Progress Report For
The Mission Blue Butterfly
(*Icaricia icarioides missionensis)*
At Twin Peaks Natural Area

USFWS Permit TE-30659A-1

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Executive Summary

Success continues with the Mission blue butterfly project at Twin Peaks Natural area.

No larvae were observed this year, and feeding evidence on random plants was only 4.1% (down from 15% in 2015, and 29% in 2014). Translocations therefore were recommended, and 29 females and 15 males were brought from San Bruno Mountain. Egg numbers increased this year following the translocation.

Based on analysis of population estimates for monitoring different life stages, we have concluded that egg monitoring provides reliable estimates and is relatively easy to conduct. Mission blue eggs are distinctive, and monitoring at this stage is not dependent on weather.

Based on 2016 egg data, we estimate 61 total females on site, leaving us in our estimated historical range that the population at Twin Peaks was in the hundreds (assuming an even sex ratio). An updated lupine census is recommended to maintain accurate estimates. Because the population appears to be holding relatively steady, we do not recommend translocations in 2017.

Scrub removal to maintain grassland habitat and lupine planting to increase number, distribution, and species richness of host plants continue to be high priorities.

Partnerships continued to strengthen this year. Golden Hour Restoration Institute (Golden Hour) and SFRPD received a USFWS Partners for Fish and Wildlife grant for habitat management in 2014 and completed their third and final year of work on this grant. They created an educational stewardship opportunity for volunteers who were willing to commit to the project for one year. Volunteers worked under close supervision of at least one permitted biologist and SFRPD staff. Golden Hour staff contributed an estimated 100 hours while volunteers contributed nearly 250 hours over eight volunteer days that included scrub removal, weed removal, planting, seeding, seed collection, grass cutting, and supporting education and instruction. Currently, Golden Hour is searching for additional funding but will continue the program through spring of 2017.

Surveys 2016

Larval surveys

Surveys are conducted for postdiapause larvae and their feeding evidence. At each site, 30 randomly selected plants are searched. In addition, searches are done on release plants (where adult translocated females were placed under mesh the previous flight season). Of the random plants, over the season, 25 of 605 plants (4.1%) surveyed had feeding evidence. This was down from 15% in 2015, and 29% in 2014. Seven of 13 release plants had feeding evidence (Table 1).

All feeding evidence was found on *L. albifrons;* none was on *L. variicolor* or *L. formosus.*

Table 1. Postdiapause larval survey results

Date	Site	# Plants with Feeding Evidence (Random)	# Plants with Feeding Evidence (Release)	Total # Plants with Feeding Evidence	Total # Larvae	Total # Random Plants Surveyed for Larvae	# of Release Plants Surveyed	Total Plants Surveyed for Larvae
2/29/2016	Mission Bowl	0	N/A	0	0	30	0	30
2/29/2016	Mission Ridge	0	0	0	0	30	6	36
2/29/2016	Gardenside	1	0	1	0	30	5	35
2/29/2016	Mission Flats	0	N/A	0	0	30	0	30
3/9/2016	Mission Bowl	0	N/A	0	0	30	0	30
3/9/2016	Mission Ridge	1	0	1	0	30	6	36
3/9/2016	Gardenside	1	0	1	0	30	5	35
3/9/2016	Mission Flats	0	N/A	0	0	32	0	32
3/17/2016	Mission Bowl	2	N/A	2	0	30	0	30
3/17/2016	Mission Ridge	1	1	2	0	30	6	36
3/17/2016	Gardenside	1	2	3	0	30	7	37
3/17/2016	Mission Flats	1	N/A	1	0	32	0	32
3/25/2016	Mission Bowl	2	N/A	2	0	31	0	31
3/25/2016	Mission Ridge	0	0	0	0	30	6	36
3/25/2016	Gardenside	1	2 (+ 1 old)	4	0	30	7	37
3/25/2016	Mission Flats	3	N/A	3	0	30	0	30
4/1/2016	Mission Bowl	4	N/A	4	0	30	0	30
4/1/2016	Mission Ridge	2	1	3	0	30	6	36
4/1/2016	Gardenside	2	1	3	0	30	7	37
4/1/2016	Mission Flats	3	N/A	3	0	30	0	30
Total		**25**	**7**	**33**	**0**	**605**	**61**	**666**

No larvae were found this year, the only recorded zero (Table 2).

Table 2. Larval survey results from previous years.

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
larvae	N/A	1	N/A	1	N/A	N/A	N/A	14	3	6	5	55	5	0

Adult surveys

In 2016, 11 males and 2 females were noted over four days. All three release sites were occupied (Table 3). All adults were noted flying. The first adults were released April 8 and 19, so the last two survey dates (which included both female sightings) could be confounded with release animals.

Table 3. 2016 adult survey results

Date	Site	Adult Males	Adult Females	Unknown	Total Adults
3/25/2016	Mission Bowl	1	0	0	1
3/25/2016	Mission Ridge	1	0	0	1
3/25/2016	Gardenside	1	0	0	1
4/1/2016	Mission Bowl	1	0	0	1
4/1/2016	Gardenside	2	0	1	3
4/1/2016	Mission Flats	1	0	0	1
4/15/2016	Mission Bowl	2	2	0	4
4/21/2016	Mission Bowl	2	0	0	2
Total		**11**	**2**	**1**	**14**

2013 still has the highest number of adults observed since surveys began in 1997 (Table 4). Numbers of unreleased adults appear fairly static over the last three seasons.

Table 4. Adult survey results from previous years.

Year	1997	2001	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
Females	3										6	2	1	6	5	6	2
Males	6		1		1						11	5	6	21	18	15	11
Unidenti-fied	1																
Subtotal, unreleased adults	10	0	1	0	1	0	0	0	0	0	17	7	7	27	23	21*	13*
Additional released females										22	0	40	11	38	0	13	29
Additional released males											0	20	5	20	0	9	15
Total Adults	**10**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**22**	**17**	**67**	**23**	**85**	**23**	**43***	**57***

*In both 2015 and 2016, two adult survey dates occurred after some releases.

