SAN BRUNO MOUNTAIN
HABITAT CONSERVATION PLAN

YEAR 2016 ANNUAL ACTIVITIES REPORT FOR FEDERALLY LISTED SPECIES AND HABITAT MANAGEMENT

Endangered Species Permit PRT-2-9818

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For:
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Table of Contents

TABLES

FIGURES

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 2016. Vegetation management activities carried out to support habitat improvements to benefit the covered species will also be discussed. This report is prepared on an annual basis for submission to the U.S. Fish and Wildlife Service. Three endangered species of butterflies are currently found on San Bruno Mountain and are covered under the San Bruno Mountain HCP: the mission blue, callippe silverspot, and San Bruno elfin butterflies.

In 2016 San Bruno elfin larvae were counted at eight permanent plots and adult callippe silverspot butterflies were counted along thirteen fixed transects. Of the three covered butterfly species found within the SBMHCP area callippe silverspot (CS) and San Bruno elfin (SBE) butterflies are monitored in even years while mission blue (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 mission blue adult monitoring and San Bruno elfin larvae monitoring overlap. Simply stated, seasonal overlap, staff time requirements, and financial constraints has led to this alternating year approach for endangered butterfly monitoring with the SBMHCP area.

San Bruno elfin (SBE) butterfly larvae were monitored and counted in 2016. Eight permanent plots have been utilized for several years. 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 320 larvae were counted. All permanent plots were surveyed three times this season.

All adult callippe butterflies observed along the thirteen fixed transects are counted. Data collected during these surveys includes date, weather conditions, location along transect of callippe 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, ≥ 64° and < 10 mph winds, and that transect observations are only counted if they are at least 1-week apart. A sightings per hour 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 transects were surveyed four times between May 31 and June 23, 2016. A total of 225 CS were observed and counted during the course of transect surveys, and an additional 55 CS were counted as incidental observations this year. No CS were observed on T-1, T-2, T-3, or T-4. No modifications were made to CS transects in 2016.

Vegetation management activities in 2016 had a singular purpose, protect all occupied grasslands from ongoing scrub encroachment. 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. Based on the Assessment scrub removal and associated high priority invasive species (i.e. fennel) were targeted in occupied high quality mission blue and callippe silverspot habitat in 2016.

Shelterbelt Builders Inc. (Shelterbelt) targeted scrub from January through June 2016. In that time they treated a combination of native and non-native scrub in 53 acres of the highest priority occupied mission blue and callippe silverspot butterfly grassland habitat. Scrub control targets young scrub species for full removal in the grasslands designated as "Essential" habitat by the Assessment. In some areas pockets of older scrub or scrub encroachment perimeters were also treated with herbicides but not fully removed due to budgetary constraints.

Shelterbelt conducted additional efficacy testing while treating scrub to determine the best herbicide application technique, timing, and chemical treatment to maximize one-time treatment of these areas for scrub control. Fall scrub control work was implemented to continue this management approach in essential grasslands.

Volunteer efforts continue in conjunction with San Bruno Mountain Watch (SBMW) in butterfly habitat areas an 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. Sixty-one percent of monitored plants survived, however some sites yielded much better results with greater than seventy percent survival.

San Mateo County Parks Department also implemented volunteer events that focused on invasive species removal within the SBMHCP. One project occurred in 2016 in Owl and Buckeye Canyon management unit.

No mission blue butterfly monitoring occurred in 2016. This species will be monitored during the 2017 adult flight season. Statistical analysis is planned for all butterfly data in 2017. 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.

In 2016, a variety of habitat management work and two butterfly species were monitored to satisfy the requirements of the U.S. Fish and Wildlife Service (USFWS) Incidental Take Permit (PRT 2-9818) for the SBMHCP. Protected butterfly monitoring for the 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 providing planning assistance to individuals, organizations and agencies related to development within the SBMHCP area and conserved habitat.

The San Bruno Mountain Habitat Conservation Plan (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.

Covered Species Population Status

Under the San Bruno Mountain Habitat Conservation Plan (HCP), 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. Federally protected species that are monitored on San Bruno Mountain include the mission blue (*Icaricia icarioides missionensis*, MB), callippe silverspot, and San Bruno elfin butterflies. In 2016, fixed transects were used to assess the status of the callippe silverspot butterfly and fixed-radius plots were used to monitor San Bruno elfin butterfly larvae on San Bruno Mountain. Mission blue butterflies were not monitored in 2016, however, any incidental observations of mission blues are recorded when encountered along CS transects in 2016.

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 (Ibid). Estimates related to detection probability and survival rates for MB and CS rely on the 1981 Biological Study that supported the development of the HCP. 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 callippe silverspot and mission blue 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 includes 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).

2016 CALLIPPE SILVERSPOT STATUS

A total of 280 CS were documented during the monitoring season, with 225 CS observed along ten of the fixed transects in 2016. This corresponds to an average sightings per hour (S/H) for all transects of 5.5 S/H. The averaged maximum for all transects was calculated to be 11.3 S/H. A total of 31 person-hours was spent on transects included in the 2016 analysis. This does reflect the lowest recorded sightings per hour since monitoring switched to fixed-length transects in 2000.

However, when these numbers are considered with the whole of the SBMHCP data record, similar level of effort and CS observations did occur in 1996 with 296 CS observed over 31.5 hours. In 1996 the average sightings per hour was 9.4 versus our 5.5 in 2016. As a comparison, the 1995 CS results showed a much higher level of effort yielded a higher CS count, 454 in just under 59 hours, but a lower sightings per hour with the average 7.7 S/H.

The 2016 monitoring data suggests that CS density observations on the Mountain exhibit a high degree of variability year-to-year and from one transect to another. The Assessment conducted the most recent statistical analysis of the data up to 2012 and concluded that the population is stable in high quality habitat but has undergone a potential reduction or loss of subpopulations in peripheral habitat due to scrub encroachment. This loss of marginal habitat is not expected to pose a significant risk to the overall population of CS on the Mountain (Weiss et al 2015). The last two years of CS data should be included in a statistical analysis in 2017. In 2014 a total of 594 CS were counted and that was the highest count since 2001 when 721 CS were counted along fixed transects. According to the 2003 Activities report a cursory relationship between rainfall amounts years and CS observations was proposed for further exploration (TRA 2004). Based on similar conclusions this year and research into past annual reports this may be an important relationship to explore when analyzing the additional two years of data.

Maintenance of existing CS habitat and previous CS hotspots through scrub reduction/ containment, thatch and non-native annual grass modification, and weed control is of highest priority in managing CS. Despite the efforts to monitor CS butterflies there is a lack of data and understanding related to *Viola pedunculata* patch size and distribution. This is expected to correlate with the adult observations and is likely related to year-to-year variation. Monitoring of habitat quality, including Viola patch size and distribution, as well as other vegetation conditions (e.g. height), may provide additional guidance on appropriate management activities to ideally reduce the high variability in the abundance seen year-to-year. This will ultimately inform how to approach increasing the distribution and abundance of *Viola* and nectar plants for CS. This will be important in our effort to restore marginal or peripheral habitat that once served as a subpopulation for this species.

The Assessment further suggests that the fixed transect system continues to be robust for tracking abundance in high quality areas for MB and CS (Weiss et al 2015). These areas do not reveal a long-term trend in the abundance of adults in these grasslands and the fluctuations observed are within an accepatable range for butterfly populations (Ibid). Additional efforts to quantify the habitat quality through host plant surveys and associated nectar plant patches will be important to refine management and improvement of habitat in marginal areas that have historically supported subpopulations. However, the highest priority is to secure the high quality habitat from further decline as these areas are key to meeting the objectives of the HCP.

In 2016 an intern with the Parks Department tested some of the methods suggested in the Assessment for host plant monitoring. The brief report on this preliminary approach is included in Appendix A. Additional modifications are being considered for 2017 to improve efficiency and inform the development of a qualitative measure to reflective what constitutes secure high quality habitat and low quality or marginal habitat.

2016 SAN BRUNO ELFIN STATUS

In 2016 a total of 320 SBE larvae were counted at eight permanent survey locations. The number of larvae observed is more than double what was observed in 2014 (145 larvae), and the first monitoring round in 2016 recorded 156 larvae. This number of larvae observed in 2016 is consistent with numbers seen in other years with three complete rounds of surveys. Similar to the survey in 2014 the second and third round of surveys correlate to peak sedum bloom, however, the highest larval counts occurred earlier. 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.

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. 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.

Habitat Management Activities

San Bruno Mountain also supports federally listed plants and in 2015 San Mateo County Parks Department (County Parks) initiated a rare plant survey to document and map all populations of federal and state listed plants as well as those considered locally rare. A final report was completed in the first quarter of 2016. County Parks will use this report to provide critical baseline data for developing a management plan for locally rare, threatened, and endangered (RTE) plants in the future. In addition County Parks is determining an appropriate monitoring interval for RTE plants located on its properties as a whole, including San Bruno Mountain State and County Park (SBM). At this time plant monitoring is

not included in the current SBMHCP monitoring program or budget due to funding constraints. The executive summary and plant list is included in Appendix B.

STATUS OF SPECIES OF CONCERN

Mission Blue Butterfly (*Icaricia icarioides missionensis*)

Monitoring of mission blue butterflies was not conducted in 2016. Data and analysis of the 2015 MB transect monitoring data are available in the 2015 Annual Report (SMC 2016).The mission blue butterfly is the most widespread of the endangered butterfly species within SBMHCP area, and its distribution corresponds closely to the distribution of its host plants. The host plants for the mission blue butterfly are three perennial lupines: silver lupine (*Lupinus albifrons* var*. collinus*), summer lupine *(L. formosus* var*. formosus)*, and varied lupine (*L. variicolor*). Mission blues are limited primarily to areas where their host plants and nectar plants are concentrated. Mission blues use a variety of native and non-native species for nectaring (especially thistles), which are found throughout the grassland, coastal prairie, and coastal scrub plant communities found within the SBMHCP area. 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 roadcut areas where host plants are present in suitable densities. Mission blues 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, San Bruno Mountain due to the urbanization barriers surrounding the mountain.

Mission blues utilize silver lupine and summer lupine as their primary host plants, and utilize varied lupine less frequently within SBMHCP area. Silver lupine is the most widespread host plant species within SBMHCP area and grows within dry habitats such as south and east-facing native and non-native grasslands, roadcuts, rock outcrops, fire breaks, ridgelines, erosion rills, and landslide scars. Summer lupine also grows within disturbed soil conditions and colonizes roadways and landslide scars 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. Mission blues tend to utilize larger patches of varied lupine if it is the only lupine species present 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, however, monitoring lupine phenology and good weather conditions are important components in determining the appropriate timing to implement the adult monitoring season. 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

mountain. Late spring rains can delay the onset of the flight season throughout the SBMHCP area while hot spring conditions can mean an early or shortened season. Mission blue colonies on the warmer, dryer south-facing slopes of the SBM begin and end their flight season earlier than colonies on the cooler north-facing slopes.

Callippe Silverspot Butterfly (*Speyeria callippe callippe*)

The callippe silverspot distribution is similar to that of the mission blue, 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 roadcuts, 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 mission blues, 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 in the late spring and early summer of 2016. 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 13 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 2). A total of 13 fixed transects were monitored in 2014.

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.

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 one week apart. 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.

RESULTS

Transect monitoring of callippe silverspot butterflies occurred between May 31 and June 23, 2016. A total of 225 CS were counted along all transects and 55 incidental observations were recorded for a total of 280 total butterflies observed in 2016 during the monitoring season. Callippe silverspots were observed on 10 of the 13 transects. The average sightings/hour (S/H) for all transect data combined in 2016 was 5.4. The maximum S/H is what is used to look for trends in abundance and for 2016 it was 11.3 S/H for CS. Each transects was surveyed at least four 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 2016, no CS were seen on Transect 1, nor were any CS observed there in 2014 or 2012. The most recent year CS were observed on Transect 1 was in 2010, when a single CS was observed during each of 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 also no CS observed over the four completed surveys dates in 2016. This is in contrast to the 2014 observations, where the greatest number of CS and highest S/H that have been recorded on this transect (15 individuals observed, 20.9 S/H).

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 3). The maximum S/H on Transect 3 was 11.7 in 2016, which is considerably lower than that recorded in 2014 (73.3). 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 3). Callippes were observed during all four surveys. The 2016 average (7.3) and maximum (18.9) S/H calculated were lower than that observed in recent years.

T-5, Transect 5 (MU Northeast Ridge; Essential) is located on the eastern side of the Northeast Ridge. Callippes were observed during all four surveys. The maximum S/H was calculated to be 9.4, which was lower than that observed in recent years. Little visual change in habitat quantity or quality has been documented in past annual reports. 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) intersects sparse viola habitat, and consequently few CS are recorded here. In 2016 there was a single CS observation on one of the survey dates, while in 2014 no CS were observed on Transect 6. Similarly to 2016, in 2012 only 1 CS was observed and in 2010 no CS were seen during any of the surveys. 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 (*Cytisus scoparius*). Meanwhile, Italian thistle (*Carduus pycnocephalus*)

has proliferated along the east-west portion of this transect. Portions of this transect are under private ownership.

T-7, Transect 7 (Ridge Trail, not associated with specific MU; Essential) is located along the Ridge Trail (Figure 3). In 2016 CS were encountered at a rate more in line with the trend seen in past years with an average and maximum S/H of 22.5 and 38.7. This was the most productive transect in 2016.

T-8, Transect 8 (MU Devil's Arroyo; Essential) is located east of the Quarry (Figure 3) 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. No CS were seen on Transect 8 in 2016.

T-9, Transect 9 (MU Owl and Buckeye Canyons; Essential) follows a ridgeline between Owl and Buckeye Canyons down from the Ridge Trail (Figure 3). Despite a fire in 2008, viola and nectar plants have regenerated along this transect based on incidental observations. The 2016 average and maximum calculated S/H were lower than 2014 sightings. 2016 was more similar to the observations recorded in 2010, with an average and maximum S/H of 14.4 and 25.3, respectively.

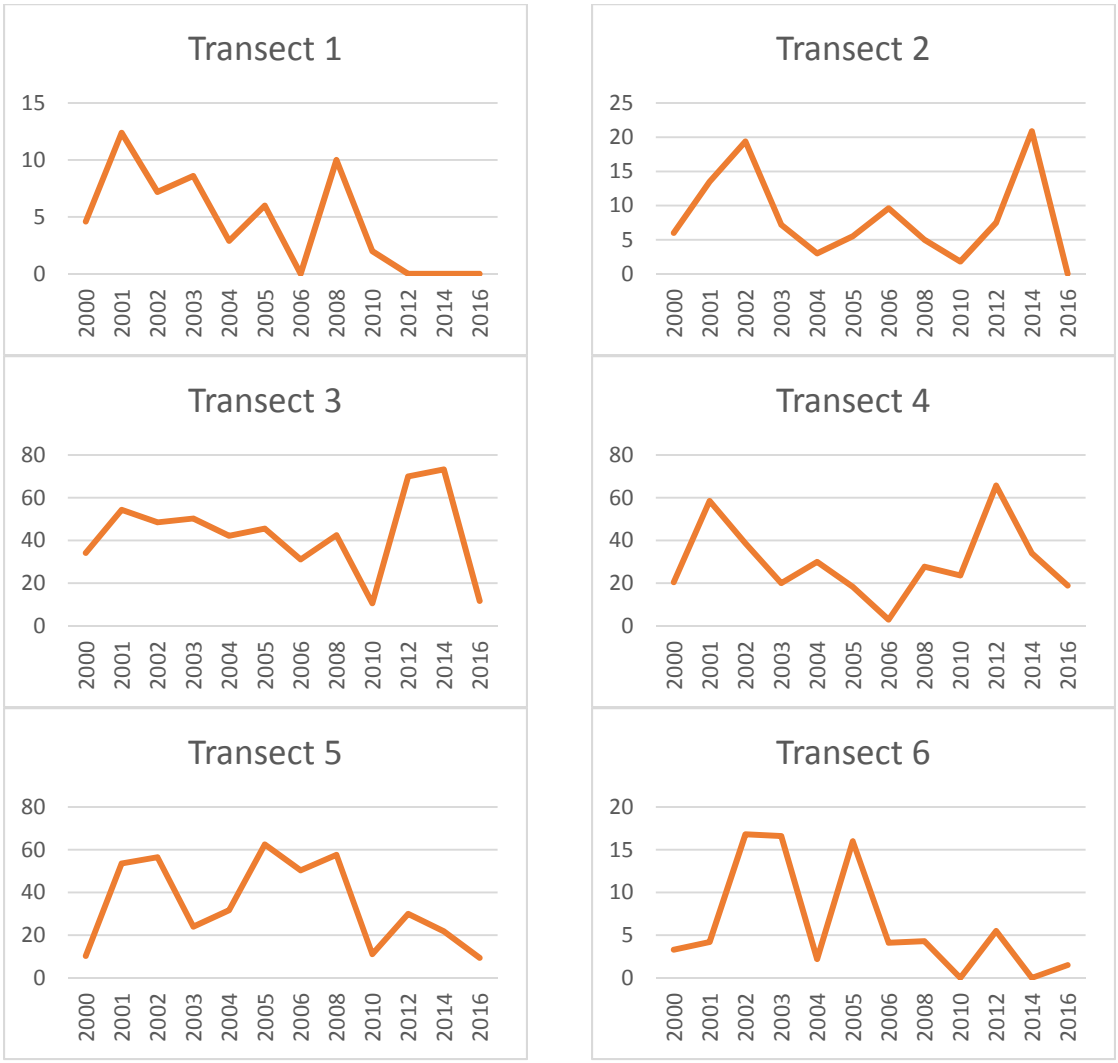
T-10, Transect 10 (MU Owl and Buckeye Canyons; Essential) is located east of Buckeye Canyon and follows an existing gravel, PG&E road (Figure 3). The maximum and average S/H on this transect in 2016 were 9.1 and 12.3 respectively. The 2016 maximum S/H was the lowest recorded over the 12 sample years since 2000. Callippes were very abundant on this transect in 2012 and 2014.

T-11, Transect 11 (Ridge Trail, not associated with specific MU; Essential) follows the eastern portion of the Southeast Ridge (Figure 3). 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. However, for 2016, there was a marked decline in observations, with an average and maximum S/H of 6.3 and 18.8, respectively. This is down from average and maximum S/H of 111.5 and 182.1 in 2014, which was the highest encounter rate ever documented on this transect or on any transect since fixed transect surveys began in 2000.

T-12, Transect 12 (MU Southeast Ridge; Valuable and Essential) follows the Southeast Ridge east and down to the mountain's base near Bayshore Boulevard (Figure 3). 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. The maximum S/H recorded in 2016 was 4.5, which is also a considerable decline from recent years.

T-13, Transect 13 (MU Carter Martin; Essential) 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.

Overall, all transects showed a decline in CS observations in 2016 when compared to counts and calculated sightings per hour in 2014.



