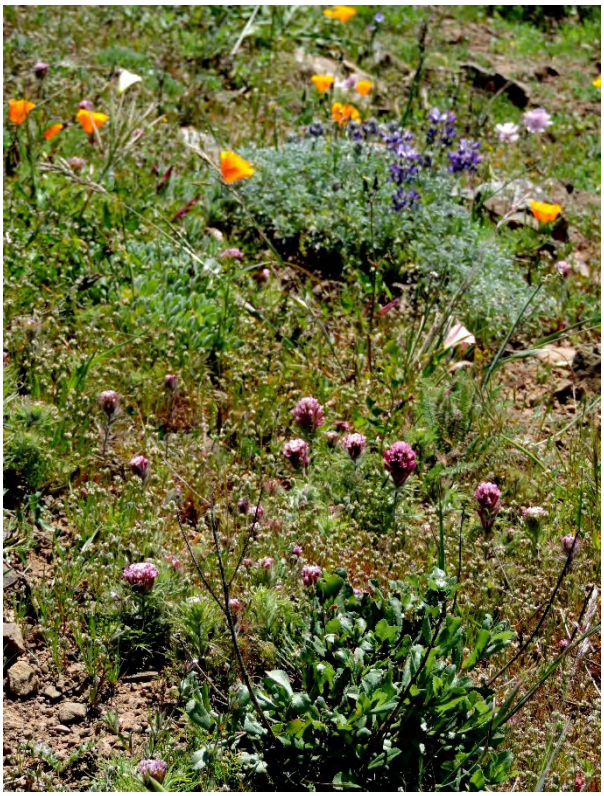
SAN BRUNO MOUNTAIN
HABITAT CONSERVATION PLAN



YEAR 2021 ACTIVITIES REPORT FOR FEDERALLY LISTED SPECIES
Endangered Species 10(a)(1)(B) Permit TE215574-6

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GLOSSARY

ANOVA - A statistical procedure called Analysis of Variance. ANOVA is used to test hypotheses about differences between two or more means without increasing the Type I error rate. ANOVA is employed to test whether the mean (or average) for butterfly abundance for a given year or on a given transect is statistically different than another year or transect.

Correlation - Tests for a relationship between two variables.

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

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

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

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

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

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

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

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

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

Management - Treatment afforded portions of San Bruno Mountain to enhance or protect existing habitat or to reclaim habitat invaded by weeds or altered by disturbance.

Monitoring - The task, undertaken by the Plan Operator, of regular observation of biological processes, development and conservation activities on San Bruno Mountain;

the purpose is to assure compliance with the HCP, and to measure the success of its implementation.

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

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

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

SUMMARY

This report describes the status of species covered under the San Bruno Mountain Habitat Conservation Plan (SBMHCP) and includes the adult butterfly monitoring results for 2021. Vegetation management activities carried out within this timeframe to support habitat improvements to benefit the covered species are also discussed. Additionally, this year's report includes a new section describing recent efforts to map species host plants across San Bruno Mountain. This report is prepared for submission to the U.S. Fish and Wildlife Service, pursuant to the Endangered Species Act section 10(a)(1)(B) incidental take permit TE215574-6.

Due to staffing constraints, butterfly monitoring is conducted on a rotating, biennial basis, with mission blue adults surveys occurring on 'odd' years (e.g., 2021), and callippe silverspot adult surveys and San Bruno elfin larvae monitoring occurring on even years (e.g., 2020). While a brief summary of 2020 monitoring activities (i.e., callippe silverspot and San Bruno elfin surveys) is provided in this report, the reader should reference the previous year's report for full details.

Three federally endangered species of butterflies are currently found on San Bruno Mountain and are covered under the SBMHCP: mission blue (*Icaricia icarioides missionensis*, MB), callippe silverspot (*Speyeria callippe callippe*, CS) and San Bruno elfin (*Callophrys mossii bayensis*, SBE) butterflies. One federally threatened species, bay checkerspot (*Euphydryas editha bayensis*, BCB) has recently been reintroduced and is also covered by the SBMHCP. In 2021 MB adult butterflies were counted along thirteen fixed transects. In 2020 San Bruno elfin larvae were counted at eight permanent plots and adult callippe silverspot butterflies were counted along fourteen fixed transects. Of the covered butterfly species found within the SBMHCP area, CS and SBE butterflies are monitored in even years while MB butterflies are monitored in odd years. This has been done to accommodate the challenging weather conditions during adult butterfly flight seasons. Both CS and MB require temperatures to be warm, usually over 65-degrees Fahrenheit and winds less than 10-miles per hour. An additional constraint is the overlap of MB adult monitoring and SBE larvae monitoring. Simply stated, seasonal overlap, staff time requirements, and financial constraints has led to this alternating year approach for endangered butterfly monitoring within the SBMHCP area. The Final 2022 annual report for the BCB reintroduction is now available and is included in Appendix C. SBE butterfly larvae were monitored and counted between May 12, 2020 and June 02, 2020. Eight permanent plots have been utilized to count species abundance within known habitat for the past 20 years (with surveys completed every two years since 2003). Fixed-radius plots are deployed around a permanent center stake and all larvae observed on broadleaf stonecrop are counted. In 2020, a season total of 1,191 larvae were counted. All permanent plots were surveyed three times this season.

All adult MB butterflies observed along the fixed transects were counted in 2021. The fixed transects are walked by observers at a slow, set pace and all observations for adult butterflies are recorded. Data collected during these surveys includes date, duration for completion of the transect, weather conditions, location along transect of MB adults, behavior, sex, and observed nectaring plant species. This information is reviewed to ensure standardization of the data for statistical analysis. The standards that should be met include minimum weather threshold, ≥65° and < 5 mph winds, and that transect observations are only counted if they are at least 1-week apart. A sightings per hour value

is calculated for each transect as well as for the year. This index is not a population estimate, but rather a coarse density measurement that can be used in statistical comparison from year to year.

With the exception of Transect 2, which has become impassable and was not surveyed in 2021, all MB transects were surveyed two to six times between March 24 and June 1, 2021. A total of 180 MB were observed and counted during the course of all transect surveys. No MB were observed on transect 1-3, 5 or 8. Aside from Transect 2, no other modifications were made to MB transects in 2021, though scrub encroachment into transects affecting the passable length was observed.

Vegetation management activities in 2021 had the purpose of protecting occupied grasslands from ongoing scrub encroachment and invasion of target weed species. Areas were prioritized using guidance from the Assessment of the Past 30 Years of Habitat Management and Covered Species Monitoring Efforts Associated with the San Bruno Mountain Habitat Conservation Plan (Assessment) by Creekside Science completed in February 2015. Using guidance from the Assessment, scrub removal and associated high priority invasive species (e.g., fennel) were targeted in occupied high quality MB and CS habitat in 2021.

Ecological Concerns, Inc. and Go Native, Inc. worked in various treatment locations of the SBMHCP area, and targeted scrub and invasive species. In that time they treated a combination of native and non-native scrub, fennel, broom, mustard, thistle, and other weed species in more than 210 acres of the highest priority occupied MB and CS butterfly grassland habitat. Scrub control targets young scrub species for full removal in the grasslands designated as “Essential” habitat by the Assessment.

Volunteer efforts continue in conjunction with San Bruno Mountain Watch (SBMW) and the San Mateo County Parks Department Stewardship Corps program in butterfly habitat areas and areas that support other unique plants or habitats. Volunteer efforts were halted and reduced in scope for 2020 due to the pandemic. SBMW volunteer 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.

Statistical analysis is planned for all butterfly data in 2020. Anyone interested in accessing data related to SBMHCP listed butterflies should contact the Parks Department’s Natural Resource Manager. Hannah Ormshaw is currently serving in this role and can be reached at (650) 599-1377 or hormshaw@smcgov.org.

I. INTRODUCTION

In 2021, a variety of habitat management work was implemented and one butterfly species was monitored to satisfy the requirements of the U.S. Fish and Wildlife Service (USFWS) Incidental Take Permit (TE215574-6) for the San Bruno Mountain Habitat Conservation Plan (SBMHCP). Protected butterfly monitoring for the federally protected mission blue (*Icaricia icarioides missionensis*, MB) and Bay checkerspot (*Euphydryas editha bayensis*) occurred. The complementary habitat management activities to support grassland dependent butterfly species included scrub and invasive species control work, habitat restoration, and coordination with volunteer groups for site specific projects. Lastly, Parks Department staff coordinate with Plan signatories, coordinate technical and natural resource committees, and provide planning assistance to individuals, organizations and agencies related to development within the SBMHCP area and conserved habitat.

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

A. Covered Species Population Status

Under the SBMHCP the primary emphasis of the biological monitoring program is to evaluate the population status of the endangered butterflies occurring within the San Bruno Mountain area. In 2021, fixed transects were used to assess the status of the MB butterfly.

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

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

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

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

The Assessment concludes that the MB population is 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 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. 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).

Summary of 2021 Mission Blue Status

A total of 180 MB were documented during the monitoring season, observed along eight of the thirteen fixed transects in 2021. This corresponds to an average sightings per hour (S/H) for all transects of 3.35 S/H. The averaged maximum for all transects was calculated to be 6.62 S/H. A total of 39.3 person-hours was spent on transects included in the 2021 analysis, down from 50.2 person-hours in 2019 and 79 person-hours in 2017. In 2021, more MB were observed over the course of fewer person-hours, producing an inflated average S/H, though still reduced compared to earlier monitoring years since new fixed transects for MB were established in 2007.

To improve our understanding of habitat quality and work on correlations of butterfly occurrences with host plant density, in 2019-20, efforts to complete coarse-scale lupine host plant mapping and quantification of host plant density was continued. Full mapping of all host plant populations was completed during the 2021 growing season, establishing complete coverage of the SBMHCP area.

Summary of 2020 Callippe Silverspot Status

During the 2020 monitoring year, a total of 686 CS were observed along fourteen of the fixed transects in 2020. This corresponds to an average sightings per hour (S/H) for all transects of 11.6 S/H. The averaged maximum for all transects was calculated to be 30.67 S/H. A total of 44 person-hours was spent on transects included in the 2020 analysis. Full details can be found in the 2019-20 HCP Annual Report.

Summary of 2020 San Bruno Elfin Status

During the 2020 monitoring year, a total of 1,191 SBE larvae were counted at eight permanent survey locations. The number of larvae observed is just over half what was observed in 2018 (2,148 larvae), but still nearly four times more than what was observed in 2016 (320 larvae). Importantly, in 2018, Parks staff expanded the SBE monitoring protocol to include earlier life stages (1st and 2nd instar) and a more thorough search of the entire plant (i.e., not only the *Sedum* flower heads), which likely accounts for much of this recent increase in numbers. Additionally, a two-week interval between survey rounds was implemented to capture a greater span of time for the life cycle of the larvae. Further details can be found in the 2017-2018 and 2019-20 HCP Annual Reports.

Rare Plant Status

At this time, rare plant monitoring is not included in the current SBMHCP monitoring program or budget due to funding constraints. The executive summary of the 2015 rare plant survey and plant list is included in Appendix A.

II. STATUS OF SPECIES OF CONCERN

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

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

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

Typically, MB butterflies begin adult flight in March and are most abundant in April. Observations begin to drop off by late May or early June. The timing and duration of the

flight season is influenced by overall seasonal climate as well as microclimate within separate regions of the SBMHCP area. Late spring rains can delay the onset of the flight season, while hot spring conditions can shorten it. MB colonies on the warmer, dryer south-facing slopes of the Mountain begin and end their flight season earlier than colonies on the cooler north-facing slopes.

METHODOLOGY

In the winter of 2006/2007, 13 fixed transects were established on SBM for MB butterflies (Figure 1). In plotting out the new transects, efforts were made to traverse as much MB habitat as possible. Historic habitat as well as restored or planted habitat was included. Where possible, old MB transects were incorporated into the new, longer transects. Transects vary in length from approximately 500 to 2100 meters and are permanently marked in the field. Of the 13 transects, 11 were established with the intention of being regularly monitored. Two transects (transects 2 and 3) were established as transects to be visited less frequently. Transects 2 and 3 were created to study MB usage of these sites, but these sites are not considered of highest importance in terms of measuring MB abundance in the SBMHCP area. Transect 2 is located east of the Pointe Pacific housing development. Transect 3 includes a planting island on the south side of Guadalupe Canyon Pkwy between the Parkway and Colma Creek. The newly established MB transects were monitored for the first time in 2007 and again in 2009, 2011, 2013, 2015, 2017, and 2019.

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

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

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

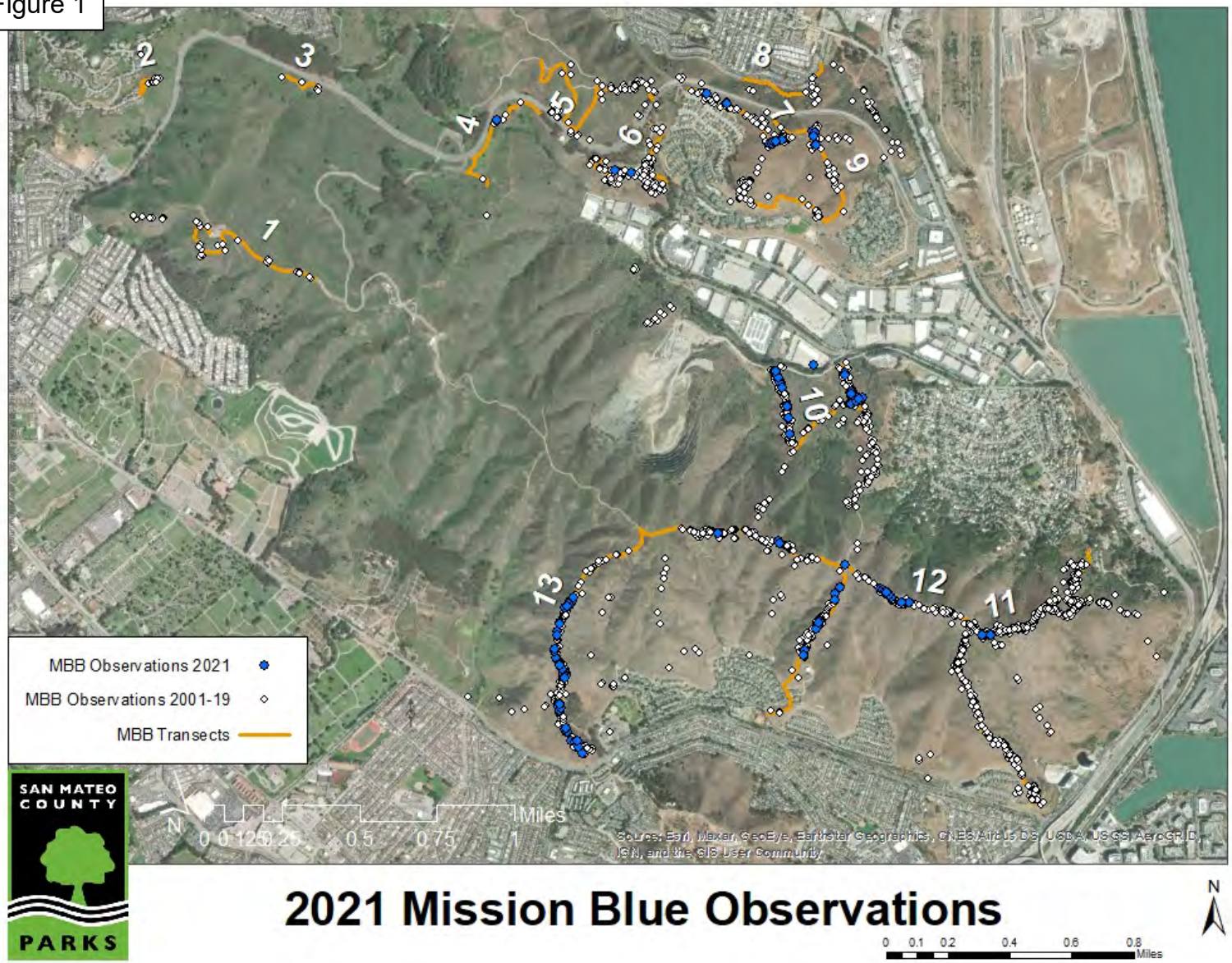
Ideally, each transect is monitored approximately 3-5 times over the peak of the flight season. Monitoring occurs only during warm, calm weather (wind speeds less than 10 miles per hour) when MB are most active. Efforts are made to complete an observation

cycle (a survey of all 13 transects) within one to two days. All butterflies observed beyond a specific transect or in the transect vicinity during travel between transects are recorded as incidental observations. While the best practice is to leave a 10 day gap of time between monitoring days for each transect, the necessity to monitor under appropriate weather conditions can make this difficult to time. The approach in 2019 for MB was to monitor transects as many times as possible during the period from April 8 through May 23, whenever weather conditions were suitable, regardless of the 10-day timing gap.

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

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

Figure 1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MBB Observations 2021
MBB Observations 2001-19
MBB Transects
SAN MATEO COUNTY
PARKS
N
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Miles
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
2021 Mission Blue Observations
N
0 0.1 0.2 0.4 0.6 0.8
Miles

RESULTS

Transect monitoring of MB butterflies occurred between March 24, 2021 and June 3, 2021. A total of 180 MB were counted along all transects. MB were observed on 8 of the 13 transects. The average sightings/hour (S/H) for all transect data combined in 2021 was 3.35. The maximum S/H is what is used to look for trends in abundance, and the average maximum across all transects in 2021 was 6.62 S/H for MB. Most transects were surveyed five or six times throughout the season, though the 7 to 10 day spacing between surveys was not always adhered to in order to accommodate weather conditions. Surveys at Transects 1-5 and 8 were limited this season due to difficult terrain, lack of suitable habitat, and/or a consistent lack of mission blue observations, as well as to allow sufficient time for surveys along extant transects while weather conditions cooperated.

Trends observed on each transect are discussed in detail below. Each transect is defined by the Management Unit (MU) that it occurs in and if it is in an Essential, Valuable, or Potential Habitat area for priority scrub management as defined in the Assessment. Priority scrub management habitat areas can be seen in Figure 2 Defining MB in terms of their MU and scrub management area is useful for interpreting butterfly monitoring findings with respect to management actions and recommendations. Sightings per hour for each transect for monitoring years 2007-2021 are summarized in Tables 1 & 2, and illustrated in Figure 3.

T-1, Transect 1 (MU Southwest Slope; some Potential habitat) –
This transect includes a portion of the road cut west of the former ranger's station, part of the summit loop trail, and habitat alongside the paved road (Battery 59 Road) leading to the former ranger's station. In 2021, no MB were observed on this transect.

T-2, Transect 2 (MU Reservoir Hill; Potential Habitat) –
This transect originally looped first through a grassy knoll, then back through scrub to hit a small population of lupine that had been planted by the Point Pacific Homeowners Association. The scrub has become too dense to pass through, therefore the grassy knoll had been the primary focus for the surveys since 2013. In 2021, no surveys were performed due to the transect being overgrown by poison oak and other scrub, making it impassable. The survey team chose to prioritize other transects while weather conditions remained favorable.

T-3, Transect 3 (MU April Brook; No Habitat Value) –
The majority of MB habitat on this transect occurs at its eastern end. Only a small number of plants are found at the western end and the route between these areas above the road cut supports coastal scrub. That scrub has become increasingly dense. In 2021, no MB were observed on this transect. This transect was only surveyed twice in 2021, in the fourth and fifth rounds.

T-4, Transect 4 (MU Dairy Wax Myrtle Ravines; some Essential some Potential) –
This transect is located in the Wax Myrtle Ravine and Dairy Ravine area. The transect begins at a planting island in Dairy Ravine, crosses through Wax Myrtle Ravine,

following Old Ranch Road trail along Guadalupe canyon parkway. In 2021, 1 MB was observed on this transect.

T-5, Transect 5 (MU Saddle; some Essential some Potential) –
Much of transect 5 follows an established trail. However, the transect departs from this trail and makes a U-turn through scrub in order to include MB habitat at the top of a road cut above Guadalupe Canyon Parkway. Coastal scrub on this route has become very thick making passage difficult. In 2013 & 2015, the U-turn was omitted from the transect, and it was assumed that zero MB detections would have occurred while surveying this leg. In 2021, no MB were observed on this transect.

T-6, Transect 6 (MU Dairy Wax Myrtle Ravines; Essential) –
Most of this transect is accessible and supports high quality MB habitat. Only the northern end of the transect has become difficult to traverse with scrub and poison oak. In 2021, a total of 3 MB were observed, all during the second of six visits.

T-7, Transect 7 (MU Northeast Ridge; Essential) –
The northwest portion of this transect is within the Toll Brothers development, and since 2011 has been fenced off and then later disturbed by grading. Transect 7 now ends at the Toll Brothers fence. A total of 25 MB were observed along this transect in 2021; no sightings in the first two of six visits, with numbers peaking in the third and fourth then tapering off in the last two visits. Maximum sightings per hour for this transect were 13.33 S/H. During the first survey on March 24, LUAL, LUVA, and VIPE were observed blooming along this transect.

T-8, Transect 8 (MU Carter Martin; Some Valuable) –
When monitored in 2011, the middle of this transect had become difficult to pass due to scrub, including non-native gorse and French broom. In 2013, the transect was monitored in two sections, one on either side of the impenetrable scrub. In 2021, dense scrub limited surveys to the eastern third of the transect; no MB were observed.

T-9, Transect 9 (MU Northeast Ridge; Essential) –
2017 represents the first year since 2007 where the maximum S/H have not declined from the previous year, though the total sightings and S/H were still quite low (1 individual observed, 1.1 max S/H). While grassland habitat along T-9 is fairly intact much of the habitat has sparsely distributed lupines. An exception is at the northern end of this transect where a robust population of lupines are found around the PG&E tower where scrub can be seen starting to expand into grassland habitat just to the west and south of the towers. The southeast corner of T-9 also contains numerous lupines. A total of 15 MB were observed in 2021, with MB observed during all surveys except the first (of five). Maximum sightings per hour for this transect was 8.89 S/H, almost equal to that of 2019 (9.1 S/H).

T-10, Transect 10 (MU Owl Buckeye Canyons, some Essential some Potential) –
T-10 is located at the foot of Owl and Buckeye Canyons within the California Department of Fish and Wildlife lands. This transect traverses open high quality prairie and grassland habitat with diverse nectar sources and scattered lupines along both ridgelines. A total of 38 MB were observed in 2021, with MB observed during all surveys except the first (of five). Maximum sightings per hour for this transect was 22.5 S/H,

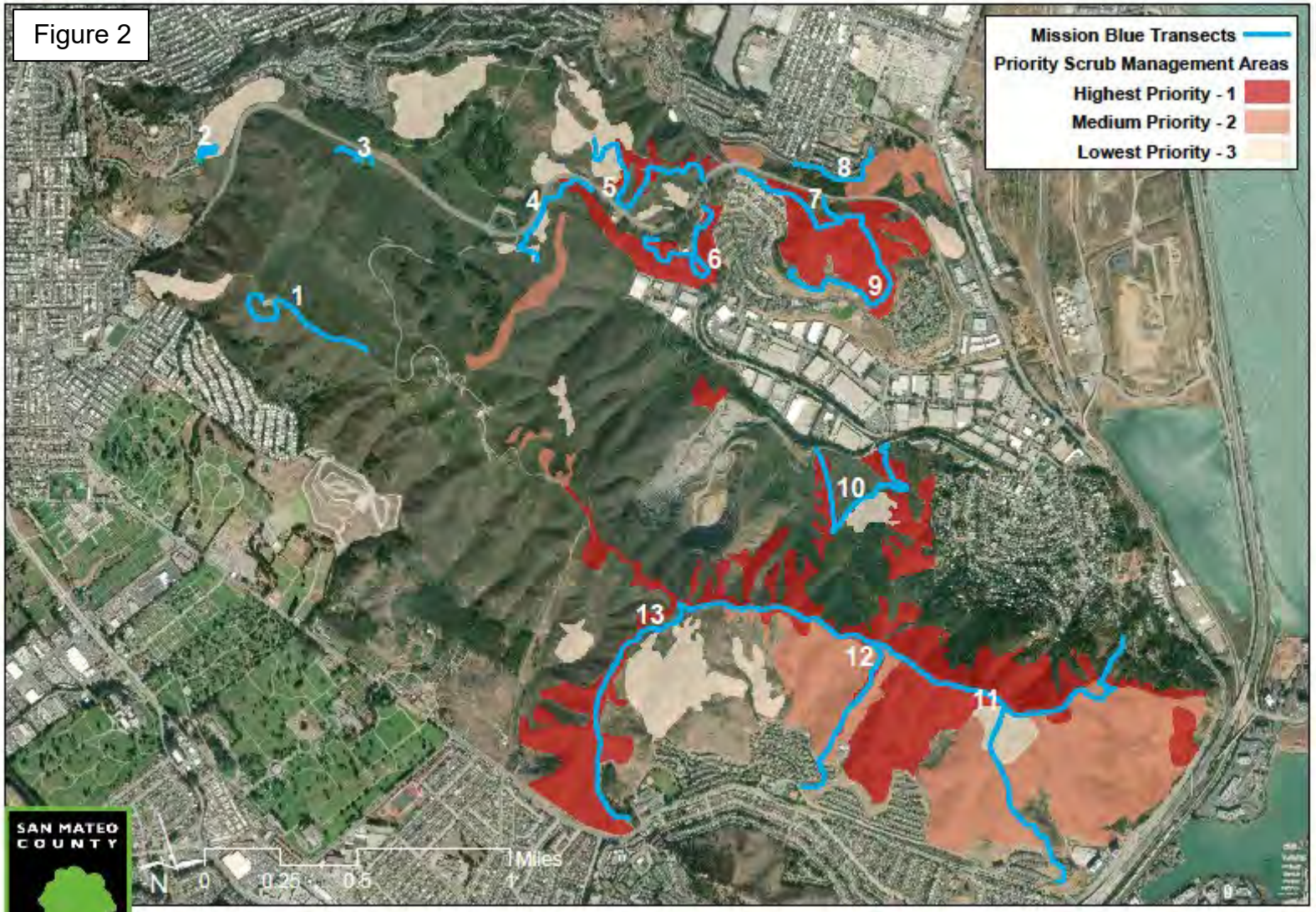
more than five times that of 2019 (4.2 S/H). As an unrelated but nonetheless interesting observation, in 2021, a wrentit was observed gathering nesting material along the trail mid-transect.

Transect 11 (MU Southeast Ridge; some Essential, some Valuable, some Potential) – T-11 is located within the Southeast Ridge Management Unit and begins at a previously disturbed slope above Sisters City/Hillside Boulevard that supports lupines. This transect follows the Ridge Trail and includes a portion of the Brisbane Acres Management Unit. T-11 intersects some of the SBM's best lupine habitat with abundant nectar sources. In 2021, a 'No Trespassing' sign placed by a local property owner was observed mid-transect; the sign as well as continuing scrub encroachment impeded access to the northern terminus of the transect. A total of 4 MB were observed on this transect in 2021, continuing a steep downward trend from 22 in 2019 and 47 in 2017. No MB were observed during the first three or last survey (of six).

T-12, Transect 12 (MU South Slope; some Essential some Potential) –
T-12 is located within the South Slope and Southeast Ridge Management Units and follows the ridgeline from the Terrabay water tank to the Ridge Trail. Similar to other locations along the South Slope and Southeast Ridge, the habitat here is extensive and continues to support annual grasses, nectar sources, and lupine host plants. 34 MB were observed along T-12 in 2021, with no MB being recorded only in the first and last (of five) surveys. Many callippe silverspot butterflies were noted along the ridge during the final survey (June 1) in 2021.

T-13, Transect 13 (MU Ridge, Essential) –
T-13 follows the Ridge Trail and then drops down a ridgeline to Hillside Blvd. T-13 is located on the south facing slope of SBM where conditions are the most dry and sunny. While scrub encroachment has been largely ignored on these slopes due to the slower rate of expansion as compared to the more mesic north and east facing slopes this is a concern in 2015. Grassland habitat supporting lupines along T-13 continue to support high MB observations during transect surveys, despite annual variability in total observations on this transect. In 2021, 60 MB were observed on T-13 (oddly the exact same count as in 2019, though the max S/H and average S/H were slightly lower in 2021.

Figure 2



Mission Blue Transects & Scrub Management Areas

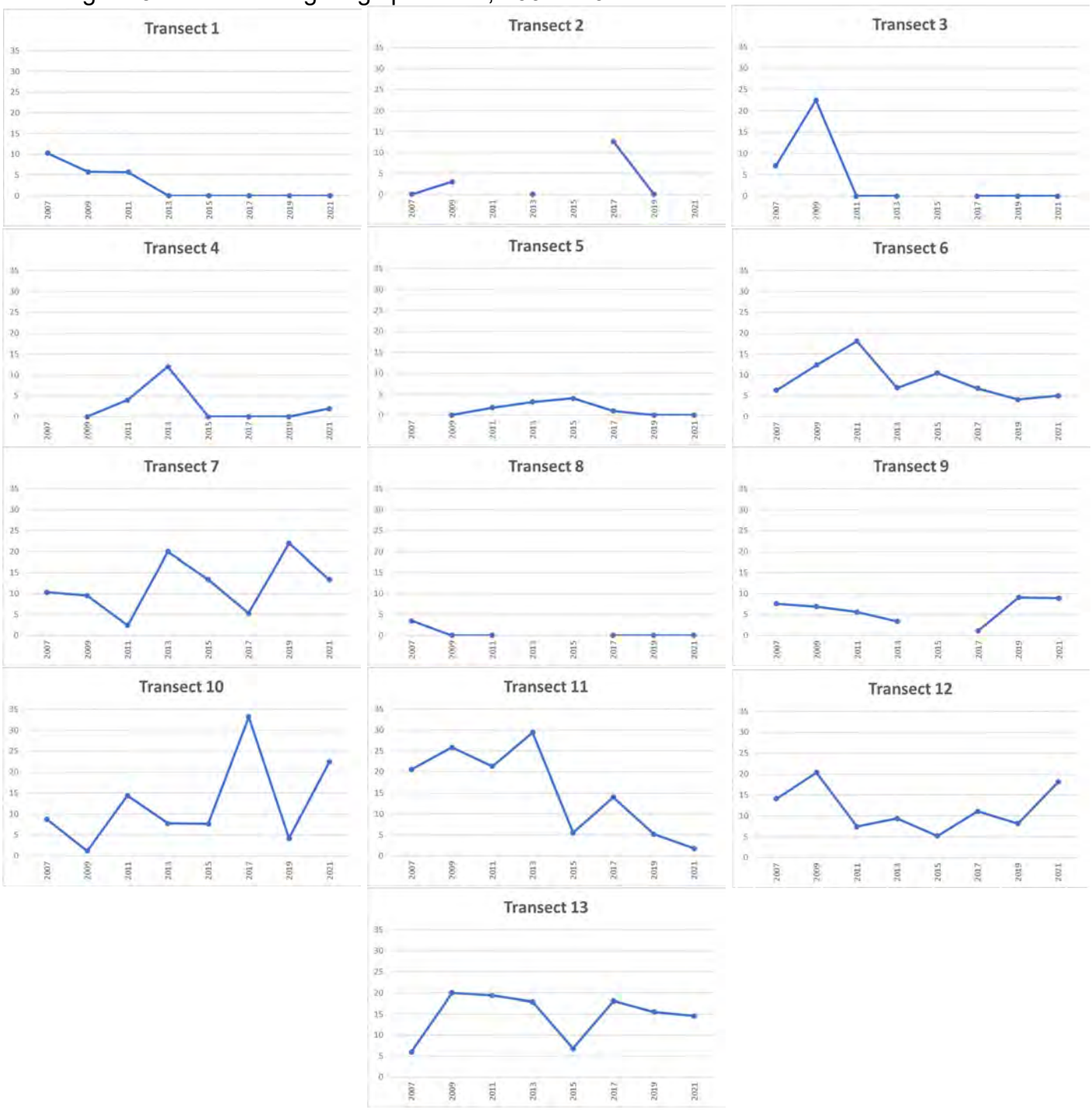
Table 1: Average S/H on each Transect: 2007 – 2021

Average S/H on each Transect from 2007 to 2019								
Year/ Transect	2007	2009	2011	2013	2015	2017	2019	2021
1	2.4	3.57	3.9	0	0	0	0	0
2	0	3	N/A	0	N/A	3.1	0	N/A
3	7.1	22.5	0	0	N/A	0	0	0
4	N/A	0	2.7	4.86	0	0	0	0.65
5	N/A	0	1.7	1.32	0.98	0.1	0	0
6	2.8	9.68	15.3	4.02	4.94	2.6	1.22	0.83
7	3.9	6.18	0.8	13.04	12	1.2	5	5.81
8	0.6	0	0	N/A	N/A	0	0	0
9	4.6	4.5	2.7	1.31	0.49	0.1	2.17	3.64
10	4	1.15	7.6	5.27	5.63	5.9	2.18	11.14
11	11.3	15.04	15.2	10.73	3.32	3.3	2.61	0.53
12	6.5	14.21	5.1	6.32	1.53	3.7	5.46	6.03
13	2.2	13.33	11.1	12.52	4.11	4.1	8.34	7.09

Table 2: Maximum S/H on each Transect: 2007 – 2021

Maximum S/H on each Transect from 2007 to 2019								
Year/ Transect	2007	2009	2011	2013	2015	2017	2019	2021
1	10.3	5.8	5.7	0	0	0	0	0
2	0	3	N/A	0	N/A	12.6	0	N/A
3	7.1	22.5	0	0	N/A	0	0	0
4	N/A	0	4	12	0	0	0	1.94
5	N/A	0	1.8	3.16	4.0	1.0	0	0
6	6.3	12.4	18.1	6.92	10.43	6.8	4.1	5
7	10.3	9.5	2.4	20	13.33	5.3	22	13.33
8	3.5	0	0	N/A	N/A	0	0	0
9	7.6	6.9	5.6	3.33	N/A	1.1	9.06	8.89
10	8.7	1.2	14.4	7.74	7.64	33.2	4.21	22.5
11	20.6	25.8	21.3	29.41	5.54	14	5.18	1.74
12	14.1	20.4	7.4	9.38	5.22	11.1	8.18	18.10
13	6	20	19.4	17.89	6.82	18.1	15.56	14.59

Figure 3: Maximum Sightings per Hour, 2007 - 2021



DISCUSSION

In 2021, MB observations were up from 2019 counts, but still largely reduced from previous years. While in 2021, 180 MB were observed on 8 of 13 transects, in 2017, 221 MB were observed on 9 of 13 transects and in 2019 there were 157 MB observed on 7 of 13 transects. In several of the transects where observations were still recorded in 2021, the maximum and average S/H have dropped from earlier monitoring years.

There are a number of potential contributing factors that could explain these decreases. In attempts to correct for previous monitoring years – issues including (1) the monitoring efforts did not meet the minimum recommended 3 annual surveys; (2) important details missing from the data sheets; and (3) low overall person-hours contributing to the efforts – the monitoring approach since 2017 has been to complete as many surveys as possible during the flight period when weather conditions are favorable, regardless of the interval between surveys (recommended 10-day intervals between survey rounds). While the level of effort, number of person hours, and attention to detail in recording observations was greatly increased for 2017 and 2019, there were still many surveys where no MB where observed for the entire duration of a transect survey. In calculating the average and maximum sightings per hour for the transects, these occurrences with 0 observations for the duration of the surveys brought down the averages overall. As a result, while the total numbers of MB observed in 2017 (221) and 2019 (157) were much greater than the total observed in 2015 (62), the average sightings per hour in 2017 (1.9) and 2019 (2.14), were lower compared to 2015 (3.2).

While the same increased-effort approach was pursued in 2021, survey efforts were persistently obstructed by poor weather conditions, resulting in lower total person-hours compared to in 2017 or 2019. Further, these limited weather windows sometimes led to surveys being conducted in suboptimal weather conditions (though still generally within the accepted thresholds), such as on Transect 6 where high winds frequently come off Guadalupe Canyon Parkway in the afternoon, possibly contributing to fewer MB observations. Transects with known extant MB populations or high quality habitat were often prioritized when survey windows were restricted due to weather, resulting in fewer surveys along Transects 1-5 and 8, and potentially inflating the combined average S/H across all transects.

In 2021, the greatest average number of MB recorded per hour was, in order, on transects 10, 13, and 12, with the main difference in order from 2019 being that average S/H was diminished on 11 and greatly increased on 10. The greatest maximum number of MB recorded per hour was, in order, on transects 10, 12, and 13. Transects 11-13 contain prime hilltopping habitat along the Ridge Trail and Southeast Ridge with thin soils. Transect 10 also contains valuable hilltopping habitat along the perimeter of Owl and Buckeye Canyons. Lupines are well-distributed across much of these grassland habitats.

Transects that performed the worst in 2019 include 1, 3-6, 8, and 11, each of which had an average S/H below 1.0, with no observations of MB adults recorded on transects 1, 3, 5, and 8 (transect 2 as not surveyed this year due to scrub encroachment). All of these transects have had few to no other MB observations in recent and/or previous years, while transect 4 did have limited observations (average S/H = 0.65) after having

zero observations the previous three survey years (2015, 2017, 2019). Scrub encroachment and lack of adequate hilltopping habitat continue to hamper MB populations in these areas, and a cooling effect from fog and a wind-tunneling effect along Guadalupe Canyon Parkway may be suppressing detections along these transects.

CONCLUSIONS

MBs are found in relatively low densities (as is typical for most *Lycanidae* species), but are widely distributed on San Bruno Mountain. The distribution of MBs observation in 2021 on San Bruno Mountain is similar to that of 2019 and 2017; while the total number of MBs observed and the combined average S/H are higher in 2021, they are still reduced compared to previous years and potentially inflated by prioritization of transects with known extant populations and high-quality habitat. However, this does not necessarily signal a downward trend in MB abundance, as year to year variation has been observed on San Bruno Mountain since 1981 when studies of this species began. North to south this species continues to be found in a wide variety of microclimates and slope exposures within SBMHCP area, though in significantly varying densities.

The western portion of SBM has not seen any reliable observations of MB in 2013, 2015, 2017, 2019, or 2021, aside from 7 MB sightings on T-2 in the Reservoir Hill area in 2017 and a single observation on T-4 in 2021. This could be due to the combination that high quality habitat is found in smaller habitat patches and unabated scrub encroachment into grassland areas. Weather variability on SBM plays a role in monitoring and it can be difficult to schedule butterfly monitoring visits during ideal monitoring conditions, warm and calm weather days.

A mitigation project undertaken by PG&E, initiated in 2018, focused on grassland restoration efforts on the west peak of SBM, on the south-west facing slope. This location is less than 0.5 miles from T-1 as well as T-2, where observations of MB were made in 2017. Though this distance is greater than the typical 0.25 mile dispersal distance for MB, there is additional restoration potential to establish a dispersal corridor with habitat islands connecting these two areas and allowing for greater movement of MB throughout this area. Mitigation activities continue in 2022.

As documented over the past 30 years of butterfly monitoring on SBM, the Southeast Ridge and South Slope historically provided significant contiguous patches of high quality habitat for MB butterflies. However, recent observations of diminished host and nectar plant densities, combined with an increase in scrub encroachment and thatch buildup, correlate with a marked decline in MB observations. While MB are still consistently observed along the Southeast Ridge and the population appears to be stable, further scrub removal and lupine plantings should be implemented. The South Slope contains large areas of contiguous grassland, and is located on south-facing aspects of San Bruno Mountain and is therefore drier and warmer. Historically coastal scrub succession has been less of a threat than on the south facing slopes, but with little natural disturbance (fire) and absence of grazing these areas are beginning to see more scrub encroachment into grassland areas. The planned San Bruno Mountain Conservation Grazing Pilot Program, which will target areas on the Northeast Ridge and Southeast Slope, may help

halt or reverse scrub encroachment and bolster host and nectar plant abundance and distribution in these areas.

The Assessment conducted by Creekside Science provides clear guidance concerning grassland evaluation in light of scrub encroachment. Grassland quality, specifically with respect to host and nectar plant distribution and abundance, are important considerations for healthy MB populations. While the HMP and the SBMHCP documents both identified scrub encroachment as threats to MB neither document provided clear guidance concerning how to define grassland quality or levels of scrub encroached grasslands with quantifiable definitions and actionable thresholds. The lack of a clear definition and SMART (specific, measurable, achievable, results-focused, and time-bound) goals and objectives coupled with limited resources had delayed meaningful management activities targeting this threat before 2016.

RECOMMENDATIONS

SCRUB ENCROACHMENT

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

1. Scrub encroachment should continue to be the primary focus for budget expenditures related to habitat management. Using the Assessment, areas designated as “essential” should continue to be prioritized for treatment. San Mateo County has completed treatment of approximately 10.87 acres of scrub removal in areas designated as essential habitat in 2021. See Figure 4 for these treatment areas. This work includes continued exotic control in these areas. Areas undergoing scrub removal may also require additional restoration work including host and nectar plantings. Restoration plantings will help increase density and distribution of host and nectar plants in essential habitat. A revised evaluation of the percent cover of grassland habitat based on aerial imagery, as well as ground-truthing by Parks staff based on a threshold percent scrub-to-grassland, should be completed in order to determine whether the required minimum of 1,200 acres of grassland is being met.

MB MONITORING

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

3. Initiate flight season documentation; may improve monitoring deployment, level

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

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

5. Per the recommendations in the 2022 Final BCB Reintroduction report (Appendix C), record incidental observations of BCB during Mission blue and other protocol-level surveys and, to the extent feasible, initiate hilltop surveys in order to establish occupancy.

MB HOST AND NECTAR PLANTS

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

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

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

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

9. Low MB numbers along the Southeast Ridge, as well as Brisbane Acres and the Southeast Slope, appear to be linked to diminished number of host plants in the area. These areas should be targeted for lupine direct seeding and diversification, specifically in previously disturbed habitats such as trail sides and road cuts.

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

A small population of the Bay checkerspot butterfly (BCB) was present near the summit of San Bruno Mountain up until the mid-1980s, but for decades had been determined to be extirpated from the mountain. To reestablish the Bay checkerspot butterfly (*Euphydryas editha bayensis*) (BCB) on San Bruno Mountain (SBM), translocations

from Coyote Ridge in south San Jose (Santa Clara County) began in 2017 with funding from the Disney Butterfly Conservation Initiative, continuing each year through 2021.

On February 27, 2021, Creekside Science translocated 2851 post diapause larvae. On March 7, an additional 1008 larvae were translocated, for a total of 3859 larvae in 2021. All larvae were released on the Northeast Ridge, a new release location. Larvae were safely relocated and were observed eating and basking after release. Field staff also documented BCB egg masses on the nonnative English plantain (*Plantago lanceolata*), demonstrating that adults are ovipositing on a novel, nonnative host. Adult butterflies were observed in late March, though windy weather limited the number of days for adult transect walks. A total of 51 adults were observed on transects on the two good days, in all the previous release areas. Plant phenology was relatively early, as a response to the second year of drought with a very dry late-winter and spring.

No adults were translocated in 2021.

The final project report written by Creekside Science, which includes analysis of all five years of releases and provides guidance on long-term monitoring and adaptive management, was prepared and submitted to USFWS and can be referenced for additional information on these translocation efforts. See Appendix C for the 2022 Final Report on BCB reintroductions at San Bruno Mountain.

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

The San Francisco garter snake (SFGS) was identified in the SBMHCP (1982) as having potential habitat on San Bruno Mountain. No SFGS were observed on the Mountain by field crew while conducting biological activities and overseeing development activities in 2019 or 2020. There have been no confirmed observations of SFGS on San Bruno Mountain in over 30 years of the SBMHCP monitoring program. Based on the lack of significant ponds and other aquatic habitats, this species is unlikely to be present.

D. California Red-legged Frog (*Rana draytonii*)

The California red-legged frog (CRLF) shares similar aquatic habitat with SFGS. Though it was not identified as a sensitive species at the time of the SBMHCP, CRLF has since been listed as a Federally Threatened species. No CRLF were observed on San Bruno Mountain by field crews while conducting biological activities and overseeing development activities in 2019 or 2020. There have been no confirmed observations of CRLF on San Bruno Mountain in over 30 years of the SBMHCP monitoring program. Based on the lack of significant ponds and other aquatic habitats on San Bruno Mountain, it is unlikely this species is present.

E. Plants of Concern

The rare plant survey completed in 2015 (see Appendix B) continues to be a guiding document for our knowledge of rare plant populations within the SBMHCP area, and allows better management decisions and appropriate avoidance an minimization measure to be in place to prevent impacts to known populations. In 2017 and 1028,

additional populations of *Silene verecunda verecunda* and *Helianthella castanea* were identified. A restoration plan for *Lessingia germanorum* was proposed and approved in 2020 and is funded through a grant from the USFWS. These restoration activities are underway, in involve seed collection and propagation of lessingia, and experimental plots for reseeding and reintroduction with dune habitat.

III. VEGETATION AND HABITAT MANAGEMENT

A. Introduction

1. Site History

San Bruno Mountain State and County Park has been the site of many landscape and landowner changes since European settlement. Prior to European's inhabiting the land, the Ohlone (Costanoan) peoples are known to be the first to establish settlements on what we call San Bruno Mountain today. Evidence of the Ohlone's presence on San Bruno Mountain can be found throughout the mountain in the form of shell mounds (San Bruno Mountain Watch, 2020). During the period of Spanish settlement (roughly 1769-1884), the land was largely displaced from the Ohlone peoples, but remained largely undeveloped, as it was being used for farming. When California became a state and the land was purchased, the majority of the area was devoted to grazing. That was until the 1970s when the majority of the park was purchased by the County of San Mateo. In 1982, the San Bruno Mountain Habitat Conservation Plan (SBMHCP) was enacted and created federally-listed species protections, but also allowed for development within certain non-County owned lands. The increased development surrounding San Bruno Mountain in the subsequent decades, and the diminished occurrence of natural disturbance regimes, saw a vast change in the mountain's native vegetation cover. Further, the affects of climate change and increased human presence in and around the mountain has had negative impacts on many sensitive wildlife habitats.

2. Vegetation Management

With European settlement came European species. Along with livestock and other farm animals, Europeans, both purposefully and accidentally, brought European plant species, the most notable and destructive being the annual grass species. These annual grasses thrived at San Bruno Mountain and throughout California, displacing many California native grassland wildflowers and grasses. The introduction of many motorways adjacent to San Bruno proliferated the European annual grass production leading to increased nitrogen input into the soils creating massive stands of grass which produce too much shade and thatch for California adapted species. Further, many native California grassland species are not adapted to high nutrient soils exacerbating the European invasive plant takeover. Once houses were built in and around San Bruno Mountain and people started planting non-indigenous ornamentals in their yards, a new wave of invasive species became present and destructive. Many people started planting Eucalyptus globulus (blue gum eucalyptus), Pinus radiata (Monterey pine), and Cupresses macrocarpa (Monterey cypress) for wind protection and as a natural

delineation of property boundaries. Unfortunately, these species as well as many garden ornamentals spread onto the mountain changing the landscape rapidly. The impact of the quarry at San Bruno Mountain was not just limited to the landform disturbance. Vehicles driving into, throughout, and across other locations in California and beyond likely spread invasive species on the periphery of the quarry which then spread outward into the mountain. Evidence of this is shown by the bright yellow display in late spring months when Cytisus striatus (Portuguese broom) is in flower.

The spread of invasive species from these initial introductions has exponentially increased due to a lack of coordinated management efforts for some time. After the SBMHCP was put into effect in 1982, vegetation management on San Bruno Mountain became structured with the focus being on protecting existing occupied habitat of federally-protected species. Further, efforts to identify specific causes for decline in federally-protected species were amplified leading to efforts to control the succession of grassland to scrub.

Beginning July 1, 2015 scrub removal became one of the highest priorities for habitat management in the SBMHCP area. This focus has been continued in 2021 and remains a priority. The 2015 30-Year Assessment identified scrub as the biggest threat to occupied high quality habitat within the SBMHCP area and was also identified as a threat in the final SBMHCP (1982). Due to constraints related to controlled burns or the infrastructure cost associated with conservation grazing strategies, manual and chemical control of scrub species, both native and invasive, have been deployed.

B. Methods

1. Location

Vegetation management in 2021 was done in the majority of management units throughout the SBMHCP area. The SBMHCP area ranges from the city limits of Daly City, Colma, South San Francisco, and Brisbane (Figure 1). Locations for habitat restoration work are selected by SMCP staff using several different criteria. Factors include but are not limited to the following:

- Invasive plant species threats to present or potentially present locally rare or state and/or federally-listed flora or fauna species
- Are considered high habitat value for any of the listed flora and fauna, and have high native plant diversity that is important to conserve
- Areas where invasive plant infestations have a high likelihood of spreading
- Areas where there are known plant species that are on the California Department of Food and Agriculture Noxious weed list, given a California Invasive Plant Council rating, or are listed as priority species on the San Mateo County Weed Management Area group.
- Areas where invasive species or encroaching natives (i.e. coastal scrub species) are threatening high value vegetation communities (i.e. grasslands)
- Areas where effort has been put into for restoration in the past and ongoing effort is needed to ensure habitat health.

- Areas deemed by the *2015 Assessment of Past 30 Years of the San Bruno Mountain HCP* to be priority grassland management areas

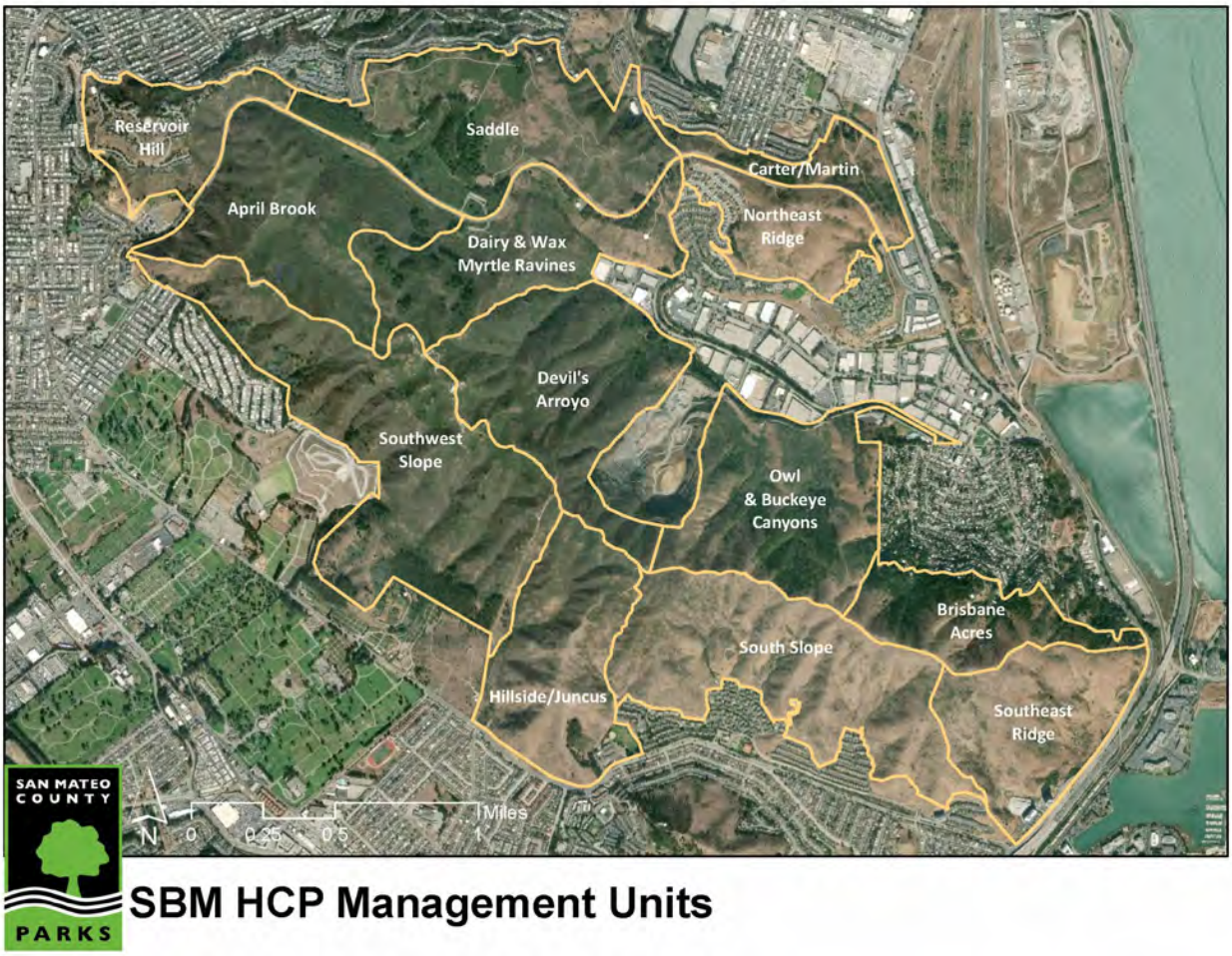


Figure 1: San Mateo County, CA. 2021. Map displaying the San Bruno Mountain Habitat Conservation boundary (green) and the corresponding Management Units.

There are thirteen official management units (MU) contained within the SBMHCP, as depicted in Figure 1. Not all MUs were prioritized for vegetation management activities as some units do not support occupied habitat for the covered butterfly species.

2. Vegetation Management Groups

In 2021, Ecological Concerns Incorporated (ECI), Go Native Incorporated (GNI), On-Point Land Management (OPLM, hired by City of Brisbane), San Bruno Mountain Watch (SBMW), and San Mateo County Parks (SMCP) staff and interns implemented vegetation management within the SBMHCP area. The majority of funds for ECI and GNI are from the SBMHCP trust fund. Some projects were also funded by County Park invasive species control budgets or funds from developers for vegetation work needed to improve dedicated lands as part of their mitigation requirements. Invasive plant control has been augmented by volunteer groups, local homeowner's associations, and private landowners throughout the life of the SBMHCP. Current groups involved are: California Native Plant Society (CNPS) volunteers, San Bruno Mountain Watch (SBMW), City of Brisbane, Toll

Brothers Inc., and TerraBay Master HOA. In addition to invasive species control, both SBMW and SMCP coordinated volunteer events within the SBMHCP to plant native species. Further, in 2018 Creekside Science Center for Earth Observation (Creekside Science) initiated a lupine direct seeding experiment within the SBMHCP to establish the most successful methods for establishing host plants for the Mission blue butterfly (MB). They have continued this experiment in new areas and with more seed in 2021.

3. Vegetation Management Techniques

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

Handwork
Seedlings and saplings are pulled from the crown upward to reduce soil disturbance. This approach is most effective with plants that have shallow root systems. Hand tools used to remove the whole plant and root systems for this method include Pulaski or axe mattock, dandelion weeder, hori hori knives, pruning saw and loppers. If the soil is disturbed when the target is removed, then it is tamped down with a foot or the tool after weed removal. Species targeted for this method include *Foeniculum vulgare* (fennel), *Cytisus striatus* (Portuguese broom), *Genista monspessulana* (French broom), eucalyptus, *Baccharis pilularis* (coyote brush), and *Rubus armeniacus* (Himalayan 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 spp.* (acacia).

In addition to brush cutters, SMCP staff have utilized the use of masticators and dozers to treat patches of thick *Ulex europaeus* (gorse). This approach is also being considered for use by CalFire in certain areas of the SBMHCP near homes as fire fuel reduction efforts. SMCP operators use dozers to crush already burned standing woody vegetation to smaller more manageable pieces so that later CalFire can use brush rakes and create burn piles. SMCP operators use masticators to cut through dense stands of woody vegetation. The operators repeatedly go over the masticated area to achieve the proper chip depth and size so that an average depth of chips is around 6 inches. This creates a layer of chips that will suppress the gorse seed bank. If a depth of 6 inches cannot be obtained SMCP brings in wood chips from other on-site tree management projects to supplement. These chips are then spread by SMCP dozers or can be spready by the use of wheelbarrows and rakes by volunteers.

Herbicides

Some weedy species are treated with an herbicide solution using foliar, basal bark and cut stump methods. The five herbicides applied are Garlon 4 Ultra® (Triclopyr ester), Vastlan® (Triclopyr amine), Roundup ProMax® (glyphosate), Roundup Custom Aquatic and Terrestrial® (glyphosate), and ClearCast® (Imazamox). These herbicides are used due to their high effectiveness and low toxicity rating. Garlon 4 Ultra® herbicide is the preferred chemical for broadleaf weeds and has little effect on monocots (grasses). Vastlan®, is a safe around aquatic environments herbicide, which also does not affect monocots drastically and has also proven to be highly effective on woody vegetation. Round Up Custom Aquatic and Terrestrial® is a safe around aquatic environments herbicide applied to plants adjacent to creeks or in areas subject to seasonal runoff. Roundup ProMax® is a non-selective herbicide with a surfactant added to the formulation and is used to treat grasses as Garlon 4 Ultra® is not very effective on monocots. Roundup ProMax® is also used to foliar spray gorse due it's known high effectiveness for this species. The active ingredient in ClearCast®, Imazamox, is of a similar chemical makeup to Imazapyr (Arsenal® and Habitat®) and has shown evidence of persisting in the soil well after the initial treatment. This herbicide is specifically to be used on difficult to control species such as *Hedera helix* (English ivy) and *Oxalis pes-caprae* (Oxalis). Anecdotally, SMCP has observed at Pillar Point Bluff that this herbicide was highly effective on targeting the below ground bulbil of Oxalis, leading to 100% control within one work area in a February 2021 treatment. The herbicide application type and method depend upon the species and location. Three application treatments (foliar, cut-stump, and thin-line) are used within SBMHCP area. Foliar treatment is when the whole of the plant's canopy and leaf area are targeted using backpack sprayers and cone/jet tips. The spray tips are designed to adjust and allow target specific applications. Cut-stump treatments are when the trunk is cut 1-2 inches above soil surface and treated with a 25% to 50% mixed solution with a Roundup® product, Garlon 4 Ultra®, or Vastlan® and vegetable oil. Thinline treatments are considered a low volume application and is used primarily on trees and shrubs less than six inches in diameter. A thin stream of undiluted or highly concentrated herbicide is applied in a horizontal line around each stem. All application techniques are focused on the target species, and drift to adjacent plants is avoided by using the appropriate equipment and applying during appropriate weather conditions.

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

Approach

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

4. Data analysis

We analyzed all spatial data using ESRI's ArcGIS Pro or ArcMap applications. Other data analysis was done in Microsoft Excel spreadsheets. All data we collected in the field using Calflora Weed Manager was transferred to spreadsheets.

C. Results

The vegetation management data we analyzed for this report is comprised of work performed from November 25, 2021 through August 21, 2021. Some work performed from September – December 2021 is not included in this report as the data was not made available in time for publishing. The data from work performed from this period and a summary will be provided on the 2022 report.

1. Personnel

Vegetation management contractors were responsible for treating the majority of managed land in 2021, treating over 210 acres or about 78% of all managed land (Figure 2).

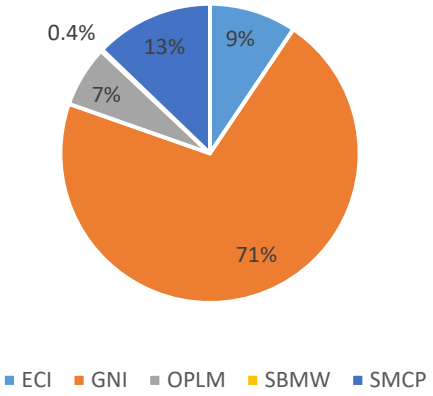


Figure 2. Percentage of acreage treated by Go Native Incorporated (GNI), San Mateo County Parks (SMCP), Ecological Concerns Incorporated (ECI), On Point Land Management (OPLM) and San Bruno Mountain Watch (SBMW) within the San Bruno Mountain Habitat Conservation Plant (SBMHCP) area in 2021.

This is a decrease from 2019-2020 where contractors combined to treat about 97% of all managed land. SMCP staff, interns, and volunteers treating over 26 acres and dedicating nearly 660 person-hours (Figure 3).

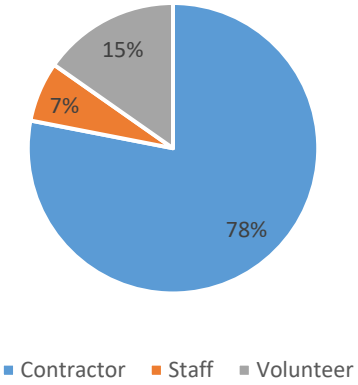


Figure 3. Percentage of time dedicated to treating vegetation by labor type within the SBMHCP in 2021.

2. Treatment Distribution

SMCP staff and contractors managed vegetation in 19 of the 24 management units in 2021 (Figure 4).

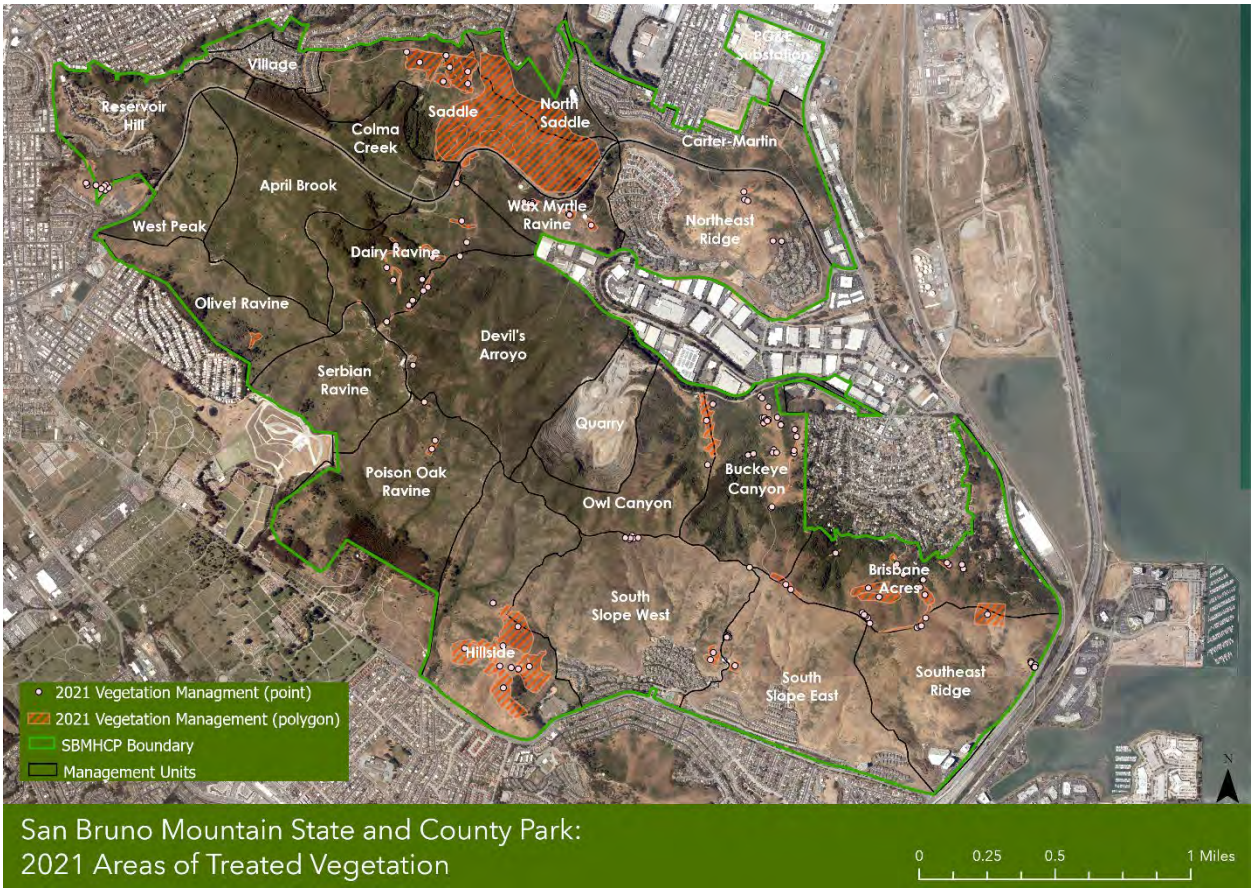


Figure 4. San Mateo County, Ca. Areas where vegetation was managed at San Bruno Mountain in 2021.

Total acreages of treatments do not represent actual on the ground manipulation of vegetation. Rather the vegetation managed in these areas show the total area vegetation was searched and encompasses areas where treatments were done. For example, treatments done in the Saddle and North Saddle were to control *Ulex europaeus* (gorse) infestations. The percent cover of these infestations was very sparse; however, contractors are instructed to record the area where they have swept for the species which helps us to know what area has been deemed clear of gorse. Contractors and SMCP also conduct vegetation management within small areas and often do so over multiple occasions to achieve a desired result. This is to ensure that the butterfly habitats are restored properly and with the proper amount of sensitivity.

3. Methods of Treatment

SMCP contractors, staff, and volunteers used manual methods whenever it was possible to reduce the amount of disturbance to area. However, most of the area that was managed in the SBMHCP area in 2021 was managed using herbicide (Figure 5). However, the area managed with herbicide is much larger than what was actually applied on the ground, as chemical treatments used are quite sparse as compared to the entire area that is treated. Comparatively, our mechanical treatments conducted represent a more precise area measurement of what vegetation was mechanized. Manual methods are somewhere in between, as manual removals are both conducted in very dense invasive plant infestations and in large less dense areas.

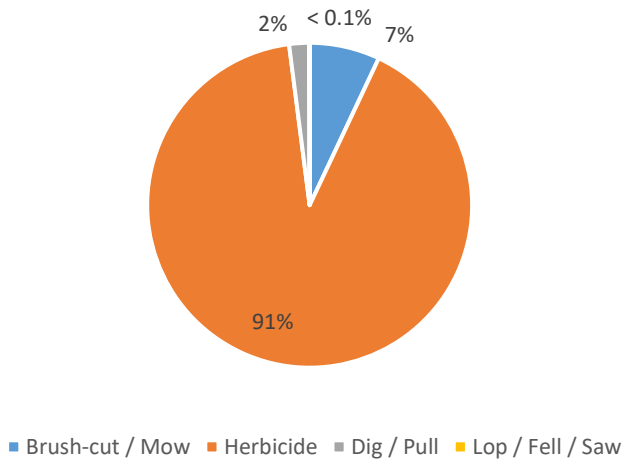


Figure 5. Percentage of acreage treated by control method within the SBMHCP in 2021.

SMCP staff did use herbicide for the first time in 2021 to control difficult to manage plants that were at a manageable size or were time sensitive and contractors were unavailable. Volunteers will never be permitted to use chemicals, but SMCP staff will continue to use chemical control methods whenever it is necessary to protect sensitive ecosystems. The contractors that SMCP has hired are well experienced to perform highly calibrated and ecologically safe herbicide applications. The contractors used the spot spraying method to control forbs and small bushes over a large landscape for very fine controlled treatments. Only in one instance were tank sprayers attached to utility terrain vehicles (UTVs). This was to control rampant invasive weeds that were sprouting during the winter

following the February 2020 fire that took place in the Saddle. This was deemed the most efficient approach as there was so much invasive plant growth in the area and very little native growth in this previously almost entire Gorse patch. SMCP staff and contractors also utilized cut stump treatments on coastal scrub encroaching into grasslands, large gorse, and some blue gum eucalyptus.

Another effective control technique utilized by both SMCP staff and contractors is the use of brush cutters or chainsaws. In 2021 we used these tools to treat weeds such as gorse, eucalyptus, Monterey pine, and Monterey cypress. Often SMCP staff and contractors would utilize both brush cutters and chainsaws with herbicide spot treatments to effectively control plants that would re-sprout after being cut. Additionally, SMCP staff conducted several grass clearing experimental plots using brush cutters to reduce the amount of invasive annual grass growth and subsequent thatch buildup. SMCP staff utilized our Caterpillar 299 masticator to crush down the burned skeletons from the 5 acre February 2020 gorse in the Saddle. In coordination with tree management contractors working within San Bruno Mountain State and County Park and other County operated parks, we acquired several thousand cubic feet of wood chips to suppress the invasive plant growth within the burn footprint. This is an ongoing project where we are continuously taking in more chips to act as a weed suppressant in the burn footprint and in the 7 acre October 2020 masticated gorse site in the North Saddle. As gorse seedlings emerge, SMCP staff and contractors will control using spot-spraying methods in the late spring or summer as this is the best timing for treatment of this species.

4. Species Treated

SMCP targeted several invasive plant species for control or containment in 2021. Unfortunately, given the capacity and resources at our disposal and the sheer number of invasive species on site, we must prioritize treatment areas based on a number of factors. As such, SMCP identifies specific high priority targets and areas that are in specific need of preservation or restoration. SMCP and partner groups targeted at least 25 species for control in the SBMHCP area in 2021 (Figure 6).

