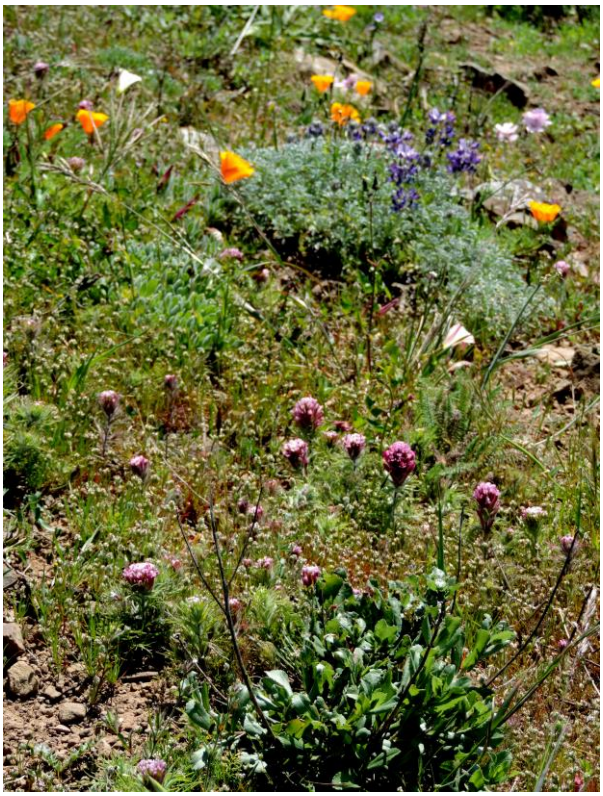
SAN BRUNO MOUNTAIN
HABITAT CONSERVATION PLAN



YEAR 2017-18 ACTIVITIES REPORT FOR FEDERALLY LISTED SPECIES
Endangered Species 10(a)(1)(B) Permit TE215574-6

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December 2018

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GLOSSARY

ANOVA - A statistical procedure called Analysis of Variance. ANOVA is used to test hypotheses about differences between two or more means without increasing the Type I error rate. ANOVA is employed 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.

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 - 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).

Invasive Species - Non-native species of plants or animals that out-compete native species in a specific habitat.

Fixed transects - Permanently marked transects that are surveyed year after year. Fixed transects 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 (HCP) - The San Bruno Mountain Area Habitat Conservation Plan as adopted by the County Board of Supervisors on September 14, 1982 (Resolution No. 43770).

Habitat Islands – Small areas of native habitat established in restoration sites. Native plantings are installed in relatively small islands where weeds can be more easily controlled. Planting islands generally range in size from 0.1 - 0.25 acres.

Host plant - Particular species of vegetation on which adult butterflies oviposit, and which provides a required food source for survival in the first stages of development after hatching.

Incidental observation - A butterfly observed outside of transects (or point survey area) during travel between survey areas. Transects are belt transect 5-meters wide. Fixed-radius point surveys have a radius of 25-meters.

Management - Treatment afforded portions of San Bruno Mountain to enhance or protect existing habitat or to reclaim habitat invaded by weeds or altered by 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 HCP, and to measure the success of its implementation.

Prescribed burn - The controlled application of fire to naturally occurring vegetative fuels, under specified environmental conditions and following appropriate precautionary measures, to achieve specific vegetation management objectives, such as brush and hardwood control, to prepare a site for planting, or reduction of fuel hazards.

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).

SUMMARY

This report describes the status of species covered under the San Bruno Mountain Habitat Conservation Plan (SBMHCP) and includes the adult butterfly monitoring results for 2017 and 2018. Vegetation management activities carried out to support habitat improvements to benefit the covered species is also discussed. This report is prepared for submission to the U.S. Fish and Wildlife Service, pursuant to the Endangered Species Act section 10(a)(1)(B) incidental take permit TE215574-6.

Three endangered species of butterflies are currently found on San Bruno Mountain and are covered under the SBMHCP: mission blue (*Icaricia icarioides missionensis*, MB), callippe silverspot (*Speyeria callippe callippe*, CS) and San Bruno elfin (*Callophrys mossii bayensis*, SBE) butterflies. In 2017 MB adult butterflies were counted along thirteen fixed transects. In 2018 San Bruno elfin larvae were counted at eight permanent plots and adult callippe silverspot butterflies were counted along fourteen fixed transects. Of the three covered butterfly species found within the SBMHCP area, CS and SBE butterflies are monitored in even years while MB butterflies are monitored in odd years. This has been done to accommodate the challenging weather conditions during adult butterfly flight seasons. Both CS and MB require temperatures to be warm, usually over 65-degrees Fahrenheit and winds less than 10-miles per hour. An additional constraint is the overlap of MB adult monitoring and SBE larvae monitoring. Simply stated, seasonal overlap, staff time requirements, and financial constraints has led to this alternating year approach for endangered butterfly monitoring within the SBMHCP area.

SBE butterfly larvae were monitored and counted between April 24, 2018 and May 24, 2018. Eight permanent plots have been utilized to count species abundance within known habitat for the past 19 years (with surveys completed every two years since 2003). Fixed-radius plots are deployed around a permanent center stake and all larvae observed on broadleaf stonecrop are counted. This year a season total of 2,148 larvae were counted. All permanent plots were surveyed three times this season.

All adult MB and CS butterflies observed along the fixed transects were counted in 2017 and 2018, respectively. The fixed transects are walked by observers at a slow, set pace and all observations for adult butterflies are recorded. Data collected during these surveys includes date, duration for completion of the transect, weather conditions, location along transect of CS adults, behavior, sex, and observed nectaring plant species. This information is reviewed to ensure standardization of the data for statistical analysis. The standards that should be met include minimum weather threshold, ≥65° and < 10 mph winds (5 mph for MB), and that transect observations are only counted if they are at least 1-week apart. A sightings per hour value is calculated for each transect as well as for the year. This index is not a population estimate, but rather a coarse density measurement that can be used in statistical comparison from year to year.

All MB transects were surveyed seven to thirteen times between April 4, 2017 and May 19, 2017. A total of 221 MB were observed and counted during the course of all transect surveys. No MB were observed on transect 1, 3, 4, 5 or 8. No modifications were made to MB transects in 2017, though scrub encroachment into transects affecting the passable length was observed.

All CS transects were surveyed five times between May 29, 2018 and July 12, 2018. A total of 387 CS were observed and counted during the course of transect surveys. No CS were observed on T-1, T-5, or T-6. In 2018 a new transect, T-14, located in the Hillside-Juncus management unit was added to the survey area.

Vegetation management activities in 2017 and 2018 had the purpose of protecting occupied grasslands from ongoing scrub encroachment and invasion of target weed species. Areas were prioritized using guidance from the Assessment of the Past 30 Years of Habitat Management and Covered Species Monitoring Efforts Associated with the San Bruno Mountain Habitat Conservation Plan (Assessment) by Creekside Science completed in February 2015. Using guidance from the Assessment scrub removal and associated high priority invasive species (i.e. fennel) were targeted in occupied high quality MB and CS habitat in 2017 and 2018.

Ecological Concerns, Inc., Go Native, Inc., Shelterbelt Builders, Inc., and West Coast Wildlands all worked in various treatment locations of the SBMHCP area, and targeted scrub and invasive species. In that time they treated a combination of native and non-native scrub, fennel, broom, mustard, thistle, and other weed species in 315 acres of the highest priority occupied MB and CS butterfly grassland habitat. Scrub control targets young scrub species for full removal in the grasslands designated as “Essential” habitat by the Assessment.

Volunteer efforts continue in conjunction with San Bruno Mountain Watch (SBMW) and the San Mateo County Parks Department Stewardship Corps program in butterfly habitat areas and areas that support other unique plants or habitats. SBMW volunteers efforts for the butterfly species focused primarily in Owl and Buckeye Canyon management unit with additional sites in Hillside/ Juncus and South Ridge management units. SBMW lead both weeding and planting events. Host and nectar plants were installed in areas where recent scrub removal efforts occurred. The total survivorship in 2018 for all plantings since project initiation was 34%. San Mateo County Parks Department also implemented volunteer events that focused on native planting and invasive species removal within the SBMHCP. Two projects occurred in 2017 and 2018 in the Saddle management unit.

Statistical analysis is planned for all butterfly data in 2019. Anyone interested in accessing data related to SBMHCP listed butterflies should contact the Parks Department’s Natural Resource Manager. Ramona Arechiga is currently serving in this role and can be reached at (650) 599-1375 or trarechiga@smcgov.org.

I. INTRODUCTION

In 2017 and 2018, a variety of habitat management work and three butterfly species were monitored to satisfy the requirements of the U.S. Fish and Wildlife Service (USFWS) Incidental Take Permit (TE215574-6) for the San Bruno Mountain Habitat Conservation Plan (SBMHCP). Protected butterfly monitoring for the federally protected mission blue (*Icaricia icarioides missionensis*, MB), callippe silverspot (*Speyeria callippe callippe*, CS) and San Bruno elfin (*Callophrys mossii bayensis*, SBE) butterflies occurred. The complementary habitat management activities to support grassland dependent butterfly species included scrub and invasive species control work, habitat restoration, and coordination with volunteer groups for site specific projects. Lastly, Parks Department staff coordinate with Plan signatories, coordinate technical and natural resource committees, and provide planning assistance to individuals, organizations and agencies related to development within the SBMHCP area and conserved habitat.

The SBMHCP and Endangered Species Act Section 10(a) permit was adopted in November 1982. The 30-year permit was renewed in March 2013. Annual monitoring and reporting of federally-listed species is conducted as part of SBMHCP implementation, and this report is presented to the U.S. Fish and Wildlife Service for review.

A. Covered Species Population Status

Under the SBMHCP the primary emphasis of the biological monitoring program is to evaluate the population status of the endangered butterflies occurring within the San Bruno Mountain area. In 2017 and 2018, fixed transects were used to assess the status of the MB and CS butterflies, and in 2018 fixed radius plots were used to monitor SBE butterfly larvae on San Bruno Mountain.

The monitoring protocol for CS and MB produce an adult observation index that can be used in a similar way as population estimates to look for population trends. The index generated from transect counts relies on the assumptions that the count is proportional to the population size and that the proportion is constant (Haddad et al. 2008). The current sightings per hour (S/H) index is modeled after the Pollard-Yates index (Pollard and Yates 1993). Pollard-Yates indices do not produce estimates of sampling variation and are believed to perform well regardless of sampling intensity (Haddad et al. 2008). These indices have been shown to correlate with mark-and-recapture estimates. Estimates related to detection probability and survival rates for MB and CS rely on the 1981 Biological Study that supported the development of the SBMHCP. The ability of monitors to observe the species is critical to meet one of the index assumptions, so monitoring is constrained by favorable weather conditions.

The current adult CS and MB monitoring approach is a density measurement. The current methodology aims at collecting peak density as an index of population size (Weiss et al. 2015). This serves as a proximate tool to determine general trends related to these butterfly populations. In 2000 long fixed transects were established to standardize this density measurement and to improve the statistical comparisons between years and among transects. Fixed transects are supposed to be surveyed 4-6 times a flight season when weather conditions meet minimum requirements for temperature and wind speeds.

The reason for at least four to six survey rounds is to ensure that the peak flight season is reflected in the monitoring observations.

In 2015 Creekside Science completed the Assessment of the Past 30 Years of Habitat Management and Covered Species Monitoring Efforts Associated with the San Bruno Mountain Habitat Conservation Plan, hereon referred to as the "Assessment." The report analyzed the last 30-years of butterfly monitoring data (both wandering and fixed transect) to determine the overall trends associated with the listed butterfly species. It included recommendations on butterfly monitoring techniques, including butterfly, habitat, and host plant monitoring.

The Assessment concludes that the MB and CS populations are stable in high quality habitat areas while marginal lower quality areas are at risk of losing their subpopulations. This was concluded after statistical analysis of the available data, including the most recently available fixed transect data. The primary causes of decline in periphery areas was attributed to scrub encroachment and for CS is likely further compounded by thatch accumulation from non-native annual grasses. It is important to remember that butterfly populations are often associated with large population variability due to individual female egg-laying ability and the many factors that influence mortality at immature life stages (Ibid). Mortality can be driven by annual weather, phenological asynchrony with host plants, predators and parasitoids, and host/nectar plant availability and quality (Weiss et al. 2015; Pollard 1988; Weiss et al 1988; van Swaay et al 2008). The key to sustaining healthy populations in high quality habitat is to increase the abundance and distribution of host and nectar plants on the mountain in close proximity to other essential habitat features for the individual species (Weiss et al. 2015; USFWS 2009; LSA 2004).

2017 MISSION BLUE STATUS

A total of 224 MB were documented during the monitoring season, observed along eight of the thirteen fixed transects in 2017. This corresponds to an average sightings per hour (S/H) for all transects of 1.9 S/H. The averaged maximum for all transects was calculated to be 7.9 S/H. A total of 79 person-hours was spent on transects included in the 2017 analysis. This does reflect the lowest recorded sightings per hour since new fixed transects for MB were established in 2007.

To improve our understanding or habitat quality and work on correlations of butterfly occurrences with host plant density, in 2017, efforts to complete coarse-scale lupine host plant mapping and quantification of host plant density was conducted. Full mapping of all host plant populations was not completed during the 2017 growing season, but it is planned for these activities to continue through 2019 and 2020 to establish complete coverage of the SBMHCP area.

2018 CALLIPPE SILVERSPOT STATUS

A total of 387 CS were observed along eleven of the fixed transects in 2018. This corresponds to an average sightings per hour (S/H) for all transects of 7.9 S/H. The averaged maximum for all transects was calculated to be 18.9 S/H. A total of 42 person-hours was spent on transects included in the 2018 analysis.

A detailed discussion is included in the 2016 annual report regarding the sightings per hour in comparison to previous monitoring years, and how annual variability in climate and monitoring effort should be considered in the big picture for these population metrics. 2016 represents the first year that County Parks took over the monitoring activities for this species. Recommendations from the Assessment are continuing to be incorporated into our management activities in an effort to maintain a robust monitoring dataset, and establish additional indicators for population variability.

To improve our understanding of habitat quality and work on correlations of butterfly occurrences with host plant density, in 2018 efforts to complete coarse-scale viola host plant mapping and quantification of host plant density was conducted. Full mapping of all host plant populations was not completed during the 2018 growing season, but it is planned for these activities to continue through 2019 and 2020 to establish complete coverage of the SBMHCP area.

2018 SAN BRUNO ELFIN STATUS

In 2018 a total of 2,148 SBE larvae were counted at eight permanent survey locations. The number of larvae observed is nearly 7 times greater than what was observed in 2016 (320 larvae). This number of larvae observed in 2018 is significantly higher than the numbers seen in other years with three complete rounds of surveys. Similar to the survey in 2016 the second and third round of surveys correlate to peak sedum bloom, however, the larval counts were still very high prior to this. Since no habitat monitoring is associated with SBE counts there is no clear explanation of this potential shift in larval abundance as it relates to peak sedum bloom. It should be noted that the methodology used for larval counts in 2018 differed from previous years, in that a two-week interval between survey rounds was implemented to capture a greater span of time for the life cycle of the larvae, other parts of the sedum plant were searched for larval presence, not just the sedum flower heads (stems, leaves, and the insides of rosettes were searched), and larvae that were observed that were likely in the 1st or 2nd instar were recorded as observations, not just those in 3rd or 4th instar stages.

Based on the Assessment's statistical analysis it appears that SBE are secure in high quality coastal scrub habitat and tracking abundance may not be worth the time and effort. The Assessment recommends establishing presence surveys at all historic sites using larval presence surveys at appropriate times of the year (April through early June) on a 3-4 year interval. Including a short timed search (10 person-minutes) once larvae are found. This would allow for a course density class to be reported as supplementary information. This should be considered for the 2018 monitoring season. A reduced frequency of SBE monitoring would enable additional host plant monitoring for MB and CS, due to the greater availability of staff time and funding to support these monitoring activities, if not dedicated to the same degree of intensive SBE surveys. This would facilitate the Assessment's recommendation of a hybrid monitoring approach (adult observations and habitat monitoring) that would better inform management activities. Since the SBE habitat was not impacted by authorized development under the SBMHCP it may be reasonable to reduce efforts here based the overall stability of this population.

RARE PLANT STATUS

At this time plant monitoring is not included in the current SBMHCP monitoring program or budget due to funding constraints. The executive summary of the 2016 rare plant survey and plant list is included in Appendix B.

II. STATUS OF SPECIES OF CONCERN

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

The MB butterfly is the most widespread of the endangered butterfly species on SBM, and its distribution corresponds closely to the distribution of its host plants. The host plants for the MB butterfly are three perennial lupines: silver lupine (*Lupinus albifrons* var*. collinus*), summer lupine *(L. formosus* var*. formosus)*, and varied lupine (*L. variicolor*). MBs are limited primarily to areas where their host plants and nectar plants are concentrated. MBs use a variety of native and nonnative species for nectaring (especially thistles), which are found throughout the grassland and coastal scrub plant communities. Protection from wind appears to be an important habitat component for MB and often the species is detected on the leeward side of slopes, or within protected road cut areas where host plants are present in suitable densities. MBs have been found to move up to approximately 0.25 miles between habitat patches (Thomas Reid Associates, 1982), though the species is likely to move further when dispersing between habitat areas. It is unlikely that MB are capable of immigrating to, or emigrating from, the SBMHCP area due to the urbanization barriers surrounding the Mountain.

MBs utilize silver lupine and summer lupine as their primary host plants, and utilize varied lupine less frequently on SBM. Silver lupine is the most widespread host plant species on the Mountain, and grows within dry habitats such as south and east-facing native and non-native grasslands, road cuts, rock outcrops, fire breaks, ridgelines, erosion rills, and landslide scars. Summer lupine also grows within disturbed soil conditions and colonizes roadways and landslide scars in more mesic areas, where soils are typically deeper and/or sandier. Varied lupine grows in grasslands and along disturbed roadsides, typically within mesic exposures, and is commonly found within north and west facing grasslands. MBs tend to utilize larger patches of varied lupine, or smaller patches of varied lupine when found in proximity to silver and/or summer lupine.

Typically, MB butterflies begin adult flight in March and are most abundant in April. Observations begin to drop off by late May or early June. The timing and duration of the flight season is influenced by overall seasonal climate as well as microclimate within separate regions of the SBMHCP area. Late spring rains can delay the onset of the flight season, while hot spring conditions can shorten it. 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.

<u>METHODOLOGY</u>

In the winter of 2006/2007, 13 fixed transects were established on SBM for MB

butterflies (Figure 1). In plotting out the new transects, efforts were made to traverse as much MB habitat as possible. Historic habitat as well as restored or planted habitat was included. Where possible, old MB transects were incorporated into the new, longer transects. Transects vary in length from approximately 500 to 2100 meters and are permanently marked in the field. Of the 13 transects, 11 were established with the intention of being regularly monitored. Two transects (transects 2 and 3) were established as transects to be visited less frequently. Transects 2 and 3 were created to study MB usage of these sites, but these sites are not considered of highest importance in terms of measuring MB abundance in the SBMHCP area. Transect 2 is located east of the Pointe Pacific housing development. Transect 3 includes a planting island on the south side of Guadalupe Canyon Pkwy between the Parkway and Colma Creek. The newly established MB transects were monitored for the first time in 2007 and again in 2009, 2011, 2013, and 2015.

Due to concern for monitor safety, in 2009 transects 4 and 5 were reconfigured so that monitors were no longer crossing Guadalupe Canyon Parkway. Transect 4 now ends at the south side of Guadalupe Canyon Parkway and transect 5 connects to that portion of the old transect 4 that is on the north side of the Parkway (Figure 1). Thus, the reconfigured transects 4 and 5 have been monitored since 2009.

The purpose of fixed transects is to provide a means with which to compare MB observations from year to year at specific locations. Fixed transect locations were not chosen randomly but were placed in habitat areas with higher butterfly densities and areas that include a variety of slope exposures, nectar plants, and soil conditions (i.e. road cuts, ravines, and natural slopes). Even within high-density habitat locations it is sometimes difficult to observe enough butterflies for statistical comparison. For this reason, fixed transects were located only in areas where there was a good chance of observing MB.

The monitoring program attempts to capture the beginning and end of the flight season and to thoroughly document the observations on a weekly or biweekly basis during that period. It is not cost effective for monitoring teams to monitor the fixed transects prior to species emergence, or to continue monitoring transects after most of the observations have dropped off. As a result, the actual monitoring period does not include the entire flight season for each butterfly species.

Ideally, each transect is monitored approximately 3-5 times over the peak of the flight season. Monitoring occurs only during warm, calm weather (wind speeds less than 10 miles per hour) when MB are most active. Efforts are made to complete an observation cycle (a survey of all 13 transects) within one to two days. All butterflies observed beyond a specific transect or in the transect vicinity during travel between transects are recorded as incidental observations. While the best practice is to leave a 10 day gap of time between monitoring days for each transect, the necessity to monitor under appropriate weather conditions can make this difficult to time. The approach in 2017 for MB was to monitor transects as many times as possible during the period from April 4 through May 19, whenever weather conditions were suitable, regardless of the 10-day timing gap.

The duration spent walking a transect is recorded by the observer and all MB observed

along the transect are noted. The location and time of the observation is recorded on a digital map. The number of MB sightings per hour (S/H) is used for analysis. The number of MB observed on a particular transect is divided by the number of minutes to complete the transect survey. For each year, the average and maximum MB sightings per hour for all transects are used to look for upward or downward trends in MB encounter rates among and within transects. The average S/H on a given transect is calculated from the total number of butterflies counted on that transect during all surveys over the total minutes spent on the transect. The maximum value is the highest S/H recorded on a transect in a given year. The maximum S/H is a useful variable for analysis. By looking at only the maximum S/H, the S/H measurements captured at the beginning or end of the flight season that may be of lower value do not skew the data.

Coastal scrub, including poison oak, has encroached on some transects, making complete coverage of these transects difficult if not impossible. Modifications made to these transects are described in the results section where relevant. The original 13 transects in entire length are shown in Figure 1. Additional figures can be seen in Appendix A


Figure 1
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SAN MATEO COUNTY
PARKS
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0.25
0.5
1
Miles
2017 Mission Blue Observations
Mission Blue Observations 2017
Mission Blue Transects

RESULTS

Transect monitoring of MB butterflies occurred between April 4, 2017 and May 19, 2017. A total of 221 MB were counted along all transects. MB were observed on 9 of the 13 transects. The average sightings/hour (S/H) for all transect data combined in 2017 was 1.9. The maximum S/H is what is used to look for trends in abundance, and for 2017, it was 7.9 S/H for MB. Each transects was surveyed seven times or more throughout the season, though the 7 to 10 day spacing between surveys was not always adhered to in order to accommodate weather conditions.

Trends observed on each transect are discussed in detail below. Each transect is defined by the Management Unit (MU) that it occurs in and if it is in an Essential, Valuable, or Potential Habitat area for priority scrub management as defined in the Assessment. Priority scrub management habitat areas can be seen in Figure 2 Defining MB in terms of their MU and scrub management area is useful for interpreting butterfly monitoring findings with respect to management actions and recommendations. Sightings per hour for each transect for monitoring years 2007-2017 are summarized in Tables 1 & 2, and illustrated in Figure 3.

T-1, Transect 1 (MU Southwest Slope; some Potential habitat) –
This transect includes a portion of the road cut west of the former ranger's station, part of the summit loop trail, and habitat alongside the paved road (Battery 59 Road) leading to the former ranger's station. In 2017, no MB were observed on this transect.

T-2, Transect 2 (MU Reservoir Hill; Potential Habitat) –
This transect originally looped first through a grassy knoll, then back through scrub to hit a small population of lupine that had been planted by the Point Pacific Homeowners Association. The scrub has become too dense to pass through, therefore the grassy knoll has been the primary focus for the surveys since 2013. There were 7 MB observations on this transect in 2017, with a max S/H of 12.6.

T-3, Transect 3 (MU April Brook; No Habitat Value) –
The majority of MB habitat on this transect occurs at its eastern end. Only a small number of plants are found at the western end and the route between these areas above the road cut supports coastal scrub. That scrub has become increasingly dense. No MB were observed on this transect in 2017.

T-4, Transect 4 (MU Dairy Wax Myrtle Ravines; some Essential some Potential) –
This transect is located in the Wax Myrtle Ravine and Dairy Ravine area. The transect begins at a planting island in Dairy Ravine, crosses through Wax Myrtle Ravine, following Old Ranch Road trail along Guadalupe canyon parkway. No MB were observed on this transect in 2017 during monitoring activities, though one incidental observation was logged.

T-5, Transect 5 (MU Saddle; some Essential some Potential) –
Much of transect 5 follows an established trail. However, the transect departs from this trail and makes a U-turn through scrub in order to include MB habitat at the top of a road cut above Guadalupe Canyon Parkway. Coastal scrub on this route has become

very thick making passage difficult. In 2013 & 2015, the U-turn was omitted from the transect, and it was assumed that zero MB detections would have occurred while surveying this leg. In 2017, one MB was observed along this transect during the surveys.

T-6, Transect 6 (MU Dairy Wax Myrtle Ravines; Essential) –
Most of this transect is accessible and supports high quality MB habitat. Only the northern end of the transect has become difficult to traverse with scrub and poison oak. In 2017, a total of 21 MB were observed over 9 visits, equating to a max S/H of 6.8.

T-7, Transect 7 (MU Northeast Ridge; Essential) –
The northwest portion of this transect is within the Toll Brothers development, and since 2011 has been fenced off and then later disturbed by grading. Transect 7 now ends at the Toll Brothers fence. 6 MB were observed along this transect in 2017, over 9 total visits. Maximum sightings per hour for this transect were 5.3 S/H.

T-8, Transect 8 (MU Carter Martin; Some Valuable) –
When monitored in 2011, the middle of this transect had become difficult to pass due to scrub, including non-native gorse and French broom. In 2013, the transect was monitored in two sections, one on either side of the impenetrable scrub. In 2017, no MB were observed on this transect.

T-9, Transect 9 (MU Northeast Ridge; Essential) –
2017 represents the first year since 2007where the maximum S/H have not declined from the previous year, though the total sightings and S/H were still quite low (1 individual observed, 1.1 max S/H). While grassland habitat along T-9 is fairly intact much of the habitat has sparsely distributed lupines. An exception is at the northern end of this transect where a robust population of lupines are found around the PG&E tower where scrub can be seen starting to expand into grassland habitat just to the west and south of the towers. The southeast corner of T-9 also contains numerous lupines. Only one MB was observed during eight surveys.

T-10, Transect 10 (MU Owl Buckeye Canyons, some Essential some Potential) –
T-10 is located at the foot of Owl and Buckeye Canyons within the California Department of Fish and Wildlife lands. This transect traverses open high quality prairie and grassland habitat with diverse nectar sources and scattered lupines along both ridgelines. A total of 55 MB were observed over ten surveys, a considerable increase from recent years. A maximum S/H of 33.2 and an average of 5.9 was recorded for 2017. While the maximum S/H is much higher than any previous monitoring year, the average S/H is within a comparable range of the previous three years.

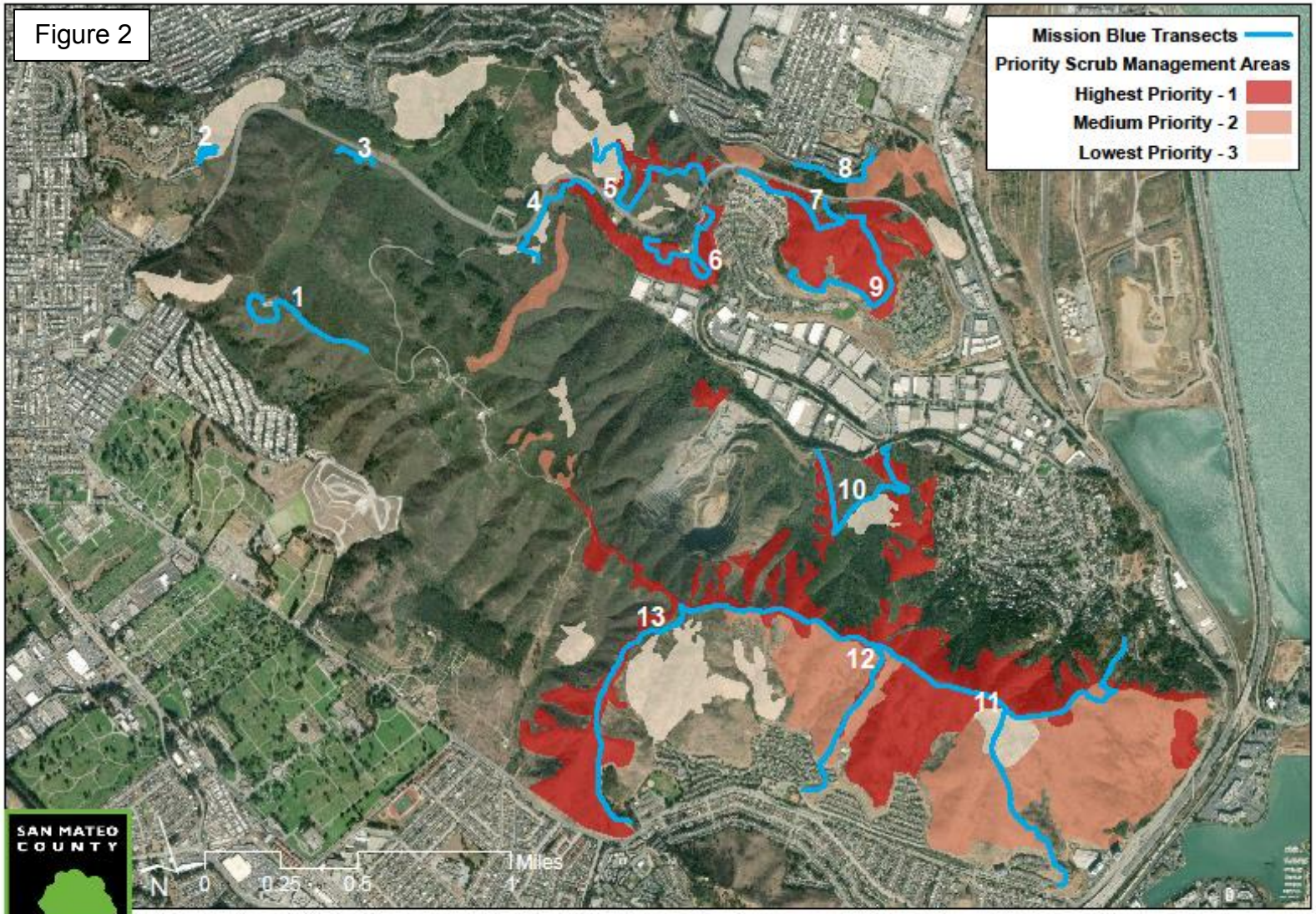
Transect 11 (MU Southeast Ridge; some Essential, some Valuable, some Potential) –
T-11 is located within the Southeast Ridge Management Unit and begins at a previously disturbed slope above Sisters City/Hillside Boulevard that supports lupines. This transect follows the Ridge Trail and includes a portion of the Brisbane Acres Management Unit. T-11 intersects some of the SBM's best lupine habitat with abundant nectar sources. A total of 47 MB were observed on this transect in 2017, up from 13 MB in 2015, with a maximum S/H of 14.0 and an average of 3.3. Similarly to transect 10,

while the maximum S/H is much higher than 2015, the average S/H equivalent. These values are both lower than what was recorded for 2007-2013 for this transect.

T-12, Transect 12 (MU South Slope; some Essential some Potential) –
T-12 is located within the South Slope and Southeast Ridge Management Units and follows the ridgeline from the Terrabay water tank to the Ridge Trail. Similar to other locations along the South Slope and Southeast Ridge, the habitat here is extensive and continues to support annual grasses, nectar sources, and lupine host plants. 37 MB were observed along T-12 in 2017 with a maximum S/H of 11.1 and an average of 3.7.

T-13, Transect 13 (MU Ridge, Essential) –
T-13 follows the Ridge Trail and then drops down a ridgeline to Hillside Blvd. T-13 is located on the south facing slope of SBM where conditions are the most dry and sunny. While scrub encroachment has been largely ignored on these slopes due to the slower rate of expansion as compared to the more mesic north and east facing slopes this is a concern in 2015. Grassland habitat supporting lupines along T-13 continue to support high MB observations during transect surveys, despite annual variability in total observations on this transect. In 2017, 47 MB were observed on T-13 (compared to 18 MB in 2015), with a maximum S/H of 18.1 and an average of 4.1.