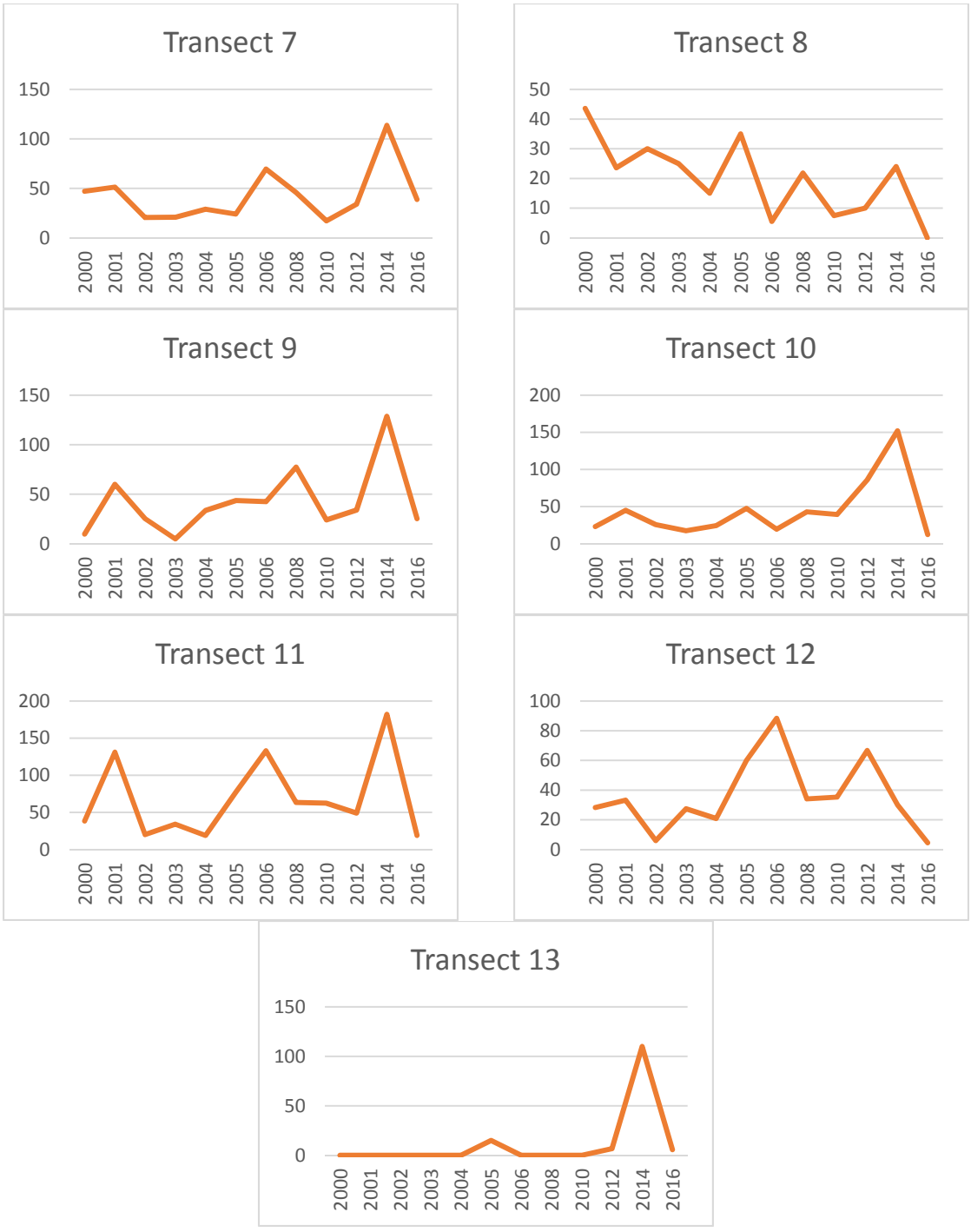


Figure 1. Individual Transect Callippe Silverspot Observations by Year

Table 1. Average Sightings per Hour All Fixed Transects, 2016

Average S/H on each Transect from 2000 to 2016												
Year/Transect	2000	2001	2002	2003	2004	2005	2006	2008	2010	2012	2014	2016
1	2.3	4.2	2.5	1.4	1.2	1.6	0	4.4	2	0	0	0
2	3.2	5	10.2	3.2	1.7	2.4	3	0.5	1	1.8	13.4	0
3	16.5	21.4	31.1	32.1	23.4	23.1	12.1	14.5	3.6	23.3	57	8.8
4	12.3	26.1	16.1	7.7	11.5	5.5	3.5	11.2	13.6	32.7	24.7	7.3
5	5.2	28.7	23.9	10	16.7	26.2	14.7	16.9	7.7	17.8	15.3	2.6
6	1.1	1.4	9.1	6.9	0.8	4.2	1.4	2.2	0	1.3	0	0.5
7	20.4	25.1	9.8	10.9	13	16.6	25.4	30.5	20.2	18.1	72.5	22.5
8	18.6	10.5	17.2	7.6	5.9	11.4	4.8	12.5	3.3	5	12	0
9	5.2	24.5	16.2	1.6	5.5	19	13.7	55.6	14.6	22.5	61.5	14.4
10	11.5	37.9	13.7	5.7	6.2	21	15.1	23	28.6	68.1	71.9	9.1
11	25.4	79	14.4	18.4	8.2	37.6	37.4	35.6	38.6	23.7	111.5	6.3
12	14.2	20.1	2	6.8	11.4	18.9	34.2	17.2	23.9	26.7	15.4	2.5
13	N/A	N/A	N/A	N/A	N/A	5.2	0	0	0	3.3	30	2.7

Table 2. Maximum Sightings per Hour All Fixed Transects, 2016

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

DISCUSSION

CS observations were much lower than in 2014 with only 225 callippe's seen along transects and an additional 55 incidental observations. In 2016, the greatest number of CS recorded per hour was on transects 7, 9, 4, and11 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 Figures 2 & 3. Transect 9 climbs the ridge adjacent to Owl Canyon and intersects with Transect 7 at its terminus on the top of the mountain's main ridge that runs east/ west. Observations along T-7 are clustered in two areas, a micro hilltop area about a third of the way up and the balance are clustered on the top of the main ridge, along the Ridge Trail. Transect 4 traverses the small ridge just north of the Northeast Ridge/ Callippe Hill on its eastern side. Observations are clustered in an area where scrub is rapidly colonizing an area above the Linda Vista neighborhood.

Transects that performed the worst in 2016 include 1, 2, and 8 with no observations of callippe silverspot adults recorded. This is the first time since 2000 that no CS were observed on transect 8. Annual reports have reported for several years that scrub encroachment has been impacting the quality of the habitat and has shortened the length of the original transect. Transect 6 had the fewest sightings of CS in 2016, however in 2010 and 2014 no observations were recorded on this transect. According to past annual reports T-6 historically intersects only limited viola populations. The overall CS population data from 2016 appears to be more similar to observations from 2010. Transects 3, 5, and 9 maximum sightings are fairly consistent between 2010 and 2016.

Within a single transect, CS abundance varies from year to year as you can see in the transect line in Figure 1. Data variability from year to year is attributed 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 on 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). Callippe silverspot monitoring in 2016 was initiated by Parks Department staff who were trained by previous Habitat Manager, Patrick Kobernus. Despite the best efforts of monitors' cool weather conditions appeared to be a factor in 2016. 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 1997, June 2016 monitoring rounds all contained transects 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. These areas included the Ridge Trail and Owl & Buckeye Canyon transects.

The cool foggy conditions in June 2016 may have ultimately impacted observation numbers as the highest counts were obtained on May 31st when temperatures were recorded with a Kestrel 2500® device in the 70's and 80's with little to no wind. Despite the new adult butterfly monitors, the level of field effort in 2016 amounted to a 31 hours on transects over four rounds of surveys. This is almost a three-fold increase in the level of effort from the 2014 CS surveys which had just over 12-hours spent on transects total. 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). The 2014-15 and 2015-16 rainfall years were average

or modestly above average. 2016 rainfall (July 2015- June 2016) returned to above average (~ 20-inches per year) conditions with 23.26 inches recorded at San Francisco International Airport for the rain-year. Both years had high rain fall amounts in January and February. The 2014-15 rain season was the first year since 2011 that rainfall totaled above 20-inches. This additional rain likely favored non-native annual grass growth and could have suppressed *Viola* populations due to height and thatch build up. The last CS season had experienced drought conditions which appeared to favor the overall callippe silverspot population on the mountain.

> *"Our data imply that the drought did not negatively affect Callippe silverspot 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 callippe silverspot functional habitat.

It is assumed that higher-yielding transects intersect the greatest amount of hilltop and Viola habitat, including, 3, 5, 7, 9, and 11. As mentioned earlier transects 7, 9, 4, and 11 were the best performers in 2016. These four transects accounted for 156 out of the 225 total observations along transects. If we add in transects 3 and 10 these six transect accounted for 205 CS observations along transects and all in prime habitat with a hilltop component. In 2014, transects 11, 10, 7, 3, and 5 also performed well. Many of 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" still yielded observations. Of the incidental observations that did not contribute to the official transect observations T-9, 10, and 3 consistently yielded observations even in cool weather conditions. These transects should be carefully evaluated in terms of the essential habitat components present throughout the area. Based on this evaluation it may be possible to develop a habitat quality ranking to aid in habitat management activities.

The 2016 data supports the concept that in our core grassland areas callippe 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.

CONCLUSION

Despite the lower adult callippe silverspot butterfly observations in 2016, these numbers are likely not outside the range of variability for the overall population contained within the San Bruno Mountain Habitat Conservation plan area. The last two monitoring years have not been included in recent statistical analysis done by Creekside Science, it is hard to confirm that 2016's data does not indicate a decline in the callippe silverspot density index. 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 hills that make up the SBMHCP area. An analysis of individual transects and year to year variation based on the last twelve 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 lower observations observed in 2016 do not seem unreasonably low. Until statistical analysis is available to confirm a downward trend, 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 and 2016 callippe silverspot 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 callippe silverspot and mission blue. 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 suggests 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 the interaction's environmental outcome on the land. As an example, if non-native grass and thatch production is negatively associated with the density of callippe silverspot 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 callippe and the mission blue 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 mission blue and callippe silverspot butterflies. However, the quality of the remaining grassland should also be considered. If host plant monitoring or specific habitat components were monitored and analyzed with CS or MB index data it would be 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 say with any certainty *why* 2016 had fewer CS observations than in previous years. 2016 had 280 total observations (official and incidental), and does not appear to be considerably different from 2010 (260) 2012 (294) observation results. However, a sizable drop did occur from 2014 to 2016. 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 callippe silverspot 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 a better understanding of callippe silverspot host plant and essential habitat components are better understood, it is difficult to determine the best management approach to improve habitat quality. However, if we can examine the habitat conditions in drought years with corresponding high CS observations, it may help us determine a set of habitat conditions to manage for. The 2016 observation data appears to be within the range of variability observed throughout the life of the HCP. 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 data into statistical models: temperature, rainfall, and solar radiation. When available vegetation 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

Callippe silverspot host and nectar plant monitoring has not been a recent priority, as a result of budget constraints and increasing costs associated with exotic species control and butterfly monitoring. CS host plants and nectar plants are a critical part of the CS lifecycle and intimately tied to the health of the population.

Consider incorporation of periodic host plant or habitat feature monitoring:

4. Implement host plant monitoring at regular intervals, perhaps every five-years. Start by updating the map of Viola patches. The last map was developed in 2005 based on surveys from 2002, 2004, and 2005 (TRA 2006).

5. Consider using quality rankings (e.g. low, medium, high) could be developed based on density of viola in the mapped patch.

6. Consider mapping essential habitat features in areas 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

Scrub encroachment continues to be a serious threat to grasslands that support been identified as a threat to covered species throughout the HCP and in all documents that provide habitat and vegetation management suggestions to date.

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

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

San Bruno Elfin (*Callophrys mossii bayensis*)

San Bruno elfin are closely associated with their host plant, Pacific stonecrop (*Sedum spathulifolium*), which grows within higher elevation grasslands on northeast to northwest facing slopes. San Bruno elfin 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 flower heads typically for 2-3 weeks occurring in May and/or June.

San Bruno elfin larvae are preferable to survey over adults as they are conspicuous, less sensitive to weather, and their movement is limited to sedum flower heads. Eight fixed permanent points for monitoring SBE larvae were established in 1998 and these were monitored every year from 1999 to 2003 (Figure 5). 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, and 2016. In 2012, monitoring was not conducted in order to allocate funds to presence/absences surveys for CS and MB. We now have ten 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 San Bruno Mountain HCP did not affect this species, and therefore monitoring and management for this species and its habitat was not a requirement of the HCP permit. However, this species' habitat partly overlaps with that of the mission blue and Callippe silverspot, 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 one survey points 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 systematically monitors 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 5.

RESULTS

Three larvae survey rounds were performed in 2016: May 3-6; May 17-20; and May 20-24. The timing for these surveys was based on presence of SBE larvae and the blooming stage of the sedum, as in previous years. A site visit on April 29th found larvae present on sedum despite the majority of sedum not in bloom, therefore the first survey was scheduled. During the second survey, most sedum was in peak bloom and the second and third surveys were scheduled back to back due to the stage of sedum bloom.

A total of 156 larvae were counted at all eight monitoring points during the first round of surveys, from May 3rd to 6th. The following two survey rounds were performed in immediate succession, from May 17th to 20th, then from May 20th to 24th. This was due to a noted decline in larvae at all survey points following the first monitoring period. For the second monitoring period, 95 larvae were counted at all eight survey points, and 69 were counted during the third monitoring period (Table 4). In 2016 a total of 320 SBE larvae were counted.

The last several years of monitoring are in Table 1 below.

Table 3. Annual San Bruno Elfin Counts 1999-2016

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

Table 4. San Bruno Elfin Larvae Counts at 8 Permanent Plots

San Bruno Elfin Larvae Observations for 2016 Monitoring Period						
Monitoring Point	Date	Larvae Count	Management Unit Name	Temp	Wind Speed	Flower Development Stage*
Monitoring Round 1 (May 3-6)						
6	May 6th	12	Devil's Arroyo	55	3	1
7	May 3rd	50	Devil's Arroyo	66	10	1
8	May 3rd	22	Devil's Arroyo	55	15	1
13	May 3rd	12	Devil's Arroyo	62	3	1
15	May 6th	25	Dairy & Wax Myrtle	52	0	1
16	May 5th	21	Dairy & Wax Myrtle	65	3	1
17	May 6th	12	Dairy & Wax Myrtle	57	3	1
19	May 5th	2	April Brook	65	3	1
Larvae Subtotal		156				
Monitoring Round 2 (May 17-20)						

6	May 20th	8	Devil's Arroyo	59	15	3
7	May 17th	17	Devil's Arroyo	75	5	3
8	May 17th	21	Devil's Arroyo	79	5	3
13	May 19th	9	Devil's Arroyo	60	20	3
15	May 18th	18	Dairy & Wax Myrtle	61	11	3
16	May 18th	10	Dairy & Wax Myrtle	70	5	3
17	May 19th	9	Dairy & Wax Myrtle	60	20	3
19	May 20th	3	April Brook	54	20	3
Larvae Subtotal		95				
Monitoring Round 3 (May 20- 24)						
6	May 24th	5	Devil's Arroyo	50	10	3
7	May 20th	13	Devil's Arroyo	55	15	3
8	May 20th	24	Devil's Arroyo	60	15	3
13	May 24th	3	Devil's Arroyo	62	5	3
15	May 23rd	6	Dairy & Wax Myrtle	54	5	3
16	May 23rd	9	Dairy & Wax Myrtle	62	18	3
17	May 23rd	6	Dairy & Wax Myrtle	60	6	3
19	May 24th	3	April Brook	60	6	3
Larvae Subtotal		69				
2016 Larvae Total		**320**				

*Flower Development Stages: 1 = most sedum not in flower; 3 = sedum in flower, some still blooming, some dying; 5 = most flowers dying

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, similar to 2014, the highest 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 more than double what was observed in 2014 – although an additional survey period was completed this year. The first monitoring period for 2016 alone accounts for a greater number of larvae observed than in all of 2014.

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 2016 and 2014 results it maybe that larvae are emerging earlier than previous monitoring years. It is unclear why this may be occurring. In 2016 the surveys were implemented ahead of peak sedum bloom due to larvae presence and many larvae were observed feeding on sedum leaves. This potential shift in emergence could account for the first counts in both 2014 and 2016 as having the highest larvae numbers recorded.

The last two rounds of larvae surveys were implemented back to back due to a marked decline in the larvae count totals. Concerns could be raised about the fact that only four days separated the second and third survey at each permanent survey point. It is unclear how long third and fourth instar larvae feed on the leaves and flower heads before they pupate. According to Arnold (1980) fourth instars spend approximately three days in prepupal stage at the base of the plants. If only considering the first two rounds of surveys in 2016 they would have still yielded 251 observed SBE larvae, well above 2014 numbers.

Based on the consistent number of larvae observed at these 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 callippe silverspot 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

San Bruno elfin 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. San Bruno elfin monitoring is also discussed in the Assessment. Based on the Assessment and the 2016 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 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 mission blue and callippe silverspot 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

9. 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.

10. Consider a longer monitoring interval for SBE larvae counts. Continue with the methodology implemented in 2016 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 within one to two days to reduce temporal variation between points. Next survey should be in 2020.

11. 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.

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-1980's. This species has not been observed on SBM in almost 30 years. No BCB larvae or adults were observed on San Bruno Mountain by field crews while conducting biological activities and overseeing development activities in 2016. In October 2000, the U.S. Fish and Wildlife Service (USFWS) proposed critical habitat for the BCB, followed by a Final Rule issuance on the critical habitat designation in April 2001. The critical habitat designation includes the historic BCB habitat on the main ridge of San Bruno Mountain. This species must be taken into account when planning any activities that could impact BCB habitat. Potential efforts to reintroduce this species to the Mountain may occur in 2017.

San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*)
The San Francisco garter snake (SFGS) was identified in the San Bruno Mountain HCP (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 2016. There have been no confirmed observations of SFGS on San Bruno Mountain in over 30 years of the HCP monitoring program. Based on the lack of significant ponds and other aquatic habitats, this species is unlikely to be present.

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 HCP, 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 2016. There have been no confirmed observations of CRLF on San Bruno Mountain in over 30 years of the HCP monitoring program. Based on the lack of significant ponds and other aquatic habitats on San Bruno Mountain, it is unlikely this species is present.

Plants of Concern
County Parks initiated a rare, threatened, and endangered (RTE) plant survey in 2015 and a final report was submitted in 2016. Funds to support this effort were provided through the Measure A and approved by the San Mateo County Board of Supervisors. The survey implemented a systematic approach to locate and map all twenty species if possible, and complete California Natural Diversity Database forms complete with photographs. The goal would be to find ways to incorporate protection and appropriate habitat management that will benefit not only the protected butterfly species but rather the whole of the diversity found

within SBMHCP area. Where covered butterfly species habitat management is complementary to RTE habitat management attempts to include RTE management considerations should be considered.