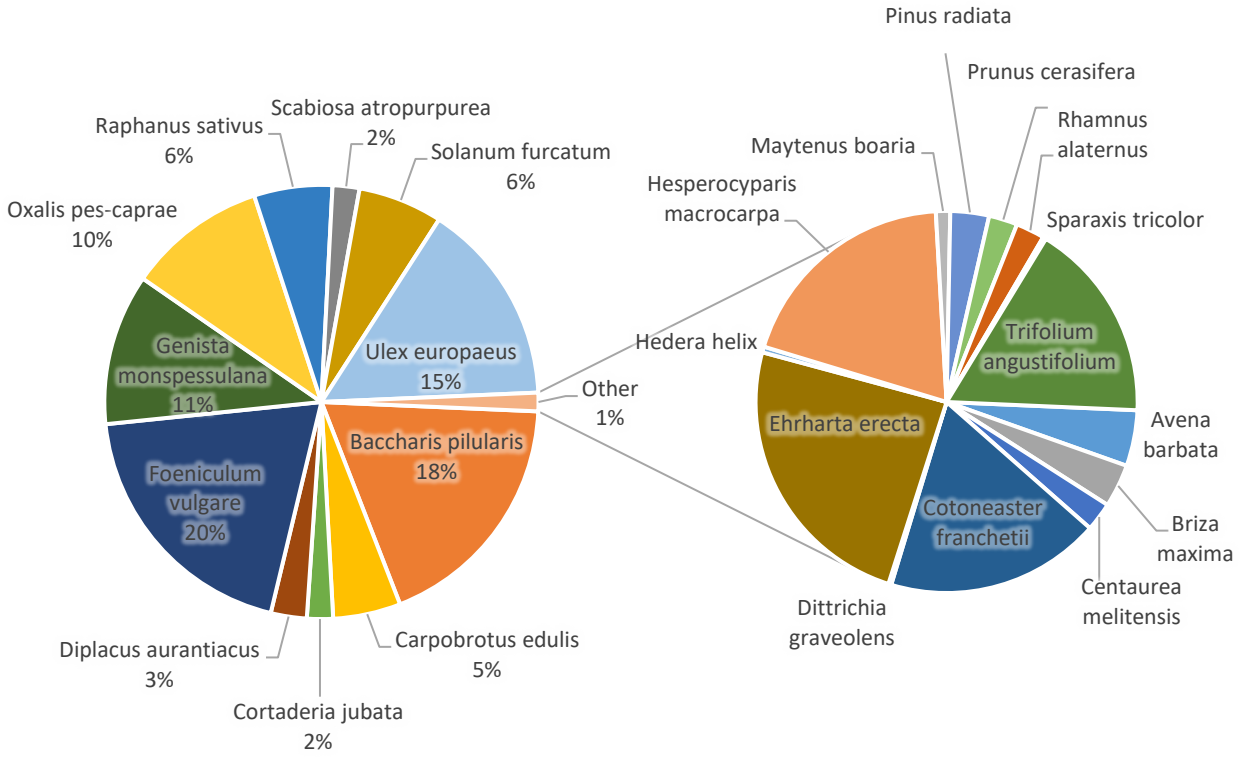


Figure 6. Percentage of person-hours spent controlling vegetation by plant species within the SBMHCP in 2021.

The species that took 10% or more of our time in 2021 are critical targets for grassland restoration. These species are highly prevalent and spreading quickly in certain areas. Species below the 10% threshold of time devoted are also key targets and certain species such as *Scabiosa atropurpurea*, *Trifolium angustifolium*, *Centaurea melitensis*, and *Trifolium hirtum* (not targeted this year) are species that we wish to get a hold of before they become more common in certain grassland patches.

D. Discussion

1. Habitat Enhancement

San Bruno Mountain's federally-listed butterfly species continue to be at risk due to invasive plant species, and native scrub encroachment. SMCP continues to prioritize areas of high-quality habitat to preserve considering butterfly life stage and invasive species effects to the habitat. We also aim to restore butterfly habitats with declining numbers or that are under threat of invasive species. SMCPs work in 2021 shows this continued effort to devote resources and people power to assess and combat invasive species while integrating the knowledge of the butterfly population data and habitat quality. Typically, areas where large scale restoration is needed to convert late-seral scrub back to grassland are beyond our capabilities unless we have special funding outside of the annual SBMHCP trust fund allocations. Consequently, efforts to conduct a landscape-scale habitat restoration project are underway with the current planning for a

Pilot Cattle Grazing Program. This project will aim to introduce cattle to certain areas of San Bruno Mountain, with the goal to reduce grass height and thatch build-up thus promoting host and nectar plant expansion. This project would deliver much needed large-scale restoration to the grasslands and help reduce the amount of thatch buildup that decades of unmanaged European annual grass growth has produced. Projects such as this are paramount for the long-term health of the butterflies and provide the data necessary to properly assess the success of the site-specific pilot program rather than having to extrapolate findings from other California based projects.

SMCP has continued to focus on habitat restoration work on large woody invasive plants which is one of the main threats to the butterfly species occupying grassland habitats and their host plants. However, the rate at which the scrub is establishing in grasslands is more than what hand crews can treat, especially with access to certain areas being difficult. The introduction of cattle will also help combat this issue. By bringing in large grazers, SMCP hopes that grazed areas will have decreased scrub recruitment, halting ongoing encroachment of the scrub into the grasslands, as well as reduced non-native annual grass cover/density and thatch buildup.

McKesson Parcels
The work in the McKesson Parcels located in the Wax Myrtle Ravine and the Devil's Arroyo MUs have been successful in improving habitat for covered butterfly species. In the Wax Myrtle Ravine, work has centered around treating fennel and native scrub species for grassland restoration. Work has also been conducted on the outskirts of the eucalyptus grove to control encroaching saplings. In the eucalyptus grove, we have focused on treating small diameter trees (less than 8 in DBH) and broom species to reduce fire ladder fuels in the grove. Work at the Devil's Arroyo site has focused on reducing Portuguese broom, French broom, and coastal scrub species from the grassland areas where Callippe butterflies are still present. Work in both areas has been ongoing in 2021. All work in the McKesson parcels has been done by ECI.

TerraBay Parcels
The work in TerraBay Parcels 1 and 2 has been primarily focused on reducing the fennel that has inundated many of the grassland areas on the southern slope of the mountain. TerraBay Parcels 1 and 2 are located in the South Slope MU. TerraBay Parcels 1 and 2 are both situated in scrub and grassland and the transition between the two areas. The goal for these sites is to treat the fennel prior to it going to seed, but at the same time prioritizing areas of high-quality host plants and of high plant species richness. Work was conducted in these parcels in late spring 2021 by ECI.

2. Butterfly Host Plant Establishment

The ability to repopulate host plants is also crucial to the restoration and continued augmentation of the butterfly's habitat. Finding ways to establish host plants in large numbers and doing so with the most diverse genetic material gives the butterfly species a higher likelihood of population expansion. The success of the lupine direct seeding and amplification projects across the Bay Area provides a hope that even with the potential for fungal pathogen outbreaks, there could still be a way to provide host plants to declining populations. The proven ability to propagate and plant sedum is also a great sign that you

can establish these hearty succulents in areas of present or historically present San Bruno elfin butterfly populations. The next challenge for SMCP is to establish nursery grown Viola at San Bruno Mountain. This has proved difficult in the past. However, thanks to our valued partners at San Bruno Mountain Watch and the Mission Blue Nursery, we are aiming to try again with a new approach. Instead of container planting which was traditionally attempted, we have set our sights on attempting a direct seeding experiment at San Bruno Mountain using site specific seed grown in Brisbane at Mission Blue Nursery. Franklin et al. (2017) were recently successful in establishing seed germination requirements for *Viola pedunculata* and *Viola purpurea*. However, trialing this novel approach is on hold until it becomes more certain whether Mission Blue Nursery will need to be relocated or not.

In January 2021, SMCP received lupine seed of the three perennial species on the mountain from Creekside Science. SMCP then went on to enact some test plots in certain areas to determine which areas within the SBMHCP had the greatest success. These areas were watered from time to time through May 2021, which we found was needed given the lack of precipitation received. Our results were interesting as it was found that the grassland patches in the Wax Myrtle Ravine MU had very poor survivorship through 3 months, while the ridgetop (near Brisbane Acres MU), and the grassland located on Owl Ridge (east edge of Owl Canyon MU) had fairly good germination rates. This was not an extensive experiment as Creekside Science and the Golden Gate Recreation Area (GGNRA) had already conducted extensive direct seeding experiments with these three species of lupine and SMCP used the methods with the best results and most efficient practices into our direct seeding protocol. On top of the plots, SMCP also went and spread all three species across the ridgetop and Buckeye Canyon in January and February 2021. In December 2021, SMCP staff set on direct seeding all three lupine species along the grassland ridge up from the Terrabay water tower (boundary separating South Slope West and South Slope East MUs), a small section along the ridgetop, and the grasslands along Buckeye Ridge (Buckeye Canyon MU). Seed was broadcast dispersed in suitable grassland habitat, as well as targeted along trailsides in rocky and disturbed areas. Future seeding efforts should further target locations where germination and survival rates are highest (e.g., cracks of rocks, exposed road cuts).

3. Bay Checkerspot Reintroduction

The continued success of the Bay Checkerspot Reintroduction Project led by Creekside Science is very promising for sustainable populations persisting at San Bruno Mountain. Having utilized the invasive English plantain as an alternate host plant, the translocation of larvae to San Bruno Mountain has been a great success thus far. With the larvae completing their life cycle, and thus reproducing, the possibility of expansion of the species wherever habitat is available is possible. SMCP has been in close contact with Creekside Science to adequately manage their habitat from invasion while also maintain buffers and timing treatments to the butterfly's phenology. This close collaboration between Creekside Science and SMCP is crucial to the recovery of the species at San Bruno Mountain.

4. Natural Disasters

Two large fires occurred during the 2019-2020 period. The first taking place in October 2019 burning oak woodland, coastal scrub, and grassland communities on an east facing slope in the Brisbane Acres management unit near the ridgetop. This fire was approximately 8.5 acres in size and burned a highly biodiverse grassland area with some radish and oxalis patches. In March 2020, radish covered many areas near the ridge trail and where European grass thatch buildup was high. ECI was deployed soon after to control the species, but the regulation put forth following COVID-19 outbreak did cause the work to be cut short. In March 2021, ECI was deployed again to control the radish. The entire area where the radish was coming up, primarily along the ridge road, was treated within the burn footprint, but also expanding outward as there were some sections of dense cover. ECI will return in Winter 2022 to conduct another treatment of this patch focusing oxalis and radish.

The second fire occurred in February 2020 and was about 5.3 acres in size. This fire burned almost a complete outline of a dense gorse stand in the Saddle management unit. The fire caused much of the gorse to be left standing while leaving a few native shrubs crumbling to the ground. With gorse being an effective coppice sprouter and fire events causing amplified stimulation of the seed bank, the opportunity to control this population following the fire has been of high importance. Soon after the fire in the early spring, stump sprouting was already occurring, and gorse seed was beginning to germinate. As mentioned in section *C. Methods of Treatment*, this gorse patch was crushed with a dozer so that the material could be piled to allow for retreatment of the area to follow. It was deemed that the area would not be successfully masticated and mulched due to the low biomass that was remaining after the fire. As such, follow up treatments were conducted 2021 as high amounts of weeds came up. The weed that took up the most area was *Solanum furcatum* (forked nightshade) and this species along with other weedy forbs were chemically controlled by ECI. After discussing with Cal Fire, it was deemed that the burned debris from the biomass was not a fire risk and Cal Fire did not see the need to conduct burn piles of the area. In Fall 2021, SMCP was able to gather arrange for a large amount of wood chips from eucalyptus projects conducted on-site and at other SMCP parks. We then had in-house staff masticate the woody debris into small pieces. As predicted, there was not enough material in the debris to produce the 6 inch chip depth. We then had our team utilize the dozer to spread the chips received from the nearby eucalyptus removal projects and have so far chipped approximately 60% of the burned footprint to a 6-inch depth.

The effect of the COVID-19 outbreak in 2020 had an impact on the ability to conduct vegetation management on the mountain. In the early stages of the virus, while San Mateo County had the shelter-in-place order, vegetation management contractors were pulled from the field. Further, volunteer projects were cancelled. Staff were only able to conduct wildlife monitoring and were unable to conduct the vegetation management work that often occurs during the crucial spring period. Restrictions did loosen as time went on and come May 2020, vegetation management contractors could conduct work. Volunteers were granted permission to conduct small scale socially distanced programs throughout SMCP network. However, volunteer projects did not resume on the mountain until December of 2020. In early 2021, SMCP and SBMW began conducting socially distant, masked, volunteer programs with a limit of 15 volunteers per program. After the arrival of the Covid-19 vaccine and subsequent lifts to gathering restrictions. in May we started to host programs with increased capacity sizes depending on staff capacity to lead

and activity being conducted. SMCP enacted two planting programs in 2021. One in the grasslands above Wax Myrtle Ravine in February 2021 and the second in the grasslands above the Terrabay water tank in December 2021. We have also hosted 5 other weeding programs over the course of the year all contributing to restoring sensitive butterfly habitat in grasslands.

E. RECOMMENDATIONS

1. Habitat Enhancement Prioritization

Scrub encroachment should continue to be a primary focus for budget expenditures related to habitat management. Using the Assessment, areas designated as "essential" should be prioritized for treatment as a starting point. Scrub encroachment should continue to be prioritized until grassland habitat increases to the minimum threshold of 1200 grassland acres. Grassland acres should be evaluated at a regular interval to ensure the minimum threshold is retained. The recent development of fine scale vegetation mapping data for San Mateo County should be leveraged to fully assess the current acreage of grassland habitat extant within the HCP area.

A more detailed analysis of the long-term butterfly monitoring data is currently underway and may become an important tool for prioritization of habitat enhancement work. With this forthcoming analysis, it become possible to identify segments of the larger fixed monitoring transects where declines in the species observations have been sustained for several years. This allows or a finer resolution look at specific areas of occupied habitat where the species occupancy is in decline. With this knowledge we can prioritize areas for scrub removal, invasive species control, and host plant seeding or planting efforts to attempt to reverse the declining trend before the habitat in these locations is entirely lost.

F. REFERENCES

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IV. COVERED SPECIES HOST PLANT MAPPING

A. MB HOST PLANT MONITORING

As discussed in the San Bruno Mountain Habitat Conservation Plan Year 2019-2020 Activities Report for Federally Listed Species, the last concerted effort to map lupine host plant distribution and quantify host plant density was completed during the 2020 growing season. From 2019 to 2020, two San Mateo County Parks Department staff members surveyed the grasslands present along the main ridgeline beginning southeast of the Quarry and moving east toward the Brisbane Acres management unit. These surveys encompassed ridgeline portions of the fixed mission blue butterfly monitoring transects 11, 12, and 13. Owl and Buckeye Ridges were also surveyed (transect 10), as was the southern portion of transect 12 (Southern Slope management unit), the Dairy Ravine management unit, and the Northeast Ridge Management Unit. In 2020, the Northeast Ridge and Southeast Slope (within the Southeast Ridge Management Unit) were also surveyed for lupine host plants by Nomad Ecology biologists as part of the Biological Resources Assessment commissioned by SMCP prior to the implementation of the planned San Bruno Mountain Cattle Grazing Pilot Program.

1. Field Data Collection Methodology

Field data was collected using the Calflora mobile application (Calflora 2020) on a Trimble TDC600 Handheld Data Collector using a host plant mapping form. The following information was collected and stored: species name, picture, date and time, location coordinates, location description, habitat type, aspect, slope, primary threat and threat qualifier, secondary threat and threat qualifier (if applicable), estimated number of plants, distribution, phenology, determination method, and notes.

2. Spatial Analysis

Data collected in 2019 and 2020 was cleaned before being combined in ArcMap Desktop (citation) with previously collected lupine host plant distribution and density information stored in the SMCP Geographic Information Systems (GIS) database and in the ArcOnline web application (citation). Additional data sets include lupine host plant distribution data collected in 2003, 2004, 2007, and 2016; and host and nectar plant distribution and host plant density data collected in 2017 and 2018. For the former data set, the only information included in the attribute table is host plant species name, year, shape area and length, and location coordinates. For the latter data set, attributes include host plant species name, density, proximity of nectar plants to mapped host plant polygons, nectar plant species name (with columns for up to three nectar plant species), shape area and length, and location coordinates. For this report, the focus was on understanding the distribution of the three lupine host plants. Only a small number of polygons covering a small extent of mapped lupine host plant area are from 2003-2007; these polygons are primarily located in the Reservoir Hill and Brisbane Acres management units.

3. Results and Discussion

Figure 1 shows the distribution of *Lupinus albifrons* subsp. *collinus, Lupinus formosus* var. *formosus,* and *Lupinus variicolor* across San Bruno Mountain, including data collected from 2003 to 2020. Figures 2a and 2b are taken from the Cattle Grazing Pilot Program BRA written by Erin McDermott and Meghan Bishop of Nomad Ecology and show the distribution of all listed butterfly host plants within the two proposed pilot study areas, the Northeast Ridge (Figure 2a) and the Southeast Slope (Figure 2b). In the BRA, these figures are labeled Figure 9a and 9b and can be found on pages 71 and 72. At the time when the host plant mapping for this report was completed in ArcMap Desktop, shapefiles containing the host plant mapping information displayed in Figures 2a and 2b were not yet available; SMCP has since obtained these files and will include the data contained therein for future analyses.

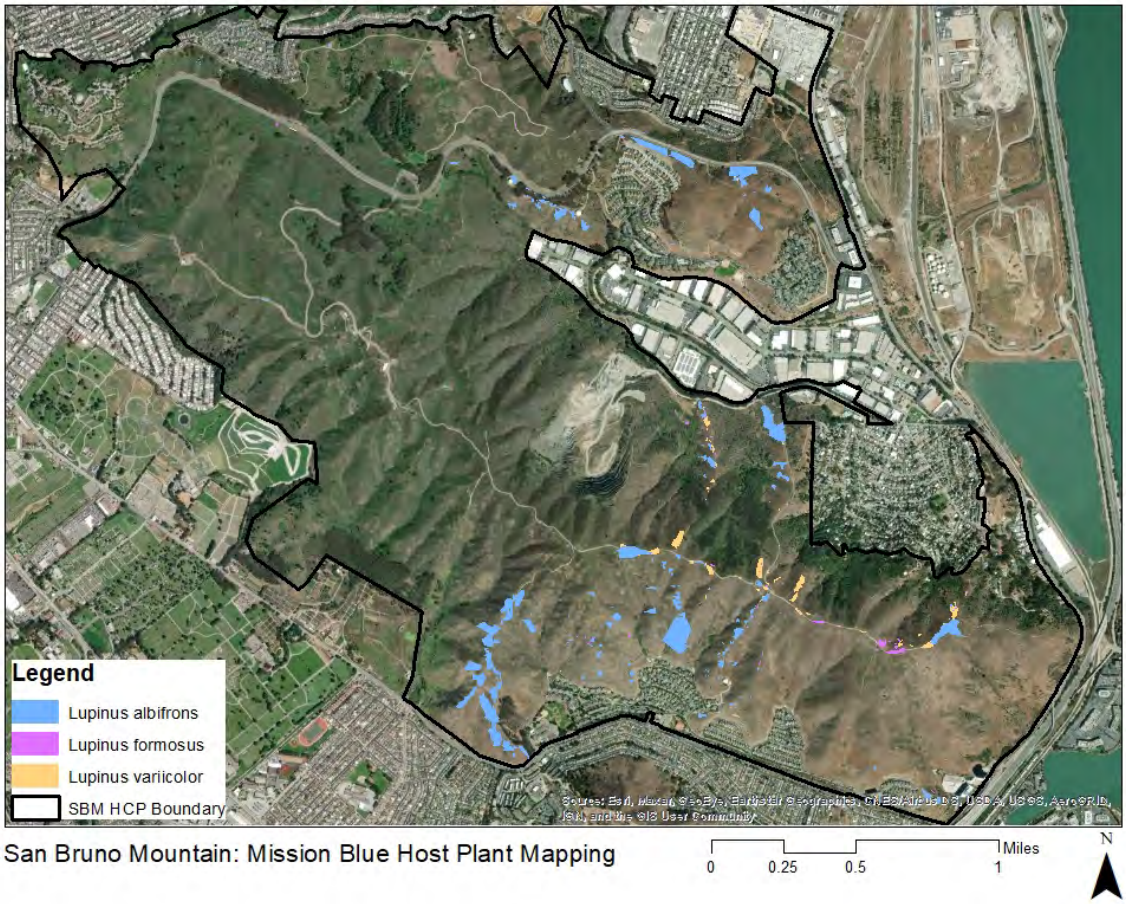

Figure 1.

Looking at Figure 1, silver bush lupine is the most prevalent lupine host plant species present on the mountain as a whole and in several of the regions containing the highest value MB habitat present on the mountain. Within the Hillside Management Unit in the southern portion of MB monitoring transect 13, where some of the highest average sightings per hour and maximum sightings per hour have been recorded in recent years, mapped lupine host plants are exclusively silver bush lupine. The southern half of transect 12, which has also had relatively high average and maximum sightings per

hour in recent years, is also dominated by silver bush lupine (see Tables 1 and 2 on page 18 for average and maximum sightings per hour from 2007 to 2021). Along Transect 11, host plant density is relatively low due to significant thatch buildup and scrub encroachment. The height of invasive annual grasses (e.g., *Avena* spp.) may also be limiting the accessibility of lupines to adult MB for ovipositing. Targeted lupine seeding along disturbed trailsides, roadcuts, and rocky outcrops should be prioritized along the Southeast Ridge in order to bolster declining MB numbers. Lupine density is difficult to summarize or track due to the inconsistent and disjointed nature of historical and recent mapping efforts; further efforts to fully census host plants and collate mapping data in order to estimate lupine density along Transect 11 should be an objective for SMCP staff in future years.

As noted by Weiss and colleagues in their 2015 “Assessment of the past 30 years of habitat management and covered species monitoring associated with the San Bruno Mountain habitat conservation plan”, diversifying the lupine host plant base is a core recommendation for mission blue butterfly management throughout their range, as silver bush lupine is susceptible to a root crown fungus in wet warm springs that has caused MB population crashes (pp. 40). In April 2021, after observing silver bush lupine exhibiting symptoms that could be caused by fungal pathogens, SMCP staff sent samples from the Owl and Buckeye Canyons, Dairy and Wax Myrtle Ravines, and South Slope management units to a University of California Cooperative Extension lab for testing. This testing detected two main pathogens: *Colletotrichum* (presumably *C. lupini*) at Owl and Buckeye Canyons and *Phomopsis* at Dairy and Wax Myrtle Ravines and the South Slope. Dr. Florent Trouillas, UC Cooperative Extension Specialist and head of the lab who completed the testing, noted that the frequency of isolation of both pathogens was low overall. This low frequency of pathogen isolation could have been caused by the timing of sampling or poor quality of the sample material shipped but could also suggest that observed lupine decline was primarily related to abiotic factors such as drought or heat stress. Because sampling occurred in the late spring, with a lag between the onset of symptom development earlier in the spring and sample collection, it is also possible that the isolated fungal pathogens represent secondary fungal contaminants, and that the main disease causal agent(s) was overlooked in this initial round of testing (F. Trouillas, personal communication, May 19, 2021). Given the inconclusive nature of this initial round of testing, Dr. Trouillas recommended additional future testing and noted that on-site observations from an expert may be required to definitively diagnose the main disease-causing agent(s). Because frequency of pathogen isolation was low and staff did not observe significant lupine die-off or a steep mission blue population decline in the areas where pathogens were detected, staff will continue to monitor silver bush lupine populations for symptoms of disease and initiate further testing as needed but do not have plans for other interventions at this time. Regular lupine monitoring beginning early in the spring of 2022 will be particularly important because the 2021-2022 rainy season has already brought several large rain events to the San Francisco Bay Area.

Though the detection of *Colletotrichum* and *Phomopsis* may not be cause for immediate concern, it underscores the importance of continued lupine host plant diversification efforts such as the ones described in Section B, Butterfly Host Plant Establishment, of the Vegetation Management portion of this report (page number). Colletotrichum was recently implicated in a mass mortality event of silver lupine in the Golden Gate National

Recreation Area, causing further concern for the introduction and spread of fungal pathogens at San Bruno Mountain. Contractors and volunteers working at San Bruno Mountain are required to sanitize and clean their boots before entering the park. San Mateo RCD provides oversight of the West Peak mitigation project and is aware of expectations for cleaning and sanitation of boots, equipment, and vehicles. PG&E is also required to adhere to the same requirements, though it's unclear whether this always occurs.

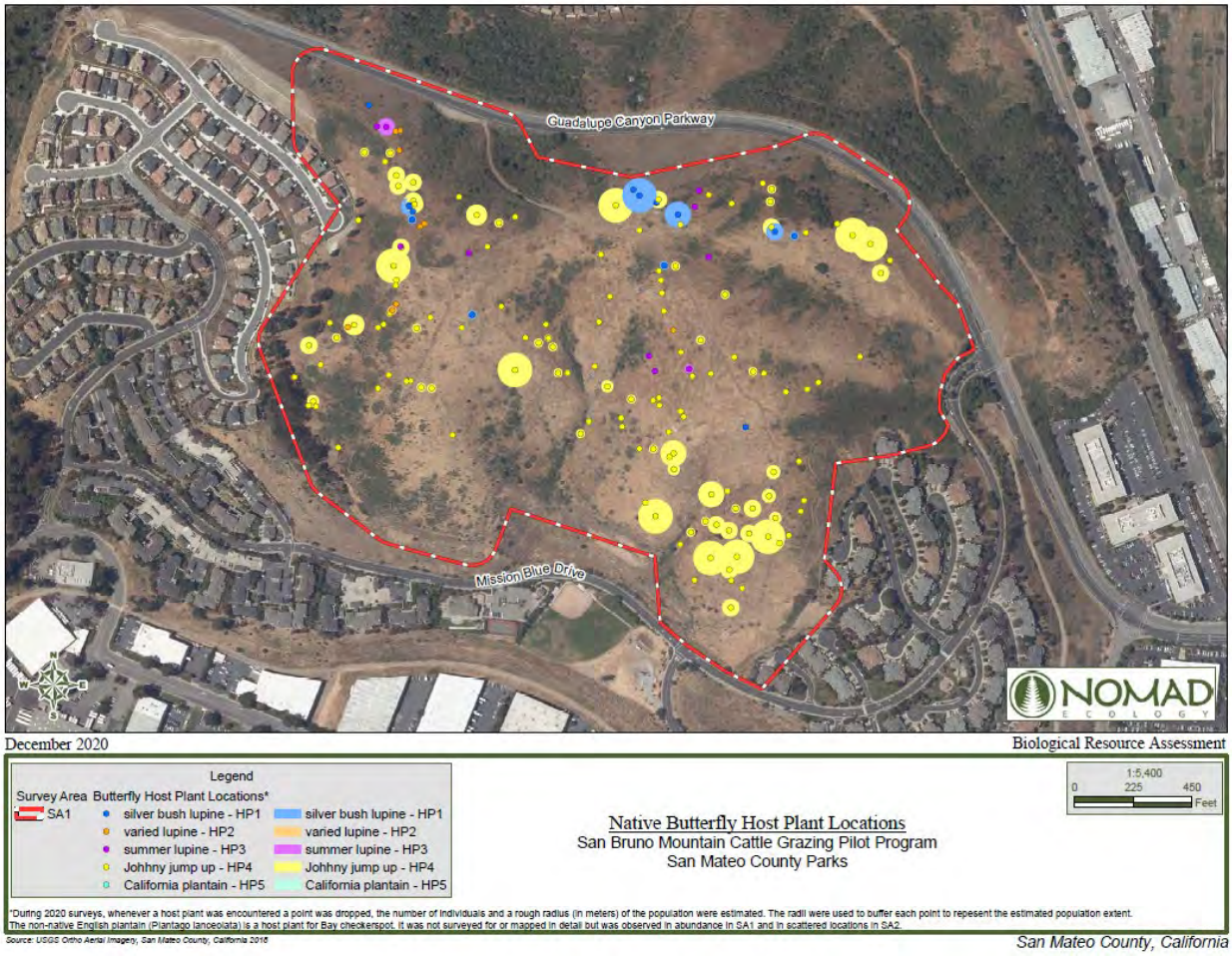

Figure 2a

Looking at Figure 2a, all three lupine host plant species are present on the Northeast Ridge, with more and larger patches growing on the northern side of the ridge, close to Guadalupe Canyon Parkway. Though lupine seeding and out-planting efforts will likely be postponed until after the start of the cattle grazing pilot program, to make sure planting areas are sited so as to minimize potential negative impacts due to the installation of fencing and other grazing infrastructure and to maximize the potential positive impacts from grazing treatment, SMCP may want to establish lupine plantings within the southeastern portions of the Northeast Ridge to try to maintain MB populations in that area. Though MB butterflies were observed in the lower southern portion of transect 9 in 2019 (see Figure 1 on page 13 of the Year 2019-2020 Activities Report), no MB butterflies were observed in this area in 2021 (see Figure 1 of this report, on page 13).

Moving to the Southeast Slope, shown in Figure 2b, there were relatively few lupine host plants present in this area as of 2020. As is the case for the Northeast Ridge, lupine seeding and out-planting efforts will likely be postponed until after the start of the cattle grazing pilot program. Though transect 11, which runs through a portion of the Southeast Slope pilot program study area intersects what has historically been considered some of SBM's best lupine habitat, few MB butterflies were observed on this transect in 2021. Both average sightings per hour and maximum sightings per hour fell to the lowest values recorded since 2007, though weather conditions at this transect did complicate sampling in 2021 (see Tables 1 and 2 on page 18 for average and maximum sightings per hour from 2007 to 2021, and Figure 3 on page 19 for trends in maximum sightings per hour from 2007 to 2021). Lupine seeding and diversification may help to improve the habitat quality of the Southeast Slope and the Southeast Ridge and Brisbane Acres management units more generally.

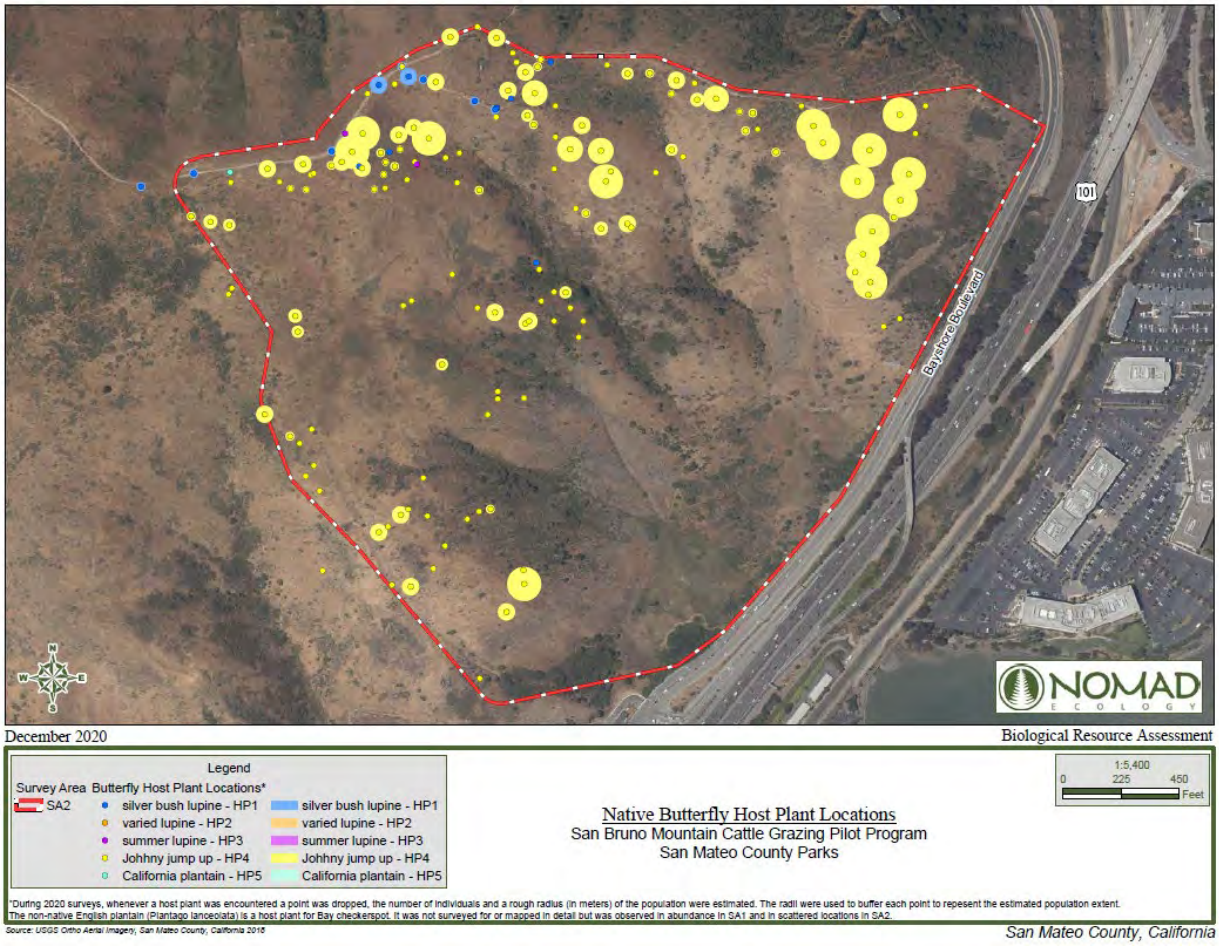

Figure 2b

4. Future Mapping Efforts

Future field mapping efforts will focus on re-mapping areas that have not been mapped in the past five years and on increasing mapping coverage of areas where data seems to be missing. For example, there are very few mapped lupine host plant polygons in the Saddle management unit, though SMCP staff know there are lupine host plants present in this area. Understanding lupine distribution and density in the Saddle along

transect 5 will help staff understand how to improve habitat quality in this area, as no MB butterflies were observed on transect 5 in 2019 or 2021. To improve our ability to accurately track which grassland areas have been mapped each year, the lupine monitoring methodology may shift to a grid system like the one used for CS host plant monitoring (described below) and for 2012 MB and CS presence/absence monitoring. Once lupine host plants have been adequately mapped, staff can move on to mapping and monitoring the distribution and density of nectar plants in close proximity to lupine host plants.

Future spatial analysis will focus on calculating host plant density for the 2019-2020 data collected using the CalFlora application and on standardizing host plant density measures between different methodologies.

B. CS HOST PLANT MONITORING

From March to April 2021, one SMCP staff member systematically surveyed for *Viola pedunculata* in the grasslands of the Saddle management unit (near CS monitoring transect 2), Dairy and Wax Myrtle Ravine management unit (near transect 1), South Slope management unit, and Hillside/Juncus management unit (near transect 14). The mapping period corresponded with the bloom season for *Viola pedunculata* for 2021; field mapping ceased for the year once the bloom season ended and plants began to senesce. As mentioned in the MB Host Plant Monitoring section above, the Northeast Ridge and Southeast Slope (within the Southeast Ridge Management Unit) were surveyed for the host plants of all federally listed butterfly species present on San Bruno Mountain by Nomad Ecology biologists as part of the Biological Resources Assessment commissioned by SMCP prior to the implementation of the planned San Bruno Mountain Cattle Grazing Pilot Program; these surveys included *Viola* mapping.

1. Field Data Collection Methodology

The focus for mapping during the 2021 bloom season was on mapping previously unmapped areas of the mountain. Areas for mapping were prioritized using a mapping grid created to map *Viola* in 2018; the mapping grid uses the 250-meter square cells created and described by Longcore and colleagues in their 2010 paper. Each grid cell with potential CS habitat is categorized as previously mapped for *Viola*, a cell where CS butterflies have been observed but that has not been mapped, or a cell that should be visited because it has potential CS habitat. The host plant monitor walked a zig-zag path, traversing all grassland present in the grid cell. As was the case with MB host plants, field data was collected using the Calflora mobile application on a Trimble TDC600 Handheld Data Collector using a host plant mapping form. The following information was collected and stored: species name, picture, date and time, location coordinates, location description, habitat type, aspect, slope, primary threat and threat qualifier, secondary threat and threat qualifier (if applicable), estimated number of plants, distribution, phenology, determination method, and notes.

2. Spatial Analysis

Data collected in 2021 was exported from Calflora and combined in ArcMap Desktop with previously collected lupine host plant distribution and density information stored in

the SMCP Geographic Information Systems (GIS) database and in the ArcOnline web application (citation). Additional data sets include host plant distribution data collected in 2002, 2004, and 2016 and host plant distribution and density data collected in 2017 and 2018. For the former data set, the only information included in the attribute table is host plant species name, year, shape area and length, and location coordinates. For the latter data set, attributes include host plant species name, density, proximity of nectar plants to mapped host plant polygons, nectar plant species name (with columns for up to three nectar plant species), shape area and length, and location coordinates. As was the case with MB, the focus for this report was on understanding the distribution of Viola.

3. Results and Discussion

Figure 3 shows the distribution of *Viola pedunculata* throughout San Bruno Mountain, excluding the fine scale mapping of the Southeast Slope performed by Nomad Ecology in December 2020 (see Figure 2b). Because a much larger proportion of the mapped Viola was mapped more than five years ago, SMCP's target interval for re-mapping host plants, the polygons are colored according to when they were mapped as described in the legend. Patches of Viola with a mapped area less than five square meters are marked with a green circle on the map, to make them easier to see.

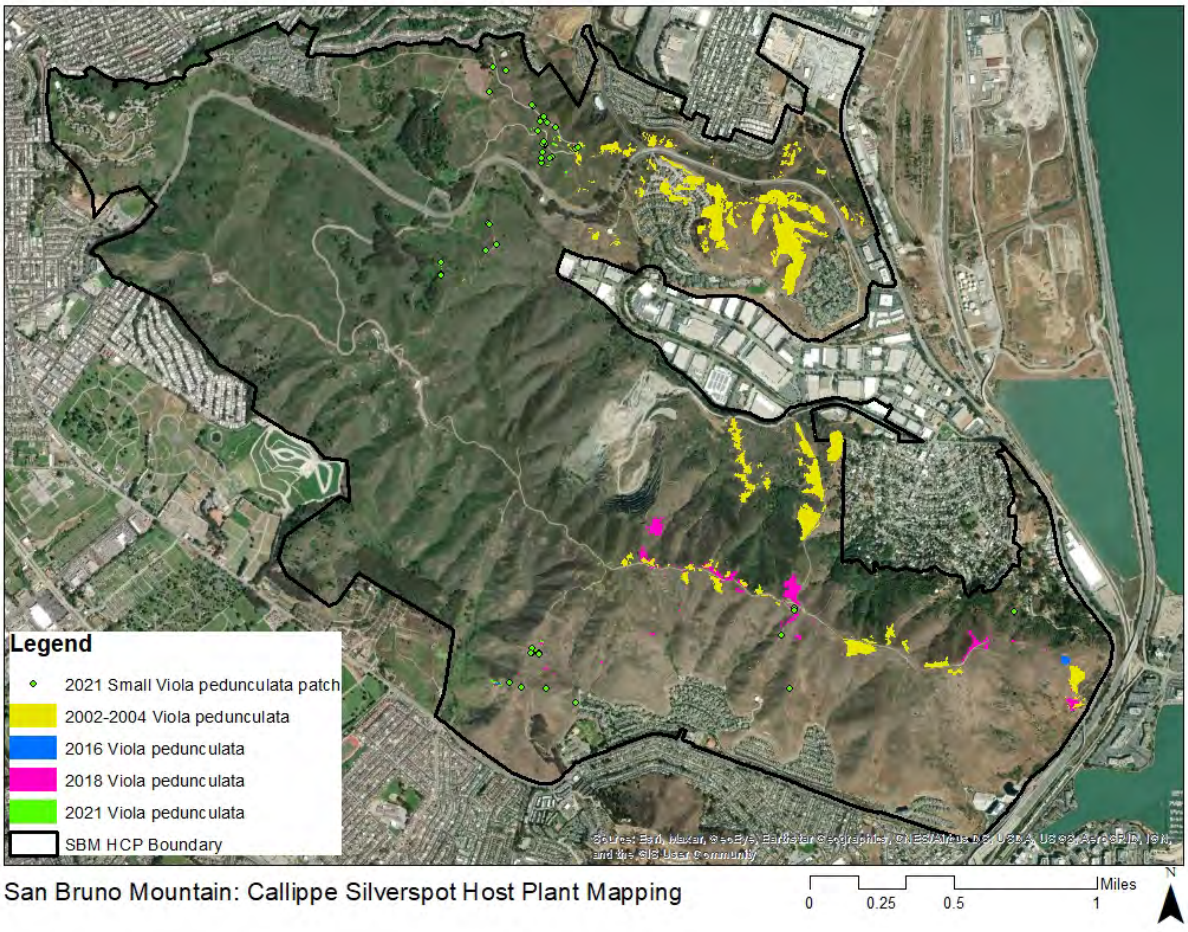

Figure 3

Though Viola is found on both north and south facing slopes, Viola patches appear to

be more commonly found and larger on slopes that do not face directly south and in relatively flat areas. While Figure 2b does show an abundance of *V.* pedunculata along the Southeast Slope, not all of these occurrences are on fully south facing slopes. This aspect preference could be related to low water availability on hot, dry, south-facing slopes. Generally speaking, the lower slopes of the South Slope and Hillside Juncus management units also tend to be dominated by tall annual grasses that contribute to the build up of thatch, which could be shading out Viola plants. Recent focus has been placed on expanding mapping to previously unsurveyed areas. Now that nearly full coverage has been achieved, SMCP staff should prioritize remapping areas in order to assess current distribution and density of *V. pedunculata*, especially along the Southeast Ridge and Southeast Slope.

Information on the spatial distribution of Viola within cattle grazing pilot program study areas on the Northeast Ridge and Southeast Slope, shown in Figures 2a and 2b will be factored into decisions about the placement of fencing and water infrastructure and to decisions about pasture layout.

4. Future Mapping Efforts

As mentioned earlier, a large proportion of Viola was mapped between 2002 and 2004, nearly 20 years ago. Future field mapping efforts should focus on re-mapping high quality CS habitat on the main ridgeline and in Owl and Buckeye Canyons. After high quality CS habitat has been re-mapped, additional mapping efforts can focus on previously unmapped areas. Figure 4 shows which of Longcore and colleagues (2010) grid cells have yet to be mapped following the 2021 field mapping effort. CS observations have been recorded within yellow grid cells, making Viola mapping within them the highest priority. Red cells feature potential grassland habitat but are not known to be occupied. Purple and blue squares have already been surveyed for Viola; Viola was found to be present in purple squares and absent in blue squares. In their 1990 chapter on thermal microclimates and the restoration of rare butterfly habitat, Weiss and Murphy observe that CS butterflies are conspicuously absent from the fog belt, noting that their May to July flight season coincides the time period in which fog dominates the macroclimate of SBM. With this broad distribution pattern in mind, the eastern portions of SBM are a higher priority for mapping than the western portions, as the eastern areas are more likely to be occupied.

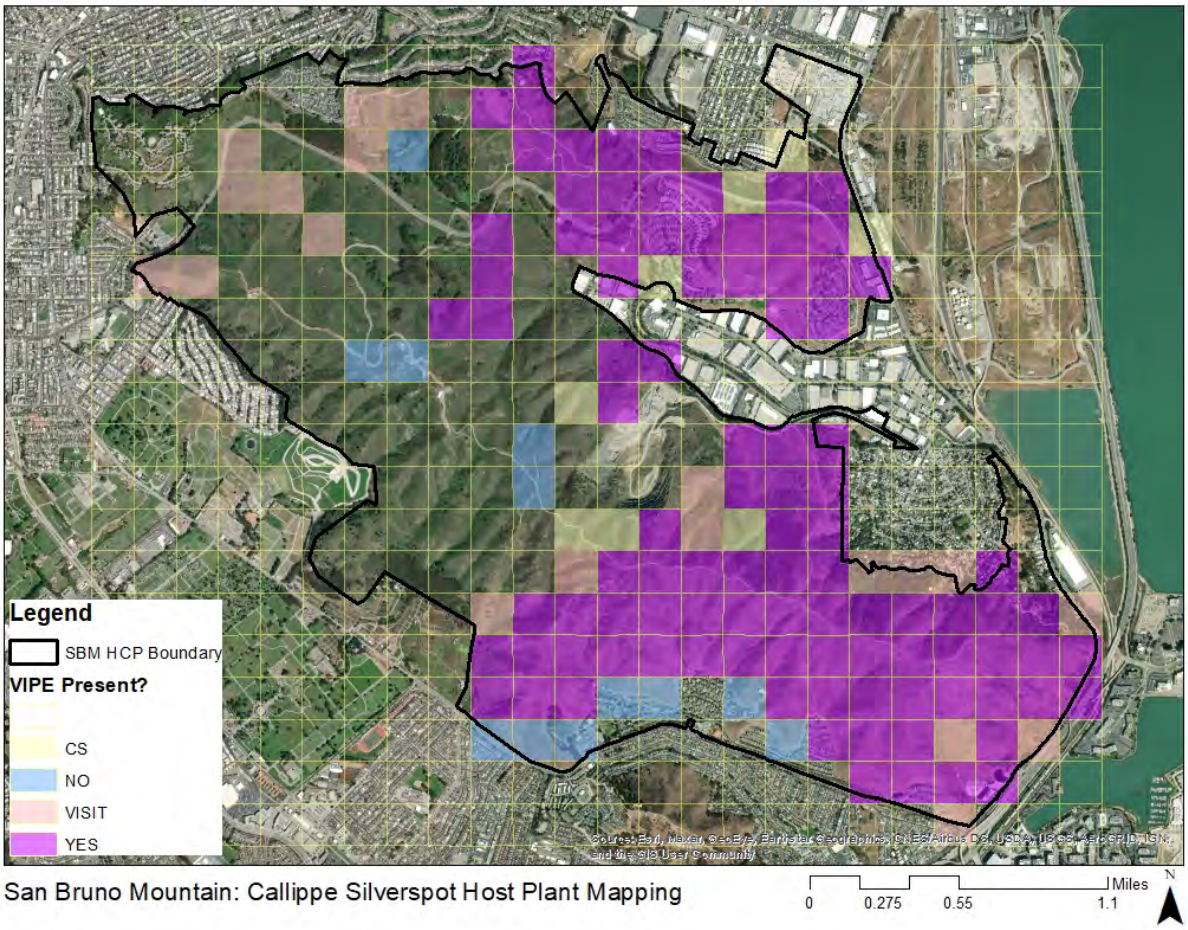

Figure 4

Future desktop mapping efforts should focus on converting the host plant distribution data collected by Nomad Ecology into a format more consistent with the 2021 host plant mapping field methodology, on calculating host plant density for the 2021 Calflora data, and on standardizing host plant density measures between methodologies.

C. SBE HOST PLANT MONITORING

Prior to 2021, no *Sedum spathulifolium* had been mapped. One SMCP staff member systematically surveyed north, northeast, and northwest facing slopes within the fog belt from May through July 2021. The beginning of the survey period coincided with Sedum bloom period. Plants had for the most part stopped flowering by July 2021, making them less conspicuous. All accessible coastal scrub and coastal scrub/grassland ecotones were surveyed; some areas could not be accessed due to steep terrain and/or dense scrub growth. Areas mapped include the April Brook, Dairy and Wax Myrtle Ravines, Devil's Arroyo, and the western portion of Owl and Buckeye Canyons management units. To begin with, 2021 host plant monitoring efforts focused on the sedum surrounding SBE monitoring points and areas north of the main ridgeline within outlined SBE habitat (see Figure 5). In July, after observing sedum south of the main ridgeline, mapping efforts expanded to include north and northwest facing slopes in the Southwest Slope and Hillside Juncus management units.

1. Field Data Collection Methodology

As was the case with MB and CS host plants, field data was collected using the Calflora mobile application on a Trimble TDC600 Handheld Data Collector using a host plant mapping form. The following information was collected and stored: species name, picture, date and time, location coordinates, location description, habitat type, aspect, slope, primary threat and threat qualifier, secondary threat and threat qualifier (if applicable), estimated number of plants, distribution, phenology, determination method, and notes. From May 20 to June 16, 2021, host plant mapping also included opportunistic SBE presence/absence surveys. While estimating the number of rosettes and mapping the boundaries of each sedum patch, the host plant monitor also looked for larvae on both inflorescences and rosettes.

2. Spatial Analysis

Data collected in 2021 was exported from Calflora, then visualized in ArcMap Desktop.

3. Results and Discussion

The distribution of sedum throughout the mountain can be seen in Figure 5. Patches of sedum with an area smaller than five square meters are marked with points. The largest patches were found in Dairy Ravine and in the Devil's Arroyo management unit, south of the Quarry.

4. Future Mapping and Monitoring Efforts

Future field mapping efforts should focus on mapping the remaining outlined SBE habitat in the Owl and Buckeye Canyons and Brisbane Acres management units and then on mapping sedum present on other north and northwest facing slopes south of the main ridgeline. Future data management and spatial analysis should focus on calculating sedum density for mapped patches and on cleaning the presence/absence data so that it can be visualized to provide a better understanding of SBE distribution throughout the mountain. Some sedum patches were mapped after the short window in which SBE larvae could be observed; these patches are a priority for future presence/absence monitoring.

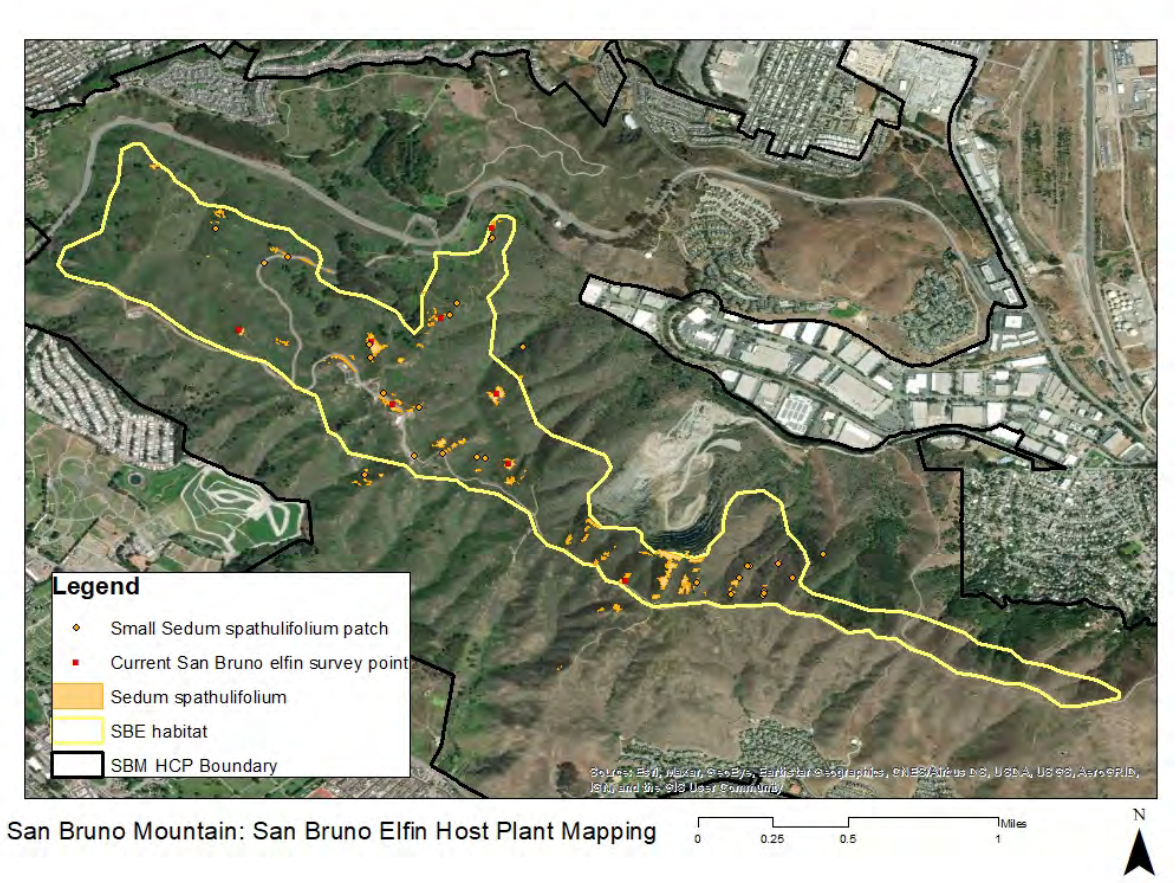

Figure 5

D. REFERENCES

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V. COVERED SPECIES AND VEGETATION MANAGEMENT PARTICIPANTS

Annual report prepared by San Mateo County Parks Natural Resource Specialist, Evan Cole, with contributions by Assistant Parks Director Hannah Ormshaw and Natural Resource Specialists Sean Correa and Samantha Faul, as well as the use of previous reports from past habitat managers, Autumn Meisel and Patrick Kobernus. Monitoring in 2021 was implemented by Hannah Ormshaw, Evan Cole, Sean Correa, and Samantha Faul.

Habitat Management Activities were implemented by: Ecological Concerns Inc. and Go Native Inc.

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Appendix A:

Mission Blue Monitoring
Raw Data

FID	OBJECTID	Transect	BUTTERFLY	TIME_	COUNT_	CONDITION	SEX	BEHAVIOUR	NECTAR_PLA	NOTES	GlobalID
0	54	Transect 4	Mission Blue	11:21	1	Worn				Could not get sight of underwing, but was nectaring and perching in area near many lupine	{3632546b-10e9-4135-ba17-1c74ae14a884}
0	12	Transect 6	Mission Blue	1104	2	Fresh		Searching		1 m and 1 f both flushed from lupines	{b2f0abaa-6ea2-4854-a922-05d60c47777e}
1	13	Transect 6	Mission Blue	1111	1	Fresh	Female	Searching			{e9d3ab21-5781-4861-870d-1d0c6e033cef}
0	55	Transect 7	Mission Blue	11:13	2	Fresh		Searching			{ce81e33d-3e8c-4fd8-b941-e866ecece0db}
1	56	Transect 7	Mission Blue	11:33	1						{348dca20-5ea3-4e05-9178-e6469efe93f9}
2	57	Transect 7	Mission Blue	11:34	2	Fresh		Chasing		Male and female	{b97d4d61-2b03-45d0-a4e3-cc4e62778eac}
3	58	Transect 7	Mission Blue	11:36	4						{23c35318-65cb-44e6-b1db-c7058a14f9b2}
4	59	Transect 7	Mission Blue	11:39	1	Fresh	Male	Searching			{0f1189fb-6e86-44a5-8666-65d1d326967f}
5	93	Transect 7	Mission Blue	9:30	1	Worn	Female	Resting		Resting on LUAL	{c5102714-0cbe-4c26-8753-07e947c87b90}
6	94	Transect 7	Mission Blue	9:57	3	Fresh	Unknown	Searching		Fluttering around LUAL.	{2b3757cc-1e22-4a0f-932a-fde6e8d6b879}
7	95	Transect 7	Mission Blue	10:00	1	Worn	Female	Resting		Resting on LUAL. Very worn.	{93ee59b5-21b6-4c8e-8429-32d07f75f223}
8	96	Transect 7	Mission Blue	10:02	1	Fresh	Female	Searching		Small female	{92f53cb4-03cd-44d0-8d93-81260d6cdd37}
9	97	Transect 7	Mission Blue	10:04	3	Unknown	Unknown	Searching			{8c87a9d3-ba60-4769-b931-33515ca7c6b6}
10	103	Transect 7	Mission Blue	14:24	1	Worn	Female	Resting		5/27/21	{405b2225-07c1-455c-b8a4-04d1c393e912}
11	104	Transect 7	Mission Blue	14:27	1	Fresh	Male	Resting		5/27/21	{dd0976cb-9025-4c90-a2c1-e0555fbbcbc7}
12	105	Transect 7	Mission Blue	14:30	1	Worn	Male	Resting		5/27/21 Very worn -- huge chunk missing from wing	{62b90363-11e0-49f4-8f0d-fc446b769bdf}
13	106	Transect 7	Mission Blue	9:31	2	Worn		Resting			{64599b40-887b-44f9-8b7d-77931d5b6eaf}
14	107	Transect 7	Mission Blue	9:33	1	Unknown		Resting			{9699212c-d075-4fca-8ff0-d32131fc1e8f}
0	19	Transect 9	Mission Blue	11:50	1	Fresh	Male	Resting		Resting on LUAL.	{7853baf6-18ca-40e9-858b-cafc6bd87bf4}
1	60	Transect 9	Mission Blue	12:05	2	Fresh		Mating		2 mb mating	{2f9c00d1-94af-4297-a7bd-f013cf8026c1}
2	61	Transect 9	Mission Blue	12:04	3			Searching			{4846dcf2-2df8-4102-94f4-d8133af6495f}
3	62	Transect 9	Mission Blue	12:11	3	Fresh		Searching			{e87e6894-4ad6-44db-ad78-26e1198481be}
4	98	Transect 9	Mission Blue	10:34	2	Unknown	Unknown	Chasing			{ae803731-057f-4a94-9d18-b9b17eeea2c7}
5	99	Transect 9	Mission Blue	10:37	1	Fresh	Male	Searching			{0d8848d1-b03b-44a3-944e-221237e29473}
6	108	Transect 9	Mission Blue	9:51	1	Fresh	Male	Resting			{57aa055f-64e1-4316-bbc1-f484c965d295}
7	109	Transect 9	Mission Blue	9:52	1	Fresh	Female	Searching			{65c21ba6-5d4b-47b2-9b79-6ada3afe3885}
8	110	Transect 9	Mission Blue	9:53	1	Unknown	Unknown	Travelling			{34d248fa-127a-448c-b10b-91db1eb354a5}
0	14	Transect 10	Mission Blue	1030	2	Fresh	Unknown	Nectaring	other	LUVA	{7b0e7be5-d5ee-499d-9807-e90f1c304bf2}
1	15	Transect 10	Mission Blue	1045	1	Fresh	Male	Searching			{241ec39a-3fc5-425a-94c2-72c22302d419}
2	16	Transect 10	Mission Blue	1125	2	Fresh	Unknown	Nectaring	other	LUAL	{39bee695-6151-4c86-aab4-a147379d4be7}
3	17	Transect 10	Mission Blue	1135	1	Unknown	Unknown	Searching			{e7050b00-5473-415d-9734-208573708739}
4	18	Transect 10	Mission Blue	1140	1	Fresh	Male	Nectaring	other	LUAL	{b5a0ca64-1902-47e5-b6a9-8d6e3bb7c550}
5	63	Transect 10	Mission Blue	1013	2						{ba5b2225-0982-4bb7-bd59-62848fa8f29e}
6	64	Transect 10	Mission Blue	1013	1						{a3d31871-543d-4f57-8a38-0ab57e0a9a04}
7	65	Transect 10		1014	2						{ae0febe9-cbfb-4f45-adda-cb05b0b2914a}
8	66	Transect 10	Mission Blue	1015	1						{e2c57fef-3cf4-494c-93b0-816ebd0067ab}
9	67	Transect 10	Mission Blue	1020	1						{642ce3ec-e75d-44ab-b03d-42a9a8f36817}
10	68	Transect 10	Mission Blue	1040	2						{3498c50f-93a5-4a20-892c-ffdae49a999a}
11	69	Transect 10	Mission Blue	1044	2						{1a99896c-a570-450a-b25b-0625649fcc70}
12	70	Transect 10	Mission Blue	1050	1						{82788d53-9664-4917-a7d8-f1ce0c420dbe}
13	111	Transect 10	Mission Blue	12:07	1	Worn	Male	Nectaring	other	6/3 Nectaring on Buckwheat. Very worn -- tattered wings.	{74a040a7-6b16-4c0d-b580-66b604480c88}
14	112	Transect 10	Mission Blue	12:41	1	Unknown	Female	Resting		6/3/21	{5cc86884-59e8-44dd-90b5-3d84510e4664}
15	113	Transect 10	Mission Blue	12:42	1	Fresh	Unknown	Nectaring	radish	6/3/21	{20ecca5e-d77a-4edb-8479-e39635df5833}
16	114	Transect 10	Mission Blue	12:46	2	Fresh	Unknown	Mating		6/3/21 Male and female mating	{33d03d18-06d6-4b04-95c6-279f31e67194}
17	115	Transect 10	Mission Blue	12:52	1	Fresh	Male	Resting		6/3/21 Resting on LUAL.	{b0f76b4f-e664-4d40-be7f-5a036bedd9cc}
18	116	Transect 10	Mission Blue	12:54	1	Worn	Female	Resting		6/3/21 Resting on LUAL.	{633f329f-0a35-46ae-a1be-06424609fe62}
19	117	Transect 10	Mission Blue	12:55	1	Worn	Female	Resting		6/3/21 Resting on LUAL.	{bc487602-5e2f-486d-87e8-7670021d8dcf}
20	118	Transect 10	Mission Blue	926	1		Male				{8e2e5e19-f27e-4be8-a59a-baf90d63a128}
21	119	Transect 10	Mission Blue	930	2						{3a39207e-c6b6-4685-84a2-8d2475bb3535}
22	120	Transect 10	Mission Blue	938	1	Fresh	Male				{637e70f5-6c88-426f-a741-6adc5d796a41}
23	121	Transect 10	Mission Blue	941	2						{7b40a9cb-c45c-4b17-9595-36973bfc1503}
24	122	Transect 10	Mission Blue	956	2						{a4f7620e-f6e2-4e4a-8f9f-639af7ff4b8a}
25	123	Transect 10	Mission Blue	956	2						{116a712c-7e96-4964-9fca-23e279837d9f}
26	124	Transect 10	Mission Blue	1003	1						{f15a209f-48c0-43e1-b535-4d0d4afbf1b0}
0	85	Transect 11	Mission Blue	11:07	1	Fresh	Unknown	Searching		Briefly rested on LUAL	{1e871422-f274-421b-a2ac-4cde7aceacc3}
1	86	Transect 11	Mission Blue	11:11	1	Fresh	Female	Resting		Resting on LUAL	{680da4a8-6550-4814-bc11-b05ecbddc0a3}
2	91	Transect 11	Mission Blue	10:39	1	Fresh	Female	Resting		On lupine	{bcd3073f-550b-4f5f-ae1a-d207237fee5d}
3	92	Transect 11	Mission Blue	10:40	1	Fresh	Male	Searching			{286ef0c2-847f-42ae-948e-cdec6643296a}
0	43	Transect 12	Mission Blue	1007	2		Female			2 Fs	{58b9626e-b9f1-4458-b319-f4c683282889}
1	44	Transect 12	Mission Blue	1009	1	Fresh	Male				{09ecf1dc-1a98-4ddc-a65f-15394def75b8}
2	45	Transect 12	Mission Blue	1010	2	Fresh	Male				{851b5a02-c791-468e-9e0d-96ba27bddf70}
3	46	Transect 12	Mission Blue	1011	1	Fresh	Male				{014addab-b97a-42d3-abae-80556ac4fa85}
4	47	Transect 12	Mission Blue	1030	2	Worn		Mating		a pair mating	{40f4673f-337b-44a3-8430-e0bfe8279bf5}
5	48	Transect 12	Mission Blue	1033	1		Female				{fd2d104f-c9e9-4aca-b9ad-92dd84944866}
6	49	Transect 12	Mission Blue	1040	3						{4dd39a5f-4f71-4e59-bc0d-e3411062f0e2}

7	50	Transect 12	Mission Blue	1042	2						{248a4aea-6c7a-47a3-9ff9-f0f887db4f13}
8	51	Transect 12	Mission Blue	1043	2	Fresh					{8c5b0e29-6ce1-45ad-b2f2-1a0f3072d981}
9	52	Transect 12	Mission Blue	1050	2						{97dc684b-df69-4387-b938-fd9506c94558}
10	53	Transect 12	Mission Blue	1052	1						{3ef02a34-a0fb-4b52-b29f-f9e3ad26b306}
11	77	Transect 12	Mission Blue	10:51	1	Fresh	Female	Resting		Resting on LUAL	{dc9fc73f-c914-48bf-bda7-a8e20b953336}
12	78	Transect 12	Mission Blue	11:10	1	Unknown	Unknown	Resting		Resting on LUAL	{1f0ea82e-cbde-48d8-8908-b81db052af4d}
13	79	Transect 12	Mission Blue	11:22	1	Fresh	Female	Searching		Flitted around for a while, briefly landing on LUAL before flying away	{93de11c3-60b0-4932-90d0-a49e2298f2dd}
14	80	Transect 12	Mission Blue	11:30	3	Fresh	Unknown	Chasing			{b6b1cc00-7889-44d2-8e11-e88843bec15e}
15	81	Transect 12	Mission Blue	11:31	1	Fresh	Female	Resting		Resting on LUVA	{941ca429-5ffa-4e5a-a487-5d5de4144d75}
16	82	Transect 12	Mission Blue	11:34	1	Fresh	Male	Resting		Resting on LUVA	{3c8cfd9b-3b5c-4278-ada1-d713c030dc3f}
17	83	Transect 12	Mission Blue	11:34	2	Fresh	Unknown	Chasing			{d25a4335-4a08-403a-bff4-efb24303ec5f}
18	84	Transect 12	Mission Blue	11:35	1	Fresh	Unknown	Searching	seaside daisy	Searching near LUVA	{e076227b-1b35-451d-9c31-b86ea4a89b11}
19	87	Transect 12	Mission Blue	9:14	1	Unknown	Unknown	Searching			{c1516c4a-1e8e-4ae9-9687-300d0f6fe1d3}
20	88	Transect 12	Mission Blue	9:43	1	Fresh	Male	Searching			{f20a9af2-71f0-4f68-ac7d-f8650da8d1a6}
21	89	Transect 12	Mission Blue	9:44	1	Unknown	Female	Searching			{b1d9b9a7-d974-4e8c-9563-4f3a9b866cc5}
22	90	Transect 12	Mission Blue	9:44	1	Fresh	Male	Searching			{0b51ac38-19a1-46e0-b8aa-e1eea20886d2}
0	1	Transect 13	Mission Blue	121	1	Fresh	Male	Travelling			{4d24ef29-4229-4531-abea-a253d74bca87}
1	2	Transect 13	Mission Blue	123	2		Male				{8bd4daf8-5e24-4d66-8acc-f840b1e4df4d}
2	3	Transect 13	Mission Blue	138	1	Fresh	Female	Nectaring	other	nectaring on erodium	{74600dfd-f82d-4d68-a3cc-318a07589cc1}
3	4	Transect 13	Mission Blue	140	3						{87e73e80-d856-4444-8102-99c7cb2d1919}
4	5	Transect 13	Mission Blue	145	1	Fresh	Male				{5c5478c6-a790-40bb-9f0d-d211eb35c0a0}
5	6	Transect 13	Mission Blue	149	3						{622b23f3-6bb5-4d8d-9a5a-128b4d59deb1}
6	7	Transect 13	Mission Blue	151	1	Fresh	Female	Resting			{300c4d5e-9c54-4394-97d8-08eb942ad73d}
7	8	Transect 13	Mission Blue	152	2						{544869a9-4d2b-4ffb-aaa8-4356fbaa5c47}
8	9	Transect 13	Mission Blue	153	2						{915a66b9-5727-4b5f-8769-9ad92bf4b01a}
9	10	Transect 13	Mission Blue	154	2						{8d04abcb-15f8-45af-ae92-b5aeb7fd410c}
10	20	Transect 13	Mission Blue	0955	2	Unknown	Unknown	Nectaring	other	LUAL	{2cabf397-5ed8-4364-8eeb-f4974826ec24}
11	21	Transect 13	Mission Blue	1000	2	Fresh		Mating		M + F mating on LUAL	{84c32b21-0e60-43f6-8cd9-d492fb62e985}
12	22	Transect 13	Mission Blue	1010	1	Fresh	Female	Ovipositing		LUVA	{a5a10ba7-5097-433b-a77d-157ec5407090}
13	23	Transect 13	Mission Blue	1015	1	Fresh	Male	Nectaring	other	LUVA	{329be4b6-a225-4832-8444-4100dc07b829}
14	24	Transect 13	Mission Blue	1019	1	Unknown	Male	Nectaring	other	Narrow leaf mules ears	{ffc9b9b9-4670-4fc2-a75c-4e8f758d7f89}
15	25	Transect 13	Mission Blue	1025	2	Unknown	Male	Nectaring	other	LUAL	{a13a7c30-ce39-43bb-8359-7a222b8cabd9}
16	26	Transect 13	Mission Blue	1028	1	Fresh	Male	Nectaring	other	LUVA	{c4beff97-4898-4002-b0a3-7c0aba72b5ac}
17	27	Transect 13	Mission Blue	1030	1	Fresh	Male	Nectaring	other	LUVA	{d8927546-287b-4ef2-ae92-5d0d0797482c}
18	28	Transect 13	Mission Blue	1042	1	Unknown	Male	Searching			{3514c378-2082-4064-9f3a-74a88b5fbab5}
19	29	Transect 13	Mission Blue	1047	2	Unknown	Male	Searching			{e53ebfda-9d38-4840-a38c-d46d24a1ddb5}
20	30	Transect 13	Mission Blue	1050	3	Fresh	Male	Nectaring	other	Blue eyed grass	{85764e94-cd5b-446e-99a1-b1787911f6ef}
21	31	Transect 13	Mission Blue	1054	1	Worn	Female	Resting			{45412a9e-a58a-4700-bec6-a414e39417d1}
22	32	Transect 13	Mission Blue	1057	2	Fresh	Male	Nectaring	other	LUVA	{2b268a1d-0bf6-4478-bee4-a4bd30a386c5}
23	33	Transect 13	Mission Blue	1100	1	Fresh	Male	Nectaring	other	LUVA	{40539a85-6a38-4995-beb3-0a378fcf1fb0}
24	34	Transect 13	Mission Blue	1108	1	Worn	Female	Ovipositing		LUVA	{7c2069dd-3203-4d72-a520-f5d9953e923a}
25	35	Transect 13	Mission Blue	1108	1	Fresh	Male	Nectaring	other	LUVA	{67919dfc-dfe0-4ce2-966b-4207d60e1f17}
26	36	Transect 13	Mission Blue	1115	1	Worn	Female	Resting			{09e93e17-d3f9-4354-84fd-442de485cda0}
27	37	Transect 13	Mission Blue	1118	1	Unknown	Unknown	Nectaring	other	LUVA	{93eaa345-7bc3-4a5d-ad5f-92e8a758a859}
28	38	Transect 13	Mission Blue	1120	3	Unknown	Male	Chasing			{f8f93df2-70e8-4ae4-b184-eed9a8061ff2}
29	39	Transect 13	Mission Blue	1125	1	Fresh	Female	Nectaring	other	LUAL	{1f1d5903-c99f-4f31-a3d9-7ebe30bd089d}
30	40	Transect 13	Mission Blue	1130	1	Fresh	Male	Searching			{8f996d81-75b5-4e4f-8a68-c5644f1b508e}
31	41	Transect 13	Mission Blue	1132	2	Unknown	Unknown	Searching			{b8b50c5a-b6e8-4e71-88d8-661812be968f}
32	42	Transect 13	Mission Blue	1202	2	Fresh	Male	Chasing			{a895a3aa-0756-4592-9115-879517bfdecd}
33	71	Transect 13	Mission Blue	1149	1	Fresh	Male	Travelling			{28538206-b863-4290-a752-ae5d4a2f2612}
34	72	Transect 13	Mission Blue	1226	1		Male				{e2bfbfd1-31d8-4c46-9fcb-3fbd7f36cb61}
35	73	Transect 13	Mission Blue	1227	1						{c1bd3a04-cf84-4a10-bf0f-ce8ca890c4d7}
36	74	Transect 13	Mission Blue	1230	1						{c86ec838-1b08-4f5b-902f-7d42f82871f5}
37	75	Transect 13	Mission Blue	1236	1						{8555acd9-010a-43ff-bfff-1486958dfa1a}
38	76	Transect 13	Mission Blue	1241	1						{83739b19-4c8f-4c38-b493-88a88bd5546f}
39	100	Transect 13	Mission Blue	1020	1	Unknown	Female	Resting			{89113375-e792-4a0e-ad96-1d58b7886aab}
40	101	Transect 13	Mission Blue	1028	1	Unknown	Male	Travelling			{4d53c6ea-ae17-49b5-9005-b143ab89029b}
41	102	Transect 13	Mission Blue	1109	1	Worn	Female	Resting			{38b01554-040a-489f-999e-a47f894dfa64}

Appendix B:

2015 Rare, Threatened, and Endangered Plant Survey

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.