Egg surveys

Visual surveys are conducted for eggs a short period after adult butterflies are observed. At each site, 30 randomly selected plants are searched. In translocation years, additional searches are done on release plants (where adult translocated females were placed under mesh upon release). Four egg surveys were done in 2016.

Eggs are most commonly observed on silver bush lupine (*L. albifrons*). Silver bush lupine is the dominant species of lupine that naturally occurs on Twin Peaks. No *Lupinus variicolor* (eight surveyed) or *Lupinus formosus* (nine surveyed) plants had eggs on them in 2016.

As in previous years, eggs were not evenly distributed. In previous years Gardenside had the larger number of eggs, but this year Mission Bowl (which is NOT a release site) stood out with 289 eggs. All previous release sites had eggs (Table 5). Across Twin Peaks, 22.2% of randomly searched lupines had eggs, and 64.2% of release plants had eggs (Table 6).

Table 5. Egg survey results by site

Site	Total # Eggs
Gardenside	93
Mission Bowl	289
Mission Flats	26
Mission Ridge	83
Total	**491**

Table 6. 2016 egg survey results

Date	Site	# Random Plants Surveyed for Eggs	# Random Plants with MBB Eggs	# Release Plants Surveyed	#Release Plants with MBB Eggs	# Total Plants with Eggs	Total# of Eggs	Total Plants Surveyed for Eggs
4/15/2016	Mission Bowl	31	6	0	na	6	21	31
4/15/2016	Misison Ridge	30	2	6	2	4	15	36
4/15/2016	Gardenside	30	3	0	na	3	4	30
4/15/2016	Mission Flats	30	1	0	na	1	5	30
4/21/2016	Mission Bowl	30	16	11	10	26	120	41
4/21/2016	Misison Ridge	30	5	6	2	7	19	36
4/21/2016	Gardenside	30	14	0	na	14	18	30
4/21/2016	Mission Flats	30	5	0	na	5	12	30
4/29/2016	Mission Bowl	30	5	11	8	13	57	41
4/29/2016	Misison Ridge	30	7	6	4	11	26	36
4/29/2016	Gardenside	30	9	na	na	9	26	30
4/29/2016	Mission Flats	30	2	na	na	2	4	30
5/11/2016	Mission Bowl	30	10	10	8	18	91	40
5/11/2016	Misison Ridge	30	7	6	5	12	23	36
5/11/2016	Gardenside	30	11	11	4	15	45	41
5/11/2016	Mission Flats	30	4	0	na	4	5	30
Total		**481**	**107**	**67**	**43**	**150**	**491**	**548**

Previous egg surveys

For comparison:
In 2008, prior to any releases, we counted 43 eggs over 3 surveys.
In 2009, after our pilot release of 22 females, we counted 242 eggs over 4 surveys.
In 2010, with zero releases, we counted 42 eggs over 4 surveys.
In 2011, after releasing 40 females, we counted 647 eggs over 4 surveys.
In 2012, after releasing 11 females, we counted 273 eggs over 3 surveys.

In 2013 after releasing 38 females, we counted 1120 eggs over just 2 surveys. It is likely the egg count would have been even higher if more surveys had been done, as in previous years.
In 2014, with no adults released, we counted 489 eggs over 5 surveys.
In 2015, after releasing 13 females, we counted 239 eggs over 5 surveys.
In 2016, after releasing 29 females, we counted 491 eggs over 4 surveys.

Egg recordings increased to a moderately high number after two years of decline (Table 7).

Table 7. Egg survey results from previous years.

Year	2001	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
Eggs	14	103	23	84	143	43	22	43	147	42	295	273	1120	489	239	491

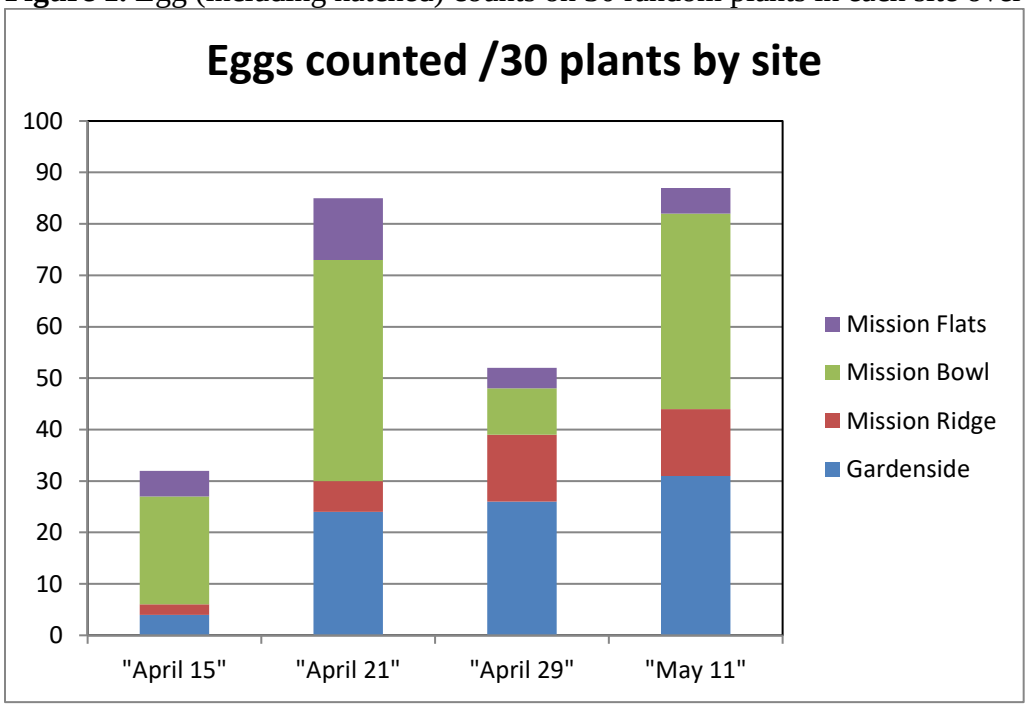
Population estimates

Last year's report (Weiss et al. 2016) compared population estimates based on surveying the three life stages: post diapause larvae, adults, and eggs. We found that estimates based on the three surveys gave similar results. Larval searches tend to locate very low numbers of larvae, and feeding evidence can be difficult to discern from other herbivory. Dampness on vegetation can further confound the searching. Adult surveys also tend to yield low numbers, and are extremely weather dependent. Adult flight is limited by clouds, high winds, and cool temperatures, each of which are common during the flight season. Eggs are small but distinct and therefore easy to identify. They are present during all sorts of weather, increasing the ease of surveying. Because surveying all three stages is time-consuming, and the occupied habitat is relatively small, we agreed that egg estimates are the best sampling technique for Mission blues on Twin Peaks.