The final report executive summary and species list is contained in Appendix B. Of note, *Silene verecunda* was located after the completion of the report in 2016.

VEGETATION AND HABITAT MANAGEMENT

This section describes efforts to address scrub encroachment and control and containment of specific invasive species as part of the 2016 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, HCP Volume I, 1982). This management approach has been in use since the inception of the HCP. 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 continued into 2016 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 San Bruno Mountain Area Habitat Conservation Plan (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. During the course of the 2015-16 fiscal year Shelterbelt Builders Incorporated (SBI) experimented with a variety of techniques for effective scrub control in essential grassland habitats. SBI recommendations from the efficacy of the different techniques will be incorporated into scrub management efforts moving forward.

In 2016 Shelterbelt Builders Incorporated (SBI), West Coast Wildlands (WCW), Ecological Concerns Incorporated (ECI), and Go Native Incorporated (GNI) implemented vegetation management within the SBMHCP area. SBI completed contracted work from January to June as part of the fiscal year 2015-16 scope of work. ECI carried out scrub and invasive work in fiscal year 2016-17 beginning in November. GNI initiated work in areas that had a funding balance from the dedication of Terrabay lands. And WCW has continued contract work on targeted projects on lands owned by County Parks and private organizations 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 HCP. Current groups involved are: California Native Plant Society (CNPS) volunteers, San Bruno Mountain Watch (SBMW), City of Brisbane, Toll Brothers Inc., and Terra Bay Master HOA.

Vegetation Management Methods

Three primary methods are employed for invasive species control, these include handwork, mechanical, and selective herbicide applications. Table 5 includes treatment timing.

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 Polaski 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. Species include listed annuals and perennial plants discussed in Table 1. 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. Species include the woody plants and trees listed in Table 1. Thin-line 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.

APPROACH

Sites targeted for work are generally visited approximately twice annually and in some cases more. Progress for WCW is denoted on daily data sheets with an accompanying aerial photo. These data sheets reflect treatment management units, treatment method, work effort, weather data, and specific work sites denoted on the aerial photo/map for each day. County Parks recently deployed use of a digital Collector form for all other work within SBMHCP area. The data captured in these digital forms corresponds to the data WCW collected over the last thirty-years of habitat management activities. The benefit of transitioning to this data collection methodology translates to annual treatments and activities are automatically integrated into the a digital record that can be tracked over time 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 6 shows the progress made by Shelterbelt implementing the scrub management work between January and June 2016. And work continued in the same areas by ECI in the fall of 2016.

<u>Vegetation Management Discussion by Management Unit</u>

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 7 for locations of individual management units.

1. SOUTHEAST RIDGE (191 acres)

The unit has significant mission blue and callippe silverspot habitat along the upper ridgelines and on the northern slopes between Bayshore Boulevard and the ridge. Significant patches of mission blue 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 the mission blue (MB), callippe

silverspot (CS) and moderate habitat value for native plant diversity and dominance according to the SBM HMP (2008). San Bruno elfin (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 only had a total of 2.53 acres treated in the SBI contract. Additional work has been initiated by GNI in the parcels dedicated to mitigate for the final Terrabay development. Beginning in the fall of 2016 parcel 6 has undergone treatment for fennel and scrub containment. A total of 99 acres has been identified for targeted scrub and fennel treatments in the large open grasslands of this MU using herbicide and handwork methods. A small patch of coyote brush was targeted and removed using manual and mechanical methods along the Ridge Trail in this MU to release silver lupine populations that support occupied MB habitat. (SBMW) carried out restoration plantings in this area.

Restoration work was carried out by San Bruno Mountain Watch (SBMW) with native host and nectar plants establishment for covered species. Additional information about SBMW activities can be read in the Appendix C. Invasive species control will be necessary in the next few years to protect the highest quality occupied habitat from degradation.

2. BRISBANE ACRES (190 acres)

The Brisbane Acres MU is considered high habitat value for the mission blue (MB), callippe silverspot (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 mission blue and Callippe silverspot habitat along the upper ridgelines. Significant patches of mission blue 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 San Bruno elfin. 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.

This MU had a limited amount of work implemented in the unit due to funding constraints, however, a 2.03 acre patch of high quality habitat was targeted for scrub treatment in the upper grasslands below the Ridge Trail. SBI completed scrub treatment of 2.73 acres with the thin-line method of herbicide application in 2016. Mustard, radish, oxalis, and thistle were the main targets along the Ridge Trail in this MU. These areas were targeted to protect patches of silver lupine and Viola populations that support occupied MB and CS habitat. 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 2016.

The City of Brisbane conducts vegetation maintenance in this MU annually based on budget allocations. Work to contain eucalyptus from spreading into conserved habitat managed by County Parks was undertaken this year. 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 callippe silverspot and mission blue 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 non-native annual grasses and undergoing scrub encroachment.

Areas under the jurisdiction of County Parks and private property were treated in this MU. Scrub control was initiated in approximately four acres of occupied habitat and 6.73 acres were treated by SBI with a foliar herbicide application.

There is French broom and fennel scattered up slope of the Terrabay development and drainage sites and along the old fire roads/trails. Treatment of these areas is scheduled for 2017 by GNI with the funding provided by the developer for mitigation of the final phase of development.

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 San Bruno elfin 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.

Approximately seventeen acres of scrub treatment was prioritized last fiscal year and an additional 55 acres were added this year. Treatment over 2016 included just over 55 acres with scrub control as the primary focus. Foliar, thin-line and limited cut and paint herbicide applications were used. ECI has focused on core grassland areas in fall 2016. Scrub control in the essential grassland areas should continue as a management priority for 2017 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 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 callippe silverspot and mission blue butterflies. Grasslands are the dominant community and abundant host plants for both the callippe silverspot and mission blue are present. Plant communities include valley needlegrass 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 Mission Blue 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. WCW carries out vegetation management activities for the private landowner within this MU. In 2016 WCW continued to control fennel, French broom, Italian thistle, mustard, and oxalis. A combination of herbicide and manual methods were implemented. Due to the extensive work many of these populations are close to eradication or full control according to WCW reporting from 2015. Diligence will be needed to ensure that the remaining populations of these problematic weed species are not allowed to rebound. Scrub will need to be prioritized moving forward in this MU to protect the quality and extent of MB and CS habitat.

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 2016 this area was treated for fennel and oxalis primarily through 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 and Loretta Heimstadt) that have been diligently working to improve both occupied butterfly habitat and native plant diversity for several years. In 2016 the Heimstadt's 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 control in the essential grassland areas and oxalis have continued to be prioritized in this MU. Approximately 27 acres were treated in 2016. This area will continue to be an important management priority for 2017 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 HCP 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. Manual, mechanical, and herbicide methods were used for invasive and scrub control totaling in about 1.5 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 in December 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 2016, dailies and supporting documents can be found in the Appendix D.

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 15 percent 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. WCW has been working with McKesson to develop and implement a weed management and habitat restoration plan to improve and restore high quality habitat that will be dedicated to County Parks. The restoration and weed management plan was finalized in 2016. Due to the funding anticipated from the McKesson organization dedication, additional SBMHCP funds will be directed to augment these efforts in adjacent County lands. In 2016 2.5 acres of scrub control was implemented in the highest quality habitat found on County lands. 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. Mission blue habitat is scattered within patches of grassland and on fire roads along ridgelines. The federally endangered San Francisco Campion (*Silene verecunda* ssp. *verecunda*) is located within this unit on the upper slopes near Radio Road. This unit has only very small patches of habitat for the San Bruno elfin and callippe silverspot 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 10.4 acres 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 a new valve lot was installed along Hillside Blvd. PG&E initiated work to revegetate the valve lot and have initiated a weed management plan for this new development. In December PG&E initiated a project to clear woody species along their gas pipeline throughout the SBMHCP area. A requirement of this work

is ongoing weed management in the cleared areas to avoid potential invasive species recolonization. This vegetation clearance continues into portions of Devil's Arroyo and Hillside/ Juncus management units. Documentation provided by WCW outlines the work carried out in 2016 to support the PG&E mitigation for their gas line clearance work.

No funding was directed to be used in the MU due to other higher priority work areas.

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 mission blue and callippe silverspot habitat and is classified by the HMP as low habitat value for these species. However it provides moderate San Bruno elfin 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 2016 using HCP 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 Callippe silverspot and mission blue 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. HCP 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 gorse containment lines should be used and prioritized, however this was not carried out in 2016. These areas are planned for treatment in 2017 for scrub removal in essential grassland areas that are occupied and support both MB and CS populations. Limited gorse containment has also been prioritized for 2017.

CONCLUSIONS

Vegetation and habitat management continues toward a focus on scrub control initiated in 2015 and likely 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; fire is often the 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 HCP was established. The absence of these disturbances has resulted in a steady decline in high quality grassland and prairie habitat able to support mission blue and callippe silverspot 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 (826-1062 acres). The 2008 HMP established an acceptable range of grassland based on historical fluctuations to be between 1200 and 1800 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 treatment work focused on completing the 103 acres out of 431 essential grassland acres,

approximately twenty-four percent. In 2016 a total of 55 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 2016 Scope of Work (SOW), were identified based mission blue and callippe silverspot 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 host plant 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 2016 budget, funding will still be necessary to prevent habitat degradation due to invasive species infestations and non-native annual grass. In 2016, additional funds were allocated in the FY 2016/2017 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 gorse. 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 host plants where time and care are of upmost 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.

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 in different areas of the Mountain.

SCRUB ENCROACHMENT

Scrub encroachment is a serious threat to the existence and quality of grasslands and prairie habitats that support mission blue and Callippe silverspot 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 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-2, and T-8 occurred in 2016. 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 began in 2016 and will likely continue into 2017. 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 a starting point.

HOST AND NECTAR PLANT MONITORING

As discussed in the monitoring recommendations host and nectar plants are a critical link to determining habitat management needs. By initiating 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 2017 and refined over the next two 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.

Continued experimentation concerning different techniques to control tall competing vegetation should be 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.

COVERED SPECIES AND VEGETATION MANAGEMENT PARTICIPANTS

Annual report prepared by San Mateo County Parks' Natural Resource Manager, Ramona Arechiga, with contributions by Senior GIS Intern Hanah Ormshaw and Erik Schmeitt, and use of previous Activities reports from past habitat managers, Autumn Meisel and Patrick Kobernus. Monitoring in 2016 was implemented by Arechiga, Ormshaw, Michele Laskowski, Terris Kasteen, and Patrick Kobernus.

Habitat Management Activities were implemented by:

2016 Ecological Concerns Inc. Field Crew; Crew Lead Garrick Hansen.

2016 Go Native Inc. Field Crew; Crew Lead Chuck Koziak.

2016 Shelterbelt Builders Inc. Field Crew; Crew Lead Dan Brubaker.

2016 West Coast Wildands Field Crew; Crew Lead Mike Forbert.

San Bruno Mountain Watch Staff: Ariel Cherbowsky, Ildiko Polony, and countless dedicated volunteers.

CNPS Volunteers: Chuck and Loretta Heimstadt and their countless weeding volunteers; Doug Allshouse and David Nelson for their work to capture the spirit of the mountain in their natural history book.

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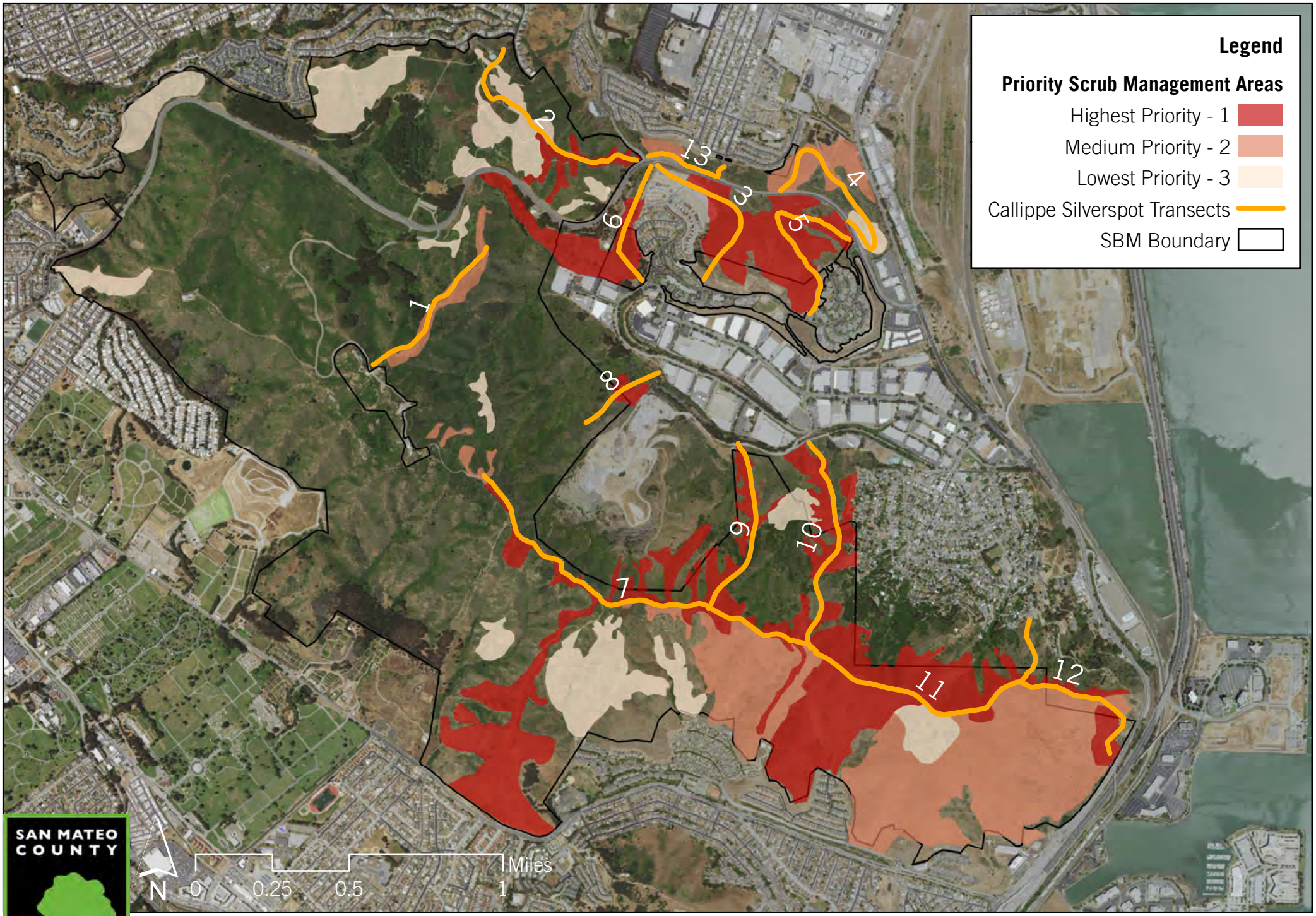

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SBM Callippe Transects & Scrub Management Areas

SAN MATEO COUNTY PARKS

SBM 2016 Callippe Silverspot Observations

Callippe Observations 2016

Callippe Silverspot Transect Lines

SBM 2010 & 2016 Callippe Silverspot Observations

SAN MATEO COUNTY PARKS

SBM Elfin Habitat & Monitoring Points

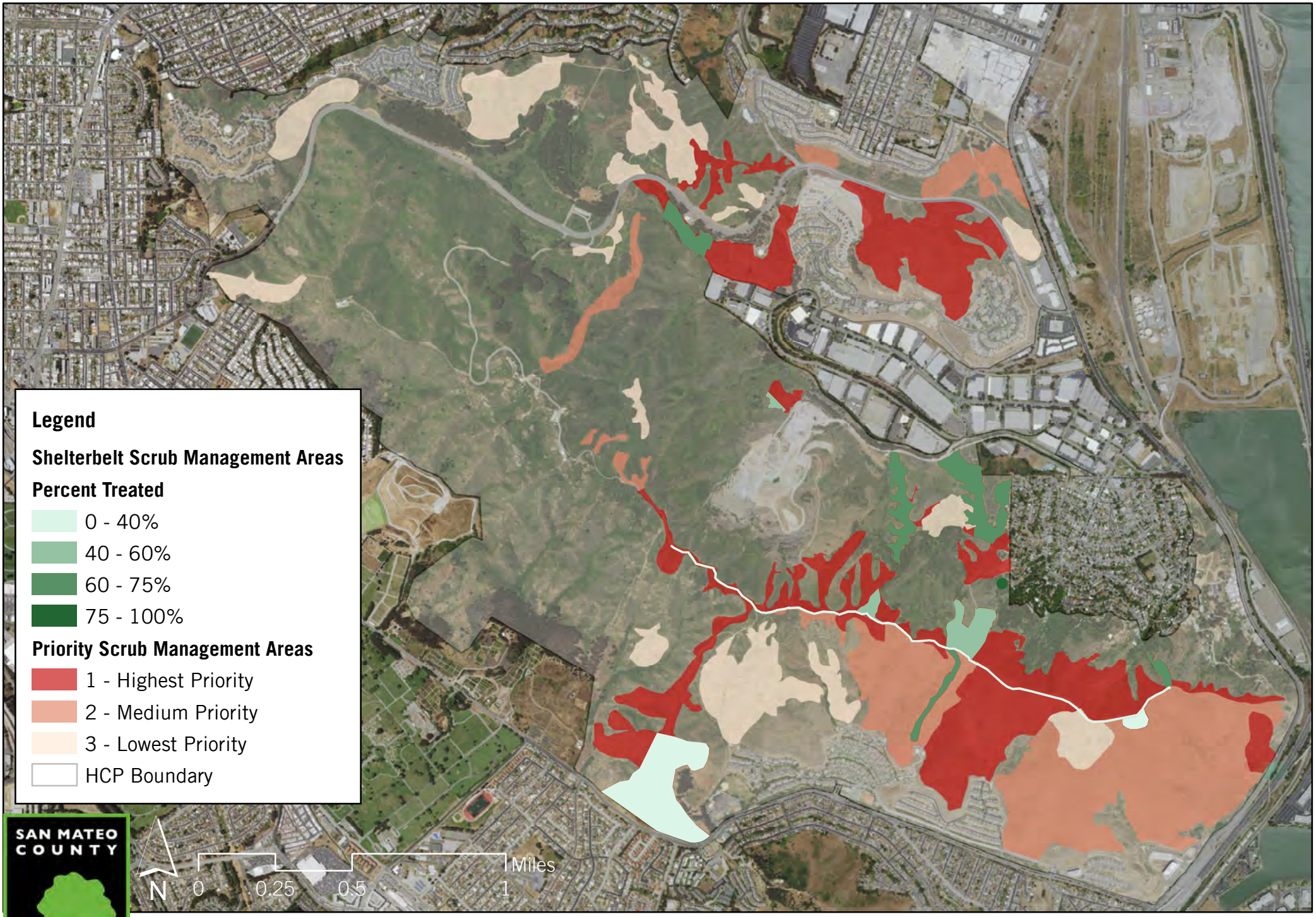
Table 4. Major Invasive Pest Plants on San Bruno Mountain and Current Hand/Herbicide/ or Mowing Treatment Methods for Each (2007).