Previous reports on RTEs

In the first 30 years of management of the SBM Habitat Conservation Plan (HCP) lands, most survey and stewardship effort was directed towards listed butterfly species (Weiss et al. 2014, TRA 2008). Although these received the majority of the focus of the HCP, the Mountain is home to rare flora and vegetation communities which are only addressed in a cursory manner. This 2015 study and survey was initiated after reviewing the incomplete data from the first 30 years of HCP management actions and reports.

Three maps of compiled rare plant surveys are provided on pages 56-58 in the 2007 management plan (TRA 2008) (Figure 21). In addition to these print figures, GIS data was offered by the County and TRA (now MIG) to allow for comparison with 2015 surveys.

The below maps represent the most recent reported surveys for these plants outside of sparse CNDDB records and herbarium collections which will be presented later with each individual species account.

Figure 2: Three rare plant maps reproduced from the 2007 HCP Management Plan

1. Kamchatka Point: Arctostaphylos imbricata imbricata, A. uva-ursi forma suborbiculata
2. Summit, Above Radio Road: A. imbricata imbricata
3. Ridge Trail "Hanging Gardens": A. uva-ursi forma coactilis, A. imbricata imbricata
4. Pacific Rock: A. imbricata imbricata, A. imbricata montaraensis, A. x pacifica, A. uva-ursi forma coactilis
5. Manzanita Dike: A. imbricata imbricata, A. imbricata montaraensis
6. Powerline Ridge: A. imbricata imbricata
7. Ridge Trail, Above Quarry: A. uva-ursi forma leobreweri
8. Brisbane Acres: A. tomentosa crustacea (also occurs in Buckeye Canyon, but not mapped in 2002)

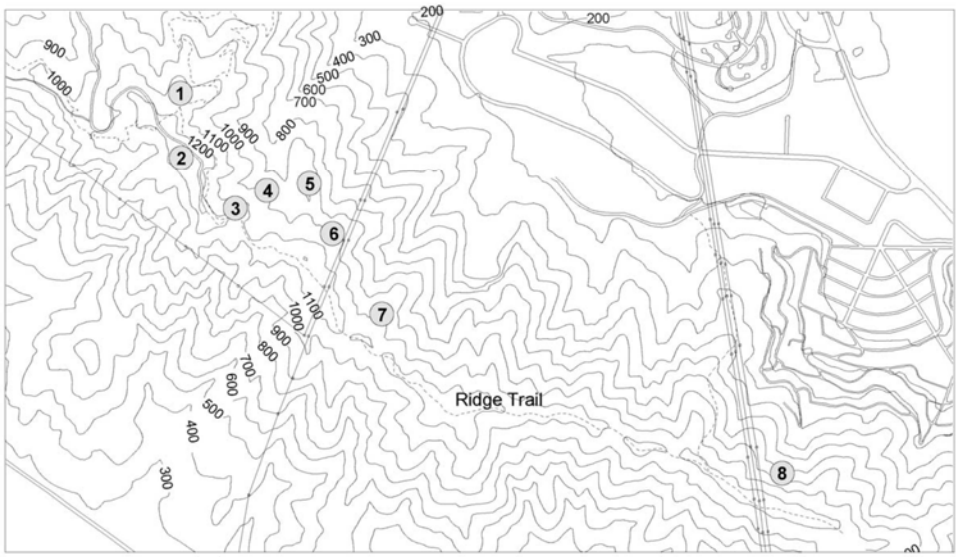
(Boundaries of species in each colony are available in TRA GIS database)

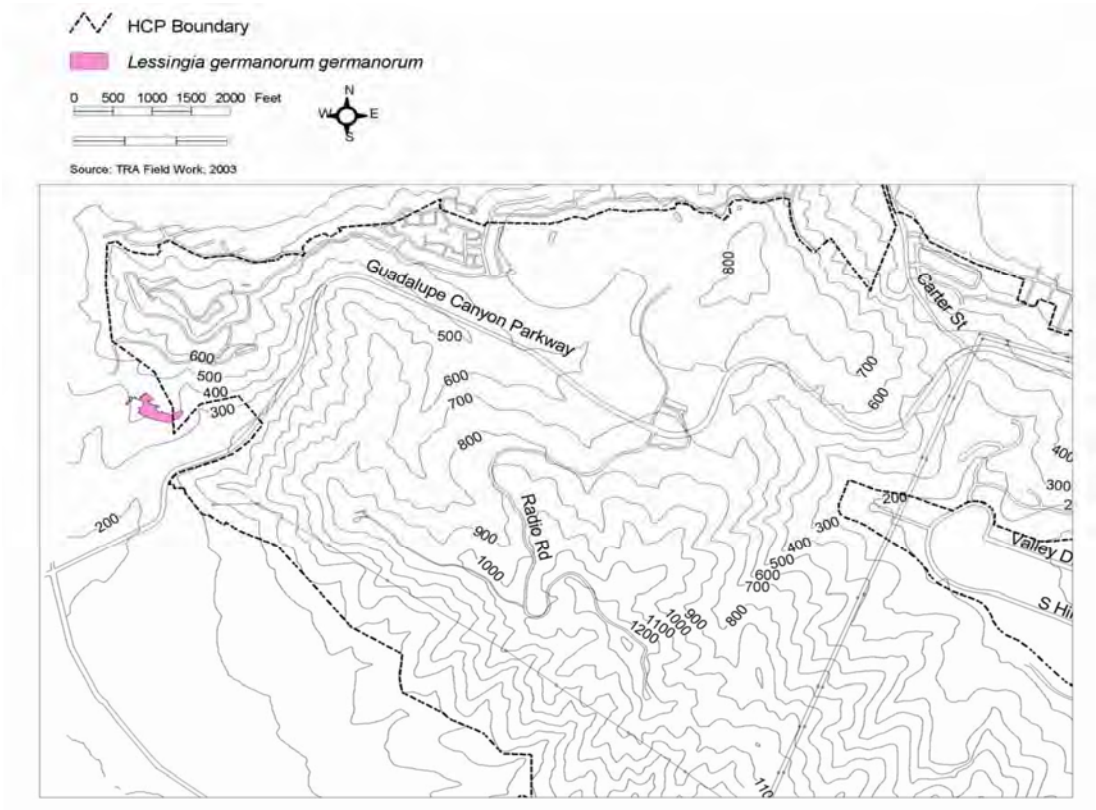
Figure 8. Manzanita distribution on San Bruno Mountain, 2002

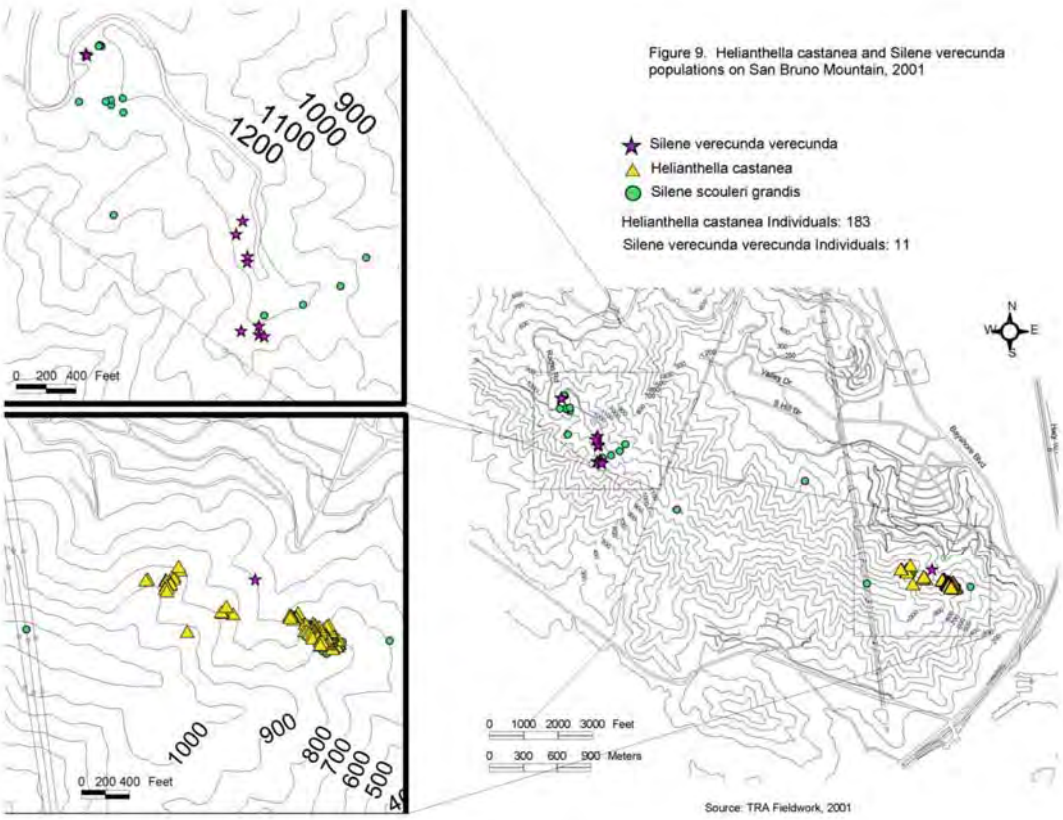
0 400 800 12001600 Feet

0 200 400 600 Meters

Source: TRA Field Work, 2002







Numerous accounts of rare taxa can also reliably be found in one other comprehensive source, McClintock et al.'s 1990 *A Flora of the San Bruno Mountains*. This publication represents the tireless efforts of Elizabeth McClintock, Paul Reeberg and Walter Knight to catalog and observe the flora of SBM. This book has been essential in our work. Information from this book will be presented throughout the report. We describe other information sources in the methods section of this report.

Methods

This project has completed the following tasks:

1. Literature (reports/websites) and CNDDB review of known current and past occurrences of 14 covered plant taxa. This information will serve as a baseline for our targeted botanical surveys. During this review process, time allowing, we investigated other taxa of interest that may have been extirpated prior to the HCP.
2. Interview botanists and naturalists that regularly visit SBM to collect anecdotal information on other occurrences.
3. Compile list with diagnostic features for RTE plants and survey areas to maximize survey coverage and optimize timing.
4. Revisit known CNDDB occurrences and update information in the database; conduct targeted intuitive wandering surveys, GPS each occurrence (including historical populations), complete CNDDB form onsite, take herbarium-quality photographs of diagnostic features and habitat, and classify vegetation. Creekside has 3 Trimble Juno units (1-2 m accuracy) and a Nomad (sub-meter accuracy) GPS unit available for mapping. Units are loaded with ArcPad.
5. Compile plant information and create GIS map with occupied, historical and potential habitat for each of the 14 covered taxa.
6. Completion of brief report compiling all survey work and photographs.
7. Delivery of all information including ArcGIS map layers, representative photos and data electronically to SMC Parks Department.

Literature/Reference data collection

Literature was used extensively for these surveys. Literature research was conducted using published materials, research papers, local floras and other germane sources. As observed in the reference materials, floras were important resources for better understanding the plants we were surveying. Our most common references used were:

- The Jepson Herbarium Jepson eFlora (online flora) at: http://ucjeps.berkeley.edu/eflora/
- The California Consortium of Herbaria SMASH database for accessing accessioned specimens at: http://ucjeps.berkeley.edu/consortium/
- A San Francisco and San Mateo search from the CDFW CNDDB database.
- McClintock et al. 1990. A Flora of the San Bruno Mountains.
- Allshouse and Nelson draft list of rare plants on San Bruno Mountain.

We compiled germane information into each Individual Species Account (ISA). ISA's are presented in this report alphabetically by scientific name.

Herbarium research was mostly conducted online. Records were viewed online at the Consortium of California Herbaria at http://ucjeps.berkeley.edu/consortium/. Both the California Academy of Sciences herbarium and the Jepson Herbarium were visited in person in order to view historic specimens.

On three occasions, local botanists and naturalists met at Doug Allshouse's home to discuss RTEs and their likely locations. At these meetings the group, including San Mateo County Parks Natural Resource Manager Ramona Arechiga, decided to include an additional six taxa to the survey effort. While additional locally rare taxa were interesting to the group, they were finally designated outside the scope of this RTE survey. The group was invaluable in sharing geographic knowledge of plant locations, and created a map of known, historical, and/or likely locations for each taxon.

This information, as well as plant descriptions and blooming times, was used to inform targeted surveys on the mountain. All surveys conform to CDFW (CDFG 2009) protocols unless otherwise noted.

Surveys were conducted from March 10th through November 30th, 2015. We estimate 160 hours of survey effort on the Mountain with Creekside Staff. Survey dates were:

- 3/10
- 3/16
- 4/8
- 4/11
- 6/18
- 6/22
- 6/26
- 7/1
- 11/13
- 11/30
- 4/18/16 (for *Silene verecunda*)

The majority of this report is found in Individual Species Accounts, which document the research and field surveys that were completed for each of the 20 RTE taxa. General information on each taxon is presented, followed by survey results and recommendations for continued inclusion as an HCP covered species. This report briefly recommends management that should be considered for the continued persistence of each RTE taxon on San Bruno Mountain. All of the recommended actions are provisional and should be completed with aid of knowledgeable volunteers and botanists. We recommend that any management action have a minimum of 3 years of monitoring for annuals and 5 for perennials.

Individual Species Accounts are listed alphabetically by genus/species name. Each account includes a brief description with key diagnostic features; a photograph and/or drawing; a description from the Jepson eFlora; known synonyms; a description of previously known locations, including CNDDB reports, herbarium records, and other floras/reports; 2015 survey results, including GIS maps of surveyed areas and/or located populations; HCP inclusion recommendations; and management recommendations. Each account also discusses how timing affected the comprehensiveness of the survey and how much potential there was for false negative surveys.

A California Field Survey Form was created for each located occurrence. These data are included in Appendix A, and have been submitted to the CNDDB. GIS shapefiles have been submitted to the Natural Resources Program (Ramona Arechiga).

GPS field data were downloaded into GIS (ESRI ArcGIS platform) to create maps of survey findings. Surveyed areas were outlined in the office. Maps were scaled so that polygons could be discerned in the document. In some cases, it is hard to know where the mapped site is on mountain, but this is described in the document and Parks Department staff can use the GIS files to map at any preferred scale.

Results

Community-based Botanical Information Sharing

Our project's success was greatly supported by the San Bruno Mountain community. Doug Allshouse kindly invited Creekside staff, San Mateo County Parks Department staff, and volunteer botanists to meet and discuss occurrences and current information on rare plants known on the mountain. In our first meeting, we created a map wherein attendees added comments and known historic locations of RTE plants we were targeting (Figures 2 and 3).

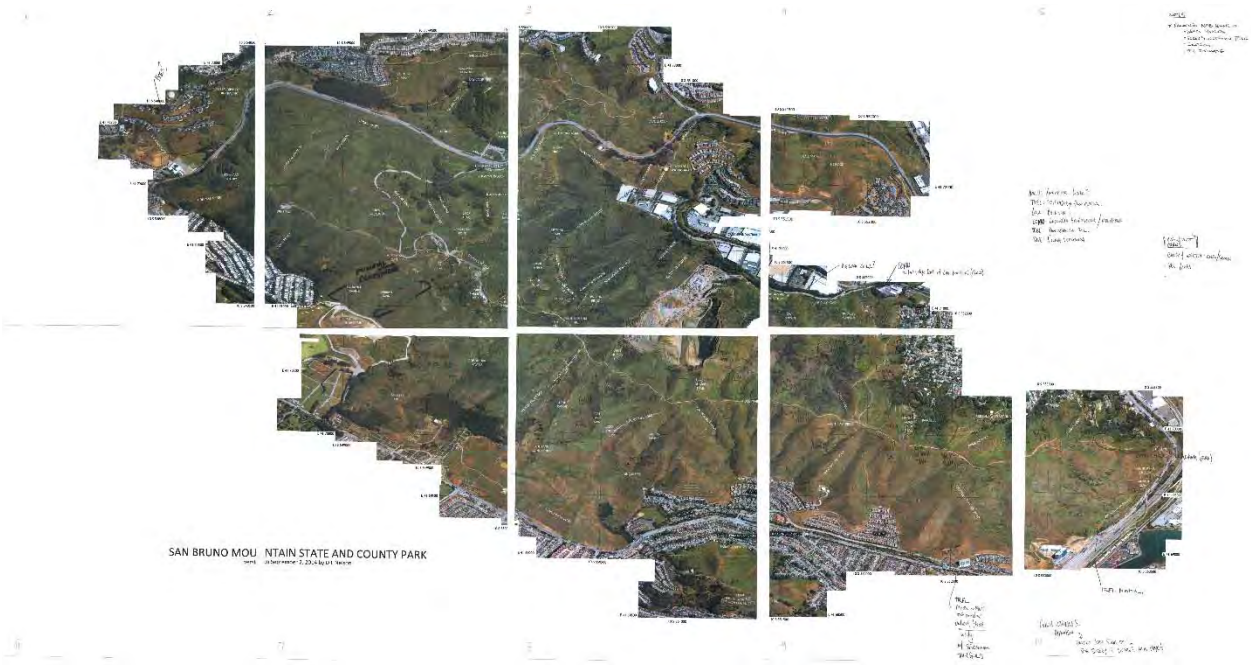


Figure 2: Scanned map of community input on rare plant occurrences on SBM.

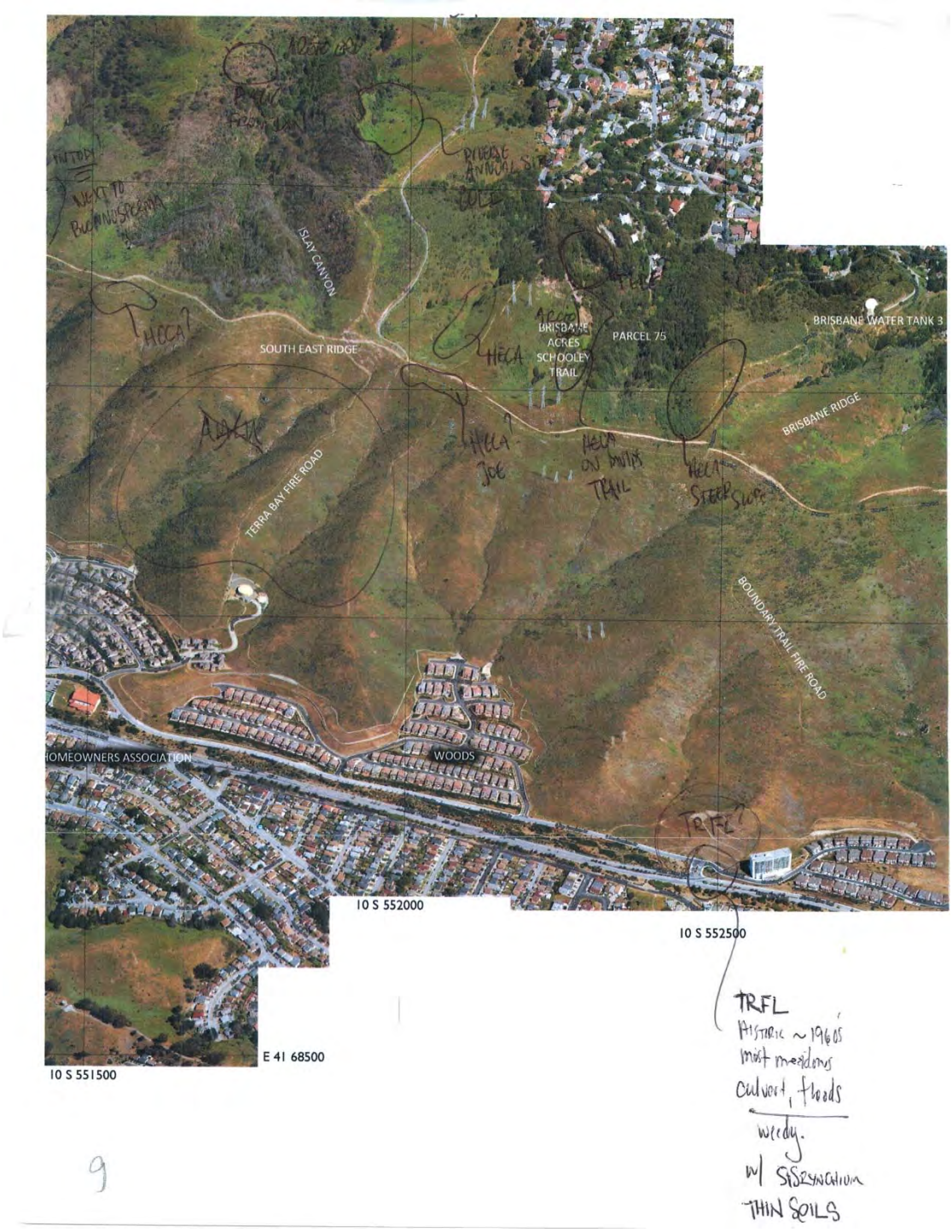


Figure 3: Annotated map detail.

Key Results

The following key results of the survey are presented in bullet format. More information on each ISA is found in the following sections.

- 16 RTEs were located and observed in 2015 and 2016. 15 were observed in 2015. San Francisco campion was only observed in 2016.
- Of these 16 located, 10 taxa are high stewardship targets that we believe will be responsive to management actions.

- 1 RTE (dune tansy) was located in a known reintroduction area, a result of an outplanting project.
- 2 RTE taxa were not located but may still be extant: Choris' popcorn flower and bent-flowered fiddleneck.
- 2 RTE taxa are likely truly extirpated from SBM: white-rayed pentachaeta and San Francisco owl's clover.
- 3 key areas are identified in order to maximize conservation effort: Colma Dunes, Summit, and Brisbane Acres area.
- New and previously forgotten occurrences were located for three manzanita taxa and Diablo helianthella.
- New polygons were mapped for San Francisco lessingia, San Francisco spineflower, and San Francisco collinsia.
- Although there is taxonomic difficulty around some of the taxa present on SBM, we believe it is wise to use the precautionary principle and maintain as many of these populations as possible for the 16 taxa located and treat all these plants as RTE elements worthy of conservation.

The following table summarizes our results (Table 2). Target taxa were placed into one of three categories: X – not found in 2015 surveys, A - locally abundant taxon, found in numerous areas and/or habitat types, and R – located in very specific environments where soils, climate, moisture and/or vegetation may have been critical to the target taxon being present. For instance, although quite a few clumps of Diablo helianthella were located, they were all restricted to a north/north-west facing area in the Brisbane acres locale. We denote this as an R-type plant. All manzanitas were considered restricted due to their unique location about the summit and typical association with sandstone.

Table 2: Summary results of targeted RTE surveys

Scientific Name	**Common name**	**Rarity Status (CRPR = California**	**Taxon found** (X = not found, A = locally abundant, R = restricted)	**Stewardship Priority** (3 is high, 0 indicates 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	Unknown	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 (taxonomically difficult)	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	A (located in 2016)	3
Tanacetum camphoratum	Dune Tansy	CBR	X (See notes)	2
Triphysaria floribunda	San Francisco Owl's Clover	CRPR 1B.2	X	1

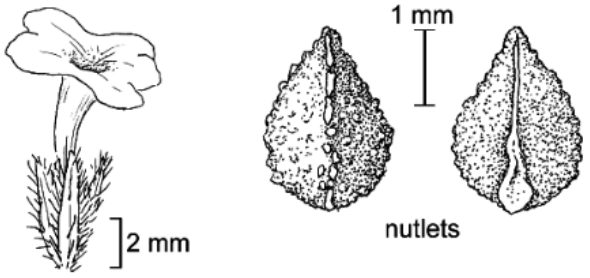
Individual Species Accounts

The majority of this report documents our research and field surveys that were completed for each of the 20 RTE taxa. Information on each taxon is presented followed by results and recommendations for continued inclusion as an HCP covered species. We briefly recommend management that should be considered for the continued persistence of the taxon on San Bruno Mountain. All of the recommended actions are provisional and should be completed with aid of knowledgeable volunteers and botanists. We recommend that any management action have a minimum of 3 years of monitoring for annuals and 5 for perennials.

Bent-flowered Fiddleneck *Amsinckia lunaris* J. F. Macbr.

Bent flowered fiddleneck is a bristly annual plant that typically grows in groups of 10 to 2000 plants. This annual plant was first collected from the “San Bruno Hills” in 1917 by Alice Eastwood. It is regularly found on cool and foggy sites on the San Francisco peninsula and in East Bay Hills, often in thin, rocky soils near local summits. It typically flowers in February through June. Fiddlenecks (*Amsinckia spp.*) typically require some regular soil disturbance in order to stimulate germination.

Identification of bent-flowered fiddleneck requires several features: 1) population of plants (within a given occurrence) usually display heterostyly (various flowers displaying different lengths of styles with respect to stamens). The plants may also be homostylous, but if this is the case, anthers are in distinct “upper corolla” and “lower corolla” groups. The five calyx lobes are more or less equal in width and calyxes are distinct to the base of the calyx. Corolla is typically bilaterally symmetrical with dark spots on two of the five corolla limbs (petals). Other *Amsinckia* (*A. intermedia*) likely found on SBM do not display heterostyly nor are flowers bilaterally symmetrical, instead these plants either have five or no red corolla spots. Identification can be difficult since heterostyly requires observation of many individuals within a given fiddleneck patch, especially since both plants have similar corolla sizes and nutlet morphology. A reference population of bent-flowered fiddleneck located near Vollmer peak (East Bay) was photographed to show bilateral symmetry with 2 spots on corolla (Plate AL-2).



Amsinckia lunaris

Plate AL-1 (top left): Bent-flowered fiddleneck, Jepson Manual (© UC Board of Regents). Plate AL-2 (bottom left): Bent-flowered fiddleneck reference population located in March, 2015. Plate AL-3 (right): Profile view of fiddleneck © Aaron Schusteff.

Description Jepson eFlora

Stem: erect, slender. Flower: bilateral; calyx lobes 5, ± equal in width, not fused above base; corolla 7–10 mm, tube bent, 10-veined near base, limb 4–7 mm diam, orange, generally with 2 dark spots. Fruit: 2.5–4 mm, ± sharp-tubercled, occasionally ridged.
2n=8. Gravelly slopes, grassland, openings in woodland, often serpentine; (5)50–800 m. North Coast Ranges, sw Sacramento Valley, Central Coast (Marin, Santa Cruz cos.), San Francisco Bay Area. Heterostylous, if homostylous then corolla smaller, anthers in upper, lower groups. Mar–Jun.

Synonyms

Amsinckia anomala Suksd., *Amsinckia cinerea* Suksd., *Amsinckia disjuncta* Suksd., *Amsinckia longifolia* Suksd., *Amsinckia papillata* Suksd., *Amsinckia yosemitensis* Suksd.

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08864 **EO Index:** 49038
Key Quad: San Francisco South (3712264) **Element Code:** PDBOR01070
Occurrence Number: 6 **Occurrence Last Updated:** 2002-10-16
Scientific Name: *Amsinckia lunaris* **Common Name:** bent-flowered fiddleneck
Listing Status: Federal: None **Rare Plant Rank:** 1B.2
State: None
CNDDB Element Ranks: Global: G2?
State: S2?
Other Lists: BLM_S-Sensitive
General Habitat: Micro Habitat:
CISMONTANE WOODLAND, VALLEY AND FOOTHILL GRASSLAND. 50-500M.
Last Date Observed: 1963-05-03 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1963-05-03 Occurrence Rank: Unknown

Owner/Manager: UNKNOWN **Trend:** Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNTAIN, "NORTH TANK HILL."
Detailed Location:
AT MARGINS OF THICKETS, SOUTH AND SOUTHEAST FACING SLOPES.
Ecological:
AMONG ROCKY OUTCROPS; WITH TOXICODENDRON DIVERSILOBUM.
Threats:
General:
ONLY SOURCE OF INFORMATION FOR THIS SITE IS A 1963 POWELL COLLECTION. NEEDS FIELDWORK.
PLSS: T03S, R05W, Sec. 16 (M) **Accuracy:** 1 mile **Area (acres):** 0
UTM: Zone-10 N4169416 E551641 **Latitude/Longitude:** 37.67048 / -122.41442 **Elevation (feet):**
San Mateo San Francisco South (3712264)
County Summary: Quad Summary:
Report Printed on Friday, July 31, 2015
Government

Sources: POW63S0001 POWELL, J. - POWELL #356 UC #1220416 1963-05-03

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
UC1220416	Amsinckia lunaris	Jerry Powell	May 3 1963	356	San Mateo	s and se facing slopes San Bruno Mountain (north tank hill)
CAS26998	Amsinckia lunaris	Alice Eastwood	May 12, 1917	s.n.	San Mateo	San Bruno Hills

McClintock et al. & Allshouse and Nelson

Bent flowered fiddleneck is not mentioned in either reference. Allshouse and Nelson note *A. intermedia* at Ridge Trail, Buckeye/Owl Canyon, Callippe Hill, Hillside Trail.

2015 Survey Results

Bent-flowered fiddleneck was not observed on any of the surveys. Few fiddleneck (*Amsinckia* spp.) were observed in 2015 on SBM in general indicating it may not have been an optimal year for surveying this genus. The location of the previous CNDDB occurrence was searched and little potential habitat was observed (Plate 4). This open grassland area was instead dominated with non-native annual grasses. Areas with known fiddleneck populations and appropriate south facing slopes with disturbance were searched (Figure 3).

Plate 4: Photo on North Tank Hill, now mostly covered in dense northern coastal scrub, with weedy annual grassland remnant patches

Figure 3: 2015 Survey Information for Bent-Flowered Fiddleneck

Recommendation for continued inclusion as HCP covered species

This plant was not located in 2015. We recommend multi-year surveys on SBM if relocation of this plant is a priority. We recommended it for inclusion as an HCP covered species because two historic collections documented and vouchered indicate this species was once present on San Bruno Mountain.

Stewardship priority and management recommendations

Stewardship priority for this taxon is low. We recommend additional surveys for this plant, especially in a medium-wet year when this plant may flourish. Reintroduction from appropriate local seed stock could be considered on a trial basis. *Amsinckia spp.* typically germinate and grow well in lightly disturbed soils and can usually compete fairly well with other plants, although other *Amsinckia* restoration projects have had difficulties (Pavlik 1993). We recommend selection of an area with thinner soil (3-6”) within the 2015 search polygons. Although their success was limited, restoration studies with *A. grandiflora* (see Pavlik 1991) may be instructive for propagation.

Coast Rock Cress, Rock Rose Cress *Arabis blepharophylla* Hook. & Arn.

Coast rock cress is a Bay Area endemic perennial mostly restricted to coastal areas with a marine influence. The plant occurs as far south as Jasper Ridge (San Mateo County), but San Bruno Mountain and the southern Golden Gate National Recreation Area parks (Rancho Corral de Tierra) and McNee Ranch State Park, about 7 miles south of San Bruno, are the most well established southern populations of this plant. The SBM population is significant in being near the south range boundary for this taxon.

The 6-12” plant forms distinct basal rosettes and can form distinct colonies in preferred habitat. It is most typically observed growing in thin soils and often very close to, or within rock outcrops in coastal prairie and coastal scrub vegetation. Flowering typically occurs from January through April.

Coast rock cress is a distinct taxon and rarely confused on SBM. Diagnostic features of coast rock cress are: 1) corollas are pink to purple unlike *Arabis glabra* (tower mustard) which has white to yellow corollas, and 2) fruits (siliques) are slightly reflexed from the main inflorescence axis unlike *A. glabra* where fruits are often tightly appressed to the inflorescence axis. (Plates AB-1,2,3)

Plates AB1-3 (left to right): AB-1: Line drawing from Abrams, 1923, AB-2: Cauline leaves and stem of *A. blepharophylla*, AB-3: Inflorescence stalk with near mature fruit.

Description Jepson eFlora:

NATIVE
Habit: Perennial herb; caudex branches 0--few; hairs simple to forked or (3)4-rayed. Stem: 1--few, simple or few-branched distally, 0.6--2.5(3) dm, hairy (glabrous). Leaf: basal 2--8(12) cm, oblanceolate to obovate, entire or dentate, hairy or glabrous, margin hairy, tip obtuse; cauline 2--7, not basally lobed. Flower: sepals 5--7 mm; petals (12)14--18 mm, 4--7 mm wide, widely spoon-shaped, rose-purple. Fruit: erect, 2--4 cm, 2--3 mm wide; style 0.2--1(1.5) mm; pedicel erect to ascending, (3)5--10(15) mm, slender, hairy. Seed: 20--28, 2--2.5 mm, +- round; wing 0.2--0.4 mm wide. Chromosomes: 2n=16.
Ecology: Rocky outcrops, bluffs, grassy slopes; Elevation: 50--300 m. Bioregional Distribution: CCo,

SnFrB. Flowering Time: Mar--Apr
eFlora Treatment Author: Ihsan A. Al-Shehbaz

Synonyms

None

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Coast rock cress is a CRPR List 4.3 plants so it is rarely tracked in CNDDB forms. The following form indicates where it has been listed as an associate, mainly to *Helianthella castanea.*

Map Index Number: 08904 EO Index: 368
Key Quad: San Francisco South (3712264) **Element Code:** PDAST4M020
Occurrence Number: 12 Occurrence Last Updated: 2011-04-21
Scientific Name: Helianthella castanea
Common Name: Diablo helianthella
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists: BLM_S-Sensitive
General Habitat: Micro Habitat:
BROADLEAVED UPLAND FOREST, CHAPARRAL, CISMONTANE WDLND,
COASTAL SCRUB, RIPARIAN WOODLAND, VALLEY & FOOTHILL
GRASSLAND.
USUALLY IN CHAPARRAL/OAK WOODLAND INTERFACE IN ROCKY,
AZONAL SOILS. OFTEN IN PARTIAL SHADE. 25-1150M.
Last Date Observed: 2001-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 2001-XX-XX Occurrence Rank: Good
Owner/Manager: SMT COUNTY, PVT **Trend:** Unknown
Presence: Presumed Extant
Location:
EAST END OF SAN BRUNO MOUNTAIN, BETWEEN SOUTH SAN FRANCISCO AND BRISBANE.
Detailed Location:
MAPPED BY CNDDB AS FOUR POLYGONS.
Ecological:
GRASSLAND ON THE RIDGETOPS AND UPPER SLOPES BECOMING BRUSHIER FURTHER DOWNSLOPE. ASSOCIATED WITH TOXICODENDRON,
BACCHARIS, AND WYETHIA ANGUSTIFOLIA WITH ERYSIMUM ANGUSTIFOLIUM, COLLINSIA MULTIFLORA, AND ARABIS BLEPHAROPHYLLA NEARBY.
Threats:
NEARBY POWERLINE AND POTENTIAL DEVELOPMENT. INVASIVE EUCALYPTUS AND CYTISUS SCOPARIUS NEARBY.
General:
PLANTS OBSERVED IN 1965, 1967, 1983, 1984, 1989, 1993, AND 2001, BUT NUMBERS OF PLANTS OBSERVED IS UNKNOWN. NO PLANTS FOUND
IN 1981. 51 CLUMPS OBSERVED IN WESTERNMOST POLYGON IN 1994. INCLUDES FORMER OCCURRENCE #13.
PLSS: T03S, R05W, Sec. 15 (M) **Accuracy:** specific area **Area (acres):** 18
UTM: Zone-10 N4169980 E552717 **Latitude/Longitude:** 37.67550 / -122.40218 **Elevation (feet):** 700
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
HAR90U0003 HARRIS, V. - CONVERSATION REGARDING HELIANTHELLA CASTANEA ON SAN BRUNO MOUNTAIN 1990-01-10
HUN94U0001 HUNTER, B. - LETTER FROM DFG WITH COMMENTS ON GENERAL PLAN FOR CITY OF BRISBANE. 1994-10-20
MCC67S0004 MCCLINTOCK, E. & P. WHEELER - MCCLINTOCK SN CAS 1967-05-14
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI85R0002 THOMAS REID ASSOCIATES - SAN BRUNO MOUNTAIN AREA HABITAT CONSERVATION PLAN 1983-1984 ACTIVITIES REPORT 1985-01-XX SIG94F0001 SIGG, J. - FIELD SURVEY FORM FOR HELIANTHELLA CASTANEA 1994-05-03
TRA08R0001 TRA ENVIRONMENTAL SERVICES - SAN BRUNO MOUNTAIN HABITAT MANAGEMENT PLAN 2007 2008-03-XX
WHE65S0001 WHEELER, P. - WHEELER SN CAS 1965-04-27

Herbarium

At least 34 accessioned records for coast rock cress on San Bruno Mountain were located in the SMASH database. These span from an earlier collection in 1891 by Willis Jepson to 1980s collections by Dean Taylor. The plant is recorded from a variety of locations on the Mountain.

McClintock et al. & Allshouse and Nelson

McClintock et al. notes coast rock cress in “many locations” on SBM. Allshouse and Nelson note it at Radio Road, Bitter Cherry Ridge, and Ridge Trail.

TRA/MIG Surveys

Only one lone occurrence of coast rock cress was found in TRA/MIG data. We understand that this species was not the target of surveys, so we presume this to be an incomplete dataset. The single point for coast rock cress was taken near the summit.

2015 Survey

Coast rock cress was regularly encountered throughout the year and mapped in 17 locations as point locations. No population of plants was larger than a few square meters. Coast rock cress was almost always located within or about rock outcrops. Most locations are on cooler slopes that have a north or east facing aspect. This plant tended to occur in small populations of 3-10 plants (Plates 8 and 9), although 35 individuals were counted in one location in the Boneyard Quarry area. Hard, mature fruits were observed indicating that the plant is likely producing viable seed. Since this plant was commonly encountered in surveys, we completed only one CNDDB form in a site that seemed representative of the majority of the locations the plant was observed (See Appendix A). The search area (approximately the entire mountain) and observations are provided in Figure AB-1.

Plate AB-4 (left): A typical clustered group of coast rock cress on a rocky substrate near Tank Hill.
Plate AB-5 (above): Typical habitat where coast rock cress was observed.

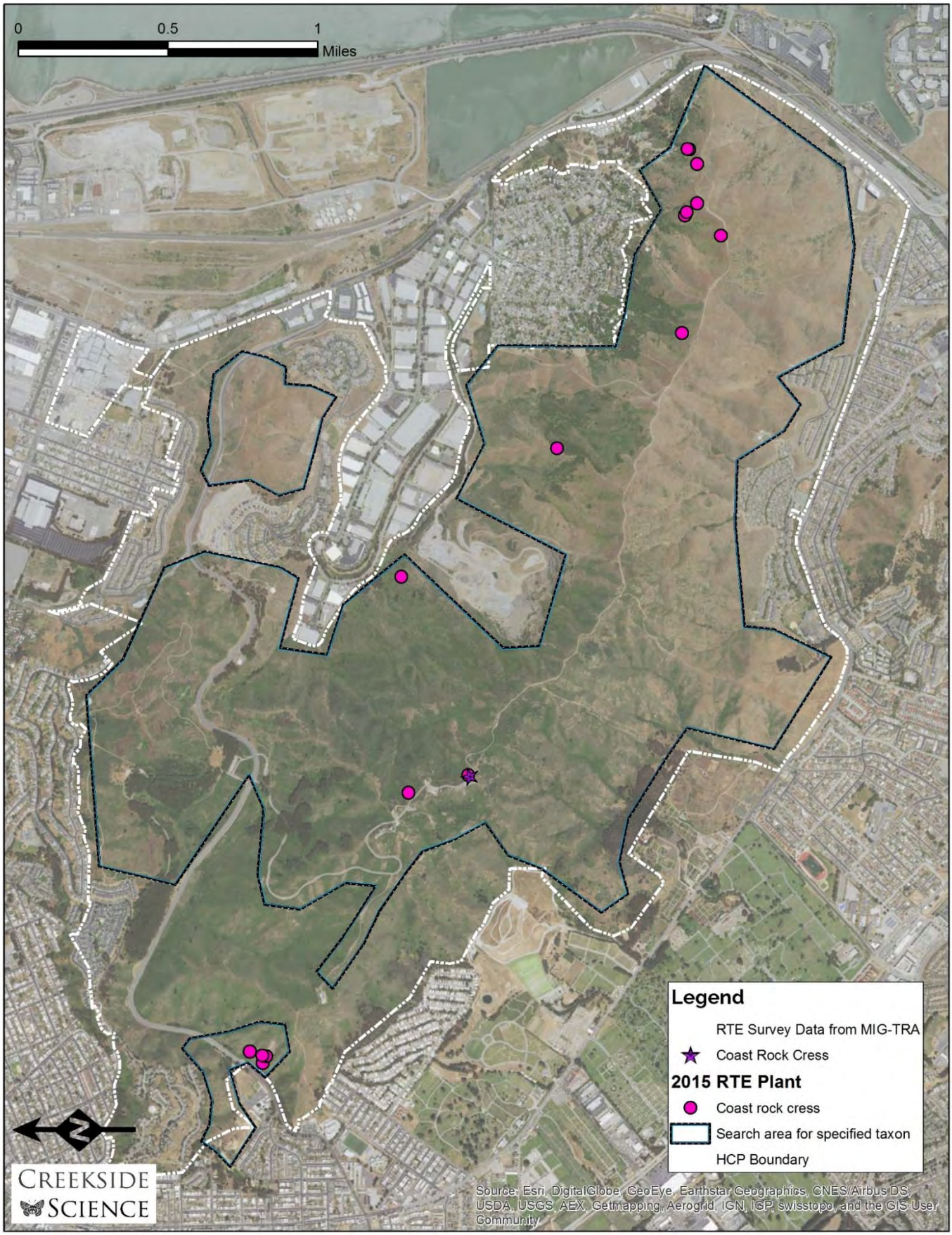


Figure AB-1: Search Area and Observations of Coast Rock Cress

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. It also serves as a nectar source for insects (likely including some of the listed butterfly species on SBM). The population is significant for this taxon since it occurs near its southern range limit.

Stewardship priority and management recommendations

Stewardship priority for this taxon is medium. This plant was observed in multiple locations across the mountain. Although there is no immediate threat to the persistence of this plant on San Bruno Mountain, it is recommended to see if 1) outplanting of nursery stock is successful and 2) direct seeding into a rocky area is successful. We recommend trying these two techniques in a pilot study. Nursery propagation, including at Mission Blue Nursery, is well documented for this plant (e.g. Schmidt, 1980).

San Bruno Mountain Manzanita *Arctostaphylos imbricata* Eastw.

San Bruno Mountain Manzanita is a perennial woody shrub endemic to San Bruno Mountain. This plant typically exists in colonies where many individuals intertwine stems above-ground, and likely roots belowground. The entire known distribution of this plant occurs in 11 distinct locations in a one-mile radius area near the summit of SBM. The plant's preferred substrate is presumed to be sandstone according to previous CNDDB records.

Although considered genetically distinct, this taxon shares many traits with *A. montaraensis* (Montara Mountain manzanita). Past taxonomy has named both San Bruno Mountain manzanita and Montara Mountain manzanita as subspecific taxa of *Arctostaphylos imbricata* (McClintock et al. 1990).

Identification of San Bruno Mountain manzanita can be difficult. Although diagnostic photos show representative overlapping, clasping leaves on prostrate stems (Plate AI-1), there are areas (e.g. Manzanita Dike) where the shrubs are upwards of 2 meters in height. Diagnostic features according to Kauffmann et al. 2015 include that the plant is not a burl-former, leaves are similar on both sides (including stomata), a prostrate growth form and auriculate to clasping leaves that are often smaller and more round in comparison to Montara Mountain (MM) manzanita. Leaf surfaces of SBM manzanita overall have fewer hairs on the surface (nearly glabrous) as compared to low density, but regular hairs on the MM manzanita leaf blades. In addition, we note that SBM manzanita branches are nearly symmetrical with leaves along the stems/branches while MM manzanita has a more random twig/leaf pattern around the main stems.

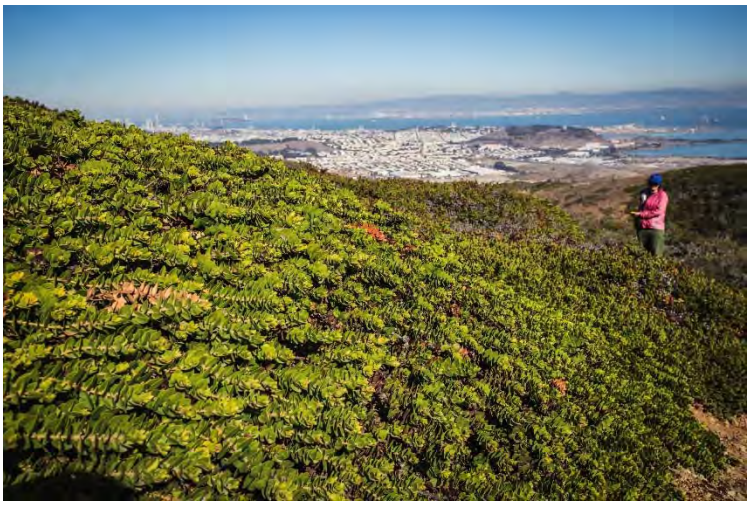


Plate AI-1(left): SBM manzanita at Pacific Rock. Low growing form. Plate AI-2(right): Branch showing leaves and branches forming an almost cylindrical shape, more or less radially symmetrical, which is different than what is observed on more pure MM manzanita.

Synonyms

Arctostaphylos andersonii Gray var. *imbricata* (Eastw.) Adams ex McMinn, *Arctostaphylos imbricata* Eastw. ssp. *imbricata*

Description Jepson eFlora

NATIVE
Habit: Shrub, prostrate, 0.1--1 m. Stem: twig densely long-glandular-hairy. Leaf: overlapped; petiole < 2 mm; blade 2.5--4 cm, 2--3 cm wide, round to round-ovate, light green, sparsely glandular-hairy, base lobed,

clasping, tip abruptly soft-pointed, margin entire, flat. Inflorescence: panicle, 3--5-branched; nascent inflorescence pendent, axis 0.5--1 cm, > 1 mm wide, long-glandular-hairy; bracts 5--10 mm, leaf-like, ovate, acute, glandular-hairy; pedicel 3--5 mm, glandular-hairy. Flower: ovary glandular-hairy. Fruit: 6--7 mm wide, depressed-spheric, glandular-hairy, sticky; stones free. Chromosomes: 2n=26.
Ecology: Sandstone outcrops, chaparral; Elevation: 200--400 m. Bioregional Distribution: CCo (San Bruno Mtn). Flowering Time: Jan--Mar
Synonyms: Arctostaphylos andersonii A. Gray var. imbricata (Eastw.) McMinn
eFlora Treatment Author: V. Thomas Parker, Michael C. Vasey & Jon E. Keeley

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08786 EO Index: 20225
Key Quad: San Francisco South (3712264) Element Code: PDERI040L0
Occurrence Number: 1 Occurrence Last Updated: 2000-01-12
Scientific Name: *Arctostaphylos imbricata* Common Name: San Bruno Mountain manzanita
Listing Status: Federal: None Rare Plant Rank: 1B.1
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
CHAPARRAL, COASTAL SCRUB. MOSTLY KNOWN FROM A FEW SANDSTONE OUTCROPS IN CHAPARRAL. 275-370 M.
Last Date Observed: 1995-07-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1995-07-XX Occurrence Rank: Unknown
Owner/Manager: SMT COUNTY Trend: Unknown
Presence: Presumed Extant
Location: SAN BRUNO MOUNTAIN, SUMMIT AND NORTH-SLOPE, SAN BRUNO MOUNTAIN COUNTY PARK.
Detailed Location: TWO COLONIES AT THIS SITE: ONE ALONG WEST SIDE OF SUMMIT JUST WEST OF THE KNBC TOWER, THE OTHER IS JUST NORTH OF THE KQED TOWER NEAR KAMCHATKA POINT.
Ecological: COASTAL SCRUB ON SANDSTONE OUTCROPS. ASSOCIATED WITH ARCTOSTAPHYLOS UVA-URSI, A. X PACIFICA, RHAMNUS CALIFORNICA, BACCHARIS PILULARIS, CEANOTHUS THYRSIFLORUS, AND VACCINIUM OVATUM.
Threats: MOTORCYCLE/ORVS ARE THREAT, FUNGUS-INDUCED DIEBACK IN 1995 WITH SUBSEQUENT RECOVERY.
General: TYPE LOCALITY. AREA BURNED IN 1974 AND 1981.
PLSS: T03S, R05W, Sec. 08 (M) Accuracy: specific area Area (acres): 5
UTM: Zone-10 N4171278 E549679 Latitude/Longitude: 37.68737 / -122.43655 Elevation (feet): 1,000
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
ANO15S0013 ANONYMOUS - ANONYMOUS SN UC 1915-02-15
ANO69S0002 ANONYMOUS - ANONYMOUS SN SJSU 1969-05-18
CAM15S0006 CAMPBELL, M. & E. MEIERE - CAMPBELL #38776 & 38777 CAS (CITED IN EAS31A0001, RAV52A0001) 1915-02-15
CAS69S0004 CASEY, S. - CASEY SN UC 1969-05-18
DPR78M0001 CALIFORNIA DEPARTMENT OF PARKS & RECREATION - MAP OF SAN BRUNO MTN. PARK (LOCATIONS OF SEVERAL RARE PLANTS). 1978-04-XX
EAS31A0001 EASTWOOD, A. - NEW SPECIES OF PLANTS. PROCEEDINGS OF THE CALIFORNIA ACADEMY OF SCIENCES, SER 4 20:149. 1931-12-18
GAN75M0001 GANKIN, R. - MAP OF RARE PLANTS IN THE SAN BRUNO MOUNTAIN AREA. 1975-XX-XX
GAN77U0002 GANKIN, R. - RARE PLANT STATUS REPORT, CNPS 1977-XX-XX
GAN77U0005 GANKIN, R. - RARE PLANT STATUS REPORT, CALIFORNIA NATIVE PLANT SOCIETY. 1977-XX-XX
GAN78M0002 GANKIN, R. - MAP OF SAN BRUNO MTN. WITH LOCATION INFORMATION ON RARE PLANTS AND 2 BUTTERFLIES. 1978-05-XX
GAN81U0003 GANKIN, R. - PERSONAL COMMUNICATION TO SUSAN COCHRANE, NDDB. 1981-11-23
GAN95U0001 GANKIN, R. - LETTER TO DFG REGARDING ARCTOSTAPHYLOS IMBRICATA ON SAN BRUNO MOUNTAIN. 1995-09-11
MAS28S0005 MASON, H. - MASON #4164 UC 1928-02-22
MCC63S0003 MCCLINTOCK, E. - MCCLINTOCK SN HERBARIUM UNKNOWN (CITED IN MCC68B0001) 1963-02-16
MCC68B0001 MCCLINTOCK, E. - A FLORA OF THE SAN BRUNO MOUNTAINS, SAN MATEO CO., CA. PROCEEDINGS OF THE CA. ACADEMY OF SCIENCES VOL. XXXII, NO. 20, PP.587-677. 1968-11-29
RAV51S0006 RAVEN, P. - RAVEN #2733 UC 1951-02-18
RAV52A0001 RAVEN, R. - PLANT NOTES FROM SAN FRANCISCO, CALIFORNIA. LEAFLETS OF WESTERN BOTANY, VOL. IV, #11 1952-08-XX
RAVNDS0002 RAVEN, P. - RAVEN #1383 HERBARIUM UNKNOWN (CITED IN RAV52A0001) XXXX-XX-XX
RAVNDS0003 RAVEN, P. - RAVEN #2733 HERBARIUM UNKNOWN (CITED IN RAV52A0001) XXXX-XX-XX
REI81U0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY OF SAN BRUNO MOUNTAIN 1981-XX-XX
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI91R0002 REID, T. (THOMAS REID ASSOCIATES) - RARE PLANTS ON SAN BRUNO MOUNTAIN - 1991 UPDATE. 1991-04-XX
REI94R0001 THOMAS REID ASSOCIATES - EIR AND EA FOR AMENDMENT TO SAN BRUNO MOUNTAIN AREA HCP 1994-06-XX
ROS51S0001 ROSE, L. - ROSE #51001 UC 1951-03-13
ROS55S0008 ROSE, L. - ROSE #55002 SJSU #5745 1955-02-23
ROS61S0003 ROSE, L. - ROSE #61014 CAS 1961-03-02
ROS64S0006 ROSE, L. - ROSE SN HSC #7758 1964-04-24
SMT79R0001 STAFF OF SAN MATEO COUNTY, DIVISION OF PARKS & REC - THE NATURAL RESOURCES MANAGEMENT PLAN FOR SAN

BRUNO MOUNTAIN COUNTY PARK 1979-05-XX
STE81F0005 STEIN, B. - FIELD SURVEY FORM FOR ARCTOSTAPHYLOS IMBRICATA 1981-03-05
TAY88S0009 TAYLOR, D. - TAYLOR #9403 UC 1988-03-16
TAY88S0010 TAYLOR, D. - TAYLOR #9584 UC 1988-04-29

Map Index Number: 08807 EO Index: 14060
Key Quad: San Francisco South (3712264) Element Code: PDERI040L0
Occurrence Number: 2 Occurrence Last Updated: 2000-01-12
Scientific Name: *Arctostaphylos imbricata* Common Name: San Bruno Mountain manzanita
Listing Status: Federal: None Rare Plant Rank: 1B.1
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
CHAPARRAL, COASTAL SCRUB. MOSTLY KNOWN FROM A FEW SANDSTONE OUTCROPS IN
CHAPARRAL. 275-370 M.
Last Date Observed: 1995-07-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1995-07-XX Occurrence Rank: Unknown
Owner/Manager: SMT COUNTY Trend: Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNTAIN, ABOUT 0.3-0.5 MILE EAST OF SUMMIT NEAR POWERLINES, SAN BRUNO MOUNTAIN COUNTY PARK.
Detailed Location:
THREE COLONIES MAPPED ALONG AND WEST OF POWER LINES. MANZANITA DIKE, INTERMEDIATE RIDGE, AND POWERLINE RIDGE POPULATIONS.
Ecological:
COASTAL SCRUB ON FRANCISCAN GRAYWACKE WITH BACCHARIS PILULARIS, ERIOPHYLLUM STAECHADIFOLIUM, IRIS DOUGLASII, SANICULA
ARCTOPOIDES, RHAMNUS CALIFORNICA, CEANOTHUS THYRSIFLORUS.
Threats:
MOTORCYCLE/ORVS ARE THREAT, FUNGUS-INDUCED DIEBACK IN 1995 WITH SUBSEQUENT RECOVERY.
General:
AREA BURNED IN 1974. AREA IS PROPOSED CRITICAL HABITAT FOR 2 ENDANGERED BUTTERFLIES.
PLSS: T03S, R05W, Sec. 08 (M) Accuracy: specific area Area (acres): 10
UTM: Zone-10 N4171057 E550527 Latitude/Longitude: 37.68533 / -122.42694 Elevation (feet): 1,000
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
BAC61S0003 BACIGALUPI, R. - BACIGALUPI #7619 JEPS 1961-04-24
DPR78M0001 CALIFORNIA DEPARTMENT OF PARKS & RECREATION - MAP OF SAN BRUNO MTN. PARK (LOCATIONS OF SEVERAL RARE PLANTS). 1978-04-XX
GAN75M0001 GANKIN, R. - MAP OF RARE PLANTS IN THE SAN BRUNO MOUNTAIN AREA. 1975-XX-XX
GAN77U0002 GANKIN, R. - RARE PLANT STATUS REPORT, CNPS 1977-XX-XX
GAN77U0005 GANKIN, R. - RARE PLANT STATUS REPORT, CALIFORNIA NATIVE PLANT SOCIETY. 1977-XX-XX
GAN78M0002 GANKIN, R. - MAP OF SAN BRUNO MTN. WITH LOCATION INFORMATION ON RARE PLANTS AND 2 BUTTERFLIES. 1978-05-XX
GAN95U0001 GANKIN, R. - LETTER TO DFG REGARDING ARCTOSTAPHYLOS IMBRICATA ON SAN BRUNO MOUNTAIN. 1995-09-11
MCC63S0004 MCCLINTOCK, E. - MCCLINTOCK SN HERBARIUM UNKNOWN (CITED IN MCC68B0001) 1963-09-02
MCC68B0001 MCCLINTOCK, E. - A FLORA OF THE SAN BRUNO MOUNTAINS, SAN MATEO CO., CA. PROCEEDINGS OF THE CA. ACADEMY OF SCIENCES VOL. XXXII, NO. 20, PP.587-677. 1968-11-29
NAC81F0005 NACHLINGER ET AL. - FIELD SURVEY FORM FOR ARCTOSTAPHYLOS IMBRICATA 1981-02-22
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI91R0002 REID, T. (THOMAS REID ASSOCIATES) - RARE PLANTS ON SAN BRUNO MOUNTAIN - 1991 UPDATE. 1991-04-XX
SMT79R0001 STAFF OF SAN MATEO COUNTY, DIVISION OF PARKS & REC - THE NATURAL RESOURCES MANAGEMENT PLAN FOR SAN BRUNO MOUNTAIN COUNTY PARK 1979-05-XX
TAY88S0008 TAYLOR, D. - TAYLOR #9479 UC 1988-04-08
TAY88S0011 TAYLOR, D. - TAYLOR #9403 UC 1988-03-16

Map Index Number: 08888 EO Index: 20222
Key Quad: San Francisco South (3712264) Element Code: PDERI040L0
Occurrence Number: 4 Occurrence Last Updated: 2000-01-12
Scientific Name: *Arctostaphylos imbricata* Common Name: San Bruno Mountain manzanita
Listing Status: Federal: None Rare Plant Rank: 1B.1
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
CHAPARRAL, COASTAL SCRUB. MOSTLY KNOWN FROM A FEW SANDSTONE OUTCROPS IN
CHAPARRAL. 275-370 M.
Last Date Observed: 1981-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1981-XX-XX Occurrence Rank: Unknown
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNTAIN, NEAR POWERLINES ON EAST SLOPE OF MOUNTAIN, ABOVE BRISBANE.
Detailed Location:
SITE MAPPED ALONG POWERLINES, ABOUT 0.75 MILE NORTH OF WHERE THEY CROSS RANDOLPH AVE.

Ecological:
Threats:
General:
ONLY SOURCE OF INFORMATION FOR THIS SITE IS 1981 DOCUMENT BY THOMAS REID ASSOCIATES. SITE IS APPARENTLY BASED UPON A MAP BY R. GANKIN.
PLSS: T03S, R05W, Sec. 16 (M) Accuracy: 1/10 mile Area (acres): 0
UTM: Zone-10 N4170119 E552108 Latitude/Longitude: 37.67679 / -122.40908 Elevation (feet): 700
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
REI81U0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY OF SAN BRUNO MOUNTAIN 1981-XX-XX
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX

Herbarium

A total of 57 herbarium specimens are accessioned for this plant on San Bruno Mountain in the Consortium of California Herbaria dating back to the first collection by Marion Campbell in 1915 from the “San Bruno Hills”.

McClintock et al. & Allshouse and Nelson

McClintock et al. notes *A. imbricata* as “common, brushy slopes and ridges between Summit and Gasline Ridge on north slope near summit, Kamchatka Point, Powerline Ridge, Blue Blossom Hill, Manzanita Dike.” Allshouse and Nelson note occurrences at Kamchatka Point, Summit Towers, Roof Rock, Pacific Rock, Manzanita Dike, and Powerline Ridge, Lower Powerline Ridge, and Parker and Vasey Ridge.

TRA/MIG Surveys

Previous surveys have cataloged the distribution of this species fairly well. SBM manzanita is noted in early TRA maps and GIS polygons exist for this taxon. These results are presented with 2015 survey results in Figure AI-1.

2015 Survey Results

All the previously identified occurrences of SBM manzanita were observed in 2015 surveys. In addition, four new polygons were located (numbers 6, 8, 9 and 11 on Figures AI-1,2). These low growing manzanita mats were found to have similar distribution as previous TRA surveys. It is likely that these polygons have changed little in the past 20 years since their outlines closely match the mapping completed by TRA/MIG. One limitation is that neither map shows dieback, which was observed in all of the large polygons (i.e. 1, 5, 7) Notably, SBM manzanita seems to be losing ground to other rare manzanitas on SBM (polygon 4). Nearly all populations were observed with some degree of dieback, presumably from moth damage (Plate AI-3). CNDDB forms in Appendix A note the amount of dieback observed at each polygon. Another notable occurrence was a large gathering of ravens, estimated to be about 100-150 birds, on top of Manzanita Dike in the middle of the SBM manzanita polygon. The ravens seemed to be harvesting bugs or fruit from either the manzanita or the ground directly below it. It could be possible that ravens were feeding on moth larvae in the area where dieback was observed.

Plate AI-3: Dieback of SBM manzanita noted by the reddish color in the center of the photo.

A total of three new polygons were located in the 2015 survey. One small population south (downslope) of the main Manzanita Dike polygon was in excellent condition. One larger population was noted on Powerline Ridge about 1/10 of a mile downslope of the main polygon there. A third notable population in good shape, with approximately 30% dieback was observed on a minor ridge between Manzanita Dike and the Powerline Ridge area.

Plate AI-4: Young SBM manzanita individual near Pacific Rock with remarkable new branch growth.

CNDDB EO (Element Occurrence ID number, see above records from CNDDB) 14060 notes provides remarkable notes on the durability of this population/occurrence. The EO mentions the area burned in 1974. Also, dieback was observed in 1995 on the plants. And finally, off highway vehicle (OHV) use threatened the plants when it was historically permitted.

At least one new recruit, estimated to be 5-10 years, was observed near Pacific Rock proper (AI-4). It seems possible that an event other than a fire may have triggered germination of this plant, possibly passage through a bird's digestive tract.

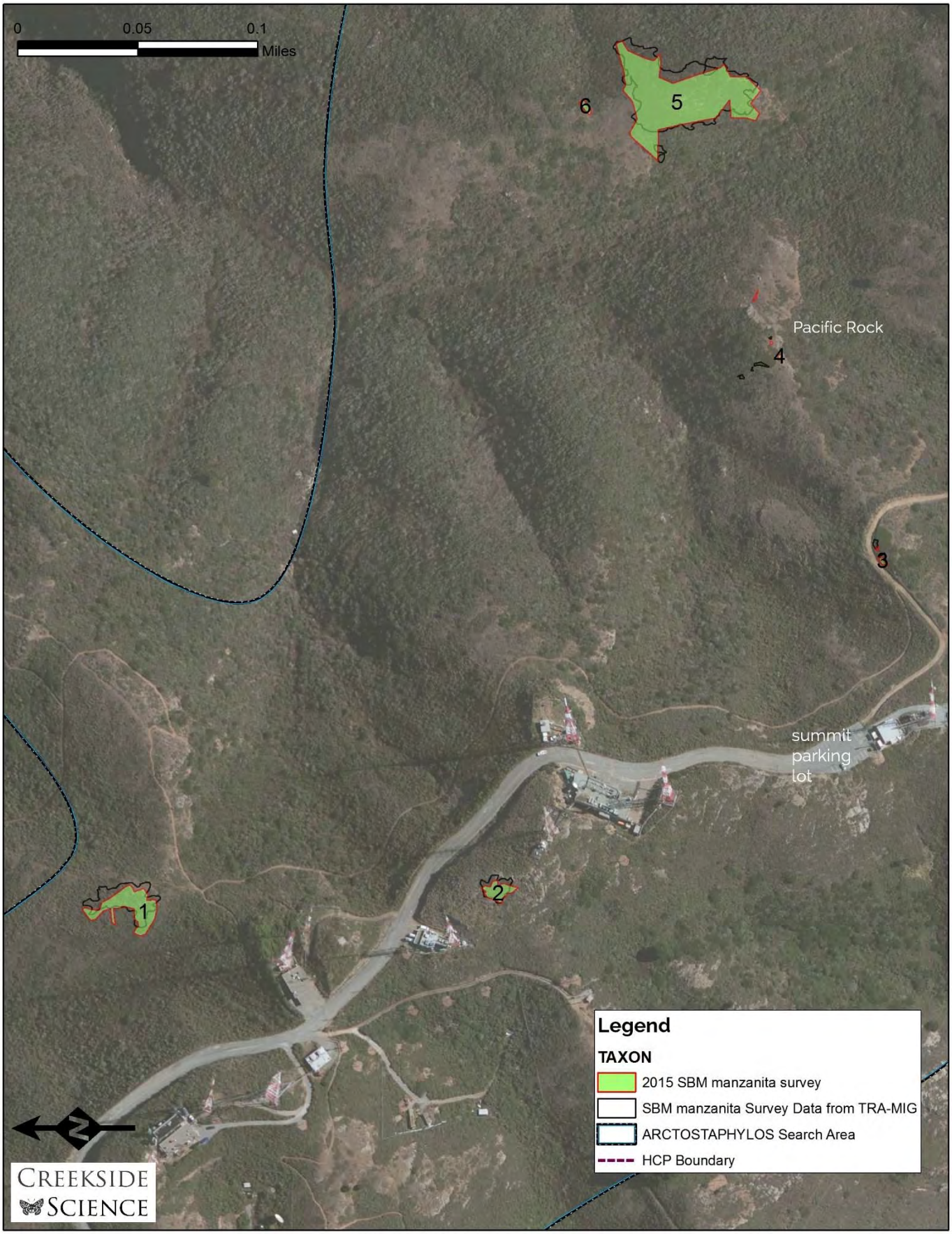


Figure AI-1: SBM Manzanita 2015 (polygons 1-6) and previous surveys

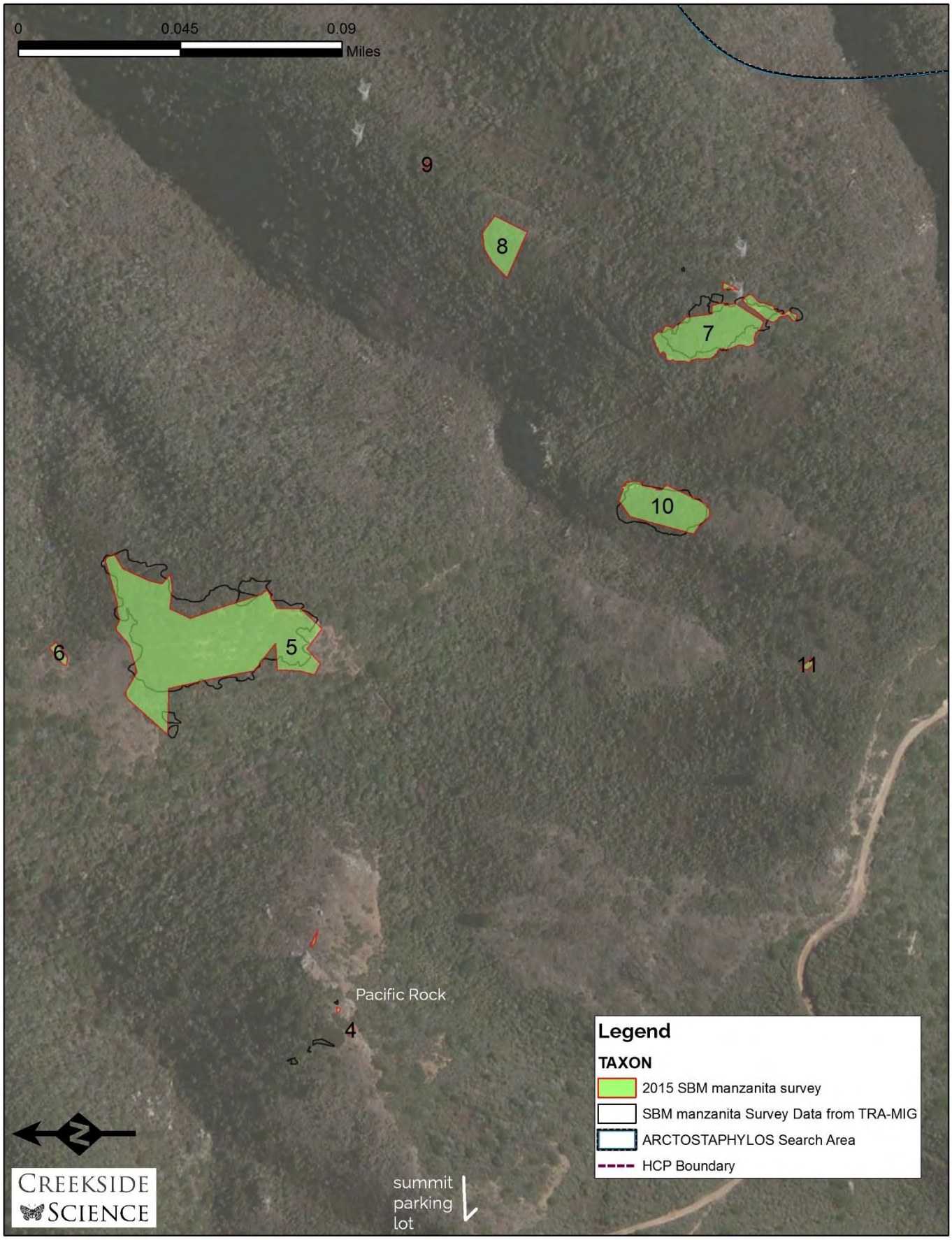


Figure AI-2: SBM Manzanita 2015 (polygons 4-11) and previous surveys

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. Conservation of the occurrences of this plant on San Bruno Mountain is essential for the survival of this species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is high. This plant was observed in multiple locations, but we recommend continual monitoring of all populations on a regular 5-year return interval since the prostrate form of this plant can be overgrown by taller vegetation. We suggest installing permanent markers to measure plant dieback or expansion, rather than comparing GPS polygons. Since both McClintock and CNDDB records refer to this plant responding favorably to fire, we recommend experimenting with either a) burn boxes in areas where berries or a seedbank may be present (or berries may be relocated to an acceptable habitat) and/or b) stacking small piles of brush on top of fruits and creating a low intensity prescribed fire in a proposed habitat restoration area. Additionally, we recommend experimenting with rooting woody cuttings grown in a soil-less system (such as 95% perlite/5% fresh compost by volume). Soilless systems greatly reduce risk of *Phytophthora* spp. infections, and have worked for other manzanitas at the Creekside Growing Facility. These plants could then be experimentally outplanted in a desirable location where unoccupied habitat exists. We recommend starting trials on the ridges of north facing slopes between the Summit and the Quarry.