We include hatched eggs in the estimate, because shells only last a few days after hatching and can represent a high proportion of the egg deposition over the sample period (7-12) days.

The method for translating egg data into population estimates is shown here. Egg counts per survey date are given in Figure 1.

Figure 1. Egg (including hatched) counts on 30 random plants in each site over four survey dates



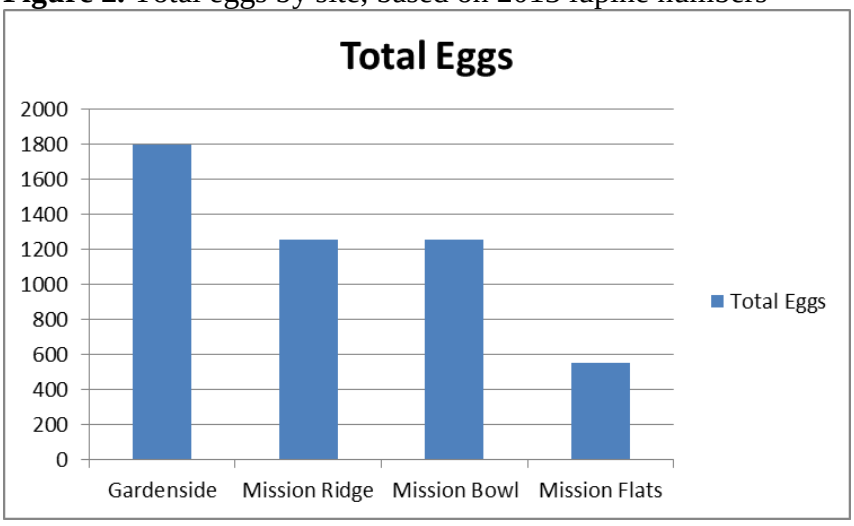
The eggs/plant were then multiplied by the total number of lupines in each site (based on 2013 census, Table 8).

Table 8. Lupine counts 2013

Site	Lupine Count
Gardenside	634
Mission Bowl	339
Mission Flats	635
Mission Ridge	1110

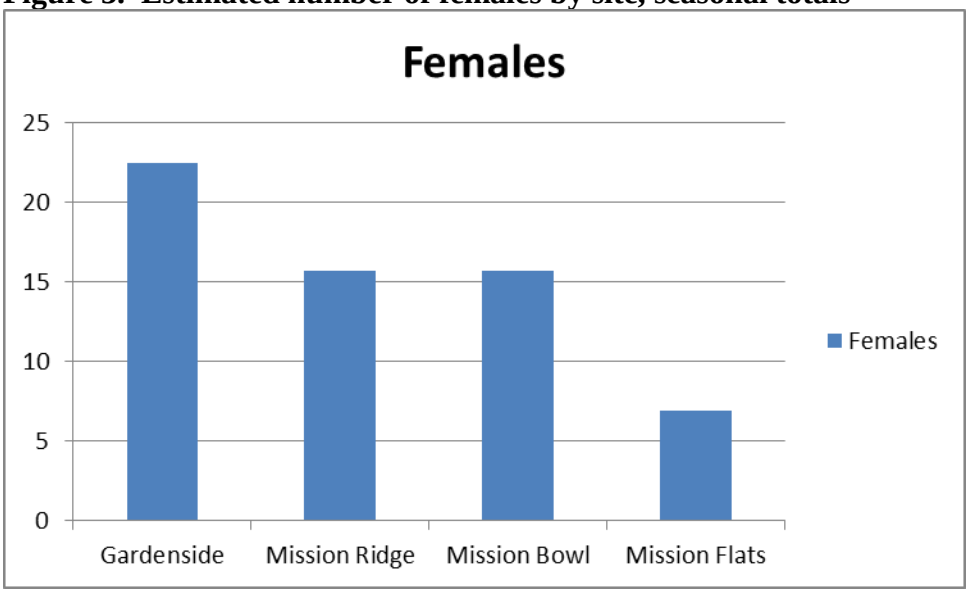
Total eggs/site were summed over the four dates, making the assumption that the population of eggs turned over completely between sampling dates (Figure 2).

Figure 2. Total eggs by site, based on 2013 lupine numbers



Estimates of total eggs were then turned into estimates of total female butterflies (Figure 3) by assuming that a female MBB lays 80 eggs over her lifespan (Weiss et al. 2016). This estimate of realized fecundity was reinforced by the observation of 10 eggs/day laid by females at Milagra Ridge while caged on plants for an entire day in 2016 (Ruby Kwan, pers. obs. 2016), and the estimate of 8 day lifespan from San Bruno Mountain (Arnold 1983).

Figure 3. Estimated number of females by site, seasonal totals



The total number of females across all sites is estimated at 61. To calculate the resident population, the following equation was used:

Total number of resident females = Total eggs estimated/80 – translocated females/40 + total eggs on release plants/40.

The last term accounts for eggs laid on the release plants (sampled separately from the random 30 plants) immediately after translocation, because these known eggs are not available for sampling in the 30 random plants.