Invasive Pest Plant Species	Area[8] (acres)	Treatment
Blue Gum *Eucalyptus spp.*	148	After trees are cut, stumps are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide
Fennel *Foeniculum vulgare*	90	Fennel is controlled by hand methods or with a 2% Garlon 4 herbicide. The plants are treated by basal foliar spray during the months of April and May prior to seed formation.
Gorse *Ulex europaeus*	34	Gorse is treated, by foliar spraying, year round with 2% Garlon 4 herbicide. Hand removal of seedlings is done when the population is greatly reduced.
French Broom *Genista monspessulana*	28	French broom is controlled with a 2% Roundup Pro (Glyphosate) herbicide throughout the year and with 2% Garlon 4 when fruiting perennial grasses are present. Hand removal of seedlings is done when the population is greatly reduced
Bermuda Buttercup *Oxalis pes-caprae*	25	Bermuda buttercup is controlled with a foliar application of 2% Galon 4/Roundup Pro mixture when a monoculture is present and 2% Garlon 4 when the infestation is intermixed with perennial grasses.
Striatus Broom *Cytisus striatus*	15	Striatus broom is controlled with a 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, year round with the same results. Hand removal of seedlings is done when the population is greatly reduced.
Monterey Cypress *Cupressus macrocarpa*	13	Monterey cypress trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.

[8] Acreages of invasives were calculated using a combination of GPS data and visual estimates in the field. * Estimates for herbaceous invasive acreages (mustards/radish, Italian thistle, bristly ox-tongue, poison hemlock.) were likely underestimated due to time and seasonal constraints on mapping.

Invasive Pest Plant Species	**Area[8] (acres)**	**Treatment**
Silver Mountain gum *Eucalyptus pulverulenta*	11	After trees are cut, stumps are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide.
Bristly ox-tongue*	9	Bristly ox-tongue is typically mowed 2-3 times prior to seed set, when present in predominately native grassland areas. For areas with dense invasive species, treatment may also include 2% Garlon 4 herbicide sprayed on the foliage prior to bolting.
English Ivy and German Ivy *Hedera helix & Delaria oderata*	7	English ivy and German ivy are controlled with 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, year round with the same results. A second application is done 3 to 6 months after the initial treatment. The entire site must be sprayed with herbicide to ensure no runners are missed.
Monterey Pine *Pinus radiate*	5	Monterey pine trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.
Pampas Grass *Cortaderia jubata*	4	Pampas grass is treated with 2% Round-up Pro. Treated primarily in summer months before seed formation, but can be treated year round.
Italian Thistle*	3	Italian thistle is treated successfully by repeated mowing, or with herbicide prior to bolting, with 2% Garlon 4 herbicide that is sprayed on the foliage.
Mustard/Radish* Brassica/Hirschfeldia/ Raphanus	3	Mustard and radish are treated, prior to flowering, with 2% Garlon 4 herbicide that is sprayed on the foliage.
Acacia sp.	3	Acacia trees are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide
Poison Hemlock* *Conium maculatum*	3	Poison hemlock is controlled with 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, during the months of April and May.
Iceplant *Carpobrotus edulis*	<1	Iceplant is treated with 1.5% or 2% Round-up (or Rodeo) herbicide. Plants are treated year round.

Invasive Pest Plant Species	**Area[8] (acres)**	**Treatment**
Cotoneaster *Cotoneaster spp.*	<1	Cotoneaster is cut at the base with a pruning or chain saw. The stumps are treated with 50% Garlon 4. The herbicide is sprayed on cut stumps within 30 minutes of cutting.
Echium *Echium pinanana*	<1	Echium are cut and the stumps are allowed to decay. Treatment is done in the Summer, prior to flowering, when the plants are more visible.
Hairy cat's ear (*Hypocharis radicata*)	UNK	Hand pulling and/or use of glyphosate.
Veldt Grass *Ehrharta erecta*	<1	Handwork is conducted with Polaski's and herbicide treatment with Aquamaster.
Lolium multiflorum	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Hordium murinum	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Holcus lanatus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Bromus diandrus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Briza maxima	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Harding grass (Phalaris	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Orchard grass	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Tall fescue	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Bromus hordeaceus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).



SBM Shelterbelt Builders Scrub Management 2015 Treatments

SAN MATEO COUNTY PARKS

SBM HCP Management Units

Management Units

Butterfly Host Plant Monitoring Protocol for San Bruno Mountain

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March 2016

Table of Contents

1.0 Overview and Purpose

This document outlines the monitoring procedures for tracking butterfly host plant populations on San Bruno Mountain (SBM). Outlined is a practical method for measuring density and size class of two butterfly species' host plants over time. This document represents a preliminary attempt to capture such results and will likely be improved and revised through further assessment.

While past data collection has primarily been qualitative, this protocol seeks to capture quantitative results on host plant density and size class. By enabling managers to identify and evaluate host plant populations this protocol will support efforts to protect endangered butterfly species on SBM.

Potential management action for protecting host plant habitat includes scrub treatment through manual, mechanical, or chemical (ie herbicides) removal. The data gathered through this methodology will enable managers to target areas of high priority butterfly habitat which must be protection from further scrub encroachment.

The Mission blue butterfly (MB) is a federally endangered species with the largest population found on SBM. The butterfly relies on three lupine species to host its larvae, *Lupinus albifrons*, *L. formosus*, and *L. variicolor,* all of which are subshrubs that can be found in rocky soils and coastal prairies.

In their thirty-year assessment, Creekside Science prioritized diversifying host plant populations as a recommendation for managing MB populations on SBM (Weiss, Naumovich and Niederer, 2015). This is important because in humid conditions *Lupinus albifrons* can succumb to infection from root crown fungus, negatively impacting MB populations. In diverse host plant stands MB are resistant to such fluctuations.

The Callippe silverspot butterfly (CS) is a federally endangered species which utilizes *Viola pedunculata* as its sole host plant. *V. pedunculata* is a small prostrate perennial that grows on north and south facing slopes. Clusters of viola provide high concentrations of food on which the energy-limited CS larvae feed.

2.0 Objectives

a) To monitor the density and size class of MB host plants, *L. albifrons, L. formosus,* and *L. variicolor,* along existing butterfly monitoring transects in areas of known high quality lupine habitat.

b) To monitor the density and size class of CS host plant, *Viola pedunculata,* along existing butterfly monitoring transects in areas of known high quality viola habitat.

c) To repeat monitoring cycle every five years in order to observe variations in perennial host plant populations. This information will inform qualitative metrics for habitat management.

3.0 Planning and Design

Lupinus albifrons, L. formosus, and *L. variicolor* grow in clusters throughout grasslands and on the thin soils of SBM. Shrub encroachment threatens lupine habitat, resulting in depressed recruitment levels and growth rates. According to the assessment presented by Creekside Science, scrub invasion is the number one threat to butterfly host plant populations (Weiss, Naumovich, and Niederer, 2015).

Viola pedunculata also relies on an open herbaceous layer, while vigorous annual grasses and woody species limit their dispersal. High host plant density is especially important for viola because larvae rely on their close proximity to feed and cannot traverse long distances in search of food.

The protocol's outcome is to asses the health of host plant populations by measuring density and age composition in host plant stands. A diverse demographic and a high density are key indicators of a healthy population. Robust recruitment levels are also important in ensuring the perpetuity of lupine and viola populations into the near future.

4.0 Methods Overview

This methodology was piloted in the winter of 2016. Data was gathered on host plant density by counting the number of individuals within a sample unit. Size class was sampled by measuring the diameter of each host plant.

Sample units for lupine surveys consisted of eight 100 ft^2 plots located along existing MB transects. Viola surveys were conducted following the Plotless Wandering Quarter Distance method, explained fully in section 6.3 Viola Data Collection. Sample units consisted of nine 100 m lengths along existing CS transects. Plots were chosen, not randomly selected, in areas where host plants were highly concentrated and therefore are representative of high quality butterfly habitat.

Overall vigor of lupines should also be considered when making management decisions. High density does not necessarily indicate vigor if certain stands of *Lupinus albifrons* are infected with crown rot within high quality MB habitat. Future monitoring and management decisions should take note of any signs of such fungus.

Sampling should begin several weeks after the onset of winter rains in order for *Viola pedunculata* to emerge from dormancy. Host plant monitoring continues from roughly the end of January through mid-March, when MB and CS butterfly monitoring takes priority. Note that *V. pedunculata* is dormant in the summer and fall. Timing will vary based on host plant and butterfly phenology. Data is to be resampled every five years to capture trends in the relatively slow-growing host plant populations.

5.0 Lupine Monitoring Methods

5.1 Equipment Needed

- string (brightly colored Masonry Twine was used) to outline plot boundaries
- marking flags to indicate plot corners
- 100 ft tape to measure plot length
- compass to delineate square plot
- tent stakes to secure string at plot corners
- paper datasheets, clipboard, and pencil to record data (see 10.0 Appendix)
- watch to record survey start time and duration
- tape measure to measure lupine diameter
- loose chalk to mark counted lupines
- paper or GPS with plot map to locate previous survey sites (points stored in GIS point shape files with plot latitude, and longitude)
- MB Butterfly Transects Map to locate survey site (see 10.0 Appendix)
- walkie-talkie in case of emergency

5.2 Layout and Marking

Surveys should be conducted by at least two people in order to ensure maximum efficiency and quality data collection.

Use 100 ft tape and compass to establish straight plot lengths. Outline plot boundary with string and secure with a tent stake at each corner. Mark corners with flags.

Capture new plot coordinates on GPS so the plot can be included in monitoring data. Plots should take no more than 30 minutes to delineate.

5.3 Data Collection

To begin survey, start at one corner and walk two abreast along plot side. Person 1 tallies number of individuals within each size class.

Lupine Size Class Based on Diameter

Small	Medium	Large
< 6 inches	6 - 12 inches	> 12 inches

Person 2 measures lupine diameter and marks lupine with chalk to avoid double counting. Chalk is most visible when applied on the soil at the base of each plant.

Note that lupines under 3 inches are not included in the tally. They are not significant in this protocol because they are too small to host MB. Instead, provide an estimation of their abundance at the end of the survey.

Not all lupines will be completely inside the plot, with some vegetation outside the boundary. Only count those lupines that have 50% or more of their vegetation within the plot. Clustered growth is counted as a single individual unless a separate vegetative or rooting mass can be distinguished.

Systematically walk back and forth throughout the entire plot. Survey duration is approximately 20 to 60 minutes for two people depending on host plant density.

Remove plot markets once all lupines have been tallied.

6.0 Viola Monitoring Methods

6.1 Equipment Needed

- 100 m tape for measuring survey length
- marking flags for marking survey length and violas
- square for creating a right angle to indicate survey area
- paper data sheets, clipboard, and pencil for recording data (see 10.0 Appendix)
- watch for recording survey start time and duration
- a tape measure for measuring viola distance and diameter
- paper or GIS Viola Transect Map to locate previous survey site (points stored in GIS point shape files with plot latitude and longitude)
- CS Butterfly Transects Map to locate survey site (see 10.0 Appendix)
- walkie-talkie in case of emergency

6.2 Layout and Marking

Surveys should be conducted by at least two people in order to ensure maximum efficiency and quality data collection.

Use CS Butterfly Transects Map to locate transects. Wandering transect lengths should be 100 m, or consist of multiple lengths with a cumulative distance of 100 m. If multiple lengths exist they should be spaced 25 m apart to prevent double counting between surveys. Lengths run approximately parallel to existing CS transects.

Set up plots around patches of 50 viola or more. From a single viola identified as the starting point use 100 m tape to measure 100 m approximately parallel to CS Transect. Pull the tape taut to create a straight line and lay on the ground to indicate direction of travel throughout the survey.

Capture new plot coordinates on GPS so the plot can be included in monitoring data.

6.3 Data Collection

To begin survey start at one end of the transect length. Person 1 tallies the distance between individuals within each size class. Person 2 measures the distance between the closest viola individuals within a 90 degree angle delineated by the square (see Diagram 1).

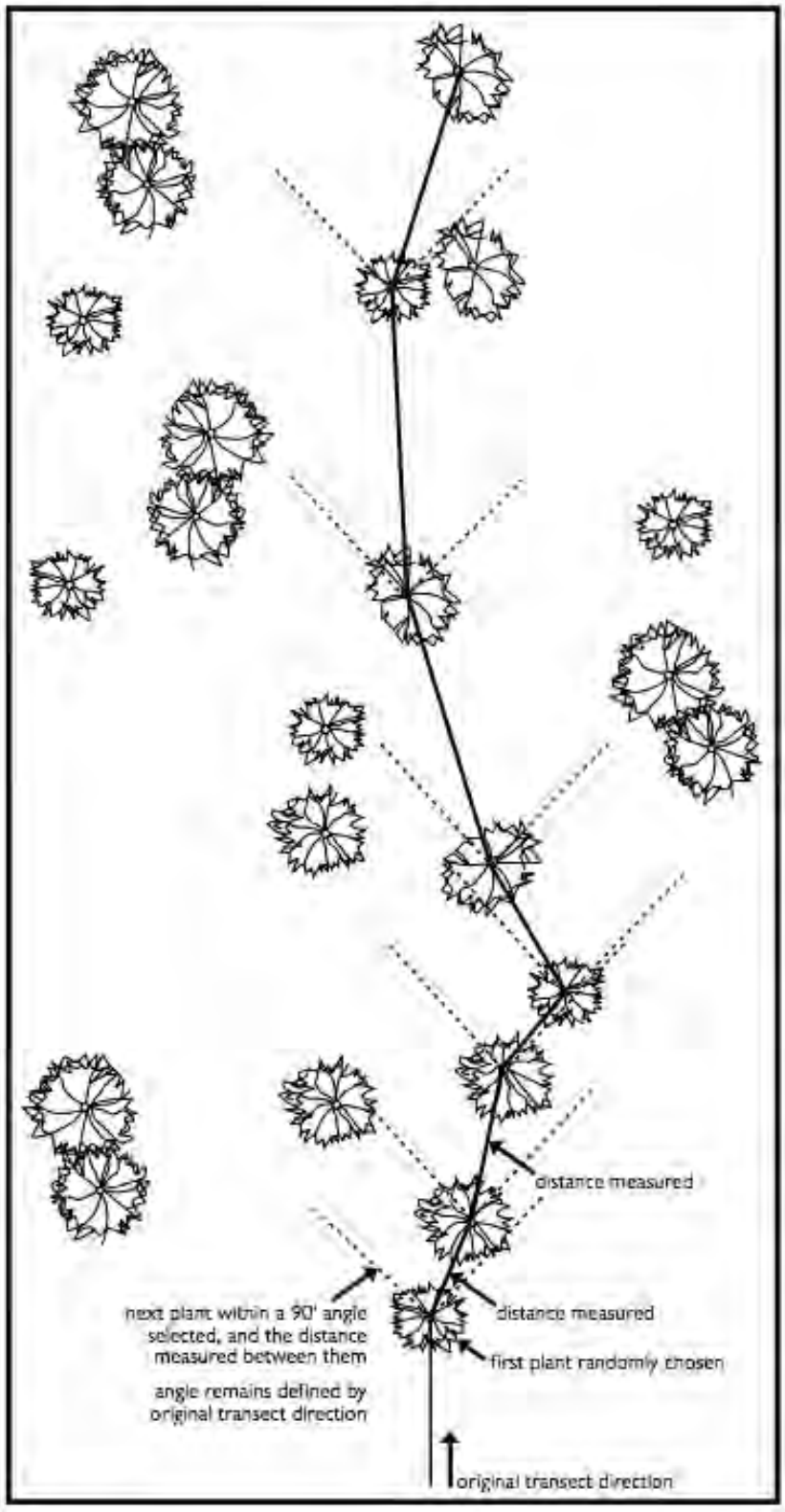
Viola Size Class Based on Diameter

Small	Medium	Large
< 6 inches	6 - 12 inches	> 12 inches

Not all viola will be completely inside the survey area. Only count those viola that have 50% or more of their vegetation within the survey area. Clustered growth is counted as a single individual unless a separate vegetative or rooting mass can be distinguished.

Survey duration is approximately 45 minutes for two people depending on host plant density.

Diagram 1: Plotless Wandering Quarter Distance Method (Elzinga et al. 1998).



7.0 Data Analysis

Calculate percentage of individuals per size class per plot to determine demographics and recruitment success.

Calculate host plant density (Density=number of individuals/area or D=n/a) to determine habitat quality. For lupine surveys, total area in m^2 is extrapolated to hectares in order to represent the broader scale at which management decisions are made. For viola surveys, total area is determined by calculating average distance between individuals before extrapolating to hectares. This is due to the fact that viola surveys lack a clear plot area. Read density as the number of individuals per hectare (ex: 600 lupines within one hectare).

The tables below provide a framework for assessing results to help identify management actions. They are a benchmark for such assessments and are subject to change with greater understanding of long term trends.