Figure 2



Mission Blue Transects & Scrub Management Areas

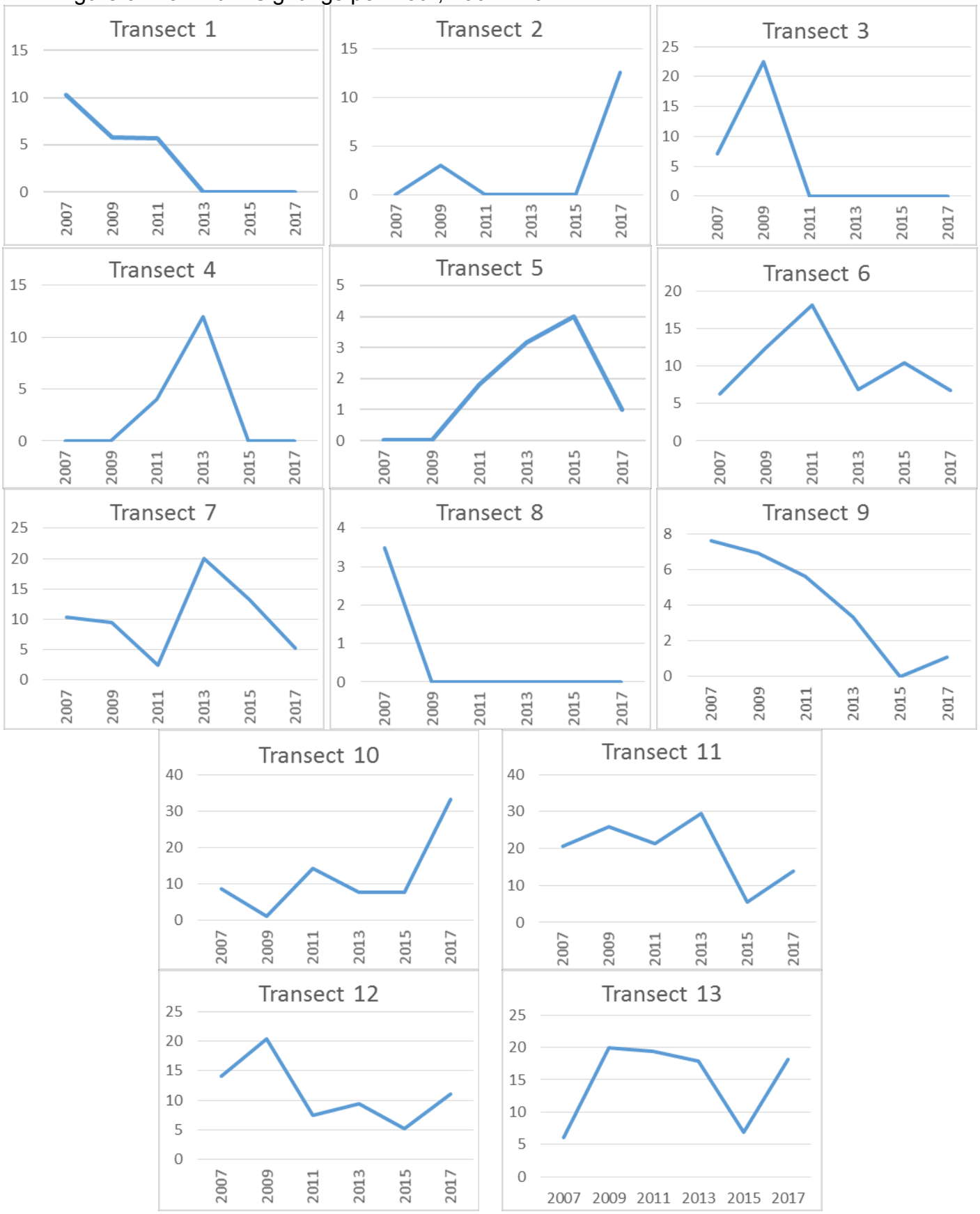
Table 1: Average S/H on each Transect: 2007 – 2017

Average S/H on each Transect from 2007 to 2017						
Year/ Transect	2007	2009	2011	2013	2015	2017
1	2.4	3.57	3.9	0	0	0
2	0	3	N/A	0	N/A	3.1
3	7.1	22.5	0	0	N/A	0
4	N/A	0	2.7	4.86	0	0
5	N/A	0	1.7	1.32	0.98	0.1
6	2.8	9.68	15.3	4.02	4.94	2.6
7	3.9	6.18	0.8	13.04	12	1.2
8	0.6	0	0	N/A	N/A	0
9	4.6	4.5	2.7	1.31	0.49	0.1
10	4	1.15	7.6	5.27	5.63	5.9
11	11.3	15.04	15.2	10.73	3.32	3.3
12	6.5	14.21	5.1	6.32	1.53	3.7
13	2.2	13.33	11.1	12.52	4.11	4.1

Table 2: Maximum S/H on each Transect: 2007 – 2017

Maximum S/H on each Transect from 2007 to 2017						
Year/ Transect	2007	2009	2011	2013	2015	2017
1	10.3	5.8	5.7	0	0	0
2	0	3	N/A	0	N/A	12.6
3	7.1	22.5	0	0	N/A	0
4	N/A	0	4	12	0	0
5	N/A	0	1.8	3.16	4.0	1.0
6	6.3	12.4	18.1	6.92	10.43	6.8
7	10.3	9.5	2.4	20	13.33	5.3
8	3.5	0	0	N/A	N/A	0
9	7.6	6.9	5.6	3.33	N/A	1.1
10	8.7	1.2	14.4	7.74	7.64	33.2
11	20.6	25.8	21.3	29.41	5.54	14
12	14.1	20.4	7.4	9.38	5.22	11.1
13	6	20	19.4	17.89	6.82	18.1

Figure 3: Maximum Sightings per Hour, 2007 - 2017



DISCUSSION

In 2017 MB observations were up slightly overall from 2015 counts, but still mostly reduced from previous years. There are a number of potential contributing factors that could explain this. In attempts to correct for previous monitoring years, which the monitoring efforts did not meet the minimum recommended 3 annual surveys, were missing important details in the data sheets, and had low overall person-hours contributing to the efforts, the monitoring approach in 2017 was to complete as many surveys as possible during the flight period when weather conditions were favorable, regardless of the interval between surveys (recommended 10-day intervals between survey rounds). While the level of effort, number of person hours, and attention to detail in recording observations was greatly increased for 2017, there were still many surveys where no MB where observed for the entire duration of a transect survey. In calculating the average and maximum sightings per hour for the transects, these occurrences with 0 observations for the duration of the surveys brought down the averages overall. As a result, while the total number of MB observed in 2017 (221) much greater than the total observed in 2015 (62), the average sightings per hour was 1.9, compared to 3.2 in 2015. In 2017, there were a number of occurrences where survey conditions were not optimal in respect to temperature or wind.

In 2017, the greatest number of MB recorded per hour was on transects 10, 13, 11, 12, and 6 respectively. Transects 11, 12, and 13 contain prime hilltopping habitat along the Southeast Ridge with thin soils. Transect 10 crosses Owl Canyon, while transect 6 traverses an area behind the Brisbane Industrial Park along Dairy/Wax Myrtle Ravines.

Transects that performed the worst in 2017 include 1, 3, 4, and 8 with no observations of MB adults recorded. All of these transects have had few to no other MB observations in recent and/or previous years.

CONCLUSIONS

MBs are found in relatively low densities (as is typical for most *Lycanidae* species), but are widely distributed on San Bruno Mountain. The distribution of MBs observation in 2017 on San Bruno Mountain is similar to that of 2015, however, the number of MBs observed is higher. North to south this species continues to be found in a wide variety of microclimates and slope exposures within SBMHCP area, although in significantly varying densities. The total observed number and calculated sightings/hour of MB in 2017 was lower than that of the previous 5 years of monitoring, but does not necessarily signal a downward trend in MB abundance as year to year variation has been observed on San Bruno Mountain since 1981 when studies of this species began.

The western portion of SBM has not seen any reliable observations of MB in 2013, 2015, or 2017, aside from 7 MB sightings on T-2 in the Reservoir Hill area in 2017. This could be due to the combination that high quality habitat is found in smaller habitat patches and unabated scrub encroachment into grassland areas. Weather variability on SBM plays a

role in monitoring and it can be difficult to schedule butterfly monitoring visits during ideal monitoring conditions, warm and calm weather days.

A mitigation project undertaken by PG&E, initiated in 2018, focused on grassland restoration efforts on the west peak of SBM, on the south-west facing slope. This location is less than 0.5 miles from T-2, where observations of MB were made in 2017. Though this distance is greater than the typical 0.25 mile dispersal distance for MB, there is additional restoration potential to establish a dispersal corridor with habitat islands connecting these two areas and allowing for greater movement of MB throughout this area.

As documented over the past 30 years of butterfly monitoring on SBM, the Southeast Ridge and South Slope continue to provide the largest contiguous patches of high quality habitat for MB butterflies. MBs are widely distributed on San Bruno Mountain, but it is primarily on the South Slope and Southeast Ridge that MB are consistently found in high densities. The South Slope contains large areas of contiguous grassland, and is located on south-facing aspects of San Bruno Mountain as is therefore drier and warmer. Historically coastal scrub succession has been less of a threat than on the south facing slopes, but with little natural disturbance (fire) and absence of grazing these areas are beginning to see more scrub encroachment into grassland areas. In 2017, Owl and Buckeye Canyons, where transect 10 intersects, had the highest density ever recorded for this transect in 2017, since the start of this monitoring. There has been a significant focus on scrub control in this area since 2015, and the enhancement of the grassland habitat due to these efforts could be benefitting the MB population in this area.

The Assessment conducted by Creekside Science provides clear guidance concerning grassland evaluation in light of scrub encroachment. Grassland quality, specifically with respect to host and nectar plant distribution and abundance, are important considerations for healthy MB populations. While the HMP and the SBMHCP documents both identified scrub encroachment as threats to MB neither document provided clear guidance concerning how to define grassland quality or levels of scrub encroached grasslands with quantifiable definitions and actionable thresholds. The lack of a clear definition and SMART (specific, measurable, achievable, results-focused, and time-bound) goals and objectives coupled with limited resources had delayed meaningful management activities targeting this threat until recently.

RECOMMENDATIONS

SCRUB ENCROACHMENT

Scrub encroachment is a serious threat to the quality of grasslands and prairie habitats that support MB butterfly populations scattered throughout SBMHCP area. Scrub has been identified as a threat to covered species throughout the SBMHCP and in all documents that provide habitat and vegetation management suggestions. Scrub within the SBMHCP area consists of both native and exotic species. Habitat management activities now balance native scrub control, along with continued containment of noxious exotic plants (gorse, fennel, broom, eucalyptus), and continued treatment of invasive plant species that have the potential to impact covered species habitat.

1. Scrub encroachment should continue to be the primary focus for budget

expenditures related to habitat management. Using the Assessment, areas designated as "essential" should continue to be prioritized for treatment. San Mateo County has completed treatment of approximately 135 acres of scrub removal in areas designated as essential habitat for 2017 and 2018. See figure 13 in the Appendix for these treatment areas. This work includes continued exotic control in these areas. Areas undergoing scrub removal may also require additional restoration work including host and nectar plantings. Restoration plantings will help increase density and distribution of host and nectar plants in essential habitat.

MB MONITORING

2. Consider adding weather & vegetation data into statistical models: temperature, rainfall, solar radiation, and host plant data can be incorporated into statistical analysis, modeling, and hypothesis testing. Standardize methodology for all monitoring.

3. Initiate flight season documentation; may improve monitoring deployment, level of effort, and limit the potential to miss the peak flight season. Monitoring for butterfly flight season may need to begin up to a month ahead of historically documented flight seasons in light of changing climate conditions. Consider, monitoring both key nectar plant phenology as well as host plant phenology to improve survey initiation and timing.

4. Continue to initiate surveys only when the base temperature of 64.4 degrees Fahrenheit is met; logistically this can be the most challenging aspect of butterfly monitoring, day-to-day and hour-to-hour, as temperatures oscillate on the mountain. Collecting more than five weeks of monitoring data may be necessary to absorb the variability associated with cool, cloudy, or windy conditions that have hampered shorter monitoring seasons.

MB HOST AND NECTAR PLANT MONITORING

MB host and nectar plant monitoring had not been a priority in recent years; however, in 2017 coarse scale vegetation mapping of lupine host plant populations was undertaken throughout grassland habitats on San Bruno Mountain. MB host plants and nectar plants are a critical part of the MB lifecycle and intimately tied to the health of the population.

5. Continue to implement host plant monitoring at regular intervals, perhaps every five-years.

6. Monitoring of MB host plants and potentially associated nectar plant densities within host plant patches to help clarify habitat management activities including scrub management. Define high, medium, and low density host plant populations. MB habitat.

7. Over the next several years and as funding allows, host plant monitoring should become part of the SBMHCP monitoring program and clear definitions of habitat quality should be created.

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

The CS distribution is similar to that of the MB, however CS is less frequently observed on the west side of the Mountain. Habitat for CS includes grasslands supporting its host plant, *Viola pedunculata*. Viola is predominately found within mesic to dry open grasslands on both north and south-facing slopes. Viola can also be found on disturbed road cuts, and along the boundaries between grassland and scrub under partial shade of taller plants. CS use a variety of native and non-native species for nectaring (especially thistles) that are found throughout the grassland and coastal scrub plant communities.

Ridgelines and hilltops within grassland habitats are an important habitat component for this butterfly species, as CS utilize these features for mate selection. The species has been shown to move up to approximately 0.75 mile between habitat patches (Thomas Reid Associates, 1982), but likely can move further in multiple movements.

The flight season for adult CS is typically from mid-May to mid-July. Due to their larger size and stronger flying ability than MBs, CS are not as sensitive to strong winds. Often this species is detected along ridgelines and hilltops in high densities, sometimes during windy conditions (>10 mph average). Transect monitoring of CS was conducted between May 29 and July 12 of 2018. Survey methodology, results, discussion, and recommendations are included in this report.

METHODOLOGY

Surveys are conducted on fixed transects to provide a means with which to compare CS observations from year to year at specific locations. Fixed transect locations were not chosen randomly but were placed in habitat areas with higher butterfly densities and in areas that include a variety of slope exposures, nectar plants, and soil conditions (i.e. road cuts, ravines, and natural slopes). Even within high-density habitat locations, it is sometimes difficult to observe enough butterflies for statistical comparison; for this reason 14 fixed transects have been located only in areas where there is a good chance of observing CS under desirable weather conditions. Transects vary in length from approximately 500 to 2100 meters and are permanently marked in the field (Figure 4). A total of 14 fixed transects were monitored in 2018.

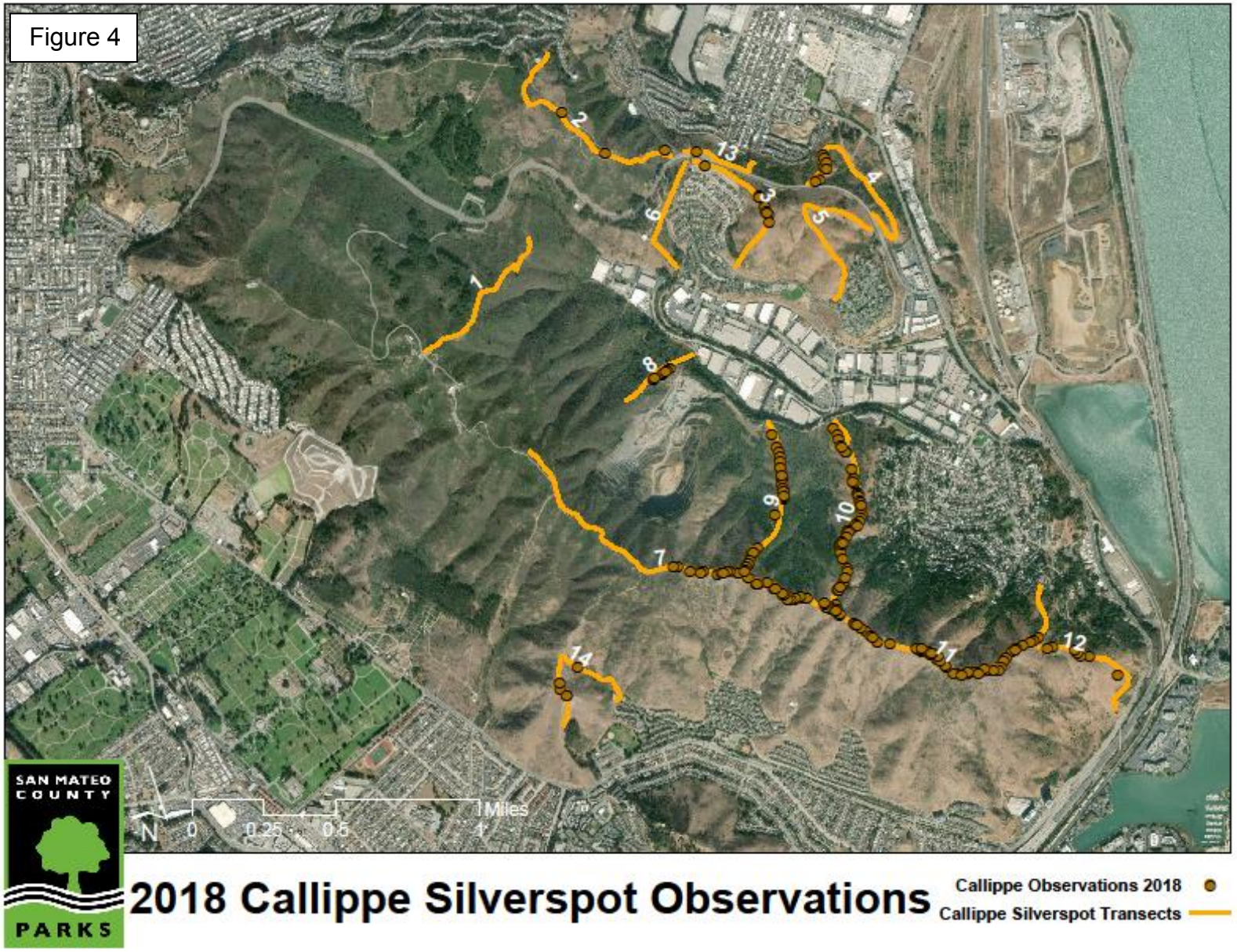
Twelve of the 13 transects have been surveyed for CS since 2000. Transect 13, east of the terminus of Carter Street and on the north side of Guadalupe Canyon Parkway, was added in 2005. This location was chosen in order to learn more about potential CS presence and movement in grasslands north of Guadalupe Canyon Parkway. Transect 14, within the Hillside-Juncus management unit, was established in the winter of 2018. This location was chosen due to the healthy populations of *Viola pedunculata*, diverse nectar sources, and open grassland habitat. This location had not, to this point, been surveyed for CS use.

Ideally, each transect is monitored approximately three to five times during the peak of the flight season, with monitoring at any individual transect spaced approximately 10 days apart, weather permitting. Monitoring occurs only during warm, calm weather (wind speeds

less than 10 miles per hour) when CS are most active. All butterflies observed beyond a transect or in the transect vicinity during travel between transects are recorded as incidental observations. Transects are considered belt transects and are three meters wide.

The duration spent walking each transect is recorded by the observer and all CS observed along within the belt transect are noted. The location and time of the observation is recorded on a digital map, as well as sex, condition, behavior, and nectaring plant information. The number of CS sightings per hour (S/H) is used for analysis. The number of CS observed on a particular transect is divided by the number of minutes to complete the transect survey. For each year the average and maximum CS sightings per hour for all transects are used to look for upward or downward trends in CS encounter rates among and within transects. The maximum value is the highest S/H recorded on a transect in a given year. The maximum S/H found on a transect in a given year is a useful variable for analysis. By looking at only the maximum S/H it can be assumed that the sightings per hour captured at the beginning or end of the peak flight season, which may be lower, do not skew the data.

Figure 4


SAN MATEO COUNTY
PARKS
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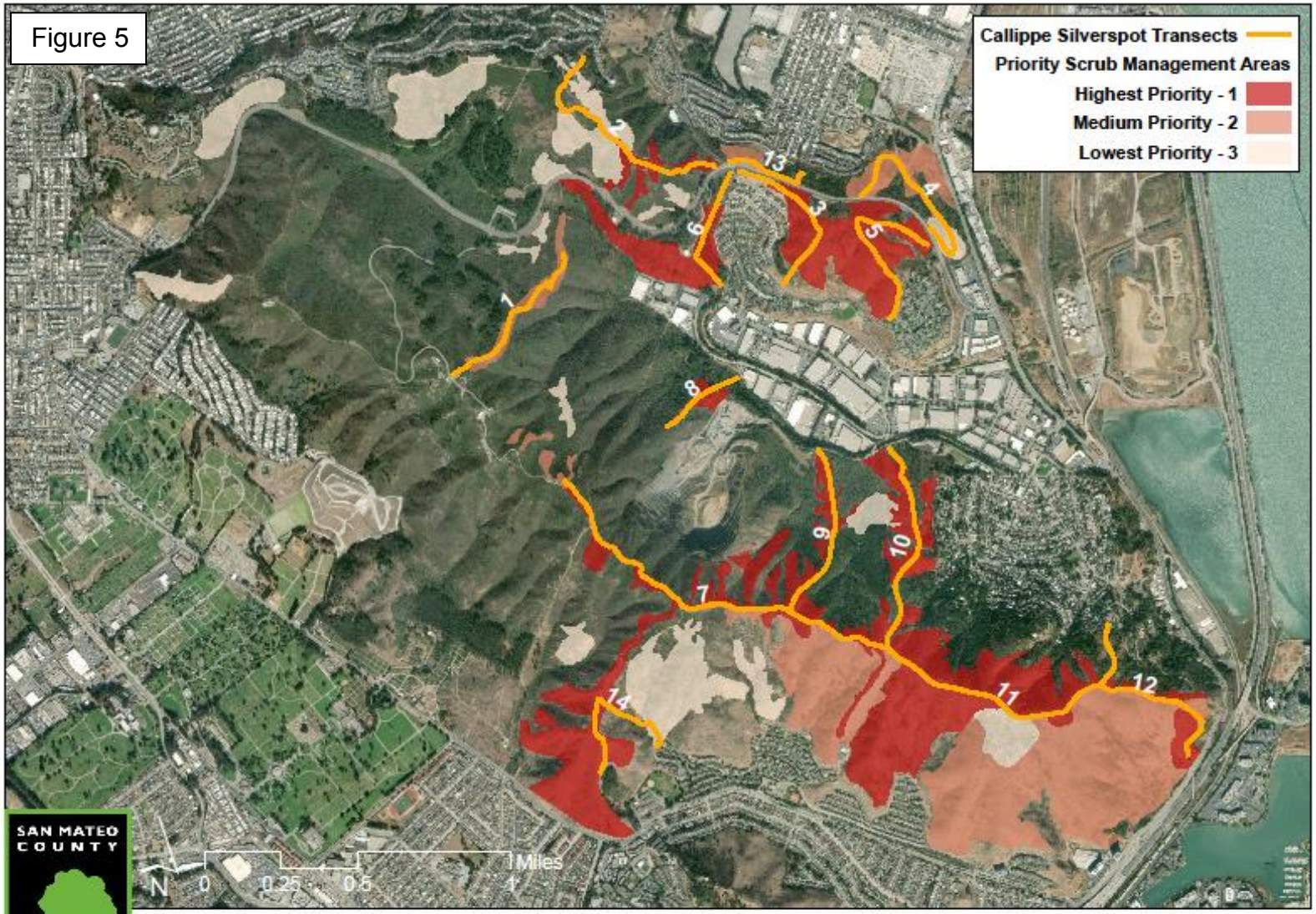
2018 Callippe Silverspot Observations
Callippe Observations 2018
Callippe Silverspot Transects

Figure 5



CallippeTransects & Scrub Management Areas

RESULTS

Transect surveys of CS butterflies occurred between May 29, 2018 and July 12, 2018. A total of 387 CS were counted along all transects. CS were observed on 11 of the 14 transects. The average S/H for all transect data combined in 2018 was 7.9. The maximum S/H is what is used to look for trends in abundance and for 2018 it was 18.9 S/H for CS. Each transects was surveyed at least five times throughout the season spaced one week apart. Trends observed on each transect are discussed in detail below. Each transect is defined by the Management Unit (MU) that it occurs in and if it is in an Essential, Valuable, or Potential Habitat area for priority scrub management as defined in the Assessment. Defining CS in terms of their MU and scrub management area is useful for interpreting butterfly monitoring findings with respect to management actions and recommendations.

T-1, Transect 1 (aka Dairy Ravine; MU Dairy and Wax Myrtle Ravines; Valuable) –
Since 2000 T-1 has consistently had a low S/H due to the limited Viola habitat along this transect. In 2018, no CS were seen on Transect 1, nor were any CS observed there from 2012 through 2016. The most recent year CS were observed on Transect 1 was in 2010, when a single CS was observed during all of the three surveys. Transect 1 supports primarily coastal scrub and adjacent areas of grassland habitat supporting viola have become increasingly limited. Although no major visible changes were recorded by monitors it is possible that cumulatively small changes in viola patch size or other habitat conditions shifted over time, an example is thatch density in grassland areas.

T-2, Transect 2 (MU Saddle; some Potential some Valuable) –
There were 3 CS observed over the five completed surveys dates in 2018. This is in contrast to the 2016 observations, where there were no CS recorded on this transect, though in 2014 there were a total of 15 individuals observed.

T-3, Transect 3 (MU Northeast Ridge; Essential) –
This transect is located on the Northeast Ridge and includes Callippe Hill and a portion of land comprising the Toll Brothers Development (Figure 4). The maximum S/H on Transect 3 was 19.4 in 2018, which is considerably lower than that recorded in 2014 (73.3), but an increase from 2016 (11.7). The western end of this transect has been eliminated since it was fenced off for the Toll Brothers development. Scrub encroachment along the ridge top leading to Arnold Slope and Arnold Slope continues; this area is under private ownership.

T-4, Transect 4 (MU Carter Martin; some Potential some Valuable) –
T-4 is located on the north side of Guadalupe Canyon Parkway across from the Northeast Ridge and/or Callippe Hill (Figure 4). The average (4.9) and maximum (15.8) S/H calculated were lower than that observed in recent years, continuing a declining trend in observations on this transect from 2016.

T-5, Transect 5 (MU Northeast Ridge; Essential) –
T-5 is located on the eastern side of the Northeast Ridge. No CSs were observed during any of the surveys in 2018, a stark contrast to 2016 where CS were observed during all 4 surveys. Little visual change in habitat quantity or quality has been documented in past annual reports, and despite some fennel and broom invasion on the lower slopes, this

transect is still through predominantly open grassland. Parks staff have noted that dense thatch under non-native annual grasses appears to be present in many areas along this transect.

T-6, Transect 6 (MU Dairy and Wax Myrtle Ravines; Essential) –
T-6 intersects sparse viola habitat, and consequently few CS are recorded here during most monitoring years. In 2018 there were no CS observed on transect 6, while in 2016 there was a single CS observation on one of the survey dates, and in 2014 no CS were observed. Modifications to this transect may be necessary since it was shortened due to the northern portion of the transect becoming more dense with scrub species including coyote brush (*Baccharis pilularis*), poison oak (*Toxicodendron diversilobum*), and Scotch broom (*Cytisusscoparius*). Meanwhile, Italian thistle (*Carduus pycnocephalus*) has proliferated along the east-west portion of this transect. Portions of this transect are a focus for habitat management in 2018, with broom and scrub removal activities taking place in the fall of 2018.

T-7, Transect 7 (Ridge Trail, not associated with specific MU; Essential) –
T-7 is located along the Ridge Trail (Figure 4). In 2018 CS were encountered at a rate more in line with the trend seen in past years with an average and maximum S/H of 16.8 and 38.5.

T-8, Transect 8 (MU Devil's Arroyo; Essential) –
This transect is located east of the Quarry (Figure 4) and access is made through the Quarry property. The scrub and particularly poison oak along this transect has increased significantly over the years and the upper portion of the transect is no longer passable. There were 10 CS observed on this transect in 2018, with an average S/H of 9.0. No CS were seen on Transect 8 in 2016. This transect is a focus for habitat management activities in 2018, addressing the overgrowth of Portuguese broom in this high quality grassland.

T-9, Transect 9 (MU Owl and Buckeye Canyons; Essential) –
This transect follows a ridgeline between Owl and Buckeye Canyons down from the Ridge Trail (Figure 4). Despite a fire in 2008, viola and nectar plants have regenerated along this transect based on incidental observations. The 2018 average and maximum calculated S/H were greater than both 2014 and 2016 sightings, with an average and maximum S/H of 16.3 and 33.0, respectively.

T-10, Transect 10 (MU Owl and Buckeye Canyons; Essential) –
This transect is located east of Buckeye Canyon and follows an existing gravel, PG&E road (Figure 4). The maximum and average S/H on this transect in 2018 were 20.4 and 51.3, an increase from 2016 where average and maximum S/H were 9.1 and 12.3 respectively. The 2016 maximum S/H was the lowest recorded over the 12 sample years since 2000. CSs were also very abundant on this transect in 2012 and 2014.

T-11, Transect 11 (Ridge Trail, not associated with specific MU; Essential) –
T-11 follows the eastern portion of the Southeast Ridge (Figure 4). In the past this has been a high performing transect as it follows hilltopping habitat with a variety of nectar plants and adjacent grasslands supporting viola. 2018 showed increased observations from 2016, with an average S/H of 29.6 and a maximum S/H of 56.6. For 2016, there was a marked decline in observations, with an average and maximum S/H of 6.3 and 18.8,

respectively, which was significantly lower than 2014 with an average and maximum S/H of 111.5 and 182.1 (the highest encounter rate ever documented on this transect or on any transect since fixed transect surveys began in 2000). For 2018, Transect 11 was the highest performing transect in terms of sightings per hour.

T-12, Transect 12 (MU Southeast Ridge; Valuable and Essential) -
T-12 follows the Southeast Ridge east and down to the mountain's base near Bayshore Boulevard (Figure 4). This transect also includes part of a subridge north toward the Brisbane Acres. In 2012 a small grass fire burned the steep slope along the southern part of the transect up to where the transect meets up with the Ridge Trail. There has also been significant scrub overgrowth along the portion of the transect that extends downslope into Brisbane acres, making the last 150 meters impassable. The maximum S/H recorded in 2018 was 8.3, which is a still relatively low compared to previous years.

T-13, Transect 13 (MU Carter Martin; Essential) –
T-13 was established in 2005 to collect data on butterfly presence as it is across from the section of the Northeast Ridge that was at that time planned for development and recently completed development. Very few butterflies have been recorded on Transect 13 in the past. During the first year this transect was surveyed (2005), an average S/H of 5.2 and a maximum of 15.0 was recorded. Then in 2006, 2008 and 2010 no CS were seen. In 2012 a single CS was recorded here, then in 2014 a total of 13 CS were seen on this transect. In 2016, however, sightings were lower than 2014 but higher than 2012 with 3 CS observations for a max S/H of 5.7. For 2018, there was only one CS observed during one of the surveys. Average S/H was 0.9, and maximum S/H was 4.6.

T-14, Transect 14 (MU Hillside Juncus; Essential) –
T-14 was established in 2018 to collect data on butterfly presence in the Hillside Juncus management unit that has not to date been surveyed for CS, despite the presence of suitable habitat components. For the 2018 survey period, there were 9 CS observed, equating to an average S/H of 3.1 and a maximum S/H of 10.3.

Overall, many transects showed an increase in CS observations in 2018 when compared to counts and calculated sightings per hour in 2016.