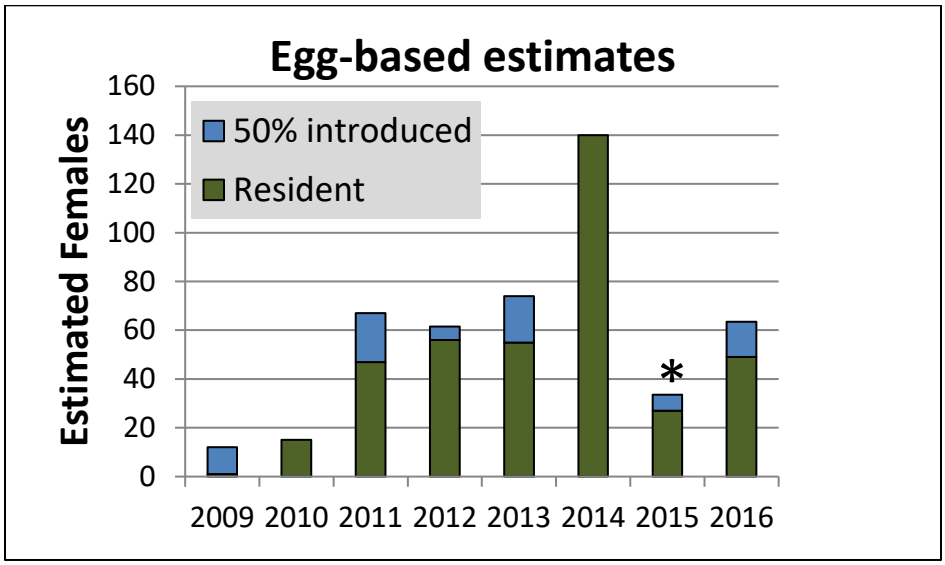
29 females were translocated from San Bruno Mountain in 2016, and we assume that they contributed 50% of their eggs (40/female) to Twin Peaks and were thus the equivalent of 14.5 females. Therefore the estimate of the resident MBB female population on Twin Peaks, prior to translocation, is 45.5. Lastly, release plant eggs were counted separately from the 30 random plants. A total of 272 eggs were observed on release plants, which accounts for 3.4 females worth of eggs, so the estimate of the resident population increases to 49 females.

Because the totals are based on the 2013 lupine census, and lupine numbers may have been increasing with plantings and natural recruitment, these 2016 estimates may be low. An updated lupine census is needed to maintain accurate Mission blue population estimates. In 2014 we estimated ~140 females, and in 2015 we estimated between 27 and 72 females. The estimate of 27 is from egg counts, but we missed the first four weeks of the season so it is definitely low. Postdiapause larval surveys indicated 72 females (see Weiss et al. 2016 for details). If the mid-point of the estimates (50 females) is assumed, then the population in 2015 had effectively replaced itself in 2016.

Despite any uncertainties, a population of MBB has been established on Twin Peaks, and it appears to be capable of replacement and population growth, as well as population declines (Figure 4). The population grew

in 4 years (2010, 2011, 2012, and 2014), even before taking into account the translocations. It is important to keep in mind that butterfly populations can fluctuate by a factor of 10 or more over several years and that high reproductive output allows for populations to take advantage of increased hostplant abundance and diversity in good weather years (like from 2013 to 2014). On the other end, the large decrease in 2015 is well within the historical range of variability for local MBB populations (Weiss et al. 2015)

Figure 4. Egg-count based estimates of resident females by year, with 50% of the number of translocated females stacked on top. *indicates a likely underestimate because of late start to the egg sampling season in 2015.



Adult translocations

This season we translocated 29 females and 15 males (Table 9). No animals were injured. We continued with our permitted collection protocol that allowed collecting up to five females (and 3 males) on each transect in a given day. We left at least two females on site (i.e., we would capture 3 to 7 females at a given transect, release 2, transferring 1 to 5 females). If the quota was reached, we waited at least seven days before returning to that transect to collect again. We collected (or searched) from multiple transects in the same day. Total translocated animals are shown in Table 10.

Table 9. MBB adult collections 2016

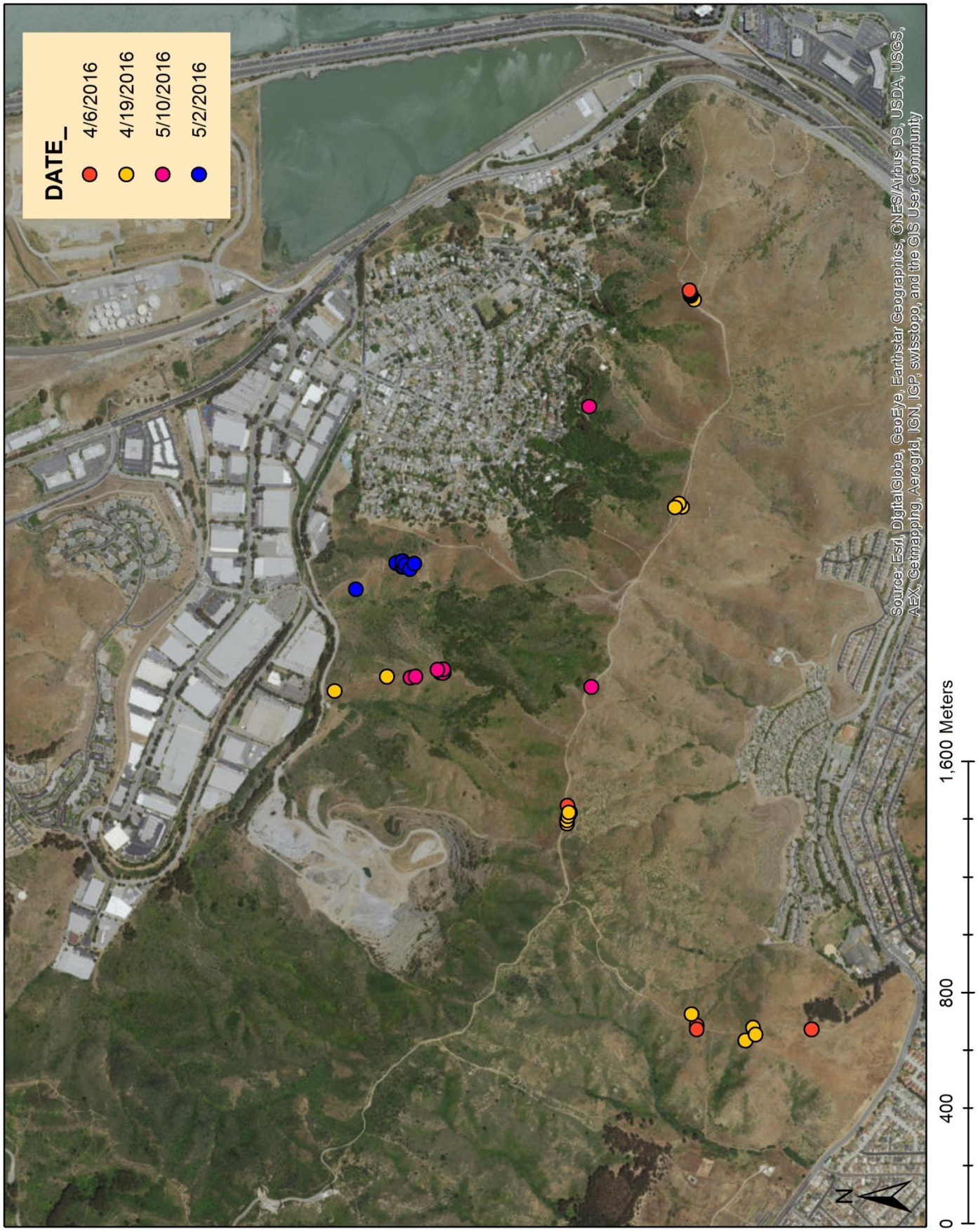
Date	Males observed	Males captured	Females observed	Females captured	Number injured	Number killed	Behavior after release
4/6/2016	44	3	13	6	0	0	Walking, perching, basking
4/19/2016	65	6	19	11	0	0	Walking, perching, basking
5/2/2016	20+	3	10+	5	0	0	Walking, perching, basking
5/10/2016	13	3	12	7	0	0	Walking, perching, basking
Total		**15**		**29**			