Lupine Habitat Quality Based on Lupine Density per Hectare

Low	Moderate	High
< 3,000	3,000 - 6,000	> 6,000

Viola Habitat Quality Based on Viola Density per Hectare

Low	Moderate	High
< 500,000	500,000 - 1,000,000	> 1,000,000

Host Plant Habitat Recruitment Success (SM/Total)

Low	Moderate	High
< 30 %	30% - 60%	> 60%

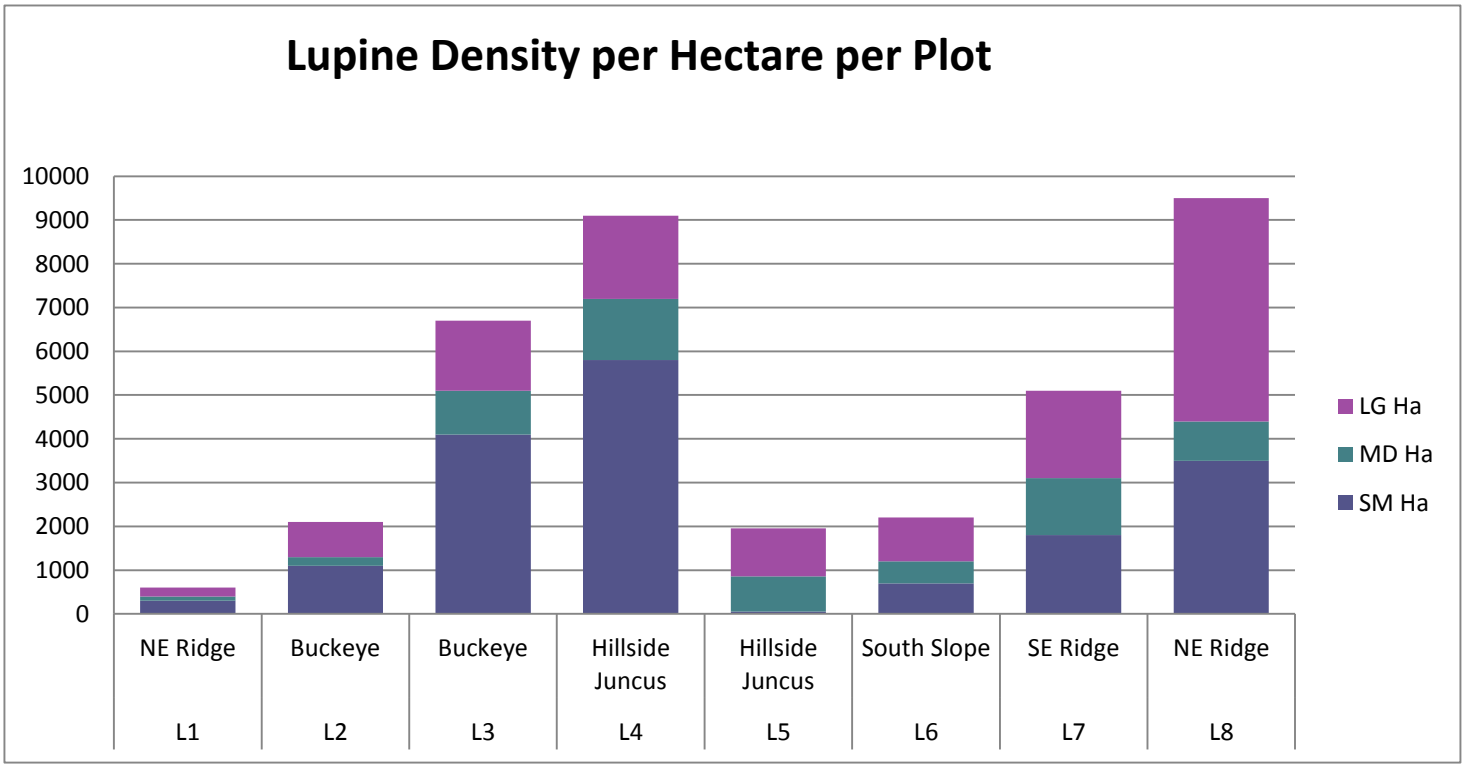
8.0 Results

Table 1: Winter 2016 Lupine Surveys

Plot ID	L1	L2	L3	L4	L5	L6	L7	L8
Local	NE Ridge	Buckeye	Buckeye	Hillside Juncus	Hillside Juncus	South Slope	SE Ridge	NE Ridge
SM (%)	25 (46.3)	103 (50.99)	384 (62.04)	542 (64.45)	534 (75.42)	65 (31.4)	171 (36.08)	324 (36.78)
MD (%)	6 (11.11)	22 (10.89)	90 (14.54)	126 (14.98)	76 (10.73)	49 (23.67)	118 (24.89)	86 (9.76)
LG (%)	23 (42.59)	77 (38.12)	145 (23.42)	173 (20.57)	98 (13.84)	93 (44.93)	185 (39.03)	471 (53.46)
Total	54	202	619	841	708	207	474	881
SM m² (ha)	0.03 (300)	0.11 (1100)	0.41 (4100)	0.58 (5800)	0.57 (5700)	0.07 (700)	0.18 (1800)	0.35 (3500)
MD m² (ha)	0.01 (100)	0.02 (200)	0.1 (1000)	0.14 (1400)	0.08 (800)	0.05 (500)	0.13 (1300)	0.09 (900)
LG m² (ha)	0.02 (200)	0.08 (800)	0.16 (1600)	0.19 (1900)	0.11 (1100)	0.1 (1000)	0.2 (2000)	0.51 (5100)
Total m² (ha)	0.06 (600)	0.22 (2200)	0.67 (6700)	0.91 (9100)	0.76 (7600)	0.22 (2200)	0.51 (5100)	0.95 (9500)

SM (%) - number and percentage of individuals within each size class
SM m² (ha) - m² density calculation with ha density calculation (1 ha = 10,000 sq m)

Graph 1: Winter 2016 Lupine Surveys



Overall, winter 2016 surveys show moderate to high levels (30 - 60%) of recruitment success, indicating that populations will continue to replace themselves into the near future. The densest plots were located in Buckeye Canyon, Hillside Juncus, and the North East Ridge. The North East Ridge plot L8 had the highest density at 9500 lupines per ha. L8 also had the lowest level of recruitment success (36.78%) and highest percentage of large individuals (53.46%). This location may undergo population fluctuations in the near future as larger lupines die off with fewer replacements. However, qualitative data suggests a greater potential for regeneration as 500 "tiny" lupines (less than 3 inches in diameter) were estimated at this location.

Hillside Juncus plots L4 and L5 had the highest recruitment success (64.45 - 75.42%) and high densities (7,600 - 9100 per ha). These locations have the greatest potential for an increase in population in the near future.

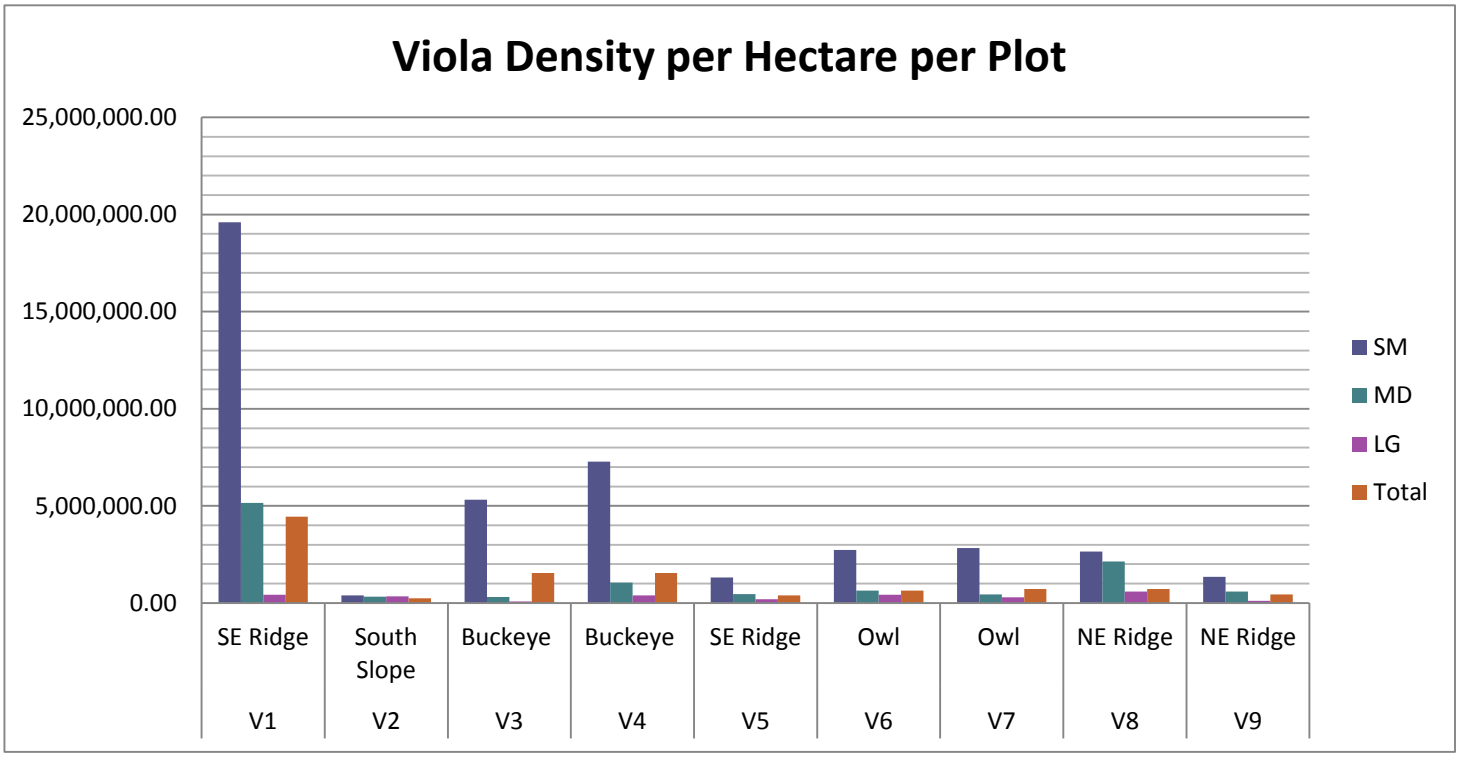
Medium individuals had the lowest success throughout all sites (9.76 - 24.89%) and may be a product of intraspecific competition or unfavorable conditions in the recent past.

Table 2: Winter 2016 Viola Surveys

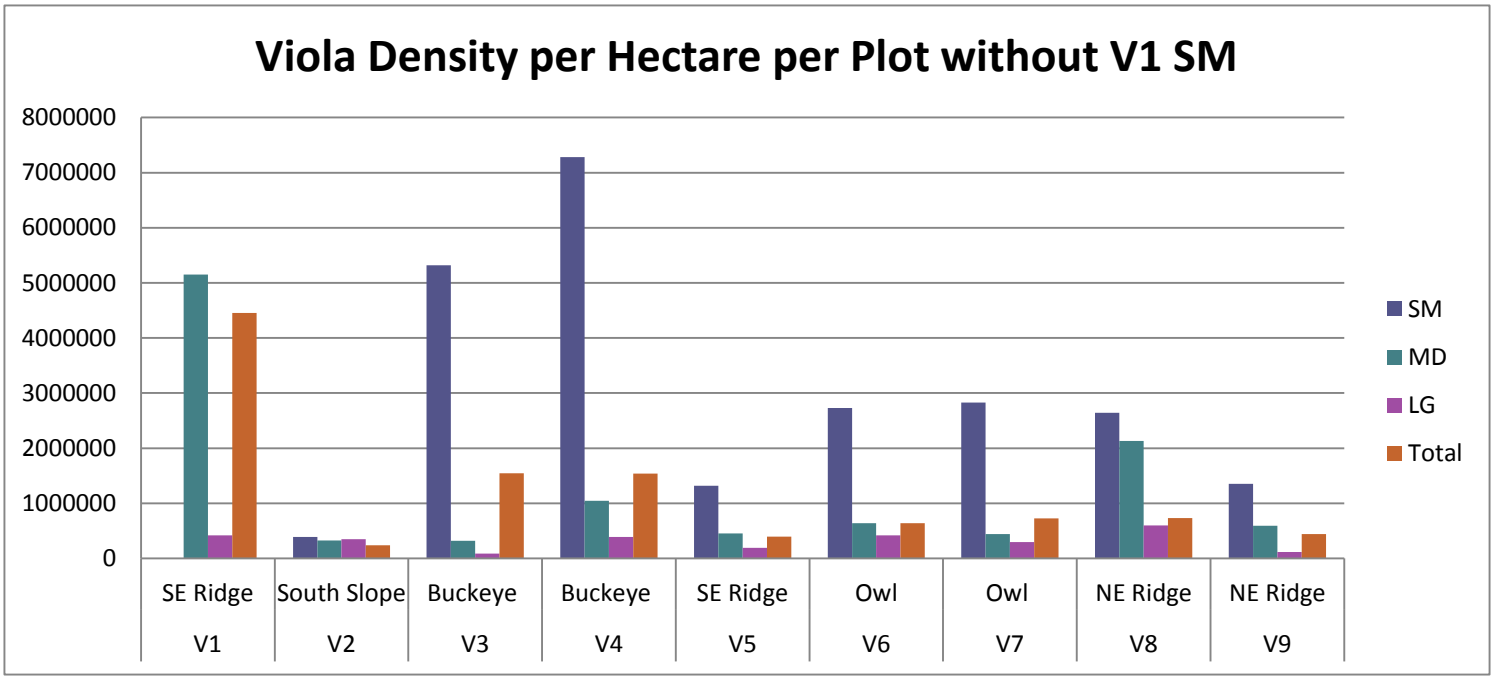
Plot ID	V1	V2	V3	V4	V5	V6	V7	V8	V9
Local	SE Ridge	South Slope	Buckeye	Buckeye	SE Ridge	Owl	Owl	NE Ridge	NE Ridge
SM cm (m)	27.66 (0.28)	78.44 (0.78)	44.22 (0.44)	37.24 (0.37)	55.07 (0.55)	44.5 (0.45)	47.55 (0.48)	40.34 (0.4)	59.54 (0.6)
MD cm (m)	44.93 (0.45)	119.43 (1.19)	107.92 (1.08)	70.54 (0.71)	86.66 (0.87)	84.99 (0.85)	101.09 (1.01)	36.88 (0.37)	75.9 (0.76)
LG cm (m)	53.54 (0.54)	90.91 (0.91)	121.54 (1.22)	99.06 (0.99)	141.91 (1.42)	104.65 (1.05)	107.65 (1.08)	100.33 (1)	171.53 (1.72)
Mean cm (m)	35.59 (0.36)	101.14 (1.01)	66.07 (0.66)	58.6 (0.59)	94.54 (0.95)	76.2 (0.76)	78.69 (0.79)	66.85 (0.67)	97.16 (0.97)
SM (%)	150 (56.39)	24 (24.24)	104 (67.53)	101 (52.88)	40 (35.4)	54 (36.99)	64 (44.76)	43 (32.58)	48 (41.38)
MD (%)	104 (39.1)	46 (46.46)	37 (24.03)	52 (27.23)	34 (30.09)	46 (31.51)	45 (31.47)	29 (21.97)	34 (29.31)
LG (%)	12 (4.51)	29 (29.29)	13 (8.44)	38 (19.9)	39 (34.51)	46 (31.51)	34 (23.78)	60 (45.45)	34 (29.31)
Total	266	99	154	191	113	146	143	132	116
SM m² (ha)	1960.51 (19605055.06)	39.01 (390111.92)	531.82 (5318245.29)	728.43 (7284269.41)	131.91 (1319088.71)	272.68 (2726830.37)	283.07 (2830745.67)	264.3 (2643017.42)	135.41 (1354124.48)
MD m² (ha)	515.12 (5151221.68)	32.25 (322496.61)	31.77 (317658.75)	104.52 (1045163.3)	45.27 (452682.22)	63.69 (636852.01)	44.03 (440330.67)	213.2 (2132049.74)	59.03 (590269.44)
LG m² (ha)	41.86 (418574.34)	35.09 (350919.23)	8.8 (88005.95)	38.72 (387246.01)	19.37 (193659.96)	42 (420045.14)	29.34 (293419.91)	59.61 (596059.52)	11.56 (115562.78)
Total m² (ha)	445.31 (4453058.4)	23.7 (236953.25)	154.72 (1547207.68)	154 (1540028.73)	39.61 (396080.16)	63.71 (637051.27)	72.29 (722869.36)	72.9 (728973.73)	43.84 (438389.53)

SM cm (m) - average distance between individuals per size class
SM (%) - number and percentage of individuals within each size class
SM m² (ha) - m² density calculation with ha density (1 ha = 10,000 sq m)

Graph 2: Winter 2016 Viola Surveys



Graph 3: Winter 2016 Viola Surveys



Graph excludes V1 SM in order to show lower density values for clearly.

For winter 2016 viols surveys, all but one plot had at least moderate recruitment success, indicating potential for plot regeneration over the coming years. Plot V3 had the highest recruitment success (67.53%).

Of the locations surveyed plot V2 had both the lowest recruitment success (24.24%) and lowest total density ($2.3 \text{ X } 10^5$ violas per ha). This location has the potential to host lower numbers of butterflies and experience a decline in population in the near future.

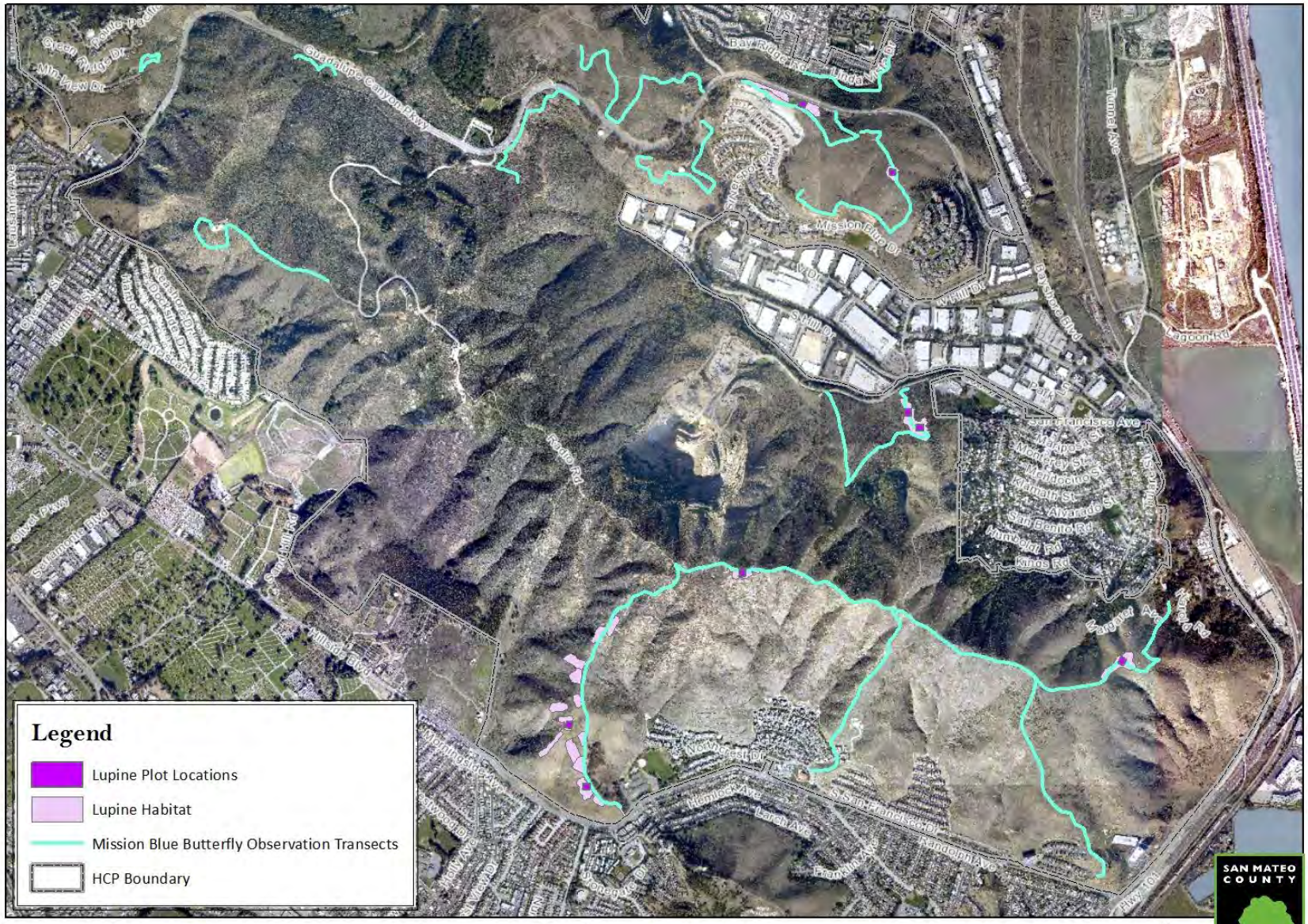
Small individuals in plot V1 had by far the greatest density at 2.0×10^6 violas per ha, more than 4 times that of the plot's total density. This trend is true for all plots where small individuals comprise the densest category and reflects the less competitive nature of smaller individuals. Although very dense, small violas in V1 had a moderate recruitment success (56.39%).