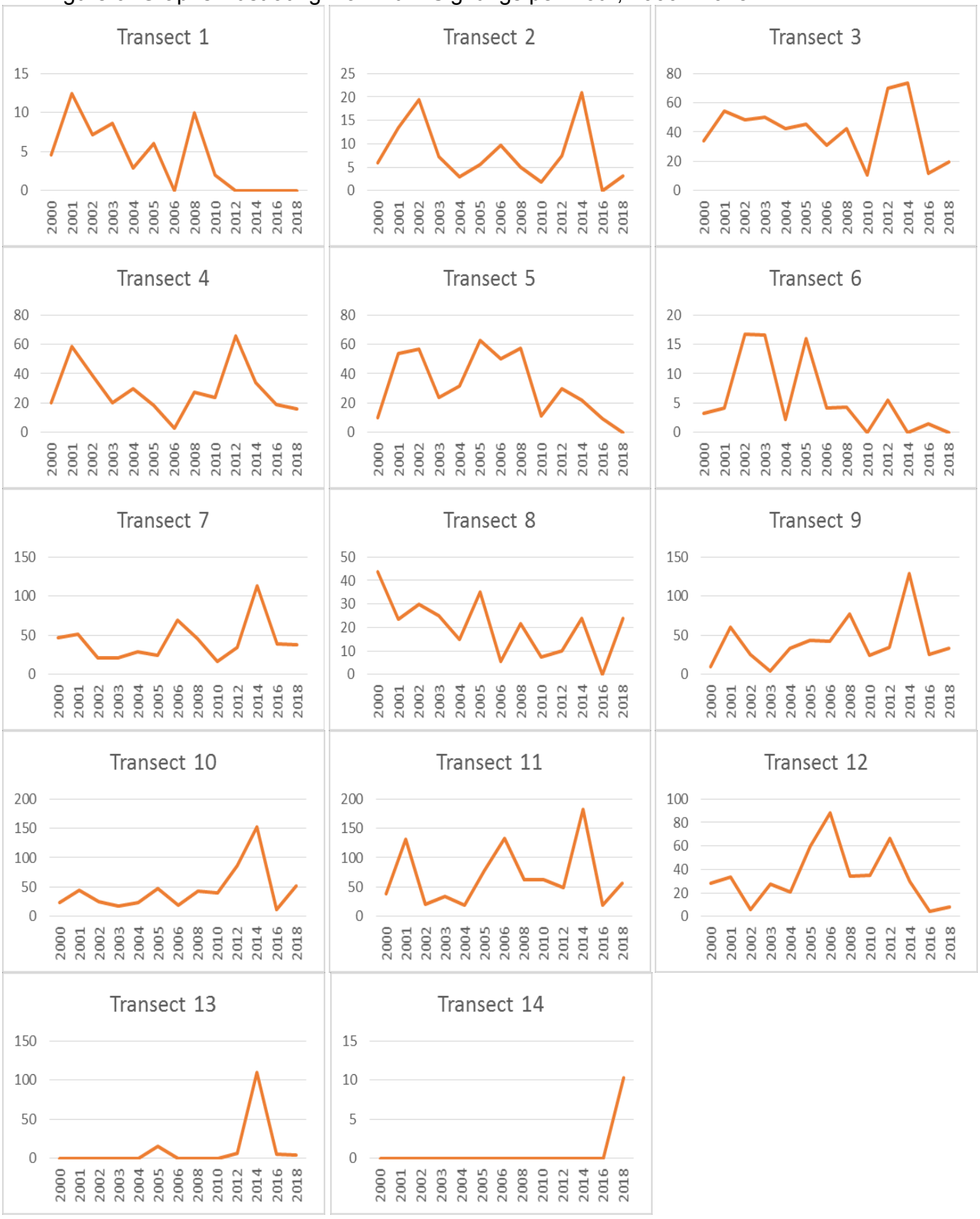
Table 3: Average S/H on each Transect from 2000 to 2018

Average S/H on each Transect from 2000 to 2018													
Year/ Transect	2000	2001	2002	2003	2004	2005	2006	2008	2010	2012	2014	2016	**2018**
1	2.3	4.2	2.5	1.4	1.2	1.6	0	4.4	2	0	0	0	**0.0**
2	3.2	5	10.2	3.2	1.7	2.4	3	0.5	1	1.8	13.4	0	**0.9**
3	16.5	21.4	31.1	32.1	23.4	23.1	12.1	14.5	3.6	23.3	57	8.9	**6.9**
4	12.3	26.1	16.1	7.7	11.5	5.5	3.5	11.2	13.6	32.7	24.7	7.4	**5.0**
5	5.2	28.7	23.9	10	16.7	26.2	14.7	16.9	7.7	17.8	15.3	3.3	**0.0**
6	1.1	1.4	9.1	6.9	0.8	4.2	1.4	2.2	0	1.3	0	0.37	**0.0**
7	20.4	25.1	9.8	10.9	13	16.6	25.4	30.5	20.2	18.1	72.5	18.8	**16.8**
8	18.6	10.5	17.2	7.6	5.9	11.4	4.8	12.5	3.3	5	12	0	**9.0**
9	5.2	24.5	16.2	1.6	5.5	19	13.7	55.6	14.6	22.5	61.5	13.4	**16.3**
10	11.5	37.9	13.7	5.7	6.2	21	15.1	23	28.6	68.1	71.9	8.7	**20.4**
11	25.4	79	14.4	18.4	8.2	37.6	37.4	35.6	38.6	23.7	111.5	6.3	**29.6**
12	14.2	20.1	2	6.8	11.4	18.9	34.2	17.2	23.9	26.7	15.4	2.1	**2.0**
13	N/A	N/A	N/A	N/A	N/A	5.2	0	0	0	3.3	30	2.4	**0.9**
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**3.1**

Table 4: Maximum S/H on each Transect from 2000 to 2018

Maximum S/H on each Transect from 2000 to 2018													
Year/ Transect	2000	2001	2002	2003	2004	2005	2006	2008	2010	2012	2014	2016	**2018**
1	4.6	12.4	7.2	8.6	2.9	6	0	10	2	0	0	0	**0.0**
2	6	13.5	19.4	7.2	3	5.5	9.6	5	1.8	7.5	20.9	0	**3.2**
3	34.2	54.3	48.5	50.3	42.2	45.6	31.1	42.5	10.6	70	73.3	11.7	**19.4**
4	20.5	58.5	38.7	20	30	18.3	2.9	27.7	23.6	65.7	34	18.9	**15.8**
5	10.3	53.6	56.5	24	31.7	62.5	50.4	57.6	11.1	30	21.8	9.4	**0.0**
6	3.3	4.2	16.8	16.6	2.2	16	4.1	4.3	0	5.5	0	1.5	**0.0**
7	47.1	51.3	20.5	20.8	28.9	24	69.5	45.8	17.1	34	113.6	38.7	**38.0**
8	43.6	23.6	30	25	15	35	5.5	21.8	7.5	10	24	0	**24.0**
9	9.6	60	25.2	4.7	33.6	43.5	42.4	77.4	24	34	128.6	25.3	**33.0**
10	23	45	25.7	17.4	24.3	47.6	19.4	42.9	39.3	86	152	12.3	**51.3**
11	38.4	131.1	20	34	18.9	77.1	132.9	63.2	62.3	49	182.1	18.8	**56.6**
12	28.3	33.2	6	27.4	20.9	60	88.4	34.1	35.3	66.7	30	4.5	**8.3**
13	N/A	N/A	N/A	N/A	N/A	15	0	0	0	6.7	110	5.7	**4.6**
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**10.3**

Figure 6: Graphs Illustrating Maximum Sightings per Hour, 2000 - 2018



DISCUSSION

Overall, many of the transects exhibited an increase in CS observations compared to 2016, with 387 individuals observed, and an average S/H of 7.9, compared to 225 CS observed in 2016, with an average S/H of 5.5. The 2018 observations were still lower overall than what was recorded for 2014, which was the monitoring year with the highest observations overall since monitoring began in 2000. In 2018, the greatest number of CS recorded per hour was on transects 11, 10, 7, and 9 respectively. Transects 7 and 11 contain prime hilltopping habitat along the Southeast Ridge with thin soils and the observation locations for these and all transects can be seen in Figure 4. Transect 10 climbs the ridge to the east of Owl Canyon, while Transect 9 climbs the ridge to the west of Owl Canyon and both intersect with Transect 7 at their terminus on the top of the mountain's main ridge that runs east/ west.

Transects that performed the worst in 2018 include 1, 5, and 6 with no observations of CS adults recorded. This is the first time since 2000 that no CS were observed on transect 5. Annual report have not reported on significant scrub encroachment along Transect 5, though high accumulations of thatch from the overgrowth of non-native annual grasses has been reported, and could be hindering the viola populations in this area. Transect 6 has had a number of years with few or no sightings, including 2010 and 2014. According to past annual reports T-6 historically intersects only limited viola populations.

Within a single transect, CS abundance varies from year to year as you can see in the transect line graphs in Figure 6. Data variability from year to year is attributable to a number of factors, van Swaay et al.(2008) indicated that variation can come from weather, time of day, observer experience, changes in vegetation height, and succession (Pollard et al 1986; Harker & Shreeve 2008; and Pellet 2008). It is unlikely that observers in a given area can detect all butterfly adults present in the study area during their visit (van Swaay et al. 2008; Dennis et al. 2006; and Kery & Plattner 2007). CS monitoring in 2018 was initiated by Parks Department staff, who have taken over the monitoring activities as of 2016 (having previously been conducted by Thomas Reid Associates). Cool temperatures and high winds hindered monitoring efforts in 2018, with monitors having short windows of time where all weather conditions met the necessary thresholds for monitoring as outlined in the methodology. According to the monitoring protocol all 13 transects should be surveyed within 2-3 days and the monitoring rounds should be spaced approximately a week apart from each other (TRA 2008). However similar to 2016, 2018 monitoring rounds all contained transect surveys in sub-optimal weather conditions, specifically temperature below the 64.4°F threshold. What is interesting to note is that even on cooler days the areas known to contain high quality habitat still yielded consistent observations below the 64.4°F threshold. See Tables 9 and 10 in the Appendix for raw data from monitoring efforts, which outlines the weather conditions for each survey. These areas included the Ridge Trail and Owl & Buckeye Canyon transects. Additionally, it was found that for some surveys where temperatures optimal and the sun was shining, but maximum wind speed gusts were greater than 10 mph, CS could still be observed.

The level of field monitoring effort in 2018 amounted to 42 hours on all transects over the five rounds of surveys, on par with the average level of effort in 2016 (31 hours over four survey rounds – close to 8 hours per survey round for both monitoring years). In

contrast, the 2014 CS surveys had just over 12-hours spent on transects total, and yet had the highest recorded counts overall. Abiotic conditions can influence a butterfly population such as rain and solar radiation and the timing of these events (Pollard 1988). This topic has been suggested in previous annual reports specifically questioning how CS populations may vary due to abiotic factors such as weather.

The growth of grassland plants (both grasses and forbs) varies not only by total rainfall amount but seasonality of rainfall including temperature during a growing season (George et al. 2001). Table 5 lists the annual rainfall totals for each rain-year since 2014 (when highest counts to date had been recorded)

Table 5: Rain Year precipitation totals, San Francisco International Airport, 2013-2018

Rain-year	Precipitation total
2013 - 2014	12.54
2014 - 2015	18.19
2015 - 2016	23.26
2016 - 2017	32.24
2017 - 2018	17.53

Our data imply that the drought conditions from 2012 through 2015 did not negatively affect CS butterflies. Rather CS were encountered overall at a greater rate than has been recorded in any other year since fixed transect monitoring began in 2000. As a species whose life span is completed within a year, year to year variation in population size is normal and expected. Results as found this year indicate only that environmental conditions in 2014 favored CS emergence and breeding. The species continues to be seen over most of the area surveyed.

It is assumed that butterflies use a variety of microhabitats from year to year, and these areas of use can shift. This change in use patterns can be influenced by host plant expansion or contraction, nectar plant sources, competing vegetation height and composition, and succession. In 2009 the USFWS issued and approved a Callippe Silverspot Butterfly (Speyeria callippe callippe) 5-year Review: Summary and Evaluation. This review document identifies five essential features believed to be required for CS: grasslands with proper topography in the San Francisco Bay area, sufficient larval host plants, adequate nectar sources, within the area influenced by coastal fog, and hilltops for mating congregations (USFWS 2009). CS behavior and usage of these habitat features plays a role in the ability of monitors to observe adults along transects during surveys. It is important to note that the inherent relationships related to CS abundance and host plant density, proximity to adult nectar plants and their temporal distribution, hilltop features for mating, and the assembly of these features and their associated adjacency within the grassland landscape is still poorly understood. It is possible that the fixed transects no longer adequately traverse through or intersect areas that support all five essential features associated with CS functional habitat.

It is assumed that higher-yielding transects intersect the greatest amount of hilltop and Viola habitat, including, 3, 7, 9, 10, and 11. As mentioned earlier transects 7, 9, 10, and 11 were the best performers in 2018. These four transects accounted for 314 out of the 387 total observations along transects. If we add in transects 3, these five transects account for 338 CS observations (87% of annual total observations) along transects and all in prime

habitat with a hilltop component. In 2016, transects 11, 10, 9, 7, 3, and 4 also performed well. These transects follow ridgeline habitat generally associated with lower non-native annual grass height. The ridgetops have thin, moisture limited soils and are more insulated from nitrogen deposition. The 1981 Phase II Biological Study does recognize that Viola unlike the lupine species does not appear to have a clear environmental requirement (e.g. rocky outcrops) yet it does tend to occur in dense stands scattered in low density grasslands (TRA 1981). It is interesting to note that even on cool days traditional "hot spots" for CS still yielded observations.

The 2018 data supports the concept that in our core grassland areas CS populations are fairly stable and continue to support butterflies even in less than optimal monitoring conditions. However, year-to-year variability appears to be high and additional statistical analysis is likely necessary to detect potential population trends based on the density index. The key to improving stewardship of this species will be to tie management activities to host plant patches to size, quality, and distribution – efforts for which are underway.

CONCLUSION

While the overall adult CS butterfly observations were greater in 2018 than in 2016, the numbers were not as high as what had been recorded in previous years. These numbers, however, are likely not outside the range of variability for the overall population contained within the San Bruno Mountain Habitat Conservation plan area, as exhibited by the high annual variability graphed in Figure 6. The last three monitoring years have not been included in recent statistical analysis done by Creekside Science. It is advisable to initiate a statistical analysis of all the currently available data to better understand the trends associated with the overall population and the subpopulations found throughout the hill that make up the SBMHCP area. An analysis of individual transects and year to year variation based on the last thirteen rounds of data collection may improve management priorities based on statistically significant findings related to adult observation trends.

When considering monitoring years 2010 and 2012, the observations recorded in 2018 seem much closer to that range. Until statistical analysis is performed to properly assess the population trends, this data suggests that the SBMHCP is successfully maintaining a steady CS population in the core habitat areas. It appears that year to year variation in marginal habitat is increasing and likely reflects decline in those areas subpopulations. The differences between the 2014, 2016, and 2018 CS sightings per hour index could be attributed to abiotic factors such as weather and likely its interaction with non-native annual grass and thatch production, however this is likely a cumulative issue that compounds over time. Continued scrub encroachment, identified in the original documents of the SBMHCP and in the more recent 2015 Assessment, is also considered a threat and increases the marginalization and loss of habitat for both CS and MB. It is important to note that increased soil moisture associated with average or wet years also favors woody species establishment in grasslands with deeper soils. However, a decline in the ability of the grasslands to support large populations of Viola host plants due to inter-annual shifts in the success of non-native annual grasses should also be seriously considered as a possible threat. Increased grass and thatch production reduces the space available for host plant population expansion/ recruitment and possibly provides additional cover to rodent

populations which target host plants for food resources. This is currently being seen in areas such as Hillside/Juncus grasslands and is impacting lupine populations.

The 2006 Annual Report suggested that additional statistical research should be focused on weather variables, such as rainfall (TRA 2006). The benefit of exploring various biotic and abiotic factors and their potential interactions is the ability to tie them to a specific management action that can directly address that interaction's environmental outcome on the land. As an example, if non-native grass and thatch production is negatively associated with the density of CS host plants, a specific and targeted management action can be developed, e.g. cattle grazing. According to the 1980 Biological Study, "During the grazing years, the populations of CS and the MB co-existed with grazing, and may have actually been enhanced by it since grazing helped to preserve the grassland against invasion by brush" (TRA 1980; pg. VII-10). Grazing is a manual control for non-native annual grass production and is used to favor a small statured host plant, *Plantago erecta*, for bay checkerspot butterflies on Coyote Ridge in the San Jose area. The benefits to host plant patch size as a function of cattle grazing may likely be positively correlated with the BCB population at that location. Until direct or indirect habitat or host plant patch size and distribution monitoring occurs we may not be able to demonstrate a statistical relationship between management actions and increases or decreases in CS populations.

With the majority of the SBMHCP budget dedicated to management, it may be a good time to review and implement a butterfly habitat monitoring approach along with adult butterfly monitoring. The goal of designing a hybrid approach is to be able to quantify that management activities are improving host plant patch size, quality, and distribution. According to Weiss et al. (2015) inclusion of a host plant mapping and monitoring protocol provides a direct link to management activities. A reduction in marginal, valuable, and essential habitat is likely to make CS less resilient to climate change in the future, unless Viola populations expand considerably with increased periods of droughts. With this in mind, in 2015 the management approach shifted from a wide-ranging invasive species control and containment strategy to a focus on scrub removal and containment focus. This was aimed at stabilizing the amount of grassland available for MB and CS butterflies. However, the quality of the remaining grassland should also be considered. As of 2017, host plant monitoring and mapping activities for both lupine and viola have been undertaken, and specific habitat components have been monitored. The goal will be to analyze this host plant data with CS or MB data to provide a more robust way to determine if specific management activities are improving habitat. CS population responses could result in increases in CS density observed along transects with active management or a decrease in the year-to-year variability along transects.

At this time it is difficult to make a full assessment of the overall population trend for CS, as the 2018 observations showed an overall increase in adult butterfly observations in comparison to 2016, though counts were still considerably lower than 2014. The 1981 Biological Study cautions the use of two consecutive years of monitoring data to determine a potential population decline (TRA 1981). TRA's annual report from 2014, monitors attributed abiotic weather conditions, i.e. drought, as likely beneficial for CS observations that year. It is possible that viola host plants were favored and occurred at a higher density due to less non-native annual grass competition in 2014. Native forbs are generally believed to be favored in California grasslands in times of drought. If this is the case perhaps increased frequency of drought periods may favor viola

expansion in the future. Until the relationships between CS host plant and essential habitat components are better understood, it is difficult to determine the best management approach to improve habitat quality. The hope is that our current efforts to collect data on host plants and habitat components will help inform this as we continue monitoring for the SBMHCP. The 2018 observation data appears to be within the range of variability observed throughout the life of the SBMHCP. Additional statistical analysis should be conducted with the most recent data years to determine if any population trends can be identified.

RECOMMENDATIONS

CS MONITORING

1. Consider adding weather & vegetation data into statistical models: temperature, rainfall, solar radiation, and host plant data can be incorporated into statistical analysis, modeling, and hypothesis testing.

2. Initiate flight season documentation; may improve monitoring deployment, level of effort, and limit the potential to miss the peak flight season. Monitoring for butterfly flight season may need to begin up to a month ahead of historically documented flight seasons in light of changing climate conditions. Consider, monitoring both key nectar plant phenology as well as host plant phenology to improve survey initiation and timing.

3. Continue to initiate surveys only when the base temperature of 64.4 degrees Fahrenheit is met; logistically this can be the most challenging aspect of butterfly monitoring, day-to-day and hour-to-hour, as temperatures oscillate on the mountain. Collecting more than five weeks of monitoring data may be necessary to absorb the variability associated with cool, cloudy, or windy conditions that have hampered shorter monitoring seasons.

CS HOST AND NECTAR PLANT MONITORING

4. In 2017 and 2018, lupine and viola host plant mapping activities were initiated, and it is recommended that periodic host plant and habitat feature monitoring continues.

5. Consider mapping essential habitat features in areas that have repeatedly high observations of CS. This may refine our understanding of high, medium, and low quality CS habitat on San Bruno Mountain.

SCRUB ENCROACHMENT AND GRASSLAND MANAGEMENT

6. Continue efforts to arrest scrub succession and expansion in essential, valuable, and in some cases potential habitat, as defined by the Assessment.

7. Pilot grazing, weed whipping, or scything plots for *Viola pedunculata*.

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

SBE are closely associated with their host plant, Pacific stonecrop (*Sedum spathulifolium*), which grows within higher elevation grasslands on northeast to northwest facing slopes. SBE butterflies occur where there are high densities of Sedum and in areas that are protected from strong winds. Arnold has documented this species movements to be at least 0.15 mile between habitat patches, however it is likely adults can move much further over the course of multiple flights (1983). The adult flight season for SBE typically occurs between early March and mid-April. Third and Fourth instar SBE larvae are present and easily identifiable on the Sedum plant parts and flower heads typically for 2-3 weeks in May and/or June, and monitoring activities in 2018 indicated the First and Second instar larvae could be observed as early as mid-April.

SBE larvae are preferable to survey over adults as they are conspicuous, less sensitive to weather, and their movement is closely tied to Sedum. Eight fixed permanent points for monitoring SBE larvae were established in 1998 and these were monitored every year from 1999 to 2003 (Figure 7). No SBE monitoring of larvae was conducted in 2004 or 2005. Monitoring was resumed in 2006 and set on a biennial schedule. SBE larvae were monitored in 2006, 2008, 2010, 2014, 2016, and 2018. In 2012, monitoring was not conducted in order to allocate funds to presence/absences surveys for CS and MB. We now have eleven years of larval monitoring data based on these fixed data points.

All of the existing SBE butterfly habitat on San Bruno Mountain has been protected as open space within San Bruno Mountain State and County Park since 1975. Development that was approved through the SBMHCP did not affect this species, and therefore monitoring and management for this species and its habitat was not a requirement of the SBMHCP permit. However, this species' habitat partly overlaps with that of the MB and CS, and is composed of some of the most pristine coastal prairie and coastal scrub habitat on the Mountain. Continued monitoring and management of SBE should continue at some level due to the biological value of this species and its habitat.

METHODOLOGY

Larvae counts are performed at 8 fixed points over three monitoring cycles historically targeting peak sedum bloom. Counts are conducted when larvae have been observed at least one survey point in the days prior to the start of monitoring. Locations of the fixed points have a permanent center point stake so that surveys occur in the same location year-to-year. A 25-meter radius circular plot is marked in the field surrounding the center-point stake with tall wire stakes or flagging tape. All sedum are marked in each quadrat of the 25-meter plot (NE, SE, NW, and SW) with a pin flag. Then monitors systematically search every sedum for larvae. No time limit is placed on the survey effort due to the high variation in sedum density at each point. As much time was taken as needed at each point to allow for inspection of all sedum plants within the 25-meter radius. Locations of the 8 SBE monitoring points are presented in Figure 7.

Figure 7


17
16
19
15
13
8
7
6
SAN MATEO COUNTY
PARKS
N
0
0.25
0.5
1 Miles
SBM Elfin Monitoring Points
Elfin Monitoring Points
Elfin Habitat
SBM Trails

RESULTS

Three larvae survey rounds were performed in 2018: April 24th- 26th; May 9th -11th; and May 21st- 24th. The timing for these surveys varied slightly from previous years, where each survey round could be conducted in immediate succession from the previous round. The decision was made for 2018 to include a 2-week time gap in between monitoring rounds, to ensure that the beginning and end of the larval activity period was captured in the survey window. This decisions was based on the fact that peak larval activity seemed to occur during the first monitoring round in 2016, with considerable declines in larvae counted in the two following rounds. Additionally, research on the life cycle of the SBE indicated that SBE can be in the larval stage for 34 days, on average. By spacing out the survey rounds to span a greater time period when larvae were active, the opportunity to capture early and late cohorts of larvae was increased. The timing of the first round of surveys, was based on was the identification of 1st and 2nd instar larvae present on Sedum at the fixed plots, though it was still early in terms of sedum bloom development and typical start date for surveys in previous years. During the second survey, most sedum was in peak bloom, while in the third round of surveys sedum bloom was past peak in many plots.

A total of 796 larvae were counted at all eight monitoring points during the first round of surveys, from April 24th to 26th. For the second monitoring period (May 7th to 11th), 896 larvae were counted at all eight survey points, and 456 were counted during the third monitoring period (May 21st to 24th) (Table 7). In 2018 a total of 2148 SBE larvae were counted. The last several years of monitoring are in Table 6 below

Table 6. Annual SBE Counts 1999-2018

Total SBE Larvae Counted at all 8 Fixed Monitoring Points, 1999 - 2018	
Year	Total Larvae Counted
1999	140
2000	115
2001	253
2002	291
2003	281
2006	373
2008	77
2010	364
2014	145
2016	320
2018	2,148

Table 7 SBE Larvae Counts at 8 Fixed Plots for 2018

SBE Larvae Counts for 2018 Monitoring Period						
Fixed Point	Date	**Larvae Count**	Management Unit	Temp	Wind Speed	Flower Development Stage
Monitoring Round 1 (April 24th to 26th)						
6	April 24th	**183**	Devil's Arroyo	54	4	1
7	April 24th	**107**	Devil's Arroyo	56	10	1
8	April 26th	**174**	Devil's Arroyo	57	2	1
13	April 26th	**56**	Devil's Arroyo	57	1.3	1
15	April 25th	**46**	Dairy & Wax Myrtle	49	5.5	1
16	April 25th	**71**	Dairy & Wax Myrtle	71	8	1
17	April 25th	**144**	Dairy & Wax Myrtle	53	11	1
19	April 26th	**15**	April Brook	55	4	1
Larvae Subtotal		**796**				
Monitoring Round 2 (May 7th to 11th)						
6	May 9th	**172**	Devil's Arroyo	50	10	3
7	May 7th	**191**	Devil's Arroyo	50	high	3
8	May 7th	**133**	Devil's Arroyo	65	moderate	3
13	May 9th	**60**	Devil's Arroyo	65	moderate	3
15	May 8th	**79**	Dairy & Wax Myrtle	55	10	3
16	May 8th	**116**	Dairy & Wax Myrtle	60	10	3
17	May 11th	**113**	Dairy & Wax Myrtle	55	5	3
19	May 11th	**32**	April Brook	55	5	3
Larvae Subtotal		**896**				
Monitoring Round 3 (May 21st to 24th)						
6	May 24th	**159**	Devil's Arroyo	60	moderate	4
7	May 22nd	**50**	Devil's Arroyo	50	high	4
8	May 22nd	**27**	Devil's Arroyo	50	high	4
13	May 21st	**58**	Devil's Arroyo	55	high	4
15	May 23rd	**60**	Dairy & Wax Myrtle	50	moderate	4
16	May 23rd	**50**	Dairy & Wax Myrtle	50	moderate	4
17	May 23rd	**31**	Dairy & Wax Myrtle	31	moderate	4
19	May 24th	**21**	April Brook	60	moderate	4
Larvae Subtotal		**456**				
2018 Total Count		**2148**				

Due to the change in monitoring protocol from previous years, larvae that were estimated to be in the 1st or 2nd instar development stage, based on the observed size, color, and marking differences, were recorded as observed larvae. In previous years, monitoring protocol had only specified to record 3rd or 4th instar larvae. All recorded larvae observations were grouped in a size class in order to record the estimated stage of development for each larvae observed. The size classes are as follow: group 1 - less than 2mm; group 2 – 2 to 4mm; group 3 – 4mm or greater. It is estimated, based on description of instar characteristics in literature, that size class group 1 would represent 1st instar

larvae, size class group 2 would represent 2nd instar larvae, and size class group 3 would represent both 3rd and 4th instar larvae. Each larvae observation was tallied in a grouping according to observer estimation of size. Table 8 below breaks down the percentage of larvae observations that fall into each size class for each monitoring round, as well as a total for all observations for the entire monitoring season.

Table 8 Size of observed larvae as a proportion of total observations for 2018 monitoring season

Size of observed larvae as a proportion of total observations for 2018 monitoring season			
	Percent of observations per size class and monitoring round		
	Size Class 1 (less than 2mm)	Size Class 2 (2mm to 4mm)	Size Class 3 (4mm or greater)
Monitoring Round 1 (04/24 to 04/26)	51.1%	35.7%	13.2%
Monitoring Round 2 (05/07 to 05/11)	26.6%	31.7%	41.7%
Monitoring Round 3 (05/21 to 05/24)	4.6%	20.1%	75.3%
% of Total Observations	33.0%	31.3%	35.7%

DISCUSSION

Based on the flower stages observed, the second and third monitoring periods correlated with the peak of the sedum bloom. Peak sedum bloom occurs when most plants observed were in flower. However, a very high number of larvae observations were made at almost all points during the first monitoring period, where most sedum had not yet flowered (prior to peak bloom). The number of observations for the entire monitoring season are nearly 7 times what was observed in 2016 (320 total).

Within a season, the abundance of larvae at a point is assumed to resemble a bell-shaped curve. It has been thought that peak larvae abundance occurs at some time midway between visibility of the first and last larvae feeding on the sedum flower heads. Upon review of the 2018, 2016, and 2014 results it maybe that larvae are emerging earlier than previous monitoring years. It is unclear why this may be occurring. In 2018 the surveys were implemented ahead of peak sedum bloom due to larvae presence, a high proportion of larvae were recorded as being in the early stage of development (1st instar), and many larvae were observed feeding on sedum leaves.

For 2018 each round of larvae surveys were implemented with a two week interval between surveys, in an attempt to capture a broader spectrum of the larval life cycle. Data presented in Table 8 supports this, showing that the 1st monitoring round in late April had the highest proportion of 1st instar larvae, while the 2nd monitoring round was distributed more evenly, though the later stages of development were more prevalent out of the total observed larvae, and for the 3rd monitoring round, when larvae counts overall were showing a decline, the most larvae observed were in the 3rd or 4th instar stage.

Based on these very high counts in comparison to previous monitoring years, along with the consistent number of larvae observed at the fixed points over the last several years, scrub succession does not appear to be a threat. However, scrub expansion into coastal terrace prairie has occurred in the Dairy Wax Myrtle Ravine management unit over the last several years. This current data set may be used for comparisons of population abundance among points and between years. Since no major changes in habitat have been noted in the incidental observations over the years it is possible that incremental shifts in habitat quality have escaped notice. It would be helpful to determine if any specific data points currently monitored have experience a decline in larvae counts so that habitat conditions can be evaluated and considered for future management.

Similar to mission blue and CS butterfly monitoring, no habitat monitoring occurs to inform the analysis of the SBE data. Sedum grows on rocky outcrops, competition from weeds does not appear to pose a significant threat due to the harsh conditions of the habitat. However, in some plots it appears that scrub is possibly expanding into the areas that support the low-growing Sedum. Shifts in abundance at different locations could indicate host plant population expansion or contraction and/or nectar plant population changes. If host plant populations are declining it will likely cause a signal in larvae numbers in areas with diminishing adult populations.

CONCLUSIONS

SBE butterfly populations appear to be stable at the eight permanent monitoring points. It is advisable to initiate statistical analysis for the ten years of data since the Assessment did not include data from 2014 or 2016. After analysis of point data from year-to-year additional larvae monitoring adjustments could be considered. The statistical analysis can inform the stability of this population of endangered butterflies. SBE monitoring is also discussed in the Assessment. Based on the Assessment and the 2018 data, SBE appear to be secure in high quality coastal scrub habitat and evaluation of the monitoring interval should be considered.

The Assessment recommends that presence surveys be established at all 21 historic points. The surveys would be conducted at appropriate times of the year and with the most recent data larvae observations may need to begin in late April and continue throughout May and possibly into June. The Assessment recommends consideration of a shift in SBE larvae monitoring from the point-counts to short timed searches, 10 person-minutes (Weiss et al. 2015). This methodology could improve efficiency and create coarse density classes. Ahead of a switch in monitoring methodology a statistical analysis should be conducted on the current data. If in fact the SBE are secure in their current habitat, it may be suitable to consider monitoring on a 3-4 year interval. The change in frequency would continue to provide long term abundance monitoring for the species, but allow for staff time and resources to be allocated to other monitoring activities more readily.

The above recommendation to change the monitoring strategy should be considered in light of long-term data needs. This should be a discussion with area experts and statisticians to ensure that the data collected can inform future management actions if deemed necessary. Changing a monitoring scheme should only occur if it has the potential to improve habitat and/or species management of SBE. Once a clear

understanding of how the changes can direct improved SBE habitat management they should be considered by the TAC. Decreased frequency of SBE monitoring would be a benefit to MB and CS monitoring needs. Additional host plant monitoring could take place if SBE monitoring was not necessary every other year.

Most areas supporting Sedum are within protected areas, and there is currently no take of SBE or their habitat authorized under the SBMHCP.

RECOMMENDATIONS

SBE MONITORING

1. Initiate statistical analysis of all SBE monitoring data at the eight fixed points. It would be helpful to determine if any specific data points currently monitored have experience a decline in larvae counts so that additional consideration of habitat conditions can be explored for future management.

2. Consider a longer monitoring interval for SBE larvae counts. Continue with the methodology implemented in 2018 with at least 3 survey rounds at all 8-fixed points, spaced approximately one week apart once larvae are initially detected. Each set of counts should be completed with two-week intervals to improve the ability to capture the full larval life cycle.

3. Changes to the current monitoring strategy should be discussed with the USFWS and experts and statisticians. If agreeable and the new methodology could improve efficiency and management of the species it would be wise to adopt it. The value of long-term data sets for evaluation of populations cannot be understated and additional analyses of the current SBE data will be important before changes in monitoring methodology should be considered.

MANAGEMENT IMPLICATIONS

At this time there are no specific management activities recommended for SBE habitat.

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

A small population of the Bay checkerspot butterfly (BCB) was present near the summit of San Bruno Mountain up until the mid-1980s, but for decades had been determined to be extirpated from the mountain. To reestablish the Bay checkerspot butterfly (*Euphydryas editha bayensis*) (BCB) on San Bruno Mountain (SBM), translocations from Coyote Ridge in south San Jose (Santa Clara County) began in 2017 with funding from the Disney Butterfly Conservation Initiative. In March 2017, 3,630 postdiapause larvae were collected from Coyote Ridge and released at SBM along the main ridge. In early February 2018, postdiapause larvae were observed, confirming that BCB larvae released in 2017 had successfully reproduced. After this trial period, the project continued in 2018 with funding from the Central Valley Project Conservation Program. An additional 5,000 larvae were translocated in mid-February 2018 in areas east and west of the original release area. Adults were observed along the entire length of the

release areas in 2018. There was a notable concentration of adults at the western release area, where a small hilltop provided a focus for aggregation. Adult butterfly encounter rates (butterflies/hour) were higher at SBM than at the Coyote Ridge reference site and the Edgewood reintroduction site. Prediapause larvae from freely ovipositing females were documented on the nonnative perennial host *Plantago lanceolata*, and in late April third instar larvae were observed on still lush hostplants. As expected, *P. lanceolata* remained green and edible through and beyond the prediapause larval period. Native annual *Plantago erecta* stands, where present, remained green and edible into late May, with *Castilleja* spp. remaining edible into early June. These observations of comparatively high adult encounter rates and host plant availability into the larval diapause stage indicate there is a high likelihood of success for BCB establishment on SBM.