Table 10. MBB translocations to Twin Peaks

Year	Females	Males	Total
2009	22	0	22
2010	0	0	0
2011	40	20	60
2012	11	5	16
2013	38	20	58
2014	0	0	0
2015	13	9	22
2016	29	15	44
Total	153	69	222

Capture areas are shown in Map 1.

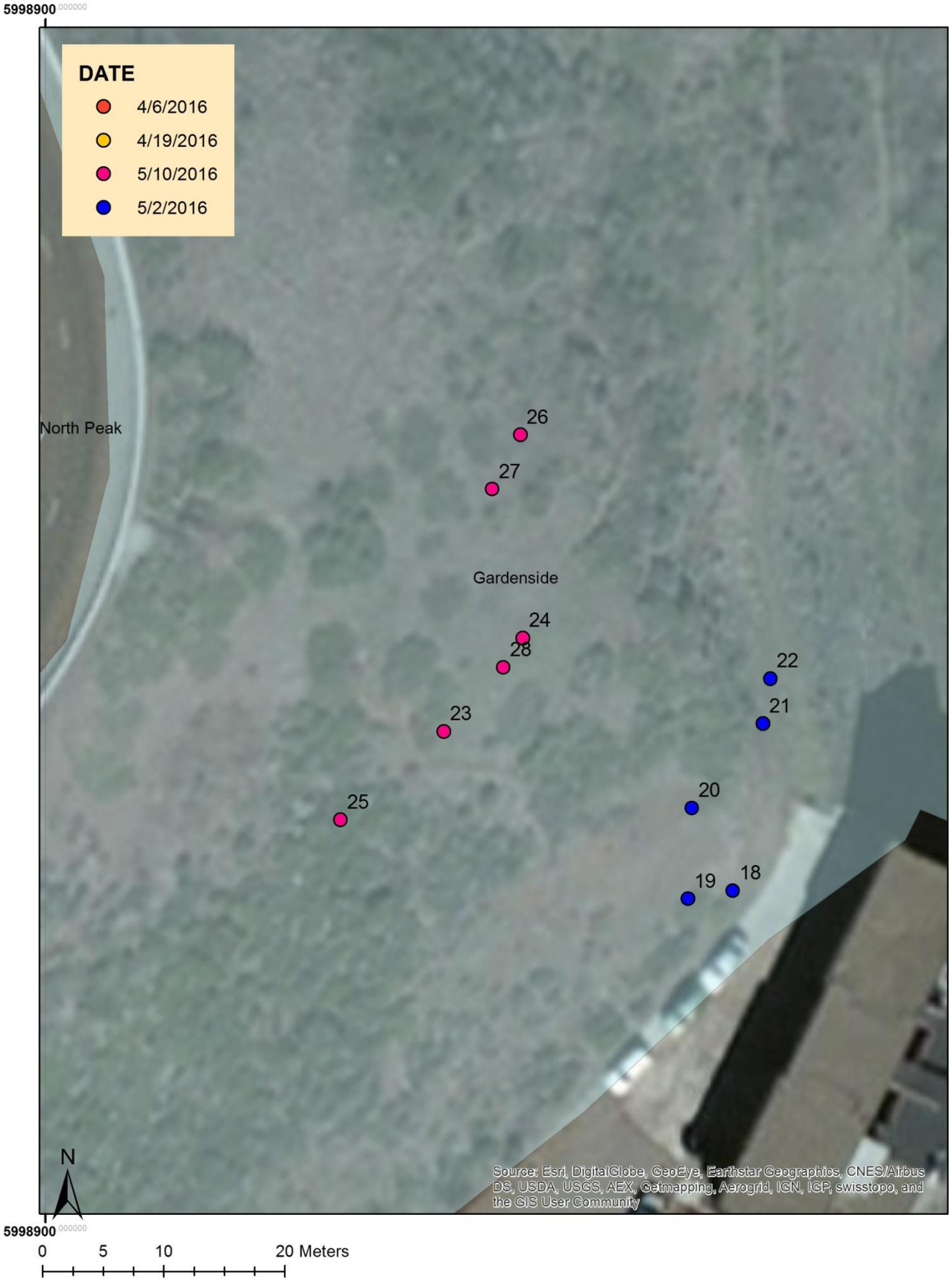
Map 1. 2016 adult Mission blue capture sites on San Bruno Mountain