Montara Mountain Manzanita *Arctostaphylos montaraensis* J.B. Roof

Montara Mountain manzanita (MM manzanita) is a large perennial shrub that is morphologically and biologically almost identical to SBM manzanita, occurring near the summit of San Bruno Mountain. This species was presumed to be extirpated from the Mountain after a single 33-year-old individual was destroyed in a 1964 fire. Auspiciously, buried seed germinated after the fire and about two dozen plants were found to replace the mother located at Pacific Rock (McClintock et al. 1980). MM manzanita does occur outside of SBM, known from the Montara Mountain/McNee Ranch State Park area. SBM denotes the northern range limit of this plant. It is endemic to San Mateo County.

Compared with the prostrate SBM manzanita, MM manzanita is typically considered more shrub-like, about 1 to 4 meters in height. Diagnostic features according to Kauffmann et al. 2015 include that the plant is not a burl-former, leaves are similar on both sides (including stomata), and it has auriculate to clasping leaves that are often larger and less round in comparison to SBM manzanita. Leaf blade surfaces of MM manzanita have regular strigose hairs, although they are rarely dense. MM manzanita has a more random twig/leaf pattern around the main stems and usually a more prominent basal stem (Plates AM-1,2,3,4).

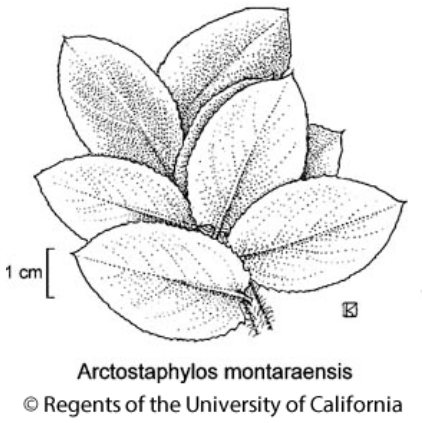


Plate AM-1 (top left): Montara Mountain manzanita seen from Pacific Rock; this plant is a large, mature shrub. Plate AM-2 (top right): Typical leaves of shrubby MM manzanita. Plate AM-3 (lower photo): Niederer GPS mapping in dense MM manzanita scrub competing with decadent coyote brush. Note the branches in the lower left portion of the photo having a more typical symmetry we observed in the low-growing SBM manzanita. These two species were difficult to tease apart in certain areas on the Mountain. Plate AM-4: Line drawing.

Synonyms

Arctostaphylos imbricata Eastw. subsp. *montaraensis* (Roof) Wells, *Arctostaphylos montaraensis* Roof

Description Jepson eFlora

NATIVE
Habit: Mounded to erect, 0.5--5 m (< 0.5 m on exposed granite outcrops). Stem: twig (and nascent inflorescence axis) densely long-glandular-hairy. Leaf: overlapped; petiole < 2 mm; blade 2.5--4.5 cm, 1.5--2.5 cm wide, ovate, bright green, sparsely glandular-puberulent, base lobed, clasping, tip acute, margin entire, flat. Inflorescence: panicle, 4--6-branched; nascent inflorescence pendent, axis 1--1.5 cm, > 1 mm wide; bracts 6--9 mm, leaf-like, lanceolate, acuminate, glandular-hairy; pedicel 5--6 mm, glandular-hairy. Flower: ovary glandular-hairy.Fruit: 6--7 mm wide, depressed-spheric, glandular-hairy, sticky; stones free. Chromosomes: 2n=26.
Ecology: Granite, sandstone outcrops, chaparral, coastal scrub; Elevation: 200--500 m. Bioregional Distribution: CCo (San Bruno Mtn), w SnFrB (Montara Mtn). Flowering Time: Jan--Mar
Synonyms: Arctostaphylos imbricata Eastw. subsp. montaraensis (Roof) P.V. Wells
eFlora Treatment Author: V. Thomas Parker, Michael C. Vasey & Jon E. Keeley

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08792 EO Index: 20208
Key Quad: San Francisco South (3712264) Element Code: PDERI042W0
Occurrence Number: 8 Occurrence Last Updated: 2015-02-20
Scientific Name: Arctostaphylos montaraensis Common Name: Montara manzanita
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
CHAPARRAL, COASTAL SCRUB. SLOPES AND RIDGES. 150-500 M.
Last Date Observed: 2010-12-12 Occurrence Type: Natural/Native occurrence
Last Survey Date: 2010-12-12 Occurrence Rank: Poor
Owner/Manager: SMT COUNTY-PARKS & REC Trend: Unknown
Presence: Presumed Extant
Location:
PACIFIC ROCK AND MANZANITA DIKE, SUMMIT OF SAN BRUNO MOUNTAIN, ABOUT 0.25 MILE NORTHEAST OF KRON-TV RADIO TOWER.
Detailed Location:
2 POLYGONS MAPPED BY CNDDB IN THE SW 1/4 OF THE NE 1/4 OF SECTION 8.
Ecological:
WINDSWEPT MINOR RIDGE OF SANDSTONE, SURROUNDED BY CEANOTHUS THYRSIFLORUS. IN COASTAL SCRUB IN ROCKY OR SHALLOW
SOILS.
Threats:
WILDFIRE SUPPRESSION, ENCROACHMENT OF CEANOTHUS THRYSIFLORUS.
General:
TWO DOZEN PLANTS SEEN IN 1980. EVEN-AGED STAND - REGENERATED AFTER A FIRE IN 1964. MANY COLLECTIONS AND OBSERVATIONS
FROM SAN BRUNO MOUNTAIN FROM 1963 THOUGH 2010 ARE ATTRIBUTED TO THIS OCCURRENCE.
PLSS: T03S, R05W, Sec. 08 (M) Accuracy: specific area Area (acres): 4
UTM: Zone-10 N4171208 E550179 Latitude/Longitude: 37.68671 / -122.43087 Elevation (feet): 900
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
ANO61S0007 ANONYMOUS - ANONYMOUS SN JEPS #88612 1961-05-XX
BOR10I0002 BORS, M. - PHOTO OF ARCTOSTAPHYLOS MONTARAENSIS, CALPHOTOS ID: 0000 0000 0611 1859 2010-12-12
GAN75M0001 GANKIN, R. - MAP OF RARE PLANTS IN THE SAN BRUNO MOUNTAIN AREA. 1975-XX-XX
GAN77U0002 GANKIN, R. - RARE PLANT STATUS REPORT, CNPS 1977-XX-XX
GAN81U0002 GANKIN, R. - PHONE COMMUNICATION TO JAN NACHLINGER, CNDDB. 1981-XX-XX
GRA94I0002 GRABER, D. - PHOTO OF ARCTOSTAPHYLOS MONTARAENSIS, CALPHOTOS ID: 0000 0000 0201 0120 1994-01-01
GRE84U0004 GREENHOUSE, J. - OBSERVATION RECORD FOR ARCTOSTAPHYLOS MONTARAENSIS, CALFLORA ID: JGR20504 1984-03-03
GRE90U0004 GREENHOUSE, J. - OBSERVATION RECORD FOR ARCTOSTAPHYLOS MONTARAENSIS, CALFLORA ID: JGR25766 1990-03-10
KNI66S0005 KNIGHT, W. & I. KNIGHT - KNIGHT #1761 JEPS #47726 1966-03-27
KNI81S0002 KNIGHT, W. & I. KNIGHT - KNIGHT #3933 CAS #644368 1981-01-25
KNI82S0003 KNIGHT, W. ET AL. - KNIGHT #4496 DAV #51756 1982-03-27
KNI86S0011 KNIGHT, W. & P. WELLS - KNIGHT #5373 RSA #364238 1986-01-03

MCC74S0004 MCCLINTOCK, E. - MCCLINTOCK SN CAS #581435 1974-11-13
MEN63S0002 MENZIES, A. - MENZIES #6 UC #525746 1963-02-05
REI91R0002 REID, T. (THOMAS REID ASSOCIATES) - RARE PLANTS ON SAN BRUNO MOUNTAIN - 1991 UPDATE. 1991-04-XX
ROO66S0006 ROOF, J. - ROOF SN JEPS #88613 1966-03-27
SIG81S0001 SIGG, J. ET AL. - SIGG #4087 CAS #646971 1981-03-11
THO63S0010 THORNE, R. & P. EVERETT - THORNE #32224 RSA #167727, SBBG #21959 1963-06-09
TRA08R0001 TRA ENVIRONMENTAL SERVICES - SAN BRUNO MOUNTAIN HABITAT MANAGEMENT PLAN 2007 2008-03-XX

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS525746	Arctostaphylos montaraensis	Arthur Menzies	February 5, 1963	6	San Mateo	San Bruno Mountain
CAS644368	Arctostaphylos montaraensis	Walter Knight, Irja Knight	January 25, 1981	3933	San Mateo	Collected from San Bruno Mt.
CAS646971	Arctostaphylos montaraensis	Jacob Sigg, Elizabeth McClintock, Walter Knight, Irja Knight	March 11, 1981	4087	San Mateo	Collected from near Pacific Rock on San Bruno Mt.
JEPS47726	Arctostaphylos montaraensis	Walter Knight and Irja Knight	Mar 27 1966	1761	San Mateo	Pacific Ridge San Bruno Mt.
JEPS88613	Arctostaphylos montaraensis	J. Roof	Mar 27 1966		San Mateo	Pacific Ridge San Bruno Mt.
RSA167727	Arctostaphylos montaraensis	R. F. Thorne, Percy C. Everett	Jun 9 1963	32224	San Mateo	On top of San Bruno Mountain on Kamchatka Point near the TV tower
RSA364238	Arctostaphylos montaraensis	Walter Knight, P. V. Wells	Jan 3 1986	5373	San Mateo	San Bruno Mountain
SBBG21959	Arctostaphylos montaraensis	R. F. Thorne, P. C. Everett	Jun 9 1963	32224	San Mateo	top of San Bruno Mtn, near the TV Tower
UCD51756	Arctostaphylos montaraensis	Walter Knight, Irja Knight, Elizabeth McClintock	03 27 1982	4496	San Mateo	Downhill and north from Pacific Rock; San Bruno Mountain

McClintock et al. & Allshouse and Nelson

McClintock et al. notes *A. montaraensis* only exists at “one locality about 100 yards northwest of Pacific Rock, and it forms a dense colony.” Allshouse and Nelson note occurrences at Pacific Rock and Manzanita Dike.

TRA/MIG Surveys

Previous TRA surveys note this plant at both Pacific Rock and on the western face below Manzanita Dike (see Figure AM-1 in survey results).

2015 Survey Results

As explained above, we observed both “typical” MM manzanitas, but we also observed hybrids that seemed to display SBM manzanita stem geometry, and an intermediate height of 0.5 to 1.5 meters. These plants were always observed near polygons where SBM manzanita was present (Plate AM-4). In fact, all of the MM manzanita polygons occur slightly downslope from a local summit which has a notable population of SBM manzanita. As one surveys farther from the local ridge, the taller the plants get and they start to have more characteristics described in the MM manzanita description. In fact, one reviewer noted they believe that a manzanita mapped as MM in Figure AM-1 could be identified as SBM. We presume there may be some genetic flow occurring here between these two species, allowing manzanita hybrids to form. An alternate hypothesis is that these are the same taxon, with lower forms growing in more exposed areas, but occasionally the two forms are adjacent to each other, apparently ruling out environmental differences.

Plate AM-4: Typical MM manzanitas (outlined in white) observed just west, and downslope of Manzanita Dike ridge. These plants seem to have some intermediate characteristics and heights, between the typical 0.5-meter height of SBM manzanita, and the taller, tree-like form of MM manzanita.

CNDDB EO 20208 notes similar ecology to that of SBM manzanita, such that this plant was observed in a stand that “regenerated after a fire in 1964.” The EO also notes this plant prefers minor sandstone ridges. All of these factors make the authors question how unique these two taxa are and whether these plants may be responding to soil and exposure differences.

Our 2015 survey located at least two distinct plants just to the west of the larger Pacific Rock polygon. It is possible these plants were missed in past surveys, although they were smaller in stature and younger individuals than those nearer Pacific Rock. Polygons from 2015 are considered to be otherwise not significantly different than those of previous surveys. Due to difficult travel and survey conditions, our 2015 GPS polygons were larger and more liberal based on where we could manage to move about the site.

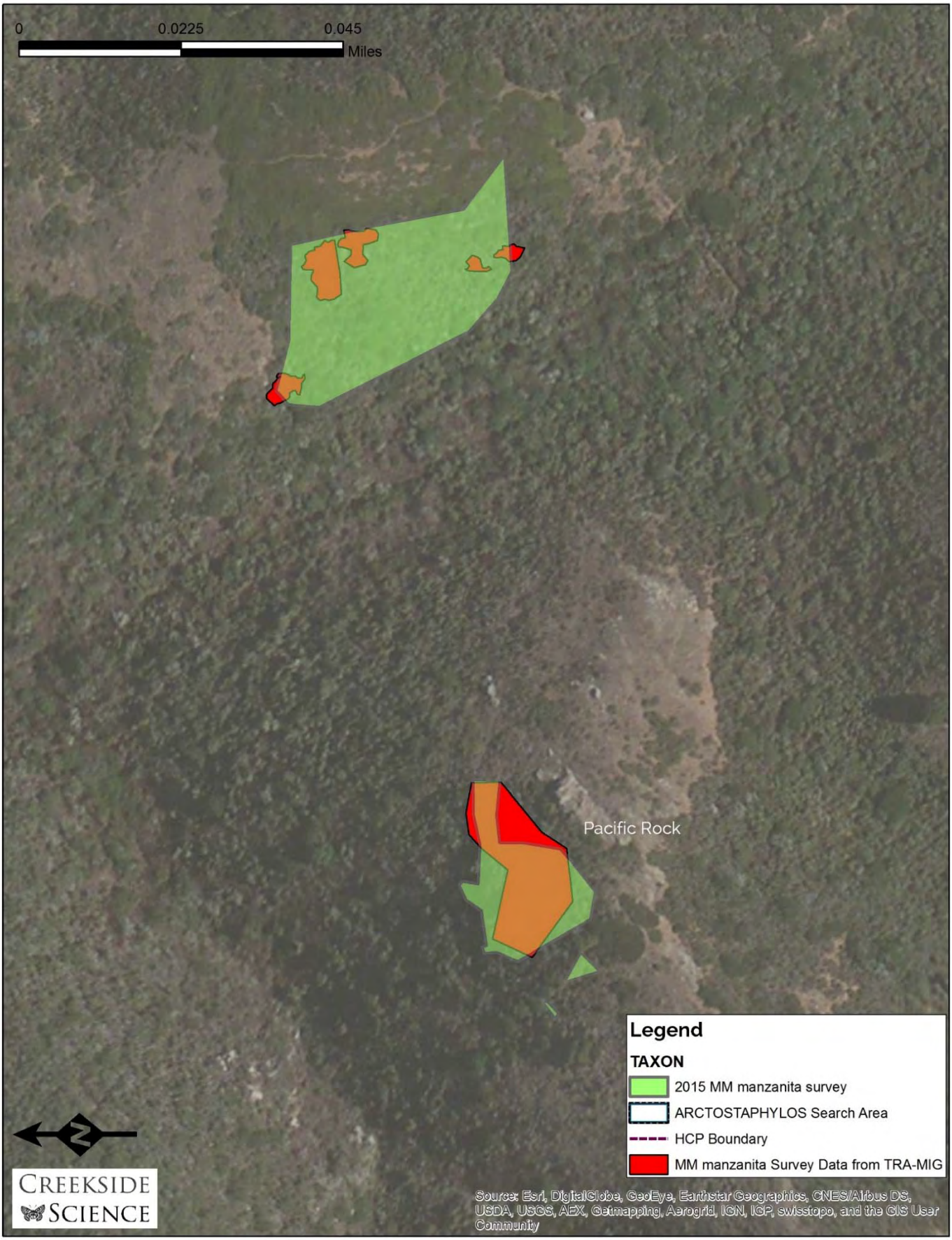


Figure AM-1: MM Manzanita 2015 and previous surveys

Recommendation for continued inclusion as HCP covered species

Just as SBM manzanita, this plant is recommended for continued inclusion as an HCP covered species. Conservation of the occurrences of this plant on San Bruno Mountain is essential for the survival of this species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is high. This plant was observed in only two distinct locations: We recommend continual monitoring of all populations on a regular 5-year return interval. We suggest installing permanent markers to measure plant dieback or expansion, rather than comparing GPS polygons. Since both McClintock and CNDDB records refer to this plant responding favorably to fire, we recommend experimenting with either a) burn boxes in areas where berries or a seedbank may be present (or berries may be relocated to an acceptable habitat) and/or b) stacking small piles of brush on top of fruits and creating a low intensity prescribed fire in a proposed habitat restoration area. Additionally, we recommend experimenting with rooting woody cuttings grown in a soil-less system (such as 95% perlite/5% fresh compost by volume). Soilless systems greatly reduce risk of *Phytophthora* spp. infections, and have worked for other manzanitas at the Creekside Growing Facility. These plants could then be experimentally outplanted in a desirable location where unoccupied habitat exists. We recommend starting trials on the ridges of north facing slopes between the Summit and the Quarry, exactly as prescribed for SBM manzanita.

Pacific Manzanita *Arctostaphylos pacifica* J.B. Roof

Pacific manzanita is a low-mat forming shrub that is known to be restricted to one location near Pacific Rock. The two sprawling individuals found at this location were severely damaged by the 1964 fire, but regenerated from sprouts arising from the lignotubers (McClintock et al. 1980). This plant was once considered a hybrid of *A. uva-ursi* and *A. glandulosa*, but recent genetic work warrants recognition as a unique taxon. This plant is endemic to San Bruno Mountain.

Key diagnostic features of this plant are its tendency to form a low-growing mat or mound (< 0.6m) with an obscure burl at the base. The plant spreads by root branches (lignotubers) which may be evident. Leaves are ovate, slightly serrate and typically fleshy, or thick. Leaves have stomata on both sides and are bifacial (with the lower leaf light green in color, while the upper is a darker, forest-green.) (Plates AP-1, 2)

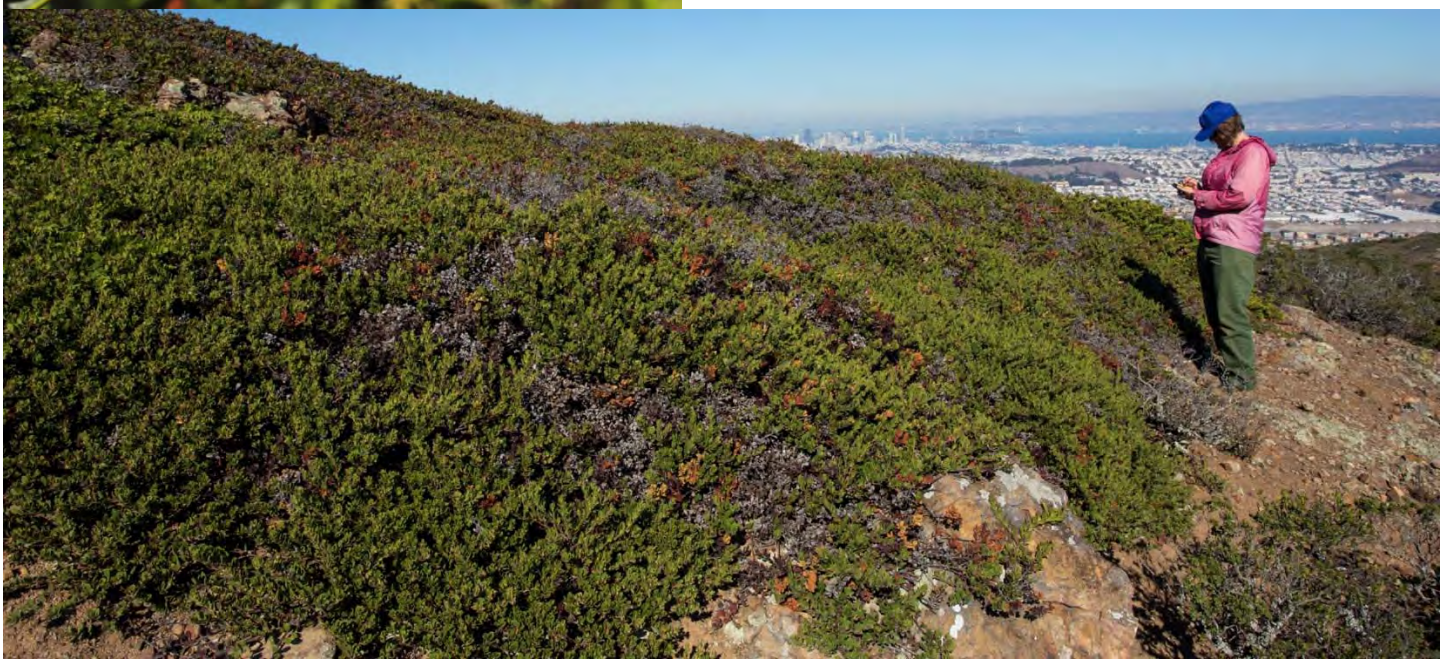


Plate AP-1 (above): Slightly serrate leaves and pinkish stems of Pacific manzanita. AP-2 (below): Notable mound form of Pacific manzanita, with moderate dieback observed within the plant polygon.

Synonyms

Arctostaphylos X pacifica Roof*, Arctostaphylos uva-ursi* (Linnaeus) *Sprengel* var. *saxicola* Roof

Description Jepson eFlora

NATIVE
Habit: Prostrate, 0.1--0.6 m; burls on stems. Stem: twig (and nascent inflorescence axis) short-nonglandular-hairy. Leaf: spreading; petiole 2--4 mm; blade 1--2 cm, 0.5--1 cm wide, elliptic, abaxially light green, adaxially dark green, sparsely nonglandular-hairy, base wedge-shaped, tip acute, margin serrate.Inflorescence: +- raceme, 0--1-branched; nascent inflorescence pendent, axis 0.5--1 cm, > 1 mm wide; bracts 0.5--1 mm, scale-like, awl-shaped, glabrous; pedicel 3--5 mm, glabrous. Flower: ovary glabrous. Fruit: 6--8 mm wide, spheric, +- red, glabrous; stones free. Chromosomes: 2n=52.
Ecology: Sandstone outcrops, chaparral; Elevation: 300 m. Bioregional Distribution: CCo (San Bruno Mtn). Flowering Time: Jan--Mar
Synonyms: Arctostaphylos ×pacifica Roof; Arctostaphylos uva-ursi var. saxicola Roof
eFlora Treatment Author: V. Thomas Parker, Michael C. Vasey & Jon E. Keeley

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08805 EO Index: 3253
Key Quad: San Francisco South (3712264) **Element Code:** PDERI040Z0
Occurrence Number: 1 Occurrence Last Updated: 2007-04-25
Scientific Name: *Arctostaphylos pacifica* **Common Name:** Pacific manzanita
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, CHAPARRAL. `
Last Date Observed: 2007-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 2007-XX-XX Occurrence Rank: Fair
Owner/Manager: PVT Trend: Unknown
Presence: Presumed Extant
Location:
NEAR SUMMIT OF SAN BRUNO MOUNTAIN JUST BELOW PARKING LOT, APPROX 0.2 MI SE OF KRON TOWER.
Detailed Location:
Ecological:
ON SANDSTONE RIDGE ASSOCIATED WITH ARCTOSTAPHYLOS IMBRICATA, A. UVA-URSI, AND ERYSIMUM FRANCISCANUM VAR. FRANCISCANUM.
Threats: PAST ANTENNAE DEVEL; MOTORBIKE DISTURBANCE, FIRE CONTROL, WEEDS, POSSIBLY GRAZING REMOVAL (WHICH RELEASED CSS & WEEDS).
General:
2 POPULATIONS IN A STAND COVERING APPROXIMATELY 8 X 9 METERS. AREA BURNED IN 1974. POPULATION MAY HAVE BEEN LARGER IN THE PAST; NEARBY DEVELOPMENT OF ANTENNAE FACILITIES REDUCED HABITAT.
PLSS: T03S, R05W, Sec. 08 (M) **Accuracy:** 1/10 mile **Area (acres):** 0
UTM: Zone-10 N4170857 E550046 **Latitude/Longitude:** 37.68355 / -122.43241 **Elevation (feet):** 1,045
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
BAC61S0002 BACIGALUPI, R. ET AL. - BACIGALUPI #7618 JEPS #27358 1961-04-24
GAN77U0002 GANKIN, R. - RARE PLANT STATUS REPORT, CNPS 1977-XX-XX
GAN78M0002 GANKIN, R. - MAP OF SAN BRUNO MTN. WITH LOCATION INFORMATION ON RARE PLANTS AND 2 BUTTERFLIES. 1978-05-XX
LAZ07U0002 LAZAR, K. & R. BITTMAN - RARE PLANT STATUS REVIEW: ARCTOSTAPHYLOS PACIFICA. 2007-01-03
PAR07U0001 PARKER, T. - EMAIL COMMUNICATION WITH R. BITTMAN REGARDING ARCTOSTAPHYLOS PACIFICA ON SAN BRUNO MOUNTAIN.
2007-04-16
ROO61S0007 ROOF, J. - ROOF SN JEPS #26639 1961-04-18
ROO62A0001 ROOF, J. - TWO NEW SPECIES OF ARCTOSTAPHYLOS FROM CALIFORNIA. LEAFLETS OF WESTERN BOTANY VOL. IX, NO'S 13,14. 1962-05-XX
SHA69S0001 SHARSMITH - SHARSMITH SN HERBARIUM UNKNOWN 1969-XX-XX
VAS80U0001 VASEY, M. - LETTER FROM MICHAEL VASEY TO ALICE HOWARD, 2 PP. 1980-02-26

All other reference materials support the above CNDDB form.

2015 Survey Results

The single individual of Pacific manzanita continues to persist in its current location with no sign of successful recruitment. Although this is characterized as one individual by McClintock et al. (1990), we observed two obvious domes, or humps, which seem to be linked to two main stems and are likely connected by roots. These may be two distinct plants that have grown together. For instance, CNDDB EO 3253 (above) notes there are "2 populations in a stand covering 8x9 meters." We currently estimate the polygon to be about 20 m^2. Additionally, EO 3253 indicates that population burned in 1974 and it "may have been larger," although it is unclear what this statement is based upon.

We observed approximately 25% dieback within this polygon, mostly located in the center of the polygon. Social trails abound in this area, and it is possible that these plants might be physically impacted by trampling from intrigued botanists and possibly other visitors (Plate AP-3). Maybe even more importantly, as more people visit these plants, there is a greater chance that a detrimental pathogen (such as *Phytophthora* spp.) could be introduced to the location. Intraspecific competition with other manzanitas (Plate AP-4) is present and may limit the vegetative spread of this polygon. Hybridization is also a concern since it is possible that the second plant (identified as the bulb found on the north end of the mapped polygon) is a hybrid (Nelson pers. com.).

Plate AP-3 (left): Social trails through the manzanitas at Pacific Rock may be impacting the plants. Plate AP-4 (below): SBM manzanita (left side of photo) competing with Pacific manzanita for resources.

Figure AP-1: 2015 distribution map of Pacific manzanita.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. Conservation of the occurrences of this plant on San Bruno Mountain is essential for the survival of this species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is high. This plant was observed in only one distinct location and was almost lost in 1964 to a fire. We recommend continual monitoring of all populations on a regular 5-year return interval and actively working towards growing a number of individuals ready for outplanting. We suggest installing permanent markers to measure plant dieback or expansion, rather than comparing GPS polygons.

Since this plant is mostly fire intolerant (although it did reproduce via lignotubers), we recommend experimenting with rooting woody cuttings grown in a soil-less system (such as 95% perlite/5% fresh compost by volume). Soilless systems greatly reduce risk of *Phytophthora* spp. infections, and have worked for other manzanitas at the Creekside Growing Facility. These plants could then be experimentally outplanted in a desirable location where unoccupied habitat exists. We recommend starting trials on the ridges of north facing slopes between the Summit and the Quarry.

Bearberry Manzanitas
Arctostaphylos uva-ursi (Linnaeus) Sprengel

There are 3 distinct formas of bearberry manzanita that occur on SBM. They all have the same parent taxonomic record of *Arctostaphylos uvva-ursi*, but are distinguished into 3 formas[2], a stable "form" of the plant which is not yet accepted as a subspecies or variety. The three formas which have been identified on SBM are a) f. *leobreweri*, b) f. *coactilis*, and c) f. *suborbiculata.*

Although the parent record is circumpolar and well distributed throughout the Northern hemisphere, each of the formas are unique with limited distributions. The three formas have a long and storied history which is well described in McClintock et al. (1980). At this point, McClintock et al. provides the most definitive description of these forms. Two of the three formas have been considered but rejected for California Rare Plant Ranking status, but despite this they are worthy of consideration as RTE plants on SBM.

Identification of bearberry manzanita, the parent taxon, requires a few diagnostic features: plants are prostrate (<0.6 m), plants typically do have a burl, even if not obvious, leaves typically only have stomata on the lower surface, leaf surface color and vestiture (hairs) are typically different on either side of the leaves, and the fruits are spherical (Plates AU – 1, 2,3). The taxanomic differences in the three formas are treated only briefly in this report. Forma *coactilis* and *suborbiculata* are nearly identical except *suborbiculata* has scattered lignotubers along the base of the stem. Forma *suborbiculata* has somewhat concave leaf blades, while f. *coactilis* leaf blades are flat to convex (see Plate AU-1 for convex blades). Forma *leobreweri* may have lignotubers at the base of branches. It also has light green colored, ovate-elliptic leaves that are typically flat (Plate AU-2).

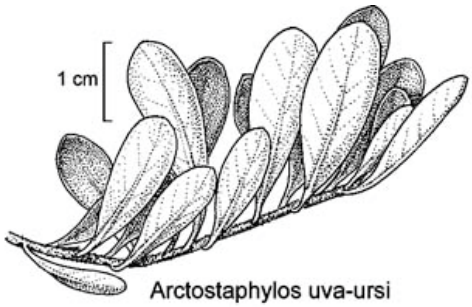


Plate AU-1 (left): forma *coactilis* at Roof Rock. Plate AU-2 (above right): forma *leobreweri* at West Quarry trail. Plate AU-3 (lower right): Line drawing © Regents of the University of California.

[2] "Forma" may be abbreviated as "f."

Description Jepson eFlora

Note, we present the *A. uva-ursi* parent record, since all the above-mentioned taxa are not recognized in the 2nd edition of the Jepson Manual.

NATIVE
Habit: Prostrate to mounded, 0.1--0.5 m; burled or not. Stem: twig (and nascent inflorescence axis) sparsely short-nonglandular-hairy, occasionally long-nonglandular- and/or short-glandular-hairy. Leaf: spreading; petiole 2--4 mm; blade 1--2.5 cm, 0.5--1.5 cm wide, oblanceolate to obovate, occasionally narrowly elliptic, abaxially light green, shiny, sparsely puberulent, in age glabrous, adaxially dark green, base wedge-shaped, tip obtuse, occasionally acute, margin entire, often cupped; stomata abaxial.Inflorescence: +- raceme, 0--1-branched; nascent inflorescence pendent, axis 0.3--1 cm, > 1 mm wide; bracts 2--6 mm, scale-like, narrowly deltate, acuminate, glabrous; pedicel 2--4 mm, glabrous. Flower: ovary glabrous. Fruit: 6--12 mm wide, spheric, glabrous; stones free. Chromosomes: 2n=26,52.
Ecology: Rocky outcrops, slopes, stabilized dunes, closed-cone conifer forest, grassy coastal headlands, chaparral, subalpine forest; Elevation: generally < 100 m (2400--3300 m in c SNH). Bioregional Distribution: NCo, c SNH (above Convict Lake, Mono Co), CCo; Distribution Outside California: to Alaska, Greenland, Virginia, Colorado, New Mexico; also Guatemala, circumboreal. Flowering Time: Jan--Jun
eFlora Treatment Author: V. Thomas Parker, Michael C. Vasey & Jon E. Keeley

Synonyms

Arctostaphylos uva-ursi f. *adenotricha* (Fernald & J.F. Macbr.) P.V. Wells*; Arctostaphylos uva-ursi* subsp. *adenotricha* (Fernald & J.F. Macbr.) Calder & Roy L. Taylor; *Arctostaphylos uva-ursi* f. *coactilis* (Fernald & J.F. Macbr.) P.V. Wells; *Arctostaphylos uva-ursi* subsp. *coactilis* (Fernald & J.F. Macbr.) Á. Löve, D. Löve; *Arctostaphylos uva-ursi* var. *coactilis* Fernald & J.F. Macbr.; *Arctostaphylos uva-ursi var. leobreweri* Roof; *Arctostaphylos uva-ursi* var. *marinensis* Roof; *Arctostaphylos uva-ursi* subsp. *monoensis* Roof.

CNDDB occurrence data, Herbarium collections, and previously known locations

Data for these plants are excluded since they likely warrant a research paper on their own. In fact, many of the herbarium reports need to be re-accessioned in order to ensure their accuracy.

2015 Survey Results

These three formas are remarkably resilient and static at the same time. Forma *suborbiculata* plants have survived catastrophic fire and resprouted from lignotubers. In contrast, the extant population of forma *leobreweri* only exists from cuttings that were taken by botanist and horticulturalist James Roof and propagated in a nursery prior to the 1964 fire. The four remaining plants were all outplanted after Roof's death in 1987 and continue to persist (although there is disagreement over whether 3 or 4 plants currently exist at this site). The plant populations are fairly static as their 2015 mapped distributions (Figure AU-1) match to about 80% overlap with previous TRA-MIG surveys. Although some fresh vegetative growth was observed in 2015 surveys, a new, significant population of *leobreweri* was relocated on a small ridge just west of the ridge with the known population (Figure AU-2). A follow-up survey by David Nelson allowed him to locate what looked like a nursery tag indicating that these plants were likely planted. Forma *leobreweri* is localized to only these two ridges and is the eastern-most of the formas. Notably, each forma is located in a specific geographical area on the mountain, and the forms are spatially separated by significant ridges.

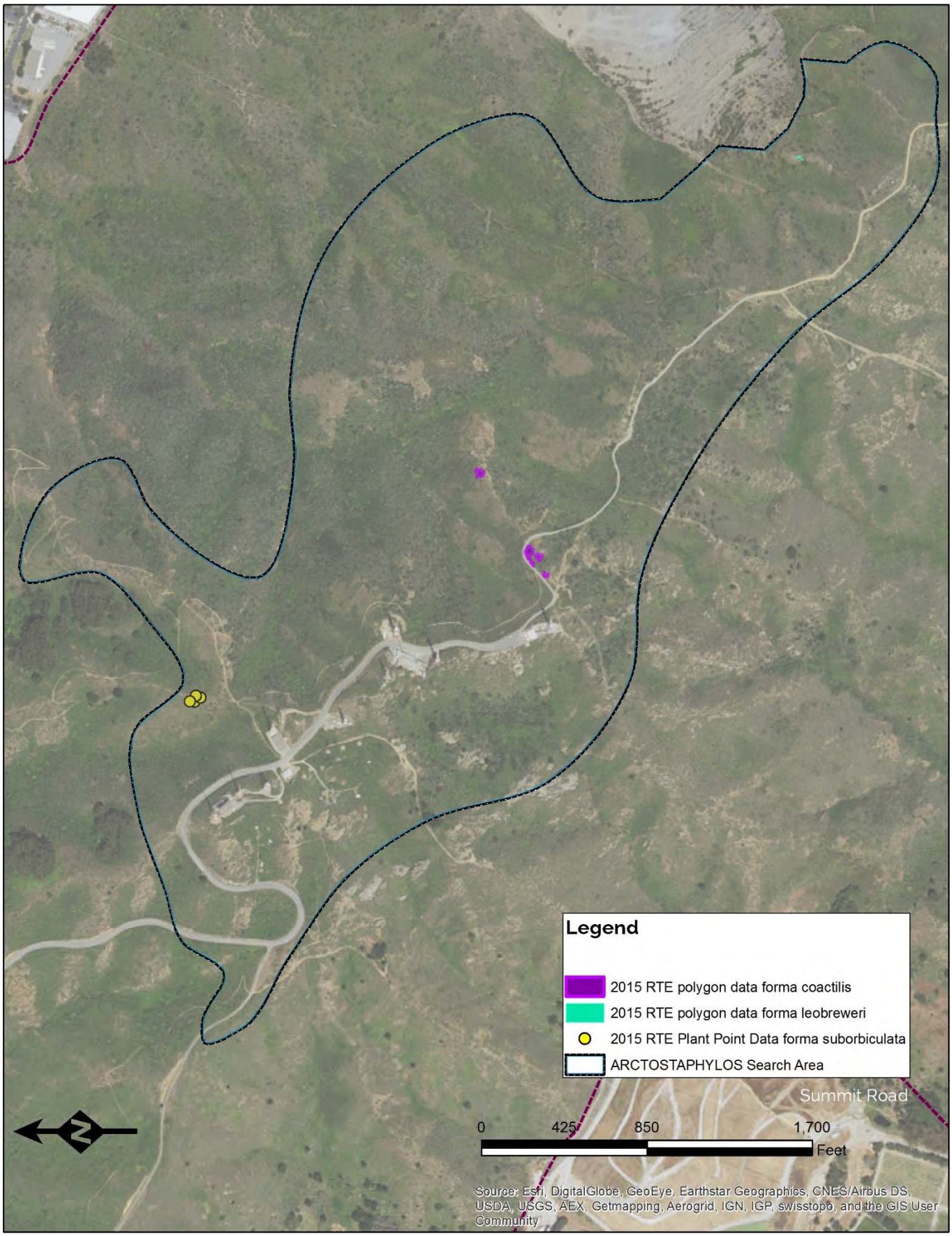


Figure AU-1: Overview of 2015 Survey results of *A. uva-ursi* on SBM.

Figure AU-2: 2015 Survey results of *A. uva-ursi* forma *leobreweri* and prior known distribution (TRA-MIG).

Forma *coactilis* is found near Pacific Rock and around the Ridge trail only a hundred feet away from the summit parking area (Figure AU-3). This forma was relocated in all but two of the previously mapped areas. It is possible that the plants found in the two polygons north of the trail are extant, but buried in deep northern coastal scrub and other vegetation. One notable new polygon was mapped which represents the western-most occurrence of this plant on the Mountain.

Forma *suborbiculata* represents the western-most form of this plant, located around Kamchatka Point (Figure AU-4). This plant was relocated and mapped as points due to the potential impact caused by mapping this plant in dense manzanita scrub. Therefore, it is difficult to compare to historic data, yet we can report that 4 notable polygons were located. A fifth occurrence, the western-most polygon, was not relocated and mapped. Due to the difficultly to surveying this area without causing significant damage (Plate AU-4), it is possible this plant may still be present in the understory of other chaparral vegetation.

Dieback, as typical with all manzanitas on SBM, was observed in all the formas to varying degrees. Typically, 10-30% of any given mound or plant would be characterized by dieback.

Figure AU-4: Typical stand of forma *suborbiculata* near Kamchatka Point where vegetation was very dense around the target plants.

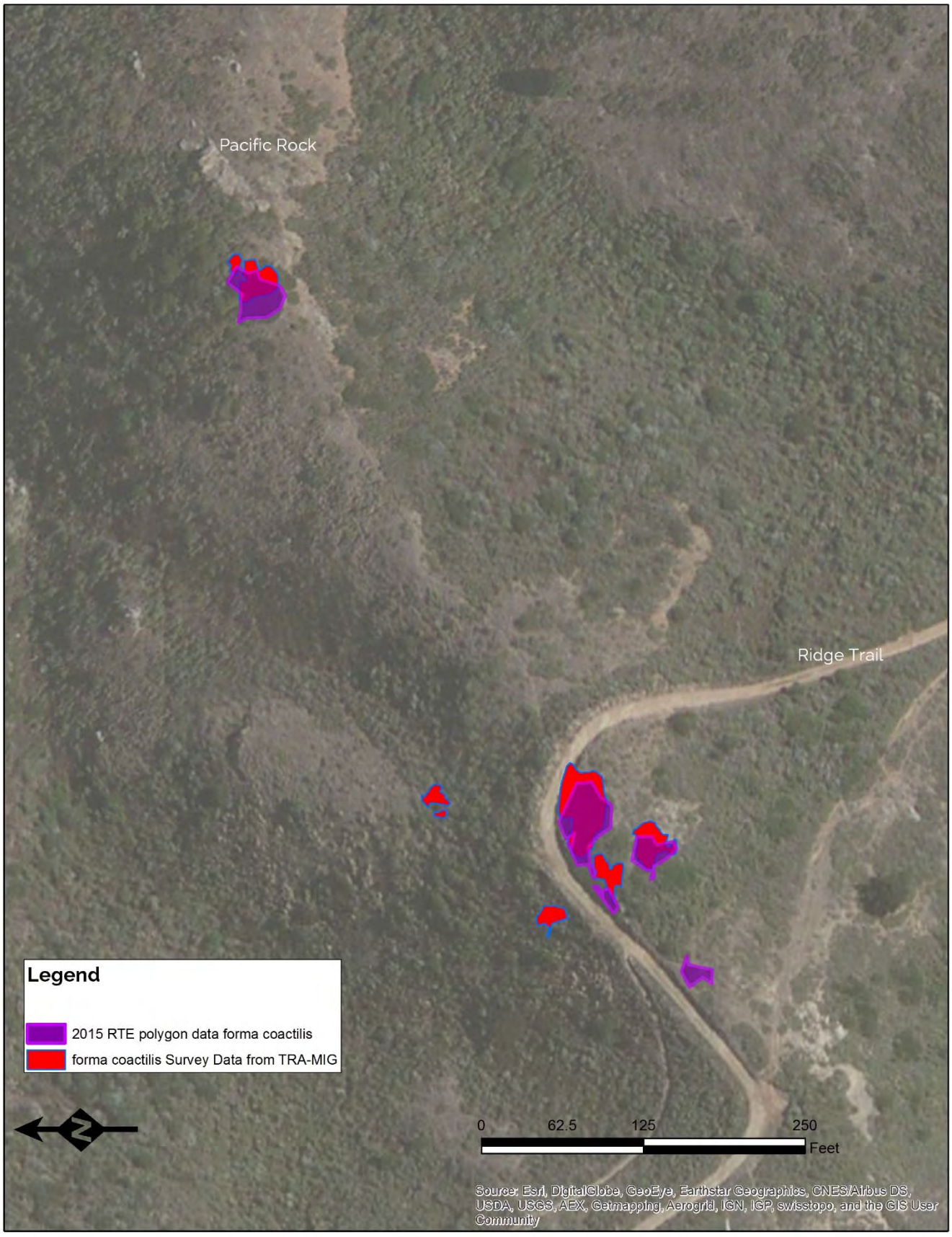


Figure AU-3: 2015 Survey results of *A. uva-ursi* forma *coactilis* and prior known distribution (TRA-MIG).

Figure AU-4: 2015 Survey results for f. *suborbiculata* and prior known distribution (TRA-MIG).

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. Although none of these three formas have official rare plant status, we recommend continued inclusion as more information about these taxa is learned.

Stewardship priority and management recommendations

Stewardship priority for these three taxa is high. We recommend continual monitoring of all distinct populations on a regular 5-year return interval and actively working towards growing a number of individuals ready for outplanting.

Since this plant is mostly fire intolerant (although forma *suborbiculata* did reproduce via lignotubers after fire), we recommend experimenting with rooting woody cuttings grown in a soil-less system (such as 95% perlite/5% fresh compost by volume). In fact, *A. uva-ursi* is well understood for its horticultural value (Schmidt 1980) so propagation should be possible with these formas. These plants could then be experimentally outplanted in a desirable location where unoccupied habitat exists. We recommend starting trials on the ridges of north facing slopes between the Summit and the Quarry, as well as other sites farther down the ridges away from existing populations. We recommend outplanting the formas separate from each other (by say ¼ mile or so) to reduce crosspollination between taxa, much like the way they are currently separated by several ridges.

San Francisco spineflower *Chorizanthe cuspidata* S. Watson

Spine-flower is a decumbent, late spring, early summer annual wildflower occurring on sandy, unconsolidated soils of SBM. Plants typically grow to 0.1 to 0.3m in height in colonies of varying density. The entirety of the population on SBM is restricted to the Daly City Dunes, located on the western end of the SBM HCP area. Notably, some of this population is located outside of the currently owned HCP lands.

Identification of spine-flower requires a few diagnostic characters: Plant is decumbent and low growing, often partially buried in sand that has blown on top of plant when in flower, or when actively growing. Inflorescence is spherical made up of many small pinkish to whitish flowers with awns (spines) at end of hairy sepals/petals (tepals). Awns are hooked at peak bloom (anthesis). Involucre is 6-ribbed with teeth which have a scarious margin.

Plate CC-1 (left): Typical plant in flower with many inflorescence clusters along stem. Plate CC-2 (right): Macro of flowers (sepals/tepals) with hooked spines (or awns). Plate CC-3 (below): Typical habitat of unconsolidated dunes where both spine-flower and San Francisco lessingia are located.

Synonyms

Chorizanthe cuspidata S. Watson*, Chorizanthe cuspidata* Wats. var. *cuspidata, Chorizanthe cuspidata* Wats. var. *marginata* Goodm.*, Chorizanthe cuspidata* Wats. var. *villosa* (Eastw.)*, Chorizanthe cuspidata* Wats.

Description Jepson eFlora

NATIVE
Habit: Plant decumbent to ascending, 0.5--10 dm diam, hairy. Inflorescence: bracts 2, awns 0.5--1.2 mm; involucre 3-angled, 6-ribbed, tube 1--3 mm, generally swollen, transversely ridged, teeth 6, 0.5--2 mm, generally without scarious margins, abaxial longest, awns 1--3 mm, hooked or straight. Flower: 1, 2--3 mm, hairy; perianth 2-colored, tube white, lobes white to rose, entire or 3-lobed and awned; stamens 9, fused to perianth tube base. Fruit: 2--3 mm.

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB
Map Index Number: 22873 EO Index: 56
Key Quad: San Francisco South (3712264) **Element Code:** PDPGN04081
Occurrence Number: 7 Occurrence Last Updated: 2014-09-05
Scientific Name: *Chorizanthe cuspidata var. cuspidata* **Common Name:** San Francisco Bay spineflower
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2T1
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL BLUFF SCRUB, COASTAL DUNES, COASTAL PRAIRIE,
COASTAL SCRUB.
CLOSELY RELATED TO C. PUNGENS. SANDY SOIL ON TERRACES
AND SLOPES. 3-215 M.
Last Date Observed: 1992-06-22 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1992-06-22 Occurrence Rank: Fair
Owner/Manager: CITY OF DALY CITY, PVT **Trend:** Unknown
Presence: Presumed Extant
Location:
"DALY CITY DUNES;" NORTH OF KENNEDY SCHOOL, DALY CITY.
Detailed Location:
OFF OF GUADALUPE CANYON PARKWAY IN COLMA CANYON, NORTH OF PRICE STREET AT BONNIE STREET.
Ecological:
OPEN, LOOSE SAND TERRACES WITH BACCHARIS PILULARIS, ERIOGONUM LATIFOLIUM, LESSINGIA GERMANORUM, LUPINUS CHAMISSONIS,
PHACELIA CALIFORNICA, SOLIDAGO, AND BRACKEN.
Threats:
SLOPE HAS BEEN BENCHED AND A SLIDE AREA WORKED BY TRACTORS (1990?) AND SEEDED WITH WEEDY SPP, PAMPAS GRASS, ETC.
General:
1000+ PLANTS OBSERVED IN 1992. SITE MAY BE WITHIN HILLSIDE PARK (DALY CITY) OR POSSIBLY PRIVATELY OWNED. COLLECTIONS FROM
"COLMA" AND "COLMA CANYON" ARE ALSO ATTRIBUTED TO THIS SITE.
PLSS: T03S, R05W, Sec. 06 (M) **Accuracy:** specific area **Area (acres):** 7
UTM: Zone-10 N4172286 E547994 **Latitude/Longitude:** 37.69655 / -122.45558 **Elevation (feet):** 400
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
ABR01S0039 ABRAMS, L. - ABRAMS #1603 DS #105964, POM #87940 1901-05-11
DUD01S0015 DUDLEY, W. - DUDLEY SN DS #110198 1901-05-11
MCC65S0003 MCCLINTLOCK, E. - MCCLINTLOCK SN CAS #520405 1965-06-13
MCC88S0001 MCCLINTOCK, E. & P. REEBERG - MCCLINTOCK SN CAS #1024522 1988-06-07
SMI92F0004 SMITH, S. - FIELD SURVEY FORM FOR CHORIZANTHE CUSPIDATA VAR. CUSPIDATA 1992-06-22

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS1024522	Chorizanthe cuspidata var. cuspidata	Elizabeth McClintock, Paul Reeberg	June 7, 1988	s.n.	San Mateo	lower Colma Canyon. San Bruno Mountains
CAS520405	Chorizanthe cuspidata var. cuspidata	Elizabeth McClintock	6/13/65	s.n.	San Mateo	Colma Canyon. San Bruno Mountain
DS110198	Chorizanthe cuspidata var. cuspidata	W. R. Dudley	May 11, 1901	s.n.	San Mateo	near Colma. Santa Cruz Mountain Peninsula
POM87940	Chorizanthe cuspidata var. marginata	L. R. Abrams	May 1901	1603	San Mateo	Colma

2015 Survey Results

Our July 1, 2015 survey for this plant covered the sandy areas at the Daly City Dunes and adjacent areas of sandy habitat (Figure CC-1). We estimated between 2,000 and 5,000 plants growing in the Daly City/Colma Dunes area. Although there is an adjacent slope to the east, plants were not located on this slope likely due to the consolidated nature of the slope. This location and these results concur with previous CNDDB and herbarium records. Notably, the size of the population surveyed is larger than previously recorded, despite large scale grading and disturbance that is referenced in EO 56, although this CNDDB record was updated recently in 2014.

Of considerable importance is that about 50% of the known population of this plant occurs outside of HCP land, on privately owned properly that isn't signed for trespass. Therefore, it is easy to mistake this area as protected under the HCP since boundaries are not easy to discern in the field.

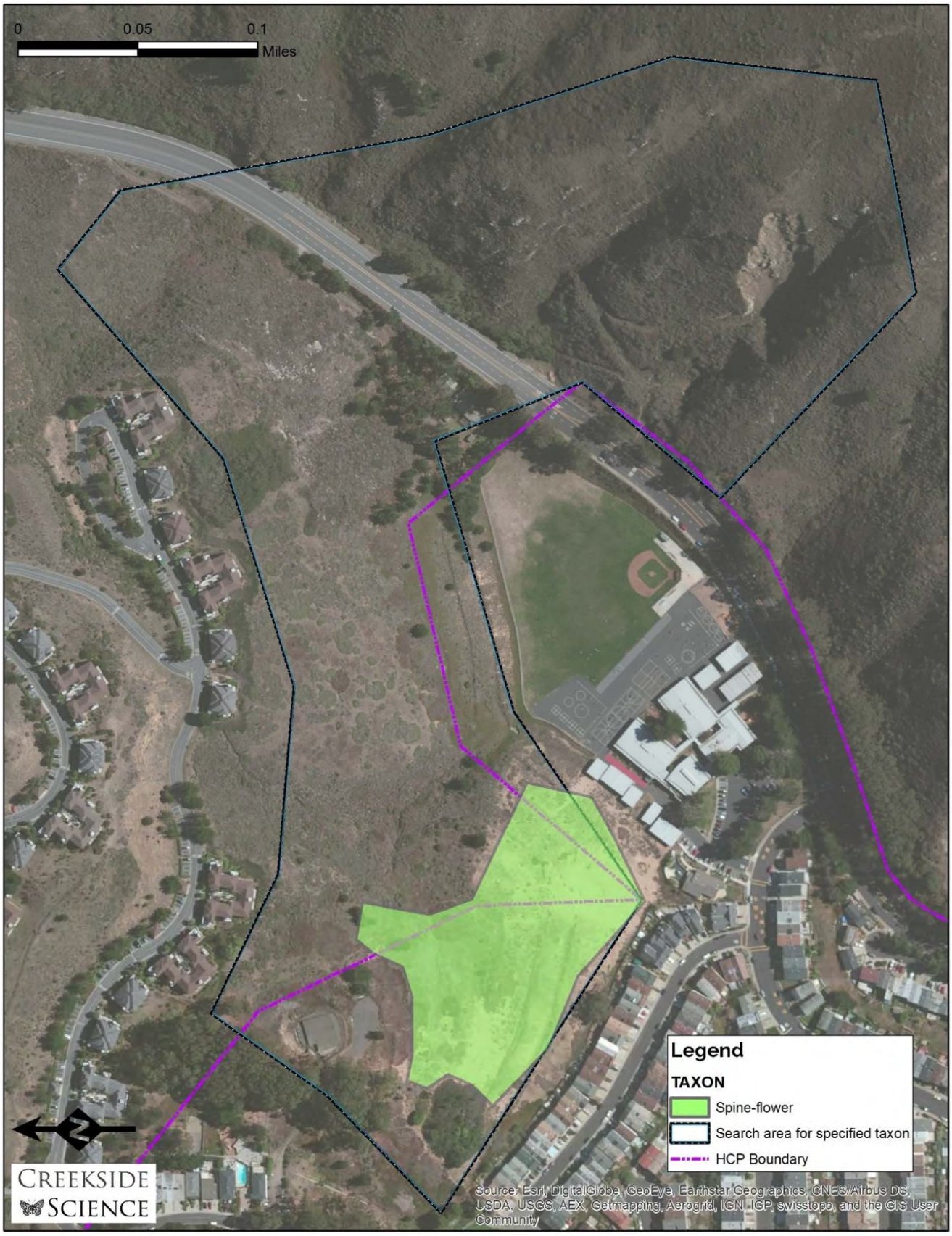


Figure CC-1: Spine-flower distribution on Daly City Dunes. Note that the density of the plants varied across the polygon, with some dense areas with about 25 plants/m^2 to other areas with < 1 plant/m^2.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. Any sandy outcrops and soils should be noted and protected for management of this taxon.

Stewardship priority and management recommendations

Stewardship priority for this taxon is high. This plant was observed on Daly City Dunes and should be resurveyed once every 2-4 years. We recommend a wider survey interval because the expression of this plant (germination/survivorship) is greatly influenced by annual weather. It may be best to resurvey in a year with above-average precipitation.

The best possible step for the conservation of this population is the acquisition of the adjacent occupied land. As stated above, much of the occupied land seems to be outside of the HCP lands.

An adjacent slope, just east of the occurrence was likely historically occupied by spine-flower. Although the vegetation is dominated by larger shrubs, allowing for less sand movement, the preferred substrate for this plant is present. We recommend two management actions: 1) control and remove weeds in and around occupied polygon on Daly City Dunes. Disturbance seems to improve habitat by increasing sand movement and decreasing competition. 2) Clear vegetation from 20-50 m^2 areas (blocks, although we don't recommend they are angular in shape, but rather more natural) on the adjacent east slope. These areas should be hand seeded with seeds collected from the adjacent population.

San Francisco Collinsia *Collinsia multicolor* Lindl. & Paxton

San Fancisco collinsia is a Bay Area endemic plant that occurs from San Francisco to Monterey. This is a 0.3-0.5 meter-tall annual wildflower with a unique two-tone white and purple corolla dotted with purple spots just above the corolla throat in the white banner petals. This taxon notably has only one to few flowers on an inflorescence, rather than a densely packed head (whorl) of flowers observed in many species of Chinese houses. The plant prefers north-facing, cool slopes with some rock component where competition is reduced. This plant typically flowers March through May and can most easily be spotted during flowering.

Identification of San Francisco Collinsia requires a few diagnostic characters: flowers appear singly or in 2-4's, but not whorled or dense, pedicle is typically longer than the calyx, leaves are typically coarsely toothed (dentate), and triangular in shape (deltate). Pedicles (most easily seen in proximal flowers) are at least 1.5x the length of the calyx (Plates CM-1, 2, 3, 4).

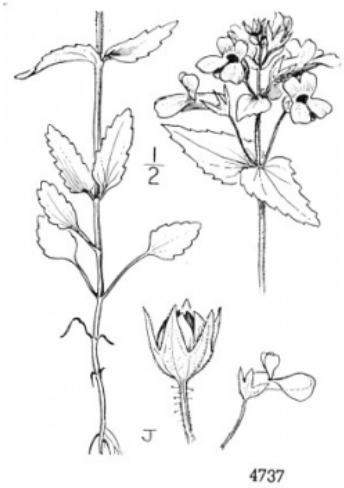


Plate CM-1 (top left): Representative plant at Boneyard Quarry, growing in large talus scree field. Plate CM-2 (top right): Deltate, serrated leaves of plant in Brisbane acres area. Plate CM-3 (bottom left): Macro of corollas showing few flowers per inflorescence and long pedicles. Plate CM-4 (bottom right): Drawing from Abrams.

Synonyms

Collinsia franciscana Bioletti, *Collinsia multicolor* Lindl. & Paxt, *Collinsia sparsiflora* F. & M. var. *franciscana* (Bioletti) Jeps.

Description Jepson eFlora

NATIVE
Habit: Plant generally 30--60 cm. Stem: loosely branched, weak. Leaf: middle and distal clasping, +- lance-deltate, generally coarsely toothed. Inflorescence: +- glandular-clammy; proximal-most pedicels 1--2 per node, >> calyx, distal pedicels 3+ per node, +- crowded, +- = calyx. Flower: calyx lobe tips acute; corolla 12--18 mm, throat longer than wide, pouch rounded, not prominent, upper lip +- white, not or faintly dotted and lined, lower lip lavender to blue-purple, lateral lobes obovate, notched, lowest lobe sometimes sparsely hairy; upper filaments hairy, basal spur 0--0.5 mm. Seed: 8+, +- plump.
Ecology: Moist, +- shady scrub, forest; Elevation: < 300 m. Bioregional Distribution: n&c CCo, SnFrB (San Mateo Co.). Flowering Time: Mar--May
eFlora Treatment Author: Michael S. Park & Elizabeth Chase Neese

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB
Map Index Number: 56870 EO Index: 56886
Key Quad: San Francisco South (3712264) **Element Code:** PDSCR0H0B0
Occurrence Number: 20 Occurrence Last Updated: 2004-09-21
Scientific Name: *Collinsia multicolor* **Common Name:** San Francisco collinsia
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists: SB_RSABG-Rancho Santa Ana Botanic Garden
General Habitat: Micro Habitat:
CLOSED-CONE CONIFEROUS FOREST, COASTAL SCRUB. ON DECOMPOSED SHALE (MUDSTONE) MIXED WITH HUMUS; SOMETIMES ON SERPENTINE. 30-250 M.
Last Date Observed: XXXX-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: XXXX-XX-XX Occurrence Rank: Unknown
Owner/Manager: SMT COUNTY? Trend: Unknown
Presence: Presumed Extant
Location: COLMA CANYON, SAN BRUNO MOUNTAIN COUNTY PARK.
Detailed Location:
EXACT LOCATION UNKNOWN. MAPPED AS BEST GUESS BY CNDDB, IN THE VICINITY OF COLMA CANYON, IN THE NW CORNER OF SAN BRUNO MOUNTAIN COUNTY PARK.
Ecological:
Threats:
General: ONLY INFORMATION FOR THIS SITE IN REFERENCE TO SITE IN 1990 "A FLORA OF THE SAN BRUNO MOUNTAINS".
PLSS: T03S, R05W, Sec. 06 (M) **Accuracy:** 2/5 mile **Area (acres):** 0
UTM: Zone-10 N4172448 E548235 **Latitude/Longitude:** 37.69799 / -122.45284 **Elevation (feet):** 500 San Mateo San Francisco South (3712264)
SOURCE: MCC90B0001 MCCLINTOCK, E. ET AL. - A FLORA OF THE SAN BRUNO MOUNTAINS 1990-XX-XX

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS28132	Collinsia multicolor	Dr. E Goodman	May 23 1922	s.n.	San Mateo	San Bruno hills
CAS28133	Collinsia multicolor	Alice Eastwood	May 4, 1918	6883	San Mateo	San Bruno hills, San Francisco

CAS528824	Collinsia multicolor	Walter Knight, Irja Knight	May 4, 1964	s.n.	San Mateo	San Bruno Mountain. Colma Canyon
CAS528833	Collinsia multicolor	Walter Knight, Irja Knight	4/4/65	1014	San Mateo	San Bruno Mountain. Bitter Cherry Ravine
CAS528834	Collinsia multicolor	Elizabeth McClintock	3/28/65	s.n.	San Mateo	San Bruno Mountain. In Devil's Arroyo
CAS528989	Collinsia multicolor	Elizabeth McClintock	3/21/65	s.n.	San Mateo	San Bruno Mountain. On north side of mountain 1/2 mi. east of Brisbane power lines
DS309716	Collinsia multicolor	Reed C. Rollins	March 22, 1941	2953	San Mateo	San Bruno Hills, 2 miles southeast of Daly City
DS63582	Collinsia multicolor	A. A. Heller	April 25, 1907	8463	San Mateo	San Bruno Hills
DS749941	Collinsia multicolor	Reed C. Rollins	April 30, 1942	3019	San Mateo	San Bruno Hills, 1 mile south of Daly City
GH365611	Collinsia multicolor	R. C. Bacigalupi	1957-05-05	5855	San Mateo	San Bruno Hills, 1 mile south of Daly City
GH365614	Collinsia multicolor	A. A. Heller	1907-04-25	8463	San Mateo	on the western end of the San Bruno hills
GH365615	Collinsia multicolor	R. C. Rollins	1941-03-22	2953	San Mateo	San Bruno Hills, 2 miles southeast of Daly City
JEPS121051	Collinsia multicolor	Janell M. Hillman	29 April 2012		San Mateo	San Bruno Mountain.
JEPS17741	Collinsia multicolor	A. Paul Martin	May 23 1957		San Mateo	San Bruno Hills, at upper edge of town of Brisbane Brisbane; San Bruno Hills, Brisbane
RSA296437	Collinsia multicolor	A. Martin	May 23 1957	s.n.	San Mateo	Upper edge of the town Brisbane, SW slope of San Bruno Hills

SD120833	Collinsia multicolor	A. Paul Martin	May 23, 1957	None	San Mateo	Northern San mateo County; upper edge of town of Brisbane, southeastern slopes of San Bruno Hills
UC676737	Collinsia multicolor	Reed C. Rollins	Mar 22 1941	2953	San Mateo	2 mi se of Daly City (San Bruno Hills); San Bruno Hills

McClintock et al. & Allshouse and Nelson

McClintock notes the plant as: Occasional, open grassy or brushy areas: Colma Canyon, Bitter Cherry Ravine, Devil's Arroyo, ravine on north-facing slope east of the East Powerline, above Harold Rd. Allshouse and Nelson have located the plant at Owl Canyon, Brisbane Acres above Margaret Ave., and Boneyard Quarry.

TRA/MIG Surveys

Collinsia GIS data was not located from TRA/MIG files.

2015 Survey

Two occurrences of this plant were located in the 2015 survey, but we expect for this plant to be present in other areas (Figure CM-1). Notably, this small annual can be difficult to locate even when in full bloom. Not regarded as a great competitor, this plant often grows among other dense vegetation (as noted in the Brisbane location).

A total of 500 plants were estimated at the Boneyard Quarry location (bottom map, Figure CM-1). Plants grew in a talus field where plants regularly occupied crevices in rocks in areas otherwise devoid of vegetation (Plate CM-5). One notable disjunct patch of 10 plants was located above the main polygon. The second notable location where 20 plants were located was near just east of Brisbane ridge in a cool, north facing canyon in dense northern coastal scrub (top map, Figure CM-1).

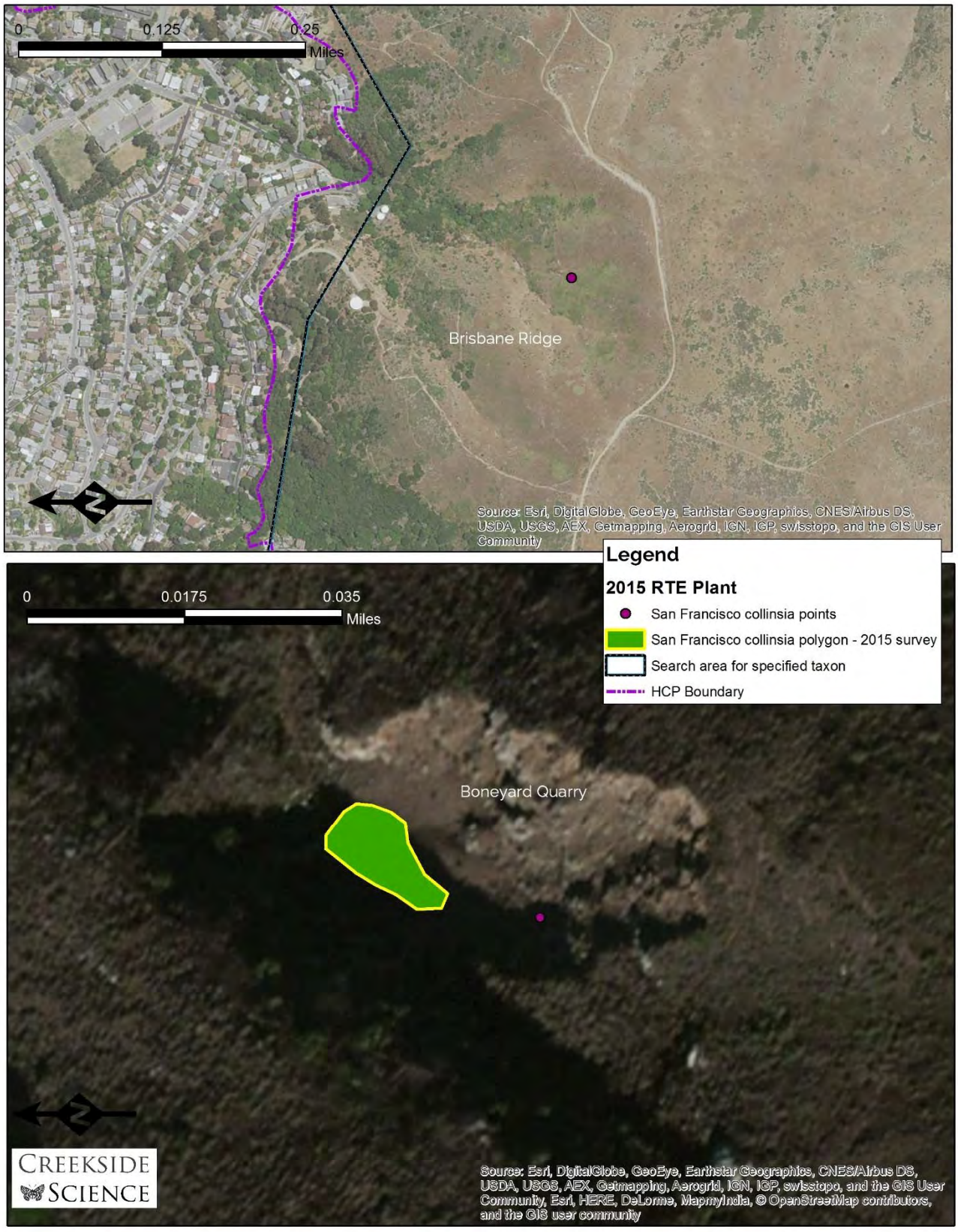


Figure CM-1: Top map shows location in Brisbane acres area, bottom map shows location in Boneyard Quarry with one disjunct location of 10 plants. Please note that the background aerial image is not ideal in this figure since there are long shadows cast into the Boneyard quarry making it difficult to see.

Plate CM-5: Typical habitat of San Francisco Collinsia in the Boneyard Quarry. Plants were observed growing through the talus.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is high. This plant was observed in two locations: one was a stony fell-field near the old quarry where little competition was present, and the second was in established northern coastal scrub where competition was vigorous and soil organic matter was high. We recommend continual monitoring of both populations on a regular 3-year return interval since it is an annual.

We also recommend resurveying other historic sites for collinsia. Since three species of collinsia are presently documented on San Bruno Mountain, it would be instructive to make sure they have all been properly identified.

We also recommend experimentation with direct seeding. We recommend a pilot project including the collection of 5% of seeds from plants totaling approximately 200 seeds. Seed should be dispersed in fall after first major rain, into a nearby talus slope that is currently devoid of collinsia to see if plants will get established easily in a new location. We recommend a minimum seeding rate of 50 seeds/m^2 allowing for the establishment of 4 m^2 test areas. Given this plant is difficult to locate in other parts of the mountain, often because of dense vegetation, vegetation management around this plant needs to proceed with great caution.