A detailed report written by Creekside Science in October 2018, summarizing these activities, was prepared and submitted to USFWS and can be referenced for additional information on these translocation efforts. See Appendix for an excerptfrom the annual report for BCB reintroductions at San Bruno Maintain. Map 1 from this report indicates BCB release sites.

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

The San Francisco garter snake (SFGS) was identified in the SBMHCP (1982) as having potential habitat on San Bruno Mountain. No SFGS were observed on the Mountain by field crew while conducting biological activities and overseeing development activities in 2017 or 2018. There have been no confirmed observations of SFGS on San Bruno Mountain in over 30 years of the SBMHCP monitoring program. Based on the lack of significant ponds and other aquatic habitats, this species is unlikely to be present.

F. California Red-legged Frog (*Rana 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 SBMHCP, CRLF has since been listed as a Federally Threatened species. No CRLF were observed on San Bruno Mountain by field crews while conducting biological activities and overseeing development activities in 2017 or 2018. There have been no confirmed observations of CRLF on San Bruno Mountain in over 30 years of the SBMHCP monitoring program. Based on the lack of significant ponds and other aquatic habitats on San Bruno Mountain, it is unlikely this species is present.

G. Plants of Concern

The rare plant survey completed in 2016 (see Appendix B) continues to be a guiding document for our knowledge of rare plant populations within the SBMHCP area, and allows better management decisions and appropriate avoidance an minimization measure to be in place to prevent impacts to known populations. In 2017 and 1028, additional populations of *Silene verecunda verecunda* and *Helianthella castanea* were identified.

III. VEGETATION AND HABITAT MANAGEMENT

This section describes efforts to address scrub encroachment and control and containment of specific invasive species as part of the 2017 and 2018 calendar year. The first management priority has been consistently applied- protection of existing occupied habitat; as this is the most efficient use of limited funds for ensuring the long-term survival of both MB and CS on San Bruno Mountain (Biological Program, SBMHCP Volume I, 1982). This management approach has been in use since the inception of the SBMHCP. It can be argued that this has largely been successful due to the continued persistence of the endangered species on San Bruno Mountain.

Beginning July 1, 2015 scrub removal became one of the highest priorities for habitat management in the SBMHCP area. This focus has continued for 2017 and 2018 and remains a priority. The Assessment identified scrub as the biggest threat to occupied high quality habitat within the SBMHCP area and was also identified as a threat in the final SBMHCP (1982). Due to constraints related to controlled burns or the infrastructure cost associated with conservation grazing strategies, manual and chemical control of scrub species, both native and invasive, have been deployed.

In 2017 and 2018 Shelterbelt Builders Incorporated (SBI), West Coast Wildlands (WCW), Ecological Concerns Incorporated (ECI), and Go Native Incorporated (GNI) implemented vegetation management within the SBMHCP area. Funds for SBI, ECI, and GNI are all from the SBMHCP trust fund or funds provided by the developers for vegetation work needed to improve dedicated lands as part of their mitigation requirements. WCW funding is provided by Pacific Gas and Electric as mitigation for work conducted on the Mountain and from private organizations with ongoing management obligations as outlined in the SBMHCP Volume II (1982). Invasive plant control has been augmented by volunteer groups, local homeowner's associations and private landowners throughout the life of the SBMHCP. Current groups involved are: California Native Plant Society (CNPS) volunteers, San Bruno Mountain Watch (SBMW), City of Brisbane, Toll Brothers Inc., and TerraBay Master HOA.

A. Vegetation Management Methods

Three primary methods are employed for invasive species control, these include handwork, mechanical, and selective herbicide applications.

Handwork

Seedlings and saplings are pulled from the crown upward to reduce soil disturbance. This approach is most effective with plants that have shallow root systems. Hand tools used to remove the whole plant and root systems for this method include Pulaski or axe mattock, dandelion weeder, hori hori knives, pruning saw and loppers. If soil is disturbed when target is removed then it is tamped down with a foot or the tool after weed removal. Species targeted for this method include fennel, broom (all species), eucalyptus, coyote brush, and Armenian blackberry.

Mechanical

A brush cutter is often used for either mowing or cutting weeds. A weed whip head mows soft forbs and grasses, where a metal triple blade on the same stock is used to cut through plants with woody stem tissue and tall seed stalks. The triple blade is used to gain access the root crown and is often followed by an herbicide application if the species is known to sprout. Two treatments based on size include 1) cut stump treatment at the base of larger (> 2 in DBH) stumps removed by chainsaws and 2) foliar application to secondary growth on smaller plants (<2 in DBH). Species include coyote brush, fennel, cotoneaster, broom (all species), eucalyptus, and acacia.

Herbicides

Some weedy species are treated with an herbicide solution using foliar, basal bark and cut stump methods. The two herbicides applied are Garlon 4 Ultra®
(Trichlopyr ester) and Round Up Custom Aquatic and Terrestrial® (glyphosate).
These herbicides are used due to their high effectiveness, low toxicity rating, and short half-life in the soil. Garlon 4 Ultra® herbicide is the preferred chemical for broadleaf weeds and has little effect on monocots (grasses). Round Up Custom Aquatic and Terrestrial® is an aquatic herbicide applied to plants adjacent to creeks or in areas subject to seasonal runoff. The herbicide application type and method depends upon the species and location. Three application treatments (foliar, cut-stump, and thin-line) are used within SBMHCP area. Foliar treatment is when the whole of the plant's canopy and leaf area are targeted using backpack sprayers and cone/jet tips. The spray tips are designed to adjust and allow target specific applications. Cut-stump treatments are when the trunk is cut 1-2 inches above soil surface and treated with a twenty-five percent mixed solution with Round Up Custom Aquatic and Terrestrial® and vegetable oil. Thinline treatments are considered a low volume application and is used primarily on trees and shrubs less than six inches in diameter. A thin stream of undiluted or highly concentrated herbicide is applied in a horizontal line around each stem.

All San Mateo County integrated pest management policies, and relevant pest control recommendations for the prescribed herbicides are adhered to for all applications.

APPROACH

Sites targeted for work are generally visited approximately twice annually and in some cases more. Activities completed by each contractor or group is entered into a digital mapping application (ArcGIS Collector / ArcGIS Online). The data recorded reflect treatment management units, treatment method, work effort, weather data, and specific work sites denoted on the map for each day. The benefit of using this data collection methodology allows for annual treatments and activities to be automatically integrated into a digital record that can be tracked overtime and as feature class layers in a GIS database. This provides a consistent record of all activities past and present and a visual representation of where activities occur over time. Figure 13 in the Appendix shows the progress work performed by all groups in 2017 and 2018.

B. Vegetation Management Discussion by Management Unit

There are thirteen official management units (MU) contained within the SBMHCP.

Not all MUs were prioritized for vegetation management activities as some units do not support occupied habitat for the covered butterfly species. Below is a brief summary of each MU that underwent vegetation management activities to support MB, CS, or SBE habitat enhancement or protection. See Figure 8 in the Appendix for locations of individual management units.

1. *SOUTHEAST RIDGE (191 acres)*

The unit has significant MB and CS habitat along the upper ridgelines and on the northern slopes between Bayshore Boulevard and the ridge. Significant patches of MB habitat are located along the ridge trail and on fire roads, rocky outcrops and slumps within the unit. The Southeast Ridge MU is considered high habitat value for MB & CS, and moderate habitat value for native plant diversity and dominance according to the SBM HMP (2008). SBE (SBE) butterfly habitat is not present. The Southeast Ridge contains 14.7 acres, only 7.4 percent of this MU, identified by the Creekside Assessment (2015) as essential habitat that should be considered and prioritized for scrub control to maintain grassland habitat for MB and CS butterflies. There are 130.3 acres (the largest acreage) considered valuable and 11.7 acres identified as potential habitat; as funding becomes available these areas should be considered for treatment. The Southeast Ridge is located on the far eastern edge of the Mountain and is bordered by Bayshore Boulevard and Highway 101 on the east and south, and the ridge trail on the north. The unit has expansive areas of grassland on steep slopes and narrow bands of coastal scrub and some woodland vegetation within the ravines. The lower slopes have an Indian midden site (the Preservation Parcel), and development grading has been done on the southeastern corner and eastern flat areas for the Terrabay Phase III commercial development. The grassland within this unit has infestations of French broom, fennel, and a variety of herbaceous weeds. This MU had a total of 33.14 acres treated by ECI and GNI, including work in the parcels dedicated to mitigate for the final Terrabay development. The primary targets for work performed in this MU was fennel, with a secondary focus on coyote brush. Herbicide was used primarily for treatment.

2. *BRISBANE ACRES (190 acres)*

The Brisbane Acres MU is considered high habitat value for MB and CS, low habitat value for SBE and high habitat value for native plant diversity and dominance according to the SBM HMP (2008). The unit has significant MB and CS habitat along the upper ridgelines. Significant patches of MB habitat are located along the ridge trail and on fire roads, rocky outcrops and slumps within the unit. There are a few rocky outcrops supporting *Sedum spathulifolium* within the unit, which may provide very marginal habitat for SBE. A few ridgeline locations also support populations of rare plants including Diablo helianthella (CNPS 1B), and one documented location of San Francisco campion (FE). Brisbane Acres contains 53.4 acres of essential habitat, this is approximately 40 percent of this MU. Much of this essential habitat should be considered and prioritized for scrub control to maintain grassland habitat for MB and CS butterflies. This MU contains the fifth largest acreage of essential habitat for grassland management and protection. The Brisbane Acres management unit is bordered by the Southeast Ridge management unit on the south side and the City of Brisbane on the north. Steep slopes, ravines and ridgelines compose a significant amount of the topography in the area. The lower northern slopes are typified by non-native Monterey cypress, Monterey pine, French broom and eucalyptus forests interspersed with native coastal scrub and coast live oak woodland. Residential

development rims the northern boundary of the unit. Upper ridge areas are typified by native grassland and a lesser amount of northern coastal scrub. Annually, North County Fire initiates a fuel reduction project adjacent to Brisbane homes along Trinity and Kings Road to reduce annual grass height and contiguous ladder fuels, total area for this work was approximately two acres in 2018. The City of Brisbane conducts vegetation maintenance in this MU annually based on budget allocations. Additional information can be obtained by contacting Karen Kinser with the City of Brisbane's Department of Public works.

3. *SOUTH SLOPE (477 acres)*

This MU has high habitat value for MB, CS and native plant community diversity and dominance according to the SBM HMP (2008). SBE habitat is not present. This unit has significant CS and MB habitat throughout the unit, with important habitat along the Ridge Trail. The South Slope contains 76.5 acres of essential habitat or stated differently 22.9 percent of this MU is considered essential grassland habitat and should be considered and prioritized for scrub control to maintain grassland habitat for MB and CS butterflies. South Slope contains 121.9 acres of valuable habitat and 51.8 acres of potential habitat and as funding allows should be considered for scrub treatment activities in the future. This MU contains the second largest acreage (76.5 acres) of essential grassland habitat in the SBMHCP area. This area is bordered by the ridge trail on the north and the Terrabay development on the south. The South Slope management unit is dominated by grasslands on steep, south facing slopes and ravines. Small areas of coastal scrub and with rocky intermittent drainages occur within the ravines. The area surrounding the Terrabay development have traditionally had lower quality habitat due to infestations of fennel, bristly ox-tongue, pampas grass and non-native grasses and forbs. Higher quality grasslands are found on undisturbed middle and upper elevation grasslands, although these areas are increasingly dominated by nonnative annual grasses and undergoing scrub encroachment. Areas under the jurisdiction of County Parks and private property were treated in this MU. Fennel and thistle control was initiated in 89.81 acres were treated by GNI with a foliar herbicide application.

4. *OWL AND BUCKEYE CANYONS (294 acres)*

This is an important MU as it has high habitat value for MB, CS, SBE, and native plant community diversity and dominance. The canyons contain a dominance of native, undisturbed communities and some of the best recreational values due to the variety of habitats (coast live oak woodlands, riparian woodlands, seasonal marsh, and coastal scrub). This unit has high habitat value for endangered species within the grassland areas, and overall high ecological diversity. Older road-cuts are found on the upper slopes on the west side of Owl Canyon, some of which provide habitat for the SBE butterfly. This MU contains 81.2 acres of essential habitat, the largest acreage of essential habitat in all of the SBMHCP area. As a result this area has been a continually targeted for vegetation and invasive species management for a number of years. The Owl and Buckeye Canyons management unit is partially owned by the California Department of Fish and Wildlife and is managed collaboratively with the County of San Mateo's Parks Department. It is located along the southern and western border of the City of Brisbane. Quarry Road leads to one of the only developed or significantly altered areas within this unit and provides access to the quarry operations. Additionally, the PG&E transmission lines pass through the eastern

slope of this management area. The area is characterized by steep canyons and ridgelines. Intermittent drainages are present in the larger canyons and associated ravines. Slopes are typified by native grasslands, and coastal scrub and Coast live oak woodland occupies ravines and slopes at mid-slope positions. Upper ridges are typified by native grassland and prairie communities and a significant amount of northern coastal scrub. The overall extent of invasive, non-native herbs, shrubs and trees is low due to vegetation management initiated by volunteer groups such as San Bruno Mountain Watch. Owl and Buckeye Canyons MU has been consistently prioritized by SBMHCP TAC and habitat managers. Treatment over 2017 and 2018 included 41.96 acres with coyote brush scrub control and fennel control as the primary focus. Foliar, thin-line and limited cut and paint herbicide applications were used. ECI focused on core grassland areas these treatments. Scrub control in the essential grassland areas should continue as a management priority for 2019 and the next several years since these areas support some of the highest quality occupied habitat. As funding becomes available additional efforts can be expanded to continue to remove additional fennel, Italian thistle, and broom species that also are found within grasslands of this MU. SBMW activities can be reviewed for this MU in their report in Appendix C.

5. *NORTHEAST RIDGE (214 acres)*

The Northeast Ridge or the Guadalupe Hills are considered high habitat value for MB and CS and low habitat value for native plant community diversity and dominance. SBE are not present in this MU. This area includes rolling hillsides, terraces and slopes. It is an important habitat area for the CS and MB butterflies. Grasslands are the dominant community and abundant host plants for both the CS and MB are present. Plant communities include valley needle grass grassland, blue wild rye grassland, northern coastal scrub, non-native grassland, eucalyptus forest, and broom shrublands. The grasslands are dominated by non-native annual grasses and herbaceous weeds in many areas, yet the grasslands still support the rare butterflies and their host plants in stable numbers. The Northeast Ridge contains 69.8 acres of essential grassland habitat, approximately 57 percent of the MU. These areas are currently privately owned, but should be prioritized for scrub control and ongoing invasive species management when accepted into the County Parks system through the dedication process. The Northeast Ridge contains the fourth largest acreage of essential grassland habitat according to the Creekside Assessment. PG&E transmission lines run northeast to southwest across the ridge. The Ridge development is located on MB Drive spanning the entire southern boundary of the conserved habitat. The Northeast Ridge supports several trails that are well used by the public and therefore provide recreational value. County Parks did not initiate any management activities in this MU in 2017 or 2018.

6. *HILLSIDE/ JUNCUS (217 acres)*

Hillside/ Juncus MU contains high habitat value for MB, moderate habitat value for CS and native plant community diversity and dominance, and low habitat value for SBE. Plant communities include northern coastal scrub, coastal terrace prairie, valley needlegrass grassland, central coast riparian scrub, valley wild rye grassland non-native grassland, and eucalyptus forest. Fennel infestations have spread throughout the lower slopes in Tank and Juncus Ravines, and Bermuda buttercup (*Oxalis pes-caprae*) has moved upslope into grasslands from the Pacific Nursery. This area contains 76.2 essential grassland habitat,

approximately 34 percent of the MU, and is the largest extent of essential habitat in the southwestern portion of the SBMHCP area. The parcel west of Hillside School is a combination of areas of low quality habitat adjacent to Pacific Nursery and Holy Cross Church coupled with steeper, rocky ravines and slopes (Juncus Ravine and Tank Ravine). There are PG&E Transmission lines through Tank Ravine and a new valve lot was installed adjacent to Hillside Blvd on land owned by Holy Cross Church and partially within the SBMHCP in 2015.Revegetation of this area is still underway and ongoing weed management of this area was a condition of the installation of the valve lot and began in 2015. During 2017 and 2018 this area was treated for fennel, prickly lettuce, and coyote brush herbicide control and historically has undergone scrub removal to facilitate host and nectar restoration plantings. Hillside/ Juncus MU has two dedicated site stewards (CNPS members Chuck Heimstadt and Loretta Brooks) that have been diligently working to improve both occupied butterfly habitat and native plant diversity for several years. These two stewards continued to contribute significant hours individually and leading volunteers. They are authorized to lead small volunteer groups in weed management activities and have contributed to the control of fennel, radish, mustard, and thistle within this MU. Scrub and invasive control in the essential grassland areas have continued to be prioritized in this MU. 72.55 acres were treated in 2017-2018. This area will continue to be an important management priority for 2019 with an additional focus on containing fennel and continued experimentation related to oxalis containment.

7. *DEVIL'S ARROYO (268 acres)*

This MU contains high value habitat for SBE and native plant community diversity and dominance. Devil's Arroyo supports two rare CNPS 1B.2 manzanita species, the largest colony of San Bruno manzanita and Montara manzanita. This MU has moderate habitat value for MB and CS covered species. Relatively small yet botanically diverse grassland patches are found on ridgelines and bald areas on the upper slopes of this unit. This area supports 8.8 acres of essential habitat and 8.9 acres of valuable grassland habitat. Devil's Arroyo represents an area of large expansive slopes covered mostly by dense coastal scrub. Steep north-facing slopes and ravines extend from the base of the slope near the Brisbane Industrial Park to the Summit Trail. Plant communities include blue blossom chaparral, northern coastal scrub, coastal terrace prairie, valley needlegrass grassland, central coast riparian scrub, eucalyptus forest, broom shrubland, and nonnative grassland. The Summit Trail forms the southern boundary, the Guadalupe Valley Quarry forms the eastern boundary, the Brisbane Industrial Park the northern boundary, and the eastern ridgeline adjacent to Dairy Ravine forms the western boundary. The upper slopes of this unit are mostly pristine, while the lower slopes have non-native infestations emanating from disturbed areas around the industrial park. A small area just west of the Quarry has been targeted for coyote brush removal and restoration. This area supports high biodiversity, is occupied habitat, and the infusion of funding to restore the adjacent privately-held property makes this area a good investment for SBMHCP funding. Additional work in Devil's Arroyo included fennel, mustard and gorse control. Select portions of this area will continue to need treatment to effectively contain gorse populations and maintain and improve occupied habitat for listed butterfly species. Herbicide methods were used for invasive and scrub control totaling in about 1.74 acres. PG&E contains a gas line easement through the lower eastern slope of the management area to the west of the Quarry. PG&E initiated work in this MU to clear the woody species along their gas pipeline. A requirement of this work is ongoing weed management in the cleared areas to avoid potential invasive species

recolonization. They have provided additional funding to County Parks to maintain this corridor free from weeds and to control brush recolonization. This work was carried out by WCW in 2018.SBMW restoration and brush clearing project activities are covered in Appendix C.

8. *DAIRY AND WAX MRYTLE RAVINE (214 acres)*

Dairy and Wax Myrtle Ravines have a moderate MB, CS, and native plant community diversity and dominance and high value habitat for SBE butterfly. This MU contains a combination of high quality native habitats and disturbed restoration areas. The unit consists of steep slopes that extend from the Brisbane Industrial Park along Guadalupe Canyon to the summit of the Mountain and includes a variety of vegetation types and slope exposures, with coastal scrub being the dominant plant community. Radio Road forms the northern and western boundary of this unit, Devil's Arroyo and the city of Brisbane form the eastern boundary, and Guadalupe Canyon Parkway forms the southern boundary. This MU contains 35.2 essential grassland habitat, approximately 15percent of the MU. Most of this MU is owned by the County Parks, with lower elevation portions in the north of this unit are owned by McKesson, Inc. A restoration and weed management plan for the dedication of the McKesson parcels to County Parks was finalized in 2016. Funding has been provided from the McKesson organization for this restoration & dedication, and additional SBMHCP funds have directed to augment these efforts in adjacent County lands. In 2017-18, 17.06 acres of scrub and broom control was implemented in the highest quality habitat found on County lands and the McKesson parcels. It is anticipated that some level of funding will continue to be needed to contain gorse and other noxious species found in this unit. SBMW restoration and brush clearing project activities are covered in Appendix C.

9. *SOUTHWEST SLOPE (436 acres)*

Southwest Slope contains high value habitat for MB and native plant community diversity and dominance and moderate habitat value for CS and SBE. MB habitat is scattered within patches of grassland and on fire roads along ridgelines. The San Francisco Campion (*Silene verecunda* ssp. *verecunda*), which has a CNPS rare plant rank of 1B.2, is located within this unit on the upper slopes near Radio Road. This unit has only very small patches of habitat for the SBE and CS butterflies. The western low elevation grasslands are dominated by purple needlegrass and fescue bunchgrasses. The MU is composed of steep south facing slopes on the west side of San Bruno Mountain. Summertime coastal fog strongly influences the vegetation, which is dominated by coastal scrub with patches of native grassland along ridgelines and isolated side slopes. The Southwest Slope contains only 2.5 acres of essential grassland habitat and 10.4acres of potential habitat. The management unit is bordered by the Cypress AMLOC landfill, the Cypress golf course and residential development within the City of Colma. Cypress AMLOC landfill is located at the base of the slopes and along the summit are a series of radio towers, dishes, transmission lines and buildings operated by American Tower Corporation and PG&E. The County Park ranger station is located on the west peak, although this is unused at this time. The lower slopes have been disturbed from farming and horticultural practices on lands above Pacific Nursery. PG&E contains a gas line easement through this eastern portion of this MU and anew valve lot was installed along Hillside Blvd. In 2018 PG&E initiated a restoration project on the west peak to mitigate for impacts to MB habitat in an off-site project. The

restoration project will restore up to 7 acres of high quality coastal terrace prairie habitat suitable for MB, with plantings of lupine host plant to occur as well.

10. *APRIL BROOK (273 acres)*

The April Brook MU is characterized by a mosaic of native grasslands, coastal scrub and rock outcrops occurring over a range of topography from rolling hills to relatively steep slopes and ravines. This management area has very limited MB and CS habitat and is classified by the HMP as low habitat value for these species. However it provides moderate SBE habitat, and contains large expanses of pristine grasslands and coastal scrub. Additional dune tansy (*Tanacetum camphoratum*) plants were found in this unit by Doug Allshouse this year. It has high habitat value for native plant community diversity and dominance and moderate value for SBE habitat. The lower slopes are typified by riparian forests and scrub along Colma Creek and associated drainages, while vegetation on the upper ridges are typified by fescue dominated prairies and rocky outcrops. Colma Creek flows westward. This unit does not contain any essential or valuable grassland habitat and only contains 0.2 acres of potential grassland habitat that could support MB or CS butterflies. The Guadalupe Canyon Parkway forms the northern border of this unit. The April Brook area is a favorite for hikers on the mountain due to its wide-open slopes covered by coastal prairie and moist scrublands. The Summit Trail loops through this management area and provides views of San Francisco, the ocean and the Farrallon Islands. This MU was not prioritized for treatment in 2017-18 using SBMHCP funds.

11. *SADDLE (320 acres)*

The Saddle MU contains moderate habitat value for MB, CS, and native plant community diversity and dominance. The eastern slopes provide important grassland habitat for the CS and MB butterflies. SBE are not present in this management unit. The northern portion of the Saddle is mostly made up of steep, inaccessible slopes primarily covered by gorse. The headwaters of Colma Creek and the botanically-rich Saddle bog area are located on the western side of the unit bordering Guadalupe Canyon Parkway with an extensive freshwater marsh and riparian wetlands. The central and western portions of the Saddle MU consist of gradual slopes and were used for farming in the past. The eastern slopes are much steeper and were likely used for cattle grazing. The essential grasslands located within this unit are estimated at 13.2 acres and mainly occur in the northeastern areas of this MU. This unit contains the most potential grassland habitat with approximately 70 acres, primarily to the west of the habitat classified as essential. It is bordered by Guadalupe Canyon Parkway on the south and east, and the City of Daly City on the north and west. A park visitor's area, parking lot, and picnic area are located in this unit just north of Guadalupe Canyon Parkway. SBMHCP approved developments were built along Carter Street adjacent to Daly City housing. This unit receives most of the visitor usage in the Park, in the form of hiking, jogging, and picnicking. This site has patches of gorse on the north side of the Saddle the 2007 estimate of gorse in this unit was 34 acres (HMP 2008). Continued maintenance of gorse containment lines and scrub removal in essential grassland areas that are occupied and support both MB and CS populations was prioritized in 2017 and 2018, with 57.69 acres treated.

C. CONCLUSIONS

Vegetation and habitat management continues following a shift in focus to scrub control initiated in 2015 and likely will continue as such for the foreseeable future. The habitat management paradigm re-focused efforts to address natural patterns of scrub succession in the absence of disturbance on the Mountain. Historically, grazing and fire provided punctuated disturbance within the SBMHCP lands. These historic disturbance events provided the mosaic of scrub and grassland habitats found on the Mountain today. Grassland requires regular return intervals of disturbance in natural or semi-natural habitats in order to remain free from scrub, and fire is an agent of disturbance. In more managed habitats a combination of grazing and fire are often used to prevent scrub encroachment. In the last thirty years, the SBMHCP area has not been grazed beyond a small goat and sheep experiment and there has been a marked reduction in fire events since the SBMHCP was established. However, as of 2018 a grazing technical advisory committee has been formed to provide advice on all aspects of implementation of a cattle grazing pilot to be implemented at San Bruno Mountain.

The absence of disturbances such as grazing and fire has resulted in a steady decline in high quality grassland and prairie habitat able to support MB and CS host and nectar plants. Most marginal areas have already been lost to scrub encroachment by both native and non-native species. Based on the Assessment by Creekside Science, the corrected grassland acres were estimated to be 944 acres ± 188 (826-1,062 acres). The 2008 HMP established an acceptable range of grassland based on historical fluctuations to be between 1,200 and 1,800 acres. This information provides a clear directive for habitat management activities within the SBMHCP- control scrub encroachment in high quality occupied grassland habitats. The Assessment provided clarity on where to focus immediate efforts to secure and protect high quality or “essential” grassland habitats against scrub encroachment within the SBMHCP. Creekside Science estimates essential grasslands as approximately 431 acres. Scrub and invasive treatment work focused on addressing encroachment in 331 grassland acres during 2017 and 2018. In 2017 and 2018 a total of 34 acres of direct scrub control were completed with additional invasive species targeted throughout all MU identified in the discussion above. Areas targeted for treatment in the 2018-2019 Scope of Work (SOW), were identified based MB and CS observation data, historical maps of host plant locations, and historical treatment. Areas immediately adjacent to populations of host plants for MB and CS were further prioritized for full scrub removal. Areas within essential grassland habitat that were not immediately adjacent to host plant populations were treated to halt scrub encroachment through herbicide applications. Diligent efforts to stop scrub encroachment into the essential grassland areas and active scrub removal in areas adjacent to hostplant populations will help bring grassland acres into the acceptable historic range between 1200-1800 acres. Scrub control cannot be obtained in one or two years, therefore, a commitment of resources for the next several years will be necessary to bring grassland acres back up to a 1200 acre threshold with a minimal scrub component.

Despite the prioritization of scrub control over invasive species management in the 2017 and 2018 budget, funding will still be necessary to prevent habitat degradation due to invasive species infestations and non-native annual grass. Funds were allocated in the budget to treat the most noxious species threatening high quality habitats. Part of the focus will be to continue containment of significant populations of highly noxious species such as

fennel, broom, thistle, and oxalis. Balance and careful consideration will be necessary to properly evaluate the risks and benefits for prioritizing invasive species treatments over scrub control moving forward. SBMHCP area benefits greatly from volunteer habitat management activities. Volunteer-based projects are actively contributing to habitat enhancement and protection of high quality butterfly habitat. Volunteer efforts supplement the work done by professionals and complements contractor work by often providing the detail work in and around hostplants where time and care are of utmost importance. The sheer size of SBMHCP area makes it very difficult to hire contractors to carry-out the final control of certain species due to the high mobilization costs associated to track down the last dozen fennel sprouts in a 20-acre area. This is where volunteers shine! They want to contribute and have the time to chase down the last few offending plants in a large parcel. Additionally, this type of work provides a real sense of accomplishment for volunteers and should be encouraged.

D. RECOMMENDATIONS

Habitat management actions are most effective when based in relevant and applicable data. Many of the recommendations outlined in the Covered Species section of this report are relevant to determining appropriate habitat management activities in the near and mid-term. New monitoring suggestions can directly tie management actions to health of butterfly populations and ideally a reduction in the year-to-year variability seen in populations found indifferent areas of the Mountain.

SCRUB ENCROACHMENT

Scrub encroachment is a serious threat to the existence and quality of grasslands and prairie habitats that support MB and CS butterfly populations scattered throughout SBMHCP area. Scrub within the SBMHCP area consists of both native and exotic species. A lack of disturbance has contributed to native scrub encroachment into covered species grassland habitat.

Scrub encroachment should continue to be a primary focus for budget expenditures related to habitat management. Using the Assessment, areas designated as “essential” should be prioritized for treatment as a starting point. Efforts should be made to evaluate the threat of climate change in covered species habitat management and prioritization. As an example, no CS observations along T-1, T-5, and T-6 in 2018. These areas may no longer support a CS population or a reduced population. It may be wise to prioritize habitat management activities here to improve this “potential” grassland habitat in light of the high concentration of habitat in the eastern portions of the SBMHCP. Investing in recovering this area with a systematic approach before it degrades further will be easier than attempting to recover this area after further decline. These scenarios are worthy of robust discussion to determine appropriate prioritization and consideration of unknown future conditions.

Scrub encroachment should continue to be prioritized until grassland habitat increases to the minimum threshold of 1200 grassland acres. Clear definitions of grassland suggested by the Assessment should be reviewed and incorporated into the HMP. This will enable consistent grassland analysis to ensure that grassland habitat is sufficient to support robust populations of MB and CS butterflies and remain within the historical range identified in the

2008 HMP. Grassland acres should be evaluated at a regular interval to ensure the minimum threshold is retained.

INVASIVE SPECIES CONTROL

Invasive species management is a difficult aspect of habitat management. It often seems as soon as you are able to control, eliminate, or contain one problematic species, a new one is identified. Marginal habitats adjacent to urban areas are most at risk for continued invasion by non-native plants and animals. Not all non-native plants are immediate threats to habitat quality or biodiversity, while others that may not appear to be significant threat and exist at low levels can suddenly reach a threshold where the population explodes. Invasive species are a very site specific problem. Invasive species lists and priorities must be evaluated from time to time to ensure that the most appropriate approach is taken based on available information. Re-evaluation the Invasive Priority Plant List found in Appendix E of the HMP is ongoing. Species should be prioritized based on threat and further classified for treatment approach. Species can be categorized into classifications such as control, contain, and eradicate. Additional guidance is provided in the Assessment and this information should be considered when revising the list. With scrub control as a clear priority funding will be even more limited to address invasive species control. Therefore, a systematic approach should be developed with SMART (specific, measurable, achievable, results focused, and time-bound) goals for the top five to ten invasive species found within the SBMHCP area and occurring in the covered species habitat as starting point.

HOST AND NECTAR PLANT MONITORING

As discussed in the monitoring recommendations, continuing efforts to map and quantify host and nectar plants is critical to understand the linkage to between habitat quality and habitat management needs. By continuing host and nectar plant monitoring appropriate data can be collected to enable the Habitat Supervisor to define high, medium, and low quality MB and CS habitat. These classifications can help in determining priorities for scrub removal, invasive species treatments, and when weighing two different areas for prioritization. Lastly, this will clearly guide where revegetation is needed to augment host and nectar populations to better support MB and CS. Host and nectar plant monitoring protocol testing should continue in 2019 and be refined over the next few years.

REVEGETATION AND RESTORATION

Grassland management in the absence of fire and grazing can be challenging. The covered species rely on primarily low-growing host and nectar plants. In habitats adjacent to urbanized areas these host and nectar plant populations are often more at risk to invasive species invasion. Both scrub and invasive species can overtop the host and nectar plants critical for MB and CS butterfly lifecycles, making it harder to locate food and egg deposit locations. Additionally, scrub and non-natives potentially outcompete and can reduce the density of host and nectar plants in occupied habitats.