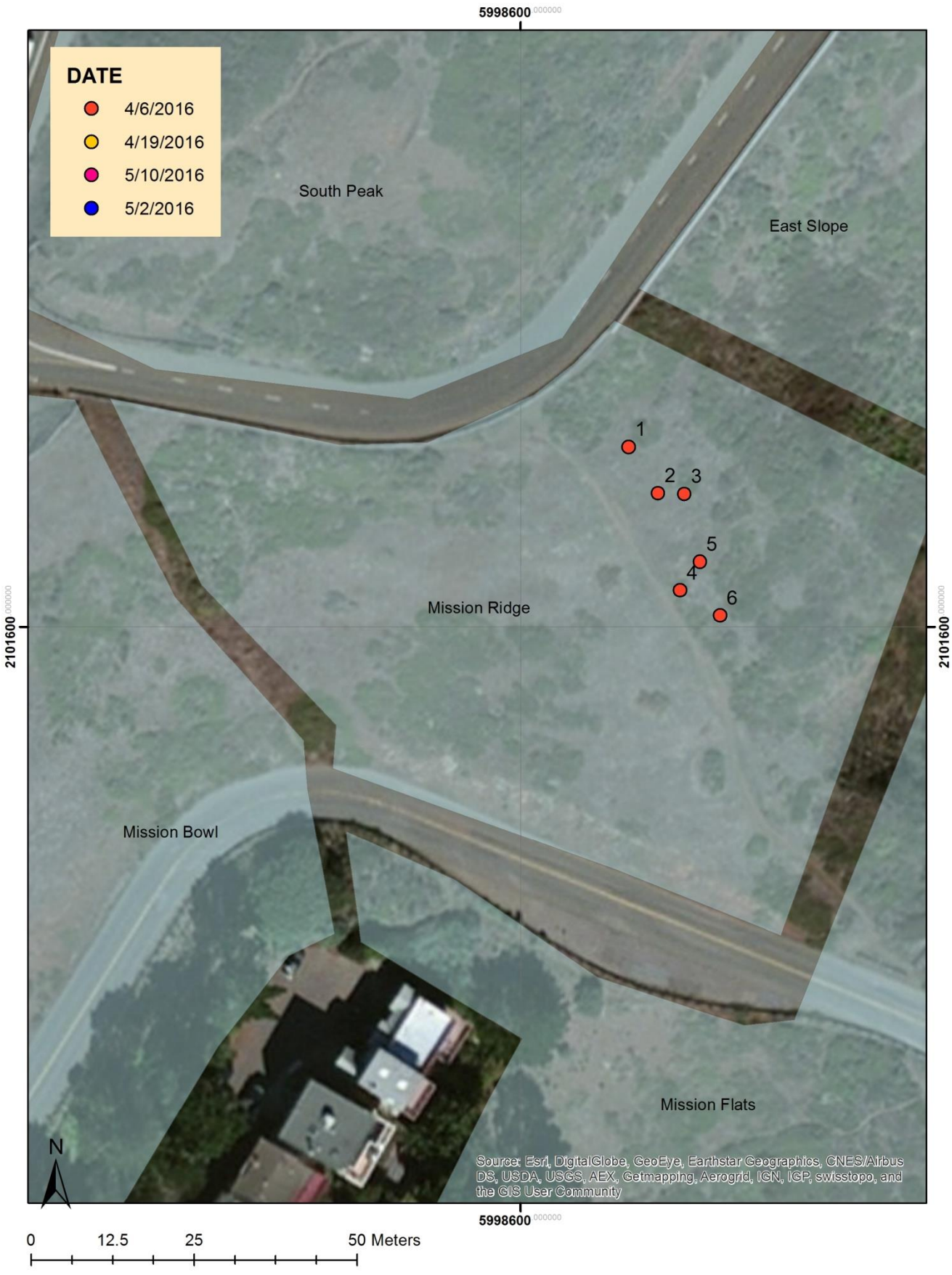
As in previous years, all butterflies were released on a robust *L. albifrons* host plant the same day at Twin Peaks. Butterflies were released under a mesh enclosure attached to the lupine, in order to encourage oviposition and to prevent butterflies from leaving the site. On cool days, when butterflies were inactive, mesh enclosures were promptly removed to minimize interference with their natural movements. On warm days, mesh enclosures were left in place until active butterfly movement slowed. Adults were released at Mission Ridge and Gardenside. Males were always placed with females. Release sites are shown in Map 2, with close up views to aid in release plant relocation shown in Maps 3-5. This marks the first year adults were released at Mission Bowl.