San Francisco Wallflower *Erysimum franciscanum* var. *franciscanum* Rossbach

San Francisco wallflower is a biennial or short-lived perennial wildflower found typically within 20 miles of the coast from Mendocino County to Monterey County. This plant typically flowers from February to May and can have a corolla color varying from cream to gold to orange. Often considered a subshrub despite its size (usually < 0.5 meters), the basal portion of the stem can become woody with time. This plant is often associated with rock outcrops, but it can be found in a variety of settings including northern coastal scrub and deeper loamy soils.

Identification of San Francisco wallflower requires only a few diagnostic characters since it is a fairly unique taxon: majority of linear-lanceolate leaves tend to occur in obvious basal rosette, leaves are dentate, flowers occur in terminal racemes. Typically one to many inflorescences are found per plant, likely depending on the age of the plant and the resource availability for the year. Fruits are a long, linear silique (Plates EF-1 and 2).

Plate EF-1 (left): Line drawing from Flora of North America. Plate EF-2 (above): Typical fruits with seeds still attached. Plate EF-3 (below): Plant in anthesis with dense cluster of flowers at top of racemed inflorescence.

Synonyms

Erysimum franciscanum var. *crassifolium* Rossbach; *Erysimum franciscanum* var. *franciscanum*

Description Jepson eFlora

NATIVE
Habit: Subshrub. Stem: 0.6--5(6) dm, base woody. Leaf: (2)3--16(20) mm wide, oblanceolate to oblanceolate-linear, flat; hairs 2--3(5)-rayed. Flower: sepals 8--12(15) mm; petals 14--29 mm, 5--12(15) mm wide, yellow to cream, claw 9--17 mm. Fruit: (3.8)4--11(14) cm, 2--4 mm wide, flat parallel to septum, not constricted between seeds (+- constricted); valves outside with (2)3(4)-rayed hairs, inside glabrous, midvein +- distinct; style 0.5--3.5 mm; pedicels spreading to ascending, 5--17(22) mm. Seed: 32--64, 2--3.5(4) mm, oblong; wing at tip, narrow along 1 or both sides. Chromosomes: 2n=36.
Ecology: Serpentine outcrops, coastal scrub or sand dunes, granitic hillsides; Elevation: < 500 m. Bioregional Distribution: NCo, n&c CCo, SnFrB. Flowering Time: Jan--Apr
Synonyms: Erysimum franciscanum var. crassifolium Rossbach; Erysimum franciscanum var. franciscanum
eFlora Treatment Author: Ihsan A. Al-Shehbaz

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

N/A

Herbarium

A total of 53 entries with the keyword “Bruno” were located for San Francisco wallflower. This plant has been well collected and observed in many locations on SBM.

McClintock et al. & Allshouse and Nelson

McClintock notes the plant as: occassional, open, rocky, or grassy slopes: lower Colma Canyon, below Summit, Quarry, East Powerline near Ridge Trail, Buckeye Canyon and Randolph Ave. Allshouse and Nelson note distribution as “all trails, profuse in certain years.”

2015 Survey

San Francisco wallflower was the most well-distributed plant surveyed for this RTE project (Figure EF-1). Often it would be found in rock outcrops, while other times it would be located in and among shrubs, dense north coastal vegetation and in the middle of large swaths of grassland. We anticipate that our survey has only detected a small portion of the plants on the mountain. Since this plant was so regularly encountered, instead of mapping polygons, we simply took points and population estimates. San Bruno Mountain might be considered the core habitat for this plant.

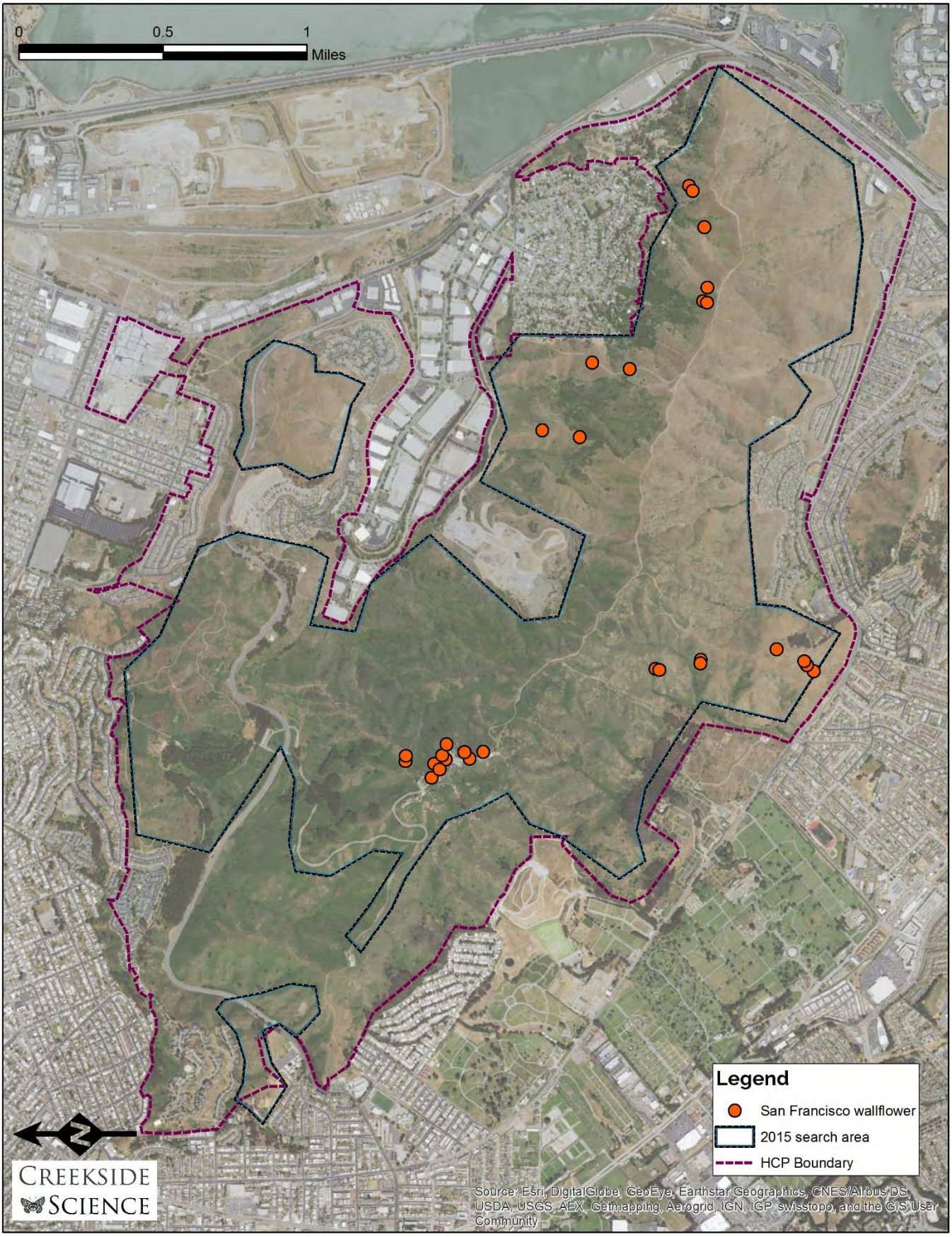


Figure EF-1: Distribution of San Francisco wallflower from 2015 surveys.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is medium. This plant was observed in multiple locations and is one of two of the most well distributed RTE plants surveyed. At this point in time, there are no critical management recommendations. Collection and relocation of seed to unoccupied rock outcrops to observe effectiveness of direct seeding may be instructive for future conservation efforts and may constitute a good volunteer project before more rare taxa are studied.

San Francisco Gum Plant
Grindelia hirsutula Hook. & Arn. Var. *maritima* (E.Greene) M.A. Lane

San Francisco Gum Plant is a taxon which is not accepted as valid in the second edition of the Jepson manual, and is described as a CRPR List 3 plant, indicating that taxonomically it is under review. San Francisco gum plant is a perennial forb in the Asteraceae family that is coastally restricted and typically starting to flower in June. This is an important characteristic for identification.

Identification of this taxon is difficult. *G. hirsutula* var. *maritima* is discerned from *G. camporum* (which also occurs on SBM) by the reddish stem color (along entire stem) of *G. maritima*, generally *maritima* is without a varnished/shiny look on leaves and other plant features, and the spiny, glabrous inflorescence head (receptacle) of *camporum* which has pronounced reflexed (and often wavy) phyllaries even before flowering (Plate GH-1). *Maritima* was discerned from other varieties of *G. hirsutula* by the following traits: phyllaries are erect or ascending and acute (but not acuminate), involucres are large (> 12mm in diameter) and fruit is generally golden or greyish and deeply ridged (Plates GH-1,2,3). *G. camporum* tends to flower before *G. hirsutula* by at least one month, but usually two months.

Plate GH-1 (top left): *G. camporum* head © 2008 Keir Morse. Plate GH-2 (middle left): San Francisco gum plant inflorescence, hirsute, not shiny but without red stem, possibly a hybrid. Plate GH-3: SF gum plant from Presidio, SF which is hirsute, red-stemmed and showing typical phyllaries for the taxon. Plate GH-4 (bottom): SF gumplant with woody caudex, typically not observed flowering until June.

Synonyms

G. maritima: G. hirsutula var. *maritima*; *G. maritima* (Greene) Steyermark; *G. rubricaulis* var. *maritima*

Description eFloras.org

G. hirsutula **- Perennials or subshrubs** (sometimes flowering first or second year), 8–60(–250+) cm. **Stems** usually erect, sometimes prostrate, decumbent, or ascending, usually green to stramineous, brown, or reddish, sometimes whitish, arachnose, hirsutulous, puberulous, or villous (sometimes stipitate-glandular as well), or glabrous (then often resinous).**Cauline leaf blades** usually oblong, oblanceolate, or spatulate (broadest at or beyond their midpoints), sometimes ovate, lanceolate, or linear, (5–)10–80(–120+) mm, lengths 2–8+ times widths, bases clasping or cuneate, margins usually serrate to dentate (teeth apiculate to setose), sometimes entire, apices truncate, rounded, or obtuse to acute, faces hirsutulous, puberulous, or villous and little, if at all, gland-dotted, or glabrous (or scabridulous near margins) and sparsely to densely gland-dotted. **Heads** usually in open to crowded, corymbiform to paniculiform arrays, seldom borne singly. **Involucres** usually broadly urceolate to globose, sometimes hemispheric, campanulate, or obconic, (6–)8–15(–20) × (6–)10–25+ mm (sometimes subtended by leaflike bracts). **Phyllaries** in 4–8+ series, reflexed to spreading or appressed, filiform or linear to ± lance-attenuate, lanceolate, or lance-oblong, apices usually recurved or straight, sometimes (the outer) looped to hooked or patent, terete or filiform to subulate, or acute, usually all glabrous and moderately to strongly resinous, sometimes all or outer villosulous to hirsutulous and little, if at all, resinous, seldom, if ever, stipitate-glandular. **Ray florets** 0 or (5–)15–60+; laminae (4–)10–25+ mm. **Cypselae** whitish or stramineous to brownish or grayish, (2–)4–6(–7) mm, apices usually ± knobby, sometimes coronate, rarely smooth, faces usually smooth, striate, or furrowed, rarely rugose; **pappi** of 2–3(–6) usually contorted or curled, sometimes straight, usually smooth, rarely barbellulate, subulate scales or setiform awns (1–)4–5(–7) mm, usually shorter than, rarely nearly equaling disc corollas. **2*n*** = 12, 24.

maritima - stems ascending, 30–80 cm, openly branched, involucres 12–25 mm diam., phyllary apices slightly recurved to nearly straight, cypselae golden or grayish, lengths of pappi ± $^1/_2$ disc corollas; coastal central California. M. A. Lane (1993b) suggested that *maritima* may have derived from hybridization between *hirsutula* and *platyphylla*.

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08768 EO Index: 16939
Key Quad: San Francisco South (3712264) Element Code: PDAST470D3
Occurrence Number: 18 Occurrence Last Updated: 1996-01-10
Scientific Name: Grindelia hirsutula var. maritima Common Name: San Francisco gumplant
Listing Status: Federal: None Rare Plant Rank: 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1988-06-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1988-06-XX Occurrence Rank: Unknown
Owner/Manager: SFO CITY/COUNTY Trend: Unknown
Presence: Presumed Extant
Location:
SLOPE ATOP CLIFFS ABOVE O'SHAUGHNESSY BLVD NEAR MARIETTA AVE, SAN FRANCISCO.
Detailed Location:
Ecological:
IN NORTH COASTAL SCRUB PLANT COMMUNITY ON CLIFFS IN FRANCISCAN RADIOLARIAN CHERT.
Threats:
PORTION OF AREA PROPOSED FOR HOUSING DEVELOPMENT.
General:
FEWER THAN 10 PLANTS SEEN.
PLSS: T02S, R05W, Sec. 19 (M) Accuracy: 1/5 mile Area (acres): 0
UTM: Zone-10 N4177012 E548975 Latitude/Longitude: 37.73909 / -122.44414 Elevation (feet): 600
San Francisco San Francisco South (3712264)
SIG88F0005 SIGG, J. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1988-06-XX

Map Index Number: 08776 **EO Index:** 16937
Key Quad: San Francisco South (3712264) **Element Code:** PDAST470D3
Occurrence Number: 19 **Occurrence Last Updated:** 1995-12-11

Scientific Name: *Grindelia hirsutula var. maritima* **Common Name:** San Francisco gumplant
Listing Status: Federal: None **Rare Plant Rank:** 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1988-06-XX **Occurrence Type:** Natural/Native occurrence
Last Survey Date: 1988-06-XX **Occurrence Rank:** Unknown
Owner/Manager: CITY OF SF-PARKS DEPT **Trend:** Unknown
Presence: Presumed Extant
Location:
E EDGE OF GLEN CYN PARK, SAN MIGUEL HILLS, SAN FRANCISCO.
Detailed Location:
Ecological:
ON HEAVILY DISTURBED SLOPE DOMINATED BY EXOTIC GRASSES.
Threats:
EXOTIC GRASSES THREATEN.
General:
1 PLANT FOUND. AREA HAS A HISTORY OF CONTROLLED JUNE BURNS.
PLSS: T02S, R05W, Sec. 20 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4177198 E549121 **Latitude/Longitude:** 37.74076 / -122.44247 **Elevation (feet):** 500

San Francisco San Francisco South (3712264)

SIG88F0004 SIGG, J. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1988-06-XX

Map Index Number: 08559 **EO Index:** 13204
Key Quad: San Francisco South (3712264) **Element Code:** PDAST470D3
Occurrence Number: 16 **Occurrence Last Updated:** 1995-12-11
Scientific Name: *Grindelia hirsutula var. maritima* **Common Name:** San Francisco gumplant
Listing Status: Federal: None **Rare Plant Rank:** 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1983-09-12 **Occurrence Type:** Natural/Native occurrence
Last Survey Date: 1985-09-08 **Occurrence Rank:** Fair
Owner/Manager: NPS-GGNRA **Trend:** Unknown
Presence: Presumed Extant
Location:
FORT FUNSTON, SAN FRANCISCO, APPROX 100 YDS SOUTH OF JCT SKYLINE BLVD & LAKE MERCED BLVD.
Detailed Location:
Ecological:
AT BASE OF STEEP SANDY BLUFF, AT BACKSIDE OF BLUFF (EAST-FACING). ASSOCIATED WTIH BACCHARIS PILULARIS SSP. PILULARIS, HAPLOPAPPUS ERICOIDES, PTERIDIUM AQUILINUM, AND LUPINUS SP.
Threats:
THREATENED BY ENCROACHMENT OF SEVERAL SPECIES OF ICE PLANT.
General:
NO PLANTS FOUND IN 1985.
PLSS: T02S, R06W, Sec. 27 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4175287 E543748 **Latitude/Longitude:** 37.72381 / -122.50357 **Elevation (feet):** 100
San Francisco San Francisco South (3712264)

BIT86U0014 BITTMAN, R. - ELEMENT CONSERVATION PLAN 1986-12-XX
CUL83F0004 CULLIGAN, K. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1983-09-12
SIG85F0011 SIGG, J. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1985-09-08

Map Index Number: 08774 EO Index: 16947
Key Quad: San Francisco South (3712264) Element Code: PDAST470D3
Occurrence Number: 10 Occurrence Last Updated: 1989-08-11
Scientific Name: Grindelia hirsutula var. maritima Common Name: San Francisco gumplant
Listing Status: Federal: None Rare Plant Rank: 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.

SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1961-08-27 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1961-08-27 Occurrence Rank: Unknown
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MTN IN NORTH PART OF SAN MATEO CO.
Detailed Location:
Ecological:
IN NORTH COASTAL SCRUB WITH BACCHARIS PILULARIS, ERIGERON GLAUCUS, SCROPHULARIA CALIFORNICA, AND SIDALCEA MALVIFLORA.
1000-1300 FT ELEVATION.
Threats:
General:
PLSS: T03S, R05W, Sec. 05 (M) Accuracy: 1 mile Area (acres): 0
UTM: Zone-10 N4172021 E549299 Latitude/Longitude: 37.69409 / -122.44080 Elevation (feet): 1,000
San Francisco, San Mateo San Francisco South (3712264)
THO61S0001 THOMAS, J.H. - THOMAS #9707 CAS, DS 1961-08-27

Map Index Number: 08721 **EO Index:** 16948
Key Quad: San Francisco South (3712264) **Element Code:** PDAST470D3
Occurrence Number: 9 **Occurrence Last Updated:** 1989-08-11
Scientific Name: *Grindelia hirsutula var. maritima* **Common Name:** San Francisco gumplant
Listing Status: Federal: None **Rare Plant Rank:** 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1988-06-XX **Occurrence Type:** Natural/Native occurrence
Last Survey Date: 1988-06-XX **Occurrence Rank:** Unknown
Owner/Manager: UNKNOWN **Trend:** Unknown
Presence: Presumed Extant
Location:
CROCKER AVE (SAN BRUNO MTN).
Detailed Location:
Ecological:
IN BACCHARIS SCRUB GRASSLAND WITH GORSE.
Threats:
General:
FEWER THAN 50 PLANTS SEEN IN 1988. PLANTS FIRST REPORTED HERE IN 1967.
PLSS: T03S, R05W, Sec. 06 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4172752 E547947 **Latitude/Longitude:** 37.70075 / -122.45609 **Elevation (feet):** 700

San Mateo San Francisco South (3712264)

MCC67S0001 MCCLINTOCK, E. - MCCLINTOCK SN CAS 1967-09-24
SIG88F0002 SIGG, J. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1988-06-XX

Map Index Number: 08628 EO Index: 16950
Key Quad: San Francisco South (3712264) Element Code: PDAST470D3
Occurrence Number: 8 Occurrence Last Updated: 1989-08-11
Scientific Name: Grindelia hirsutula var. maritima Common Name: San Francisco gumplant
Listing Status: Federal: None Rare Plant Rank: 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1985-09-08 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1985-09-08 Occurrence Rank: Poor
Owner/Manager: UNKNOWN Trend: Decreasing
Presence: Presumed Extant
Location:
UPPER S EDGE OF GULLY S OF STANLEY DRIVE, E OF LAKE MERCED.
Detailed Location:
Ecological:
EDGE OF GULLY.
Threats:
OCCURRENCE DEGRADED SINCE IT IS ADJACENT TO ROADS, AREA ALSO DOMINATED BY WEEDY SPECIES.
General:
FEWER THAN 10 PLANTS SEEN IN 1985.

PLSS: T02S, R06W, Sec. 35 (M) Accuracy: 1/5 mile Area (acres): 0
UTM: Zone-10 N4174218 E545441 Latitude/Longitude: 37.71409 / -122.48442 Elevation (feet): 50
San Francisco San Francisco South (3712264)
BIT86U0014 BITTMAN, R. - ELEMENT CONSERVATION PLAN 1986-12-XX
RUB56S0001 RUBTZOFF, P. - RUBTZOFF #3084 CAS, RSA 1956-11-14
SIG85F0006 SIGG, J. - FIELD SURVEY FORM FOR GRINDELIA HIRSUTULA VAR. MARITIMA 1985-09-08

Map Index Number: 08748 **EO Index:** 16949
Key Quad: San Francisco South (3712264) **Element Code:** PDAST470D3
Occurrence Number: 7 **Occurrence Last Updated:** 1996-01-10
Scientific Name: *Grindelia hirsutula var. maritima* **Common Name:** San Francisco gumplant
Listing Status: Federal: None **Rare Plant Rank:** 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1957-07-14 **Occurrence Type:** Natural/Native occurrence
Last Survey Date: 1985-08-24 **Occurrence Rank:** None
Owner/Manager: SFO CITY/COUNTY **Trend:** Unknown
Presence: Extirpated
Location:
SITE OF MCATEER HIGH SCHOOL, HEAD OF GLEN CYN, SAN MIGUEL HILLS, SAN FRANCISCO.
Detailed Location:
Ecological:
ON HILLSLOPES IN 1957.
Threats:
MCATEER HIGH SCHOOL NOW OCCUPIES SITE WHERE RUBTZOFF COLLECTION WAS MADE IN 1957.
General:
APPROPRIATE HABITAT SEARCHED IN 1985, BUT NO PLANTS FOUND.
PLSS: T02S, R05W, Sec. 19 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4177657 E548506 **Latitude/Longitude:** 37.74493 / -122.44942 **Elevation (feet):** 300
San Francisco San Francisco South (3712264)
BIT86U0014 BITTMAN, R. - ELEMENT CONSERVATION PLAN 1986-12-XX
RUB57S0002 RUBTZOFF, P. - RUBTZOFF #3424 CAS, DS 1957-07-14
SIG85F0002 SIGG, J. - FIELD SURVEY FORM FOR CLARKIA FRANCISCANA 1985-07-31

Map Index Number: 08735 **EO Index:** 16951
Key Quad: San Francisco South (3712264) **Element Code:** PDAST470D3
Occurrence Number: 6 **Occurrence Last Updated:** 1989-08-11
Scientific Name: *Grindelia hirsutula var. maritima* **Common Name:** San Francisco gumplant
Listing Status: Federal: None **Rare Plant Rank:** 3.2
State: None
CNDDB Element Ranks: Global: G5T1Q
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, COASTAL BLUFF SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
SANDY OR SERPENTINE SLOPES, SEA BLUFFS. 15-400M.
Last Date Observed: 1974-06-23 **Occurrence Type:** Natural/Native occurrence
Last Survey Date: 1974-06-23 **Occurrence Rank:** Unknown
Owner/Manager: PVT **Trend:** Unknown
Presence: Presumed Extant
Location:
OPEN N-FACING SLOPE OF MT DAVIDSON NEAR MYRA WAY, SAN FRANCISCO.
Detailed Location:
Ecological:
ON OPEN NORTH-FACING SLOPE.
Threats:
General:
1 PLANT FOUND. COLLECTION #2098 BY NORRIS DETERMINED TO BE FORMA ANOMALA.
PLSS: T02S, R05W, Sec. 19 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4177099 E548094 **Latitude/Longitude:** 37.73992 / -122.45414 **Elevation (feet):** 750
San Francisco San Francisco South (3712264)

NOR74S0001 NORRIS, R. - NORRIS #2098 RSA 1974-06-23

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
UCSC776	Grindelia maritima	Stage and Thorp	Jul 9 1960	55	San Francisco	San Bruno Mountains, San Francisco

McClintock et al. & Allshouse and Nelson

McClintock et al. notes the plant as difficult taxonomically also. She actually notes that three different taxa were being lumped: *G. hirsutula, G. humilis,* and *G. maritima*, noting that the genus is being worked on. Allshouse and Nelson note *G. hirsutula* in “many locations”, but no plants have been determined to the subspecific determination of *maritima.*

2015 Survey Results

Much of our research and understanding of this plant on San Bruno Mountain is from CNDDB reports by Jake Sigg and others (see above). After a conversation with Aaron Sims, CNPS Rare Plant Coordinator, there may be interest to study this plant further to resolve the CRPR plant rank of 3 which indicates the taxon isn’t well understood taxonomically.

San Francisco gum plant (with possible hybrids) was mapped in at least 17 locations where anywhere between 1 and tens of plants were observed. Locations varied from the Boneyard Quarry to the Northeast Ridge, to the Saddle area and Tank Hill. These plants were well distributed on SBM and often were not simple to identify.

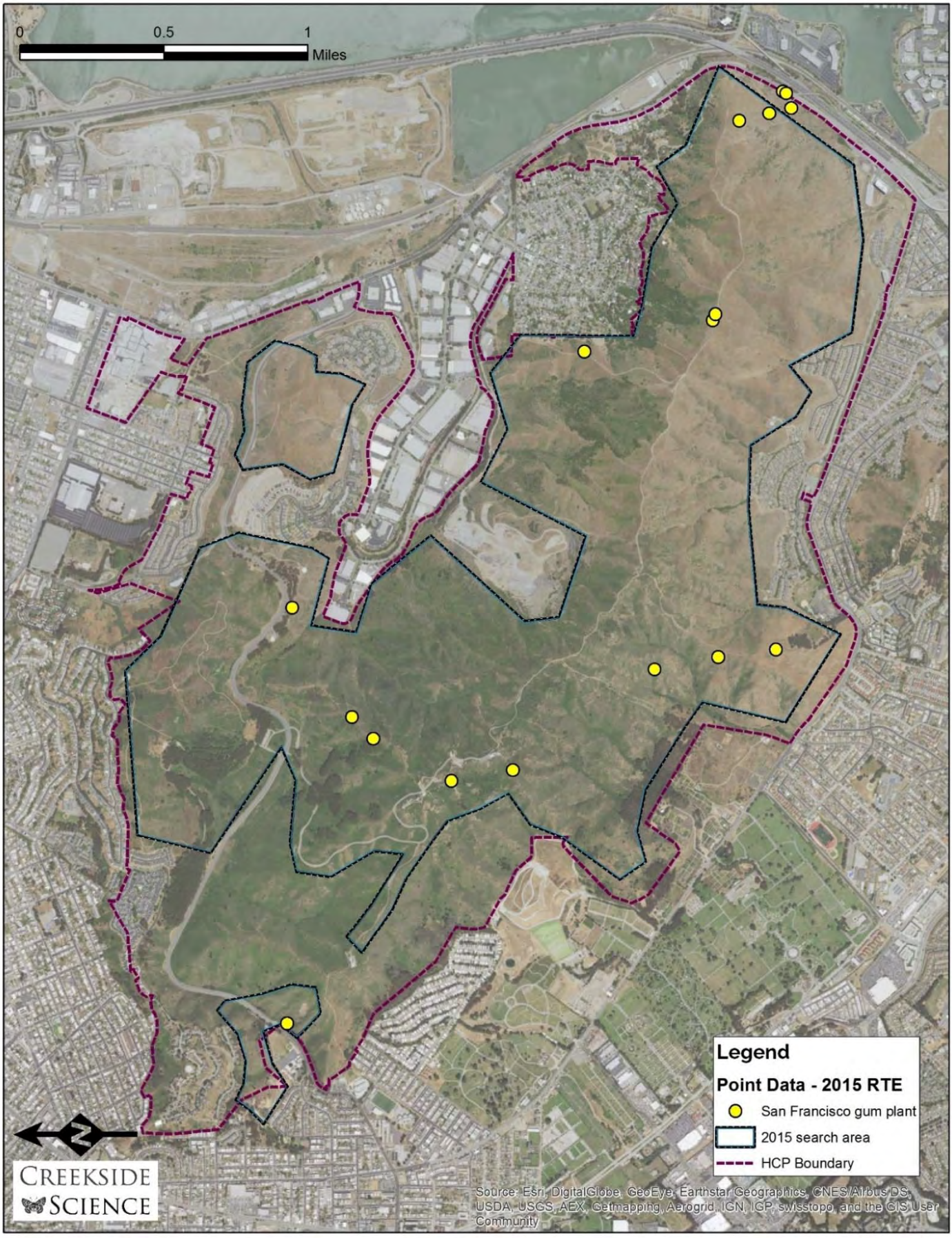


Figure GH-1: Map of locations of *Grindelia* occurrences that may be SF gum plant or gum plant hybrids.

Recommendation for continued inclusion as HCP covered species

Grindelia hirsutula var. *maritima* is not currently recommended for continued inclusion as an HCP covered species, until its taxonomic difficulties are better understood. Currently, this plant seems to be well distributed on SBM so it is unlikely this will be extirpated by a single event.

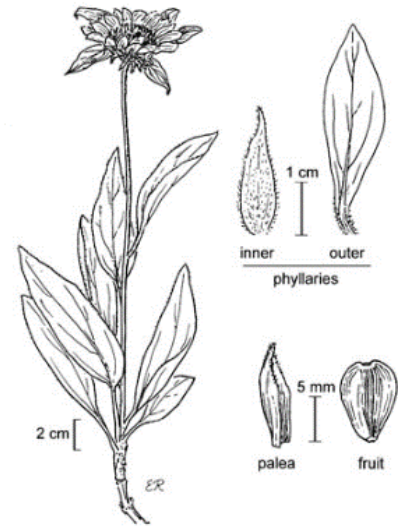
Stewardship priority and management recommendations

Stewardship for this taxon is not recommended. No on-the-ground management action is recommended at this point. We recommend working with Aaron Sims (CNPS) or other interested botanists in pursuing taxonomic work.

Diablo Helianthella *Helianthella castanea* Greene

Diablo helianthella is a perennial in the sunflower (Asteraceae) family. This plant forms dense clumps of vegetation and single individuals can be difficult to differentiate from the clusters. The plant occurs on north facing slopes typically near ecotones between grassland and scrub, often having plants in both vegetation types. The plant typically flowers from March to May. This is the only extant occurrence of this taxon outside of the East Bay, although it was formerly known from San Francisco and Marin. Often this plant can be confused with *Helianthella californica* and even *Wyethia.*

Identification of Diablo helianthella requires a few diagnostic characters: phyllaries are notably irregular length, often varying in size 4-fold in anthesis (peak bloom), phyllaries often extending above the corolla and having a leaf-like appearance, fruits are flattened with a central bulge or ridge and a notch at the apex where the fruit was connected to the receptacle (Plates HC-1,2,3,4,5)



Helianthella castanea
© Regents of the University of California

Plate HC-1 (above left): Diablo helianthella in full flower with leaf-like phyllaries. Plate HC-2 (above center): Anthesis with ants © David Nelson. Plate HC-3 (above right): Typical clump of plants with dense leaves and stems, drying in the summer. Plate HC-4 (below right): Mature notched fruit still attached to receptacle centrally located in photo. Plate HC-5 (below left): Line drawing © Regents of the University of California.

Synonyms

Helianthella castanea Greene

Description Jepson eFlora

NATIVE
Stem: 1--5 dm, glabrous to coarsely hairy. Leaf: cauline few; petioles long; blades 2--6 cm wide, narrowly to widely elliptic. Inflorescence: head generally 1; peduncle 7--20 cm, stout, +- rough-hairy, often with 1--few bracts near tip; involucre 2.5--4 cm diam; outer phyllaries generally leaf-like, 3--10 cm, 7--20 mm wide, curving up around head; inner phyllaries 2--2.5 cm, coarsely ciliate. Ray Flower: 13--21; ray 1--3 cm. Disk Flower: corolla 6--7 mm, yellow; anthers yellow. Fruit: 8--10 mm, obovate, glabrous; center thick; edges thin; pappus awns 0 or 2, <= 1 mm. Chromosomes: 2n=30.
Ecology: Open, grassy sites; Elevation: 200--1300 m. Bioregional Distribution: n CCo, n SnFrB. Flowering Time: Apr--Jun
eFlora Treatment Author: David J. Keil

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08904 EO Index: 368
Key Quad: San Francisco South (3712264) **Element Code:** PDAST4M020
Occurrence Number: 12 Occurrence Last Updated: 2011-04-21
Scientific Name: *Helianthella castanea* **Common Name:** Diablo helianthella
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists: BLM_S-Sensitive
General Habitat: Micro Habitat:
BROADLEAVED UPLAND FOREST, CHAPARRAL, CISMONTANE WDLND,
COASTAL SCRUB, RIPARIAN WOODLAND, VALLEY & FOOTHILL
GRASSLAND.
USUALLY IN CHAPARRAL/OAK WOODLAND INTERFACE IN ROCKY,
AZONAL SOILS. OFTEN IN PARTIAL SHADE. 25-1150M.
Last Date Observed: 2001-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 2001-XX-XX Occurrence Rank: Good
Owner/Manager: SMT COUNTY, PVT **Trend:** Unknown
Presence: Presumed Extant
Location: EAST END OF SAN BRUNO MOUNTAIN, BETWEEN SOUTH SAN FRANCISCO AND BRISBANE.
Detailed Location:
MAPPED BY CNDDB AS FOUR POLYGONS.
Ecological:
GRASSLAND ON THE RIDGETOPS AND UPPER SLOPES BECOMING BRUSHIER FURTHER DOWNSLOPE. ASSOCIATED WITH TOXICODENDRON,
BACCHARIS, AND WYETHIA ANGUSTIFOLIA WITH ERYSIMUM ANGUSTIFOLIUM, COLLINSIA MULTIFLORA, AND ARABIS BLEPHAROPHYLLA NEARBY.
Threats: NEARBY POWERLINE AND POTENTIAL DEVELOPMENT. INVASIVE EUCALYPTUS AND CYTISUS SCOPARIUS NEARBY.
General: PLANTS OBSERVED IN 1965, 1967, 1983, 1984, 1989, 1993, AND 2001, BUT NUMBERS OF PLANTS OBSERVED IS UNKNOWN. NO PLANTS FOUND IN 1981. 51 CLUMPS OBSERVED IN WESTERNMOST POLYGON IN 1994. INCLUDES FORMER OCCURRENCE #13.
PLSS: T03S, R05W, Sec. 15 (M) **Accuracy:** specific area **Area (acres):** 18
UTM: Zone-10 N4169980 E552717 **Latitude/Longitude:** 37.67550 / -122.40218 **Elevation (feet):** 700
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
HAR90U0003 HARRIS, V. - CONVERSATION REGARDING HELIANTHELLA CASTANEA ON SAN BRUNO MOUNTAIN 1990-01-10
HUN94U0001 HUNTER, B. - LETTER FROM DFG WITH COMMENTS ON GENERAL PLAN FOR CITY OF BRISBANE. 1994-10-20
MCC67S0004 MCCLINTOCK, E. & P. WHEELER - MCCLINTOCK SN CAS 1967-05-14
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI85R0002 THOMAS REID ASSOCIATES - SAN BRUNO MOUNTAIN AREA HABITAT CONSERVATION PLAN 1983-1984 ACTIVITIES REPORT 1985-01-XX
SIG94F0001 SIGG, J. - FIELD SURVEY FORM FOR HELIANTHELLA CASTANEA 1994-05-03
TRA08R0001 TRA ENVIRONMENTAL SERVICES - SAN BRUNO MOUNTAIN HABITAT MANAGEMENT PLAN 2007 2008-03-XX
WHE65S0001 WHEELER, P. - WHEELER SN CAS 1965-04-27

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS284694	Helianthella castanea	G. Ward	April 12, 1941	s.n.	San Mateo	Brisbane hills
CAS529902	Helianthella castanea	Philip Wheeler	4/27/65	s.n.	San Mateo	San Bruno Mountain. Sierra Point
CAS530613	Helianthella castanea	Elizabeth McClintock, Phillip C. Wheeler	May 14, 1967	s.n.	San Mateo	San Bruno Mountain. East side of mountain, above Harold Ave., Brisbane. Near fence separating Brisbane from Crocker Estate portion of mountain
CAS8125	Helianthella castanea	Miss E. Cannon	Sep - 1899	s.n.	San Mateo	South San Francisco hills
CAS954373	Helianthella castanea	Glenn L. Clifton	11 May 1988	17823	San Mateo	San Bruno Mountain, canyon on north-facing slope above Brisbane, adjacent to right-of-way of eastern-most set of PGandE high-voltage powerlines crossing the mountain
CAS8123	Helianthella castanea	Miss E. Cannon	June 1892	s.n.	San Mateo	Hills near the Bay, South S.F.

McClintock et al. & Allshouse and Nelson

McClintock et al. notes the plant as: Uncommon, grasslands. Slope above Harold Rd in Brisbane. Allshouse and Nelson have located the plant at Brisbane acres and Firth Canyon.

TRA/MIG Surveys

Diablo helianthella has been mapped over a number of years by TRA/MIG. We present distribution data from their surveys along with our 2015 survey results (Figure HC-1).

2015 Survey

Diablo helianthella was mostly observed after peak flowering. The profusion of mules ears (*Wyethia*) flowering at the same time made detection very difficult. After peak bloom, residual stalks could easily be located with their diagnostic irregular phyllaries and notched seeds. Plants were observed in 4 distinct areas, including one individual on its own in the Brisbane acres area.

Although some previous monitoring documents and surveys refer to individuals, it is virtually impossible to count individuals in a large clump of plants. Not all individuals likely flower every year, and some may produce multiple inflorescences so this is not an accurate measurement of population, either. Instead, we counted unique clumps of plants that likely did not have intertwining roots (3-4 feet from nearest next plant with no above-ground vegetation connecting the two).

Our surveys indicate that plants occurred on north facing slopes in an elevation band from about 110 to 230 meters. Four sites were censused containing a total of 106 clumps. The largest polygon (2) contained 88 clumps, while the smallest (polygon 3) included a single individual (noted by a point on Figures HC-1). Polygon 1 contained 10 clumps, while polygon 4 contained 7 clumps. Polygons 1, 3, and 4 are reproduced in a detail map (Figure HC-2). Although it is impossible to compare quantitative data from the past, we believe 2015 numbers likely correspond well with past surveys indicating that this population is likely stable (see Figure HC-3, reproduction of 2001 data from TRA/MIG). If GPS positions are accurate, it seems as though the population has likely shifted over the years, maybe due to changes in environmental conditions.

Surveys conducted in March 2016 by volunteers confirmed the general polygon extent and notably confirmed that counting of individuals was difficult (Nelson, pers. com.).

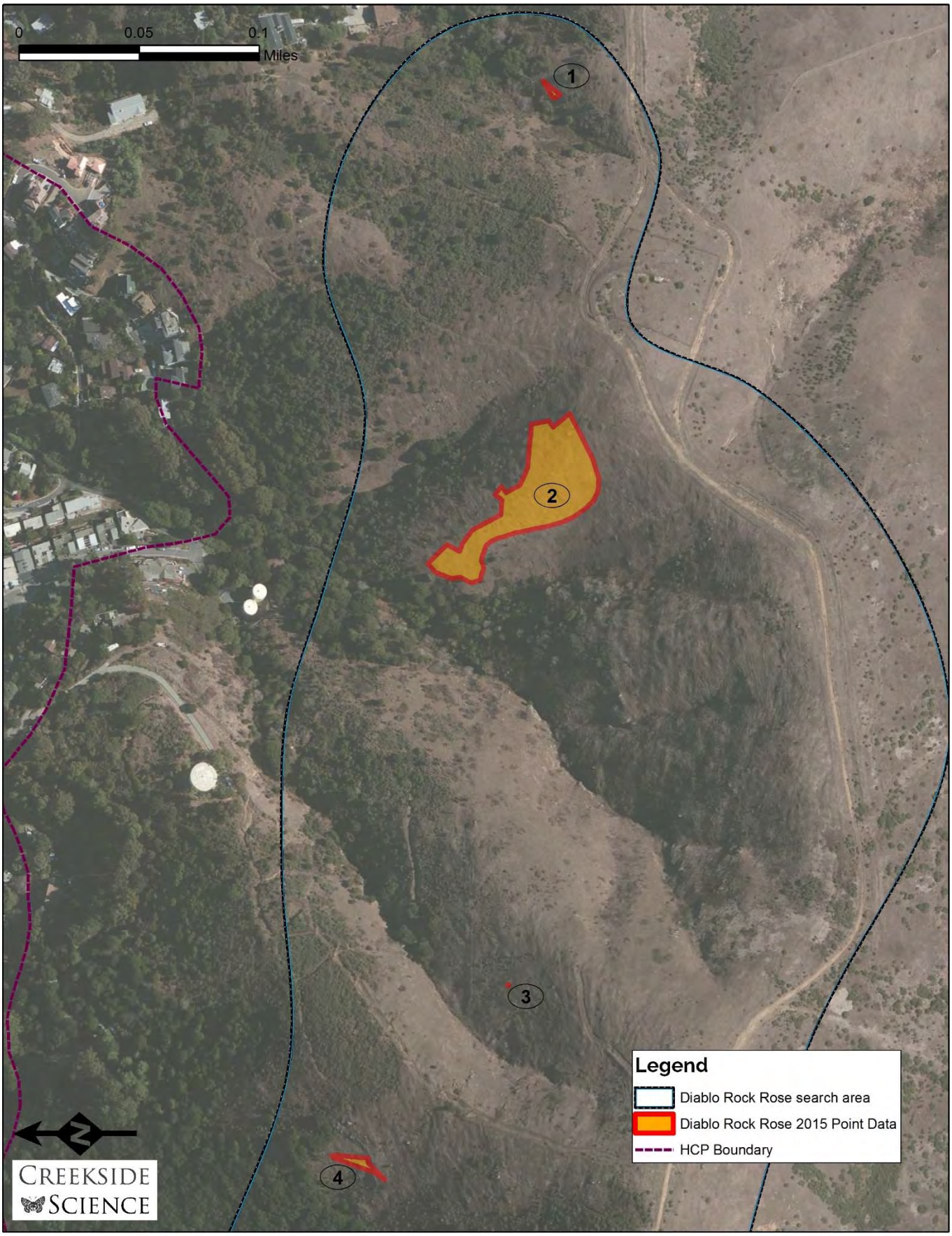


Figure HC-1: Distribution map of Diablo helianthella from 2015 survey data.

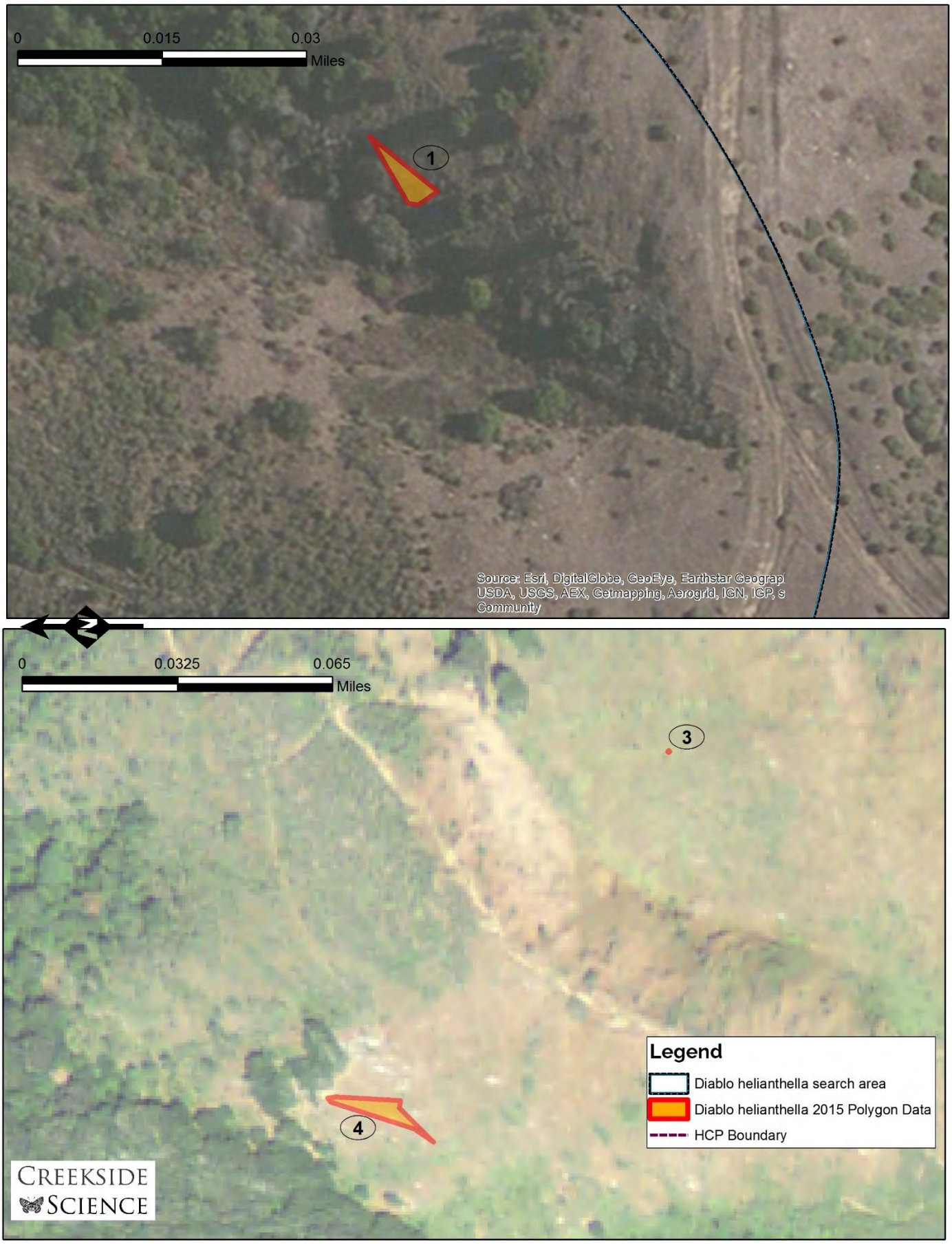


Figure HC-2: Detail maps of Diablo helianthella clusters from 2015 survey data.

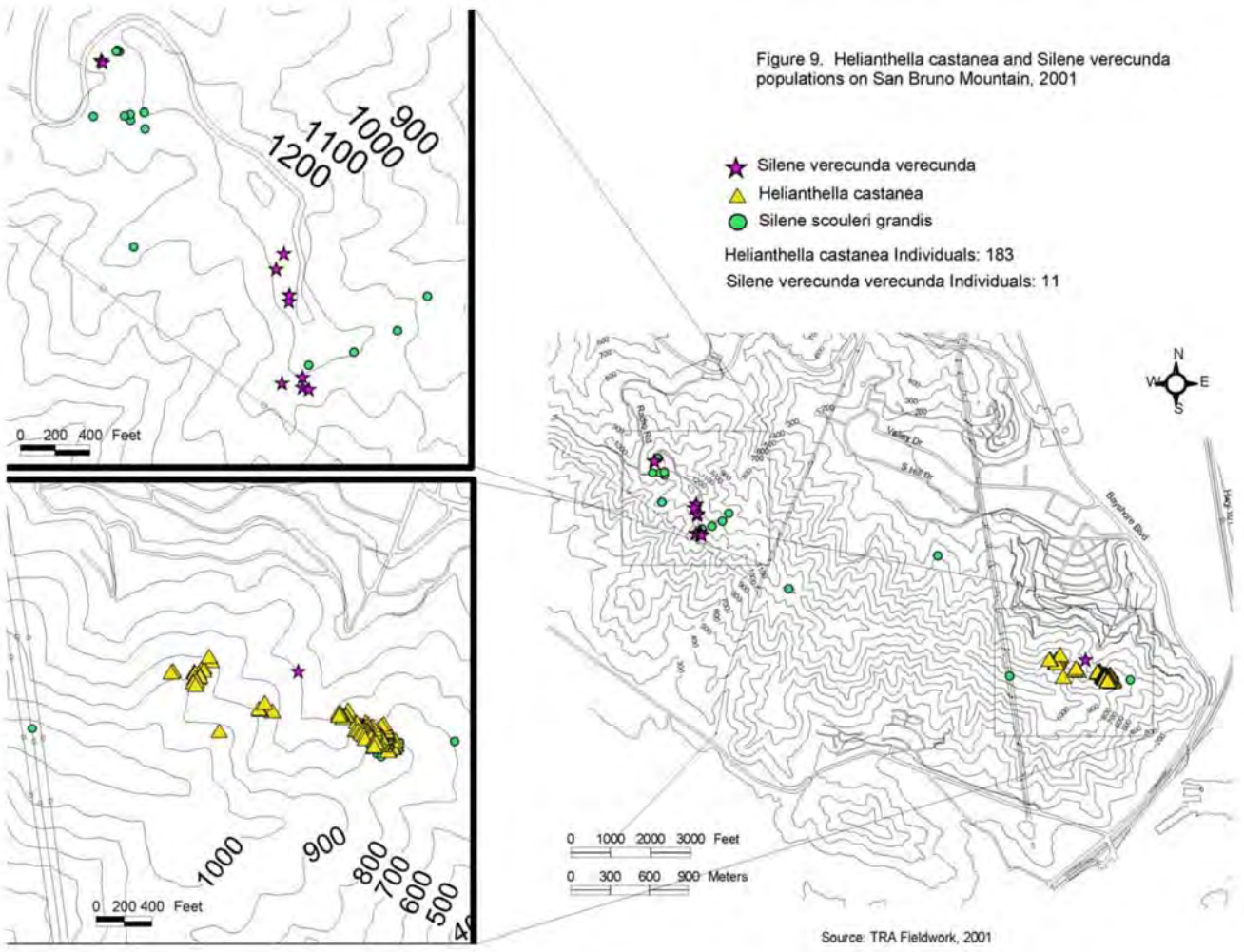


Figure HC-3: Distribution map of Diablo helianthella from 2001 TRA/MIG data from 2008 HMP Report.

Since our surveys were late in the season, we inspected fruits for insect damage. Bore holes were present, therefore we believe it is likely these fruits are not fertile, and this may impact future dispersal of this plant (Plate HC-6).

Figure HC-6: Mature and intact Diablo helianthella fruits showing what seem to be entrance or exit holes from burrowing insects (circled in red).

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. The location of this population is unique and it remains the only extant population of this taxon west of the San Francisco Bay.

Stewardship priority and management recommendations

Stewardship priority for this taxon is medium. This plant was observed in multiple locations in the Brisbane acres area. Although one population is well established and seemingly flourishing, it would be worthwhile to attempt to establish more plants adjacent to the smaller populations. We recommend researching three methods for augmentation: 1) direct seed a defined area with fresh, undamaged fruits, 2) attempt to remove small, viable fractions of roots and tubers in the winter from a clump and transplant to adjacent location and 3) attempt to germinate seed in a nursery and outplant individuals after one year. In late 2016, a management plan was written by Nelson, Allshouse, Polony and Salmon (2016) that serves as an example for how stewardship efforts can be tactfully planned and executed.

Coast Iris *Iris longipetala* Herbert.

Coast iris is a perennial plant that occurs mostly along the coast from Monterey County up to nearly Oregon. This plant typically flowers March through May with showy blueish purplish corollas similar in form to horticultural varieties of iris. Coast iris typically occurs in wetter areas on SBM, although it is deep rooted and can tap into subsurface water in more xeric sites.

Coast iris is most similar to Douglas' iris (*Iris douglasiana*) which can grow sympatrically in areas of northern coastal scrub. Coast iris can be discerned by its lighter green leaves that are similar on both sides, versus the bifacial leaves (dissimilar on the two sides) of Douglas' iris which have a notable reddish hue at the base (Plates IL-1,2,3).

Plate IL-1 (left): Drawing from Curtis' Botanical Magazine 1862. Plate IL-2 (right top): Coast iris flowers and previous year's fruit. Plate IL-3 (bottom right): C. Niederer mapping first RTE occurrence from the survey. Typical population of coast iris.

Synonyms

N/A

Description Jepson eFlora

NATIVE
Habit: Rhizome 10--25 mm diam. Stem: rarely branched, 30--60 cm. Leaf: basal 5--11 mm wide; cauline 1--2, bract-like for at least 2/3 stem length. Inflorescence: flowers 3--6; lowest 2 bracts alternate (opposite), enclosing perianth tube, 0.5--10 cm apart, outer 7--15 cm. Flower: perianth lilac-purple, veined darker, tube 5--13 mm, funnel-shaped; sepals 6--10 cm, 30--50 mm wide, obovate; petals 5--9 cm, 15--21 mm wide, elliptic; ovary rounded, style branches 35--43 mm, crests 12--15 mm, stigmas 2-lobed. Chromosomes: 2n=86--88. Ecology: Moist, coastal prairie or open coastal forest; Elevation: < 600 m. Bioregional Distribution: c&s NCo, s

NCoRO, n&c CCo, SnFrB. Flowering Time: Mar--Jun Note: May be a coastal form of Iris missouriensis. eFlora Treatment Author: Carol A. Wilson

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

N/A since plant is a list 4. CNDDB records are typically collected for list 1 and 2 species. Plant is referred as an associate for other CNDDB forms.

Herbarium

A total of 18 collections of this plant from the San Bruno area are accessioned in the SMASH database.

McClintock et al. & Allshouse and Nelson

Both sources note this plant as common and widespread on SBM.

2015 Survey Results

Coast Iris was encountered and mapped at least 41 times on SBM (Figure IL-1). We approximate some 1000 or more plants were observed on SBM. It is likely that the SBM population is between 2,000 and 5,000 plants.

Alongside the Franciscan wallflower, this plant was the most cosmopolitan plant on the mountain of the RTEs. This taxon was slightly more restricted to areas which were cooler and soils were wetter. Notably, this plant did occur in direct competition with some scrub species (Plate IL-4), therefore some occurrences are at risk of disappearing with increased scrub succession.

Plate IL-4: Coast iris competing with coyote brush for habitat on SBM. Location: Preservation parcel area.

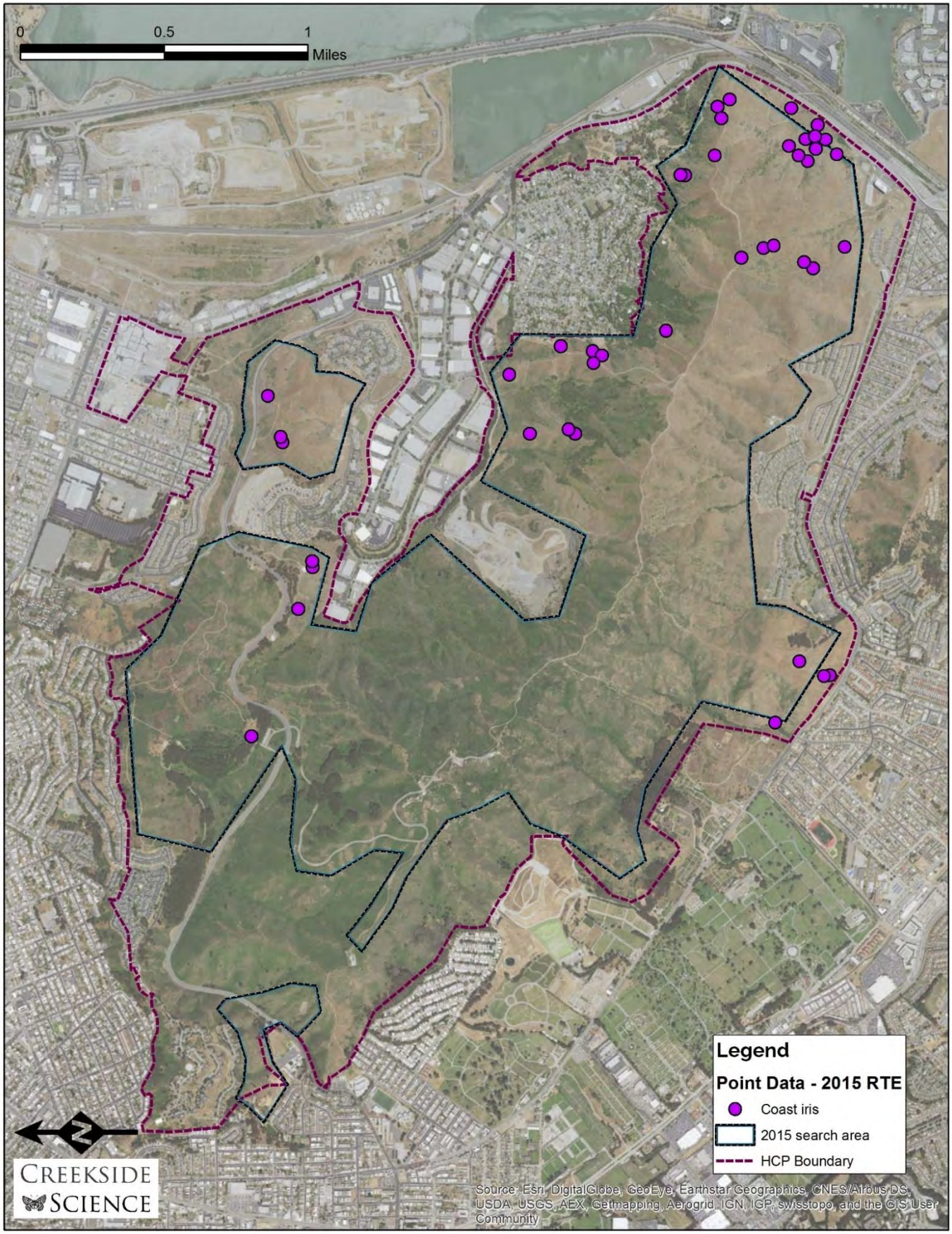


Figure IL-1: Distribution of coast iris on SBM.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species.

Stewardship priority and management recommendations

Stewardship priority for this taxon is low. This plant was observed in multiple locations and is one of the two most well distributed RTE plants surveyed. At this point in time, there are no critical management recommendations. Collection and relocation of seed to unoccupied rock outcrops to observe effectiveness of direct seeding may be instructive for future conservation efforts and may constitute a good volunteer project before more rare taxa are studied.

In addition, transplants of rhizomes and root/shoots from mature clumps or patches may be a successful way of vegetatively propagating this plant. We would recommend this as an experimental species for honing that technique before utilizing it on more rare taxa.

San Francisco Lessingia *Lessingia germanorum* Cham.

San Francisco lessingia is an annual plant in the Asteraceae family that is restricted to sandy soils. It was first discovered in 1816 by Adelbert von Chamisso while on an around-the-world exploration expedition by the Russians. This plant typically grows to a height of 0.25 to 0.75 meters, flowers from July through September, and then dies back and leaves little remains/chaff observable in the following year. This plant can grow in dense populations in preferred habitat which is typically unconsolidated sand. This plant is only known from four occurrences, three in the Presidio and one on San Bruno Mountain.

SF lessingia can be identified by its late bloom period, yellow ray flowers, occurrence on sandy substrate, and annual growth form. Heads usually have 3-5 rows of phyllaries which are sparsely glandular. Stems are pubescent and slight with diminutive leaves often seeming to be appressed to the stems (Plates LG-1,2,3).

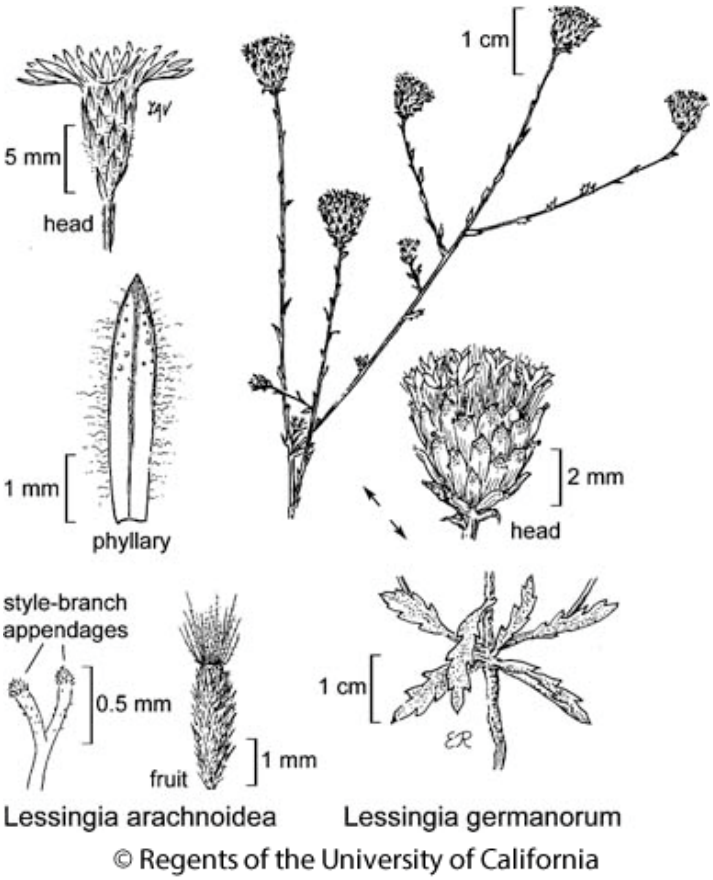


Plate LG-1 (above): Line drawing © Regents of the University of California. LG-2 (top right): One individual with terminal flower head and lateral branch. LG-3 (bottom right): Typical sandy-soil habitat of this plant.

Synonyms

Lessingia germanorum Cham., *Lessingia germanorum* Cham. var. *germanorum* Cham., *Lessingia germanorum* Cham.

DESCRIPTION Jepson eFlora

NATIVE
Stem: erect, 5--30 cm, tan to +- red-brown, distally glabrous or sparsely hairy. Leaf: basal petioled; cauline 0.5--3 cm, oblong to oblanceolate, entire to pinnately lobed, glandless, glabrous or long-soft-hairy. Inflorescence: involucre 4--8 mm, obconic to bell-shaped; phyllaries lanceolate, glabrous, puberulent, and/or thinly tomentose, rarely with sparse bead-like sessile glands, tips recurved, generally purple. Flower: 20--40; corolla funnel-shaped to tubular, yellow, tube purple-brown banded inside; style branch appendage 0.1--0.4 mm, short-triangular, abruptly pointed. Fruit: 1--3 mm; pappus >= fruit, tan.
Ecology: Sandy soil; Elevation: < 100 m. Bioregional Distribution: CCo (Presidio, San Francisco Co.), SnFrB (Hillside Park, San Mateo Co.). Flowering Time: Jun--Nov
eFlora Treatment Author: Staci Markos

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 22873 EO Index: 55
Key Quad: San Francisco South (3712264) **Element Code:** PDAST5S010
Occurrence Number: 7 Occurrence Last Updated: 2007-08-31
Scientific Name: *Lessingia germanorum* **Common Name:** San Francisco lessingia
Listing Status: Federal: Endangered Rare Plant Rank: 1B.1
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB. ON REMNANT DUNES. OPEN SANDY SOILS RELATIVELY FREE OF
COMPETING PLANTS. 20-110 M.
Last Date Observed: 1999-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1999-XX-XX Occurrence Rank: Fair
Owner/Manager: CITY OF DALY CITY, PVT **Trend:** Unknown
Presence: Presumed Extant
Location:
DALY CITY, SAN BRUNO MOUNTAIN. BETWEEN HILLSIDE PARK AND KENNEDY SCHOOL.
Detailed Location:
NEAR BONNIE STREET, OFF OF PRICE STREET, OFF OF NEW MARKET.
Ecological:
OPEN SAND AND WELL-DRAINED SLOPES. WITH POLYGONUM PARONYCHIA, CALIFORNIA POPPY, LOTUS SCOPARIUS, LUPINUS SP., PHACELIA,
AND SOLIDAGO CALIFORNICA. 400-600 FT ELEVATION.
Threats:
THREATENED BY CONSTRUCTION ACTIVITES (WATER PIPELINE WORK AND TERRACING) AND AN ABUNDANCE OF INVASIVE PLANTS.
General:
FIRST REPORTED IN 1989. 1600 PLANTS OBSERVED IN 1991. HISTORY OF OCCURRENCE UNCLEAR; MAY HAVE BEEN UNINTENTIONALLY PLANTED HERE BY CONSTRUCTION WORK. GENETIC WORK SHOWS THIS POPULATION IS GENETICALLY DIFFERENT FROM PRESIDIO POPS.
PLSS: T03S, R05W, Sec. 06 (M) **Accuracy:** specific area **Area (acres):** 7
UTM: Zone-10 N4172286 E547994 **Latitude/Longitude:** 37.69655 / -122.45558 **Elevation (feet):** 500
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
FWS03R0002 U.S. FISH & WILDLIFE SERVICE - RECOVERY PLAN FOR THE COASTAL PLANTS OF THE NORTHERN SAN FRANCISCO PENINSULA 2003-08-08
SMI91F0010 SMITH, S. - FIELD SURVEY FORM FOR LESSINGIA GERMANORUM 1991-09-16
SMI91U0002 SMITH, S. - LETTER TO T. MCGUIRE 1991-XX-XX
TIB98U0001 TIBOR, D. - COMMENTS REGARDING CONSTRUCTION ACTIVITIES AT LESSINGIA GERMANORUM OCCURRENCE #7 1998-07-29

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
SJSU15428	Lessingia germanorum	Toni Corelli	09/14/2011	720a	San Mateo	Northeast of Hillside Park, above houses
CAS1024514	Lessingia germanorum	Elizabeth McClintock, Paul Reeberg	August 19, 1989	s.n.	San Mateo	San Bruno Mountains, Reservoir Hill.

To date, only two collections of this plant have been accessioned from San Bruno Mountain.

McClintock et al. & Allshouse and Nelson

Both references note this plant in the same “lower Reservoir Hill” or “Daly City Dunes/Colma Dunes” area. It has only been documented in this singular location on SBM.

TRA/MIG surveys

This plant was mapped in the Daly City Dunes area and the most recent survey polygon (2002) is noted in Figure LG-1 (in 2015 Survey Results).

2015 Survey

The one known population was located and mapped. The plants were restricted to loose sandy soils, often seemingly benefiting from small scale and heterogeneous disturbances across the landscape. The plant grows sympatrically with SF spine-flower. The main polygon was similar in size to the previously mapped polygon, although it was notable that some areas of SF lessingia previously mapped by the upper entrance area (where the willow thicket now exists), were not observed as occupied. The polygon was expanded in the northward and eastward directions significantly. We estimated between 10,000 and 30,000 individuals throughout the slopes, using a logarithmic scale. Converting data into logarithmic scales is important for annual plant populations in order to easily observe significant population changes. Total occupied habitat was around 7 acres (Figure LG-1).

Notably, a second small polygon of about 100 plants was located across the drainage to the east. This polygon is on a sandy bench where soils are less consolidated and similar to the main population.

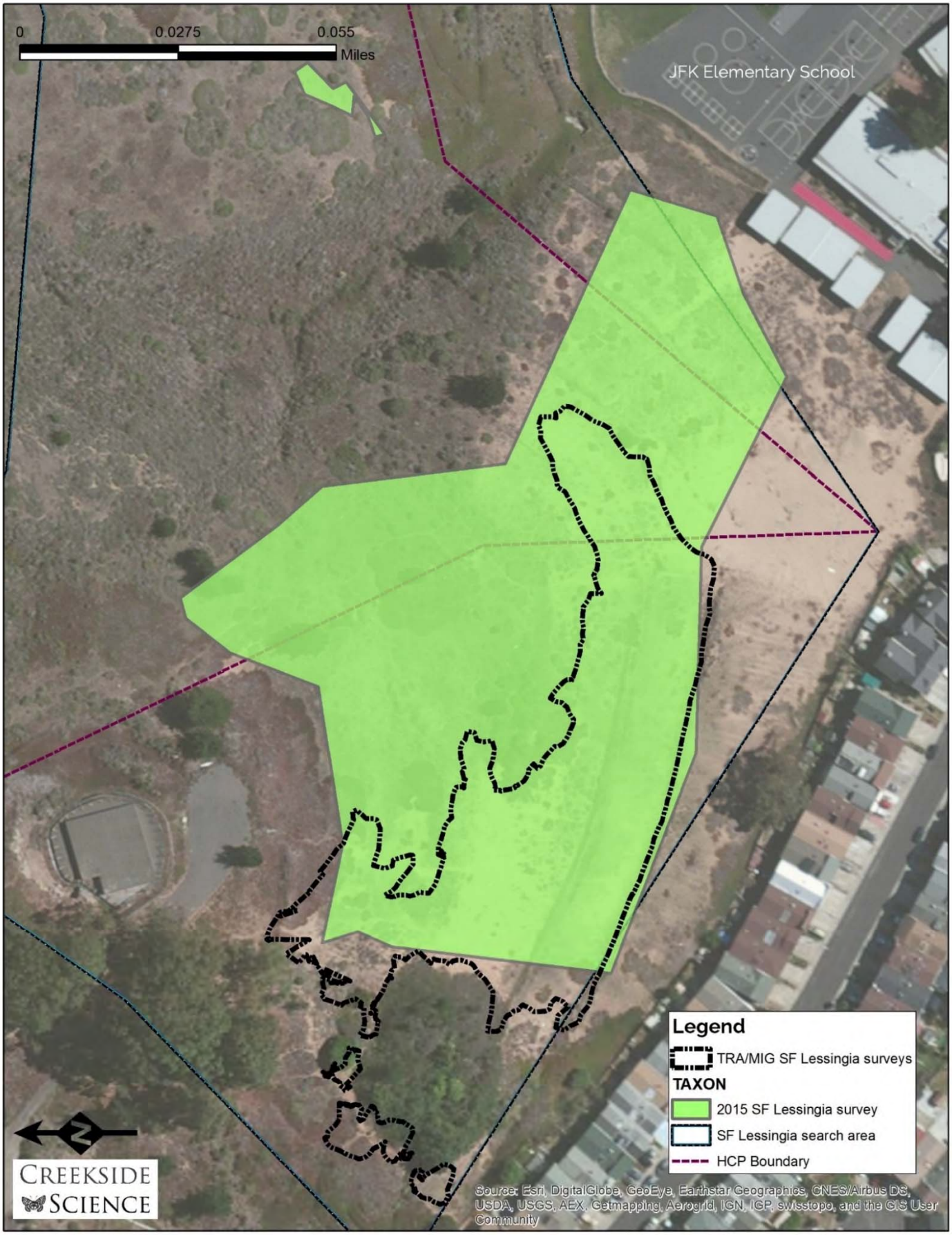


Figure LG-1: 2015 and 2002 mapped SF lessingia distribution.