A grazing pilot project is in the planning stages for two areas within the SBMHCP area, as cattle have proven effective in conservation grazing operations for the management of protected species habitat. Continued experimentation concerning different techniques to control tall competing vegetation should be also implemented when and where appropriate.

It may be best to test methods in unoccupied habitat first to see how the target plants respond. Weed whips, scything, and mowing if done at the right time of year can reduce weed populations and provide additional resources to host and nectar plants. In some areas experiments with grass-specific herbicides have proven effective in developing a more robust herbaceous layer in bay checkerspot habitat at Coyote Ridge (personal communication Niederer 2015).If definitions of high, medium, and low quality habitat for MB and CS are associated with density of these resources this could also be used as a management tool to inform and guide where additional revegetation is needed. All of these techniques can contribute to the restoration of covered species habitat and should be considered for implementation when adequate funding is available to initiate a project for multiple years.

VOLUNTEER PROGRAMS

SBMHCP should continue to encourage and collaborate with interested and knowledgeable volunteers. Weed work and restoration events utilizing volunteers have proven an effective restoration tool and should continue with appropriate oversight and guidance.

MANAGEMENT AND COVERED SPECIES POPULATIONS

There are close to 1000 acres of grassland within the SBMHCP area according to the Assessment. These areas support CS and MB populations scattered throughout the Mountain. Invasive species and scrub control cannot be carried out on all 1000 acres with the current budget. Based on the last two years of scrub control, it is clear that fewer acres can be treated in a year than when invasive species was the focus for control. Despite more than thirty-years of habitat management we have not seen a clear relationship between the vegetation work and an increase in either butterfly populations. In order to manage for the next thirty years and confidently state that habitat management program benefits MB and CS butterfly populations a new monitoring paradigm must be initiated. Technical experts and County Parks' natural resource management staff should work collaboratively to design a vegetation monitoring protocol that can explore the relationship between management and butterfly population responses. It is also important that protocols should be developed that can be analyzed using statistical hypothesis testing and identify important factors contributing to these complex ecological relationships. Lastly, data derived from monitoring protocols can provide critical baseline data in advanced of more holistic management approaches such as grazing. It will be critical to map and quantify the size, distribution, and quality of host plant populations in advance of any grazing trials. Cattle grazing remains likely the single most effective tool for managing grassland habitats, but due to the infrastructure costs has not been tried on San Bruno Mountain.

IV. COVERED SPECIES AND VEGETATION MANAGEMENT PARTICIPANTS

Annual report prepared by San Mateo County Parks' Natural Resource Specialist, Hannah Ormshaw, with contributions by Natural Resource Manager Ramona Arechiga, and use of previous Activities reports from past habitat managers,
Autumn Meisel and Patrick Kobernus. Monitoring in 2017 and 2018 was implemented by Arechiga, Ormshaw, Michele Laskowski, Jana Ng, Jodi Gunning, Dan Krug, and contractors from Coast Ridge Ecology.
Habitat Management Activities were implemented by: Ecological Concerns Inc., Go Native Inc., Shelterbelt Builders, Inc., and West Coast Wildlands, Inc.

REFERENCES

Arnold, 1983. Ecological studies of six endangered butterflies (Lepidoptera, Lycaenidae): island biography, patch dynamics, and design of habitat preserves. Univ. of Calif. Publications in Entomology. 99:1-161.

Thomas Reid Associates, 1982. Endangered Species Survey San Bruno Mountain. Biological Study 1980-1981. Prepared for San Mateo County.

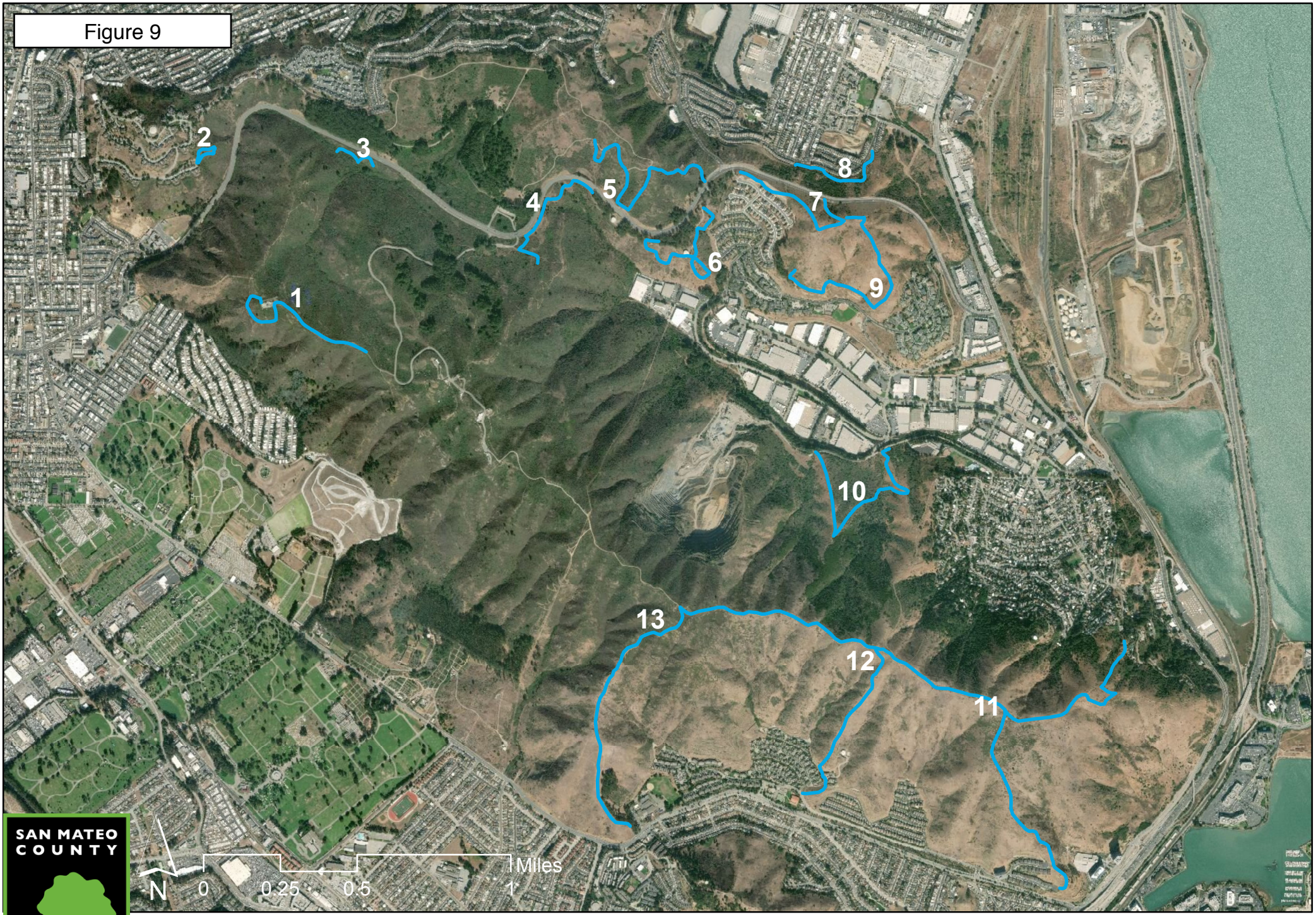
TRA Environmental Sciences, 1983-2014. SBMHCP Annual Activities Reports. Prepared for the County of San Mateo.

SAN MATEO COUNTY PARKS

SBM HCP Management Units

Management Units

Figure 9

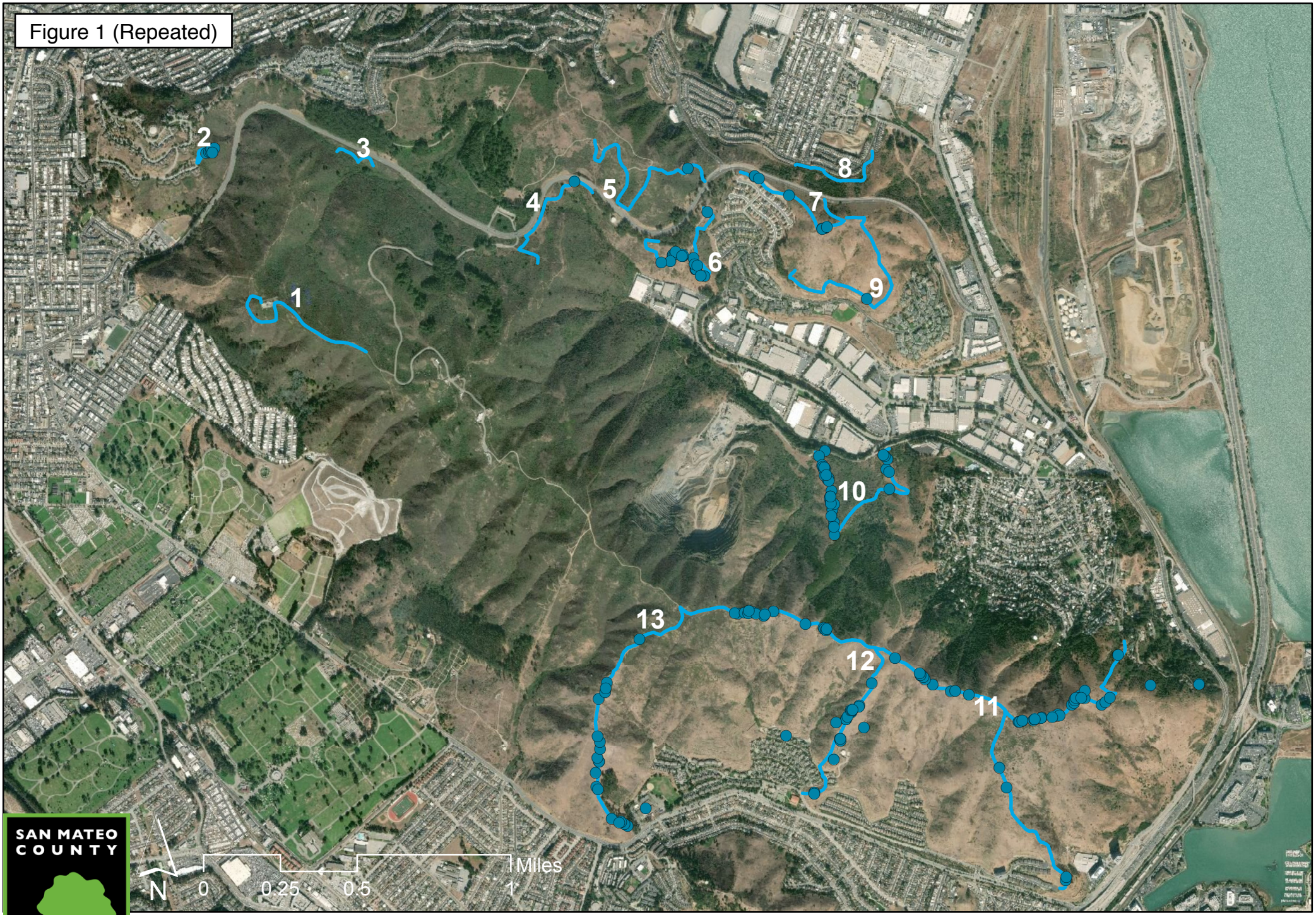


SAN MATEO COUNTY PARKS

2017 Mission Blue Transects

Mission Blue Transects

Figure 1 (Repeated)



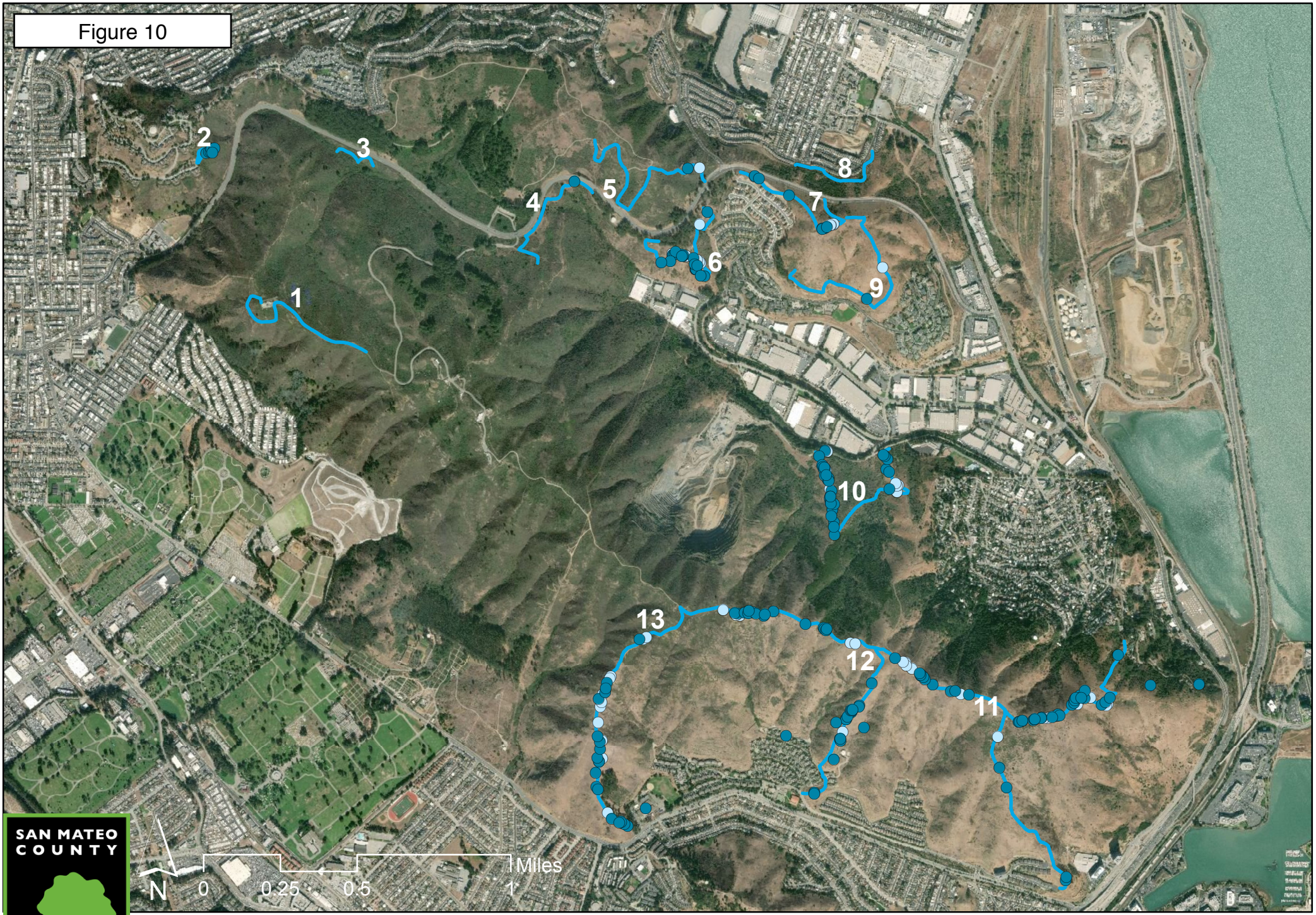
SAN MATEO COUNTY PARKS

2017 Mission Blue Observations

Mission Blue Observations 2017

Mission Blue Transects

Figure 10



SAN MATEO COUNTY PARKS

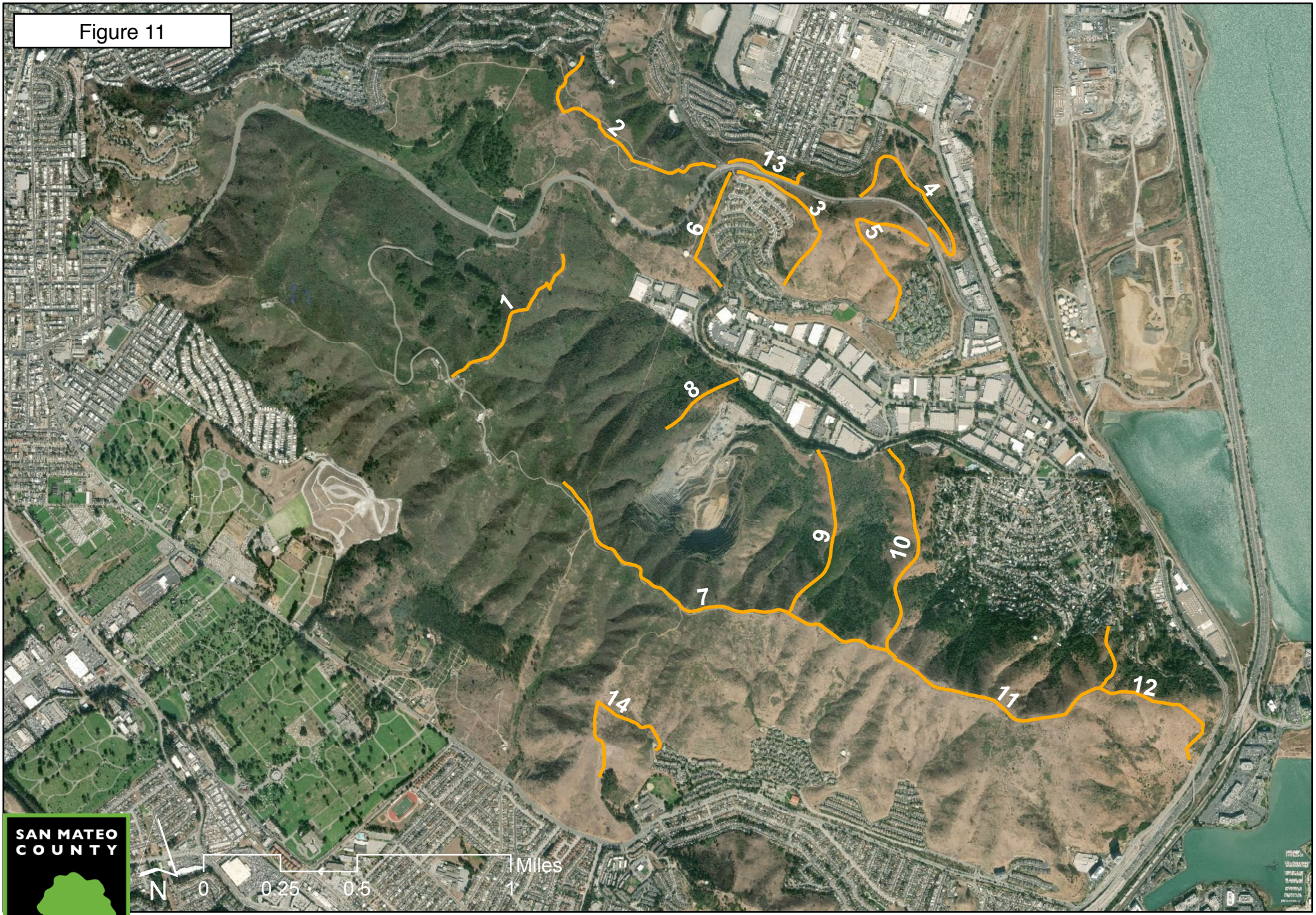
2015-17 Mission Blue Observations

Mission Blue Observations 2017

Mission Blue Observations 2015

Mission Blue Transects

Figure 11

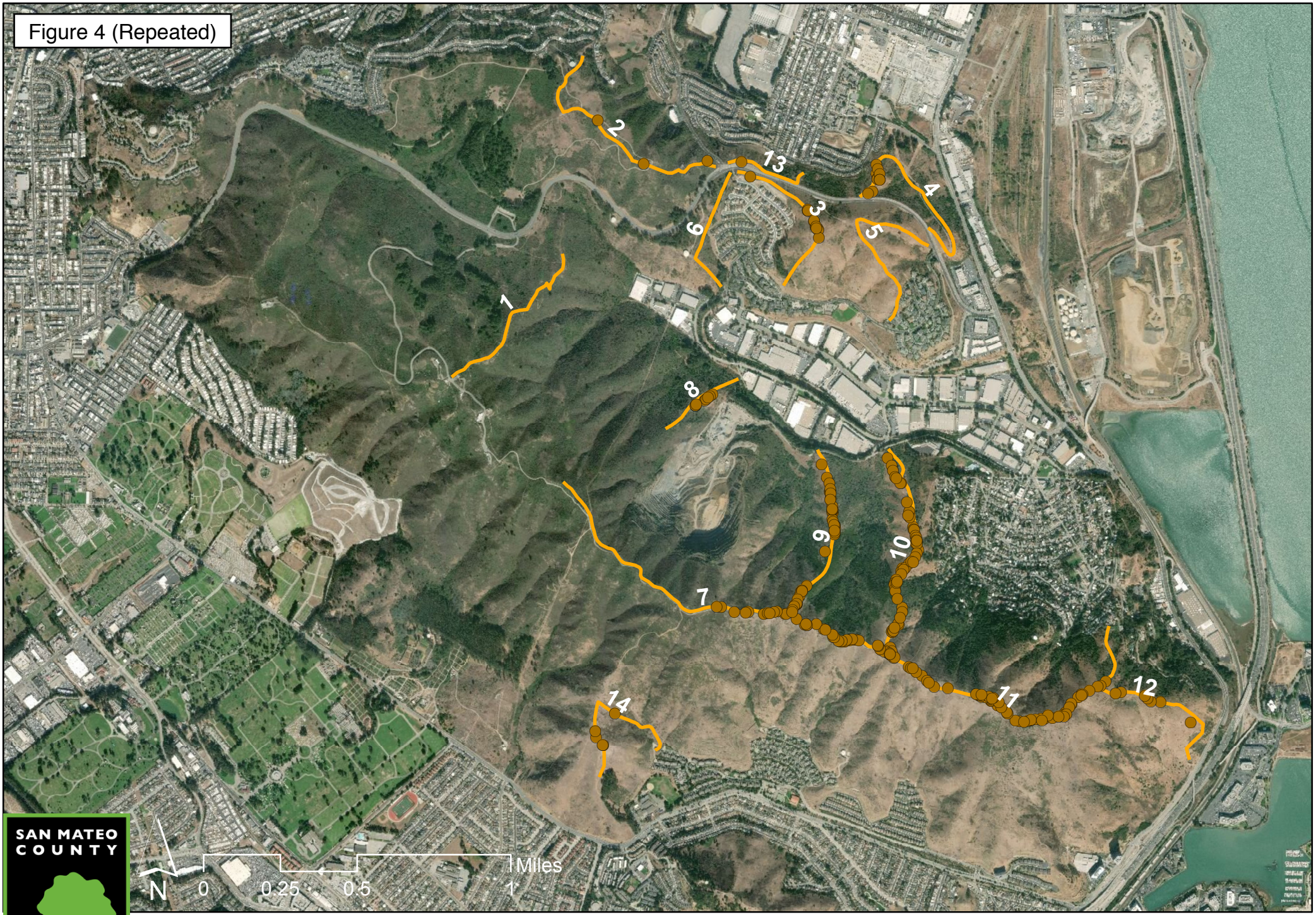


SAN MATEO COUNTY PARKS

Callippe Silverspot Transects

Callippe Silverspot Transects

Figure 4 (Repeated)



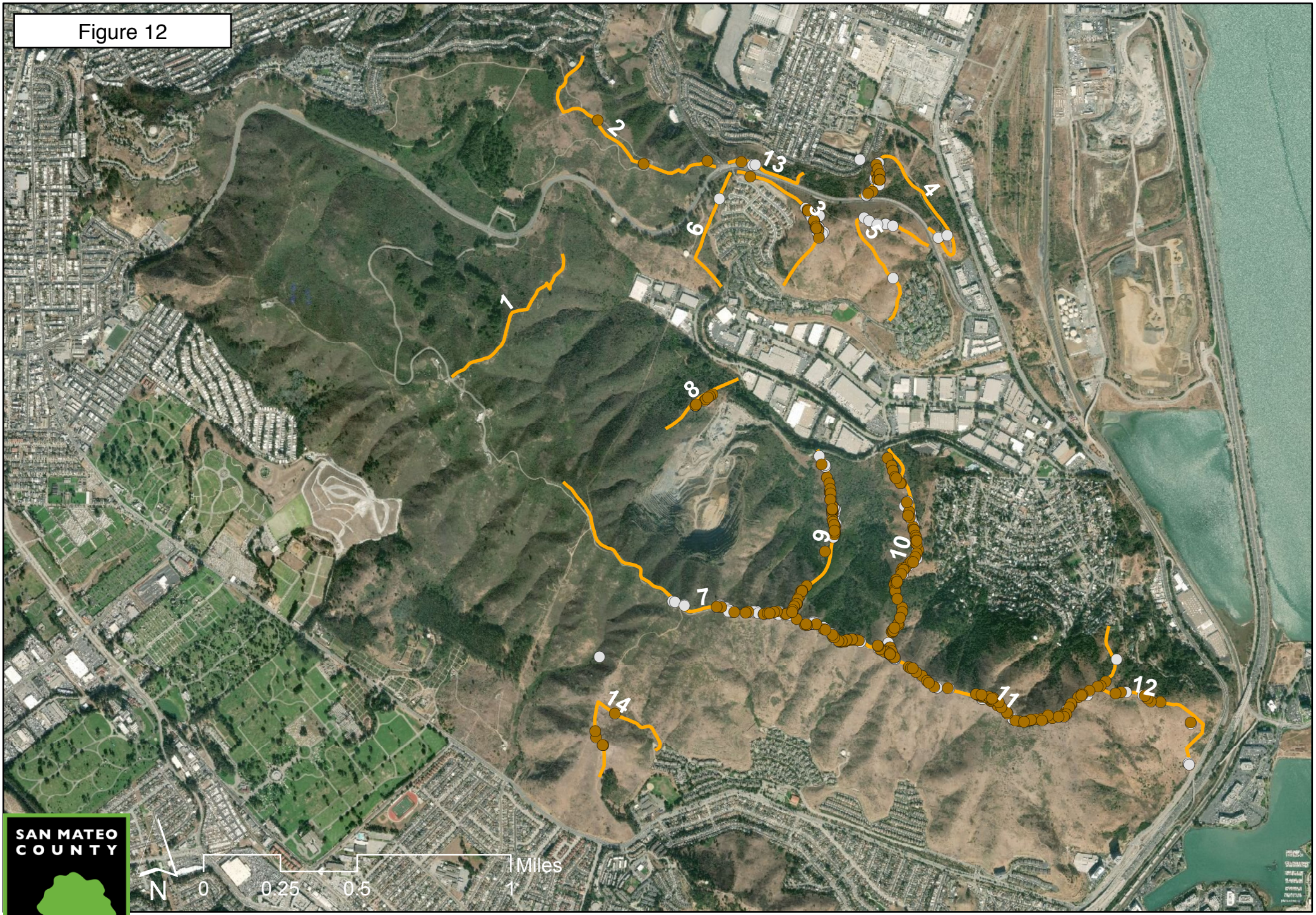
SAN MATEO COUNTY PARKS

2018 Callippe Silverspot Observations

Callippe Observations 2018

Callippe Silverspot Transects

Figure 12



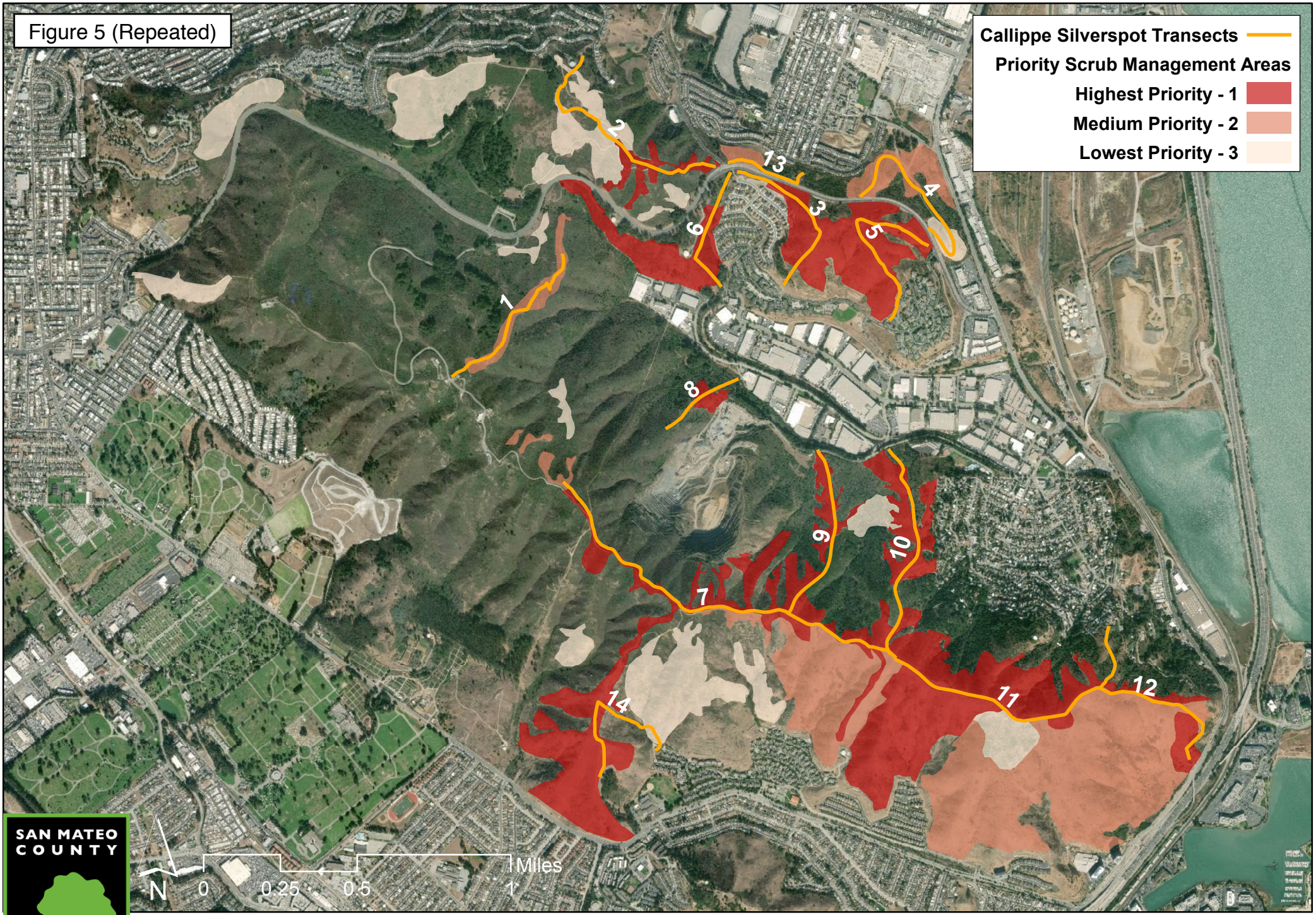
SAN MATEO COUNTY PARKS

2016-18 Callippe Silverspot Observations

Callippe Observations 2018

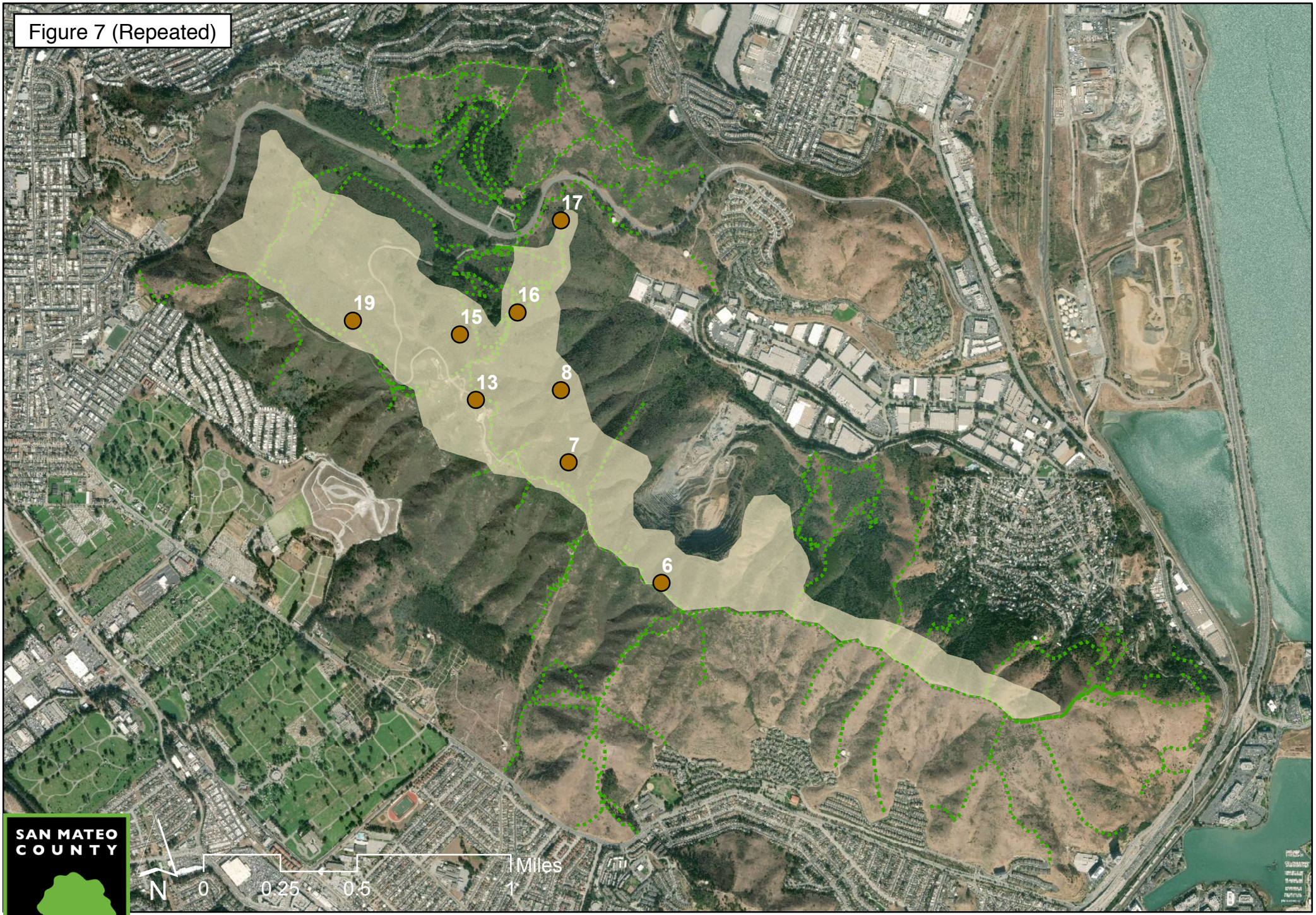
Callippe Observations 2016

Callippe Silverspot Transects



CallippeTransects & Scrub Management Areas

Figure 7 (Repeated)



