights	X			
04 Levinson Property	X			
05 Brisbane Office Park	X			
06 Parcel Z	X	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		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		X
04 Terrabay Project	X	X	X	X
05 County Park	X	X	X	X
06 Hillside School				
07 PG&E Transmission Lines	X	X		X
08 Juncus Ravine	X	X	X	X
09 Water Pipelines	X			X
10 Fire Breaks	X			X

Administrative Parcel	Species Monitoring	Exotics Control	Revege-tation	*Planning Assistance
RADIO RIDGE (3)				
01 Telecommunications Site	X	X		X
02 County Park	X	X	X	X
03 Guadalupe Canyon Pkwy.	X	X		X
04 PG&E Transmission Lines	X	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