Plot V1 represents the highest quality habitat with the greatest overall density at 4.5×10^6 violas per ha, twice that of the closest competitor. Other locations with high quality habitat include Buckeye Canyon, with a density of 1.5×10^6 violas per ha. It is interesting to note the habitat similarity been Owl Canyon plots V6 and V7 which have a nearly identical demographic and density.

9.0 Conclusion

These results for 2016 winter surveys represent the first year of host plant density data collection on San Bruno Mountain and provide baseline values for understanding long term trends in populations. Potential future analysis includes correlating host plant habitat data with butterfly sightings to better understand MB and CS distribution. In addition, host plant data can be used in conjunction with scrub data to address areas where scrub encroachment threatens high quality butterfly habitat.

10.0 Appendix



San Bruno Mountain State and County Park:
Lupinus spp. Host Plant 1/4 acre Plot Locations

San Bruno Mountain State and County Park:
Viola pedunculata Host Plant Plotless Wandering Transect Locations

LUPINE / VIOLA
HOST PLANT DATA SHEET

Observer Name:		
Date:	Start Time:	
Butterfly Transect:	End Time:	
Plot ID:		
Location (Management Unit):		
Habitat:		
	SIZE CLASS	
Small (SM) <6 inches	Medium (MD) 6-12 inches	Large (LG) >12 inches
Tiny (TY) <3 inches Estimate:		

11.0 Works Cited

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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

Table of Contents

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.

Figure 1: Draft map of San Bruno Mountain with place names provided kindly by David Nelson.

San Bruno Mountain
Habitat Conservation Plan
Report on the 2015-2016 Planting Season

Prepared by

Ariel Cherbowsky Corkidi, Stewardship Coordinator

For the

San Mateo County Parks Department

November 2016

TABLE OF CONTENTS

SUMMARY

San Bruno Mountain Watch (SBMW) was contracted by the County of San Mateo to supply and plant 2,100 native plants in order to improve grassland habitat for the endangered Mission Blue and Callippe Silverspot butterflies. Planting was carried out at five different sites on San Bruno Mountain (OB-05, OB-03, OB-01, HJ-01, SR-02) with the assistance of community volunteers from November 2015 through February 2016.

At the end of October 2016, San Bruno Mountain Watch monitored 17.2% of the 2,100 plantings and determined that 61% of the plants monitored had survived.

Plant survivorship varied by site. In sites OB-03, OB-01, and SR-02, over 70% of the monitored plantings survived. In site HJ-01, almost 50% of the monitored plantings survived, while only 12% of the monitored plantings survived in site OB-05.

Plant survivorship, by species, by site, and by planting category (nectar plants, host plants, and grasses), is included in this report.

Due to the low quality of the flags and "permanent" markers that were used to tag individual plants for monitoring purposes, San Bruno Mountain Watch monitored 2.8% less plants than the expected 20%. Engravable metal plant tags will be used for all future monitoring purposes.

INTRODUCTION: SHADOWS, FLOWERS, AND SAVIORS

Is there such a thing as a perfect refuge?

San Bruno Mountain is a wonderful refuge, but those who might claim it as a perfect one don't understand it very well. San Bruno Mountain is a wonderful but conflicted refuge. So conflicted is the recent history of the mountain that even the definitions of the word "refuge" won't agree with each other when used to describe it.

A refuge is "something providing shelter," as San Bruno Mountain does, providing precious habitat to countless beings, human and non-human.

Its steep slopes rising above hunched canyons and its smooth ridges flowing with fog are well-known as the most significant sanctuaries of three species of delicate endangered butterflies and a tremendous collection of rare plants, some of which grow wild nowhere else on Earth.

The Ohlone shellmounds, village sites, and the little 20th and 21st century towns and neighborhoods tucked into its canyons, hillsides, and valleys reveal the mountain's significance as an ancient and continuing home for many people.

However, another meaning of refuge is "a condition of being safe or sheltered from pursuit, danger, or trouble," and the mountain is not in such a condition. San Bruno Mountain is not saved, as David Schooley and others who carry the saga of the mountain deep in their hearts cautiously remind us.

This may seem strange to hear at first, as it was for me, especially coming from David Schooley, one of the many great and powerful saviors of San Bruno Mountain. In Ravines of the Heart he writes, "quietly, I was drawn into a struggle that has lasted for over 40 years and doubtless will continue for many more."

We must understand the act of saving not as a one-time effort, but rather a process that must be constantly and lovingly renewed. It is an act whose outcomes are not all-encompassing; the successes are astounding and inspiring, while the failures feel heartbreaking and painful.

San Bruno Mountain is graced and haunted by so many of these stories:

The story of how thick creek-banks were swallowed under a four-lane asphalt parkway but a saddle was saved from a city of tens of thousands.

Or the story of how the Mission Blue and Callippe Silverspot butterflies continue their ancient cycles on the mountain's grassy, colorful hills, but on its subdivided slopes they are only a memory now, commemorated by tall metal gravestones that serve additionally as neighborhood street signs.

I do not intend to continue pointing out the constellations of battles hovering over the mountain like the heavy night sky, nor will I list here the numerous threats that continue to rain down upon it.

Instead, I'd like to explore one of the mountain-saving acts that I most treasure, and depict it in the flesh, as it happens on the ground, every week of the year, in the company of many good people. I'm referring to the act of stewardship, which is intertwined with the act and meaning of saving.

To save is to "keep safe, to rescue from danger, to guard from injury or destruction." The word "steward" carries this meaning with it, applied to the concept of a home. Steward comes from stigweard, an Old English term defined as a housekeeper. Stigweard is itself a meeting of two words—stig references a house and weard means to guard.

To steward is to save the home. To steward the mountain is to guard its many ecosystems, in other words, its many types of homes. Like the stig of steward, the eco of ecosystem means "house or household," arising from the Greek oîkos.

One of the many ecosystems we work to steward is the coastal prairie ecosystem, the beautiful grassland habitat home to the endangered Mission Blue and Callippe Silverspot butterflies and the webs of life they rely on.

Native prairie plants laid out in the footprint of a removed shrub. Local youth helped with the planting of this site in February 2016 on the Mountain's grassy slopes above South San Francisco.

One of the main threats to the mountain's grasslands are the invading shrubs, both native (e.g. coyote brush) and non-native (e.g. french broom), that have converted many acres of the butterflies' prairie habitat into dense stands of woody shrubs, leafy shields that absorb nearly all the sunlight, leaving little for the grasses and wildflowers they rise above, spread over, and kill.

Battling against the tide of woody plants, referred to as "scrub encroachment," is the most urgent management priority for those working to save the Mission Blues and Callippe Silverspots.

This was affirmed by Weiss, Naumovich, and Niederer in the "Assessment of the past 30 years of habitat management and covered species monitoring associated with the San Bruno Mountain habitat conservation plan."

Those who read this assessment will finish with the acknowledgment that "San Bruno Mountain is not saved" - once again ringing in their minds, bouncing off the long list of challenges to the health of the mountain's ecology.

No, the mountain is not saved, despite more than thirty years of habitat management activities under the controversial San Bruno Mountain Habitat Conservation Plan, and despite all the toil and tears of its guardians.

No, the butterflies are not saved. No, the prairies are not saved.

Yes, there is work to do, and fortunately there are many working together with hope, determination, and good energy.

The prairies were historically protected from the invasion of shrubs by the burning practices of indigenous peoples and the grazing of domestic livestock in the 19th and 20th centuries.

San Bruno Mountain Watch is collaborating with the San Mateo County Parks and restoration contractors like Shelterbelt Builders and West Coast Wildlands to protect and improve the prairies in alternative ways. In the past year we've worked on the hilltops and meadows of Owl and Buckeye Canyons, on the south slopes of the mountain above South San Francisco, and on the southeast ridge of the mountain.

In brief, many of the shrubs invading the highest quality grasslands in these areas were cut away or pulled up by the aforementioned restoration contractors. During the months of November, December, January, and February, volunteers with San Bruno

Mountain Watch helped plant over two thousand native prairie plants grown at the Mission Blue Nursery in the patches where the shrubs had been.

Families and friends joined our planting event on Valentine's Day - and gifted flowers to the butterflies, on the ridge of San Bruno Mountain.

We planted a mix of native grasses (purple needlegrass, California oatgrass, red fescue, California melic, blue wildrye, junegrass, and California brome), wildflower nectar plants for the butterflies (checkerbloom, California phacelia, brownie thistle, coyote mint, blue-eyed grass, coast buckwheat, narrowleaf mule's ear, lace parsnip, California horkelia, California buttercup, hairy gumplant, yarrow, California acaena, California dandelion, Franciscan wallflower, and golden aster), and the three species of the Mission Blue's lupine host plants (silver lupine, summer lupine, and varied lupine).

By March 2016, everything was planted and we were back to carrying weed wrenches up the slopes, plucking invasive plants from the prairie, once again.

I'd like to share a poem I wrote about this cycling work and express my heartfelt gratitude to all the people who are are an essential part of these efforts; the San Mateo County Parks Department, the restoration contractors, Ildiko Polony and the friendly volunteers at Mission Blue Nursery who collected and grew the mountain plants, and the Stewardship Mountaineers who join me every Saturday to renew our shared commitment to save San Bruno Mountain through community-based ecological restoration and participatory stewardship.

Flowers and shadows
by Ariel Cherbowsky

During the drier seasons
we unravel the twisted and freckled
shadows of shrubs,
flooding the scars marking darkness
with the sun's bright light.

When the winter brings rains
we return with what we grew,
bringing back the Franciscan flowers
and bunches of blades
we gathered nearby here as seeds,
to fill in the earth's bare pockets
with our hands full of Californian prairie—
gold, green grasses,
petals and nectar.

This introduction was originally written in the spring of 2016 for the general public on the SBMW website.

RESULTS

At the end of October 2016, San Bruno Mountain Watch monitored 362 or 17.2% of the 2,100 plants that were planted from November 2015 through February 2016. 222 or 61% of the plants monitored were found alive.

Plant survivorship varied by site. In sites OB-03, OB-01, and SR-02, over 70% of the monitored plantings survived. In site HJ-01, almost 50% of the monitored plantings survived, while only 12% of the monitored plantings survived in site OB-05.

Survivorship also varied by species. 75% or more of the following monitored nectar plants were found alive: *Erysimum franciscanum, Sidalcea malviflora, Eriogonum latifolium, Horkelia californica, Grindelia hirsutula, Acaena pinnatifida,* and *Monardella villosa.*

75% or more of the following monitored native grasses were found alive: *Bromus carinatus, Nassella pulchra, Festuca rubra, Elymus glaucus,* and *Danthonia californica.*

Regarding Mission Blue butterfly host plants, 82% of the monitored *Lupinus albifrons* and 50% of the monitored *Lupinus variicolor* were found alive, while only 5% of *Lupinus formosus* survived.

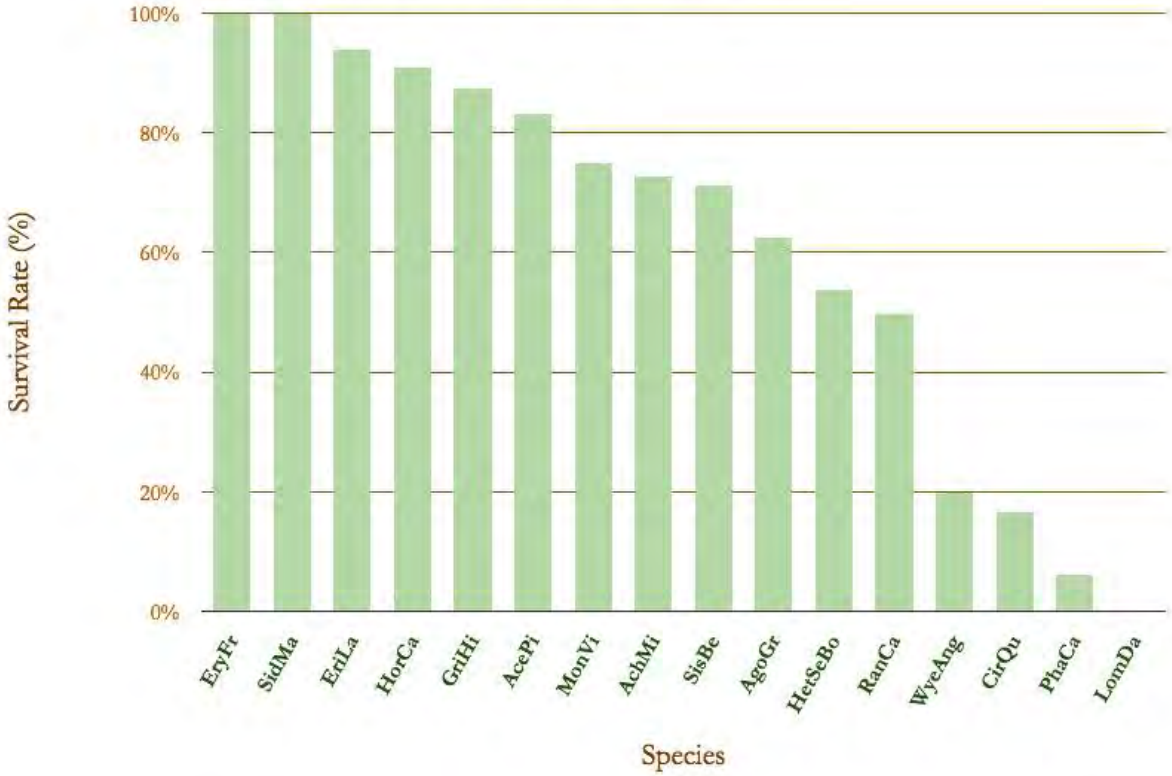
Planting events engaged volunteers from various Bay Area communities and took place on the following dates from November 2015 through February 2016.

2015: 11/21, 12/5, 12/12, 12/14, 12/15, 12/19
2016: 1/9, 1/16, 1/23, 1/30, 2/6, 2/13, 2/14, 2/16, 2/27

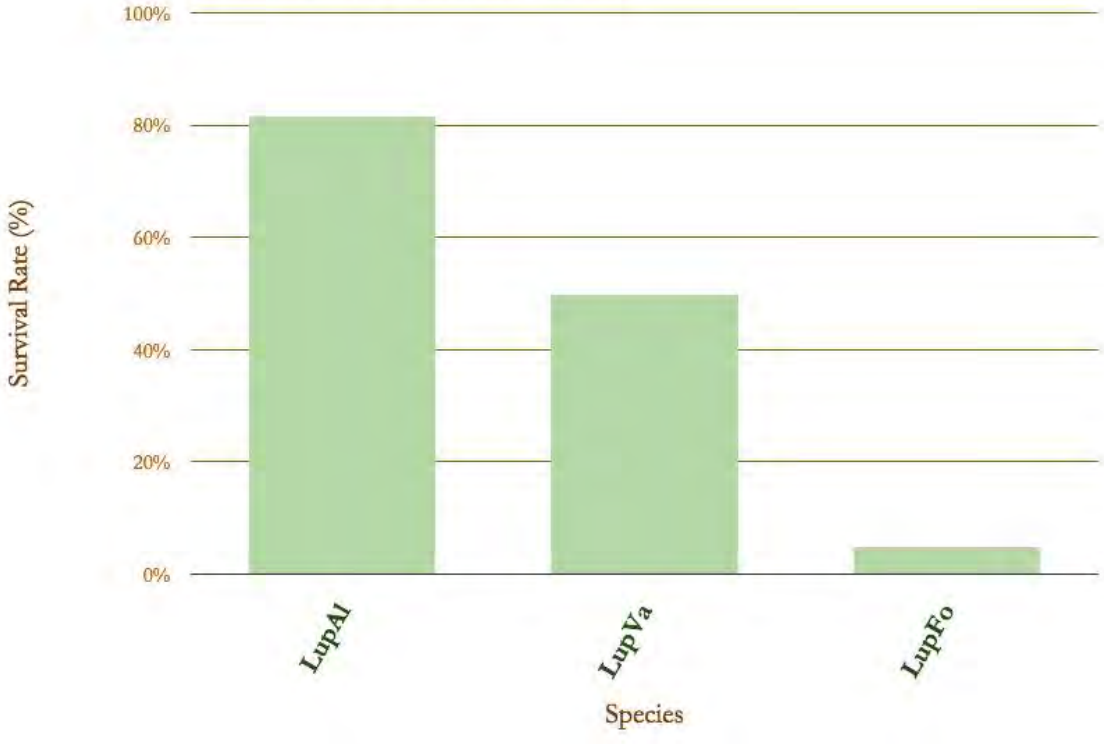
Volunteers kindly contributed 322 hours towards this planting effort.