SAN MATEO COUNTY PARKS

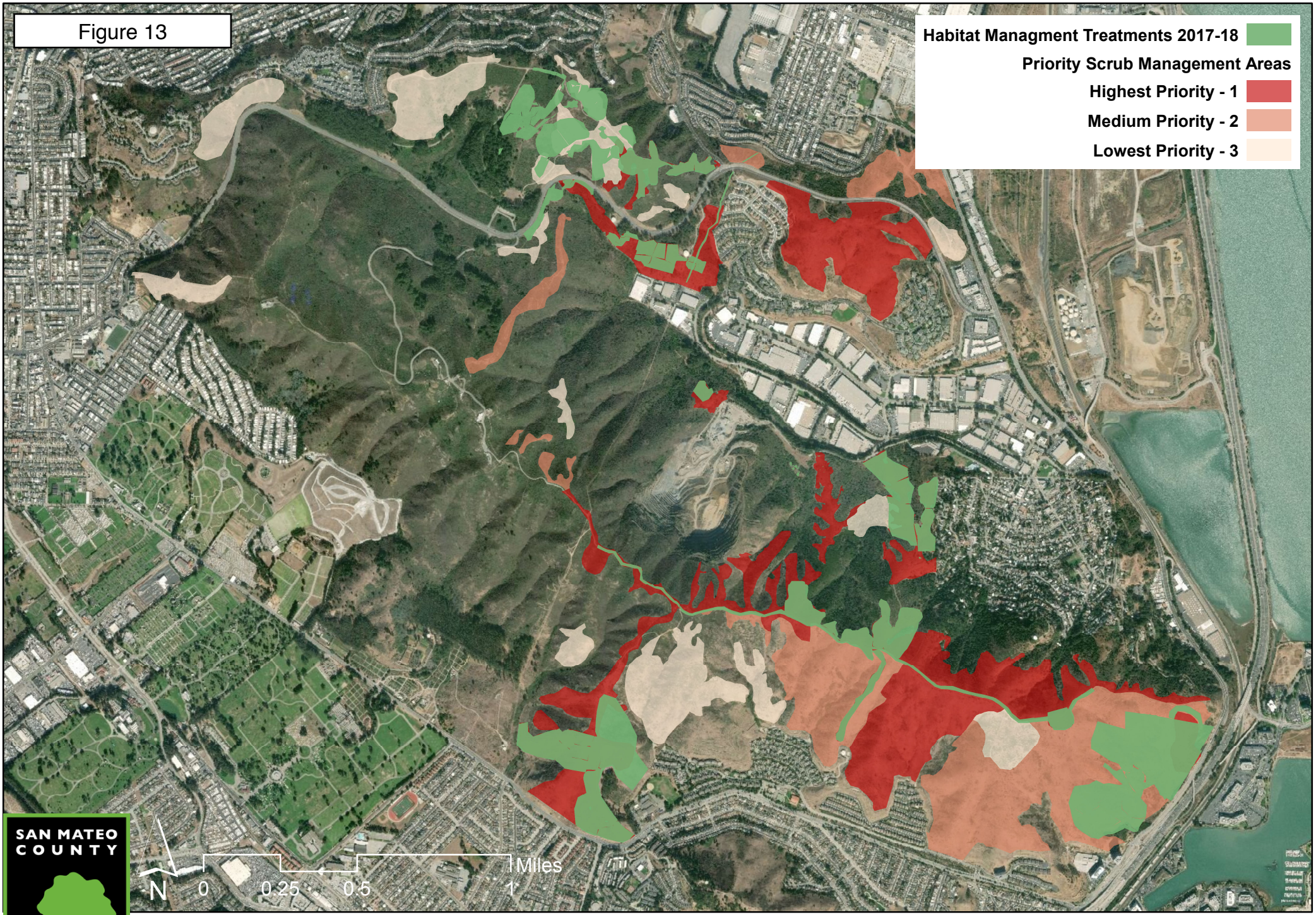
SBM Elfin Monitoring Points

Elfin Monitoring Points

Elfin Habitat

SBM Trails

Figure 13



SAN MATEO COUNTY PARKS

2017 - 18 Habitat Management Treatment Areas

2015 Rare, Threatened, and Endangered Plant Survey
San Bruno Mountain

A REPORT FOR SAN MATEO COUNTY PARKS DEPARTMENT

CREEKSIDE SCIENCE

2015 Rare, Threatened, and Endangered Plant Survey: San Bruno Mountain

Report for San Mateo County Parks Department

Report Authors: Lech Naumovich, Christal Niederer of Creekside Science, 27 Bishop Lane, Menlo Park, CA 94025

Report Date: August 19, 2016

Preferred Citation: Naumovich, L. and C. Niederer. 2016. 2015 Rare, Threatened, and Endangered Plant Survey: San Bruno Mountain. Report for the San Mateo County Parks Department. Creekside Science. Menlo Park, CA

Cover photo: San Francisco spineflower located on the San Bruno Mountain in 2015, in the Colma Dunes area. Above photo: Extensive San Bruno Mountain manzanita stand located on Manzanita Dike. All photos provided by L. Naumovich unless otherwise noted.

CREEKSIDE SCIENCE

Executive Summary

From February thru November 2015, targeted botanical surveys were conducted for 20 unique taxa within the San Bruno Mountain (SBM) Habitat Conservation Plan (HCP) area. These unique taxa are also known as "Rare, Threatened, and Endangered" (RTE) plants that have been afforded regulatory protection from either the US Fish and Wildlife Service or the California Department of Fish and Wildlife. Fifteen (15) of the 20 RTE taxa were observed in 2015. Each taxon located was documented with photographs, GPS location, and the completion of a California Natural Diversity Database (CNDDB) form for each separate occurrence of these plants. Four (4) of the RTE plants were designated as "locally abundant," indicating that they were found in numerous locations and habitat types on SBM. Eleven (11) plants were designated as restricted, indicating that their presence on the mountain was closely linked to specific climate, substrate, or confluence of other conditions. Five (5) taxa were not located in 2015 surveys and we believe at least two taxa (white-rayed pentachaeta and San Francisco owl's clover) are extirpated from SBM because habitat where they once existed is now gone. The remaining three taxa that were not located (bent-flowered fiddleneck, Choris's popcorn flower, and San Francisco campion) may persist outside of our survey areas, or may occur in very low densities and were not detected in our surveys. In 2016, a notable population of San Francisco campion was relocated by volunteers. Since we are in the midst of a historic 4-year drought, it is likely that certain annual plants are not germinating as they do in a year with average precipitation.

Plant population data were updated for all the occurrences. Plant/population vigor is also presented as a measure of conservation success. Notably, at least three taxa have well documented taxonomic inconsistencies and can be difficult to identify: San Bruno Mountain manzanita (intergrading with Montara mountain manzanita), San Francisco Gumplant (which has been lumped into a parent genus in the most recent taxonomic treatment), and San Francisco campion (which has been studied with other campion only to determine that the taxa in the San Francisco area would benefit from further study).

Despite taxonomic difficulties and historically dry weather, we believe this report will help land managers, citizens and non-profit groups take meaningful steps to help preserve the RTE flora of San Bruno Mountain. To this end, this report provides preliminary recommendations for stewardship actions and ranks each RTE element in terms of its priority for receiving stewardship. We believe a distinct subset of the RTE plants can benefit greatly from well-timed and executed stewardship projects. Our intent in providing this information is that it may encourage a thoughtful, informed discussion about conserving extant populations of RTEs and even introductions of new or extirpated populations where appropriate.

Table ES-1: Results of 2015 RTE plant surveys on San Bruno Mountain

Scientific Name	Common name	**Rarity Status** (CRPR = California Rare Plant Rank list 1B plants are rare, threatened or endangered in CA and elsewhere, list 3 plants require more information, list 4 plants are of limited distribution)	**Taxon found** (X = not found, A = locally abundant, R = restricted)	**Stewardship Priority** (3 is high, 2 is medium, 1 is low, 0 is no action recommended)
Amsinckia lunaris	Bent-flowered Fiddleneck	CNPS 1B.2	X	1
Arabis blepharophylla	Coast Rock Cress	CRPR 4.3	A	2
Arctostaphylos imbricata	San Bruno Mountain Manzanita	CE/CRPR 1B.1	R	3
Arctostaphylos montaraensis	Montara Manzanita	CRPR 1B.2	R	3
Arctostaphylos pacifica	Pacific Manzanita	CE/CRPR 1B.2	R	3
Arctostaphylos uva-ursi forma *coactilis*	Bearberry Manzanita	None	R	3
Arctostaphylos uva-ursi forma *leobreweri*	Bearberry Manzanita	CBR (considered for status but rejected)	R	3
Arctostaphylos uva-ursi forma *suborbiculata*	Bearberry Manzanita	CBR (considered for status but rejected)	R	3
Chorizanthe cuspidata	San Francisco Spine-Flower	CRPR 1B.2	R	3
Collinsia multicolor	San Francisco Collinsia	CRPR 1B.2	R	3
Erysimum franciscanum var. *franciscanum*	San Francisco Wallflower	CRPR 4.2	A	2
Grindelia hirsutula var. *maritima*	San Francisco Gum Plant	CRPR 3.2	A	0
Helianthella castanea	Diablo helianthella	CRPR 1B.2	R	2
Iris longipetala	Coast Iris	CRPR 4.2	A	1
Lessingia germanorum	San Francisco Lessingia	FE/CE/CRPR 1B.1	R	3
Pentachaeta bellidiflora	White-Rayed Pentachaeta	FE/CE/CRPR 1B.1	X	2
Plagiobothrys chorisianus var. *chorisianus*	Choris's Popcorn Flower	CRPR 1B.2	X	1
Silene verecunda ssp. *verecunda*	San Francisco Campion	CRPR 1B.2	R (located in 2016)	3
Tanacetum bipinnatum	Dune Tansy	CBR	R	2
Triphysaria floribunda	San Francisco Owl's Clover	CRPR 1B.2	X	1

See http://www.cnps.org/cnps/rareplants/ranking.php for more information on rare plant ranks.

Acknowledgements

A number of people were instructive in creating this report. Volunteers of the San Bruno Mountain community, San Mateo County Parks staff, local non-profit groups, and regional experts offered volumes of information and insight. Their support was essential. We want to especially thank a few people who have been intimately involved in our work including: Doug Allshouse (and his wife who kindly shared their home for meetings), David Nelson, David Schooley, Aaron Sims, California Department of Fish and Wildlife staff, Mike Vasey, Jake Sigg, Mike Forbert, Joe Cannon, Scott Simono, Aaron Schusteff, Mark Sustarich, Margo Bors, Thomas Stoughton, the San Bruno Mountain HCP Technical Advisory Committee, the California Academy of Sciences herbarium staff, and our project manager at the County: Ramona Arechiga.

We apologize for any omissions, they are unintentional.

This study was funded by County of San Mateo Measure A funds.

Introduction

Ecological Setting

San Bruno Mountain (SBM) State and County Park is an ecological landmark of regional significance that protects a majority of the remaining, undeveloped San Bruno Mountains. Formally, all that remains undeveloped of the San Bruno Mountains is the main southeast to northwest ridge of San Bruno Mountain and its slopes, the Guadalupe Hills (Callippe Hill) and Colma Canyon and its surrounding slopes. For this report, SBM refers to the larger San Bruno Mountains. The survey area stands as a virtual ~2,500 acre island of habitat in the midst of the urban South San Francisco area metropolis. SBM is both an island and a critical bridge between the vast expanses of habitat north of the Golden Gate and the contiguous expanses of the Santa Cruz Mountain Range. The vegetation on SBM has been studied since the late 1800s and its elevation relief and heterogeneity allow for the mountain, with its many nooks and crannies, to serve as a refuge for unique flora and fauna.

San Bruno Mountain is an tectonostratigraphic terrane where one tectonic plate breaks off and is sutured onto a second. The mountain's ridge line runs in an east-west configuration, with slopes ranging from zero to vertical, and elevations ranging from 250 to 1,314 feet. The bulk of the mountain is composed of late Cretaceous (~100 million years old) dark greenish-grey graywacke of the Franciscan formation (McClintock et al. 1990). This graywacke is a type of poorly sorted sandstone that consists of angular rock fragments, detrital chert and feldspar (Ibid.). Serpentinite is restricted to small lenses on Serbian ridge and is not a prominent geologic feature of the Mountain. A notable sand dune and sandy soils occur near the head of Colma canyon on the western end of SBM. McClintock notes that since “SBM is composed almost entirely of one rock type, there is little variation in the type of soil… the varying factor is the soil depth” (Ibid.).

Vegetation on San Bruno Mountain is a dynamic mix of several prominent communities, most notably coastal prairie grassland and northern coastal scrub that are in a continuous battle for real estate. Non-native annual grassland, needlegrass grassland, blue blossom chaparral, central coast riparian scrub, and eucalyptus forest are also dominant vegetation types on the island. A number of other unique vegetation types dot the landscape (e.g. central dune scrub, fresh water marsh, gorse scrubland, manzanita scrubland, and seasonal wetlands) to further add to the diversity of the area.

The parks' principal biotic resources include 20 species of rare, threatened and endangered (RTE) plant life, as well as host and nectar plants of endangered butterflies. The endangered or threatened butterflies (San Bruno elfin, Mission blue, and Callippe silverspot) are found in only a few other places in the world. Another species considered for listing, the San Francisco tree lupine moth (*Grapholita edwardsiana*), was known to inhabit the area, but urban development destroyed this population. Conserved habitat on SBM is managed under the nation’s first Habitat Conservation Plan established in 1982.

Many community groups are interested and invested in this park. In fact, it was the work of several community groups and an interested public that helped conserve this unique mountain. The work in this report, as well as much of its foundation, was based on the research and dedication of volunteers.

San Bruno Mountain has undergone dramatic ecological changes since the HCP was first approved over 30 years ago. The island has become more isolated by increased development, climate is changing, many invasive species populations have been limited and locally eradicated, and a major vegetation shift on the mountain is occurring from grasslands to coastal scrub (Weiss et al. 2015). Very limited resources have been directed toward understanding how these changes affect the RTE plants. This 2015 survey aims to address this issue.

Scope of Work

This report updates the current state of knowledge around rare, threatened and endangered (RTE) plants that occur, or once occurred on San Bruno Mountain. This study aims to comprehensively visit all known rare plant occurrences on the Mountain and document the findings. In addition, a task of this survey was to actively search areas of likely habitat for new occurrences of RTEs. The findings will directly inform the Parks Department's natural resource management program in order to implement improved management and stewardship strategies.

Completed Tasks:

- Survey known and historic rare, threatened, and endangered (RTE) plant species (Table 1) on SBM using all available means, best available science, and local SBM experts
- Capture population demographics (population size, status, health, threats etc.) and habitat information (Manual of California Vegetation's Alliances) for each located species using the accepted CA Department of Fish and Wildlife protocols
- Create spatially accurate maps of all RTE species in one GIS project
- Provide management recommendations for the continued conservation of RTEs on SBM

Table 1: Taxa for which targeted surveys were conducted

Scientific Name	**Common name**	**Rarity Status** (CRPR = California Rare Plant Rank list 1B plants are rare, threatened or endangered in CA and elsewhere, list 3 plants require more information, list 4 plants are of limited distribution)
Amsinckia lunaris	Bent-flowered Fiddleneck	CNPS 1B.2
Arabis blepharophylla	Coast Rock Cress	CRPR 4.3
Arctostaphylos imbricata	San Bruno Mountain Manzanita	CE/CRPR 1B.1
Arctostaphylos montaraensis	Montara Manzanita	CRPR 1B.2
Arctostaphylos pacifica	Pacific Manzanita	CE/CRPR 1B.2
Arctostaphylos uva-ursi forma *coactilis*	Bearberry Manzanita	None
Arctostaphylos uva-ursi forma *leobreweri*	Bearberry Manzanita	CBR (considered for status but rejected)
Arctostaphylos uva-ursi forma *suborbiculata*	Bearberry Manzanita	CBR (considered for status but rejected)
Chorizanthe cuspidata	San Francisco Spine-Flower	CRPR 1B.2
Collinsia multicolor	San Francisco Collinsia	CRPR 1B.2

Erysimum franciscanum var. *franciscanum*	San Francisco Wallflower	CRPR 4.2
Grindelia hirsutula var. *maritima*	San Francisco Gum Plant	CRPR 3.2 (taxonomically difficult)
Helianthella castanea	Diablo helianthella	CRPR 1B.2
Iris longipetala	Coast Iris	CRPR 4.2
Lessingia germanorum	San Francisco Lessingia	FE/CE/CRPR 1B.1
Pentachaeta bellidiflora	White-Rayed Pentachaeta	FE/CE/CRPR 1B.1
Plagiobothrys chorisianus var. *chorisianus*	Choris's Popcorn Flower	CRPR 1B.2
Silene verecunda ssp. *verecunda*	San Francisco Campion	CRPR 1B.2
Tanacetum camphoratum	Dune Tansy	CBR
Triphysaria floribunda	San Francisco Owl's Clover	CRPR 1B.2

See http://www.cnps.org/cnps/rareplants/ranking.php for more information on rare plant ranks.

Our work on San Bruno Mountain relies heavily on place names. We were generously provided the following map (unpublished) from David Nelson which highlights many of the most recognized place names (Figure 1). The locations listed on this map will be referenced throughout this report.

San Bruno Mountain
Habitat Conservation Plan
Report on the 2017-2018 Planting Season

Prepared by

Ariel Cherbowsky Corkidi, Programs Director

For the

San Mateo County Parks Department

October 2018

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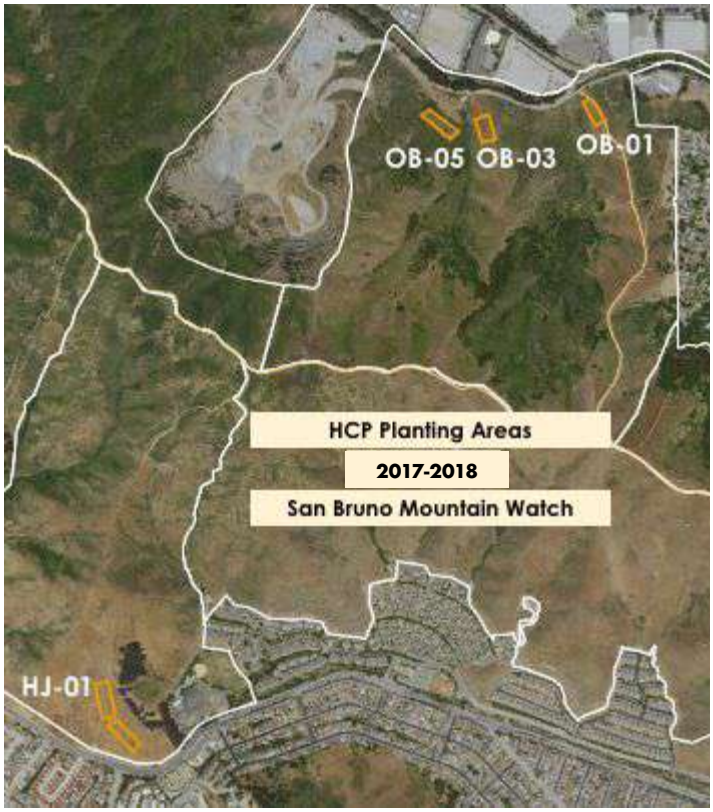
PLANTING SUMMARY



San Bruno Mountain Watch (SBMW) submitted a proposal in December 2017 to the San Mateo County Parks in response to the Request for On-Call Habitat Maintenance and Adaptive Management Services for the San Bruno Mountain Habitat Conservation Plan. The proposal, attached in the Appendix, expressed SBMW's continued interest in carrying out grassland stewardship activities for the benefit of the mountain's endangered butterflies.

San Bruno Mountain Watch then planted 1,825 native grassland plants with the assistance of community volunteers from January 2018 through March 2018, who contributed 252 volunteer planting hours to this effort. Planting was carried out at four different sites on San Bruno Mountain (OB-05, OB-03, OB-01, and HJ-01). All plants were propagated and grown at SBMW's Mission Blue Nursery from local mountain seed.

In July of 2018, San Bruno Mountain Watch monitored 1,041 of the 1,825 plantings by surveying each planting area, and determined that 33% of the plantings monitored had survived.

San Bruno Mountain Watch combined monitoring data from this and the previous two planting seasons. Data from three planting seasons shows 5,555 plantings were completed, 3,185 of the 5,555 plantings were monitored, and 34% of the 3,185 plantings monitored were found to be surviving.

The tables below detail the planting efforts at four planting areas. Data includes the species planted, planting quantities, planting dates, and the social and environmental data corresponding to the planting dates.

Site OB-05			
Species	**Common Name**	**Planting Plan**	**Planting Event 1/21/18**
AcaPi	CA Acaena	30	30
AchMi	Yarrow	30	30
EriLa	Coast Buckwheat	15	15
EryFr	Franciscan Wallflower	30	30
GriHi	Hairy Gumplant	30	30
HorCa	CA Horkelia	30	30
PhaCa	CA Phacelia	30	30
		Total	**Total Planted**
		195	**195**
		COLLECTOR	
		SBMW Staff	Ariel C.C.
		Staff Planting Hours	2
		Qty of Volunteers	8
		Volunteer Planting Hours	16
		Starting Temperature (°F)	51
		Starting Wind Speed (mph)	4-7
		Starting Precipitation	None
		Starting Cloud Cover (%)	33
		Ending Temperature (°F)	55
		Ending Wind Speed (mph)	4-7
		Ending Precipitation	None
		Ending Cloud Cover (%)	33%

Site OB-01					
Species Code	**Common Name**	**Planting Plan**	**Planting Event 1/18/18**	**Planting Event 2/28/18**	**Planting Event 3/3/18**
AcaPi	CA Acaena	60	30	30	
AchMi	Yarrow	50	25	25	
AgoGr	CA Dandelion	50	30		20
CirQu	Brownie Thistle	20	20		
DanCa	CA Oatgrass	35	25		10
ElyGl	Blue Wildrye	15	15		
EriLa	Coast Buckwheat	25	25		
EryFr	Franciscan Wallflower	60	30	30	
FesRu	Red Fescue	25	25		
GriHi	Hairy Gumplant	50	30		20
HetSeBo	Golden Aster	30	15	15	
HorCa	CA Horkelia	40	30		10
IriLo	Coast Iris	30	15	15	
KoeMa	Junegrass	35	25		10
LomDa	Lace Parsnip	10	10		
LupAl	Silver Lupine	50		50	
LupFo	Summer Lupine	10		10	
StiPu	Purple Needlegrass	15	15		
PhaCa	CA Phacelia	30	30		
RanCa	CA Buttercup	10	10		
		Total	**Total Planted**	**Total Planted**	**Total Planted**
		650	**405**	**175**	**70**
		COLLECTOR			
		SBMW Staff	Ariel C.C.	Ariel C.C.	Ariel C.C.
		Staff Planting Hours	2	3.5	2.5
		Qty of Volunteers	53	2	1
		Volunteer Planting Hours	53	4	2.5
		Starting Temperature (°F)	49	52	54
		Starting Wind Speed (mph)	8-12	4-7	4-7
		Starting Precipitation	Light Rain	None	None
		Starting Cloud Cover (%)	100	33	67
		Ending Temperature (°F)	54	55	52
		Ending Wind Speed (mph)	8-12	4-7	8-12
		Ending Precipitation	Moderate Rain	None	Moderate Rain
		Ending Cloud Cover (%)	100	33	100

Site OB-03				
Species Code	**Common Name**	**Planting Plan**	**Planting Event 1/20/18**	**Planting Event 2/15/18**
AcaPi	CA Acaena	30	30	
AchMi	Yarrow	30	25	5
AgoGr	CA Dandelion	30	30	
CirQu	Brownie Thistle	20	20	
DanCa	CA Oatgrass	25	25	
ElyGl	Blue Wildrye	25	25	
EriLa	Coast Buckwheat	20	20	
EryFr	Franciscan Wallflower	30	30	
FesRu	Red Fescue	25	25	
GriHi	Hairy Gumplant	30	30	
HetSeBo	Golden Aster	20	20	
HorCa	CA Horkelia	30	30	
LomDa	Lace Parsnip	15	15	
LupAl	Silver Lupine	50	15	35
LupFo	Summer Lupine	15	15	
StiPu	Purple Needlegrass	25	25	
PhaCa	CA Phacelia	40	30	10
RanCa	CA Buttercup	10	10	
		Total	**Total Planted**	**Total Planted**
		470	**410**	**50**
		COLLECTOR		
		SBMW Staff	Ariel C.C.	Ariel C.C.
		Staff Planting Hours	2	1.75
		Qty of Volunteers	21	0
		Volunteer Planting Hours	42	0
		Starting Temperature (°F)	53	62
		Starting Wind Speed (mph)	4-7	1-3
		Starting Precipitation	None	None
		Starting Cloud Cover (%)	0	33
		Ending Temperature (°F)	55	63
		Ending Wind Speed (mph)	4-7	4-7
		Ending Precipitation	None	None
		Ending Cloud Cover (%)	0	33

Site HJ-01				
Species Code	**Common Name**	**Planting Plan**	**Planting Event 1/28/18**	**Planting Event 2/10/18**
AcaPi	CA Acaena	30	15	15
AchMi	Yarrow	25	15	10
AgoGr	CA Dandelion	35	15	20
CirQu	Brownie Thistle	20	10	10
DanCa	CA Oatgrass	25	15	10
ElyGl	Blue Wildrye	25	15	10
EriLa	Coast Buckwheat	25	15	10
EryFr	Franciscan Wallflower	30	15	15
FesRu	Red Fescue	25	15	10
GriHi	Hairy Gumplant	30	15	15
HetSeBo	Golden Aster	20		20
HorCa	CA Horkelia	30	15	15
IriLo	Coast Iris	15	7	8
KoeMa	Junegrass	25	15	10
LomDa	Lace Parsnip	10		10
LupAl	Silver Lupine	50	7	43
LupVa	Varied Lupine	15		15
StiPu	Purple Needlegrass	25	15	10
PhaCa	CA Phacelia	40	15	25
RanCa	CA Buttercup	10	5	5
		Total	**Total Planted**	**Total Planted**
		510	**224**	**286**
		COLLECTOR		
		SBMW Staff	Ariel C.C.	Ariel C.C.
		Staff Planting Hours	2	2
		Qty of Volunteers	7	14
		Volunteer Planting Hours	106	28
		Starting Temperature (°F)	57	63
		Starting Wind Speed (mph)	4-7	4-7
		Starting Precipitation	None	None
		Starting Cloud Cover (%)	33	33
		Ending Temperature (°F)	63	65
		Ending Wind Speed (mph)	4-7	8-12
		Ending Precipitation	None	None
		Ending Cloud Cover (%)	0	33

PLANTING RESULTS

In July 2018, San Bruno Mountain Watch monitored all of the planting areas within each of the four sites. 1,041 of 1,825 plantings were monitored. 33% of the 1,041 monitored plantings were found to be alive.

In previous planting seasons, monitoring had been performed by either marking 20% of plantings and monitoring those for survivorship or surveying the whole population of plantings. In this planting season, two of the sites were monitored fully (OB-05 and OB-01) and two of the sites were monitored through the 20% method (OB-03 and HJ-01).

Monitoring results were consistent with prior observations; monitoring 20% of plantings produces data showing higher survival rates. However, when monitoring results were combined across the four sites, the overall survival rate of 33% was similar to the combined survival rate of this planting season combined with the prior two seasons. A table showing this combined data of monitoring results from the three seasons (2015-2016, 2016-2017, and 2017-2018) is presented on the page following the monitoring results from the 2017-2018 season.

In the 2017-2018 season, ten species were found to have survival rates higher than 30%. These species were *Grindelia hirsutula, Lupinus albifrons, Heterotheca sessiliflora spp. bolanderi, Eriogonum latifolium, Horkelia californica, Festuca rubra, Achillea millefolium, Acaena pinnatifida, Phacelia californica, and Stipa pulchra.*

Eleven species of plants showed a survival rate higher than 30% in the combined data from the three planting seasons, including all of the ten species noted above with the addition of *Sisyrinchium bellum*.