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. SBM is vital for the conservation of this species.

Stewardship priority and management recommendations

Stewardship priority for this plant is high. This plant was observed on the Daly City Dunes and should be resurveyed every 2-4 years. SF lessingia has seemingly similar habitat requirements as SF spine-flower and we would recommend the same management techniques for this plant. We recommend survey timing to be coordinated with annual weather. The expression of this plant (germination/survivorship) is greatly influenced by annual weather, so it would be instructive to survey in both extreme drought years, wet years, and hot/cool years. Mapping where this plant persists over various annual conditions allows better conservation planning.

An adjacent slope, just east of the occurrence was likely historically occupied by spine-flower. Although the vegetation is dominated by larger shrubs, allowing for less sand movement, the preferred substrate for this plant is present. We recommend two management actions:

1) Control and remove weeds in and around occupied polygon on the Daly City Dunes. Disturbance seems to improve habitat by increasing sand movement and decreasing competition,

2) Clear vegetation from 20-50 m^2 areas (regular square or rectangular blocks in order to observe change easily) on the adjacent east slope. These areas should be hand seeded with seeds collected from the adjacent population,

3) If direct seeding is successful, clear vegetation areas in more natural shapes along a greater portion of the extant sandy soils.

White-rayed Pentachaeta *Pentachaeta bellidiflora* E. Greene

White-rayed pentachaeta is an annual forb in the sunflower family (Asteraceae). It is currently known from only one extant population in Redwood City that is bisected by Interstate 280. The majority is on a property named the Triangle, and a smaller portion is on the other side of the highway at Edgewood County Park and Natural Preserve. This taxon has not been noted at SBM for decades.

The plant grows 6-17 cm high. Its defining characters are the 7-16 pink to white ray flowers and yellow disk flowers. The genus gets its name from a five-bristled pappus, although Jepson allows that this taxon will have five or zero. The Jepson Manual describes the habitat as grassy, moist places, ephemeral drainages, coastal scrub, and chaparral. The extant site at the Triangle is better described as dry, rocky serpentine grassland, although some plants do grow in the moister drainages there.

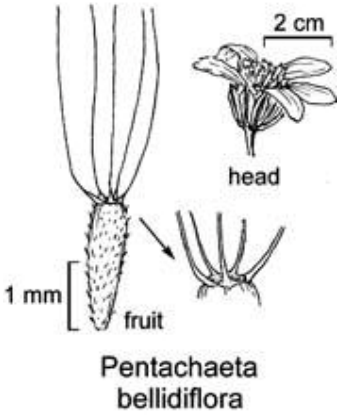


Plate PB-1 (left): *Pentachaeta bellidiflora*. Jepson Manual (© UC Board of Regents). Plate PB-2 (center): *Pentachaeta bellidiflora*. Plate PB-3(right): Habitat shot from the Triangle property, March 21, 2012. Photos by Christal Niederer.

Synonyms

Chaetopappa bellidiflora (Greene) Keck

Description Jepson eFlora

NATIVE
Stem: 6--17 cm, sparsely hairy. Leaf: < 4.5 cm, 1 mm wide, glabrous. Inflorescence: heads <= 4 per pl; peduncle glabrous to short-hairy; involucre widely bell-shaped; phyllaries elliptic to obovate, glabrous. Ray Flower: 7--16; ray 3--6 mm, white, sometimes +- red abaxially. Disk Flower: 16--38; corolla 5-lobed, yellow. Fruit: pappus bristles 0 or 5, slightly expanded at base. Chromosomes: 2n=18.
Ecology: Grassy or rocky areas; Elevation: < 620 m. Bioregional Distribution: n CCo, SnFrB. Flowering Time: Mar--May
Synonyms: Chaetopappa bellidiflora (Greene) D.D. Keck
eFlora Treatment Author: David J. Keil & Meredith A. Lane

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08910 EO Index: 16681
Key Quad: San Francisco South (3712264) **Element Code:** PDAST6X030
Occurrence Number: 6 Occurrence Last Updated: 1998-04-14
Scientific Name: *Pentachaeta bellidiflora* **Common Name:** white-rayed pentachaeta
Listing Status: Federal: Endangered Rare Plant Rank: 1B.1
State: Endangered
CNDDB Element Ranks: Global: G1
State: S1
Other Lists: SB_UCBBG-UC Berkeley Botanical Garden
General Habitat: Micro Habitat:
VALLEY AND FOOTHILL GRASSLAND, CISMONTANE WOODLAND. OPEN DRY ROCKY SLOPES AND GRASSY AREAS, OFTEN ON SOILS DERIVED FROM SERPENTINE BEDROCK. 35-620 M.
Last Date Observed: XXXX-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: XXXX-XX-XX Occurrence Rank: None
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Possibly Extirpated
Location:
JUST S OF BRISBANE, ON E EDGE OF SAN BRUNO MTN.
Detailed Location:
Ecological:
Threats:
General:
AT 1997 RECOVERY WORKSHOP, IT WAS REPORTED THAT THE GRAYWACKE SOILS ON SAN BRUNO MTN ARE HIGH IN MG AND LOW IN CA, BUT ARE NOT SERPENTINE-DERIVED. SURVEYS NEEDED.
PLSS: T03S, R05W, Sec. 15 (M) **Accuracy:** 1/5 mile **Area (acres):** 0
UTM: Zone-10 N4170041 E553058 **Latitude/Longitude:** 37.67603 / -122.39831 **Elevation (feet):** 500
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
CNP80M0017 CALIFORNIA NATIVE PLANT SOCIETY - CNPS 1980 MAP WITH NOTE 1980-XX-XX
GAN80U0005 GANKIN, R. - NOTE FROM PHONE CALL REGARDING OCCURRENCE ON SAN BRUNO MTN. 1980-XX-XX
ROB92R0001 ROBISON, M. - REPORT TO THE FISH AND GAME COMMISSION ON THE STATUS OF PENTACHAETA BELLIDIFLORA. 1992-05-XX
TIM91U0001 TIMBY, S. - A PETITION TO THE STATE FISH & GAME COMMISSION FOR PENTACHAETA BELLIDIFLORA 1991-02-19

Herbarium

There are at no accessioned records for white-rayed pentachaeta on San Bruno Mountain located in the SMASH database.

McClintock et al. & Allshouse and Nelson

McClintock et al. (1990) states white-rayed pentachaeta is “uncommon, [found in] grassy areas: Above Harold Ave. in Brisbane.” Allshouse and Nelson only state it has “not been seen on SBM since before the HCP adoption” in 1982.

2015 Survey

White-rayed pentachaeta was not found during the 2015 surveys. While the plant was considered throughout the year, the most targeted searches were completed in March and April, when it would have likely been flowering. The area above Harold Ave. was targeted as the last known location (Figure PB-1). The plant is small in stature, but distinctive. It is possible that in the drought year, a small population would have been difficult to find. However, the length of time since this taxon has been seen, and the high number of interested botanists in the area make it seem more likely that *P. bellidiflora* has been extirpated.

Figure PB-1: Search Area of White-rayed pentachaeta

Recommendation for continued inclusion as HCP covered species

This plant is currently recommended for continued inclusion as an HCP covered species, but this can be re-evaluated if restoration efforts are unsuccessful or unlikely. While it is presumed extirpated, the option for reintroducing the species should always be considered. The survival of the species is more likely if more than one population is extant.

Stewardship priority and management recommendations

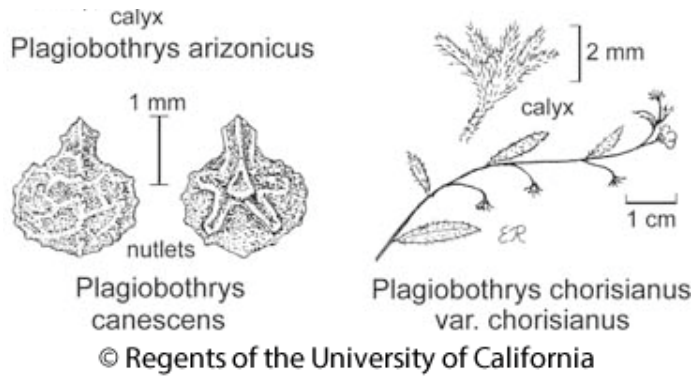
Stewardship priority for this taxon is low. While one can prove a species is present, one can't prove absence. Occasional continued surveys should take place; it would be exciting to find this species. In addition, the reference population could be visited and characterized, with the intention of determining whether appropriate habitat exists or could be restored on San Bruno Mountain. It is also interesting that the extant population at the Triangle and Edgewood is in rocky, thin serpentine soils, very different than the mesic grasslands described as the historical habitat on SBM, and this apparent discrepancy could be explored. Perhaps at some point reintroductions could be an option. Seeds do exist in one herbarium voucher from the Cal. Academy of Sciences that was inspected (Plate PB-4), so it may be possible to introduce the historic gene pool if plants get established.

Plate PB-4: Herbarium specimen of white-rayed pentachaeta.

Choris's Popcorn Flower *Plagiobothrys chorisianus* (Cham.) I.M. Johnston var. *chorisianus*

Choris's popcorn flower is an annual forb in the borage family, from 10-40 cm high. This wildflower typically blooms from February through May and is usually found in dense patches. There are three taxa on San Bruno Mountain that can be identified commonly as "popcorn flowers", so close inspection of fruits is critical. San Bruno Mountain represents the northern-most occurrence of this taxon.

For identification, the observer should have both a flowering individual and one with mature nutlets (fruits). The lowest nutlets are first to mature. *Plagiobothrys* can be distinguished from the similar genus *Cryptantha* by its nut scars. In *Plagiobothrys,* the nut scar is adaxially keeled above the scar, or generally raised, while in *Cryptantha* it is grooved. Other distinguishing characters for this taxon are hairs that are sparse to short-strigose; lower cauline leaves that are opposite, with upper being generally alternate; and a corolla 6-10 mm wide. Notably, this taxon has a very long corolla limb for the species measuring 10 to 20 mm. Unlike the most similar species on the mountain, *Cryptantha micromeres*, Choris's popcorn flower was historically found in moist areas.



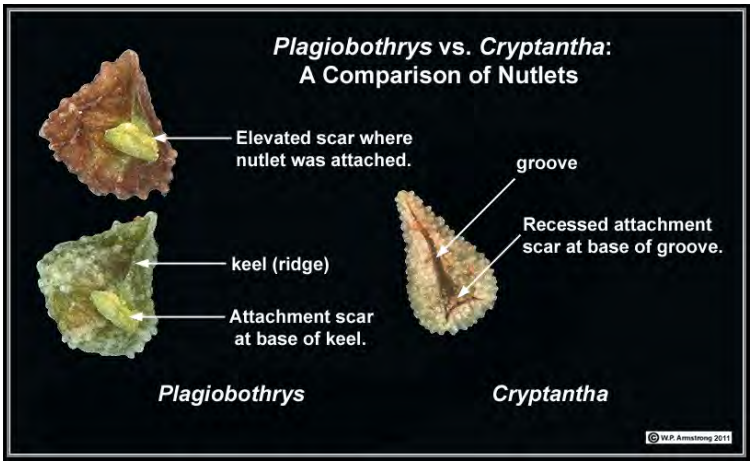


Plate PC-1: *Plagiobothrys chorisianus* var. *chorisianus*, Jepson Manual (© UC Board of Regents). Plate PC-2 (right): Long corolla limb noted © 2009 Neal Kramer. Plate PC-3 (bottom left): Comparing Plagiobothrys and Cryptantha by © WP Armstrong.

Synonyms

Allocarya chorisiana (Cham.) Greene, *Krynitzkia chorisiana* (Cham.) Gray, *Myosotis chorisiana* Cham., *Eritrichium chorisianum* (Cham.) A. DC., *Eritrichium connatifolium* Kell.

Description Jepson eFlora

NATIVE
Stem: decumbent to erect, branched from upper axils. Leaf: lower pair generally fused at base, +- sheathing stem. Inflorescence: pedicel generally >> calyx. Flower: corolla limb 6--10 mm diam.

Ecology: Grassy, moist places, ephemeral drainages, coastal scrub, chaparral; Elevation: < 650 m. Bioregional Distribution: KR, NCoRO, n CCo, w SnFrB. Flowering Time: Mar--Jun
eFlora Treatment Author: Ronald B. Kelley, Robert Patterson, Richard R. Halse & Timothy C. Messick, family description, key to genera; treatment of genera by Ronald B. Kelley

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 93154 EO Index: 94302
Key Quad: San Francisco South (3712264) **Element Code:** PDBOR0V061
Occurrence Number: 39 Occurrence Last Updated: 2014-07-14
Scientific Name: *Plagiobothrys chorisianus var. chorisianus* **Common Name:** Choris' popcornflower
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G3T2Q
State: S2
Other Lists:
General Habitat: Micro Habitat:
CHAPARRAL, COASTAL SCRUB, COASTAL PRAIRIE. MESIC SITES. 15-160 M.
Last Date Observed: 1961-05-07 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1961-05-07 Occurrence Rank: Unknown
Owner/Manager: SMT CO-SAN BRUNO MTN PARK **Trend:** Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNAIN IN NORTH PART OF COUNTY.
Detailed Location:
ALONG ROAD. MAPPED AS BEST GUESS BASED ON A 1961 THOMAS COLLECTION, ON SAN BRUNO MOUNTAIN ALONG RADIO ROAD, WHICH IS THE MAIN ROAD WITHIN SAN BRUNO MTN STATE PARK, AND WITHIN THE GIVEN ELEVATION OF 1000-1300 FT.
Ecological:
NORTHERN COASTAL SCRUB. IN VERY DENSE STANDS IN LOW WET DEPRESSIONS ALONG ROAD. COMMON SPECIES: BACCHARIS PILULARIS, ERIGERON GLAUCUS, SCROPHULARIA CALIFORNICA, SIDALCEA MALVIFLORA, SALVIA SPATHACEA, SENECIO SYLVATICUS, ETC.
Threats:
General:
SITE BASED ON A 1961 THOMAS COLLECTION. A 1893 DUDLEY COLLECTION FROM "THE SANTA CRUZ MOUNTAIN PENINSULA. N OF SAN BRUNO" IS ATTRIBUTED TO THIS OCCURRENCE. NEEDS FIELDWORK.
PLSS: T03S, R05W, Sec. 08 (M) **Accuracy:** nonspecific area **Area (acres):** 123
UTM: Zone-10 N4170913 E550140 **Latitude/Longitude:** 37.68405 / -122.43134 **Elevation (feet):** 1,150
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
DUD93S0014 DUDLEY, W. - DUDLEY SN DS #392011 1893-05-01
THO61S0011 THOMAS, J. - THOMAS #9258 DS #749755 1961-05-07

Herbarium

There are at least 12 accessioned records for Choris's popcorn flower on San Bruno Mountain located in the SMASH database. The earliest collection is in 1893 by W.R. Dudley, and the most recent is 1984 by Robert A. Norris. Localities range from the specific (Point San Bruno; just east of KRON television tower, below and southeast of end or paved ridgetop road, on Guadalupe Valley side of summit; about halfway down Devil's Arroyo; north power line ridge; along trail in saddle between parking lot /summit and blue blossom hill) to more generalized locations such as San Bruno Mountain or even the Santa Cruz peninsula North of San Bruno.

McClintock et al. & Allshouse and Nelson

McClintock et al. (1990) states Choris's popcorn flower is "uncommon, damp soil: upper Colma Canyon, Devil's Arroyo, Ridge trail at West Powerline." Allshouse and Nelson state it is "Endemic to Santa Cruz Mountains; San Francisco, San Mateo and Santa Cruz counties. On San Bruno Mountain it is thought to be located in April Brook, Devil's Arroyo, Trillium Gulch and West Power Line area."

2015 Survey Results

Choris's popcorn flower was not found in 2015, despite searching far and wide (Figure PC-1). Few popcorn flowers (such as the more common *Cryptantha micromeres*) were found at all in 2015. While the plant was considered throughout the year, the most targeted searches were completed in March through June, when it would have likely been flowering. Moist grassland areas were targeted. Based on fairly recent vouchers and sightings, it is likely that this annual that is found in mesic areas may be persisting as a seedbank or at very low densities during the drought.

Figure PC-1: Search Area and Observations of Choris's popcorn flower

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. It should not be presumed extirpated, and habitat for Choris's popcorn flower should be maintained.

Stewardship priority and management recommendations

Stewardship priority for this taxon is low. While one can prove a species is present, one can't prove absence. Because this plant was recently located in past surveys, it is probably extant even though we could not locate it. The severe drought and large survey areas make it possible that the plant was not detectable in 2015. We recommend additional surveys, especially in wetter years. If the plants are found, threat assessments should be completed. In addition, reference populations could be visited and characterized, with the intention of determining whether appropriate habitat exists or could be restored on San Bruno Mountain. Reintroductions or enhancements could then be an option.

San Francisco Campion *Silene verecunda ssp. verecunda* S. Watson

San Francisco campion (also referenced as *S. verecunda* and/or *S. verecunda* complex in this ISA) is an entity that needs further taxonomic study. Given this report is not a taxonomic study, but rather a report on RTE taxa known from SBM, our work will only provide a cursory analysis of the difficulties relating to our findings. Per the Jepson eFlora description of *Silene verecunda* (Hartman et al. 2016), this plant is a perennial herb growing to about 0.5m in height, typically flowering in the summer. On San Bruno Mountain, this plant is found to be in anthesis in March and April, much earlier than reported in formal taxonomic references. The early flowering state of this plant differentiates it from the larger *Silene scouleri.* The caudex may or may not be branched, stems may or may not be glandular. Corolla color may vary from white to lavender (Plates SV-1,2,3). The 2015 survey results section includes what we observed on SBM, specifically diagnostic details that aid in discerning *S. scouleri* from *S. verecunda.*

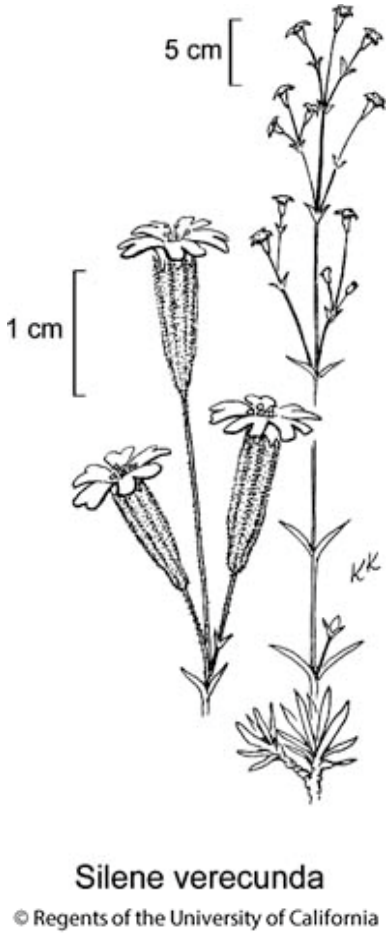


Plate SV-1 (left): Line drawing © Regents of the University of California. Plate SV-2 (top right): Campion observed near summit, SBM, which is more morphologically similar to *S. scouleri.* Plate SV-3 (bottom right): SF campion observed from sand dunes in Presidio, SF. This plant (which had completed its flowering at least 2 months prior to purported *S. verecunda* on SBM) is a good morphological match to the type specimen.

Synonyms

Silene verecunda subsp. *andersonii* (Clokey) C.L. Hitchc. & Maguire; *Silene verecunda* subsp. *platyota* (S. Watson) C.L. Hitchc. & Maguire; *Silene verecunda* subsp. *verecunda; Silene verecunda* var. *eglandulosa* C.L. Hitchc. & Maguire; *Silene verecunda* var. *platyota* (S. Watson) Jeps.; *Silene verecunda* var. *verecunda*

Description Jepson eFlora

NATIVE
Habit: Perennial herb 10--55 cm; caudex branches few to many. Stem: erect, +- scabrous to puberulent, glandular above or not. Leaf: +- gradually reduced upward, stiff to flexible; lower 3--9 cm, 2--9 mm wide, generally lanceolate; middle spreading to erect; upper 1--4.5 cm, 2--6 mm wide, linear to lanceolate. Flower: calyx 10--15 mm, +- densely puberulent to glandular-puberulent, 10-veined, lobes 2--5 mm; petal claw ciliate throughout or at base, appendages 2, limb white to rose, lobes 2; stamens +- = petal claws; styles 3(4), exserted. Fruit: oblong to ovoid; stalk 2--5 mm, puberulent. Seed: 1--1.5 mm, dark brown to black. Chromosomes: 2n=48.
Ecology: Open areas, chaparral, sagebrush, oak woodland, pinyon/juniper woodland, conifer forest; Elevation: < 3400 m.Bioregional Distribution: c&s NCoR, SN (exc n SNF, Teh), ScV (Sutter Buttes), CW (exc s CCo), SW, W&I, DMtns;Distribution Outside California: to Oregon, Utah, Arizona, Baja California. Flowering Time: Summer
eFlora Treatment Author: Ronald L. Hartman, Richard K. Rabeler & Dieter H. Wilken

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08788 EO Index: 21266
Key Quad: San Francisco South (3712264) **Element Code:** PDCAR0U213
Occurrence Number: 7 Occurrence Last Updated: 2005-02-28
Scientific Name: *Silene verecunda ssp. verecunda* **Common Name:** San Francisco campion
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G5T2
State: S2
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, VALLEY AND FOOTHILL GRASSLAND, COASTAL
BLUFF SCRUB, CHAPARRAL, COASTAL PRAIRIE.
OFTEN ON MUDSTONE OR SHALE; ONE SITE ON SERPENTINE. 30-645
M.
Last Date Observed: 1994-05-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1994-05-XX Occurrence Rank: Unknown
Owner/Manager: PVT, DPR-SAN BRUNO MOUNTAIN SP **Trend:** Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNTAIN, NEAR RADIO TOWERS.
Detailed Location:
PRIMARILY USED THOMAS REID 1983 MAP TO MAP OCCURRENCE AT CNDDB.
Ecological:
ON ROCKY OUTCROPS.
Threats:
General:
SEARCHED FOR BUT NOT FOUND IN 1981. SEEN IN 1983. IN 1994 A PORTION OF THIS OCCURRENCE NEAR THE PEAK WAS SURVEYED AND 3
POPULATIONS WERE OBSERVED WITH 38, 119, AND 129 PLANTS.
PLSS: T03S, R05W, Sec. 08 (M) **Accuracy:** specific area **Area (acres):** 19
UTM: Zone-10 N4171133 E549756 **Latitude/Longitude:** 37.68606 / -122.43567 **Elevation (feet):** 1,200
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
GAN75M0001 GANKIN, R. - MAP OF RARE PLANTS IN THE SAN BRUNO MOUNTAIN AREA. 1975-XX-XX
HAR91U0001 HARRIS, V. - RARE PLANTS ON SAN BRUNO MOUNTAIN - 1991 UPDATE 1991-07-07
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI83M0001 THOMAS REID ASSOCIATES - MAP OF HELIANTHELLA CASTANEA 1983-XX-XX
REI94R0001 THOMAS REID ASSOCIATES - EIR AND EA FOR AMENDMENT TO SAN BRUNO MOUNTAIN AREA HCP 1994-06-XX

Map Index Number: 08788 EO Index: 21266

Key Quad: San Francisco South (3712264) **Element Code:** PDCAR0U213
Occurrence Number: 7 Occurrence Last Updated: 2005-02-28
Scientific Name: *Silene verecunda ssp. verecunda* **Common Name:** San Francisco campion
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G5T2
State: S2
Other Lists:
General Habitat: Micro Habitat:
COASTAL SCRUB, VALLEY AND FOOTHILL GRASSLAND, COASTAL
BLUFF SCRUB, CHAPARRAL, COASTAL PRAIRIE.
OFTEN ON MUDSTONE OR SHALE; ONE SITE ON SERPENTINE. 30-645
M.
Last Date Observed: 1994-05-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 1994-05-XX Occurrence Rank: Unknown
Owner/Manager: PVT, DPR-SAN BRUNO MOUNTAIN SP **Trend:** Unknown
Presence: Presumed Extant
Location:
SAN BRUNO MOUNTAIN, NEAR RADIO TOWERS.
Detailed Location:
PRIMARILY USED THOMAS REID 1983 MAP TO MAP OCCURRENCE AT CNDDB.
Ecological:
ON ROCKY OUTCROPS.
Threats:
General:
SEARCHED FOR BUT NOT FOUND IN 1981. SEEN IN 1983. IN 1994 A PORTION OF THIS OCCURRENCE NEAR THE PEAK WAS SURVEYED AND 3
POPULATIONS WERE OBSERVED WITH 38, 119, AND 129 PLANTS.
PLSS: T03S, R05W, Sec. 08 (M) **Accuracy:** specific area **Area (acres):** 19
UTM: Zone-10 N4171133 E549756 **Latitude/Longitude:** 37.68606 / -122.43567 **Elevation (feet):** 1,200
San Mateo San Francisco South (3712264)

County Summary: San Mateo
Quad Summary: San Francisco South (3712264)
Sources:
GAN75M0001 GANKIN, R. - MAP OF RARE PLANTS IN THE SAN BRUNO MOUNTAIN AREA. 1975-XX-XX
HAR91U0001 HARRIS, V. - RARE PLANTS ON SAN BRUNO MOUNTAIN - 1991 UPDATE 1991-07-07
REI82R0001 THOMAS REID ASSOCIATES - ENDANGERED SPECIES SURVEY ON SAN BRUNO MOUNTAIN 1982-05-XX
REI83M0001 THOMAS REID ASSOCIATES - MAP OF HELIANTHELLA CASTANEA 1983-XX-XX
REI94R0001 THOMAS REID ASSOCIATES - EIR AND EA FOR AMENDMENT TO SAN BRUNO MOUNTAIN AREA HCP 1994-06-XX

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS1024846	Silene verecunda	Elizabeth McClintock, Paul Reeberg	August 12, 1988	s.n.	San Mateo	Grassland near Summit. San Bruno Mountains
CAS560825	Silene verecunda	Elizabeth McClintock	May 10, 1972	s.n.	San Mateo	East of Parking Lot summit of mountain. San Bruno Mountain
CAS1176501	Silene verecunda	Dean Wm. Taylor	8 April 1988	9505	San Mateo	Santa Cruz Mountains. San Bruno Mountain, summit of mountain, near the parking lot at the eastern extent of public road access
CAS519659	Silene verecunda	Elizabeth McClintock, Walter Knight, Irja Knight, Baki Kasapligil	7/18/67	s.n.	San Mateo	San Bruno Mountain. North side of ridge road adjacent to Buckeye Canyon

McClintock et al. & Allshouse and Nelson

McClintock et al. notes this plant as: uncommon, grassland: near Summit. Meanwhile, discussions with Allshouse, Nelson, Schusteff, Dean Taylor, Neal Kramer and other local experts have led to varying opinions on the valid identification of this taxon.

TRA/MIG surveys

This plant was mapped by TRA in several areas and the most recent survey polygon is noted in Figure LG-1 (in 2015 Survey Results) which notes our larger search area as well as known populations of *S. scouleri*.

2015 Survey Results

Although we spent three days searching for SF campion in various locations noted by McClintock et al. and herbarium specimens, only plants that more closely resemble *S. scouleri* were located in 2015 surveys (Plate SV-2 and Figure SV-1). We note that past CNDDB records also note that this plant has “disappeared” in previous years (see “general” in EO 21266, found above). In fact, past specimens (see Plate SV-4) that were collected on SBM that were annotated as *S. verecunda* in fact seem to be closer to *S. scouleri* or another intermediate from the *S. verecunda* complex. An even older collection by McClintock is included and also seems to have mostly *S. scouleri* traits.

Plate SV-4: 1988 Collection annotated as *S. verecunda ssp. verecunda* that seems to have mostly plants that are more similar to *S. scouleri* except the bottom left specimen which looks more similar to *S. verecunda.* This collection is from the summit, one of the known/presumed locations of this plant.

Plate SV-5: 1972 collection of *Silene* also from similar area (summit) as 1988 collection. Collections seem to catalog the same taxon: *S. scouleri.*

Since this taxon is so confusing we reached out to Thomas Stoughton and Dean Taylor for insight into this genus. Taylor confirmed seeing *S. verecunda* on SBM within the past 5 years. Stoughton, a PhD candidate at Rancho Santa Ana Botanic Garden and researcher of *Silene* notes: "I'm not sure about the numbers but there are at least 2 or 3 taxa from the bay area worthy of recognition that would be well-placed as varieties of *S. verecunda*, but that would leave the bulk of the diversity in southern California as something different altogether (i.e., the *S. platyota* species complex)." Stoughton (2014) notes that "botanists who are familiar with the *S. verecunda* complex have confirmed this 'species' has served as a taxonomic dumping ground for numerous entities possessing some but not all the diagnostic morphology of *S. verecunda* S. Watson." His published work on a new species of *Silene* notes this genus as particularly difficult to identify using morphological characteristics and ecological settings (Stoughton et al. 2014) even though some preliminary separation was noted by Morton (2005). Characters for identification include: a) glandular hairs (trichomes) and their location on the plant, b) leaf morphology including pedicles, c) calyx color, d) growth habitat (low and spreading). Stoughton also notes that *S. verecunda* typically has longer pedicles (1-2x calyx length), than *S. scouleri* which has short pedicles. He also notes that carpophore (calyx capsules) are distinctly constricted in *verecunda* (Plate SV-6).

Here is a list of traits we (completed at CAS with D. Nelson and D. Allshouse present) have attributed to *S. verecunda* based on its type specimen from Mt. Davidson area (Plate SV-7) in comparison to *S. scouleri.*

Table SV-1: Comparing morphological and habitat traits of two *Silene* taxa expected to be present on SBM.

verecunda (*type*)	*scouleri*
Plant of sandy soils	Plant of rocky substrate, rock outcrops
Stalks/flowering stems frequently branched	Not branched
Stalks usually < 2mm diameter	Stalks often > 4mm in diameter
Leaves slender, drying linear often 4-5x long as wide	Leaves more lanceolate, often only 2-3x long as wide
Leaves usually less than 4mm wide	Leaves usually > 10mm wide at widest point
Inflorescence open, airy	Inflorescence often clustered, dense with flowers
Flowers often singular along inflorescence axis, with a terminal cluster of 1 to many	Flowers often paired or greater when found along inflorescence axis, terminal cluster of many flowers
Carpophore drying with pronounced restriction	Carpophore gradually tapering to pedicle
(see Plate SV-6)	(see Plate SV-6)

Plate SV-6: Carpophore constriction noted in *verecunda* after anthesis. *Scouleri* is more conical without a notable constriction (photo and annotation: David Nelson).

Plate SV-7: *S. verecunda* type specimen courtesy of the Harvard herbarium.

In conclusion, although it is not clear which *Silene* taxon occurs on SBM, 2015 surveys only revealed one taxon. It is possible to annotate these plants as either *verecunda* or *scouleri*, since it seems like intergrading between *Silene* is not only possible, but rampant.

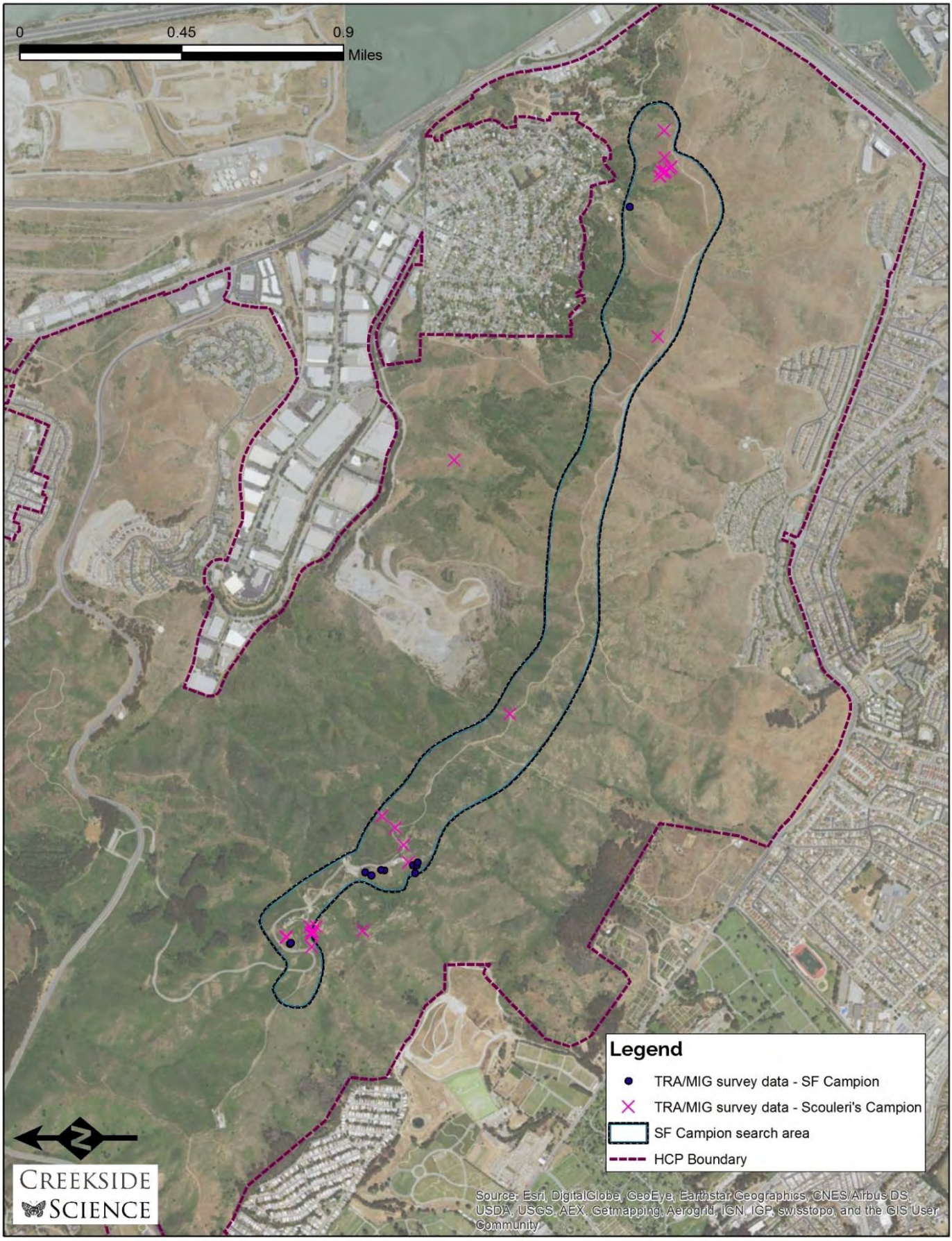


Figure SV-1: *Silene* distribution data from TRA/MIG and 2015 surveys.

2016 Survey and Volunteer Effort

In March and April of 2016, a remarkable volunteer botanist effort relocated a significant population of 34 *Silene verecunda* plants located near the summit. An additional survey on 4/16/16 counted and mapped 82 plants. This information was submitted to the County Parks Department. L. Naumovich visited the site on 4/18/16 to observe and complete a cursory map of the area which is included below (Figure SV-2).

Figure SV-2: Cursory distribution map of *Silene verecunda* observed on the SBM summit on 4.18.16

Mark Sustarich, David Nelson and Doug Allshouse, among others, all visited this summit site and photographed (Plates SV-8,9) what can be fairly confidently described as *S. verecunda.* Most notably, we would annotate Table SV-1 (from above) with these changes marked in red, which indicate that the plants found on SBM are unique from the type specimen (Table SV-2).

Plates SV-8 (left): *S. verecunda* photo by D. Nelson (summit area). Plate SV-9 (right): *S. verecunda* inflorescence stalk.

Table SV-2: Comparing morphological and habitat traits of three *Silene* 'taxa' expected to be present on SBM. Taxon "*verecunda* (San Bruno)" is not yet described.

verecunda (*type*)	*verecunda* (*San Bruno*)	*scouleri*
Plant of sandy soils	Plant of rocky substrate, rock outcrops	Plant of rocky substrate, rock outcrops
Stalks/flowering stems frequently branched	Stalks/flowering stems frequently branched	Not branched
Stalks usually < 2mm diameter	Stalks usually < 2mm diameter	Stalks often > 4mm in diameter
Leaves slender, drying linear often 4-5x long as wide	Leaves slender, drying linear often 3-5x long as wide	Leaves more lanceolate, often only 2-3x long as wide
Leaves usually less than 4mm wide	Leaves 3-10mm at widest point	Leaves usually > 10mm wide at widest point
Inflorescence open, airy	Inflorescence open, airy	Inflorescence often clustered, dense with flowers
Flowers often singular along inflorescence axis, with a terminal cluster of 1 to many	Flowers often singular along inflorescence axis, with a terminal cluster of 1 to many	Flowers often paired or greater when found along inflorescence axis, terminal cluster of many flowers
Carpophore drying with pronounced restriction (see Plate SV-6)	Carpophore may or may not gradually tapering when dry	Carpophore gradually tapering to pedicle (see Plate SV-6)
Pedicle & caylx non-glandular	Pedicle and calyx may be glandular	Pedicle and calyx may be glandular, at least minutely

We are overwhelmed that these plants were relocated and are not lost from the extant flora of SBM. The effort of the volunteer botanists cannot be understated. These plants should be formally surveyed much earlier in the year (March and April) in a year with average to above-average precipitation in order to confirm their distribution on SBM.

Recommendation for continued inclusion as HCP covered species

This plant is provisionally recommended for continued inclusion as an HCP covered species until a second round of targeted surveys for this taxon can be conducted. We do believe there is a unique *Silene* present on SBM, but it may not yet have a proper epithet. Until this taxonomy is resolved, we recommend continued inclusion.

Stewardship priority and management recommendations

Stewardship priority of this taxon is high. In light of the 2016 discovery, this plant is present in a limited distribution on SBM. We would recommend trials with direct seeding and outplanting nursery stock into areas where this plant was historically observed in TRA/MIG surveys. We recommend direct seeding in a few trial areas that can be easily monitored, but we do not recommend outplanting at the summit, or anywhere else, where the re-located (extant) population exists. We would recommend the county encourages researchers to study the *verecunda* complex in order to better understand the Bay Area taxonomy.

Dune Tansy *Tanacetum bipinnatum* (L.) Sch. Bip.

Dune tansy is a rhizomatous perennial herb in the sunflower family (Asteraceae). This plant is largely restricted to coastal dunes, thus there has been much confusion about its taxonomy at San Bruno Mountain. Its late-flowering yellow composite flowers are discoid, often forming a showy golden inflorescence typically in June through September. It is differentiated from other *Tanacetum* species by leaves that are bipinnately lobed, with long, soft to tomentose hairs. It is fairly easy to differentiate from other taxa on SBM (Plates TB-1,2,3).

McClintock et al. (1990) notes “Its occurrence on SBM, so far removed from its coastal dune habitat, is interesting and puzzling”. Indeed, the one individual was found not in the Colma Sand Dunes where one might expect, but near the main parking area at the Saddle Area with more clayey soil. Local lore says that individual was planted.

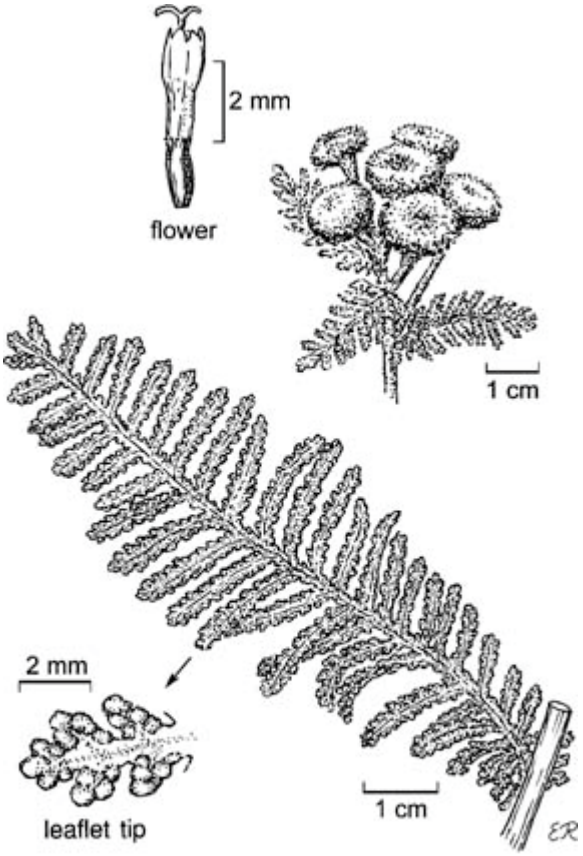


Plate TB-1 (left): *Tanacetum camphoratum* (syn. *T. bipinnatum*), Jepson Manual (© UC Board of Regents). Plate TB-2 (upper right): inflorescence from plant in the Presidio, SF. Plate TB-3 (lower right): Bipinnate leaves of dune tansy.

Synonyms

Tanacetum bipinnatum (L.) Sch. Bip., *Omalotes camphorata* (Less.) DC., *Omalanthus camphoratus* (Less.) Less., *Tanacetum douglasii* DC., *Tanacetum elegans* Decne.

Description Jepson eFlora

NATIVE
Habit: Perennial herb from rhizome, 5--80 cm. Stem: +- decumbent to ascending or erect. Leaf: basal and cauline, petioled or sessile, generally 7--25+ cm, 3--10+ cm wide, ovate to elliptic, obovate, or spoon-shaped, 2--3-pinnately lobed, 1° lobes generally 6--24+ pairs, linear to +- oblong to linear-elliptic, 2° lobes +- lanceolate to oblong or ovate, sometimes curled, ultimate margins entire or +- dentate, faces generally +- long-soft-hairy to tomentose, sometimes +- glabrous. Inflorescence: heads disciform to +- radiant or +- radiate, (1)5--12(20+); involucre 8--22+ mm diam; receptacle flat to hemispheric. Ray Flower: 8--21+ or rayless pistillate flowers 15--30+; corolla yellow, ray 0--7+ mm, or rayless flowers with +- bilateral, 3--5-lobed corolla. Disk Flower: corolla, 2--4 mm. Fruit: 2--3(4) mm, weakly 5-ribbed or -angled. Chromosomes: 2n=54.
Ecology: Uncommon. Coastal dunes; Elevation: < 30 m. Bioregional Distribution: NCo, n CCo; Distribution Outside California: to Alaska, northern Canada, north-central United States; Eurasia. Flowering Time: Jul--Oct Synonyms: Tanacetum camphoratum Less.
eFlora Treatment Author: Linda E. Watson

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Dune tansy is not a federal- or state-listed plant, so it is rarely tracked in CNDDB forms. We found it is listed as an associate for *Chorizanthe cuspidata* and *Gilia capitata*. We did not include these three forms because none of the occurrences were located on SBM.

Herbarium

Herbarium Specimen #	Taxon	Collector	Date	Collection #	County	Notes
CAS508408	*Tanacetum bipinnatum*	Walter and Irja Knight	Aug. 5, 1963	s.n.	San Mateo	San Bruno Mountain. Radio Road

McClintock et al. & Allshouse and Nelson

McClintock (1990) says “it is now extinct at its original location on Radio Rd across from Summer Seep, however cuttings taken to the Regional Parks Botanic Garden, Berkeley, several years ago it has been recently transplanted near its original site”. In a recent conference, it was revealed that the cuttings were actually from Sunset Heights, not SBM. Allshouse and Nelson say it can be found in San Francisco dune remnants including Sutro Baths area; one plant at non-sandy site on San Bruno Mountain since about 1964.

2015 Survey Results

Three plants were located November 30 near the main parking lot, between the service road and the bog trail. Instead of sand dune, it was in a highly disturbed, weedy trailside strip. The plant was growing in clayey soil, near the canopy line of a Monterey Cypress. The location did not seem sustainable. Threats included disturbance from road and trail (trampling or maintenance) and invasive species such as *Oxalis pes-caprae* and *Holcus lanatus.* Dune tansy was not found in the more suitable sandy habitat of the Colma Dunes (Figure TB-1).

Figure TB-1: Search Area and Observations of Dune Tansy

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. The sand dune community is uncommon SBM, and uncommon so far inland, and should be protected and enhanced.

Stewardship priority and management recommendations

Stewardship priority for this plant is medium. The current location where this plant has been restored to is not appropriate habitat. It may be more prudent to put limited resources into introducing this plant in the right habitat, rather than trying to maintain the plant in its disturbed, weedy, shady site.

While this taxon is not as rare as some of the others found on SBM, it seems likely that a robust population could be created with a fairly small effort. We recommend a reintroduction location in the Colma Dunes area. The sandy soils at the Colma Dunes seem to be excellent potential habitat for this plant. Because this plant is not federal- or state-listed, an introduction may not need to go through a long regulatory process. People who have worked with this plant, such as the Regional Parks Botanic Garden at Berkeley, and the National Park Service restoration team at the Presidio of San Francisco, should be consulted with for tips on propagating the plant and using it in restoration projects. Currently this plant is being propagated at the Mission Blue Nursery.

San Francisco Owl's Clover *Triphysaria floribunda* (Benth.) Chuang & Heckard

San Francisco owl's clover is an annual forb in the broomrape family. This plant is highly restricted to areas typically within 20 miles of the coast from Marin to Santa Cruz County. Like most members of this family, these plants are hemiparasitic, meaning they both photosynthesize and form parasitic root connections with host plants.

Key features for identification include: leaves are alternate, and the upper two corolla lobes form an open beak. As with other *Triphysaria*, there is only one anther sac per stamen. Key diagnostic features of this plant are the yellow-brown color of the stem, the white to cream-colored corolla, and the stamens that protrude beyond the upper lip of the corolla (Plates TF 1-2).

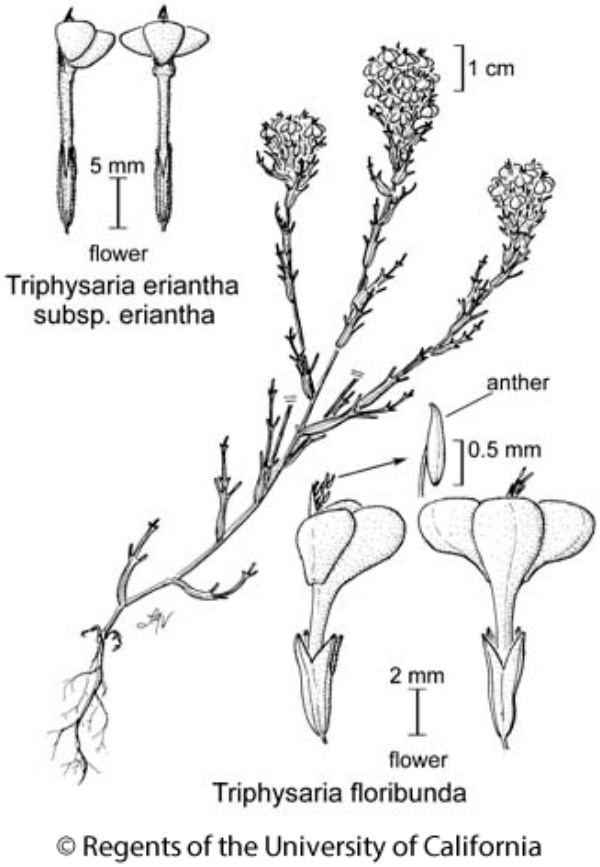


Plate TF-1: *Triphysaria floribunda,* Jepson Manual (© UC Board of Regents). Plate TF-2 (right): Image from CalFlora © 2015 Robert Sikora.

Synonyms

Orthocarpus floribundus Benth.

Description Jepson eFlora

NATIVE
Habit: Plant 10--30 cm, yellow-brown, +- glabrous or sparsely stiff-hairy. Leaf: 10--40 mm, 5--9-lobed. Inflorescence: generally 1--5 cm, dense; bracts 5--12 mm, 3--7-lobed, +- glabrous. Flower: calyx 4--6

mm, divided 1/4--1/2; corolla 10--14 mm, creamy white, tube glabrous, lower lip +- = beak, pouches +- 2 mm deep; stamens exserted. Fruit: 4--5 mm. Seed: 20--30, dark brown.
Ecology: Coastal grassland, serpentine slopes; Elevation: < 200 m. Bioregional Distribution: n CCo, w SnFrB (Marin, San Mateo cos.). Flowering Time: Apr--May
eFlora Treatment Author: Margriet Wetherwax, T I. Chuang & Lawrence R. Heckard

CNDDB occurrence data, Herbarium collections, and previously known locations

CNDDB

Map Index Number: 08927 EO Index: 17742
Key Quad: San Francisco South (3712264) **Element Code:** PDSCR2T010
Occurrence Number: 13 Occurrence Last Updated: 2008-01-23
Scientific Name: *Triphysaria floribunda* **Common Name:** San Francisco owl's-clover
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists:
General Habitat: Micro Habitat:
COASTAL PRAIRIE, COASTAL SCRUB, VALLEY AND FOOTHILL GRASSLAND. ON SERPENTINE AND NONSERPENTINE SUBSTRATE (SUCH AS AT PT. REYES). 10-160 M.
Last Date Observed: 1965-04-25 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1965-04-25 Occurrence Rank: Unknown
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Presumed Extant
Location:
POINT SAN BRUNO, AT EASTERN END OF SAN BRUNO MOUNTAIN, SOUTH SAN FRANCISCO.
Detailed Location:
EXACT LOCATION UNKNOWN. MAPPED BY CNDDB AS A BEST GUESS BASED ON MULTIPLE VAGUE COLLECTION SITE DESCRIPTIONS.
Ecological:
Threats:
General:
3 COLLECTIONS FROM "SOUTH SAN FRANCISCO" AND ONE COLLECTION FROM "2 MILES SOUTH OF COLMA" ALSO ATTRIBUTED TO THIS SITE.
PLSS: T03S, R05W, Sec. 23 (M) **Accuracy:** 1 mile **Area (acres):** 0
UTM: Zone-10 N4167626 E554614 **Latitude/Longitude:** 37.65417 / -122.38085 **Elevation (feet):** 125
County Summary: Quad Summary:
San Mateo Hunters Point (3712263), San Francisco South (3712264)
Sources:
BAK02S0002 BAKER, C. - BAKER #346 UC #75150 1902-03-22
ELM03S0025 ELMER, A. - ELMER #4522 UC #311192 1903-04-XX
HOO39S0012 HOOVER, R. - HOOVER #4057 JEPS #4532 1939-04-21
JEP19S0003 JEPSON, W. - JEPSON #8231 JEPS #4533 1919-04-19
JEP91S0012 JEPSON, W. - JEPSON #21406 JEPS #4528 1891-04-04
KNI65S0001 KNIGHT, W. & I. KNIGHT - KNIGHT #1054 JEPS #47716 1965-04-24
MCC68B0001 MCCLINTOCK, E. - A FLORA OF THE SAN BRUNO MOUNTAINS, SAN MATEO CO., CA. PROCEEDINGS OF THE CA. ACADEMY OF SCIENCES VOL. XXXII, NO. 20, PP.587-677. 1968-11-29
PEN40S0004 PENNELL, F. & D. KECK - PENNELL #25426 UC #1012338, SBBG #54528 1940-05-15

Map Index Number: 70733 EO Index: 17744
Key Quad: San Francisco South (3712264) **Element Code:** PDSCR2T010
Occurrence Number: 14 Occurrence Last Updated: 2008-01-23
Scientific Name: *Triphysaria floribunda* **Common Name:** San Francisco owl's-clover
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists:
General Habitat: Micro Habitat:
COASTAL PRAIRIE, COASTAL SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
ON SERPENTINE AND NONSERPENTINE SUBSTRATE (SUCH AS AT PT.
REYES). 10-160 M.
Last Date Observed: 196X-XX-XX Occurrence Type: Natural/Native occurrence
Last Survey Date: 196X-XX-XX Occurrence Rank: Unknown
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Presumed Extant
Location:
RAVINE NORTH OF JUNCTION OF RANDOLPH DRIVE AND HILLSIDE BLVD, SAN BRUNO MOUNTAIN.
Detailed Location:
EXACT LOCATION UNKNOWN. MAPPED BY CNDDB AS A BEST GUESS.
Ecological:
Threats:

General:
ONLY SOURCE OF INFORMATION FOR THIS OCCURRENCE IS A COLLECTION BY PENALOSA FROM THE 1960S.
PLSS: T03S, R05W, Sec. 16 (M) **Accuracy:** 3/5 mile **Area (acres):** 0
UTM: Zone-10 N4169702 E551653 **Latitude/Longitude:** 37.67305 / -122.41427 **Elevation (feet):**
County Summary: Quad Summary:
San Mateo San Francisco South (3712264)
Sources:
MCC68B0001 MCCLINTOCK, E. - A FLORA OF THE SAN BRUNO MOUNTAINS, SAN MATEO CO., CA. PROCEEDINGS OF THE CA. ACADEMY OF SCIENCES VOL. XXXII, NO. 20, PP.587-677. 1968-11-29
PENNDS0001 PENALOSA, J. - PENALOSA #2734 HERBARIUM UNKNOWN (CITED IN MCC68B0001) 196X-XX-XX

Map Index Number: 08774 EO Index: 45076
Key Quad: San Francisco South (3712264) **Element Code:** PDSCR2T010
Occurrence Number: 15 Occurrence Last Updated: 2001-03-09
Scientific Name: *Triphysaria floribunda* **Common Name:** San Francisco owl's-clover
Listing Status: Federal: None Rare Plant Rank: 1B.2
State: None
CNDDB Element Ranks: Global: G2
State: S2
Other Lists:
General Habitat: Micro Habitat:
COASTAL PRAIRIE, COASTAL SCRUB, VALLEY AND FOOTHILL
GRASSLAND.
ON SERPENTINE AND NONSERPENTINE SUBSTRATE (SUCH AS AT PT.
REYES). 10-160 M.
Last Date Observed: 1932-04-07 Occurrence Type: Natural/Native occurrence
Last Survey Date: 1932-04-07 Occurrence Rank: Unknown
Owner/Manager: UNKNOWN Trend: Unknown
Presence: Presumed Extant
Location:
HILLS ABOVE COLMA.
Detailed Location:
EXACT LOCATION UNKNOWN. MAPPED BY CNDDB ON SAN BRUNO MOUNTAIN IN VICINITY OF COLMA.
Ecological:
Threats:
General:
ONLY SOURCE OF INFORMATION FOR THIS SITE IS A 1932 COLLECTION BY FERRIS AND WIGGINS.
PLSS: T03S, R05W, Sec. 05 (M) **Accuracy:** 1 mile **Area (acres):** 0
UTM: Zone-10 N4172021 E549299 **Latitude/Longitude:** 37.69409 / -122.44080 **Elevation (feet):**
County Summary: Quad Summary:
San Francisco, San Mateo San Francisco South (3712264)
Sources:
FER32S0002 FERRIS, R. & I. WIGGINS - FERRIS #8038A UC #1303092, DS, SD 1932-04-07

Herbarium

Seven accessioned records for San Francisco owl's clover on San Bruno Mountain were located in the SMASH database. The earliest collection is in 1893 by W.R. Dudley, and the most recent is 1965 by Walter and Irja Knight. Localities range from the specific (eastern end of San Bruno Mountain; Point San Bruno; north of Randolph Drive at Hillside Blvd. in SSF; to more generalized locations such as Hills above Colma or even the Santa Cruz peninsula North of San Bruno.

McClintock et al. & Allshouse and Nelson

McClintock et al. (1990) states *T. floribunda* is uncommon, and found in moist grassland: ravine north of junction of Randolph Avenue and Hillside Blvd. Her flora says it has not been seen on the mountain since the 1960s despite several searches. Allshouse and Nelson state there are no recent records of *T. floribunda* on San Bruno Mountain; and that it was last seen on the south slopes. The community botanist meeting honed in on Preservation Parcel, Juncus ravine, and other locations on the south slopes as optimal search areas.

2015 Survey Results

San Francisco owl's clover was not found during the 2015 surveys. While the plant was considered throughout the year, the most targeted searches were completed in March and April, when it would have likely been flowering. Southern slopes, drainages, and moist grassland areas were targeted. The areas that were believed to be historical locations were mostly graded, which seemed to imply that former habitat would have been destroyed. It is also possible that this annual that is found in mesic areas may be persisting as a seedbank or

at very low densities during the drought. However, the length of time since this taxon has been seen, and the high number of interested botanists in the area make it seem more likely that *T. floribunda* has been extirpated.

Figure TF-1: Search Area of San Francisco Owl's Clover

Recommendation for continued inclusion as HCP covered species

This plant is recommended for continued inclusion as an HCP covered species. While it is presumed extirpated, the option for reintroducing the species should always be considered.

Stewardship priority and management recommendations

Stewardship priority for this taxon is low. While one can prove a species is present, one can't prove absence. Many negative surveys through the years have documented the absence of this plant. Occasional continued surveys should take place; it would be exciting to find this species. In addition, reference populations could be visited and characterized, with the intention of determining whether appropriate habitat exists or could be restored on San Bruno Mountain.

Reintroductions could then be an option, but proper hydrology and soils are essential. Historic habitat on SBM for this plant seems to be either developed or severely impacted. Notably, reintroductions with species in the same family have proven difficult (e.g. *Castilleja spp.*) because they can be very difficult to grow in a nursery and these plants typically do not germinate from direct seeding.

Other taxa considered in surveys

Several other unique taxa were targeted in our searches. Although no specific surveys were carried out for the following taxa based on historic data, we were always cognizant that these may be found. We recommend considering looking for these rare taxa that are considered RTE or unusual taxa by CNPS and/or CRPR:

Checker lily – dark form (*Fritillaria affinis* var. *tristulis*) – An entity of questionable taxonomy. Recent genetic analysis of Fritilaria (Ryan 2014) provides a strong case for recognizing *tristulis* as a distinct taxon which is found in Marin and on the San Mateo coast.

Blue coast Gilia (*Gilia capitata* ssp. *chamissonis*) – Known from Presidio area, growing in sandy soils similar to the Daly City Dunes.

Kellogg's horkelia (*Horkelia cuneata* var. *sericea*) – A coastal horkelia known historically from sand dunes in the area.

Coastal triquetrella (*Triquetrella californica*) – A native moss known from San Bruno mountain. Currently it is considered rare, but it may be simply under surveyed.

Conclusions: Rare Plant Survey

The goal of our 2015 rare plant survey was to execute a complete and systematic survey of plants on SBM. We believe that we succeeded in many cases, meanwhile, we know there are areas where the survey could have been improved.

Fifteen (15) of the 20 RTE taxa were observed in 2015-6. New populations, relocation of historic populations, or polygon extensions were recorded for 11 of the 15 taxa, including *Arctostaphylos imbricata, Arctostaphylos uva-ursi* forma *leobreweri*, *Chorizanthe cuspidata, Collinsia multicolor,* and *Helianthella castanea*. Each taxon located was documented with photographs, GPS location, and the completion of a California Natural Diversity Database (CNDDB) form for each separate occurrence. Four (4) of the RTE plants were designated as "common" 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. 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 (*Silene*) taxa 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.

We deeply appreciate all the assistance given to us by volunteers of the San Bruno Mountain community, San Mateo County Parks staff, and regional experts. The project was intriguing and challenging, and we are in debt to all who assisted us, especially the volunteers who donated many hours to allow us to streamline our search process and better understand plant distributions on San Bruno Mountain.

Next Steps

TAC Meeting

While the scope of this project focused on current surveys and a rudimentary discussion of threats and management options, we recommend a meeting with the TAC and/or key stakeholders to review the key findings of this document. While actual locations and search results/maps will be interesting to the group, the TAC's key role should be to review this document's stewardship priorities and management recommendations, and to provide direction on next steps.

Future Surveys

Throughout the years and into the present, San Bruno Mountain has been well botanized by scores of professionals and local experts. The current survey provides a key update to previous records. The mountain is large and the topography is rugged, however, so it is possible some areas or taxa remain under-surveyed. Although we made our best effort to research the rare taxa and survey all potential sites, there were likely some areas that were omitted. In addition, the four-year drought could have made some species more difficult to locate if they germinated at lower densities or are persisting in a seedbank. Future surveys should target the taxa we were unable to find. Extant taxa are also important to continue surveying, to determine whether their numbers, areal distribution, and habitat quality are increasing or decreasing.

RTE Management Plan

Creekside Science recommends a formal RTE management plan for San Bruno Mountain. A formal RTE management plan should outline a schedule for future surveys. Species that are persisting in habitat that is declining in acreage and/or quality should especially be surveyed regularly. Threats should be continually assessed, especially because scrub encroachment and invasive species have created a dynamic vegetative environment. An RTE management plan should also outline management options and stewardship goals for each taxon. Some of the more locally abundant taxa will need little attention, while others could benefit greatly from simple to more complex stewardship actions.

An RTE management plan should also compile and begin addressing some of the outstanding research questions. Further taxonomic research is recommended for *Grindelia* and *Silene*. Many experiments could be, and should be, initiated in order to assess best management options for the different RTEs (propagation questions and assessment of different management options, etc.).

Other Unique Flora

There are several taxa that were not considered in this survey because they were not technically considered rare, threatened, or endangered, but that are still unique resources on the mountain. Currently, Nelson and Allshouse are working on a locally rare classification system for SBM which will highlight plants that deserve management attention due to their restricted distributions, threats, uniqueness, and other factors. Species that are at the edge of their distribution range, or that are uncommon on the mountain but more common elsewhere, are still important resources and deserving of surveys and/or stewardship attention. Lists of these taxa should be compiled and similar steps (survey schedules, threat assessment, determination of management options, and creation of stewardship goals) should be taken to protect them, too. While species with legal protection under the HCP get the majority of attention, other species are also important for maintaining biodiversity on SBM.

The HCP was finalized in 1982, and in the spirit of adaptive management, new information should be considered. We recommend an update to the HCP's Species of Concern (Exhibit C).