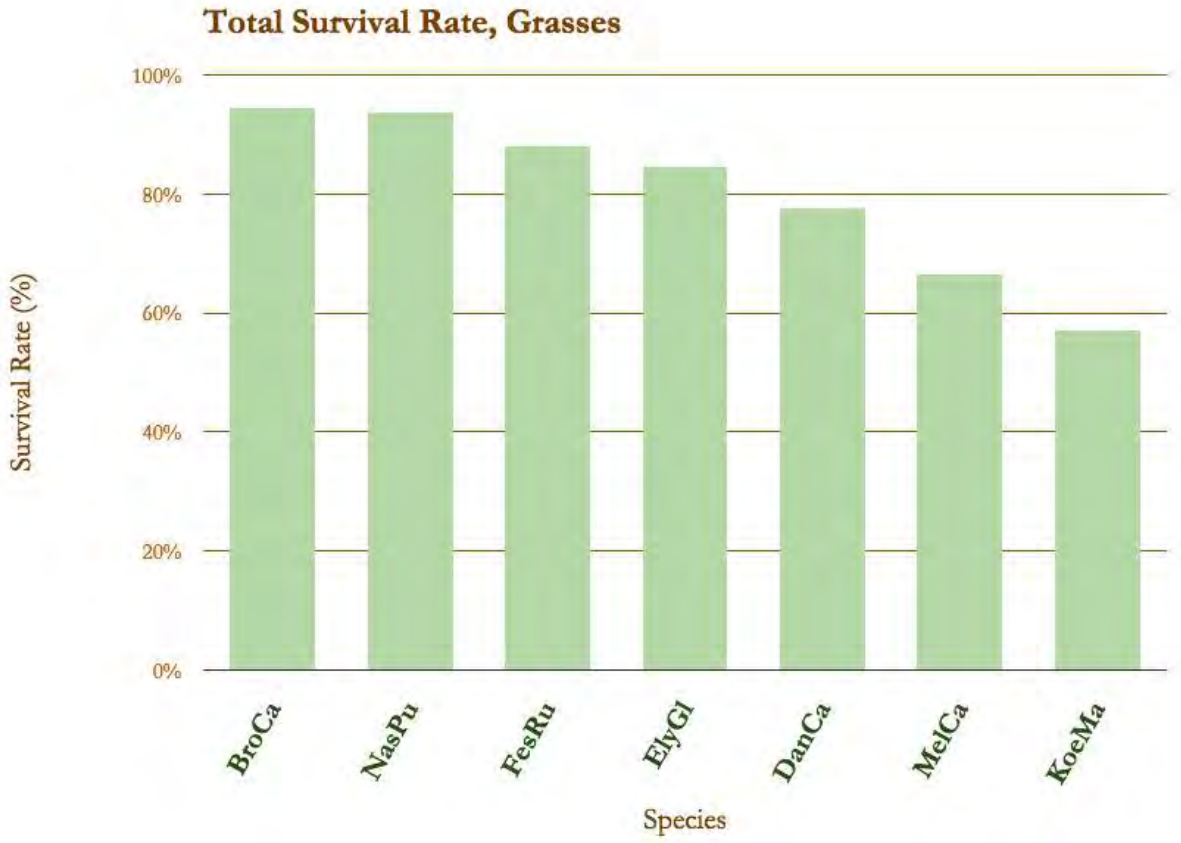
TOTAL SURVIVAL RATES BY SPECIES					
Species Code	Common Name	# Planted	# Monitored	# Surviving	Survival Rate
EryFr	Franciscan Wallflower	60	10	10	100%
SidMa	Checkerbloom	36	6	6	100%
BroCa	CA Brome	160	18	17	94%
EriLa	Coast Buckwheat	104	17	16	94%
NasPu	Purple Needlegrass	160	16	15	94%
HorCa	CA Horkelia	60	11	10	91%
FesRu	Red Fescue	120	17	15	88%
GriHi	Hairy Gumplant	84	16	14	88%
ElyGl	Blue Wiildrye	160	13	11	85%
AcePi	CA Acaena	36	6	5	83%
LupAl	Silver Lupine	120	49	40	82%
DanCa	CA Oatgrass	80	9	7	78%
MonVi	Coyote Mint	84	12	9	75%
AchMi	Yarrow	60	11	8	73%
SisBe	Blue-Eyed Grass	51	7	5	71%
MelCa	CA Melic	40	6	4	67%
AgoGr	CA Dandelion	60	8	5	63%
KoeMa	Junegrass	80	7	4	57%
HetSeBo	Golden Aster	84	13	7	54%
LupVa	Varicolor Lupine	25	14	7	50%
RanCa	CA Buttercup	35	2	1	50%
WyeAng	Narrowleaf Mule's Ears	36	5	1	20%
CirQu	Brownie Thistle	36	6	1	17%
PhaCa	CA Phacelia	109	16	1	6%
LupFo	Summer Lupine	145	59	3	5%
LomDa	Lace Parsnip	65	8	0	0%
PerKe	Yampa	10	0	N/A	N/A
		Total # Planted	Total # Monitored	Total # Surviving	Total Survival Rate
TOTAL		2100	362	222	61%
		Percent Monitored			
		17.2%			

Total Survival Rate, Nectar Plants



Total Survival Rate, Host Plants





SURVIVAL RATE BY SITE

TOTAL SURVIVAL RATE BY SITE	
Site	**Total Survival Rate**
OB-03	**73%**
OB-01	**71%**
SR-02	**70%**
HJ-01	**48%**
OB-05	**12%**

OB-03 (Total Plants: 500)			Monitoring			
Species Code	Common Name	# Planted	Monitoring Goal #	# Monitored 10/31/16	# Surviving 10/31/16	Survival Rate
AcePi	CA Acaena	9	2	1	0	0%
AchMi	Yarrow	15	3	3	3	100%
AgoGr	CA Dandelion	15	3	3	1	33%
BroCa	CA Brome	40	8	5	5	100%
CirQu	Brownie Thistle	9	2	1	0	0%
DanCa	CA Oatgrass	20	4	2	1	50%
ElyGl	Blue Wildrye	40	8	5	4	80%
EriLa	Coast Buckwheat	21	4	4	4	100%
EryFr	Franciscan Wallflower	15	3	2	2	100%
FesRu	Red Fescue	30	6	6	5	83%
GriHi	Hairy Gumplant	21	4	4	3	75%
HetSeBo	Golden Aster	21	4	2	1	50%
HorCa	CA Horkelia	15	3	3	3	100%
KoeMa	Junegrass	20	4	2	1	50%
LomDa	Lace Parsnip	15	3	0	N/A	N/A
LupAl	Silver Lupine	30	15	13	11	85%
LupFo	Summer Lupine	30	15	9	2	22%
MelCa	CA Melic	10	2	1	1	100%
MonVi	Coyote Mint	21	4	3	3	100%
NasPu	Purple Needlegrass	40	8	2	2	100%
PhaCa	CA Phacelia	21	4	2	1	50%
RanCa	CA Buttercup	15	3	0	N/A	N/A
SidMa	Checkerbloom	9	2	0	N/A	N/A
SisBe	Blue-Eyed Grass	9	2	0	N/A	N/A
WyeAng	Narrowleaf Mule's Ears	9	2	0	N/A	N/A
		Total # Planted	Total Monitoring Goal #	Total # Monitored 10/31/16	Total # Surviving 10/31/16	Total Survival Rate
TOTAL		500	118	73	53	73%
			% Monitored Goal	% Monitored		
			24%	14.6%		

OB-01 (Total Plants: 500)			Monitoring			
Species Code	Common Name	# Planted	Monitoring Goal #	# Monitored 10/31/16	# Surviving 10/31/16	Survival Rate
AcePi	CA Acaena	9	2	2	2	100%
AchMi	Yarrow	15	3	3	1	33%
AgoGr	CA Dandelion	15	3	2	2	100%
BroCa	CA Brome	40	8	6	5	83%
CirQu	Brownie Thistle	9	2	1	1	100%
DanCa	CA Oatgrass	20	4	2	2	100%
ElyGl	Blue Wildrye	40	8	7	6	86%
EriLa	Coast Buckwheat	21	4	3	3	100%
EryFr	Franciscan Wallfl.	15	3	2	2	100%
FesRu	Red Fescue	30	6	4	4	100%
GriHi	Hairy Gumplant	21	4	4	4	100%
HetSeBo	Golden Aster	21	4	4	2	50%
HorCa	CA Horkelia	15	3	3	2	67%
KoeMa	Junegrass	20	4	2	1	50%
LomDa	Lace Parsnip	5	3	0	N/A	N/A
LupAl	Silver Lupine	30	15	15	15	100%
LupFo	Summer Lupine	30	15	7	0	0%
LupVa	Varicolor Lupine	5	3	4	0	0%
MelCa	CA Melic	10	2	2	1	50%
MonVi	Coyote Mint	21	4	3	2	67%
NasPu	Purple Needlegrass	40	8	7	7	100%
PhaCa	CA Phacelia	21	4	4	0	0%
PerKe	Yampa	10	2	0	N/A	N/A
RanCa	CA Buttercup	10	2	1	0	0%
SidMa	Checkerbloom	9	2	2	2	100%
SisBe	Blue-Eyed Grass	9	2	2	2	100%
WyeAng	Nar. Mule's Ears	9	2	1	0	0%
		Total # Planted	Total Monitoring Goal #	Total # Monitored 10/31/16	Total # Surviving 10/31/16	Total Survival Rate
TOTAL		500	122	93	66	71%
			% Monitored Goal	% Monitored		
			24%	18.6%		

SR-02 (Total Plants: 500)			Monitoring			
Species Code	Common Name	# Planted	Monitoring Goal #	# Monitored 11/1/16	# Surviving 11/1/16	Survival Rate
AcePi	CA Acaena	9	2	2	2	100%
AchMi	Yarrow	15	3	3	3	100%
AgoGr	CA Dandelion	15	3	1	1	100%
BroCa	CA Brome	40	8	7	7	100%
CirQu	Brownie Thistle	9	2	2	0	0%
DanCa	CA Oatgrass	20	4	4	4	100%
ElyGl	Blue Wildrye	40	8	0	N/A	N/A
EriLa	Coast Buckwheat	21	4	4	4	100%
EryFr	Franciscan Wallfl.	15	3	3	3	100%
FesRu	Red Fescue	30	6	6	5	83%
GriHi	Hairy Gumplant	21	4	4	3	75%
HetSeBo	Golden Aster	21	4	4	2	50%
HorCa	CA Horkelia	15	3	2	2	100%
KoeMa	Junegrass	20	4	3	2	67%
LomDa	Lace Parsnip	15	3	3	0	0%
LupAl	Silver Lupine	30	15	13	9	69%
LupFo	Summer Lupine	30	15	9	0	0%
LupVa	Varicolor Lupine	15	8	7	7	100%
MelCa	CA Melic	10	2	2	1	50%
MonVi	Coyote Mint	21	4	3	2	67%
NasPu	Purple Needlegrass	40	8	6	6	100%
PhaCa	CA Phacelia	21	4	2	0	0%
SidMa	Checkerbloom	9	2	2	2	100%
SisBe	Blue-Eyed Grass	9	2	2	2	100%
WyeAng	Narrowleaf Mule's Ears	9	2	2	0	0%
		Total # Planted	Total Monitoring Goal #	Total # Monitored 11/1/16	Total # Surviving 11/1/16	Total Survival Rate
TOTAL		500	123	96	67	70%
			% Monitored Goal	% Monitored		
			25%	19.2%		

HJ-01 (Total Plants: 500)			Monitoring			
Species Code	Common Name	# Planted	Monitoring Goal #	# Monitored 11/1/16	# Surviving 11/1/16	Survival Rate
AcePi	CA Acaena	9	2	1	1	100%
AchMi	Yarrow	15	3	2	1	50%
AgoGr	CA Dandelion	15	3	2	1	50%
BroCa	CA Brome	40	8	0	N/A	N/A
CirQu	Brownie Thistle	9	2	2	0	0%
DanCa	CA Oatgrass	20	4	1	0	0%
ElyGl	Blue Wildrye	40	8	1	1	100%
EriLa	Coast Buckwheat	21	4	3	2	67%
EryFr	Franciscan Wallfl.	15	3	3	3	100%
FesRu	Red Fescue	30	6	1	1	100%
GriHi	Hairy Gumplant	21	4	4	4	100%
HetSeBo	Golden Aster	21	4	3	2	67%
HorCa	CA Horkelia	15	3	3	3	100%
KoeMa	Junegrass	20	4	0	N/A	N/A
LomDa	Lace Parsnip	15	3	2	0	0%
LupAl	Silver Lupine	30	15	8	5	63%
LupFo	Summer Lupine	30	15	13	1	8%
LupVa	Varicolor Lupine	5	3	3	0	0%
MelCa	CA Melic	10	2	1	1	100%
MonVi	Coyote Mint	21	4	3	2	67%
NasPu	Purple Needlegrass	40	8	1	0	0%
PhaCa	CA Phacelia	21	4	3	0	0%
RanCa	CA Buttercup	10	2	1	1	100%
SidMa	Checkerbloom	9	2	2	2	100%
SisBe	Blue-Eyed Grass	9	2	2	0	0%
WyeAng	Nar. Mule's Ears	9	2	2	1	50%
		Total # Planted	Total Monitoring Goal #	Total # Monitored 11/1/16	Total # Surviving 11/1/16	Total Survival Rate
TOTAL		500	120	67	32	48%
			% Monitored Goal	% Monitored		
			24%	13.4%		

OB-05 (100 plants)			Monitoring			
Species Code	Common Name	# Planted	Monitoring Goal #	# Monitored 10/31/16	# Surviving 10/31/16	Survival Rate
EriLa	C. Buckwheat	20	4	3	3	100%
LomDa	Lace Parsnip	15	3	3	0	0%
LupFo	Su. Lupine	25	25	21	0	0%
PhaCa	CA Phacelia	25	5	5	0	0%
SisBe	Blue-eyed Gr.	15	3	1	1	100%
		Total # Planted	Total Monitoring Goal #	Total # Monitored 10/31/16	Total # Surviving 10/31/16	Total Survival Rate
TOTAL		100	40	33	4	12%
			% Monitored Goal	% Monitored		
			40%	33%		

CONCLUSIONS

- The majority of planted nectar plants experienced high rates of survival, suggesting their participation in future planting seasons would be successful.

- It is possible that a few species that did not seem to perform well may have show better results with alternative timing of monitoring efforts. The timing of the monitoring, near the beginning of a new rainy season, may have produced results skewed to show low survival rates for certain species. For example, narrowleaf mule's ear (*Wyethia angustifolia*), lace parsnip (*Lomatium dasycarpum*), and California phacelia (*Phacelia californica)* were monitored at a time when they appeared missing but perhaps had not regenerated following the summer dry period when they can experience "dieback." Similarly, brownie thistle (*Cirsium quercetorum*) is an annual species and it seemed the majority of the plantings had already completed their lifecycle and died by the time monitoring took place.

- *Lupinus albifrons* was the most successful host plant, with over 80% of the monitored plantings surviving. *Lupinus varlicolor,* while not as successful as *L. albifrons,* showed a survival rate over 50%. *Lupinus formosus* had extremely low survival. It is likely that *L. formosus* seedlings were not mature enough at the time of planting; future attempts to plant *L. formosus* should use more mature plants that have developed in larger pots. Perhaps planting fewer *L. formosus* from 1-gallon pots would result in more surviving individuals than planting more from smaller pot sizes. Alternatively, seeding of *L. formosus* rather than planting may be attempted.

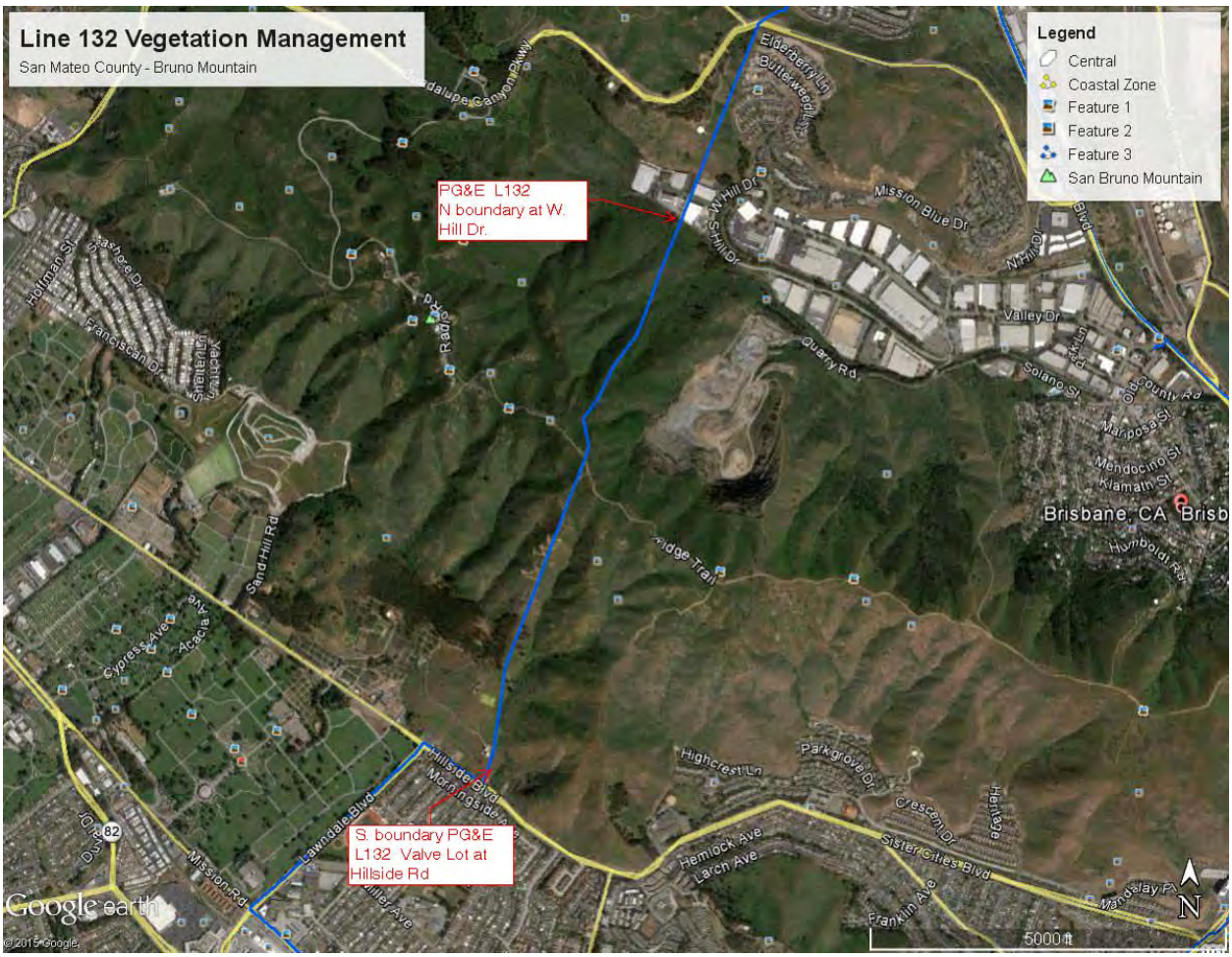
- Of the planting areas, OB-05 experienced the worst survival rate, likely due to the poor quality of the soil which appeared highly compacted and heavy at the time of planting. The site has a history of disturbance related to the adjacent Quarry, as the slope where planting took place was graded and stripped of its topsoil in the late 1970s. However, some species were successful in this site (*Eriogonum latifolium)*, and new species should be planted here in future planting seasons to determine other species that can be successful in this challenging environment.

- Site HJ-01 is the driest site, as its southern exposure receives the highest levels of solar insolation, and it showed lower survival rates than sites OB-03, OB-01, and SR-02. Planting in HJ-01 and other future sites with warmer and drier conditions should take place earlier in the planting season to provide a lengthier period of time for the plantings in these sites to receive rainfall.

- Engravable metal tags will be used exclusively for future monitoring purposes. The landscape flags proved to be very troublesome; monitoring data was lost when the flags tore and flew away or the ink faded or washed away (even though permanent marker was used). Metal tags were used for Site OB-05 and this site had the highest percent of plants monitored in relation to the original site monitoring goal.

- Coffeeberry (*Frangula californica)* and Toyon berry (*Heteromeles arbutifolia*) were observed to resprout in planting areas despite cut-stump treatments, particularly in sites OB-01 and OB-03, and will need to be treated again.

2016 Annual Report for PG&E L132 Brush Control Project
Agreement No. 39000-16-D041



Prepared by;
West Coast Wildlands, Inc.
Pacifica, CA 94044

For:
San Mateo County Parks Department
Redwood City, CA

December 2016

PG&E L132 GAS LINE BUFFER ZONE BRUSH CONTROL

Native and Non-Native Brush Control within the Gas line Buffer Zone

This report describes the native and non-native brush control along the PG&E L132 gas line from the L132 Valve Lot adjacent to Hillside Rd, So. San Francisco, CA. to W. Hill Drive, Brisbane, CA. PG&E contractors removed the initial brush along the gas line buffer zone using mechanical tools and marked the sensitive habitat with yellow caution tape. West Coast Wildlands, Inc., did the initial herbicide application and follow up brush control using manual, mechanical and herbicide methods (Figure 2: Exhibit A).