Survival Rate Across All Planting Sites for the 2017-2018 Planting Season (OB-05, OB-03, OB-01, HJ-01)					
Species Code	**Common Name**	**Plantings**	**# Monitored**	**# Surviving**	**Survival Rate**
GriHi	Hairy Gumplant	140	92	57	62%
LupAl	Silver Lupine	150	70	40	57%
HetSeBo	Golden Aster	70	38	21	55%
EriLa	Coast Buckwheat	85	49	23	47%
HorCa	CA Horkelia	130	82	35	43%
FesRu	Red Fescue	75	35	13	37%
AchMi	Yarrow	135	91	32	35%
AcaPi	CA Acaena	150	102	35	34%
PhaCa	CA Phacelia	140	76	26	34%
StiPu	Purple Needlegrass	65	25	8	32%
CirQu	Brownie Thistle	60	28	7	25%
KoeMa	Junegrass	60	40	7	18%
ElyGl	Blue Wildrye	65	25	4	16%
DanCa	CA Oatgrass	85	45	7	16%
AgoGr	CA Dandelion	115	63	9	14%
IriLo	Coast Iris	45	33	4	12%
EryFr	Franciscan Wallflower	150	102	10	10%
RanCa	CA Buttercup	30	14	1	7%
LomDa	Lace Parsnip	35	15	1	7%
LupFo	Summer Lupine	25	13	0	0%
LupVa	Varied Lupine	15	3	0	0%
		Total Planted	Total Monitored	Total Surviving	Overall Survival Rate
		1825	1041	340	33%

Survival Rate of Three Planting Seasons 2015-16, 2016-17, & 2017-18					
Species Code	**Common Name**	**Plantings**	**# Monitored**	**# Surviving**	**Survival Rate**
GriHi	Hairy Gumplant	350	234	136	58%
EriLa	Coast Buckwheat	291	168	89	53%
HetSeBo	Golden Aster	257	154	78	51%
LupAl	Silver Lupine	388	237	116	49%
HorCa	CA Horkelia	304	207	93	45%
AcaPi	CA Acaena	439	312	130	42%
SisBe	Blue-Eyed Grass	92	48	19	40%
FesRu	Red Fescue	255	112	41	37%
PhaCa	CA Phacelia	363	206	73	35%
StiPu	Purple Needlegrass	285	101	33	33%
AchMi	Yarrow	219	175	55	31%
MonVi	Coyote Mint	119	47	14	30%
ElyGl	Blue Wildrye	285	98	26	27%
EryFr	Franciscan Wallflower	304	206	48	23%
CirQu	Brownie Thistle	154	92	21	23%
DanCa	CA Oatgrass	225	114	24	21%
KoeMa	Junegrass	200	107	20	19%
AgoGr	CA Dandelion	238	134	23	17%
LupVa	Varied Lupine	70	47	8	17%
SidMa	Checkerbloom	110	80	11	14%
RanCa	CA Buttercup	65	16	2	13%
IriLo	Coast Iris	45	33	4	12%
MelCa	CA Melic	85	51	5	10%
LupFo	Summer Lupine	223	125	10	8%
LomDa	Lace Parsnip	100	23	1	4%
WyeAng	Narrowleaf Mule's Ears	89	58	2	3%
		Total Planted	Total Monitored	Total Surviving	Overall Survival Rate
		5555	3185	1082	34%

Site OB-05					
Species	**Common Name**	**Planting Plan**	**# Monitored (All)**	**# Surviving 7/9/18**	**Survival Rate**
GriHi	Hairy Gumplant	30	30	23	77%
AcaPi	CA Acaena	30	30	17	57%
EriLa	Coast Buckwheat	15	15	7	47%
HorCa	CA Horkelia	30	30	14	47%
AchMi	Yarrow	30	30	13	43%
PhaCa	CA Phacelia	30	30	9	30%
EryFr	Franciscan Wallflower	30	30	2	7%
		Total Planted	**Total Monitored**	**Total Surviving**	**Total Survival Rate**
		195	**195**	**85**	**44%**

Site OB-01					
Species Code	**Common Name**	**Planting Plan**	**# Monitored (All)**	**# Surviving 7/13/18**	**Survival Rate**
HetSeBo	Golden Aster	30	30	16	53%
LupAl	Silver Lupine	50	50	23	46%
GriHi	Hairy Gumplant	50	50	22	44%
FesRu	Red Fescue	25	25	8	32%
EriLa	Coast Buckwheat	25	25	7	28%
NasPu	Purple Needlegrass	15	15	4	27%
HorCa	CA Horkelia	40	40	9	23%
AchMi	Yarrow	50	50	10	20%
CirQu	Brownie Thistle	20	20	4	20%
PhaCa	CA Phacelia	30	30	5	17%
ElyGl	Blue wildrye	15	15	2	13%
AcaPi	CA Acaena	60	60	7	12%
KoeMa	Junegrass	35	35	4	11%
IriLo	Coast Iris	30	30	3	10%
DanCa	CA oatgrass	35	35	3	9%
AgoGr	CA Dandelion	50	50	3	6%
EryFr	Franciscan Wallflower	60	60	2	3%
LomDa	Lace Parsnip	10	10	0	0%
LupFo	Summer Lupine	10	10	0	0%
RanCa	CA Buttercup	10	10	0	0%
		Total	**Total Monitored**	**Total Surviving**	**Total Survival Rate**
		650	**650**	**132**	**20%**

Site OB-03					
Species Code	**Common Name**	**Planting Plan**	**# Monitored (20%)**	**# Surviving 7/9/18**	**Survival Rate**
AchMi	Yarrow	30	6	6	100%
EriLa	Coast Buckwheat	20	4	4	100%
GriHi	Hairy Gumplant	30	6	6	100%
HorCa	CA Horkelia	30	6	6	100%
LupAl	Silver Lupine	50	10	9	90%
AcaPi	CA Acaena	30	6	5	83%
PhaCa	CA Phacelia	40	8	6	75%
EryFr	Franciscan Wallflower	30	6	4	67%
AgoGr	CA Dandelion	30	6	3	50%
HetSeBo	Golden Aster	20	4	2	50%
FesRu	Red Fescue	25	5	2	40%
CirQu	Brownie Thistle	20	4	1	25%
DanCa	CA oatgrass	25	5	1	20%
ElyGl	Blue wildrye	25	5	1	20%
NasPu	Purple Needlegrass	25	5	1	20%
LomDa	Lace Parsnip	15	3	0	0%
LupFo	Summer Lupine	15	3	0	0%
RanCa	CA Buttercup	10	2	0	0%
		Total	**Total Monitored**	**Total Surviving**	**Total Survival Rate**
		470	**94**	**57**	**61%**

Site HJ-01					
Species Code	**Common Name**	**Planting Plan**	**# Monitored (20%)**	**# Surviving 7/13/18**	**Survival Rate**
AcaPi	CA Acaena	30	6	6	100%
EriLa	Coast Buckwheat	25	5	5	100%
GriHi	Hairy Gumplant	30	6	6	100%
HorCa	CA Horkelia	30	6	6	100%
LupAl	Silver Lupine	50	10	8	80%
HetSeBo	Golden Aster	20	4	3	75%
PhaCa	CA Phacelia	40	8	6	75%
AchMi	Yarrow	25	5	3	60%
DanCa	CA oatgrass	25	5	3	60%
FesRu	Red Fescue	25	5	3	60%
KoeMa	Junegrass	25	5	3	60%
StiPu	Purple Needlegrass	25	5	3	60%
CirQu	Brownie Thistle	20	4	2	50%
LomDa	Lace Parsnip	10	2	1	50%
RanCa	CA Buttercup	10	2	1	50%
AgoGr	CA Dandelion	35	7	3	43%
EryFr	Franciscan Wallflower	30	6	2	33%
IriLo	Coast Iris	15	3	1	33%
ElyGl	Blue wildrye	25	5	1	20%
LupVa	Varied Lupine	15	3	0	0%
		Total	**Total Monitored**	**Total Surviving**	**Total Survival Rate**
		510	**102**	**66**	**65%**

CONCLUSIONS

- Data from three planting seasons suggests that overall, at least a third of grassland plantings can be expected to survive.

- Eleven species showed survival rates higher than 30% over three planting seasons, and are listed here in order of highest to lowest survivorship: *Grindelia hirsutula, Eriogonum latifolium, Heterotheca sessiliflora spp. bolanderi, Lupinus albifrons, Horkelia californica, Acaena pinnatifida, Sisyrinchium bellum, Festuca rubra, Phacelia californica, Stipa pulchra,* and *Achillea millefolium.*

- The eleven species noted above showed a combined survival rate of 44% during the three planting seasons (3,243 planted, 1,954 monitored, and 863 survived).

- If the main intention of these planting efforts is to benefit the mission blue and callippe silverspot butterflies, focusing the planting palette on the species that have shown highest survivorship would seem to be the most successful strategy. Planting with a more encompassing and diverse palette of native grassland species (even those showing lower survivorship) guides restoration efforts towards the idea of restoring to an "intact," "pristine," or "relic" native grassland ecosystem; however, current planting efforts are carried out on relatively tiny patches compared to the acreage of grasslands present on the mountain, and furthermore, the grasslands on San Bruno Mountain are now largely novel ecosystems that can't widely and easily be returned to historic conditions. If restoration seeking to encompass all members of the grassland plant community can't be carried out on a large-scale due to a variety of constraints, perhaps small-scale planting efforts should not strive towards this ideal; rather, a focus on a more selective planting palette composed of the hardiest plants providing the greatest benefit for the listed butterflies may be the best use of the available funds (though some well-performing grassland plants that aren't host or nectar plants could still be included in the mix and provide complimentary benefits). The mountain's listed butterflies are already engaging with novel conditions on the mountain (for example, having been observed to nectar or host on introduced "weeds"). While working towards more wholesome restoration of the vegetative cover of historic native grasslands on parts of San Bruno Mountain would be valuable and meaningful for other reasons and could hopefully be pursued through other projects, this may not be the best model in the context of planting efforts like those described in this report. It would be interesting for the San Bruno Mountain Technical Advisory Committee to have a discussion related to the thoughts above.

- Further study is needed to more accurately evaluate the survivorship of certain species that are known to be dormant during the summer when monitoring takes place; their survival rates may be higher than shown in the data collected.

PHOTOMONITORING: PLANTING

The following pages contain monitoring photos depicting planting efforts and their respective dates. Photos show examples of the preparation, planting, maintenance, and growth of some planting areas within the sites HJ-01, OB-03, OB-01, and OB-05.

HJ-01

1/27/18

1/28/18

7/13/18

5/6/18

1/27/18

2/9/18

2/10/18

2/9/18

7/13/18

OB-03

1/19/18

1/19/18

1/19/18

1/20/18

1/20/18

2/15/18

7/9/18

OB-01

1/17/18

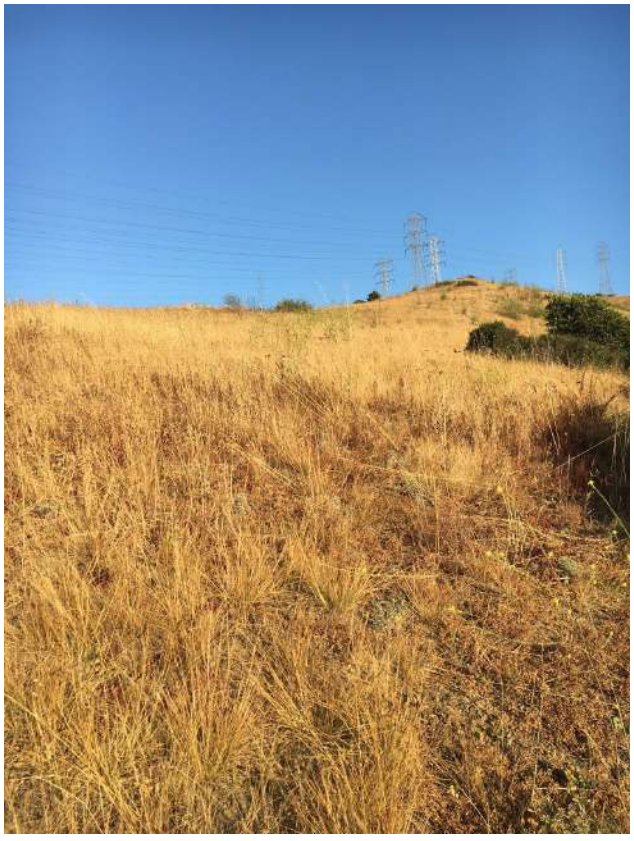
1/18/18

1/17/18

7/13/18

1/18/18

1/18/18



7/13/18

OB-05

1/21/18

7/9/18

1/21/18

1/21/18

December 14, 2017

San Mateo County Parks Department
Ramona Arechiga, Natural Resource Manager
455 County Center, 4th Floor
Redwood City, CA 94063-1646

Dear Natural Resource Manager Ramona Arechiga,

I'm writing on behalf of San Bruno Mountain Watch to express great excitement at the prospect of contributing once again to the important work carried out by the San Bruno Mountain Habitat Conservation Plan under the direction of the San Mateo County Parks.

San Bruno Mountain Watch is interested in implementing restoration projects under the Ecological Services Tasks noted in the Request for Proposal. In particular, we wish to carry out the propagation, planting, and seeding of native species including host and nectar plants for the mountain's endangered butterflies in designated conservation areas, to follow up planting activities in these areas with weeding efforts targeting non-native and invasive plants, and to assess the success of these efforts through photo-documentation and vegetation monitoring.

We have various years of experience carrying out such efforts as a partner to the San Mateo County Parks and would be grateful for the opportunity to build upon our experience and continue to provide positive and improved restoration outcomes.

Due to our strength as a grassroots organization with close connections to local communities, we would successfully implement restoration projects by engaging local people in project efforts. We believe that facilitating public participation in the stewardship work of the San Bruno Mountain Habitat Conservation Plan builds community awareness, support, and appreciation for the many activities undertaken to prevent the extinction of endangered species and the loss of their habitats.

Thank you for the opportunity to submit a proposal. In the following page , please find additional information for your consideration and review regarding our qualifications for implementing restoration projects, the costs of our involvement, and references who can attest to our qualifications.

Sincerely,

Ariel Cherbowsky Corkidi
Programs Director
ariel@mountainwatch.org

COST FOR LABOR CLASSIFICATIONS

1. Ecological Restoration Practitioner- $2.10 per plant planted on San Bruno Mountain
2. Nursery Technician- $3.68 per plant propagated at Mission Blue Nursery
3. Monitoring Technician- $45 per hour of monitoring
4. Report Writer- $30 per hour of project reporting

EQUIPMENT FOR PLANTING & WEEDING

1. Trowels
2. Weed wrenches
3. Loppers
4. Pruning saws
5. Hand picks
6. Hand sickles
7. Weed bags
8. Tablet with ESRI Collector application
9. Native grassland plants, including host and nectar species; species list available upon request

QUALIFICATIONS OF SAN BRUNO MOUNTAIN WATCH

- Multiple years of experience implementing restoration plantings and weeding efforts as part of the San Bruno Mountain Habitat Conservation plan, as well as experimental native seeding projects
- Multiple years of experience training, overseeing, educating, and inspiring community volunteers in the implementation of restoration projects
- Prior use of ESRI Collector application according to reporting guidelines set by San Mateo County Parks
- Operation of Mission Blue Nursery specializing in the propagation of plants native to San Bruno Mountain; implementation of nursery best management practices to prevent and test for phytophthora
- Brisbane-based organization in close proximity to San Bruno Mountain, allowing for efficient and intimate access to restoration sites with minimal transportation time and greenhouse gas emissions
- Familiarity with optimal and appropriate trails, parking, and staging areas for preparation and implementation of restoration events and activities
- Familiarity with procedures for mitigating potential environmental damage while implementing restoration activities off-trail, including sanitation of equipment and shoes, avoidance of trampling host plants and sensitive areas, avoidance of movements that cause erosion, and more

REFERENCES

City of Brisbane
Public Works Department
Randy Breault, Public Works Director & City Engineer
rbreault@ci.brisbane.ca.us / (415) 508-2130

City of South San Francisco
Parks and Recreation Department
Sharon Ranals, Director
sharon.ranals@ssf.net / (650) 829-3807

City of Daly City
Public Works Department
John L. Fuller, Director
jfuller@dalycity.org / (650) 991-8038

OBJECTID	BUTTERFLY	TRANSECT	DATE	OBSERVER	START_TIME	END_TIME	START_TEMP	END_TEMP	START_WIND	END_WIND	OTHER_BFLY	NOTES_MERGED
2	MB	10	4/4/2017	RA	10:31	1128	65	64.4	Max 3.2; avg 1.0	Avg 1.1; max 3.8	6 ringlets; 1 cab wht; 1 wht checkerspot?	4/4/17Top portion of transect completely scrubbed over. P.O. And no habitat values left.
4	MB	10	4/4/2017	RA	12:20	1234	60.1	71	Avg 1.3; max 4.9	Avg 1.1; max2.8	4 cab whites; 2 checkerspots; 2 ringlets	Top portion of transect completely scrubbed over. P.O. And no habitat values left.4/4/2017
6	MB	6	4/4/2017	RA	1302	1436; time 44 min	74.2	63.1	Avg 0.9; max 3.7	Avg 2.4; max9.8	1 green hair streak; 3 ringlets	4/4/20174/5/2017
8	MB	9	4/5/2017	RA	1027	1124	67.3	78.3	Avg 1.1; max 3.3	Avg 0; max 1.0	5 annis; 3 ringlets	4/5/20174/5/2017
10	MB	7	4/5/2017	RA	11:58	1220	71.5	75.6	Avg 0.7; max3.3	Avg 0.8; max 2.0	3 green hairstreaks; 5 ringlets	4/5/20174/5/2017; Great habitat must treat this year!
12	MB	8	4/5/2017	RA	1347		74.3		Avg 0.7; max 1.4			4/5/2017; Completely closed in by broom! CDC crew project this year! Follow drainage ditchImpassable after 10 minutes of walking
14	MB	8	4/5/2017	RA	1420	1430	78.5	69.5	Avg 0.7; max 2.8	Avg 2.4; max 4.3		4/5/2017; Great habitat must treat this year!4-4-17
17	MB	11	4/4/2017	ML	10:37	11:46	64.5	66.9	1.6 avg 7.7 max	1.1 avg 2.0 max	1 echo blue, 1 pipe vine swallow tail, 4 anise swallow tail, 3 ringlets, 2 cabbage white, 1 unknown	4-4-17
19	MB	10	4/4/2017	ML	13:00	14:07	69.5	67.2	4.4 max 1.3 avg	6.2 max, 2.2 avg	16 checkerspots (c/f bay checkerspot), 6 ringlets, 2 anise, 1 mourning cloak, 1 Sara orange tip,	4-5-17
21	MB	1	4/5/2017	ML	10:22	11:00	70.3	69.8	3.9 max 0.8 avg	2.7 max 1.2 avg	Green hairstreak, 3 echo blues, 2 ladies, 2 elfin	4-5-174-5-17

23	MB	13	4/5/2017	ML	12:41	13:44	73.5	72.5	4.7 Max 1.4 avg	1.6 avg 2.7 max	Various checkerspots, ringlets, anise, cabbage whites, mylitta crescent,	4-5-17Cool and rainy this morning
25	MB	1	4/5/2017	ML	15:34		60.4		4.2 Max 1.4 avg			4-5-17
26	MB	2	4/6/2017	ML	10:01	10:25	55.2	55	3.1 max 1.0 avg	5.1 Max 0.6 avg		Cool and rainy this morning4.6.17 rainy and cool
28	MB	3	4/6/2017	ML	11:13	11:19	55.7	57.3	5.1 max 0.6 avg	5.1 max 0.6 avg		4.6.17 rainy and cool4-6-17
30	MB	5	4/6/2017	ML	12:28	1:30	58.7	58.7	4.3 max 2.4 avg	7.6 max 1.2 avg		4-6-1720170411 JN
32	MB	12	4/11/2017	JN	1010	1115	62.2	60.5	Max 1.7 , avg 0.6	Max 7.7, avg 2.0		20170411 JN20170411 JN start T11
34	MB	11	4/11/2017	JN	1140	1238	66.1	63.6	8.0 max 1.0 avg	Max 5.9, avg 2.2		20170411 JN start T1120170411 JN start T10
37	MB	10	4/11/2017	JN	1340	1452	64.6	68.4	Max 3.9 avg 0.9	Max 2.6 avg 0.7		20170411 JN start T10Less than ideal weather conditions.
39	MB	13	4/11/2017	ML	10:29	11:22	60.1	61	3.2 max 1.7avg	6.5 max 2.1 avg	1 mylitta, 1 variable check spot, 1 bay checkerspot (also recorded as other sps in butterfly data)	Less than ideal weather conditions.4-11-17 less than ideal weather
41	MB	7	4/11/2017	ML	13:37	2:01	64.7	63.8	15.2 max 3.7 avg	1.2 avg 15.3 max		4-11-17 less than ideal weather4-11-17
43	MB	9	4/11/2017	ML	14:13	2:58	64.8	63.8	1.6 avg 15.2 max	2.3 avg 22.4 max	4 ringlets, 2 ladies, 2 cabbage whites	4-11-1720170412 JN start T5
45	MB	5	4/12/2017	JN	1045	1150	55.9	67.2	Max 9.8 avg 6.3	Max 1.5 avg 1.1	2 ringlets near pine tree	20170412 JN start T520170412 JN start t6
47	MB	4	4/12/2017	JN	1215	1240	67.7	63.6	Max 7.1 avg 0.9	Max7.1 avg 0.8	3 ringlets	20170412 JN start t620170412 JN
49	MB	4	4/12/2017	JN	1245	1300	65.4	64.4	Max 7.1 avg 0.7	Max 7.1 avg 0.7	3 ringlets, 1 checkerspot, 1 cabbage white	20170412 JN20170412 JN start
52	MB	2	4/12/2017	JN	1423	1435	61.1	61.5	Avg 2.4 Max 6.5	Avg 0.9 Max 7.4		20170412 JN start20170412 JN

54	MB	3	4/12/2017	JN	1452	1458	66.1	66.4	Avg 1.1 Max 10.3	Avg 1.2 Max 10.3		20170412 JN4-12-17 cool and windy
56	MB	1	4/12/2017	ML	10:41	11:05	52.2	54.1	3.0 avg 15.9 max	2.6 avg 15.9 max	None	4-12-17 cool and windyRedo of 8. The other end of the transect is lost and impassable in parts.
58	MB	8	4/11/2017	ML	12:30		68.4		1.4 avg 4.1 max			4-11-17 improving weather conditions, very dense broom at the end of this transect.
59	MB	8	4/11/2017	ML	12:59	1:14	72.5	68.9	0.8 Avg 4.3 max	0.8 avg 4.3 max	None	Redo of 8. The other end of the transect is lost and impassable in parts.20170419 JN start T5
61	MB	5	4/19/2017	JN	945	1037	64.3	64.1	Avg 1.5 Max 3.1	Avg 0.6 Max 3.4	3 ringlets, 2 orange moths?	20170419 JN start T520170419 JN start T8
63	MB	8	4/19/2017	JN	1230	1250	69.4	67.1	Avg 0.7 Max 3.1	Max 3.1 avg 0.6		20170419 JN start T820170419 JN start T1
65	MB	1	4/19/2017	JN	1335	1402	64.3	71.7	Max 5.3, avg 1.8	Max 5.4 avg 0.8		20170419 JN start T14-20-17
67	MB	13	4/20/2017	ML	10:53	12:09	65	64.3	8.2 Max 2.2 avg	1.5avg 8.0 max	32 variable check spots in scrub, 3 ladies, 2 cabbage, 2 anise, 3 bay checkspots, 2 unknown cf ski	4-20-174-20-17
69	MB	2	4/20/2017	ML	14:25	14:43	64.1	63	3.2max 1.1 avg	3.2 Max 0.7 avg	1 variable checkerspot	4-20-174-20-17
71	MB	3	4/20/2017	ML	2:57	15:01	64.7	64	11.8 Max 0.9 avg	11.8 Max 1.0 avg	1 cabbage white	4-20-1720170420 JN start T7
73	MB	7	4/20/2017	JN	1035	1120	66.8	67.2	Max 1.6 avg 0.6	Max 2.4 avg 0.6	16 ringlets, 2 cabbage whites, 2 checkerspots(?)	20170420 JN start T720170420 JN start T9
75	MB	9	4/20/2017	JN	1145	1250	66.4	69.6	Max 2.4 avg 0.6	Max 0.8 avg 0.7	6 ringlets, 2 cabbage whites	20170420 JN start T94-25-17
77	MB	13	4/25/2017	ML	10:10	11:00	59.9	62.2	2.7 avg 15.8 max	1.0 avg 15.8 max	37 Chalcedon checkerspots, 1 Anise swallowtail, 1 cabbage white,	4-25-174-25-17 repeat of transect- none seen on the first run.

79	MB	13	4/25/2017	ML	11:09	12:02	64	64	1.1 avg 15.8 max	14.2 Max 3.8 avg	43 checkerspots, 3 ringlets, 1 anise swallowtail	4-25-17 repeat of transect- none seen on the first run.4-25-17
81	MB	10	4/25/2017	ML	12:48	1:29	65.5	59.6	1.1 avg 14.2 max	5.1 Avg 10.2 max	1 echo blue, 3 Chalcedon checkerspots, 10 ringlets	4-25-174-25-17
83	MB	3	4/25/2017	ML	14:02	14:08	59.8	63.5	10.2 Max 1.0 avg	1.0 avg 10.2 max	None	4-25-174-25-17
85	MB	2	4/25/2017	ML	14:29	14:48	63.8	62	10.2 Max 0.9 avg	10.2 Max 0.8 avg	3 ringlets, 1 checkspot	4-25-17
87	MB	11	4/20/2017	RA	10:45	12:09; 56 minutes total	64.5	66.5	Avg 1.1; max 2.7	Avg 1.7; max 2.8	6 chal ckrspt; 1 acmon; 3 field crescent; 2 painted ladies; 4 pipeline; 3 annis	
89	MB	12	4/20/2017	RA	13:01	13:55; 44 minutes total	66.4	68.8	Avg 1.2; max 2.2	Avg 0.7; max 10.4	5 variables; 1 myletta; 1 annis	
91	MB	7	4/19/2017	CRE	9:45am		70		1mph			
92	MB	9	4/19/2017	CRE	11:04am	12:24pm	74	85	0mph	1mph		
94	MB	6	4/19/2017	CRE	1:34pm	3:12pm	77	73	2.5mph	1mph		20170425 JN start T12
96	MB	12	4/25/2017	JN	1009	1115	57.3	62.7	Max 5.7 avg 2.9	Max 4.4 avg 2.2	3 checkerspot, 2 anise	20170425 JN start T1220170425 JN start T11
98	MB	11	4/25/2017	JN	1209	1306	57.6	69.8	Max 7.9 avg 0.7	Max 7.9 avg 2.6	2 cabbage whites, 7 checkerspots, 3 large black and blue butterflies?, 3 anise	20170425 JN start T1120170425 JN start T1
100	MB	1	4/25/2017	JN	1442	1506	60.6	59.6	Max 13.2 avg 1.0	Max 13.2, avg 1.0	2 checkerspots	20170425 JN start T120170426 JN start T5
102	MB	5	4/27/2017	JN	909	954	62.5	67.1	Max 2.8 avg 1.1	Max 2.4 avg 0.9	1 ringler	20170426 JN start T520170426 JN start T6
104	MB	6	4/27/2017	JN	1012	1118	63.8	69.4	Max 4.8 avg 0.8	Max 4.5 avg 2.5	14 ringlers, 4 cabbage whites	20170426 JN start T6

106	MB	4	4/27/2017	JN	1135	1153	62.7	61.2	Max 2.2, avg 1.2	Max 9.2 avg 1.0	1 ringlets, 13 checkerspots	
108	MB	11	5/2/2017	CRE	4:26pm	5:46pm	74	67	6mph	2mph		2017.05.02; clear calm warm; GGNRA staff to collect on this transect today
110	MB	13	5/2/2017	RA	10:06	11:26; 59 min total	81.9	86.5	Avg 0; max 0	Avg 0.9; max 2.5	Cab wht 1; ca ring 5; var check 35+++; cS 1?; pale swallow 2; mourning dusky 3; big bulk swallow 1	2017.05.02; clear calm warm; GGNRA staff to collect on this transect today2017.05.02;
112	MB	2	4/28/2017	RA	13:50	14:06: 13 min total	71	72.5	Avg 1.6; max 3.1	Avg 0.7; max 3.1	10 variable checkerspots	2017.05.02;20170428 JN start T4
114	MB	4	4/28/2017	JN	948	959	60.1	62.2	Max 5.1 avg 1.6	Max 5.0 avg 2.4	13 checkerspots, 3 ringlets	20170428 JN start T420170428 JN start T7
116	MB	7	4/28/2017	JN	1029	1103	62.7	73.8	Max 4.6 avg 1.8	Max 4.0 avg 2.2	6 checkerspots, 6 ringlets	20170428 JN start T720170428 JN start T10
118	MB	10	4/28/2017	JN	1152	1241	76.9	70.3	Max 4.0 avg 0.7	Max 3.5 avg 1.7	8 ringlets, 5 checkerspots, 1 anise	20170428 JN start T1020170428 JN start T1
120	MB	1	5/2/2017	JN	1352	1412	64.3	69.2	Max 5.0 avg 1.6	Max 3.8 avg 1.6	2 checkerspots, 2 emerald hairstreaks	20170428 JN start T15-1-17 snr
122	MB	12	5/2/2017	SR	12:40	1:33	85.9	78.2	Max 6.7 average 1.9	Max 12.4 average 6.6	Lady's, anise, mournful dusky, ringlets, pipeline, variable	5-1-17 snr5-2-17 snr
124	MB	1	5/3/2017	SR	2:30	3:03	76.7	70.7	Max 5.4 average 1.9	Max 6.4 average 0.9	Crescent, lady, ringlet	5-2-17 snr5-3-17
126	MB	4	5/3/2017	ML	10:54	11:07	82.6	81.7	1.3 max 0.6 avg	1.3 max 0.2 avg	Mylitta crescent, Chalcedon checkerspot, American painted lady, anise swallowtail, ringlets,	5-3-175-3-17
128	MB	4	5/3/2017	ML	11:22	11:36	81.3	84.9	1.3 max 0.0 avg	2.0 max 0.0 avg	Mylitta Crescent, variable checkerspot,	5-3-175-3-17

											American paints ladies, ringlets	
130	MB	7	4/27/2017	ML	12:05	12:37	84.3	88.3	4.9 max 0.6 avg	0.6 avg, 4.9 max	Ringlets,checkerspots, crescents, anise, mournful duskywings,	5-3-174-27-17
132	MB	7	4/29/2017	ML	10:20	10:57	62.1	66.8	1.8 avg 10.7 max	1.9 avg 3.4 max	26 Ringlets, 9 Chalcedon checkerspots, 5 anise swallowtails	4-27-174-29-17
134	MB	9	4/29/2017	ML	11:16	11:56	64.6	64.5	4.2 Max 1.4avg	2.2 avg 5.2 max	15 Ringlets, 1 Chalcedon checkerspot, 1 anise swallowtail	4-29-174-29-17
136	MB	8	4/28/2017	ML	12:46	13:01	64.2	65.5	7.3 Max 0.7 avg	0.7 avg 7.3 max	1 cabbage white	4-29-174-28-17
138	MB	11	4/29/2017	ML	9:55	11:14	63.7	65.1	5.4. Max 1.8 avg	5.3 Max 2.6 avg	3 Anise, 19 Chalcedon, 1 lady, 10 Ringlets,	4-28-174-29-17 awesome weather for MB
140	MB	12	4/29/2017	ML	11:58	12:58	65.5	64.3	6.4 Max 0.8 avg	8.9 Max, 3.3 avg	Anise, pale swallowtail, unknown black with white at lower bottom, Chalcedon, ringlets, ladies,	4-29-17 awesome weather for MB4-29-17
142	MB	6	5/2/2017	ML	13:50	2:30	64.3	67.3	11.0 Max 0.9 avg	4.0 Max, 1.8 avg	Pale, Anise, Chalcedon, ringlet	4-29-1720170502 JN start T7
144	MB	7	5/2/2017	JN	946	1021	81.5	81.5	Max 2.3, avg 0.7	Max 1.9 avg 0.7	26 ringlets, 1 checkerspot, 1 anise	20170502 JN start T720170502 JN start T9
146	MB	9	5/2/2017	JN	1025	1118	80.7	86.6	Max 1.9 avg 0.6	Max 0.7 avg 0.5	27 ringlets, 1 anise	20170502 JN start T920170502 JN start T10
148	MB	10	5/2/2017	JN	1226	1322	92.3	88.3	Max 2.0 avg 1.4	Max 3.0 avg 1.1	17 ringlets, 2 checkerspots	20170502 JN start T1020170502 JN start T8
150	MB	8	5/9/2017	JN	1420	1441	89	83.1	Max 4.6 avg 0.6	Max 4.7 avg 0.6	4 ringlets	20170502 JN start T82017.05.09;
152	MB	9	5/9/2017	RA	10:37	11:16; 38 min total	77.5	70.5	Avg 0.6; max 1.6	Avg 1.8; max 4.1	12 cabbage whites; 3 annis swallowtail	2017.05.09;2017.05.09
154	MB	7	5/9/2017	RA	11:48	12:17; 25 min total	82.5	75.6	Avg 0.6; max 4.1	Avg 1.9; max 3.3	12 CA ringlet; 13 variable	2017.05.092017.05.09

											checkerspot; 1 pale orange lady	
156	MB	13	5/9/2017	RA	13:24	14:20; 54 minutes	74.8	76.5	Avg 1.6; max 4.7	Avg 1.4; max16.5	62 variable; 1 miotis; 2 pale swallowtails; 1 ca ring	2017.05.0920170509 JN start T12
158	MB	12	5/9/2017	JN	1022	1128	72.8	82.5	Max 2.6 avg 0.8	Max 1.7 avg 0.7	4 checkerspots, 1 anise, 1 cabbage, 1 ringlet	20170509 JN start T1220170509 JN start T11
160	MB	11	5/9/2017	JN	1203	1300	82.6	82.6	Max 4.7 avg 0.6	Max 4.5 avg 0.9	4 checkerspots, 2 cabbage whites, 2 anise, 2 ringlets	20170509 JN start T1120170509 JN start T10
162	MB	10	5/9/2017	JN	1352	1456	72.7	75.4	Max 9.7 avg 2.8	Max 9.9 avg 3.8	7 ringlets, 4 cabbage whites	20170509 JN start T102017.04.28
164	MB	6	5/11/2017	CRE	12:15	13:23	64	66	Max 5 Avg 2.5	Max 5 Avg 2.5		
165	MB	10	5/12/2017	CRE	9:45	11:15	59	63	Max 1 Avg 0.5	Max 5 Avg 4		
166	MB	4	4/19/2017	CRE	13:30	13:50	65	67	Max 3 Avg 1.5	Max 3 Avg 1.5		4-19-2017
167	MB	13	4/28/2017	RA	10:27	11:22; 51 minutes total	66.4	68.9	Avg 0.8; max 3.4	Avg 1.2; max 3.0	55 variable checkerspots; 3 myletta cresents; 1 annis; 1 lady	2017.04.282017.04.28
169	MB	2	4/28/2017	RA	13:45	14:02: 13 minutes	73.1	68.5	Avg 1.0; max 2.3	Avg 0; max 2.3	2 echo blues	2017.04.285-2-17
171	MB	11	5/2/2017	ML	9:47	11:00 subtracted 30 mins for training	78	80.6	2.5 max 0.9 avg	1.8 max, 0.9 avg	Variable checkspot, ladies, cabbage, anise, mournful duskywing, ringlet, pipevine swal, skippers	5-2-175-3-17 snr
173	MB	5	5/3/2017	SR	9:43	10:23	86.5	87	1.9 max average 0.5	0.6 average 0.9 max	4 Checkerspot, monarch, 8 ringlets, cabbage white	5-3-17 snr5-3-17 snr
175	MB	6	5/3/2017	SR	10:30	11:24	81.4	89.7	Max 2.1 average 0.5	0.0 max 0.0 average	Checkerspot, ringlet, skipper	5-3-17 snr5-3-17 snr