Map 2. 2016 adult Mission blue release sites on Twin Peaks

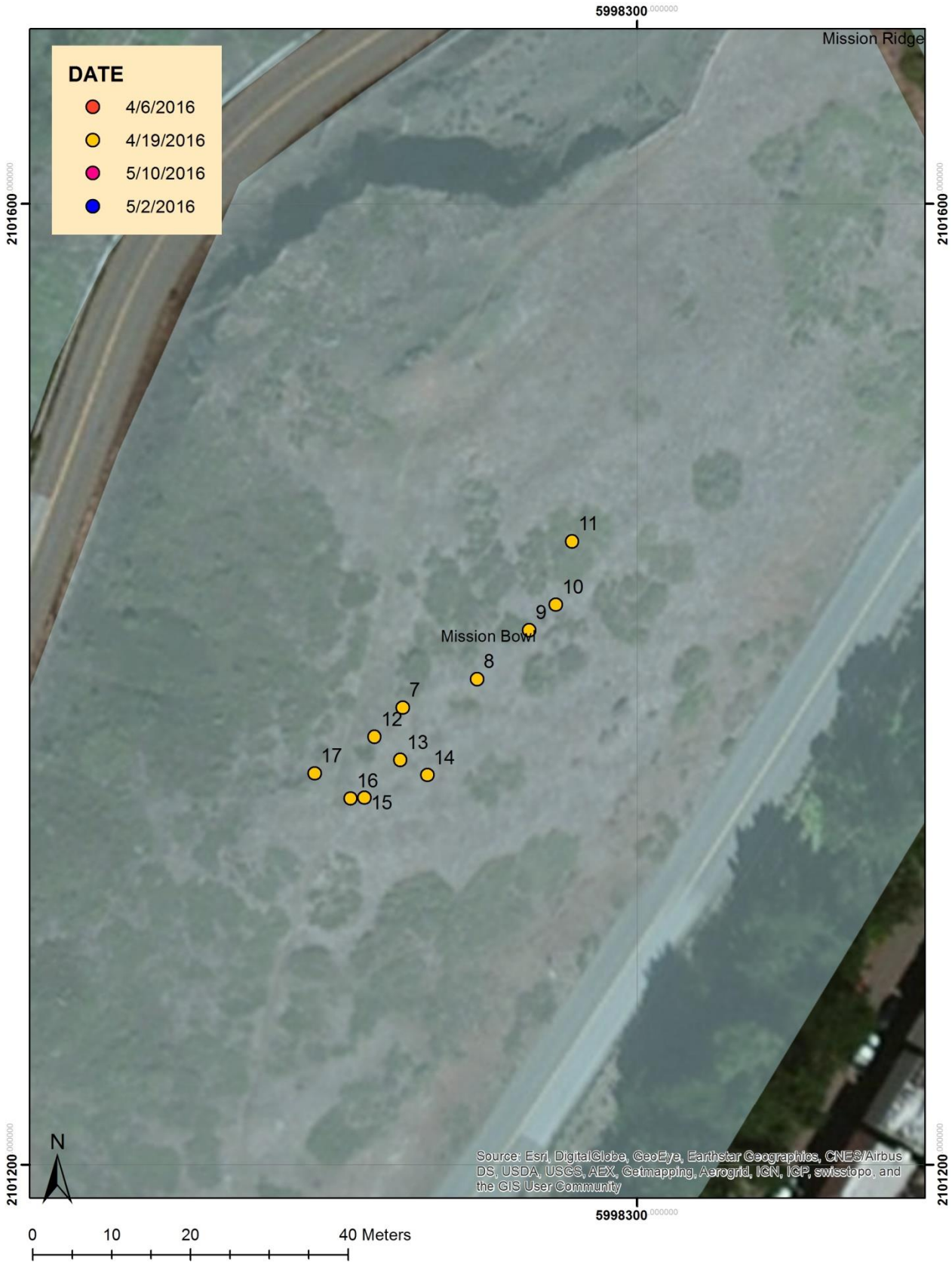
Map 3. 2016 adult Mission blue release sites at Gardenside, Twin Peaks. One release plant from 5/10/2016 is unmapped.



Map 4. 2016 adult Mission blue release sites at Mission Ridge, Twin Peaks



Map 5. 2016 adult Mission blue release sites at Mission Bowl, Twin Peaks



Habitat management

SFRPD and Golden Hour Restoration Institute have completed their grant from USFWS's Partners in Fish and Wildlife Program [Award F13AC00712]. This funding has been used to supplement existing on-the-ground habitat management and has provided for additional stewardship activities deemed crucial for this project. The importance of this work was underscored by 2013 lupine mapping, which showed that managed habitat improves, and unmanaged habitat degrades quickly.

Under the grant, 15 volunteers committed to participating in at least six work days on Twin Peaks. A total of eight work days occurred in 2016, on the second Saturday of January 9, March 12, April 9, June 11, July 9, October 8, September 10, November 12. Volunteers worked under close supervision of at least one permitted biologist, but two were on-site for 7 of the 8 days. Golden Hour staff contributed an estimated 100 hours while volunteers contributed nearly 250 hours over the course of eight volunteer days. These eight "peak experience" volunteer days took place in occupied habitat, and included growing and outplanting native host and nectar plants, direct seeding lupine trials, invasive removal (fennel, thistles, radish, mustard, alyssum, English plantain, non-native annual grasses), seed collection, and lupine recruitment monitoring. In particular, coyote brush invading the Mission Bowl area was targeted with three work days. In addition to volunteer stewardship days, SFRPD performed spot treatment of oxalis with herbicides, scrub control, nursery propagation, plant maintenance, erosion control, trail maintenance and social trail closure.

Habitat management success is predicated on balancing our skill sets: SFRPD provides regular scheduled workers, property oversight, and nursery infrastructure. Golden Hour brings additional planning, outreach, volunteer management, and recruitment.

Scrub management

Scrub encroachment will be a long-term management issue at Twin Peaks. Historical photos using Google Earth show how the grasslands at Twin Peaks have been invaded from 1938 to 2014 (Figure 5a-b).

Figure 5a. Twin Peaks 1938; **b.** Twin Peaks 2014.

Between SFRPD and Golden Hour volunteers, about 5500 ft^2 of coyote brush scrub has been removed from key habitat areas since 2014 (Figure 6). The focus in 2016 has been on expanding habitat at Mission Bowl and Mission Flats. Golden Hour workshops occurred at both of these sites throughout the year.

Figure 6. Coyote brush removal at Mission Flats. This area was both replanted and reseeded with native grassland species, including lupines.

Current scrub removal work focuses on removing "islands" of coyote brush and creating larger contiguous patches of grassland habitat. Coyote brush is removed mainly by intensive pruning. Using this technique, the regrowth on the plants needs to be cut repeatedly to starve the root system.

Weed control

Volunteers also removed fennel, thistles, radish, mustard, alyssum, and English plantain. Other weeds were also managed throughout Twin Peaks including the ongoing annual treatment of *Oxalis pes-caprae* within and adjacent to critical habitat and cotoneaster and invasive shrubs along roadsides adjacent to MBB habitat. Approximately 10,500 ft^2 of other weeds such as fennel, thistles, broom, radish, echium, valerian, mustard, alyssum, and English plantain were controlled by volunteer and SFRPD staff near and within MBB habitat (Figure 7).

Figure 7. Volunteer removal of mustard (*Brassica nigra*) near the edge of the Mission Ridge grassland.

Seed collection

Volunteers and staff coordinated two rounds of seed collection: one for *Lupinus* species and another for nectar plants. Seeds were successfully collected from *Achillea millefolium*, *Phacelia californica*, *Eriogonum latifolium*, *Lupinus variicolor*, and *Eschscholzia californica.*

Seeds are stored with the SFRPD and were used for direct seeding into the areas of coyote brush removal on Mission Bowl. Nectar plant seeds will be sown into the soil in 2017 at a Golden Hour workshop.