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Appendix A: CNDDB Spreadsheet

Appendix A begins on Page 132 as 11x17 sheets.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
2	AB1	552818	4169788	Arabis blepharophylla	3/10/2015	229	1	census	1	100	0	0	Near ridge trail in Firth Canyon	NW	25	north coastal prairie near top of ridge, on rock outcrop	Achillea millefolium, Chlorogalum pomeridianum, Rumex acetosella, Hypochaeris radicata, Eriogonum nudum, Fesctuca rubra, Festuca bromoides	excellent	open space	none	2	1	1	y	vioped and lupine nearby, dudleya far
3	AB2	552923	4169985	Arabis blepharophylla	3/10/2015	151	5	census	5	80	0	20	Halfway down Firth canyon, above double water tank	NNW	25	north coastal prairie with toyon moving in, midway down canyon, on rock outcrop	Briza maxima, Pteridium aquilinum var. pubescens, Wyethia angustifolia, Acaena pinnatifida, Fritillaria affinis, Luzula comosa, Achillea millefolium	excellent	open space	none	2	3	1	y	
4	AUL1	550601	4170664	Arctostaphylois uva-ursi leobrewerii	11/30/2015	278	4?	visual estimate	GPS 25	0	0	100	midslope above quarry	NNE	10	midslope rocky ridge, coastal scrub	Baccharis pilularis, Ceanothus thrysiflorus, Erigeron glaucus, Frangula californica	good	open space	none	1	4	2	y	~10% dieback, someone has cut scrub from edges to slow succession, but plant
5	AUL2	550472	4170680	Arctostaphylois uva-ursi leobrewerii	4/18/2016	285	4	census	GPSed, about 20	0	0	100	taking small trail - requires bushwhacking to relocated - not well	NNE	10	midslope rocky ridge, coastal scrub	Baccharis pilularis, Ceanothus thrysiflorus, Erigeron glaucus, Frangula californica	good	open space	none	1	4	1	y	dieback minimal (~10%)
6	AI1	549719	4171588	Arctostaphylos imbricata	16-Mar	313	30-50 NOTABLE CLUMPS	census	2000	40	60	0	Kamchatcka rock	NW	15	SUMMIT N FACING SLOPE IN MATURE MARITIME CHAPARRAL	Vaccinium cespitosum, Erigeron foliosus, Calamagrostis nutkaensis, Arctostaphylos imbricata, Eriophyllum staechadifolium, Baccharis pilularis, Ceanothus thrysiflorus	E	OPEN SPACE	2	1	3	2	Many plants scattered in area - most mature, little to no recruitment observed.	Yes
7	AI2	550266	4170942	Arctostaphylos imbricata	11/13/2015	320	1?	visual estimate	GPS, 25	0	0	100	midslope above Manzanita Dyke, fairly tall coastal scrub	N	15	midslope, fairly tall coastal scrub, rocky soil with developed O horizon	Baccharis pilularis, Pteridium aquilinum var. pubescens, Iris douglasiana, Ceanothus thrysiflorus	excellent	open space	none	1	4	1	y	
8	AI3	549734.1	4171327	Arctostaphylos imbricata	11/13/2015	370	50-100	ESTIMATE	700	0	0	100	Summit off Radio Rd	W	5%-25%	summit of SBM, rocky outcrop, low organic soils, slope varies from summit flats to steep drops	Baccharis pilularis, Calamagrostis nutkaensis, Vaccinium cespitosum, Toxicodendron diversilobium	E	Radio towers	1	1	2	1	Large mat of plants, v. difficult to determine true individual #'s, some senescence in plants observed maybe 10-15% of total cover, leaves eaten at edge - possibly rabbits, some leaf spots observed in plants	y
9	AI4	549958	4171070	Arctostaphylos imbricata	11/13/2015	333	5 to 15	ESTIMATE	20	0	0	100	Ridge trail at summit loop, downslope from prior polygon	N	15	rocky local ridgeline, low OM soils	Baccharis pilularis, Calamagrostis nutkaensis, Vaccinium cespitosum, Toxicodendron diversilobium, Ceanothus thrysiflorus	E	TRAIL SERVICE RD	1	1	2	2	INDIVIDUALS CLUMPED, DIF TO TELL APART, HEALTHIER PLANTS, but some dieback and bare spots	Y, 2 sep nearby
10	AI5	550091	4171144	Arctostaphylos imbricata	11/13/2015	290		census	see gps	0	0	100	Pacific Rock	N to E	10	rocky ridgeline	Baccharis pilularis, Calamagrostis nutkaensis, Vaccinium cespitosum, Toxicodendron diversilobium, Ceanothus thrysiflorus	E	NA	1	1	1	2		Y
11	AI6	550260	4171246	Arctostaphylos imbricata	11/13/2015	278		ESTIMATE	see gps	0	0	100	Manzanita Dike	N	8	rocky ridgeline	Baccharis pilularis, Mimulus aurantiacus	E	NA	1	1	1	1	ONE LARGE CONTIGUOUS STAND	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
12	AI7	550429	4170979	Arctostaphylos imbricata	11/30/2015	286		visual estimate	GPS 1000	0	0	100	midslope on powerline ridge, adjacent to second set of towers from summit, near gasline sign	N to NW	50 to 20	midslope, rocky outcrop, coastal wscrub	Ceanothus thrysiflorusr, Baccharis pilularis, Vaccinium cespitosum, Iris douglasiana, Pteridium aquilinum var. pubescens, Frangula californica, Mimulus aurantiacus	excellent	open space	pge gas lines/trail	2	2	2	y	there appera to be a couple hybrids with A. montaraensis., Dieback low, aqbout 5-10%, some spots on leaves; one social trail through population, but looks OK, PGE line is mostly adjacent, not
13	AI8	550448	4171090	Arctostaphylos imbricata	11/30/2015	247		visual estimate	GPS 1000	0	0	100	midslope, adjacent to poiwerline trail	NNW	15	midslope, rocky doil adjacent to powerline trail, coastal scrub	Baccharis pilularis, Frangula californica Mimulus aurantiacus, Vaccinium cespitosum, Salvia spathaceathacea	excellent	open space	none	1	4	1	y	confidence is 2 because some taller plants seem to be potential A. montaraensis hybrids
14	AI9	550325	4170989	Arctostaphylos imbricata	11/30/2015	295		visual estimate	GPS 1000	0	0	100	midslope, above Manzanita dyke	N	25	midslope ridge, rocky soil, remnant coastal prairie above it,	Baccharis pilularis, Rubus ursinus, Vaccinium cespitosum, Mimulus aurantiacus, Pteridium aquilinum var. pubescens, Salvia spathaceathacea, Ceanothus thrysiflorus	excellent	open space	none	1	1	1	y	100m2 of dieback, but lots of active growth/expansion along oother edges.
15	AM1	540213	4171233	Arctostaphylos montaraensis	11/13/2015	260	30-50	visual estimate	GPS, 3000	0	0	100	Manzanita dyke	W	20	local rocky ridge and slope, coastal scrub. Arcto imb on top of ridge and intergrading with arc mon.	Baccharis pilularis, Ceanothus thrysiflorusToxicodendron diversilobium Frangula californica Iris douglasiana	excellent	open space	none	1	2	1	y	*confidence is 5 for two species present, confidence lowers for differentiating presumed hybrids
16	AM2	550085	4171144	Arctostaphylos montarensis	11/13/2015	290		census	see gps	0	0	100	Pacific Rock	N	10	rocky ridgeline	Baccharis pilularis, Ceanothus thrysiflorus, Toxicodendron diversilobium, Frangula californica, Iris douglasiana	E	NA		1	1	1	2	both taller and dwarf forms observed	Y
17	AM3	550458	4171105	Arctostaphylos montarensis	11/30/2015	245	1?	visual estimate	GPS 10	0	0	100	midslope, adjacent to poiwerline trail	NW	20	midslope, below ridge off trail, tall coastal scrub	Baccharis pilularis, Toxicodendron diversilobium, Vaccinium cespitosum, Polystichum munitum, Rubus ursinus, Mimulus aurantiacus	excellent	open space	none	1	4	1	y	confidence is 3 because of hybridization issues. It seems like A. imbricata is on ridges, more exposed rocky soil. Just off the ridge the plants grow taller, competing with other scrub. Probably richer soil and less exposure to wind make plant growth higher
18	AP1	5500989	4171144	Arctostaphylos pacifica	11/13/2015	290	2 mounds	census	20	0	0	100	Pacific Rock	E	10	rocky ridgeline	Arctostaphylos imbricata	E	NA		1	1	1	2	TWO NOTABLE CLUMPS, MAYBE MORE THAN 2 PLANTS. Dieback present at 25% cover	Y
19	AUC1	550085	4171144	Arctostaphylos uva-ursi coatilis	11/13/2015	290		census	see gps	0	0	100	Pacific Rock	E	10	rocky ridgeline	Arctostaphylos imbricata	E	NA		1	1	1	2		Y

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
20	AUC2	549937.3	4171043	Arctostaphylos uva-ursi forma coactilis	11/13/2015	340	3 distinct mounds	census	30	0	0	100	Ridge trail at summit loop	NE	7	rocky local ridgeline, low OM soils	Baccharis pilularis, Iris douglasiana, Ceanothus thyrsiflorus	E	TRAIL SERVICE RD	1	1	2	2	INDIVIDUALS CLUMPED, DIF TO TELL APART, HEALTHIER PLANTS, EROSION CONTROL MATERIALS OBSERVED ON PLANT… IMPLIES EXPANSION	Y
21	AUC3	549958	4171070	Arctostaphylos uva-ursi forma coactilis	11/13/2015	333	unk		400	0	0	100	Ridge trail at summit loop, downslope from prior polygon	N	15	rocky local ridgeline, low OM soils	Baccharis pilularis, Calamagrostis nutkaensis, Vaccinium cespitosum, Toxicodendron diversilobium, Ceanothus thrysiflorus	E	TRAIL SERVICE RD	1	1	2	2	INDIVIDUALS CLUMPED, DIF TO TELL APART, HEALTHIER PLANTS	Y
22	AUS1	549719	4171588	Arctostaphylos uva-ursi forma suborbicularis	16-Mar	313	4 Clones	census	30	75	0	25	Kamchatcka rock	W	15	SUMMIT W FACING SLOPE IN MATURE MARITIME CHAPARRAL	Vaccinium cespitosum, Erigeron foliosus, Calamagrostis nutkaensis, Arctostaphylos imbricata, Eriophyllum staechadifolium, Baccharis pilularis, Ceanothus thrysiflorus	E	OPEN SPACE	2	1	3	4	4 OBVIOUS CLONAL PATCHES, TWO DOING WELL, TWO DECEDANT, GPS MAPPED	YES
23	CC1	547997	4172260	Chorizanthe cuspidata	1-Jul	100	2,000-5000	ESTIMATE	7 ACRES	67	33	0	Colma Dunes	W to S, few E	31 to 0	inland coastal dune, disturbed soils as well as fairly stable soils	Bromus diandrus, Avena barbata, Baccharis pilularis, Acmispon glaber, Lupinus chamissonis, Carpobrotus edulis, Eriogonum latifolium, Chorizanthe cuspidata, Phacelia californica, Acaena pinnatifida	FAIR	SCHOOL, HOUSING						
24	CM1	552775	4169879	Collinsia multicolor	10-Mar	181	20	census	5	30	0	70	FIRTH CANYON	N	30	HIGH QUALITY NORTH COASTAL GRASSLAND, NEAR RIDGE, THINNER SOIL, WITH FRITILLARIA	Horkelia californica, Phacelia imbricata, Salvia spathaceathacea, Heracleum maximum, Polypodium scouleri, Bromus carinatus, Galium porrigens, Lathyrus vestitus	E	OPEN SPACE	0	1	2	1	PLNTS SCATTERED IN DENSE VEGETATION	
25	CM2	548364	4172081	Collinsia multicolor	3/16/2015	118	500	visual estimate	GPS/500	80	20	0	Boneyard Quarry	wnw	30	rocky scree, sunny, in smaller rocks at edge of large pieces	Oxalis pes-capre, Avena barbata, Eschscholzia californica, Eriogonum latifolium, Phacelia californica, Chlorogalum pomeridanium, Marah fabacea, Clarkia spp., Bromus carinatus,Bromus diandrus	good	open space	old quarry, current human trampling potential	3	1	3	y	
26	EF1	552523	4169275	Erysimum franciscana	3/10/2015	160	100	visual estimate	GPS/500+	50	50		ridge east of sign hill ravine	WSW	30	rocky forb rich grassland with some coastal scrub	Avena barbata, Baccharis pilularis, Salvia spathacea, Plantago lanceolata, Achillea millefolium	good	open space	none	2	4	1	y	
27	EF2	552910	4169934	Erysimum franciscana	3/10/2015	151	1000	visual estimate	GPS/500+	50	50		Near ridge trail in Firth Canyon	W	30	forb rich north coastal prairie, some rocky outcrops, some deep moist soils	salv spa, mar ore, Fesctuca rubra, vio ped, Carduus pycnocephalus, avevar, Toxicodendron diversilobium	excellent	open space	none	1	1	1	y	Amsinckia present

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
28	EF3	552575	4169386	Erysimum franciscanum	10-Mar	199	250	visual estimate	2000	60	30	10	SER area	SE	10	open slope with large boulders and BACPIL encroaching, with PLAERE and Lupine species	Baccharis pilularis, Plantago lanceolata, Viola pedunculata, Avena barbata, Achillea millefolium, Heterotheca sessiflora, Eschscholzia californica, Fesctuca rubra, Chlorogalum pomeridianum	G	OPEN SPACE	0	2	3	1	large sparce ppn on south facing slope, good coastal prairie habitat	Y
29	EF4	552733	4169851	Erysimum franciscanum	10-Mar	213	5	census	30	100	0	0	FIRTH CANYON	N	30	HIGH QUALITY NORTH COASTAL GRASSLAND, NEAR RIDGE, THINNER SOIL	Horkelia californica, Phacelia imbricata, Salvia spathaceathacea, Heracleum maximum, Polypodium scouleri, Bromus carinatus	E	OPEN SPACE	0	1	3	1	FEW PLANTS SCATTERED IN SCRUB/GRASSLAND - SUCCESSION HAPPENING AWAY FROM GRASSES	
30	GH1	553586	4169515	Grindelia hirsitula	16-Mar	10	50	visual estimate	100	10	5	85	Brisbane City Limit Sign at Bayshore Blvd	E	45	Cut slope above Bayshore ave and flat graded rdside	Melilotus indicus, Bromus madritensis, Avena barbata, Medicago polymorpha, Plantago lanceolata, Plantago coronopus, Foeniculum vulgare, Erodium botrys	G/F	roadside	grading	3	2	5	Two habitats here - one graded flat (weedy) and adjacent road cut.	point
31	HC1	552884	4170005	Helianthella castanea	18-Jun	113	88	census	750	0	100	0	Firth canyon - two drainage junction	NW	25	grassland at edge of riparian, just upslope	Pteridium aquilinum var. pubescens, Briza maxima, Avena barbata, Toxicodendron diversilobium, Clarkia rubicunda, Mimulus aurantiacus, Quercus agrifolia, Salvia spathaceathacea, Wyethia angustifolia	E	open space	0	2	2	1	ID of Helianthella seems likely, but species looks unique, needs attention - plants in clumps and individuals may be difficult to determine	Y
32	HC2	552472	4170057	Helianthella castanea	18-Jun	168	7	census	300	0	100	0	Brisbane Acres above Margaret Ave.	NW	30	grAassland at edge of oak forest, rocky soils with 2-3 foot boulders	Pteridium aquilinum var. pubescens, Briza maxima, Mimulus aurantiacus, Salvia spathaceathacea, Fesctuca rubra, Heterotheca sessiflora, Rumex acetosella, Dudleya farinosa,Achillea millefolium	E	open space	0	3	2	1	ID of Helianthella seems likely, but species looks unique, needs attention - plants in clumps and individuals may be difficult to determine	Y
33	HC3	552598	4169966	Helianthella castanea	18-Jun	222	1	census	1	0	100	0	Brisbane Acres above Margaret Ave., SW@ of water tower - 200m away	NW	30	open grassland with pocket of BACPIL adjacent, not near ecotone	Briza maxima, Heterotheca sessiflora, Baccharis pilularis, Plantago lanceolata, Poa secunda, Rumex acetosella, Pteridium aquilinum var. pubescens	E	open space	0	2	3	1	ID of Helianthella seems likely, but species looks unique, needs attention - plants in clumps and individuals may be difficult to determine, PICTURE OF SEED PREDATOR INCLUDED	point

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
34	HC4	553209	4169956	Helianthella castanea	26-Jun	120	10	census	200	0	90	10	Above Harold Ave	NW	30	early succession scrub with grassland areas dissappearing	Briza maxima, Toxicodendron diversilobium, Salvia spathaceathacea, Pteridium aquilinum var. pubescens, Mimulus aurantiacus, Genista monspessulana, Agrostis hallii, Elymus glaucus, Bromus carinatus, Heteromeles arbutifolia	GOOD	open space	0	3	4	1	Scott Simono relocation and survey	Y
35	IL1	552483	4169136	Iris longipetala	3/10/2015	70	200	visual estimate	GPS/250	10	0	90	open grassy slope east of sign hill ravine	SW	20	open grassy slope, largely nonnative	Avena barbata, Viola pedunculata, Lysimachia arvensis, Helminthotheca echioides	good	open space	none	2	2	1	y	
36	IL2	552507	4169340	Iris longipetala	3/10/2015	188	30	visual estimate	20	20	10	70	open grassy slope just west of fire road	SE	15	open grassland with coyote brush encroachment	Baccharis pilularis, Festuca bromoides, Avena barbata, Carduus pycnocephalus, Erodium botrys, cirsium brevistylum	fair	open space	none	2	4	1	y	
37	IL3	552714	4169620	Iris longipetala	3/10/2015	234	120	visual estimate	100	10	0	90	Scrub at headwaters of drainage	ESE	10	coyote brush filled top of drainage	Baccharis pilularis, Carduus pycnocephalus, marah oregana, weedy mustard not flowering	poor	open space	none	2	5	1	y	
38	IL4	552459	4169169	Iris longipetala	10-Mar	85	57	census	15	10	10	80	SIGN HILL RAVINE	W	30	in lower drainage	Avena barbata, Plantago lanceolata, Carduus pycnocephalus, Lathyrus vestitus	G	OPEN SPACE	0	2	1	1	3 separate ppns in ravine bottom, 30 in one, 20 in another and 7 in the upper most-10m apart for first two, thrid was about 30m up canyon farther, GPS is for lowest,largest ppn	
39	IL5	552589	4169470	Iris longipetala	10-Mar	213	22	census	3	10	10	80	SER area	SE	5	in BACPIL polygon, upper slope	Baccharis pilularis, Festuca myuros, Erodium botrys, Avena barbata	F	OPEN SPACE	0	3	5	1	1 ppn in BACPIL near ridge, browsing evidence, photo of fungus?	
40	IL6	552591	4169436	Iris longipetela	10-Mar	209	200	visual estimate	15	10	10	80	SER area	SE	5	in BACPIL polygon, upper slope	Baccharis pilularis, Festuca myuros, Erodium botrys, Avena barbata, Cirsium brevistylum	G	OPEN SPACE	0	2	3	1	3 PTNS IN BACPIL POLYGON, GPS FROM 2 LOWEST ABOUT 5 M APART,	
41	IL7	552774	4169668	Iris longipetela	10-Mar	232	100	visual estimate	12	40	10	50	NEAR RIDGE TRAIL	W	5	in BACPIL polygon, upper MTN	Baccharis pilularis, Avena barbata, Erodium botrys, Carduus pycnocephalus	F	OPEN SPACE	0	2	4	1	3 LOCALES WITHIN 10M, WITH VIOPED	
42	IL8	552864	4169018	Iris longipetela	10-Mar	55	20	visual estimate	4	50	0	50	NEAR TECH SKSCRAPER	NE	10	BOTTOM OF SLOPE IN BACPIL	Avena barbata, Baccharis pilularis, Carduus pycnocephalus	F	OPEN SPACE, COMMERCIAL	0	4	4	3	PATCH NEAR ENTRANCE/TRAILHEAD TO BOUNDARY FIRE RD WITH SOME	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Polygon ID	UTM E	UTM N	TAXON	DATE	Elevation (m)	Population / # plants	Population recording/estimation method	Occupied habitat size (m2)	Pheno: Flowering %	Pheno: Fruiting %	Pheno: Vegetative %	Location description	Aspect	Slope	Habitat description (noatble soils, shade, etc.)	Dominant Associates (6-letter codes): EG Toxicodendron diversilobium	Overall site quality: Excel/Good/Fair/Poor	Immediate/surround land use	visible disturbance	threats: Invasives (1-5, 5 is highest)	threats: Succession/Scrub (1-5, 5 is imminent)	threats: Human caused e.g. rds/trails/digging. (1-5)	GPS polygon	Notes
43	LG1	547997	4172260	Lessingia germorum	1-Jul	100	10,000-30,000	ESTIMATE	7 ACRES	50	1	49	Colma Dunes	W to S, few E	30 to 0	inland coastal dune, disturbed soils as well as fairly stable soils	Bromus diandrus, Avena barbata, Baccharis pilularis, Acmispon glaber, Lupinus chamissonis, Carpobrotus edulis, Eriogonum latifolium, Chorizanthe cuspidata, Phacelia californica, Acaena pinnatifida	FAIR	SCHOOL, HOUSING	GRADING, TRAILS/TRAMPLING	4	3	2	threats are succession from eastern end and none native grasses and rumex, some erosion is good	Y
44	TB1	549850	4172398	Tanacetum bipinnatum	11/30/2015	172	4?	visual estimate	GPS 3	0	0	100	Near main parking lot between service road and bog trail, almost under cyopress canopy	W	5	Weedy trailside strip, disturbed area, clay	Oxalis pes-capre, Holcus lanatus, Festuca perennis, Achillea millefolium	poor	trail/roadside	trail/road	5	2	5	y	Planted by Joe Cannon? Persisting. Should put some in sand dunes.
45																									

Appendix C:

Bay Checkerspot Reintroduction
Final Report - January 2022

Central Valley Project Conservation Program
and Central Valley Project Improvement Act Habitat Restoration Program

R17AP00018

Reintroduction of the Bay Checkerspot Butterfly to San Bruno Mountain

Final Report and Adaptive Management Plan
January 2022

Stuart B. Weiss Ph.D., Kirra Swenerton, Christal Niederer, and
Marissa Kent
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CREEKSIDE SCIENCE

Cover photos

Upper left: postdiapause larva feeding on *Plantago lanceolata*

Upper Center: Mating Bay checkerspot butterflies (BCB) on San Bruno Mountain

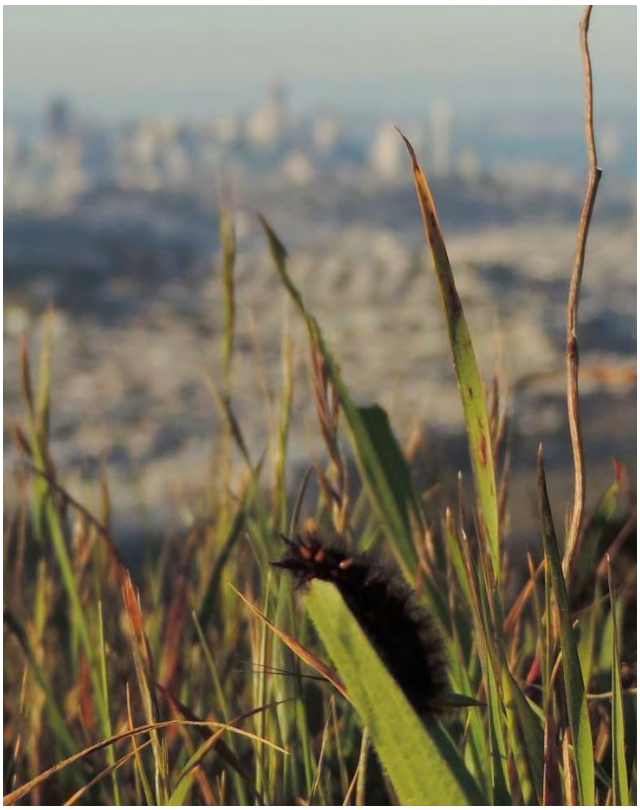
Upper Right: BCB nectaring on *Achillea millefolium*, a widespread nectar source

Lower Left: Egg mass deposited on *P. lanceolata* by a caged female, 2018

Lower Center: 2nd instar prediapause larva just outside of web on *P. lanceolata.*

Lower Right: web of 1st instar prediapause larvae feeding on *P. lanceolata*

Kirra Swenerton releasing larvae from yogurt container, San Francisco Airport in the background, March 2, 2017



Newly released BCB larva eating *P. lanceolata* with San Francisco in the background

All photos by Kirra Swenerton and Stuart Weiss

Contents

Executive Summary

This project aimed to re-establish the Bay checkerspot butterfly (*Euphydryas editha bayensis*) (BCB) on San Bruno Mountain (SBM). A major goal was for the BCB to switch its larval hostplant from the native annual *Plantago erecta* (PLER) to the non-native perennial *Plantago lanceolata* (PLLA). Annual translocations of postdiapause larvae from Coyote Ridge in south San Jose (Santa Clara County) began in 2017, first funded by the Disney Butterfly Conservation Initiative followed by four years of funding by CVPCP. Each year since then, adult butterflies and postdiapause larvae were detected in all the release areas, including 2.5 km of the Main Ridge and Upper Owl and Buckeye Canyons, Lower Owl and Buckeye Canyons, and the Northeast Ridge. By 2021 after five years of translocations of a total 22,489 larvae, the presence of adult BCB and native born postdiapause larvae indicated that the population was establishing.

Eggs and prediapause larvae were found on PLLA, demonstrating oviposition and larval survival on the new hostplant, meeting one of the explicit project goals. In addition, postdiapause larvae were found in stands of PLER on the northern slopes of Upper Buckeye and Owl Canyons in all years after 2017.

Based on the results of monitoring adults and postdiapause larvae, the project has met and exceeded the goal of 300 adult butterflies or 600 postdiapause larvae in two of the four monitoring years. Estimates across all subareas in 2021 (except the new release area on the Northeast Ridge) indicate that there were likely more than 6,000 resident postdiapause larvae.

This final project report includes summary and analysis of all five years of releases and monitoring data. The annual details of milestones and more details can be found in the eight semi-annual progress reports from 2018 to 2021.

This final report also provides recommendations on long-term monitoring and adaptive management. Key elements of the adaptive management guidance include:

- Presence-absence monitoring of BCB adults across the release sites moving forward, coordinated to the degree possible with Mission blue butterfly transect monitoring on a 2-year cycle to be cost efficient.
- Continued emphasis on native scrub control, to maintain open grassland where PLLA and PLER thrive.
- No control of PLLA in the release areas and adjacent grasslands.
- Explicit delineation of areas where PLLA will be considered as BCB habitat, so that plants growing in heavily disturbed areas outside the HCP boundaries such as road margins, vacant lots, and lawns are not considered habitat.
- Consider attempts to establish BCB on other parts of SBM if the current release sites thrive.

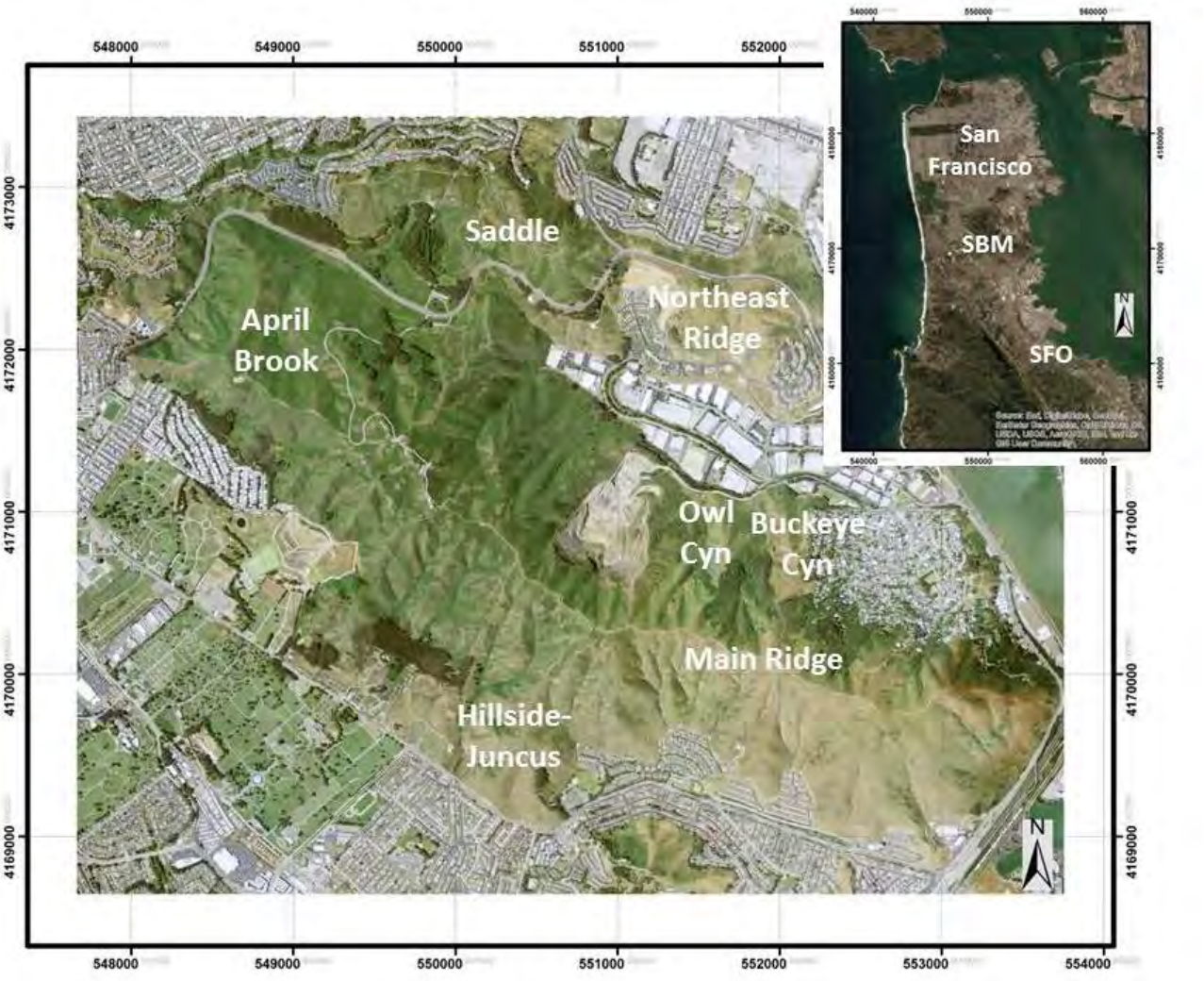
This project is an innovative experiment that can help secure the future of the Bay checkerspot butterfly should it ultimately succeed, albeit in a different ecological setting than when the BCB was extirpated from SBM. Given the rapidly changing global and local environments, the opportunities to manage biodiversity in the face of irreversible changes such as invasive species should be explored with open minds.

Introduction

San Bruno Mountain (Map 1) is home to three species of butterflies listed as endangered by the U.S. Fish and Wildlife Service (USFWS): the Mission blue butterfly (*Icaricia icarioides missionensis*), the San Bruno elfin butterfly (*Callophrys mossii bayensis*), and the callippe silverspot butterfly (*Speyeria callippe callippe*). Their habitat is protected in perpetuity as a part of the SBM Habitat Conservation Plan (HCP). Portions of SBM were identified as critical habitat for the BCB in the HCP based on known occurrences of this butterfly. Unfortunately, in the mid-1980s, the BCB was extirpated from SBM as grasslands were increasingly invaded by non-native annual grasses and forbs, displacing the native larval hostplant *Plantago erecta* (PLER) (TRA Environmental Sciences 1986, 2008). USFWS commissioned a feasibility study for a BCB reintroduction at SBM (Niederer et al. 2015). Habitat surveys in spring 2014-2015 mapped many small patches of PLER and several 1 ha+ sized ones, but not enough to support a viable BCB population.

But the surveyors noted near ubiquitous stands of the nonnative perennial *Plantago lanceolata* (PLLA), which could likely provide enough habitat to sustain a population of BCB. The last postdiapause larvae observed (1983) were feeding on PLLA along the Main Ridge fire road (Weiss pers. obs.), therefore some host-switching was already occurring before the extirpation of the BCB from SBM. PLLA was believed to be less common on the mountain at that time. *Euphydryas editha* ssp. *taylori* populations in Oregon and Washington (Severns and Grosboll 2011) and an *E. editha* population in the Sierra Nevada (Schneider's Meadow) have adopted PLLA as a hostplant (Ehrlich and Hanski 2004). PLLA was successfully used in several laboratory experiments with BCB at the Stanford Department of Biological Sciences in 1985 (Weiss pers. observation.). PLLA is a robust biennial/perennial species that remains green many weeks and even months longer than the native PLER. Given that BCB adult females will oviposit on PLLA, and that prediapause and postdiapause larvae survive on it (experimentally confirmed), potential BCB habitat occurs across much of the grassland on SBM. Nectar is plentiful during the flight season. The mountain is large and topographically/climatically diverse, like Coyote Ridge in Santa Clara County where a healthy, thriving population of BCB persists.

Euphydryas editha is an adaptable species. The large BCB population on Coyote Ridge can supply thousands of postdiapause larvae for translocation without harming the source populations. Reintroducing the BCB to SBM with the expectation they will switch to a nonnative hostplant is a conservation experiment that raises many interesting ecological and policy issues in a rapidly changing environment. This project could show we are able to reintroduce extirpated species into conserved lands, without the technical difficulties and expense of restoring all historical conditions.



Map 1. Locator map for San Bruno Mountain (SBM) and place names within SBM

Translocation of Postdiapause Larvae and Postdiapause Larval Monitoring

Postdiapause BCB larvae were collected on mornings and early afternoons from populations on Coyote Ridge, Santa Clara County that support hundreds of thousands of BCB larvae over a ~2,000 ha expanse of serpentine grassland (Table 1). Coyote Ridge has been the source of larvae for translocations to Edgewood Natural Preserve (San Mateo County) and Tulare Hill (just west of Coyote Ridge) in 2011-2016. Well less than 5% of the Coyote Ridge population was collected in any given year (the highest proportion was 2.2% in 2018), well within the limits set by the USFWS permits. The Kirby Canyon subarea is presented to give a sense of the errors in population estimates, which ensure that collection does not overly impact the populations.

	Kirby Canyon (100 ha)	Coyote Ridge*
2011	94,000 ± 32,000	530,000
2012	132,000 ± 38,000	470,000
2013	250,000 ± 47,000	1,250,000
2014	92,000 ± 35,000	780,000
2015	190,000 ± 70,000	2,100,000
2016	45,000 ± 16,000	380,000
2017	12,000 ± 4,300	380,000
2018	5,500 ± 4,000	220,000
2019	16,000 ± 10,000	890,000
2020	108,000 ± 53,000	695,000
2021	186,000 ± 42,000	790,000

Table 1. Estimated numbers of postdiapause larvae on Coyote Ridge 2011-2021. Kirby Canyon is 100 ha (250 ac.) within the larger ~2,000 ha (7,000 ac.) of Coyote Ridge. The Kirby numbers are shown with 95% confidence intervals.

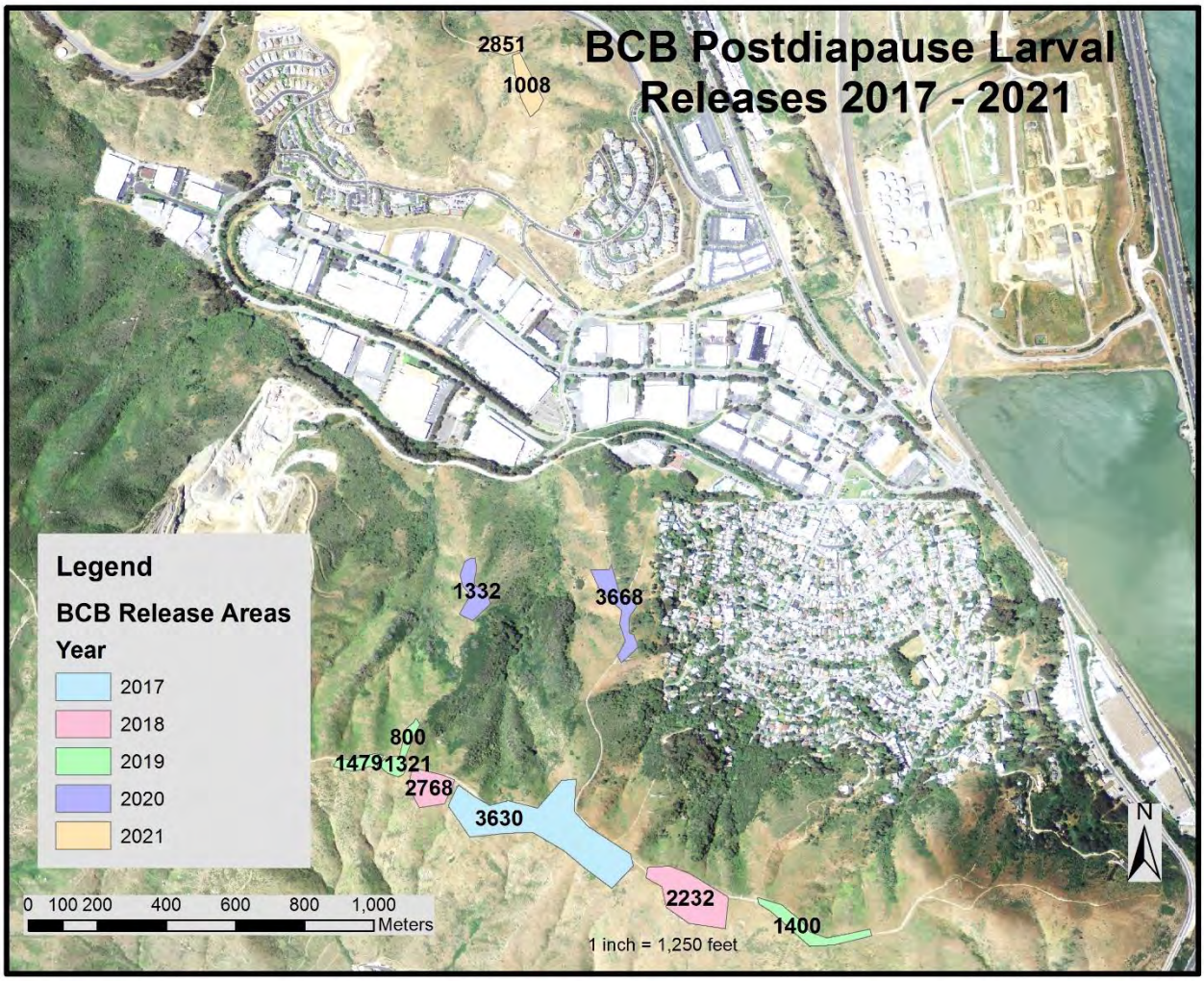
A group of permitted collectors was gathered each collection day. Larvae were found, picked up by hand, and placed into 1 quart plastic yogurt containers which were then put in coolers with blue ice to temporarily reduce their metabolic rate. The larvae were transported to SBM the same day, and released directly onto PLLA or in dense stands of PLER. Upon release, larvae were observed crawling, feeding, and basking until temperatures dropped at sunset and they became inactive. Postdiapause larvae are robust, and none were obviously harmed during translocation. Containers were sterilized with bleach in a dishwasher between uses.

Timed searches for postdiapause larvae have been the standard method for population estimation in BCB populations since 1985 on Coyote Ridge (Murphy and Weiss 1988). Areas ranging from 0.1 to 0.5 ha are delineated in areas of relatively uniform aspect and slope. The number of larvae in a 10-person minute search is recorded, and translated into a density by an empirical equation developed by Weiss (1996). As will be seen below, this method does not work as well in the tall dense grassland with perennial PLLA.

Table 2 shows the number of larvae translocated each year. A total of 22,489 larvae were translocated over the five years, with a maximum permitted 5,000 per year. The number of postdiapause larvae found in the previous year release areas indicates successful reproduction. Release areas are delineated in Map 2. Adult observations will be described in detail below.

Year	Larvae released	Postdiapause Larvae Observed Main Ridge (MR)	Postdiapause Larvae Observed Owl-Buckeye (OB)
2017	3,630 (MR)	n/a	n/a
2018	5,000 (MR)	3	n/a
2019	5,000 (MR)	91	n/a
2020	5,000 (OB)	8	n/a
2021	3,859 (NER)	7	16

Table 2. Release numbers and BCB postdiapause larval observations 2017-2021. Postdiapause larvae observations exclude the current year release areas (i.e., are representative of the resident population).

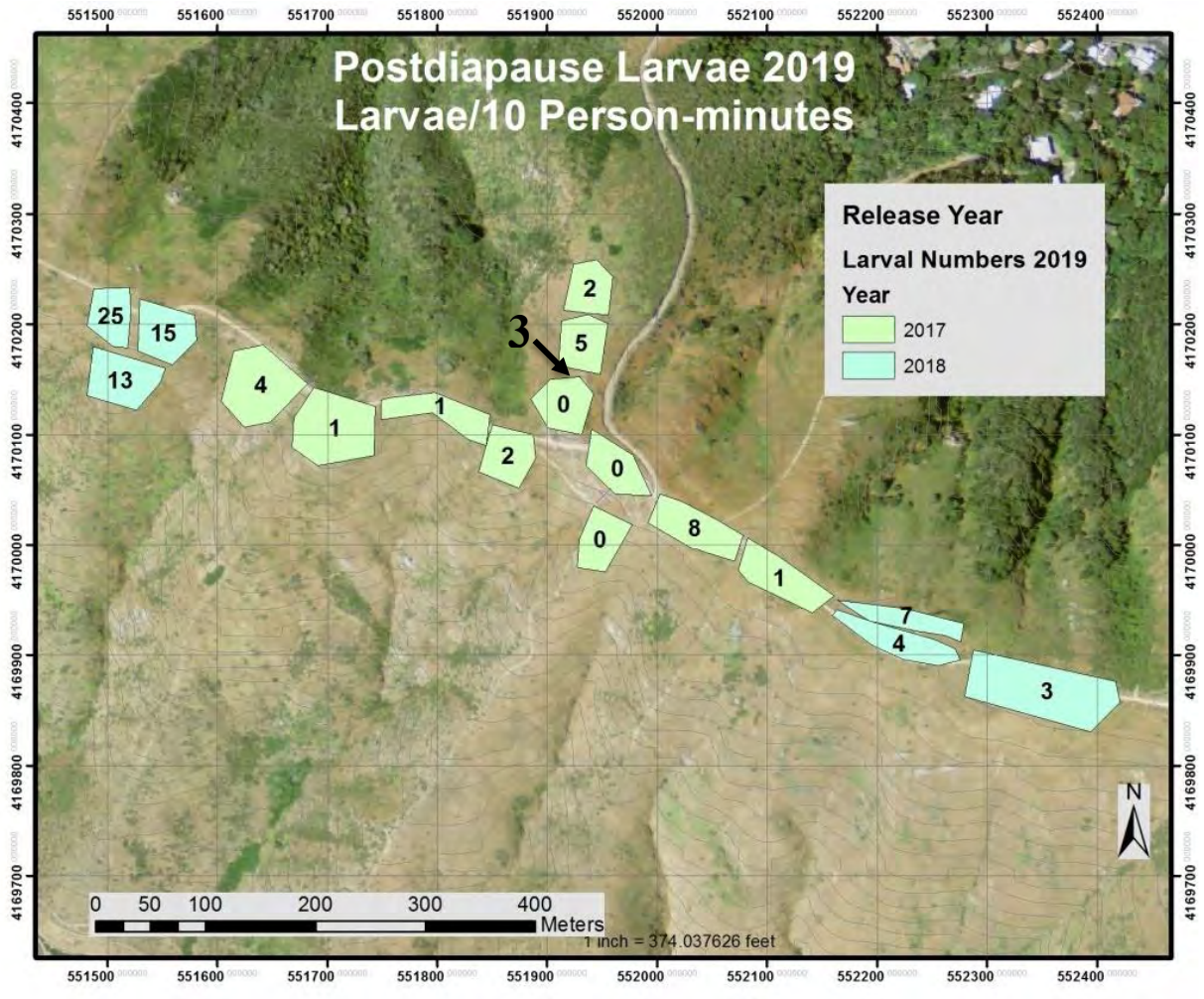


Map 2. Larval release areas 2017-2021, with number released in each site, release year differentiated by colors.

The first year of translocation took place in 2017 funded by the Disney Butterfly Conservation Initiative. In March 2017, 3,630 postdiapause larvae were released along the ~ 1 km of the Main Ridge (Map 2). Three postdiapause larvae descended from these 2017 adults were observed on February 8, 2018, before 2018 translocations, all three in stands of PLER in Upper Buckeye Canyon (Map 3).

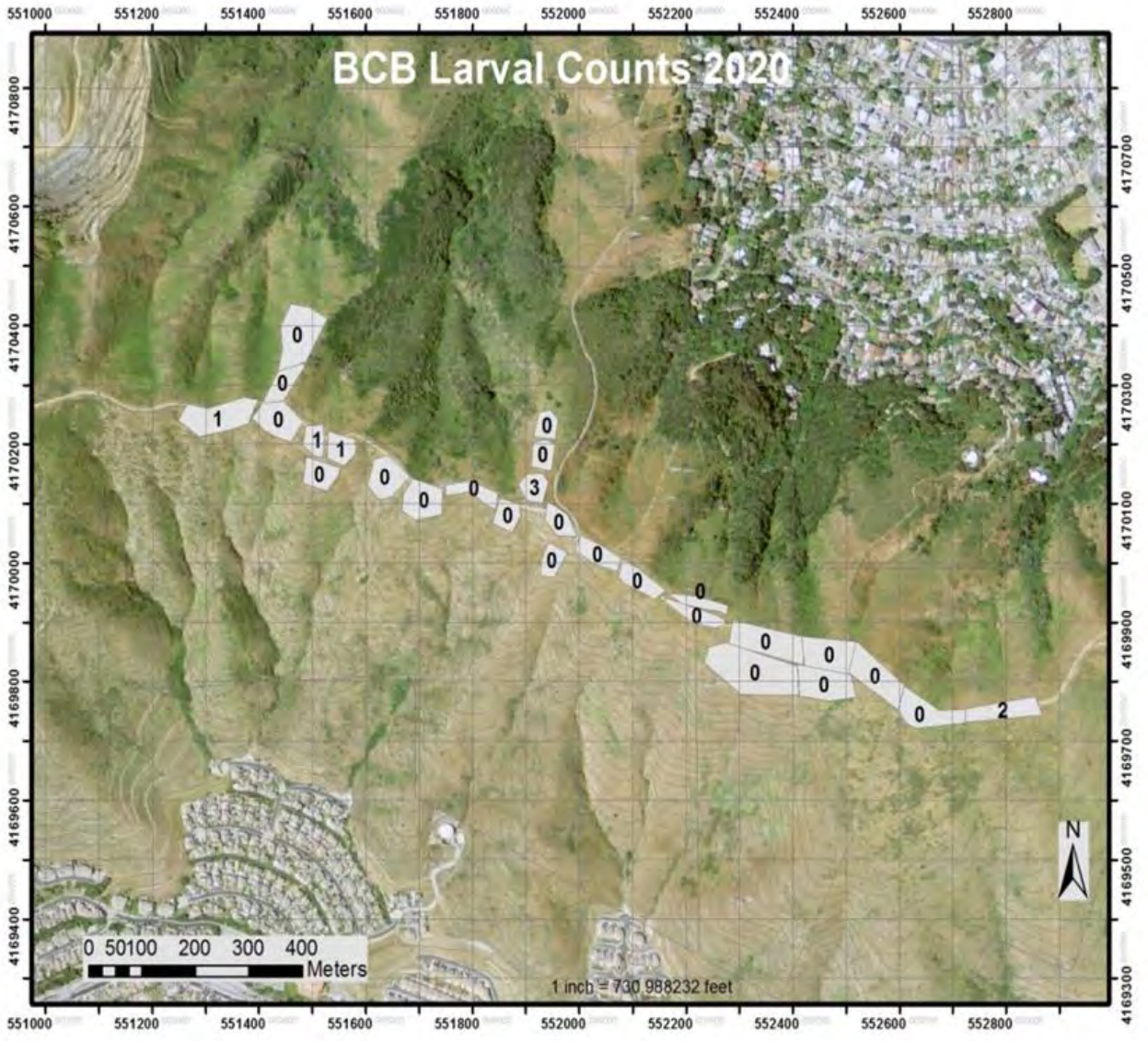
Funding from CVPCP started in fall 2017. In winter 2018, 5,000 larvae were translocated from Coyote Ridge into areas west and east of the 2017 release area (Map 2).

In February 2019, a total of 24 larvae were observed in the 2017 release areas, and an additional 67 larvae observed in the 2018 release areas (Map 3). There was a notable hotspot at the west end of the 2018 release area (Western Hill). The larval population across the 2017 and 2018 release area was estimated at ~4,000 using the standard methodology. Later in February 2019, 5,000 larvae were translocated from Coyote Ridge into areas further east and west of the previous release areas (Map 2).



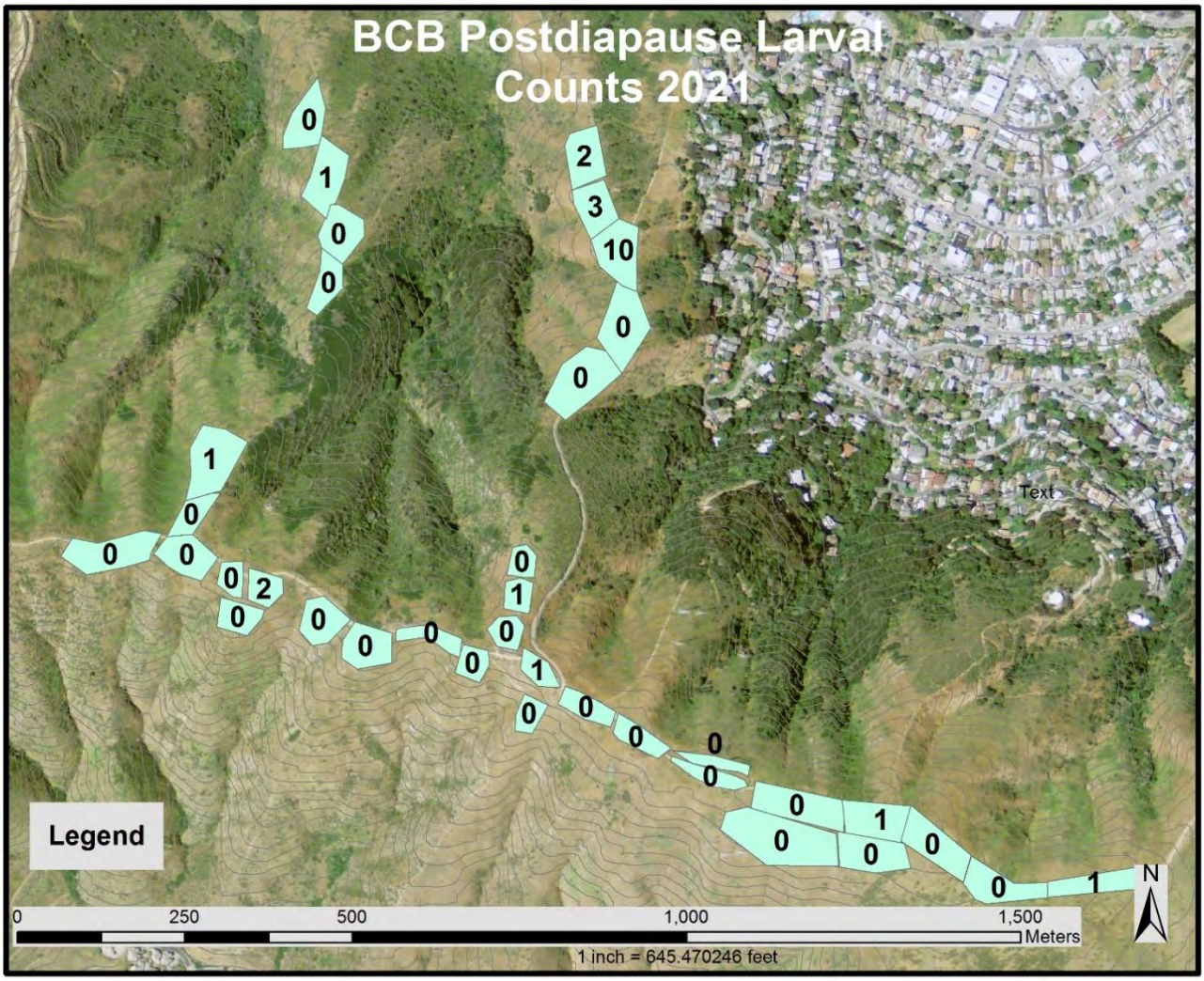
Map 3. Number of larvae observed in 10-person minute searches in 2019. Only the 2017 and 2018 release sites were counted. The "3" with the arrow shows the location of the three larvae found in February 2018.

In February 2020, only eight postdiapause larvae were found along the Main Ridge (Map 4). That month 5,000 larvae were translocated from Coyote Ridge into Owl and Buckeye Canyons.



Map 4. Number of larvae observed in 10-person minute searches in 2020.

In 2021, seven larvae were observed along the Main Ridge and 15 observed in Buckeye Canyon, and only one in Owl Canyon (Map 5). A total of 3,859 larvae were translocated in February-March 2021 to the Northeast Ridge around two small hilltops that support dense stands of PLLA (Map 2, toward the top of the map).



Map 5. Number of larvae observed in 10-person minute searches in 2021.

Adult Butterfly Monitoring

When the transect system was established in 2017, it consisted of 35 segments including 33 50-m segments spanning 1650 m along the Main Ridge and Upper Buckeye Ridge plus an additional two wandering transects segments to sample additional areas downslope from the Main Ridge. In 2018, the transect system expanded to 37 segments including 33 50-m segments spanning 1650 m along the Main Ridge and Upper Buckeye Ridge and four wandering transects to sample downslope areas. In 2019, ten segments were added through the 2019 eastern release area, and four additional segments were added down the north side of Upper Owl Ridge for a total of 51 segments, with 47 50-m segments spanning 2350 m transects primarily along the Main Ridge and Upper Buckeye and Upper Owl Ridges and a few transect spurs on the north and south (Map 6). Transects are walked at 1.5 minutes/50 m and the total number of butterflies observed within 5 m of the centerline are recorded. Incidental butterfly observations outside of the 5-m zone or outside the timed period are noted. Transects were walked every 6-10 days, weather permitting. The number of butterflies observed was converted to butterflies/hr to facilitate comparisons

among years and sites when different lengths of transects were walked. Only days with non-zero observations were included, and counts from particularly windy, cold days were dropped because of low butterfly activity. Butterfly phenology was characterized by the weighted mean date of observations, and the weighted standard deviation of the observation curve.

Data for each year and site are summarized in Table 3, and the flight phenology presented in Figure 1. Maps of the transect system and numbers observed on each transect are in Maps 6 through 10.

Site	Total Butterflies (BF)	Peak BF/day	BF/ hour	Sample days	Mean Date	S.D Days	Segments	Length (m)
MR 2017	47	16	7.0	6	4-Apr	5.2	35	1750
MR 2018	110	30	14.8	7	1-Apr	9.0	37	2122
MR 2019	185	69	32.8	4	13-Apr	7.4	51	2822
MR 2020	45	14	5.0	7	31-Mar	13.1	51	2822
OB 2020	53	21	11.2	7	30-Mar	10.3	27	1350
MR 2021	13	11	5.1	2	1-Apr	4.5	51	2822
OB 2021	9	6	6.2	2	3-Apr	6	27	1350
NER 2021	25	15	21.4	2	4-Apr	6	14	700

Table 3. Flight season summary for 2017-2021. MR = Main Ridge, OB = Owl-Buckeye, NER = Northeast Ridge, S.D. = weighted standard deviation

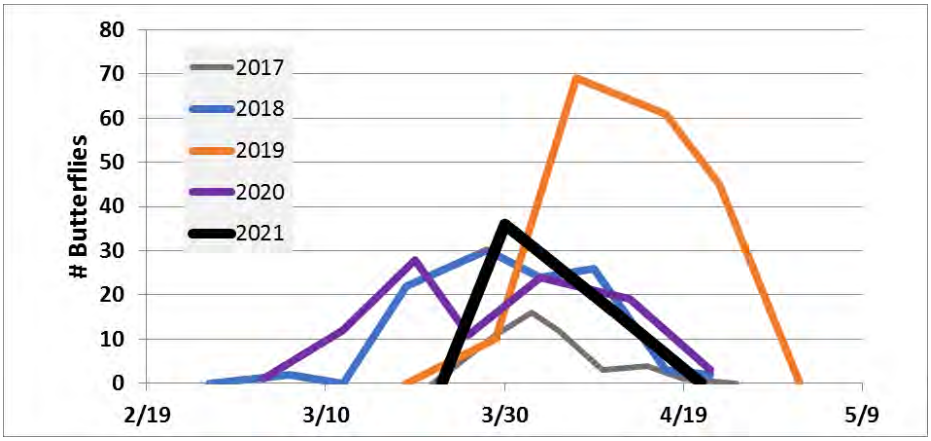
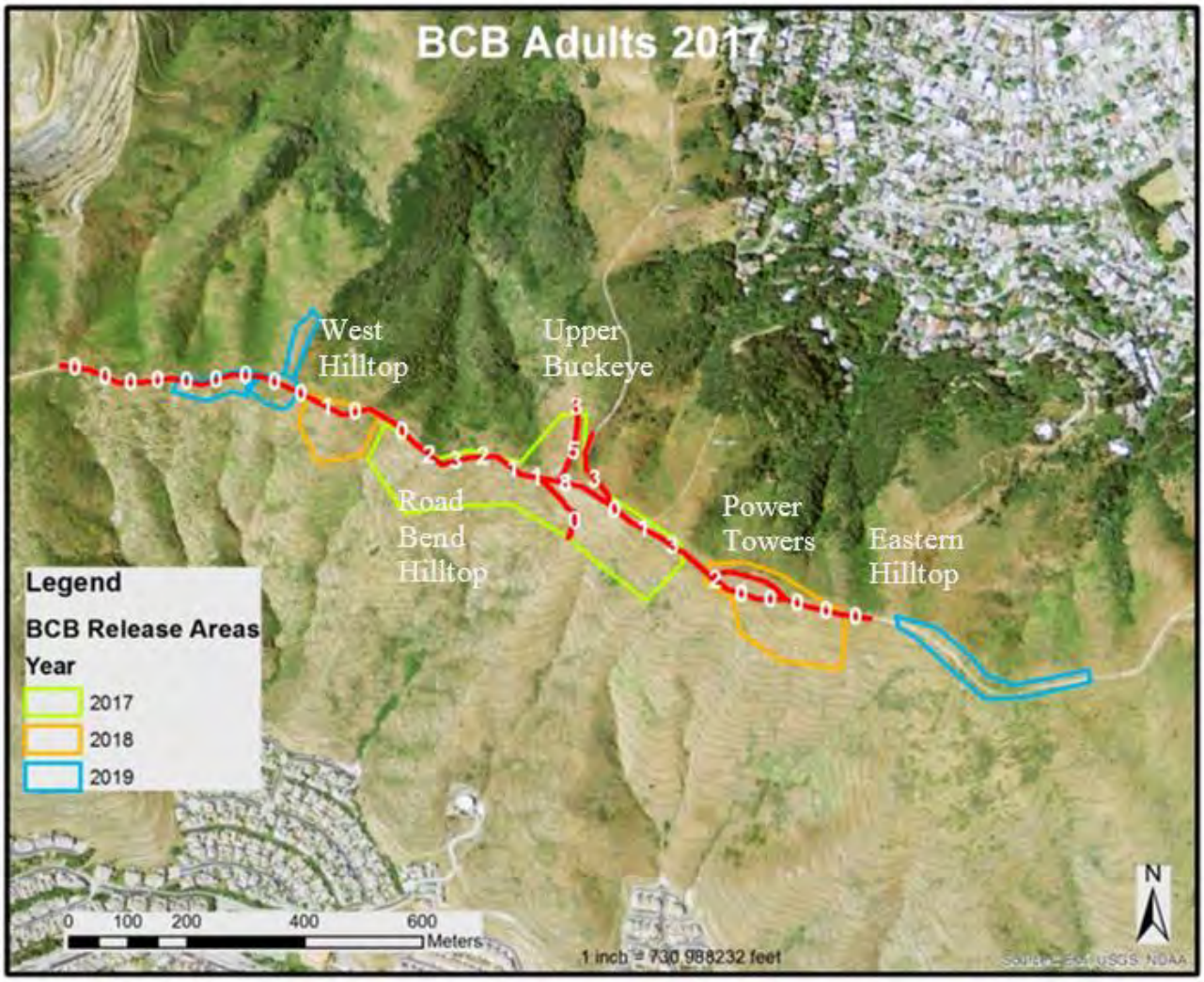


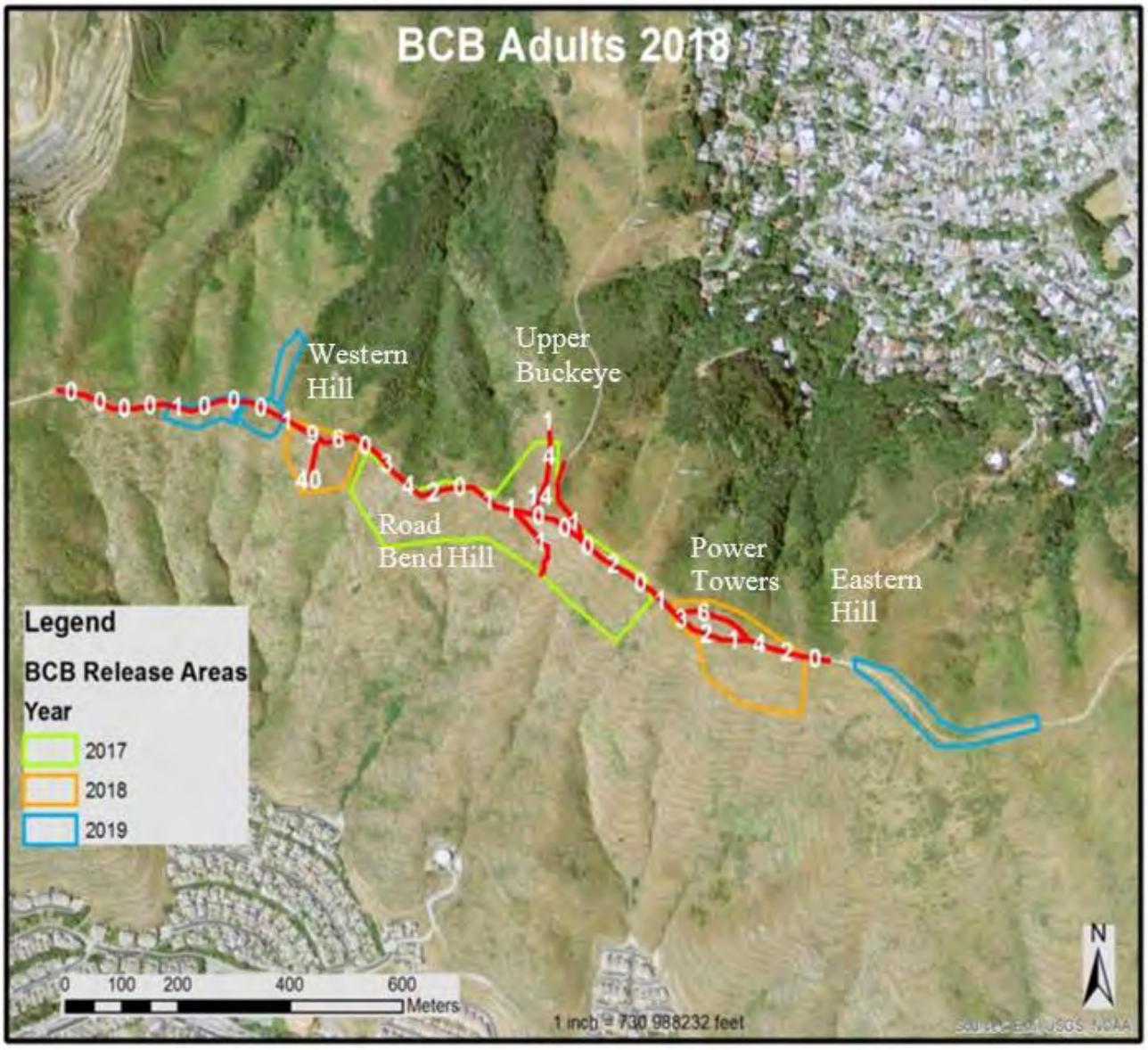
Figure 1. Flight season phenology 2017-2021, whole mountain

In 2017, a total of 47 butterflies were observed over six sample days on the transect system at a rate of 7.0 butterflies/hr (Table 3). The flight season mean date was April 4, and the peak numbers observed was 16 on April 1. Butterflies were distributed across the entire 2017 release area (Map 6), and one was observed 100 m west of the release area, and two were observed 100 m east of the release area indicating only a small amount of dispersal outward from the larval releases (6%). The hotspot for butterfly observations (19 in four segments) were around the hilltop at Upper Buckeye Canyon, with a second concentration (7 in three segments) at a local hilltop 150m to the west at a bend in the road.



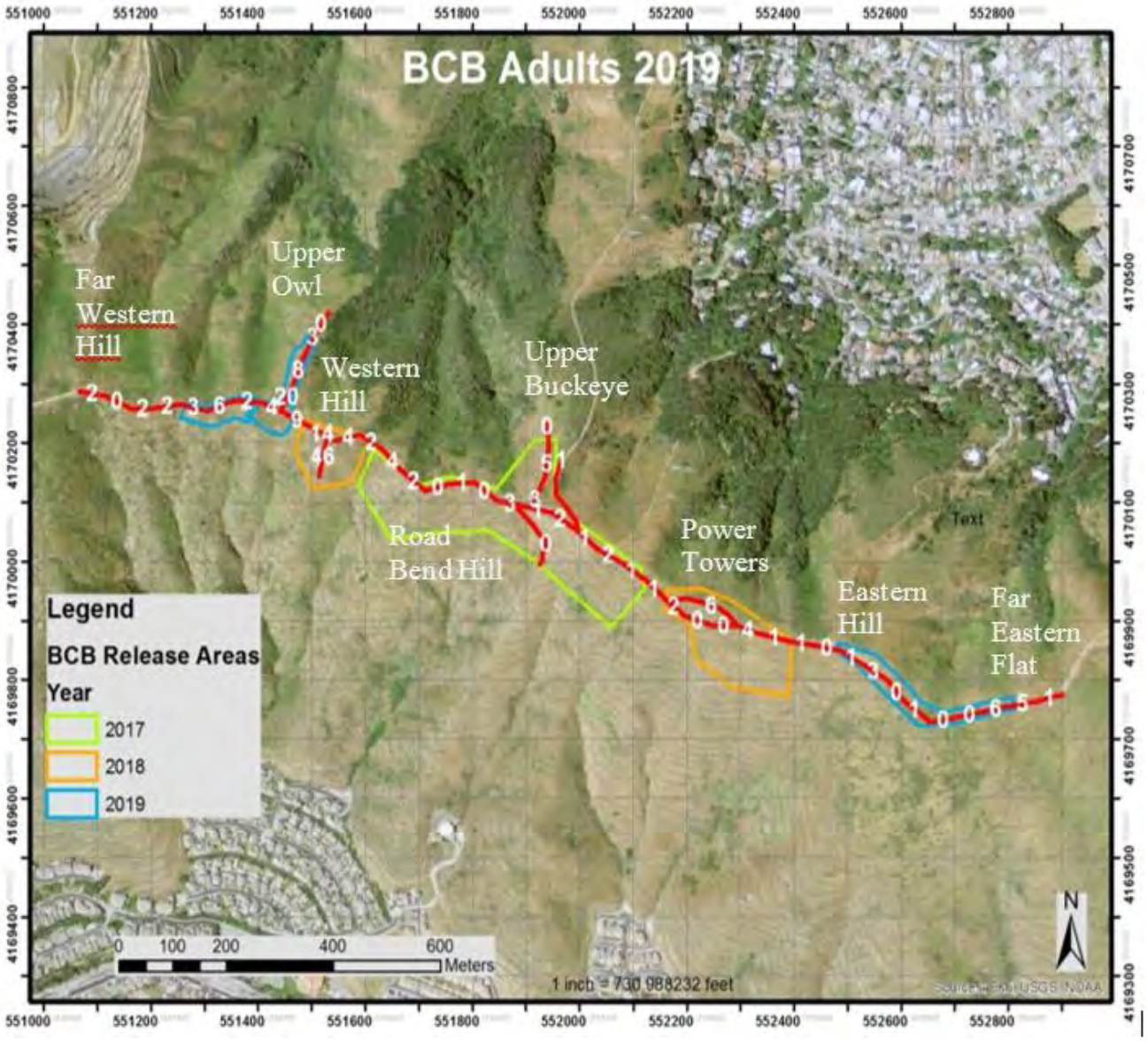
Map 6. Total number of adults observed on transects 2017.

In 2018, a total of 110 butterflies were observed over seven sample days on the slightly expanded transect system at a rate of 14.8 butterflies/hr, with a peak of 30 butterflies/day on March 29 (Table 3). The mean date was April 1, and the flight season was longer than in 2017 (s.d. 9.0 in 2018 versus 5.2 in 2017). The real hotspot was West Hilltop, where a total of 56 butterflies were observed over four segements (Map 7). Upper Buckeye was a hotspot again, with 19 butterlies observed on three segements at the hilltop. The Power Towers hilltop and adjacent road segements was another hotspot (16 butterflies). Only one butterfly was seen outside the release areas, 200 m west of the West Hilltop, again indicating only a small amount of dispersal away from the release areas.



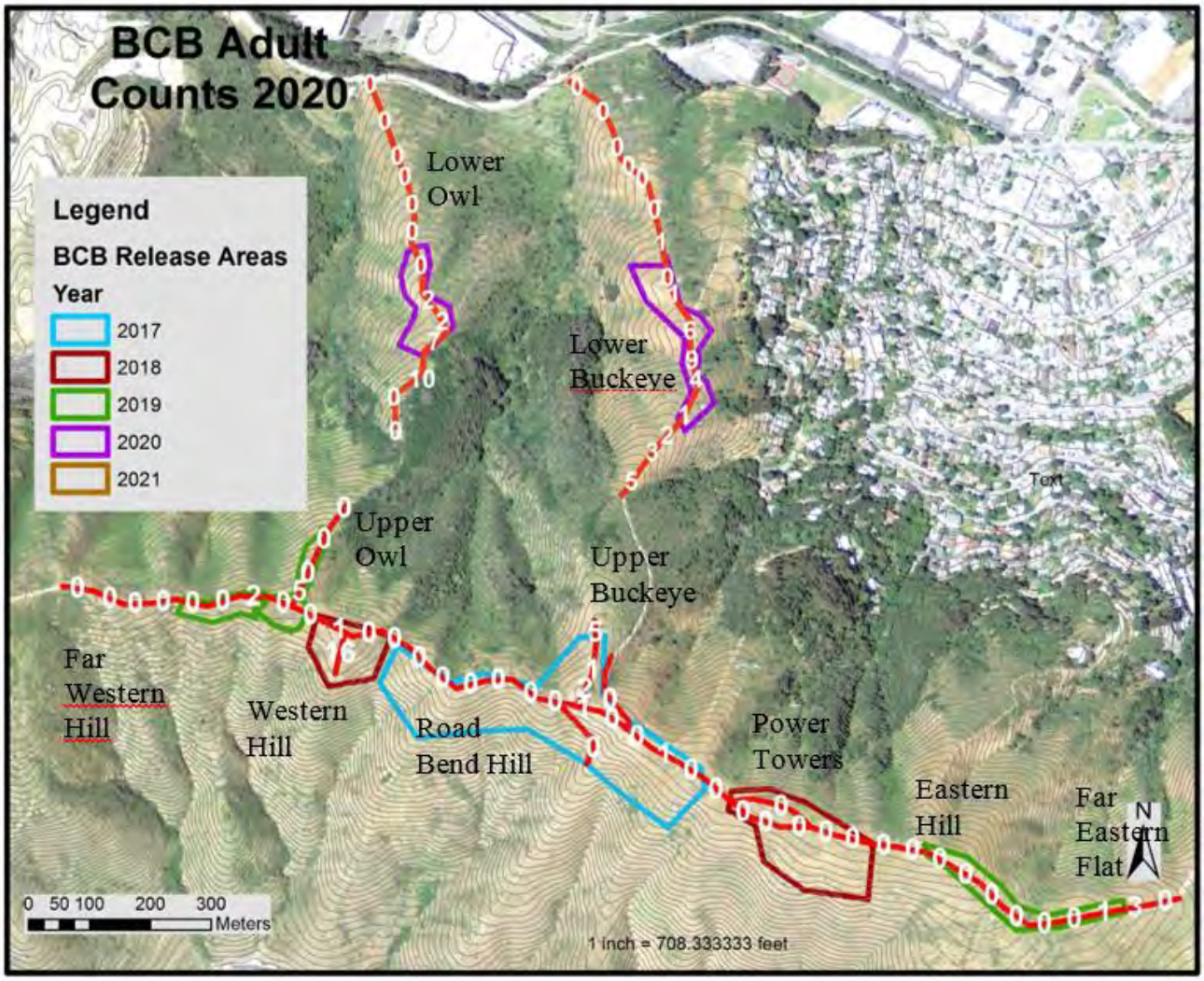
Map 7. Total number of adults observed on transects, 2018

In 2019, 185 butterflies were observed over four sample days on an expanded transect system that extended farther east to cover the far eastern release area, at a rate of 32.8 butterflies/hr. Peak numbers were 69 butterflies. The mean date was April 13, the latest of any year, with a relatively narrow spread (s.d. = 7.4 days). Hotspots were at the usual hilltops (Western Hill 54, Upper Buckeye 13 and Power Towers 12 (Map 8). The larvae released at the far eastern release area concentrated on the Far Eastern Flat near the end of the transect. Six butterflies were observed west of any release areas, including two at the Far Western Hill at the west end of the grassland – dispersal of up to 200 m.



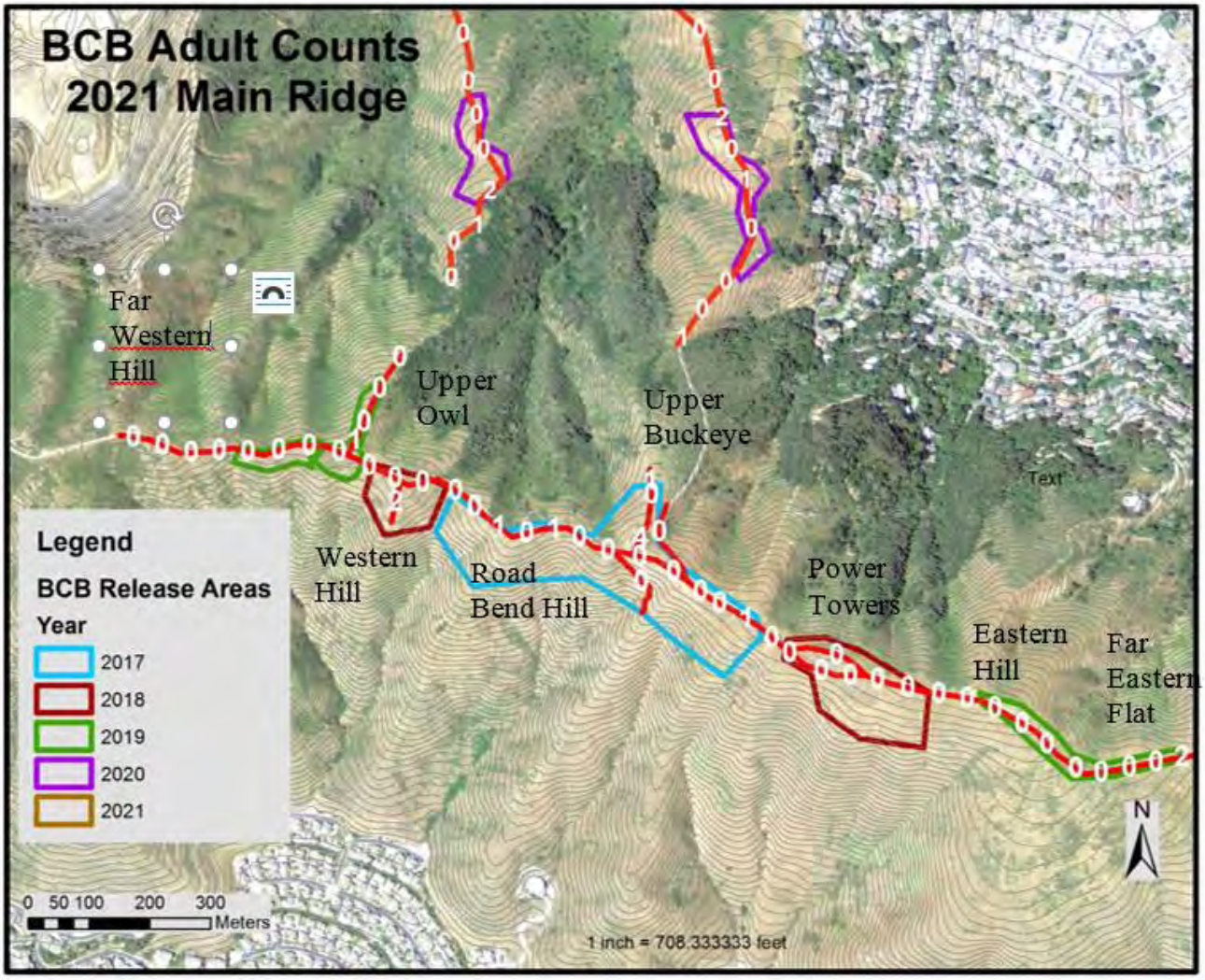
Map 8. Total number of adults observed on transects, 2019

In 2020, 45 butterflies were observed on the Main Ridge transects over seven sample days, at a rate of 5.0 butterflies/hr. The adults were observed (Map 9) where the limited number of postdiapause larvae were observed in 2020 (Map 4), and the Power Tower site had no observations. No larvae were added to the Main Ridge area in 2020 (see Table 2). The 2019 releases produced 21 butterflies in Owl and 32 in Buckeye, a rate of 11.2 butterflies/hr, a rate commensurate with the larvae released (see below for a more detailed analysis).