177	MB	3	5/3/2017	SR	12:43	12:47	85.8	88.2	3.5 max average 1.3	1.2 max 0.8 average	Ringlet	5-3-17 snr
179	MB	2	5/11/2017	JN	10:15	10:48	65.8	73.8	Max 1.2 Avg 0.1	Max 4.0 Avg 0.5	5 Checkerspots, 6 Ringlets	5/11/2017 JN
180	MB	1	5/11/2017	JN	12:27	12:54	61.3	58.6	Max 6.1 Avg 0.5	Max 6.6 Avg 0.6	1 Checkerspot, 1 Cabbage White, 1 Ringlet	5/11/2017 JN
181	MB	4	5/11/2017	CRE	12:40	1:05	63	63	Max 7 Avg 5	Max 7 Avg 5		5/11/2017
182	MB	6	5/11/2017	CRE	11:22	12:30	63	63	Max 5 Avg 4	Max 10 Avg 7.5		5/11/2017
183	MB	5	5/11/2017	CRE	10:15	11:20	60	63	Max 0 Avg 0	Max 5 Avg 4		
185	MB	8	5/11/2017	JN	11:54	12:11	71.4	68.3	Max 3.4 Avg 2.2	Max 3.4 Avg 0.6	2 Cabbage Whites, 2 Ringlets	5/11/2017 JN
186	MB	10	5/9/2017	JN	1:52	2:56	72.7	75	Max 9.7 Avg 2.8	Max 9.9 Avg 3.8	7 Ringlets, 4 Cabbage Whites	5/9/2017 JN
187	MB	11	5/9/2017	JN	12:03	1:00	82.6	82.6	Max 4.7 Avg 0.6	Max 4.5 Avg 0.9	4 Checkerspots, 2 Cabbage Whites, 2 Anise, 2 Ringlets	
188	MB	12	5/9/2017	JN	10:22	11:28	72.8	82.5	max 2.6, avg 0.8	Max 1.7, Avg 0.7	4 Checkerspots, 1 Anise, 1 Cabbage White, 1 Ringlet	
189	MB	13	5/17/2017	ML	10:12	11:09	61.5	73	Max 4.7 average 0.7	Max 5.1 average 3.1	Ringlet, anise, chelida checkerspot	Transfer log submitted at 12 invalid. Ggnra just passed through transect prior to monitoring
192	MB	11	5/17/2017	SR	12:24	1:30	62.7	63	Max 5.6 average 0.8	Max 12.8 average 6.8	Pipeline, anise, checker, ringlet	Transfer log submitted at 12 invalid. Ggnra just passed through transect prior to monitoring5/17/17 snr
194	MB	12	5/17/2017	SR	2:20	3:08	59	64	Max 12.1 average 5.7	Max 8.9 average 6.2		5/17/17 snrSnr 5/19/17
196	MB	9	5/19/2017	SR	10:08	10:52	76.5	82	Max 3.1 average 1.1	Max 4.1 average 1.1	Anise, ringlet	Snr 5/19/175/19/17 snr
198	MB	7	5/19/2017	SR	11:00	11:25	80	76.6	Max 2.7 average 1.3	Max 2.8 average 1.2	Anise, ringlet, checkerspot	5/19/17 snr5/19/17 snr

200	MB	13	5/19/2017	SR	12:36	1:38	82.9	87.6	Max 4.2 average 2.3	Max 1.5 average 0.8	Ringlet, anise	5/19/17 snr2017-05-19; sunny warm day
202	MB	11	5/19/2017	RA	10:13	11:18; 62 minutes total	67.5	76.3	Avg 1.7; max 3.6	Avg 2.1; max 3.3	5 Annis; 5 variable; 1 mournful; recorded callippe along transect	2017-05-19; sunny warm day2017-05-19; calm warm conditions
204	MB	12	5/19/2017	RA	12:05	12:52; 45 min total	84.5	81.1	Avg 0.7; max 1.9	Avg 1.4; max 2.8	21 Annis; 5 pipevine swallowtail; 3 mournful dusky; 1 Cabbage; 1 buckeye	2017-05-19; calm warm conditions20170517 JN start T1
206	MB	1	5/17/2017	JN	0950	1008	62.6	60.7	Max 3.4 avg 0.6	Max 3.4 avg 0.5		20170517 JN start T120170517 JN start T10
208	MB	10	5/17/2017	JN	1044	1118	74.8	70.2	Max 1.4 avg 0.6	Max 6.0 avg 0.6	26 ringlets, 2 cabbage whites, 5 checkerspots	20170517 JN start T1020170519 JN start T2
210	MB	2	5/19/2017	JN	1003	1022	80	85.6	Max 1.8 avg 0.5	Max 0.8 avg 0	1 checkerspot, 1 cabbage white, 8 ringlets	20170519 JN start T220170519 JN start T3
212	MB	3	5/19/2017	JN	1043	1046	83	81.1	Max 3.5 avg 0.5	Max 3.5 avg 0.6	1 checkerspot	20170519 JN start T320170519 JN start T8
214	MB	8	5/19/2017	JN	1100	1110	82.7	75.7	Max 1.2 avg 0.5	Max 2.9 avg 1.8	2 ringlets	20170519 JN start T820170519 JN start T10
216	MB	10	5/19/2017	JN	1212	1254		86.9	Max 1.8 avg 1.1	Max 2.1 avg 0.8	16 ringlets, 6 checkerspots, 5 cabbage whites	20170519 JN start T105-19-17
218	MB	5	5/19/2017	ML	10:02	10:38	77.9	81.5	6.1 max 1.6 avg	6.1 max 0.9 avg	Ringlet, cabbage white, mylitta crescent	5-19-175-19-17
220	MB	6	5/19/2017	ML	10:48	11:31	78	79.4	6.1 max 0.9 avg	6.1 max 0.7 avg	Ringlets	5-19-175-19-17
222	MB	4	5/19/2017	ML	11:45	11:59	85.6	81.4	6.1 max 0.7 avg	6.1 max 0.7 avg	Fiery skipper, anise swallowtail, painted lady, cabbage white	5-19-175-19-17
224	MB	1	5/19/2017	ML	12:43	13:06	77.9	71.4	3.4 max 0.6 avg	6.9 max 0.6 avg	Pale swallowtail, mylitta crescent, cabbage whites, ringlets, pAinted ladies	5-19-17

OBJECTID	BUTTERFLY	Monitoring Round	Transect	Date	Observer	CS Observed	Start Time	Starting Temperature (F)	Starting Wind Speed (avg MPH)	End Time	Ending Temperature (F)	Ending Wind Speed (avg MPH)	Other Butterflies Observed	Notes		
31	CS	1	1	6/1/2018	HO	0	12:31:00	78	1.5	12:57:00	64	10	Only 2 ringlets	More exposed at bottom of transect and winds had picked up but most of transect was calm and warm		
56	CS	2	1	6/12/2018	HO	0	12:23	73.4	3.6	12:52	69.4	11.7	swallowtails, Painted Lady	High wind at bottom of transect, but majority of transect was calmer and warm		
77	CS	3	1	6/21/2018	DK	0	12:53:00 PM	74.3	3.6	1:26:00 PM	72.1	13.1				
123	CS	4	1	7/5/2018	HO	0	103	58.7	2.4	135	57	18.2	Pale swallowtail acmon blue	Pretty windy and cool for most of transect		
132	CS	5	1	7/12/2018	HO		945	68.1	0.7	1013	66.7	4.7	Acmon blue field crescent western brown elfin			
20	CS	1	2	6/1/2018	CRE	1	10:10:00	70.5	0.6	11:00:00	64	1.3	5 anise swallowtail 2 California ringlet 2 cabbage white 1 west coast lady			
54	CS	2	2	6/12/2018	HO	2	10:53	75.9	2.8	11:31	66.2	10				
79	CS	3	2	6/22/2018	CRE	0	10:05:00 AM	72 deg F	1 mph avg, 2 mph max	11:05 am and subtract 5 mins (11:00 am)	81 deg F	1.5 mpg avg, 4 mph max	Anise swallowtail, common ringlet, cabbage white. Unidentifiable skipper and blue.	Sometimes necessary to walk parallel to transect due to inability to traverse scrub within transect. Followed parallel to transect along hilltop grassland areas.		

107	CS	4	2	7/5/2018	RA	0	12:32:00	64	Avg 6.3; max 11.7	13:05; stopwatch 30:16	60	Avg 9.2; max 13.3	Annis (2); CA ringlet (2) sheltered spot at start			
149	CS	5	2	7/12/2018	CRE		11:20:00	69f	2.4 average	11:53:00	75f	1.7 average	Anise swallowtail			
7	CS	1	3	5/29/2018	HO	11	10:45:00 AM	70.5	2.6	11:19:00	79.5	3	Anise swallowtail	Observed primarily around top of hill, chasing searching and nectarine behavior		
42	CS	2	3	6/11/2018	HO	3	9:41:00	71	1.5	10:16:00	69	1.4	Anise swallowtail CA ringlet			
64	CS	3	3	6/20/2018	HO		1142	63	3	1201	55	8	Anise, CA tortoiseshells, ringlet all flushed by me walking	Full cloud cover at start of transect. Open skies visible further along transect. Mid transect top of hill still under cloud temp 55 wind avg7 max17 only butterlies seen were flushed. Temps at top of hill too cold and wind too high (avg 8but very gusty)		
69	CS	3	3	6/21/2018	RA	5	11:04:00	60	Avg 3.0; max 7.6	11:34:00	59	Avg 5.5; max 13.4	Anise swallowtail	Arnold slope needs fennel, brush, it. Thistle. Scrub along ridge. Chain link removed		
96	CS	4	3	7/2/2018	CRE	0	11:18:00 AM	63 deg F	3 mph avg, 6.5 mph max	12:18pm (minus 15 min off transect, 12:03pm)	72 deg F	2 mph avg, 10 max	Anise swallowtail, acmon blue, cabbage white, red admiral, mission blue, unidentifiable skipper.	Top of hill wind approx 13 mph max, 58 deg F. Approx half buttterflies were flushed from walking transect, other half traveling/ regularly active along transect. Transect difficult to follow due to fencing and scrub succession.		
135	CS	5	3	7/12/2018	HO		1049	63.1	4.8	1123	77.2	0	Anise swallowtails acmon blue ringlet moths			

11	CS	1	4	5/29/2018	HO	1	12:24:00	80	4	12:54:00	78	1.5				
46	CS	2	4	6/11/2018	HO	10	11:08:00	74.1	3.6	11:46:00	70	4.7	Anise swallowtail, cabbage white, ringlet, buckeye	Lots of CS but also lots of weeds! Address as weed management area?		
67	CS	3	4	6/21/2018	HO	5	1105	60.4	2.6	1148	57.9	10.3	Anise swallowtail, acmon blue, ca tortoiseshell	Sunny, Wind 7 temp 60 near where CS were observed		
98	CS	4	4	7/2/2018	HO	0	1132	62.5	6.7avg 11 max	1210	62.6	9.5	3 anise swallowtail, several acmon blues. Activity under these weather conditions	Overcast, winds picking up, marginal temps. No CS observed but other butterfly activity seen. 64 degrees and 6.4mph winds where CS usually seen		
139	CS	5	4	7/12/2018	HO	0	1218	71.5	4.9	1251	79.5	2.4	Anise swallowtail acmon blue cabbage whites			
9	CS	1	5	5/29/2018	HO	0	11:41:00	81	1	12:12:00	81	3	Anise swallowtail common ringlet California sister			
44	CS	2	5	6/11/2018	HO	0	10:32:00	74	1.2	11:03:00	77.9	1	Anise swallowtails, buckeyes, small orange butterfly	Wind up to avg 6mph		
71	CS	3	5	6/21/2018	CRE	0	11:05:00 AM	60	3 mph	12:07pm and subtract 5	68	3.5 mph avg, 10 mph	Anise swallowtail, boisdoval's blue, acmon	No callippes observed. Several unidentifiable small moths and small skipper sized butterflies.		

										mins for time off transect		max. Start avg 3, max 6 mph.	blue, common ringlet, skipper, mission blue (eggs)			
101	CS	4	5	7/3/2018	HO	0	1155	72.1	2.1 avg 3.6 max	1234	68	3.9 avg 7.7 max	Anise swallowtails, acmon blue, checkered skipper, ringlet, copper	Sunny and warm. Winds at top of hill maxed at 8.4		
137	CS	5	5	7/12/2018	HO	0	1138	76.6	0.9	1210			Winds at top of hill avg 6mph and 66 degrees. Patchy cloud cover	Cabbage white acmon blues anise swallowtails copper buckeye		
23	CS	1	6	6/1/2018	CRE	0	12:13:00	76	1.9	12:45:00	76.8	1.6	Grey hairstreak cabbage white	North end of transect too dense with shrubs to walk. Stayed on old ranch road and water tower access road then cut in when grassland appeared. South end past bend to east very dense with thistle		
50	CS	2	6	6/11/2018	HO	0	12:21:00	64.4	3.3	12:35:00	69.1	4.3	Ringlet			
81	CS	3	6	6/22/2018	CRE	0	11:49:00 AM	85 deg F	1 mph avg, 3 mph max	12:25 pm and subtract 10 mins (12:15 pm)	85 deg F	1 mph avg, 2 mph max	Cabbage white, acmon blue, common ringlet. Unidentifiable skipper.			
103	CS	4	6	7/3/2018	HO	0	1245	66.8	4.7 avg 6.7 max	109	77.3	2.5	Acmon blues, copper?			

3	CS	1	7	5/29/2018	RA	7	12:06	78.1	3.0M; 0.9A	12:34			Mourning dusky; an is swallowtail; CA ringlet	5/29/18; Aborted transect due to high winds. Max 15 and avg 10-11.1	
17	CS	1	7	6/1/2018	JG	12	12:16:00	80	1	13:02:00	84	1			
38	CS	2	7	6/11/2018	CRE	26	10:43:00	71	0.8	11:24:00	67	0.6			
75	CS	3	7	6/21/2018	DK	29	11:35:00 AM	77.5	1.6	12:36:00 PM	83.4	0.9			
121	CS	4	7	7/5/2018	HO	1	1201	63.5	7.4	1245	60	6	Anise swalllowtail buckeye acmon blue	Gusts up to 16 mph. Breeze cool	
129	CS	5	7	7/11/2018	HO	2	1215	72.7	1.4	106	66.7	5.3	Anise and pale swallowtails acmon blues mournful duskywing, checkered skipper	Patches of marine layer rolling in near end, winds picking up and bringing cooler air (61 degrees and 9.9 mph at one point)	
27	CS	1	8	6/1/2018	HO	3	10:05:00	75	1.5	10:25:00	70	2	Several CA ringlets, one blue (acmon possibly?)		
62	CS	2	8	6/12/2018	CRE	4	12:45	80	2	12:55	84	1.5			
85	CS	3	8	6/22/2018	HO	3	1207	81.9	1.7	1222	82	1.5	Acmon blue and ringlet		
109	CS	4	8	7/5/2018	RA	0	13:59:00	72	Avg 1.3; max 2.7	14:09; 10:05 on stopwatch	77	Avg 1.5; max 2.9	Ca ringlet	French broom infestation must treat 2018/19	
145	CS	5	8	7/11/2018	CRE	0	1:07:00	70f	0.6 average	1:16:00	80f	0.6 average	California ringlet		
5	CS	1	9	5/29/2018	RA	20	12:37:00	74	14.9M; 2.9A	13:23:00	70	4.2A; 8.0M	Annis and pale swallowtail;	One CS traveling before start, Wind picked up 2/3rds of the way down the route	

													painted lady; acmon blue; CA ringlet			
40	CS	2	9	6/11/2018	CRE	22	12:00:00	69	3.4	12:40:00	74	4				
73	CS	3	9	6/21/2018	DK	18	10:28:00	79.3	1.2	11:20:00	78.9	1.3				
119	CS	4	9	7/5/2018	HO	1	1103	70.2	2.1	1145	60.8	3.7				
141	CS	5	9	7/11/2018	CRE	0	10:50:00	67f	1.3 average	11:26:00	78f	0	Brown elfin, California ringlet, anise swallowtail, Acmon blue, common checkered skipper	No CS observed, not that many butterflies flying but great conditions		
1	CS	1	10	5/29/2018	RA	20	10:50	81.4	2.9M; 0.9A	11:49	74.4	4.9M; 1.8A	Pale swallowtail, variable checkerspot, cabbage white, acmon blue	5/29/18; VIPE still visible and light green in some places. Treat fennel, broom, scabiosa, and ITl thistle		
35	CS	2	10	6/11/2018	CRE	41	9:45:00	67	1.7	10:33:00	71	1.5				
94	CS	3	10	6/22/2018	RA	14	13:38:00	95	Avg 1.0; max 2.2	14:20:00	85	Avg 1.6; max 3.7	Anise, acmon, CA ringlet	Hypericum, fennel, scrub		
115	CS	4	10	7/5/2018	CRE	5	1:09:00 PM	66 deg F	5.5 mph avg, 8.5 max	1:58pm (minus 5 min)	75 deg F	1 mph avg, 5.5 mph max	Ca tortoiseshell, red admiral, anise swallowtail, grey hairstreak, buckeye			

143	CS	5	10	7/11/2018	CRE	3	11:53:00	75f	0.6 average	12:34:00	77f	0.9 average	Anise swallowtail, painted lady, cabbage white, spring azure? ,			
15	CS	1	11	6/1/2018	JG	23	11:41:00	75	1	12:14:00	82	1	Swallow tails Acmon blue mission blue			
60	CS	2	11	6/12/2018	CRE	33	11:02	84	0.5	11:37	86	1				
92	CS	3	11	6/22/2018	RA	24	12:39:00	86.6	Avg 1.6; max 4.1	13:29; 50.07 minutes	95	Avg 1.0; max 2.2	anise swallowtail, mournful duskywing; buckeye; pipeline swallowtail, CA ringlet, cabbage white, acm	Radish near SBMW scrub plot and Italian thistle		
113	CS	4	11	7/5/2018	CRE	7	11:36:00 AM	69 deg F	5.5 mph max, 2.5 mph avg	12:42pm (minus 15 min, 12:17pm)	73 deg F	3 mph avg, 6.5 max	Red admiral, ca ringlet, checkered skipper, acmon blue, anise swallowtail, buckeye, silvery blue,etc	In first cluster of callippes logged (located off of fire trail), many have been up to two additional callippes but unidentifiable, chasing, moves quickly far away from transect. For secon cluster logged (located on fire trail), 3 fresh and 1 worn, activities included chasing, nectaring, resting, traveling, and may have observed ovipositing.		
127	CS	5	11	7/11/2018	HO	7	1130	66.1	2.4	1210	70.2	1.6	Anise and pale swallowtails acmon blues buckeyes mournful duskywing checkered skipper copper			
13	CS	1	12	6/1/2018	JG	9	10:08:00	75	1	11:13:00	75	1	Chels ringlet			
58	CS	2	12	6/12/2018	CRE	2	9:25	73	1.1	10:28	81	0.6				

89	CS	3	12	6/22/2018	RA	0	9:59:00	75	Avg 1.2; max 3.1	10:44; 44.11 minutes	75.5	Avg 1.5; max2.4	Anise swallowtail; acmon blue; CA ringlet		
90	CS	3	12	6/22/2018	RA	0				Same. Re-walked from T-11 end.	Same	Same	Cabbage white and myletta crescent		
111	CS	4	12	7/5/2018	CRE	0	10:12:00 AM	73 deg F	1 mph avg, 2.5 max	11:17am (minus 5 min, 11:12am)	75 deg F	0 mph avg, 1 mph avg	Ca ringlet, cabbage white, red admiral, anise swallowtail, mission blue, acmon blue	Difficult to find trail uphill portion near start of transect, obscured due to brooms, and alternate routes slippery with dry grasses. End of transect short of actual end because trail downhill of here overgrown with poison oak, took safety precaution.	
125	CS	5	12	7/11/2018	HO	0	1037	73	1.1	1121	71.2	0.1	Anise swallowtail acmon blues grey hairstreak cabbage whites	Sunny	
22	CS	1	13	6/1/2018	CRE	0	11:30:00	73	1.7	12:00:00	85	0.9	1 Acmon blue 4 California ringlets		
33	CS	1	13	5/30/2018	HO	0	11:33:00	60	7	11:47:00	54	13.8		Scratch transect. Winds picked up once more exposed on transect. Too cool and too windy. One CA ringlet seen.	
48	CS	2	13	6/11/2018	HO	1	11:56:00	67.6	6.1	12:09:00	64.5	9.6	None - 1 CS	Gusts up to 20 mph	
83	CS	3	13	6/22/2018	CRE	0	12:57:00 PM	77 deg F	3 mph avg, 8 mph max	1:19 pm and subtract 5 mins	83 deg F	3 mph avg, 7 mph max	Common ringlet, cabbage white. Unidentifiable skipper.	At highest elevation along transect, wind speeds approx avg 8 mph, max 18 mph.	

										(1:14pm)				
105	CS	4	13	7/3/2018	HO	0	120	65.1	6.7 avg 10.8 max	139	68.3	4.5	Acmon blues, California tortoiseshell	Gusts up to 16 mph at top of hill
151	CS	5	13	7/12/2018	CRE	0	12:34:00	72f	1.5 average	12:44:00	79f	1.1average		
29	CS	1	14	6/1/2018	HO	2	10:59:00	71.5	1.5	11:34:00	68	4	Acmon blue, ringlet, buckeye, skipper, Annis swallowtail	Lots of butterflies!! No CS… (NOTE- 2 CS seen just after ending transect)
52	CS	2	14	6/12/2018	HO	6	9:33	71	1.5	10:08	72.5	1.5	Lots of buckeyes, swallowtails, checkered skipper, acmon blues, ringlets	Rerouted transect to follow alternate path - wanted to capture prime hilltopping area where callippe are actually observed
87	CS	3	14	6/22/2018	HO	0	1252	72.8	4.3	126	77.4	1.2	Buckeyes, acmon blues, anise swallowtails, field crescent, common checkered skipper	Transect 14. Average wind at top of hill was 8.4 mph
117	CS	4	14	7/6/2018	HO	1	1022	67.3	2.4	1052	75.2	0.6	Anise swallowtail, west coast lady, acmon blue	Much less butterfly activity than previous visits. Overcast
147	CS	5	14	7/12/2018	CRE	0	9:40:00	67f	1.2average	10:09:00	72f	1.8 average	California ringlet, common buckeye, Acmon	This is transect 14

													blue, myletta crecent, anise swallowtail			

Central Valley Project Conservation Program

and Central Valley Project Improvement Act Habitat Restoration Program

R17AP00018

Reintroduction of the Bay Checkerspot Butterfly to San Bruno Mountain

First Year Annual Report October 2018

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Contents

Executive Summary

To reestablish the Bay checkerspot butterfly (*Euphydryas editha bayensis*) (BCB) on San Bruno Mountain (SBM), translocations from Coyote Ridge in south San Jose (Santa Clara County) began in 2017 with funding from the Disney Butterfly Conservation Initiative. In early February 2018, postdiapause larvae were observed, confirming that BCB larvae released in 2017 had successfully reproduced. After this trial period, the project continued in 2018 with funding from the Central Valley Project Conservation Program. An additional 5000 larvae were translocated in mid-February 2018 in areas east and west of the original release area. Adults were observed along the entire length of the release areas in 2018. There was a notable concentration of adults at the western release area, where a small hilltop provided a focus for aggregation. Adult

butterfly encounter rates (butterflies/hour) were higher at SBM than at the Coyote Ridge reference site and the Edgewood reintroduction site. Prediapause larvae from freely ovipositing females were documented on the nonnative perennial host *Plantago lanceolata*, and in late April third instar larvae were observed on still lush hostplants. As expected, *P*. *lanceolata* remained green and edible through and beyond the prediapause larval period. Native annual *Plantago erecta* stands, where present, remained green and edible into late May, with *Castilleja* spp. remaining edible into early June. These observations of comparatively high adult encounter rates and host plant availability into the larval diapause stage indicate there is a high likelihood of success for BCB establishment on SBM.

Introduction

SBM is home to three species of butterflies listed as endangered by the U.S. Fish and Wildlife Service (USFWS): The Mission blue butterfly (*Icaricia icarioides missionensis*), the San Bruno elfin butterfly (*Callophrys mossii bayensis*), and the callippe silverspot butterfly (*Speyeria callippe callippe*). Their habitat is protected in perpetuity as a part of the SBM Habitat Conservation Plan (HCP). Portions of SBM were identified as critical habitat for the BCB in the HCP based on known occurrences of this butterfly. Unfortunately, in the mid-1980s, the BCB was extirpated from SBM (TRA Environmental Sciences 1986, 2008). USFWS commissioned a feasibility study for a BCB reintroduction at SBM (Niederer et al. 2015). Habitat surveys in spring 2014-2015 mapped many small patches of the BCB native annual host plant *Plantago erecta*, not enough to support a viable BCB population. Also observed were near ubiquitous stands of the nonnative perennial *Plantago lanceolata*, which could likely provide enough habitat to sustain a population of BCB. The last postdiapause larvae (1983) were feeding on *P*. *lanceolata* (Weiss pers. obs.), therefore host-switching was already occurring before the extirpation of the BCB from SBM. *Euphydryas editha* ssp. *taylori* populations in Oregon and Washington (Severns and Grosboll 2011) and in the Sierra Nevada (Schneider's Meadow) have adopted *P*. *lanceolata* as a hostplant (Ehrlich and Hanski 2004). *P*. *lanceolata* was successfully used in several laboratory experiments with BCB at the Stanford Department of Biological Sciences in 1985 (Weiss pers. obs.). *P*. *lanceolata* is a robust biennial/perennial species that remains green many weeks and even months longer than the native *P*. *erecta*. Given that BCB adult females have been observed ovipositing on *P*. *lanceolata* in the field, and that prediapause and postdiapause larvae survive on it (experimentally confirmed), potential BCB habitat occurs across much of the grassland on SBM. Nectar is plentiful during the flight season. The mountain

is large and topographically/climatically diverse, similar to Coyote Ridge where a healthy, thriving population of BCB persists. *Euphydryas editha* is an adaptable species. Reintroducing the BCB to SBM with the expectation they will switch to a nonnative hostplant is a conservation experiment that raises many interesting ecological and policy issues in a rapidly changing environment. This project could show we are able to reintroduce extirpated species without the technical difficulties and expense of restoring all historical conditions.

Summary of Previous Reintroduction Work

A single year of translocations took place in 2017 under a related project funded by the Disney Butterfly Conservation Initiative. In March 2017, 3630 postdiapause larvae were collected from Coyote Ridge and released at SBM along the main ridge in "Central 2017" area (Map 1). Adults were observed along a transect system later in the season (their abundance, distribution, and phenology will be discussed later). Postdiapause larvae from these 2017 adults were observed on February 8, 2018, before 2018 translocations (Photo 1).

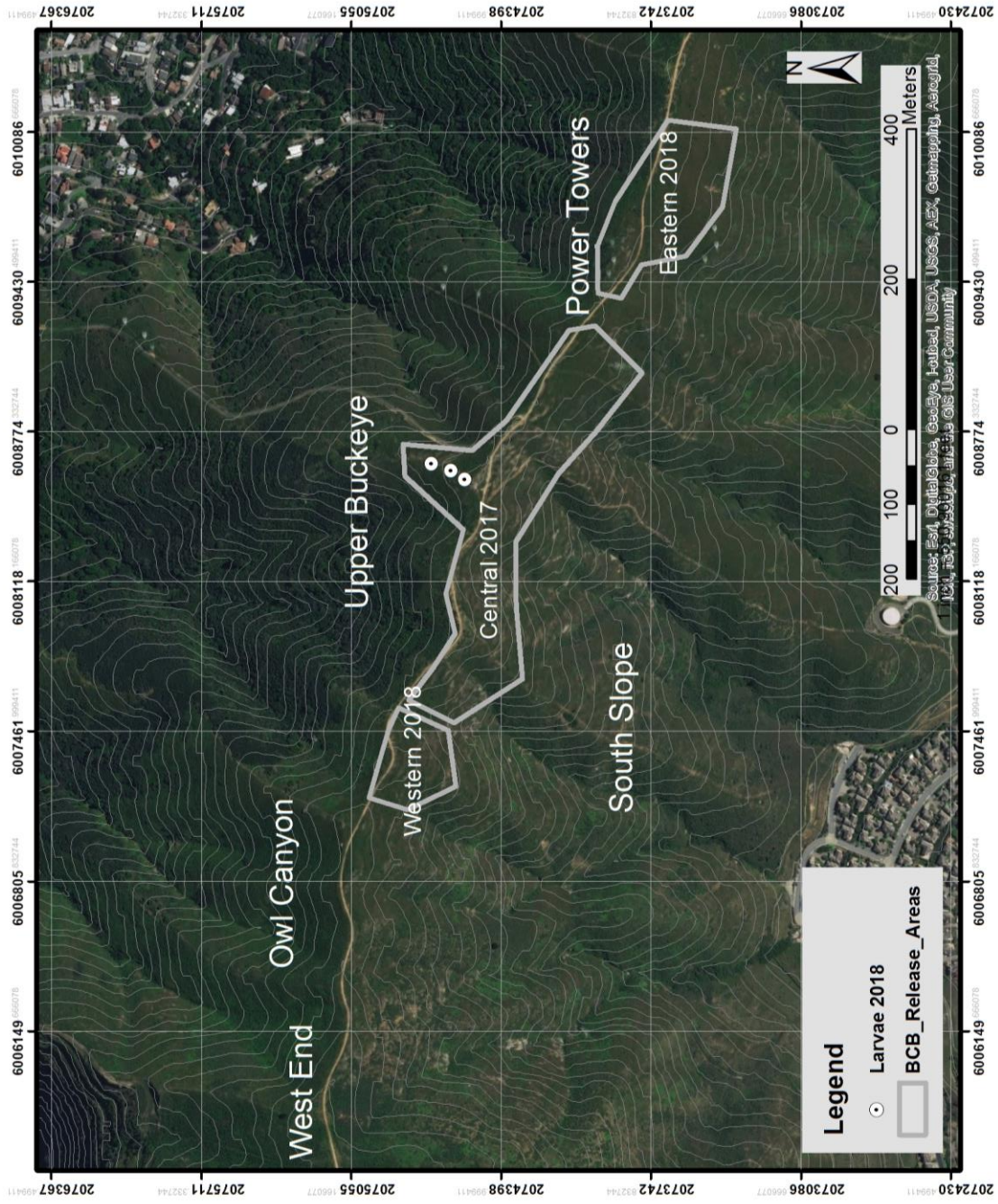
Project Objectives

1. Re-establish an initial population of at least 300 adult or 600 postdiapause BCB larvae on SBM in two of the four monitoring years.
2. Document BCB oviposition on the plant *Plantago lanceolata*.
3. Document BCB larval use of *Plantago lanceolata*.

2018 Progress

Of the primary project objectives outlined above, re-establishment of the BCB population is well underway. Additional years of data collection and analysis are still required before this objective can be met. The second two objectives, documentation of BCB oviposition and documentation of BCB larval use of *Plantago lanceolata* have both been met in 2018 and are described in detail below.

To date, all project milestones are on track for completion (Table 1). All 2018 translocations are complete and the monitoring season came to a close in early June. Data analysis and reporting are completed in this document. Below is a summary of the progress and ongoing work required to meet each project milestone. More detailed data analysis and discussion follows



Map 1. Larval Release Areas 2017 and 2018. White circles are locations of postdiapause larvae observed in 2018 from 2017 releases. Grid interval = 200 meters

Photo 1. Postdiapause larva, 2017 release site Upper Buckeye Canyon

Milestones	Progress for 2018	Final Completion Date
1. Obtain permits and conduct project planning with regulators and landowners	February 2018, complete	Ongoing until December 2019
2. Conduct postdiapause BCB larval and adult collection and transfers	February 2018, complete	Ongoing through Y4
3. Conduct postdiapause BCB larval monitoring at SBM.	February 2018, complete	Ongoing through Y4
4. Set up adult butterfly and plant phenology monitoring courses as SBM and Coyote Ridge.	March 2018, complete	March 2018, complete
5. Monitor adult butterflies at SBM	April 2018, complete	Ongoing through Y4
6. Monitor host plant phenology at SBM	May 2018, complete	Ongoing through Y4
7. Collect adult butterfly and plant phenology data at Coyote Ridge	May 2018, complete	Ongoing through Y4
8. Conduct data analysis	August 2018, complete	Ongoing through Y4
9. Write Year 1 report	October 2018, complete	Ongoing through Y4

Table 1. Scope of work and milestones