The scope-of- work was divided into four sections, A-D, for easier access to the brush control areas. Section 'A' was accessed from Hillside Blvd Valve Lot and extended north to the eucalyptus trees. Section 'B' was accessed from the SBM County and State Park Ridge Trail and extended southbound to the Eucalyptus trees. (See below).

Section “C” was accessed from the SBM County and State Park Ridge Trail and extended south to the open PG&E gas pipeline. Section “D” was accessed from W Hill Rd and extended northbound to the open PG&E gas pipeline.

The project included the manual, mechanical and herbicide control during the month of March and 2 follow up site visits from April to June. Buffer zone brush maintenance was performed once a month for 3 months from September to late November 2016 in the L132 gas line buffer zone (Figure 3: Exhibit B). All site visits were recorded on daily data sheets (Figure 1) with a site map showing working locations (Found in the **Daily Data Sheet Section**). The 2016 final walk through was documented with photos (Found in the **Photo documentation section**). The daily Data Sheet and Photo Documentation Sections are located at the end of the report.

INTRODUCTION

This report describes the native and non-native brush control methods within the buffer zone. Handwork removal was applied to those areas designated as sensitive by the PG&E biologist using yellow caution tape to surround the area and by Patrick Kobernus, Coast Ridge Ecology, who flagged the endangered Manzanita (*Arctostaphylos imbricata*). Hand control was used within the taped areas and along the outside margins of the Manzanita. We did mechanical control of brush using brush cutters with weed whip and triple blade heads in areas outside of the sensitive habitat. A broadleaf specific Herbicide was applied to the original cut stumps from the PG&E L132 buffer zone clearing.

BUFFER ZONE BRUSH CONTROL

The initial efforts were scheduled over two days in March. The southern sections A & B were managed first followed by the Northern sections C & D the second day. WCW targeted all cut stumps in the buffer zone and treated with 25% Garlon 4 Ultra herbicide using backpack sprayers. The northern sections had the higher concentration of cut stumps and required 2 gals of the herbicide mix and the southern sections only required 1 gallon. All emerging or residual plants in the PG&E L132 Buffer Zone were brushcut on each visit. WCW used weed whip heads on plants within rocky outcrops and triple blades for the more dense perennial plants. Plants within sensitive areas were hand pulled and any disturbed soil was tamped in place.

The follow up maintenance in the buffer zone had a bi-monthly schedule from April to June. The field crew walked south to the Valve Lot and brushcut all emerging plants and the same procedure was done heading north from the Ridge Trail to W. Hill Rd. WCW did mainly one-way shuttles from the Ridge Trail on SBM County Park for the remainder of the project with occasional maintenance accessed from the W Hill rd or

the Valve Lot. All protective clothing and equipment was prepared prior to entering the buffer zone and cleaned after a section was finished.

Common Plants Controlled within the Buffer Zone:

Southern Buffer Zone: Sections A & B

Mares Tail (*Equisetum Arvense*)	Poison Oak (*Toxicodendron diversilobum*)
Poison hemlock (*Conium maculatum*)	Lambs quarter (*Chenopodium album*)
Coyote brush (*Baccharis pilularis*)	Curley dock (*Rumex crispus*)
Willow (*Salix* sp)	Night shade (*Solanum* sp)
C. blackberry (*Rubus ursinus*)	Bristly ox-tongue (*Picris echioides*)
Fennel (*Foeniculum vulgare*)	W Radish (*Raphanus raphanistrum*)
S Mustard (*Hirschfeldia incana*)	Sheep sorrel (Rumex acetosella)
Cud weed (Gnaphalium sp.)	C. sage (*Artemisia californica*)
Rattlesnake grass (*Briza maxima*)	W oats (*Avena* spp)

Northern Buffer Zone: Sections C & D

Pearly everlasting (*Anaphalis margaritacea*)	Yarrow (*Eriophyllum* spp)
Cotoneaster (*Cotoneaster* spp)	Poison Oak (*Toxicodendron diversilobum*)
C. blackberry (*Rubus ursinus*)	A. blackberry (*Rubus armeniacus*)
Night shade (*Solanum* spp)	Coyote brush (*Baccharis pilularis*)
It. thistle (*Carduus pycnocephalus*)	C. sage (*Artemisia californica*)
Toyon (*Heteromeles* sp.)	W. rose (*Rosa* sp)
Hummingbird sage (*Salvia spathacea*)	Lizard tail (*eriophyllum staechadifolium*)
Ferns (*Polypodium* spp)	Coffee berry bush (*Frangula californica*)
Rattlesnake grass (*Briza maxima*)	W oats (*Avena* spp)
F broom (*Genista monspessulana*)	P broom (*Cytisus striatus*)

FIGURE 1: Daily data sheet and site map

Contractor: _____
Number of crew: _____
Start Time: _____
End Time: _____

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

FIGURE 2: Exhibit A

Exhibit A

In consideration of the payments set forth in Exhibit B, Contractor shall provide the following services for the PG&E L-132 - Brush Control Project Hillside Valve Lot to W. Hill Place, San Bruno Mtn.:

2016 Initial Non-native Annual/Perennial Weed Control with Native Brush Management (Table 1).

FIGURE 3: Exhibit B

Exhibit B

In consideration of the services provided by Contractor described in Exhibit A and subject to the terms of the Agreement, County shall pay Contractor based on the following fee schedule and terms:

2016 Initial Non-native Annual/Perennial Weed Control with Native Brush Management

Table 1. Initial scope-of-work costs for proposed 2 year invasive weeds and brush control - PG&E L-132 Brush Control from Hillside Valve Lot to W. Hill Place, San Bruno Mountain

	Exotic species	Field Crew FS (1) FC (4 crew Herbicide Application	Herbicide (Gal) Garlon 4 Ultra 25% (cut stump treatment)	Field Crew FS (1) FC (4 crew Hand/ Mechanical
1. PG&E Brush Control Valve Lot to W Hill Pl - SBM (1.7 Acres)	Cotoneaster (spp) Broom (spp) Gorse Fennel It. thistle W. mustard	6.00 hrs (285.00hr)	3 gal Solution (92.00)	Brushcut Polaski Loopers Hand Saw 6.00 hrs (285.00hr)
Initial control - March 2016		**$1710.00**	**$276.00**	**$1710.00**

April 2016 control - 8 hrs (2 site visits)	**Listed species (New**				**$2280.00**
May 2016 control - 8 hrs (2 site visits)	**Listed species (New**				**$2280.00**
June 2016 control - 8 hrs (2 site visits)	**Listed species (New**				**$2280.00**
August - December 2016 control	**Listed species (New**				**$5,130.00**

Annual Cost - 2016	**$15,666.00**

2016 Photo Documentation of the PG&E Buffer Zone by Sections

Section A: Valve Lot North to Eucalyptus trees

Photo A1 – Valve Lot North Buffer Zone

Section B: SBM Ridge Trail South

Photo B1 – Ridge Trail South Buffer Zone

Section B (Cont.)

Photo B2: Middle section of B Buffer Zone

Photo B3: Lower section of B Buffer Zone

Section C: SBM Ridge Trail to exposed PG&E Gas Line

Photo C1 – Ridge Trail Buffer Zone North

Photo C2 – Middle section of ‘C’ Buffer Zone

Section C: SBM Ridge Trail to exposed PG&E Gas Line (Cont.)

Photo C3 – Lower section of ‘C’ Buffer Zone

Photo C4 – Typical Cut Stump dieback from Herbicide Application

Section D: W. Hill Rd to the exposed PG&E Gas Line

Photo D1 – W Hill Rd lower Section D Buffer Zone

Section D: W. Hill Rd to the exposed PG&E Gas Line (cont)

Photo D2 – Mid Section D Buffer Zone

Photo D3 – Upper Section D – Exposed PG&E Gas Line

Working Daily Data Sheets with Site Maps

Date: 3/24/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 2:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
3/24/16	Perennials	PG&E Pipeline L-132 Line	Cut stump application Garlon 4 Ultra 25%	64 oz / gal	Competitor	1.5 oz / gal	Hi Light	2 oz	5	30.0
		L312 N boundary at W. Hill Dr. to	Loppers, Hand saw BP Sprayers	oz / gal		oz / gal		oz		
	Annuals/perennials	Ridge Trail	Brushcutters	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 3/25/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 2:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
3/25/16	Perennials	PG&E Pipeline L-132 Line	Cut stump application Garlon 4 Ultra 25%	32 oz / gal	Competitor	96 oz / gal	Hi Light	4 oz	5	30.0
		Ridge Trail to S. boundary PG&E	Loppers, Hand saw BP Sprayers	oz / gal		oz / gal		oz		
	Annuals/perennials	L132 Valve Lot	Brushcutters	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 4/8/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
4/8/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut annual and perennia	oz / gal		oz / gal		oz	5	20
			Plants in buffer zone	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 4/21/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
4/21/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut annual and perennial	oz / gal		oz / gal		oz	5	20
			Plants in buffer zone	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 5/7/2016

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
5/7/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut annual and perennial	oz / gal		oz / gal		oz	5	20
			Plants in buffer zone	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 5/20/2016

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
5/20/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut annual and perennia	oz / gal		oz / gal		oz	5	20
			Plants in Buffer Zone	oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 6/2/2016

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
6/2/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut emerging annual and perennial plants.	oz / gal		oz / gal		oz	5	20
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 6/29/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 12:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
6/29/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut emerging annual and perennial plants.	oz / gal		oz / gal		oz	5	20.0
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

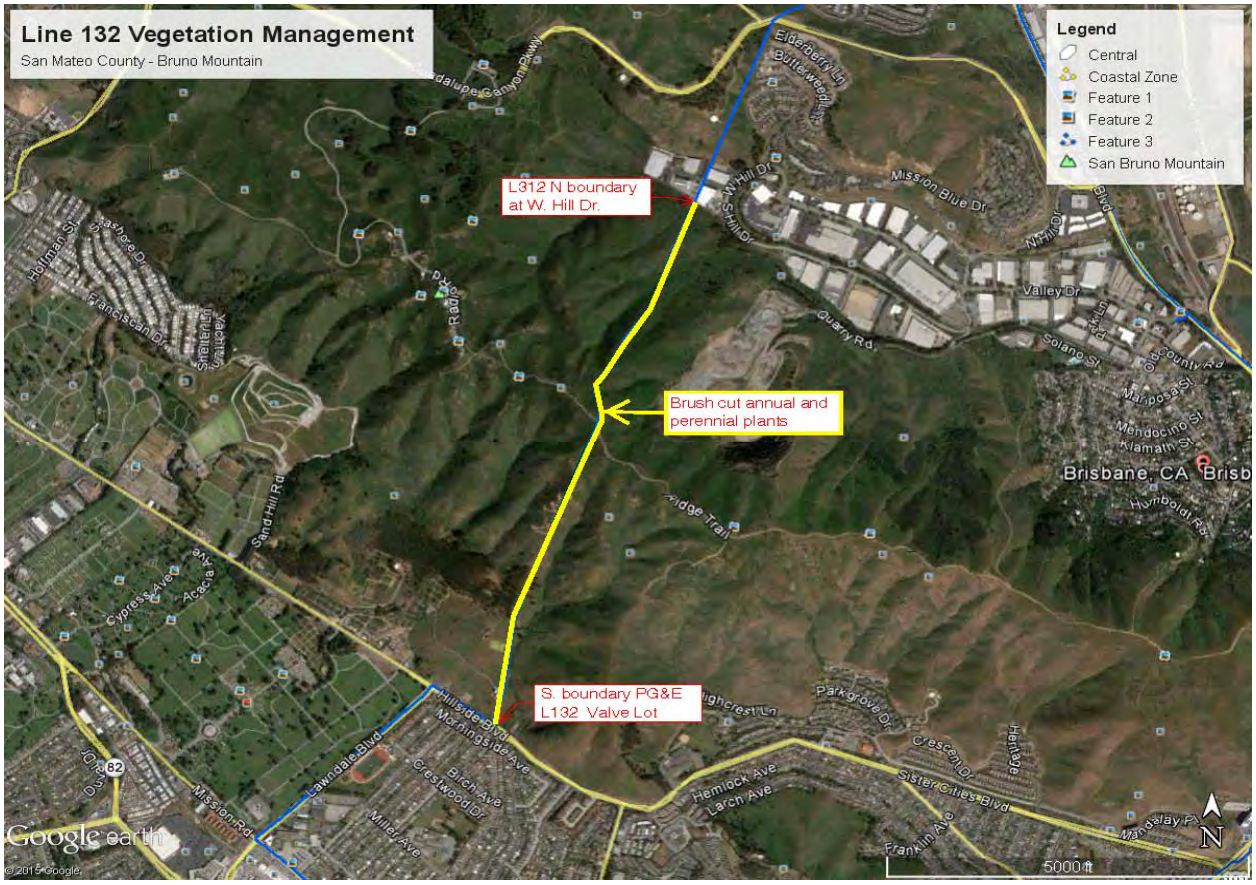
Date: 8/2/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 2:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
8/22/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut Annual and Perennial plants	oz / gal		oz / gal		oz	5	30.0
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		



Date: 9/14/16

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 2:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
9/14/16	Perennials	PG&E Pipeline L-132 Line	Brush cut plants in buffer zone	oz / gal		oz / gal		oz	5	30.0
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

Date: 11/29/2016

Contractor: West Coast Wildlands, Inc
Number of crew: 5
Start Time: 8:00 am
End Time: 2:30 pm

SMCO Parks Agreement No.: 39000-16-D041

For each species and mangement unit, please record the following information. Then indicate where you worked by drawing on the map on the reverse side.

Work Order			Costs							
			Chemical		Additives				Labor	
Date	Species	Mangagement Unit	Herbicide	Amount	Surfactant	Amount	Indicator Dye	Amount	Num of Crew	Hours
11/29/16	Annuals/perennials	PG&E Pipeline L-132 Line	Brush cut emerging annual and perennial plants.	oz / gal		oz / gal		oz	5	30.0
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		
				oz / gal		oz / gal		oz		

San Bruno Mountain Scope of Work

Areas identified by the TAC/ HM for treatment within each Management Unit ~ 120 acres of scrub removal. See the map for each Management Unit:

1. **Scrub prescription:**
    a. Remove **all** 1-2 year old scrub in the interior of the assigned polygon - treat and eradicate seedlings and first year plants within core treatment areas and secure the perimeter
        A. Treatment Options:
            1. Hand control and/or
            2. Cut and paint with an EPA-approved herbicide to prevent sprouting
    b. Control **up to 50%** of the polygon interior for single 2-5 year old scrub in the core of the polygon where adjacent to viola and/or lupine points or polygons, see the map.
        A. Treatment Options:
            1. Hand control and/or
            2. Cut and paint with an EPA-approved herbicide to prevent sprouting
    c. Control **up to 25%** of the polygon interior and perimeter for 2-5 year old scrub clusters (≤3 bushes with ≤ 1" DBH) adjacent to the viola and/or lupine points and polygons within the interior or to secure the perimeter.
        A. Treatment Options:
            1. Hand control and/or
            2. Cut and paint with an EPA-approved herbicide to prevent sprouting
    d. Photo-monitor **before** and **after** at the photo points identified in the map.
    e. Follow-up monitoring to determine if a secondary invasion occurs
        A. Eradicate secondary invasion

Scrub includes all woody species including but not limited to: coyote brush, bitter cherry, Indian plum, buckeye, coffeeberry, any and all broom, eucalyptus, and any other woody species within the treatment polygon

2. **Invasive Species prescription:**
    a. Fennel (*Foeniculum vulgare*) – throughout the site
        A. Treatment Options:
            1. Hand control and/or
            2. Cut and paint with an EPA-approved herbicide to prevent sprouting
    b. Oxalis (*Oxalis pes caprae*) - adjacent to the viola and/or lupine points and polygons within the interior or to secure the perimeter.
        A. Treatment Options:
            1. Treat with an EPA-approved herbicide to prevent spread
    c. Mustard and Radish (*Brassica* spp. and *Raphanus raphanistrum*) - adjacent to the viola and/or lupine points and polygons within the interior or to secure the perimeter.
        A. Treatment Options:
            1. Hand control and/or
            2. Apply an EPA-approved herbicide
    d. Italian thistle (*Carduus pycnocephalus*) - adjacent to the viola and/or lupine points and polygons within the interior or to secure the perimeter.
        A. Treatment Options:
            1. Hand control and/or
            2. Apply an EPA-approved herbicide
3. **Restoration Activities:**
    a. Restoration activities in the form of planting native host and nectar plants for the mission blue butterfly (*Icaricia icaricioides missionensis*) and Callippe silverspot (*Speyeria callippe callippe*) will be considered for the following management units:
        A. Owl & Buckeye Canyon:
            1. OB-01
            2. OB-03
        B. Southeast Ridge:
            1. SR-02
        C. Dairy & Wax Myrtle Ravines
            1. DW-01
        D. Devil's Arroyo:
            1. DA-01
        E. Hillside Juncus:
            1. HJ-01

b. See the attached 2015 Restoration Plan Required Components document concerning developing an appropriate plan for these areas and what is expected.

Contractor Requirements:

4. **Reporting and Monitoring**:
    a. All treatment areas will be evaluated for baseline condition assessment prior to initiating work. Form will be provided by SMC Parks Department.
    b. Photo monitoring Points
        A. Before treatment
        B. After treatment
    c. Self-evaluation and treatment suggestions
        A. Form will be provided by SMC Parks Department.
5. **Obligations and Qualifications:**
    a. Provide a prescription for all herbicide use by a licensed Pest Control Advisor.
        A. Provide at least one staff person to oversee work on a daily basis that holds a Qualified Applicators License.
        B. Provide quarterly reports concerning herbicide use on San Bruno Mountain State and County Park.
        C. Submit all required paperwork for herbicide applications to the regulatory agency.

Supplementary Documents:

6. **Management Unit Maps** (photo points in parentheses- can be adjusted)
    a. Brisbane Acres (1)
    b. Dairy & Wax Myrtle Ravine (2)
    c. Devil's Arroyo (1)
    d. Hillside Juncus (2)
    e. Owl & Buckeye Canyon (15)
    f. Ridge Trail (5)
    g. South Slope (4)
    h. Southeast Ridge (4)
7. **2015 Restoration Plan Required Components**

Bids are due to the Ramona Arechiga, Natural Resource Manager, by **June 12, 2015 at 5 p.m.** (electronic or hardcopy). A site visit to the management areas will be held on June 5th at 1 p.m., please email Ramona Arechiga to sign up. If enough contractors express an interest in a site visit, an email will be sent to confirm on June 1st. If you have any questions please contact Ramona Arechiga, trarechiga@smcgov.org or 650-599-1375.