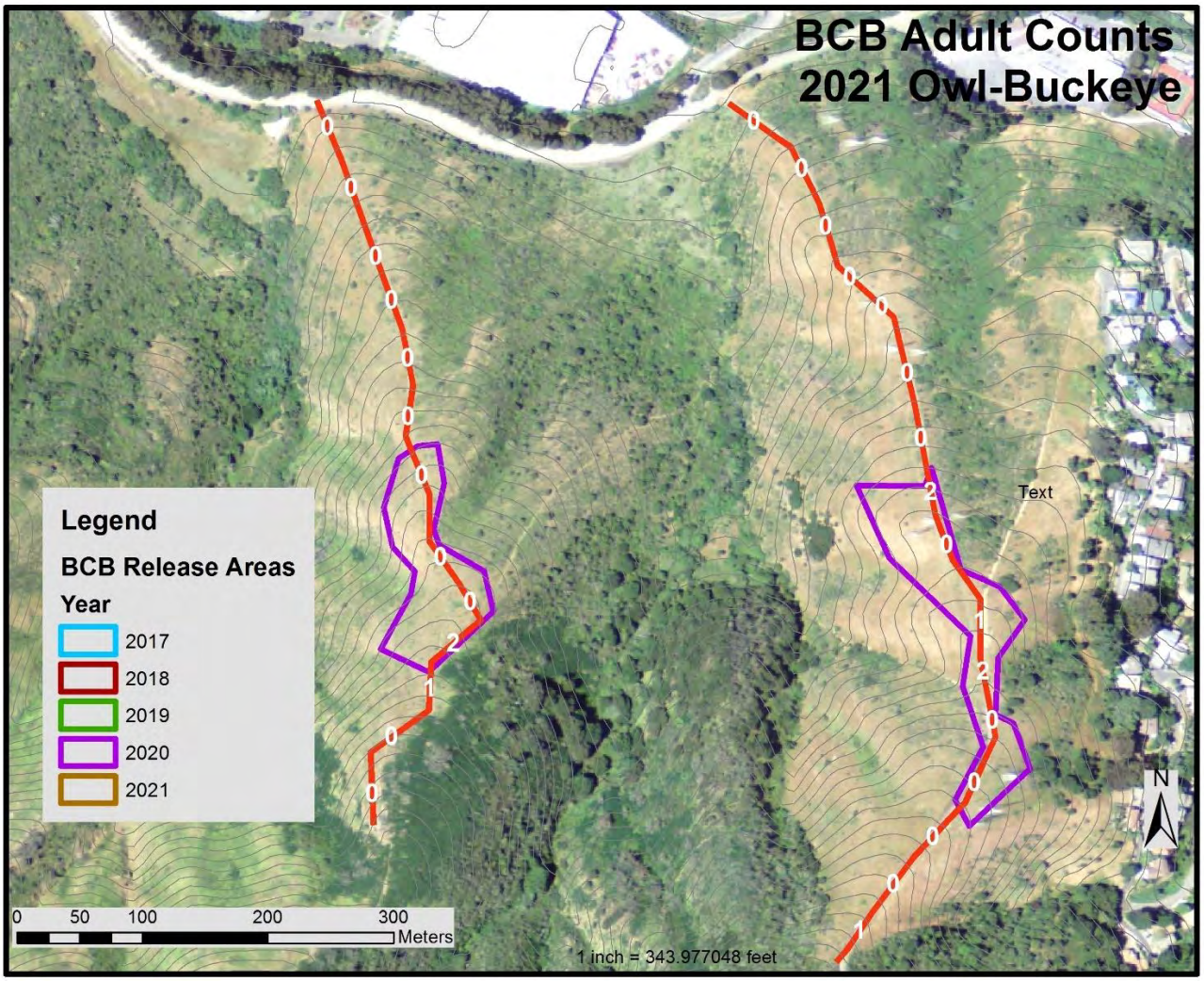


Map 9. Total number of adults observed on transects, 2020

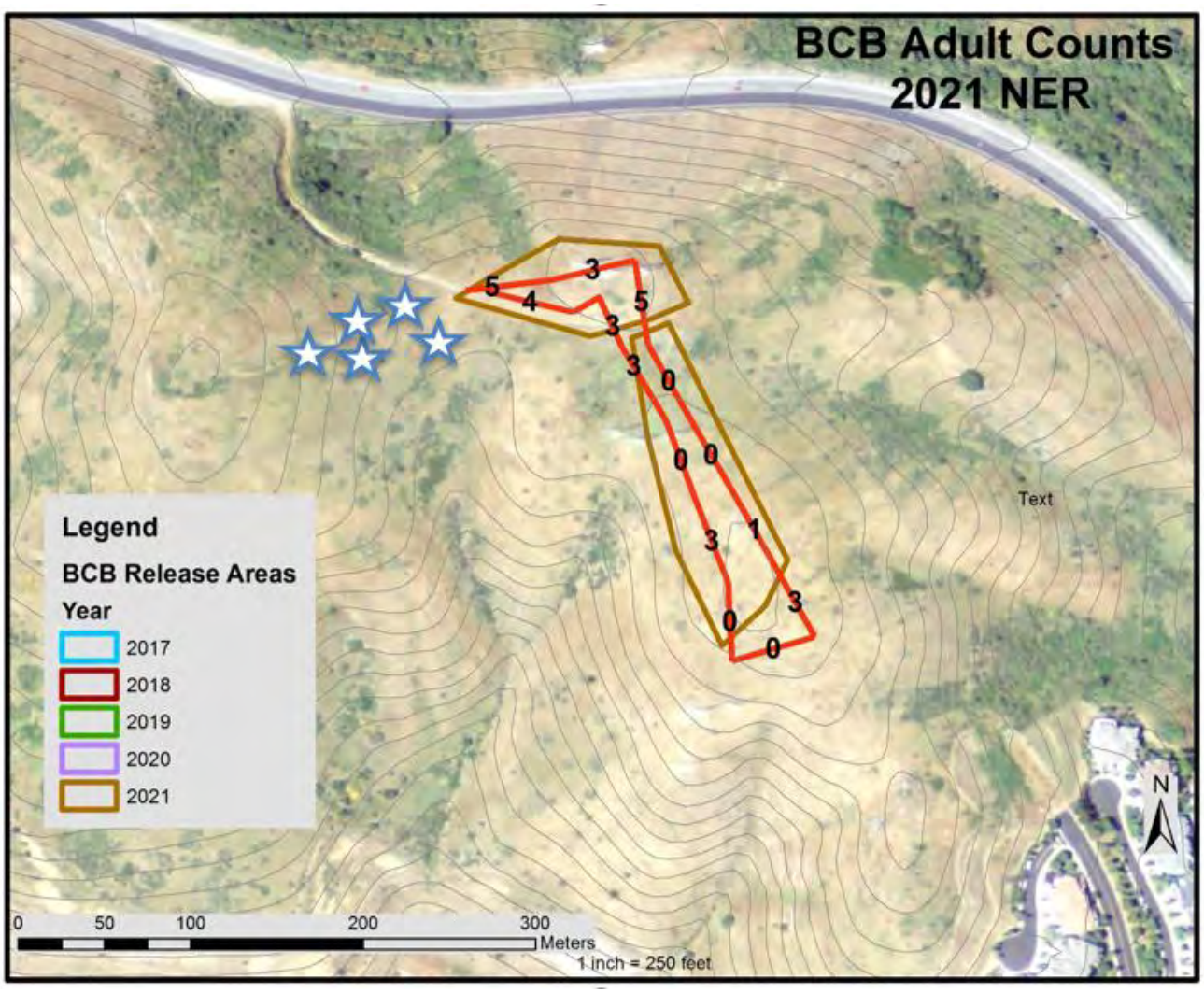
In 2021, 13 adults were observed on the Main Ridge on two good weather sampling days (two other days were washed out by wind and fog), for a rate of 5.1 butterflies/hr, similar to that in 2020. The adults (Map 10) were seen in the same areas where the larvae were observed (Map 5). Nine adults were observed in Owl-Buckeye (Map 11) in two good sample days, at a rate of 6.2 butterflies/hr, again in the areas where larvae were found earlier that year (Map 5). On the Northeast Ridge (Map 12), 25 butterflies were observed on two good sample days, for a rate of 21.4 butterflies/hr. The two small hilltops apparently were quite good at attracting butterflies. A total of 5 adults were observed west of the release area, up to 200 m away, halfway up the highest hilltop on the NER.



Map 10. Adult butterfly observations Main Ridge 2021. Full Owl-Buckeye in Map 11.



Map 11. Adult butterfly observations Owl-Buckeye 2021



Map 12. Adult butterfly observations Northeast Ridge 2021. Stars are adult observations off transect

Hostplant Phenology

The timing of the flight season relative to host plant growth and senescence is critical. An early start to the flight season and/or late host plant senescence increase the likelihood the new generation of larvae will grow large enough to enter diapause before their host plants dry out. Data on host plant phenology are compared with flight season data to estimate whether most butterflies survived to diapause.

Generally, prediapause larval survivorship increases substantially if host plants remain fresh four weeks or more after the midpoint of flight season. We compare phenology of *Plantago erects* (PLER) at SBM with phenology at Kirby Canyon Butterfly Reserve on Coyote Ridge, which has a large checkerspot population. We use Kirby Canyon host plant phenology as a reference (Niederer 2017).

Monitoring hostplant phenology (flowering and senescence) provides insights into habitat suitability on an annual basis. Although PLLA provides a long-lasting larval hostplant for prediapause larvae that relieves the phenological constraints on prediapause larvae, PLER can still play a role in several spots in the release areas (i.e., on thin soils in Upper Buckeye where the postdiapause larvae were

found in PLER only stands, and in Upper Owl where 1+ ha of PLER exist on the north-facing slope).

Log scale estimates of flowering PLER, and the fraction senescent, were recorded weekly on two transects of ten 1-m^2 quadrats each, one at the western end of the adult transects, and one on north facing slopes in Upper Buckeye (Map 13). Host plant phenology monitoring continued until all the annual host plants senesced (generally early June in all years). Seven similar transects were monitored at the Kirby Canyon Butterfly Reserve for comparative purposes. Graphs show the progression of PLER senescence for each year (Figure 2a), comparisons with Kirby Canyon (Figures 2b-f) and the weekly abundance of green flowering *Castilleja* (Figure 3). And 90% senescence as a benchmark is compiled in Table 4.

The interannual variability in PLER senescence curves on SBM (Figure 2a) spanned 10 days. The time from the start to final senescence of PLER stands was 30-40 days.

The temporal relationship between SBM and KC varied over the five years (Figures 2b-f, Table 4). Comparing the 90% senescence dates, PLER senescence on SBM was later than KC in 4 four years by 5-19 days, and 1 day later in one year (2020). In general, the cool coastal climate at SBM, especially fog, delays PLER senescence compared with the warm temperatures at KC in the inland South Bay. But the sample at KC also includes some steep north-facing slopes where senescence is delayed (Weiss et al. 1988).

The secondary hostplant, *Castilleja exserta*, was senescent by mid-May to early June, and outlasted PLER by about a week in the plots. Elsewhere on SBM, especially on steeper north-facing slopes and in the western fog belt, *C. exserta* has been observed to remain green well into June. Peak abundance class varied from 2 (corresponding to ~7 plants/m^2) in 2017 and 2019 (wet years) to 0.5 in 2021 (<2 plants/m^2) in the driest year.

The difference between mean butterfly flight and 90% senescence ranged from 39 to 51 days (Table 5), more than enough time for freshly hatched larvae to reach diapause. Postdiapause larvae were found in the PLER stand at Upper Buckeye every year indicating that the remaining stands of PLER do provide suitable local habitat; the main problem is that they are not spatially extensive enough and are too fragmented to support a viable BCB metapopulation.

Plantago lanceolata, in contrast, is locally dense and widespread. PLLA cover was visually estimated in four transects of contiguous 1 m^2 quadrats at the Western Hill in 2018 (Map 14). Cover was 2.23%, and it was present in 59% of quadrats with >5% cover in 16% of the quadrats (Figure 4). These cover values, up to 20%, correspond to tens or even 100+ plants/sq meter, easily encountered by searching females and wandering larvae. PLER mean cover was 0.17% cover, and was present in 6% of quadrats, all in a cluster along the westernmost transect and insufficient to support a BCB population. *Castilleja exserta* was present in only 1.5% of quadrats.

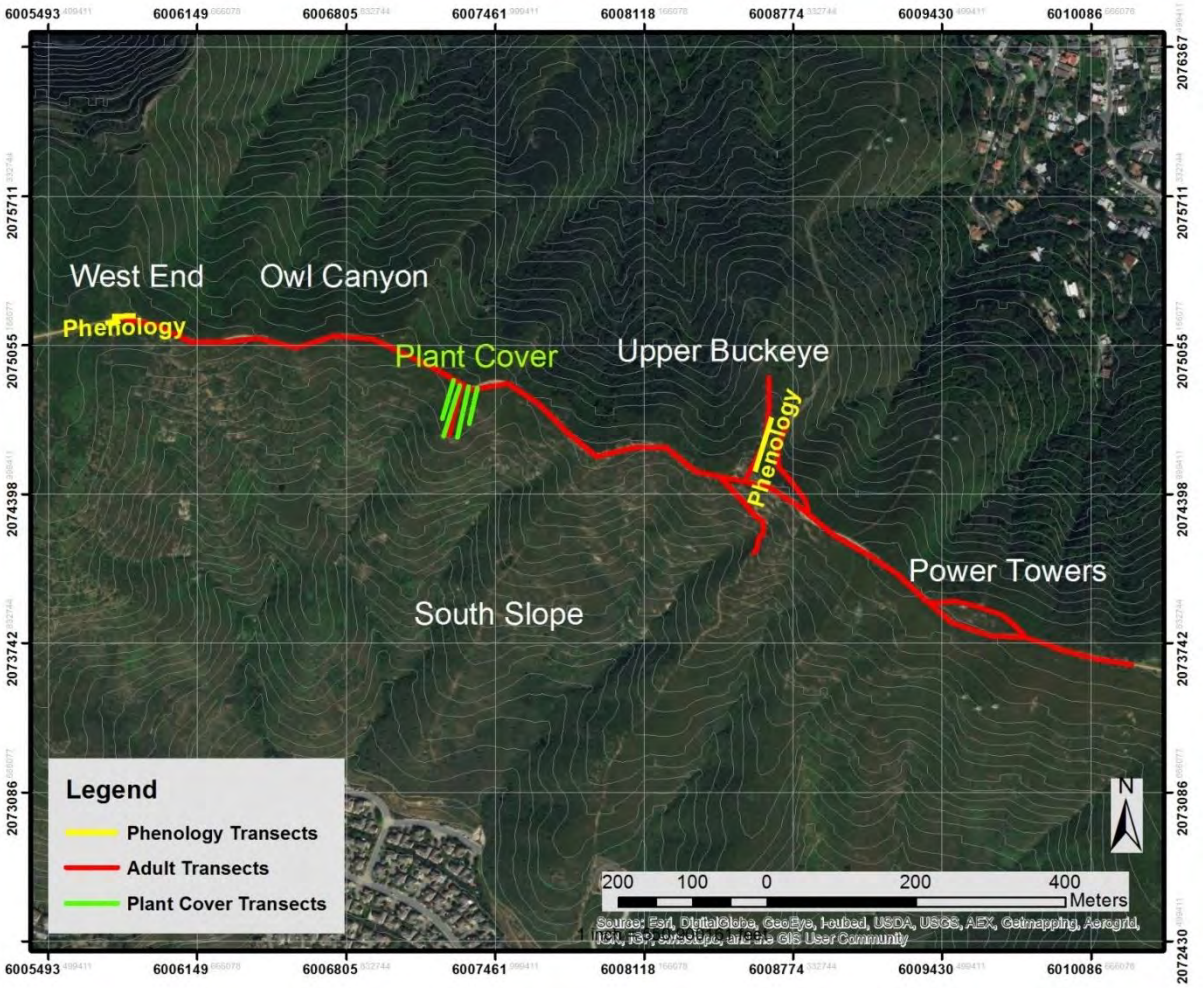
The density of *Plantago erecta* in the phenology transects exceeded 100 plants/m^2 on average, and locally greater than 1000 plants/m^2 – these areas are representative of the remaining multi-hectare PLER stands on SBM and give a sense of the ancestral condition, comparable to serpentine grasslands.

In 2019, systematic mapping of SBM butterfly hostplants (lupines, violets, and PLLA) was conducted on the Northeast Ridge and Owl-Buckeye. A 50 m grid was laid out in GIS, and the points were visited using Avenza maps. Hostplants were scored in a 10m radius circle on a log scale (0, 1-3, 4-10, 31-100, 101-300, 301-1000, 1000+). The results for PLLA show that it is widespread and abundant, with enough dense stands on the NER and Owl-Buckeye, comparable to those on the Main Ridge, to support translocation. This mapping was key in establishing that these areas were suitable for larval releases in 2020 and 2021.

Nectar sources

Nectar sources can be an important component of BCB habitat. Access to nectar increases egg production after the first two egg masses (Murphy et al. 1983), and can extend lifespan and allow for higher levels of activity. Sometimes, adult butterfly movements are related to the distribution of key nectar species.

Nectar does not appear to be limiting in any way. BCB are highly opportunistic, and their nectar sources include many of the common widespread annual and perennial forbs in the rich grasslands of SBM. Among the most important are *Lomatium* spp., *Lasthenia californica, Achillea millefolium* (see cover photo), *Sidalcea malviflora*, *Allium sp.*, *Sanicula arctopoides* and *S. bipinnitifida*, both native and non-native *Cirsium* – basically anything that is in flower during the flight season that can be probed with a butterfly proboscis.



Map 13. Plant phenology and hostplant cover transects

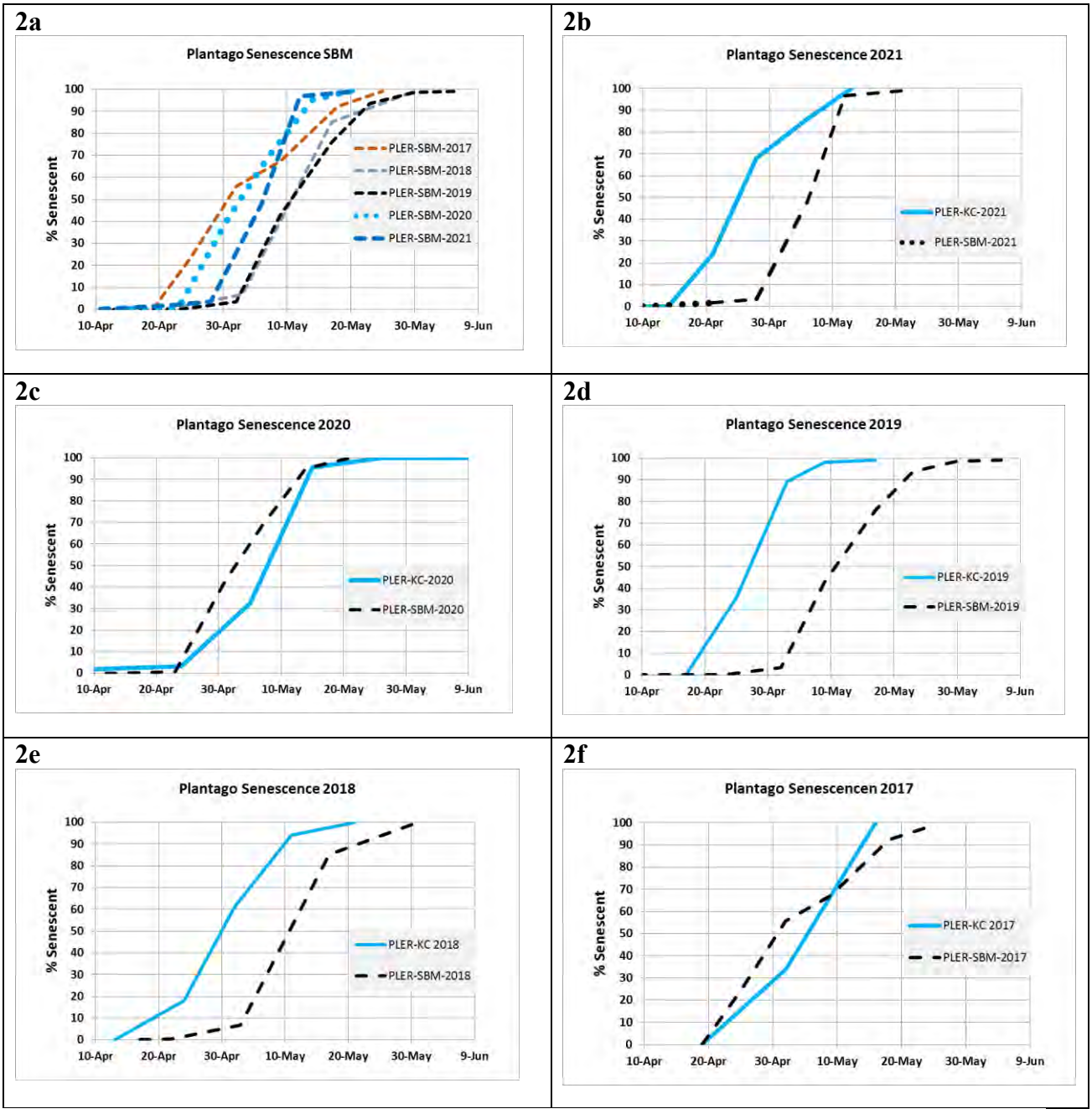


Figure 2b-f. *Plantago erecta* phenology at SBM (dashed lines) and Kirby Canyon (KC, solid lines) by year. 2a shows the interannual variation on SBM over the five years.

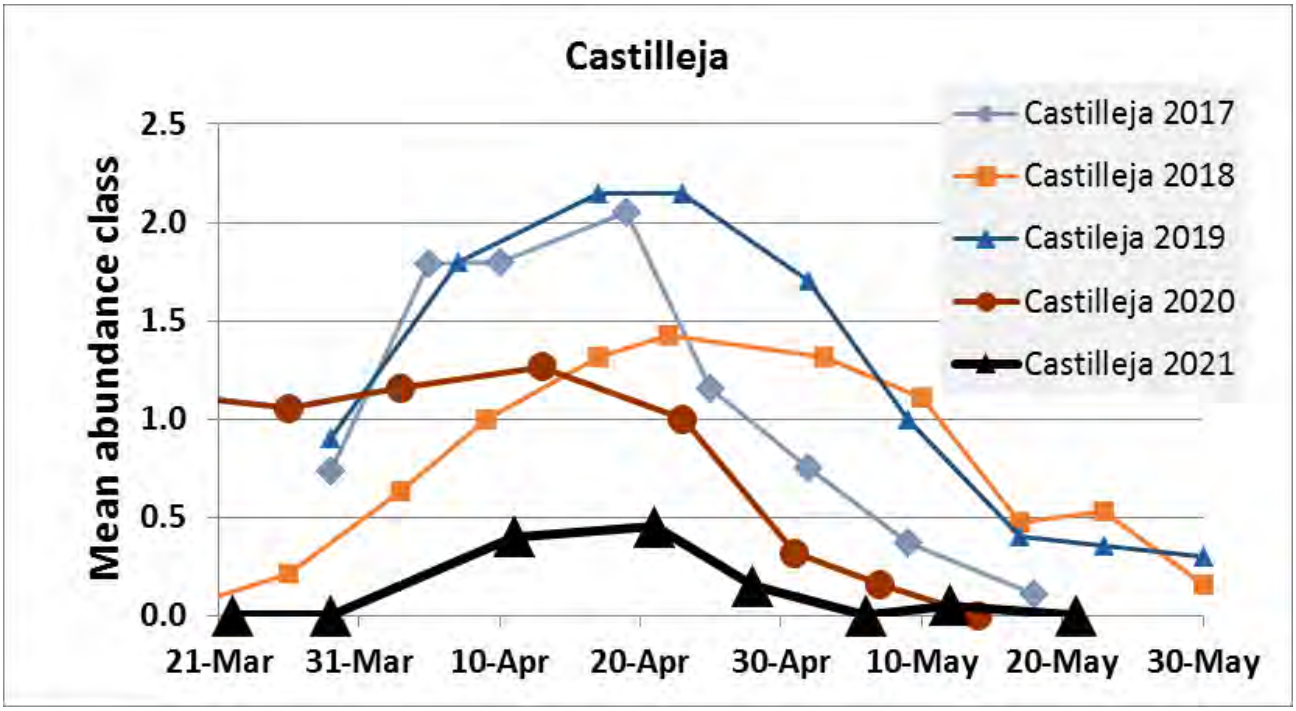


Figure 3. *Castilleja* flowering phenology and abundance at SBM 2017-2021.

Year	90% KC	90% SBM	Difference days (SBM-KC)
2017	13-May	17-May	4
2018	10-May	22-May	12
2019	3-May	22-May	19
2020	13-May	13-May	0
2021	7-May	12-May	5
Average	8-May	17-May	8.4
S.D.	3.9	4.8	7.0

Table 4. Comparison of 90% *Plantago erecta* senescence dates between Kirby Canyon and San Bruno Mountain.

Year	SBM Adult Mean	SBM 90% Senescence	Difference (days)
2017	4-Apr	17-May	43
2018	1-Apr	22-May	51
2019	13-Apr	22-May	39
2020	31-Mar	13-May	43
2021	1-Apr	12-May	41
Average	3-Apr	17-May	43
S.D.	4.8	4.3	4.1

Table 5. Difference between mean flight date (Table 4) on the Main Ridge and 90% *Plantago erecta* senescence on San Bruno Mountain.

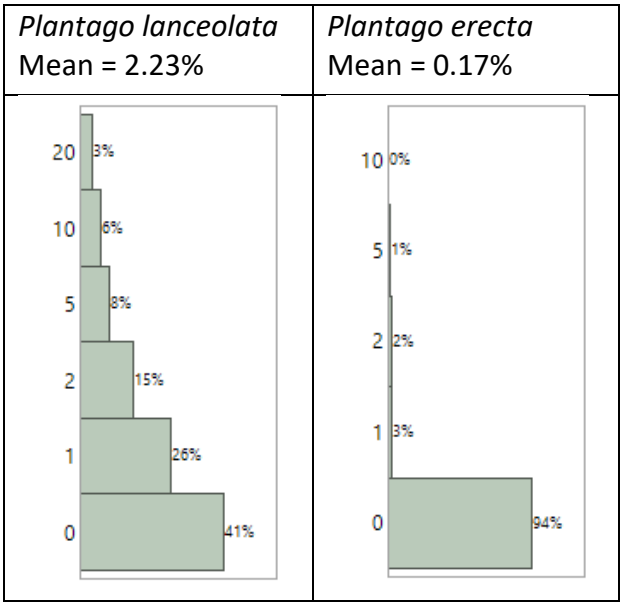
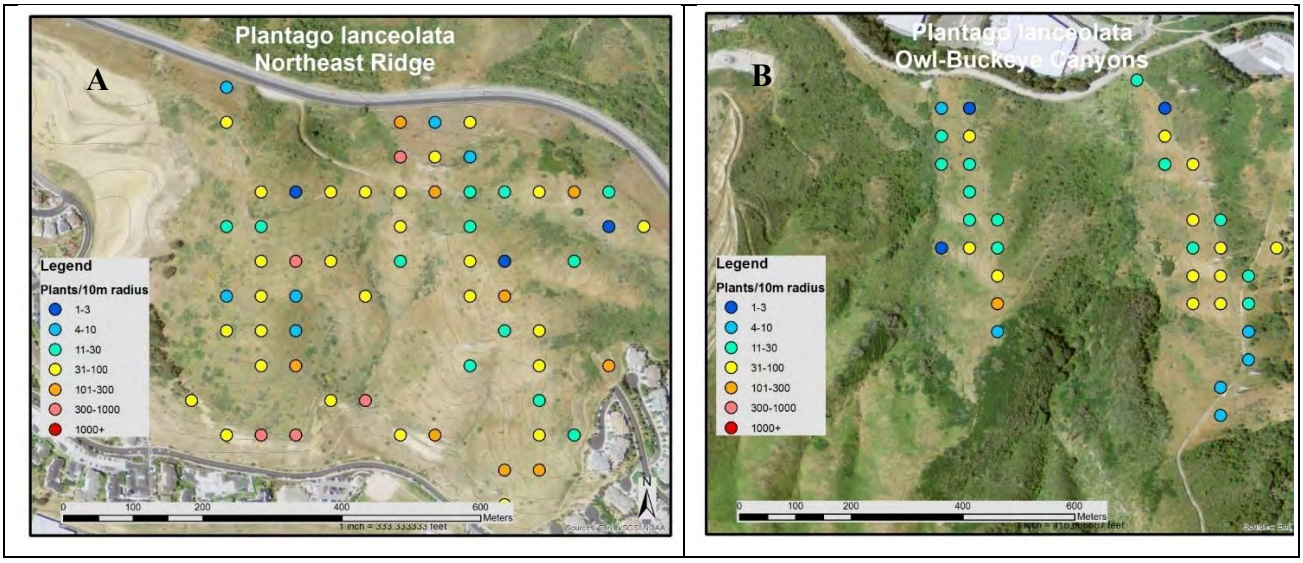


Figure 4. Histograms of percent cover classes of hostplants on West Hill (shown in Map 13 as "Plant Cover"), from four 50 m long transects with contiguous 1 m^2 quadrats (n=200 quadrats).



Map 14. Distribution and abundance of PLLA on a 50 m grid in 2019 on the NER (A) and Owl-Buckeye (B)

Weather

Weather is a common driving factor in butterfly populations, and needs to be considered as background environmental variation, especially in an age of rapid climate disruption. BCB populations in serpentine grassland respond to annual weather with complex, highly variable population fluctuations that are largely, but not completely, driven by the phenological window for prediapause development as described above (Weiss et al. 1988). The phenological pressure appears to be relieved on SBM, because the perennial habit of PLLA allows for prediapause feeding well into summer. *Plantago erecta* also provides less time pressure (at least over the past five years); the

39 to-51-day span from mean flight to 90% PLER senescence is more than sufficient for freshly hatched larvae to reach diapause.

Although the BCB is not on a phenological knife edge on SBM, other weather factors do play a role in population dynamics. Heavy extended rainfall during the pupal, adult, and prediapause larval stages can greatly increase mortality. High mortality was observed in heavy March, April, and May rains, in week+ long storm sequences in years such as 1982, 1983, 2006, and 2016. Postdiapause larvae can move around in cool conditions and find safe roosts, and are tough in general. Immobile pupae, in contrast, are vulnerable to direct impact of heavy rainfall, and extended development times increase predation and disease mortality (White 1986, Weiss et al. 1988). Adults can be grounded for a week or more and suffer mortality. Because female BCB can deposit an egg mass in a few hours of flight activity, flight time is far less limiting compared with butterflies that lay eggs one by one, like the Mission blue (and most other species). Egg masses can be readily knocked off hostplants. Prediapause larvae are vulnerable because of their small size, limited mobility, and the possibility that whole webs will be dislodged. Taylor's checkerspot in the very wet climate of Oregon and Washington, feeding primarily on PLLA, faces these hazards annually, while the rainfall regime in the Bay Area only occasionally poses these risks.

Weather data (precipitation, T_{max} and T_{min}) for nearby San Francisco Airport (SFO) were compiled from Weather Underground (2021) for October – May for water years (WY) 2017-2021. (Figure 5a-f). Total precipitation varied from 103 mm in WY2021 (one of the driest years on record) to 758 mm in WY2017 (one of the wettest years), with a 5-year average of 398 mm compared, only 60% of the 30-year average (1991-2020) of 500 mm, indicative of long-term drought (Table 6). Even in the wettest year (2017), there were long dry periods in March-May when the life stages are most vulnerable.

Average October-May temperature varied from 13.0°C (55.4°F) in 2019 to 14.1°C (57.4°F) in 2018. Peak spring heatwaves of T_{max} 30°C (86°F) occurred each year. Warmer springs drive faster hostplant phenology, but as discussed above this factor is relaxed for BCB on SBM. The annual average temperature masks high month to month, week to week, and day to day variability, as evidenced by the large fluctuations in daily T_{max} and the intermittent rainfall event separated by dry spells.

This high variance regime typical of California is being exacerbated by climate disruption and has been linked to the extinction of the Jasper Ridge populations of BCB (McLaughlin et al.2002).

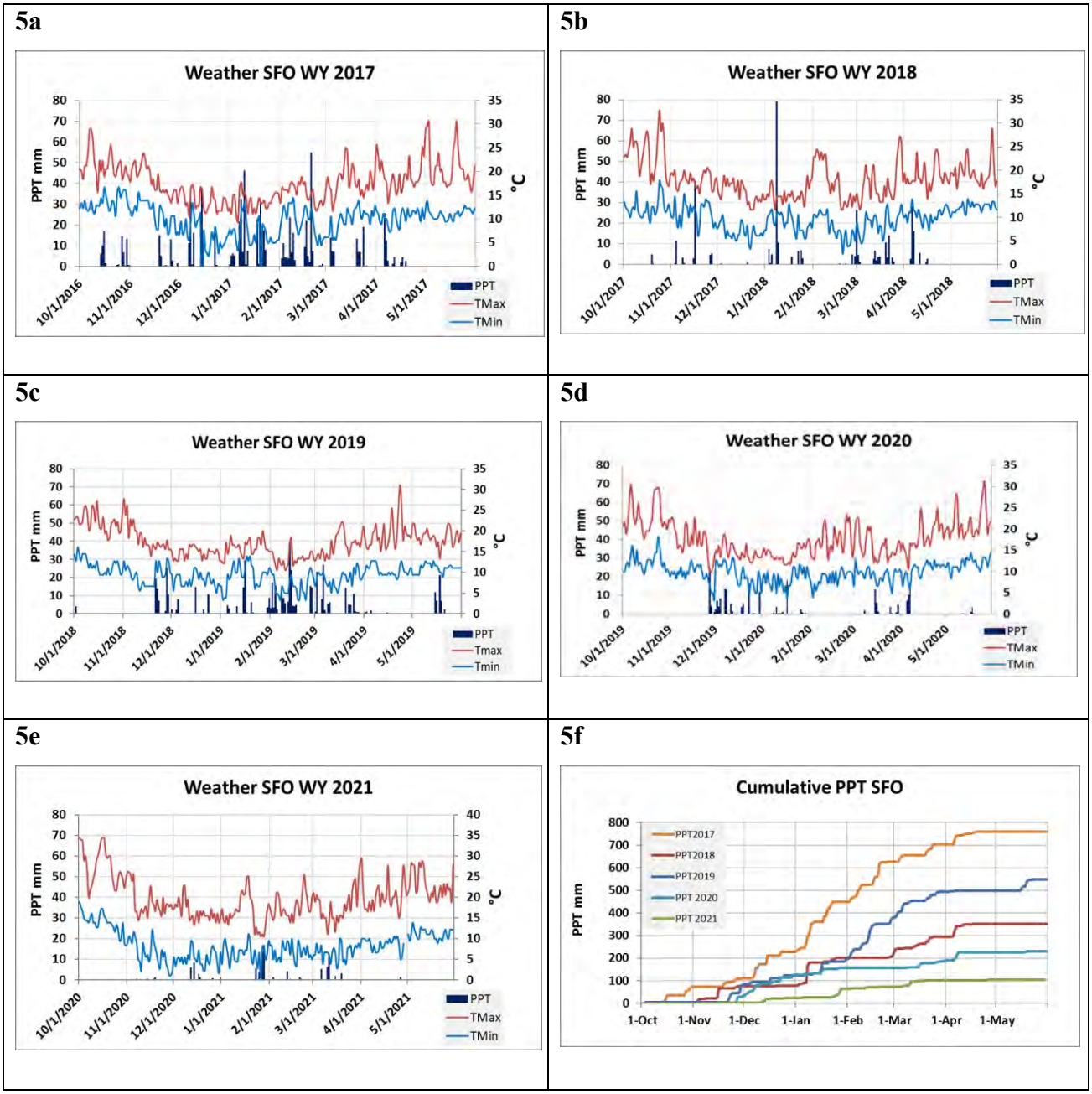


Figure 5a-f. October-May daily weather for San Francisco Airport (SFO) (https://www.wunderground.com/history/daily/us/ca/san-francisco)

Year	T_{max}	T_{Avg}	T_{min}	PPT
2017	17.5	13.8	9.7	758
2018	18.1	14.1	9.8	352
2019	17.0	13.0	9.5	548
2020	17.7	13.3	9.9	230
2021	19.8	13.3	8.0	103
Average	18.0	13.5	9.4	398
S.D.	1.1	0.4	0.8	260

Table 6. Mean October-May weather for SFO

Transition to *Plantago lanceolata*

The switch from PLER to PLLA is the critical step in establishing a viable population of BCB on SBM. One primary objective of this project was to directly observe oviposition and larval feeding on PLLA. The title page of this report has some documentary photographs. Freshly released postdiapause larvae freely feed on PLLA, caught on still photos and videos. Caged female butterflies oviposited on it, but more importantly, wild prediapause webs and of first through third instar prediapause larvae were observed. All observations were at West Hill. This site has had the highest densities of adults (see Maps 7 and 8) and high cover of hostplant (Figure 4). Successful reproduction also occurred in pure stands of PLER, at Upper Owl and Buckeye Canyons, evidenced by presence of wild postdiapause larvae there each year. A mix of hostplant species can further add to population resiliency, because as one host species becomes less abundant or suitable in a particular year, an alternate species can fill the gap and support the population (Ehrlich and Hanski 2004).

Euphydryas editha is scientifically famous for its opportunism and ability to switch host plants, leading to wide ecological diversity among populations across the range (Ehrlich and Hanski 2004). Numerous independent populations of *E. editha* (primarily ssp. *taylori*), have made the switch and are persisting, even thriving in many different habitat configurations. Adaptations to novel hostplants take several generations to evolve. Oviposition height choice, egg mass size, and prediapause larval aggregation and dispersal are all under extreme selection pressure. It is likely that a transition period will be characterized by a population bottleneck as behaviors evolve. Reintroductions of *E. editha taylori* in Western Washington State have taken 5-10 years to solidly establish (M. Linders, pers. comm).

At the end of this CVPCP grant, it is encouraging that populations have established in all release areas; and some areas have persisted for four years post-release, albeit at lower densities than the release numbers. The level of effort on SBM – introducing thousands of larvae at five distinct areas over five years – should provide sufficient chances for the population to pass through any bottlenecks and adapt to PLLA. Whether they persist in the long run remains to be seen, and that uncertainty is part of this exciting novel experiment.

Population Estimates

Distribution

Distribution, defined as habitat occupancy by one or more life stages, is the most straightforward characteristic of a butterfly population to measure through presence-absence observations. Presence requires a single observation, but absence can only be assigned a probability after numerous visits,

and is never a sure thing (although the probability can be vanishingly small after many visits over many years). As of 2021, BCB adults occupy all the release zones, and naturally expanded several hundred meters beyond release areas to the Far West end of the Main Ridge in 2019 (Map 8), and on the Northeast Ridge in 2021 (Map 12). They have not yet moved downslope in Owl and Buckeye Canyons, although the PLLA thins out considerably downslope of the release areas (Map 14A).

The hilltopping behavior of BCB on SBM is quite apparent – local hilltops have had the highest numbers of adult observations, especially when numbers were low (Maps 6-9). And excursions down the south slope of the Main Ridge did not detect any adults. A fraction of the male population aggregates on hilltops and perches, waiting for unmated females to arrive. All the while they are interacting with the other hilltopping males and other butterflies passing by – they become quite apparent. Another fraction of the male population exhibits patrolling behavior off the hilltops, intercepting unmated females as they emerge and fly toward the hilltops. Both strategies have enough success that it appears to be an evolutionarily stable mix (Ehrlich and Hanski 2004). From a practical viewpoint, surveying for presence of adult butterflies on local hilltops is the most efficient way to monitor at the presence-absence level.

Abundance

The numerical goal set for this project was:

"Establish an initial population of 600 postdiapause larvae or 300 adults in two of the four monitoring years."

Evaluating whether this goal has been met requires abundance monitoring. Estimating abundance requires much more effort than distribution. The only definitive population numbers we have are exact release numbers. Both postdiapause larvae and adults were sampled with the standard methods presented above, and this section below presents several analyses of converting those raw numbers into a valid population estimate for evaluating success in meeting the numerical goals.

Postdiapause larvae

We attempted our standard postdiapause larval techniques (10 person-minute timed searches in 0.1-0.5 ha plots) in each year (Maps 3-5). No topoclimatic stratification was done (as at Coyote Ridge), since the sampling covered a high fraction of the habitat in each area (Map 2), and was proportional to the topoclimatic distribution within the release areas. The results for 2018 - 2021, applying the standard methods, are shown in Table 7.

The Main Ridge estimate in 2019 (3941 larvae) is an order of magnitude higher than the estimate for 2020 (330), and 2021 (286). 2020, only counting MR, apparently did not meet the goal of 600 larvae. OC and BC in 2021 (40 and 795) added to MR (286) makes a total of 1087 larvae in 2021, which does meet the goal. The one hotspot of larvae in BC (10 larvae) drove this estimate.

	2019	2020	2021 MR	2021 OC	2021 BC	Units
Sampled Area	4.33	9.67	9.7	1.6	2.65	ha
Total Area	7.86	11.01	11.01	1.8	2.75	ha
Mean larvae count	5	0.30	0.26	0.25	3	Larvae/10minutes
Avg Density	500	30	26	25	300	larvae/ha
SE Density	130	10	10	25	200	larvae/ha
N	17	27	27	4	5	plots
Total	3941	330	286	40	795	Larvae
+95%*	6144	170	155	NC	NC	Larvae
-95%*	1737	610	590	NC	NC	Larvae

Table 7. Total larvae calculation in 2020 and 2019. *Limits were calculated with a Poisson distribution because of low numbers, hence the asymmetrical confidence limits. The 2021 estimates for OC and BC could not produce meaningful confidence limits (NC) because of small sample size. The larval survey in 2018 (three larvae in one plot out of ten) could not yield a useful quantitative estimate.

There is reason to believe that these are gross underestimates of larval numbers, the most obvious is that on the Main Ridge in 2020 BF/hr was 5.0, compared with 7.0 in 2017 (Table 3), when we know that there were 3630 larvae along the transect system (Table 2). The larval estimate on MR in 2020 was 330, an order of magnitude lower. Similar reasoning applies to 2021 on the Main Ridge, and the comparison between Owl-Buckeye in 2020 (release year) and 2021.

There were several issues identified with the standard postdiapause larval surveys executed on SBM, including:

1. The dense grassland and large clumped perennial PLLA reduce visibility of postdiapause larvae compared with the short sparse PLER with much bare ground. In practice, by far most of the larvae found were in relatively bare areas – road and trail verges, or thin soils on ridgetops - similar in structure to serpentine grassland, not in the tall grass that comprises most of the search area, or perched on PLLA. Decades of experience at serpentine grassland sites suggest that the number of larvae observed in tall grass areas, even with dense stands of PLLA, are substantial underestimates.

2. Low numbers also introduce high statistical variance, as evidenced by the wide confidence intervals in Table 7 (a threefold range for MR in all three years, and an inability to calculate meaningful confidence intervals at OB and OC in 2021).

3. In some areas (Far Eastern Flat, BC), postdiapause larvae of *Euphydryas chalcedona* (chalcedon checkerspot butterfly, CCB) were intermixed and feeding on PLLA, and were more abundant than BCB larvae. Despite BCB being darker black and CCB larvae having more grey spots (and other minor distinguishing characters), it can be virtually impossible to distinguish the two species, especially in the fifth and sixth instars. This problem was especially apparent at the Far Eastern release in 2020 and 2021, and at Buckeye Canyon in 2021 where coastal scrub with *Scrophularia californica* (a key CCB hostplant) was adjacent to the release areas. The 10 larvae counted in one plot in BC had to be individually examined, especially if they were sixth instars similar in size to the largest CCB in the area (CCB grow somewhat later than BCB). CCB larvae were also observed feeding on PLLA at

NER in 2021, having wandered from nearby *Scrophularia* stands. This confusion is almost impossible to avoid and adds noise to and slows down the larval counts.

4. Because of the low numbers and statistical noise, the postdiapause surveys in 2020 and 2021 are more effectively presence surveys. Presence was demonstrated at five points along MR, and in OC and OB. It is notable that the only adults observed in 2021 on MR were in areas where larvae had been seen, which were on or adjacent to hilltops. Reliable inference of true absence requires much more sampling time, and may not be feasible over the long run.

Adult-based estimates

The butterflies/hr (BF/hr, Table 3) provides another estimate of relative density, but converting to an absolute density requires several assumptions and calculations. Using the known number of larvae introduced, and the observation that nearly all adults appear to have remained within the release areas, the following calculations provide an estimate of larval numbers from BF/hr.

1) Area = N (segments in release area) x 0.25 (25 meters on either side)

2) Larval density = Number released/Area

3) BF/hr = BF Observed/(days * N(segments) * 0.025 hours/segment)

4) Eight observations of 0 BF/hr = 0 larvae/ha, corresponding to the eight releases, were included to make sure that the origin was close to the fitted line.

The graph of BF/hr versus larvae/ha shows the expected positive relationship (Figure 6). The equation of the best fit line is:

$$\text{Larvae/ha} = 32.18 * \text{BF/hr} + 206,\ R^2 = 0.89,\ \text{RMSE} = 362$$

The intercept (206) at 0 BF/hr is unavoidable noise that is part of any regression with noisy data. Note that the 0,0-point falls within the confidence envelope of the regression line (dashed lines).

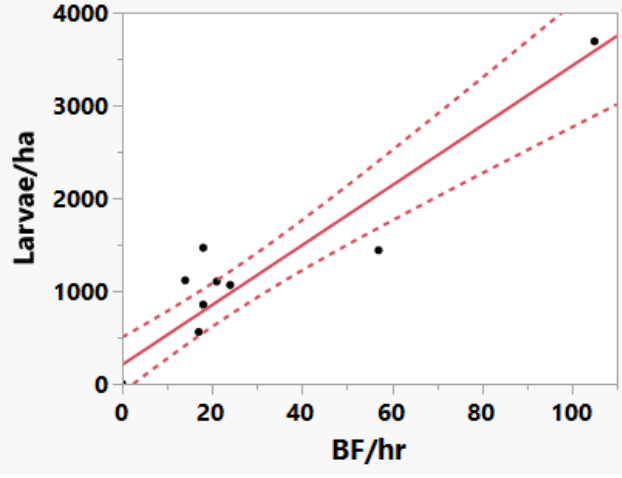


Figure 6. Regression of BF/hr and larvae/ha taken from 8 release sites on SBM

Application of this equation to the entire transect system in each subarea greatly increases the population estimates over those from larval surveys. And release year estimates are commensurate with the numbers released (Table 8), the largest underestimate was at BC in 2020, where it underestimates the larval release number by 43%. It appears to be conservative, in that there are three underestimates and one accurate estimate (OC 2020 within 10%). It is not a perfect fit by any means, but does indicate that as of 2021, there are more than 1,000 resident larvae in OC and OB, and several thousand along MR.

The peak numbers of resident larvae on MR were in 2019, when an estimated 11,000 larvae had resulted from the previous two years of releases – the large concentration on West Hill (60 adults on two segments) appears to drive this estimate. There was also a high concentration of postdiapause larvae (53 in three plots) at this site earlier in 2019, but the larval estimate in Table 7 as only 3941 (95% CI 1737-6144) compared with ~11,000 from Table 8.

It may seem surprising that such low numbers of adult observations can produce such large population estimates of the number of larvae that produced the adults. Several factors play into this relationship:

1) Only a tiny fraction of the actual adult population is observed. Observers are spending very limited time (1.5 minutes/50 m) in any part of the habitat, and the area sampled by transects is only 10 m wide.

2) There is turnover of the individuals, as butterflies emerge, die, and disperse away.

3) Adults may disperse out of the release and transect areas, although dispersal along the ridge appears to be minimal (see above, Maps 6-10). A low density of dispersing adults is difficult to detect without large efforts.

4) Adult butterflies spend much of their time sitting, even under optimal flight conditions, but especially when it is windy, and are not readily observable

5) Parasitoids and pupal mortality thin the number of postdiapause larvae by 50% or more (White 1986, Weiss et al. 1988).

Site	Total BF on transect	BF/ hr	Days	50 m Segs	Area (ha)	Hrs	Larvae /ha	Larvae Total	Known Release	Resident Estimate
MR2017	47	7.0	6	35	8.75	5.3	379	3320	3630	-310 (-8%)
MR 2018	110	14.8	7	37	9.25	7.4	638	5905	5000	905
MR 2019	185	32.8	4	51	12.75	5.6	1236	15758	5000	10,758
MR 2020	45	5.0	7	51	12.75	9.9	313	3991	0	3991
OC 2020	21	9.2	7	13	3.25	2.3	453	1474	1332	142 (+10%)
BC 2020	32	11.4	7	16	4	2.8	526	1448	3668	-1562 (-43%)
MR 2021	13	5.1	2	51	12.75	2.8	316	4033	0	4033
OC 2021	5	7.7	2	13	3.25	0.7	402	1308	0	1308
BC 2021	10	12.5	2	16	4	0.8	562	2248	0	2248
NER 2021	25	21.4	2	14	3.5	0.7	857	3001	3859	-858 (-22%)

Table 8. Estimation of larval numbers from regression in Figure 6. The last column is the estimated number of resident butterflies, yellow highlights indicate first year releases where the resident population should be zero.

The results of this analysis of adult transects are robust enough to state that the goal of 600 larvae or 300 adults total have been met, and perhaps exceeded by an order of magnitude (total resident larvae >6,000 in 2021).

Several ongoing issues with adult surveys for abundance include:

1) Adult surveys are utterly dependent on relatively calm, sunny weather, in common with the other butterflies monitored on SBM. These periods on SBM can be fleeting, and scheduling multiple surveys over the course of a season over three dispersed transect systems (as in 2021) proved to be challenging, so only two days on each transect were judged reliable. Changes in weather during a transect walk (afternoon winds and fog often pick up quicky) can also bias counts. Monitoring BCB abundance this way will require six or more dedicated days of monitoring, and may not even then be reliable.

2) Extrapolating from low numbers of observations leads to large confidence intervals. The two good sample days in 2021 produced only 5 observations at OC, for example. Count data of the magnitude seen in 2021 (13, 5, and 10 at MR, OC, and BC respectively) are fitted with a Poisson distribution, which has a wide variance; for example, the 95% confidence interval for a count of 5 extends from 2.2 to 10.7 (JMP16.1 calculation). Low larval counts also suffer from this issue (see Table 7).

3) The flight seasons of BCB and CCB overlap, and some skill and experience are necessary to tell them apart in flight on transect walks. CCB are more locally abundant (for now) and more widely distributed across all the transect areas (CCB is one of the most abundant butterflies on SBM). Key characters include BCB having lighter dorsal wing surfaces with less black and more red and cream compared with the darker CCB, and BCB have less red on the ventral wing surfaces. Adult CCB are slightly larger. They also have a different flight pattern, with more gliding between wing flaps, which becomes discernable after several encounters with each species. This is like the situation with postdiapause larvae of the two species being mixed up.

4) The short time spent on any transect segment (1.5 minutes) reduces the ability to detect presence when densities are low and weather, especially wind, is so variable. A few zeros do not provide definitive evidence of absence on a transect segment, which a general problem with butterfly transect surveys.

5) The largest relative error - underestimate of -60% of the larvae released at BC during the release year in 2020 - may have been influenced by the position of the transect, which did not cross one prominent hilltop within the release area, so surveys likely encountered fewer adults. Other estimates of resident larvae in known releases were between -38% and -8% of the true numbers.

6) Hilltopping behavior was evident (Maps 6-12) and provides a template for efficient presence/absence monitoring for distribution. On MR, the only butterflies observed in 2020 and 2021 on at the local hilltops, and the absence at Power Towers in 2021 may have been an artifact of short sampling time and poor weather. Concentrating adult survey efforts toward establishing presence on the hilltops may be the optimal strategy for monitoring BCB. However, any observations during the time spent walking between hilltop survey areas are valuable, and should also be tallied and mapped. More about these proposed monitoring strategies are discussed below in the Adaptive Management section.

Despite these issues, we are confident that the goal of 600 larvae or 300 adults in two of four years has been met.

Adaptive Management

Reintroducing the Bay checkerspot butterfly to San Bruno Mountain is an experiment in 21st century conservation in a rapidly changing environment. The effort builds on the numerous instances of native butterflies adapting to non-native hostplants, and takes advantage of the well-documented flexibility and opportunism of *Euphydryas editha* in hostplant use.

The initial goals of the project have been met: Local populations of BCB have established in four areas on SBM (Main Ridge, Owl Canyon, Buckeye Canyon, and Northeast Ridge), there are well more than 600 resident larvae, and the switch to PLLA has been documented. Moving forward with limited resources places an emphasis on maximum efficiency in BCB monitoring and habitat management.

The overarching mandates of the San Bruno Mountain Habitat Conservation Plan are the framework for these adaptive management recommendations. They are informed by the data and experience of the last five years, deep familiarity with SBM, an appreciation of how limited resources need to be carefully allocated, backed up by decades of research, monitoring, and management of imperiled butterflies

For now, they are initial recommendations to be considered by the broader stakeholders, including the HCP Trustees, USFWS, San Mateo County Parks staff, groups such as San Bruno Mountain Watch and CNPS, local residents, and the broader scientific and conservation communities.

Monitoring plan

Monitoring is an essential part of adaptive management that needs to be tailored to the target species and available resources. The level of effort during these initial five years is not sustainable over the long run, without an influx of firm additional funding. Therefore, a pared -down monitoring plan has been conceived.

The recommendation is that presence-absence monitoring, focused on hilltops, be implemented to keep track of the occupancy pattern of BCB on SBM. The experience of trying to rigorously track abundance, as discussed above, has been a lot of work that was necessary to document meeting the project goals, but would be difficult to implement on a routine basis going forward. This suggested presence-absence protocol is especially designed for low density populations, as were encountered in 2020 and 2021 at MR, OC, and BC. There are broad similarities with the presence-absence monitoring being done in the Marin Headlands for the Mission blue butterfly (Bill Merkle. pers. comm.).

The key elements include:

1) Identification of key hilltops along MR, which are the sites labeled in Maps 6-10, as well as the upper extent of grassland on Lower Buckeye (BC) and Owl Canyons (OC), and the three local hilltops on NER. The initial set of 14 points is presented on Map 15 for easy reference.

2) Once BCB are observed anywhere on SBM and reported by reliable sources during other activities (such as Mission blue transects), initiate the hilltop surveys. If no incidental observations have been made, start in late-March into early-April, a period that spans all five flight seasons 2017-2021 (Table 3 and Figure 1).

3) Spend up to 10 minutes in sunny weather, >15°C (60°F) with winds <4.5 m/s (10 mph), wandering within a 50 m radius of the hilltop area, until an adult BCB is observed. This

amount of time and flexibility allows for exploration of locally wind-sheltered spots, and provides more confidence that an observed absence is a true absence.

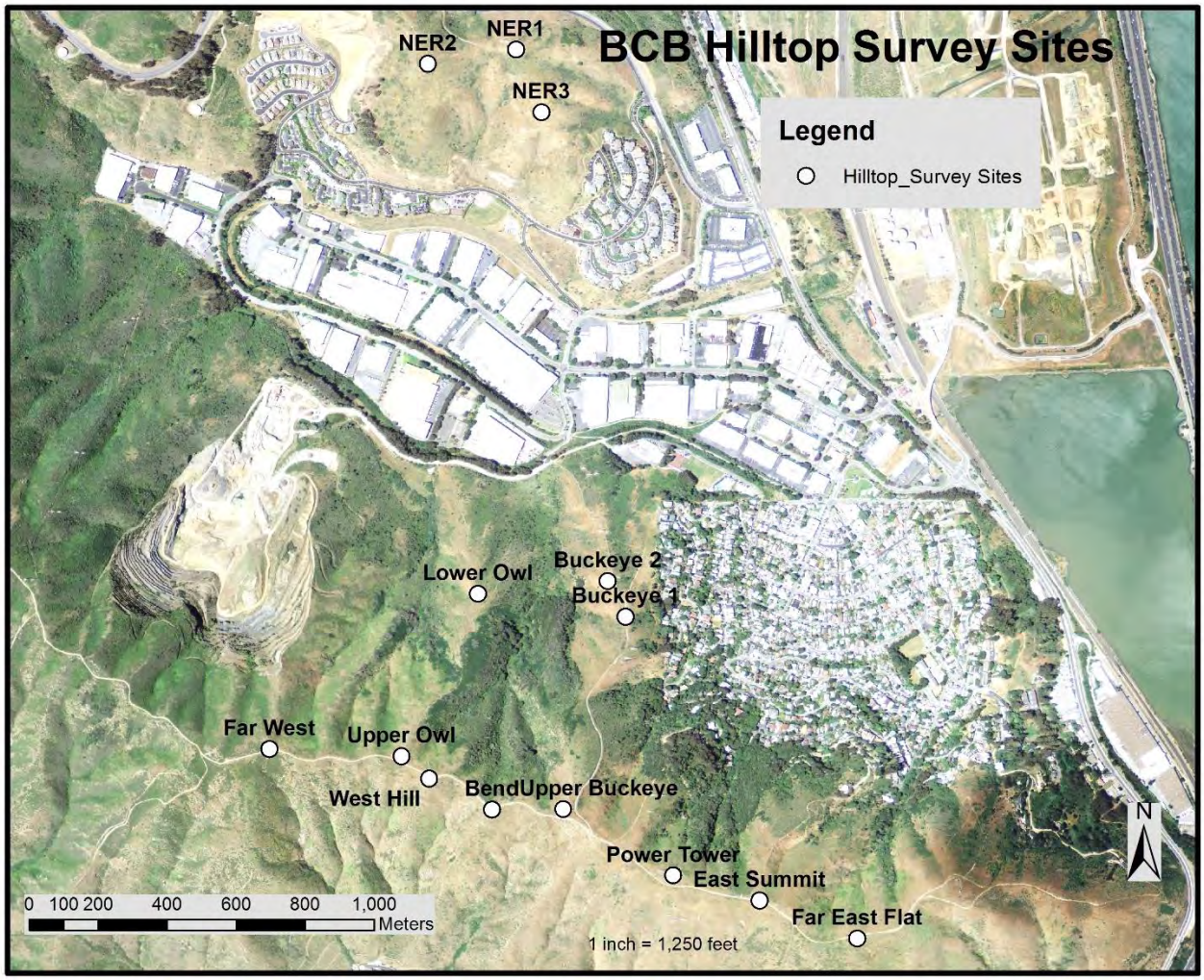
4) Once presence is confirmed, then there is no need to revisit that specific hilltop that season. This is the main time saver compared to transect walks. Revisit initially vacant sites up to two more times during the flight season as weather allows.

5) Obviously, the time walking between the hilltop sites should not be wasted. For example, the time hiking up to Lower Owl and Lower Buckeye from the quarry road also serves as time searching the lowest slopes, and as does time between the nine sites on MR and three sites on NER. Any observations should be tallied and mapped using an app like Avenza. GPS tracks should be kept so that survey time and route are recorded.

6) Occupancy rate of the 14 points is the primary metric of BCB population status. Other metrics include occupancy of the four main areas, and occupancy rates along the Main Ridge sites. The overall number of butterflies along the route is an indicator of abundance, and could qualitatively classify years/sites as low, medium, or high abundance. Quantitative measures of abundance require a consistent number of repeat visits across all sites, as mentioned above, which is what this method is trying to avoid.

7) All these sites are along or close to Mission blue transects, which are run during the late-March early April period, so incidental observations (not 10-minute search periods) of BCB during biannual MBB surveys can serve to establish occupancy and save more effort.

8) It may be possible for trained volunteers to carry out at least some of the monitoring. Local volunteers could observe the weather directly before heading out, and avoid poor weather days.



Map 15. Suggested hilltop observation sites for BCB monitoring: 10-minute maximum wandering searches within 50 m of the hilltop to detect presence.

Habitat management

Management for the BCB mostly falls within the ongoing HCP activities, and special actions are largely unnecessary. Key points include:

1) Treatment and control of non-native PLLA has been of lowest weed management priority, and should remain so. The species is widely distributed and rarely forms the type of dense stands that threaten key native species such as other butterfly hostplants. The dense stands at places like West Hill are still rich native grasslands with high biological values.

2) Maintaining open grassland in the face of native scrub succession is a prime management goal for SBM (Weiss et al. 2015). Native scrub control around Essential and Important grasslands outlined in that report benefit BCB as much as MBB and CSB.

3) PLLA can thrive in disturbed areas – it is particularly abundant on road and trail verges and even in the middle of the Ridge fire road. It can rapidly recover from local disturbances, which is one of the reasons it has spread so widely since its introduction from Europe centuries ago. No need is foreseen to actively propagate PLLA on SBM. It spreads and thrives on its own if grassland is maintained as grassland,

4) The precautions taken when using herbicides should be sufficient to protect the broader PLLA stands. Because of its ubiquitous distribution in many areas, some individual plants may be impacted but with minimal effect on the overall abundance of PLLA. The positive effects of maintaining grassland as grassland far outweigh the loss of a few host plants.

5) The proposed grazing trial on the NER and SE slope will be an opportunity to reduce annual grass cover and thatch and open more habitat for butterfly hostplants, including PLLA. Grazed coastal grasslands on Pt. Reyes have dense stands of PLLA (S. Weiss, pers. observ. May 2020). BCB populations thrive under the moderate grazing regimes (1 cow-calf per 10-15 acres) on serpentine grasslands in Santa Clara County, despite some unavoidable mortality from trampling (Weiss 1999). The newly established population on NER will be a test bed for assessing grazing impacts on BCB at SBM. The abundance of PLLA will be explicitly tracked in the experimental monitoring plots (paired exclosures and grazed plots).

6) PLLA can be common in lawns, roadsides, and other urban environments. It is recommended that this species not receive special protection outside of the HCP boundaries. If BCB ever spread out into urban areas, it would be a sign that the local populations on SBM are large and robust, and extra measures outside the HCP boundaries would be unnecessary to maintain the populations. Avoiding unnecessary conflict in the areas surrounding the HCP is an important goal to keep in mind, as it distracts from the necessary management of the conserved habitats. This will require some policy consensus among USFWS and the various HCP stakeholders.

Other potential reintroduction areas on San Bruno Mountain

The initial feasibility study (Niederer et al. 2015) identified several other potential areas on SBM for BCB introduction, which could be considered if the newly established populations increase sufficiently. These sites include:

1) Hillside-Juncus: this was one of the first sites considered when the initial surveys were undertaken in 2015, the year after a fire. Large stands of PLLA were in the burn area. However, the rapid regrowth of grasses, especially *Avena* sp. buried most of the hostplants under tall grass and accumulated thatch by 2016. Some linear stands of dense PLLA still occur along the fire roads and trails. This site was rejected for translocation because of the rebound in the grasses – sites low on the South Slope are subjected to nitrogen deposition from vehicles in the upwind urban areas. The added nitrogen allows for excessive grass growth. In average to wet years, *Avena* can reach head height on thin, rocky soils as was observed here in 2016 and 2017, and elsewhere on the south slope.

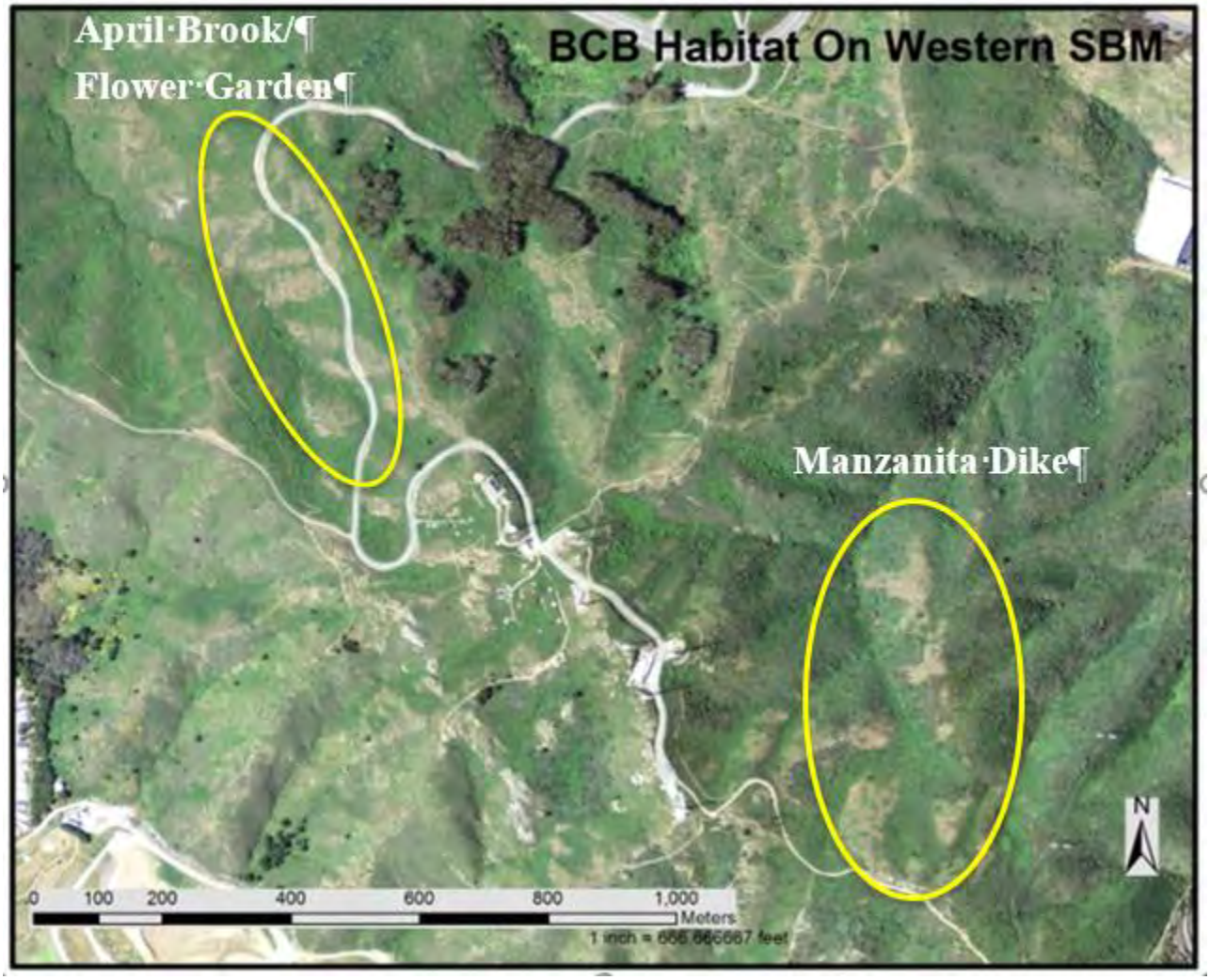
2) Slightly upslope, a large patch (1 ha+) of PLER was found on a south-facing slope east of the road in a native-rich grassland community that hints at the ancestral condition on SBM – dense stands of PLER and *Lasthenia californica* among bunchgrasses and native perennial forbs including *Viola pedunculata* and *Lupinus albifrons* and *L. variicolor*. The upper reaches of this site are separated by a few hundred meters of scrub from the Far West site.

3) Wax Myrtle Ravine: Dense stands of PLLA occupy the south and east facing slopes between Guadalupe Parkway and the business park. This area is not yet dedicated habitat and is still being prepared with scrub and weed control for transfer to the HCP. A more detailed survey of PLLA would be necessary before any further BCB consideration. The site is about 500 hundred meters direct line from the NER, but the intervening suburban neighborhood is a major barrier to dispersal.

4) Western SBM has several hectares of disconnected grassland patches that support PLER (Map 16). In the April Brook/Flower Garden area, there are series of nearly continuous grassland patches between the stream and Radio Road filled with PLER, *Castilleja* spp., and a variety of nectar sources in one of the most pristine coastal prairie sites in California. Combined, the patches may provide enough habitat for a local population, but detailed mapping is needed before further consideration as BCB habitat.

5) Just east of the summit, grassland patches on and south of Manzanita Dike (Map 16) have supported large stands of PLER in past years, along with *Lasthenia* and numerous potential nectar sources. These patches have diminished in recent decades from scrub encroachment, and like April Brook harbor some of the finest remaining coastal prairie anywhere. This is another area for a more detailed survey.

6) As documented in the plant phenology section, the long-lasting PLER in the mild coastal climate can provide quality habitat. These western grasslands have diminished over the decades because of scrub encroachment, but a concerted effort over a few years of clearing scrub from grassland patches and connecting them again would not only increase potential as BCB habitat, but also benefit the prairie itself.



Map 16. Grassland patches on western SBM that support PLER and are potential BCB habitat.

At this point no additional translocations are planned. The first step is to help San Mateo County Parks to jump start a BCB monitoring program, and track the distribution over several years. Continued presence of BCB at each release site (Main Ridge, Owl Canyon, Buckeye Canyon, Northeast Ridge) precludes the need more additional translocations. Absence (or no confirmed presence) for more than one season in two or more of the release sites should trigger a stakeholder meeting of regulators and stakeholders to consider additional translocations. A threshold of two extirpated sites allows for some metapopulation dynamics, and recognizes that local BCB populations can go extinct and can be naturally recolonized (Ehrlich and Hanski 2004). Additional larvae from Coyote Ridge could be translocated, repeating the procedures so far. Or translocations within SBM to repopulate extirpated areas would be possible if populations were dense enough on parts of the mountain. Such decisions are several years away as it is now up to the butterfly to adapt to the new environment.

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