Planting

The 2016 water year was just above the mean. The 30-year average (1981-2010) for Twin Peaks is 58.7 cm of precipitation, and 64.7 cm fell in 2015 (Table 11).

Table 11. Precipitation records for Twin Peaks (Westmap 2017)

	Yearly Precipitation (cm)
Oct 2007-Sep2008	42.3
Oct 2008-Sep2009	42.2
Oct 2009-Sep2010	57.7
Oct 2010-Sep2011	67.0
Oct 2011-Sep2012	38.0
Oct 2012-Sep2013	40.8
Oct 2013-Sep2014	30.8
Oct 2014-Sep2015	45.7
Oct 2015-Sep2016	64.7

In December 2015 and January 2016, volunteers and staff planted 25 *L. albifrons*, 112 *L. formosus*, and 19 *L. variicolor* (Table 12), for a total of 156 lupines.

Table 12. Lupine plantings 2016 season

	Lupinus albifrons	*Lupinus formosus*	*Lupinus variicolor*
Mission Bowl	25	5	5
Mission Flats	0	53	9
Mission Ridge	0	54	5

Sixty *Achillea millefolium* and 60 *Phacelia californica* were also planted throughout Mission Ridge and Mission Flats for nectar.

On site to date, a total of 2051 lupines have been planted (Table 13).

Table 13. Total lupines planted, 2002-2016

Lupinus albifrons	741
Lupinus formosus	737
Lupinus variicolor	573
All lupine species	**1895**
Gardenside, Lupinus albifrons	92
Gardenside, Lupinus formosus	140
Gardenside, Lupinus variicolor	94
Gardenside, all lupine species	**326**
Mission Bowl, Lupinus albifrons	119
Mission Bowl, Lupinus formosus	115
Mission Bowl, Lupinus variicolor	55
Mission Bowl, all lupine species	**289**
Mission Flats, Lupinus albifrons	235
Mission Flats, Lupinus formosus	208
Mission Flats, Lupinus variicolor	169
Mission Flats, all lupine species	**612**
Mission Ridge, Lupinus albifrons	230
Mission Ridge, Lupinus formosus	274
Mission Ridge, Lupinus variicolor	186
Mission Ridge, all lupine species	**690**
Other sites, Lupinus albifrons	65
Other sites, Lupinus formosus	0
Other sites, Lupinus variicolor	60
Other sites, all lupine species	**125**

There are now small clusters of reproductive *Lupinus formosus* at all three release sites. Continuing scrub removal and expanding *Lupinus formosus* patches continues to be a priority.

Direct seeding trials

In December 2015, lupine seeds were dispersed in an area on Mission Bowl where coyote brush removal was recently completed. Lupine seeds collected in the past 12 months (approximately 200), were individually inserted into the soil to a depth of about ½ inch. The area where seeds were sown directly into the soil did not have any actively growing lupine plants. In March 2016, we placed two 1/2-m wide belt transects through the cleared and seeded area and censused these areas:

Transect A: 14 meters long: 26 lupine seedlings were observed for an average density of 3.7 plants/m^2.
Transect B: 9 meters long: 39 lupine seedlings were observed for an average density of 8.67 plants/m^2.

Results from this pilot study indicate that sowing lupines in the winter is effective for producing a crop of seedlings. Although it is possible that some lupine seeds were in the seed bank of the cleared areas, such regular germination and cover of lupine seedlings indicated that our seeding was likely the seed source for these new plants. These two restoration areas will be revisited in spring of 2017 to further report on survivorship.

Plans for 2017

Translocations

- Based on high egg counts and continuing replacement, we plan to pause on translocations. If numbers decrease in 2017, we will strongly consider additional translocations in 2018.

Surveys

- Continue post diapause larval surveys solely as phenological checks indicating onset of flight season.
- Adult monitoring will be restricted to presence/absence in different management areas.
- Egg surveys will be the key data used to estimate populations. Surveys should begin within a week of the start of flight season.

Habitat management

- Continue to remove coyote brush, especially in areas where corridors can connect lupine patches. Maintain and revisit sites that have been treated in the past two years.
- Focus lupine planting and direct seeding efforts and trials in areas that will link habitats, such as Mission Bowl.
- If resources allow, continue *L. formosus* seed collection from San Bruno Mountain, under renewed permit by SFRPD.
- Create lupine islands that will connect Mission Ridge to Mission Flats with pockets of host and nectar plants.
- Install defoliated Baccharis around plantings to protect from ravens.
- Continue to control weeds encroaching in key habitat and near the edges including thistles, mustards, and non-native annual grasses as appropriate.
- Evaluate annual grass height prior to the start of the flight season and determine if it would be useful to hand-clip grasses around lupines.

Conclusion

We are pleased to find further evidence of reproductive success of Mission blue butterflies at Twin Peaks Natural Area.

The main conclusions are:

1) The resident population on Twin Peaks was ~ 50 female butterflies and continues to occupy much of the available habitat, including release zones and adjacent lupine stands.
2) Estimated fluctuations are within bounds of butterfly populations.
3) The response of resident females from 2015 to 2016 was either an increase (with the low 2015 estimate) or replacement (mid-point 2015 estimate).
4) The estimate for 2016 may be above the threshold for demographic stochasticity to be a major threat to extinction. The same can be said for genetic factors (drift and inbreeding). Environmental stochasticity, primarily weather, will remain a threat given the small habitat area and lack of natural connection to other Mission blue populations.

The increasing number of eggs this year is particularly promising. As we take a year off translocating in 2017, we will continue monitoring the population and managing habitat.

With continued diversification of the lupine populations, the threat of lupine dieback from wet, warm springs should be ameliorated.

Reducing scrub and increasing lupines numbers, distribution, and species richness continues to be an important priority at Twin Peaks. We are excited to continue sharing information with the staff at GGNRA, and intend to incorporate some of the techniques that have worked for them. We hope they will find our experiences helpful as well as we continue developing a collaborative network of Mission blue professionals.

We want to thank USFWS and its Partners in Wildlife Program. The Partners in Fish and Wildlife grant has been key to increasing needed on-the-ground restoration work, and creating a committed core of well-educated volunteer site stewards.

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