Bay Checkerspot Translocation

Coyote Ridge to Tulare Hill

USFWS Permit TE-30659A-1

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Executive Summary

The goal of this project is to enhance a small Bay checkerspot butterfly (*Euphydryas editha bayensis*) population in restored habitat at Tulare Hill in San Jose, CA. Extant populations from Coyote Ridge in Santa Clara County numbering in the hundreds of thousands were the source of the translocated larvae.

This year there were two postdiapause larvae found, in comparison to one postdiapause larva found in 2022. At this low density, we estimate the larval population was around 200. Previous years saw one postdiapause larva in 2021, two postdiapause larvae in 2020, zero in 2019, one in 2018, zero in 2017, four in 2016, 44 in 2015, and six in 2014. Even with the low population estimate this year, habitat on Tulare Hill is still high in quality, with decent cover of the host plant *Plantago erecta*. The downside is that plants can develop and senesce quickly here. The overall trend of warmer spring temperatures may lead to premature host plant senescence; climate change could render this site inhospitable for Bay checkerspot butterfly.

The source population for this effort is nearby Coyote Ridge. The Kirby Canyon Butterfly Reserve within Coyote Ridge is still well above a historic low in 2018, but has shown decreases the last two years. The larger Coyote Ridge dropped to a historic low in 2023. The Kirby Canyon Butterfly Reserve was an important refuge against declining numbers throughout the rest of Coyote Ridge in 2022 and 2023. No larvae have been transferred to Tulare Hill since 2016. Creekside Science is also involved with ongoing introduction monitoring at Edgewood Preserve (Niederer et al. 2023) and has completed a reintroduction project at San Bruno Mountain (Weiss et al. 2022), both in San Mateo County.

In 2023 two adult Bay checkerspot butterflies were observed and the flight season was very short at only 2 weeks. This is the same length as last year, which was the shortest flight season since monitoring began in 2013, however last year four adult butterflies were observed. The highest number of adults observed since this project began was 268 in 2015 (which was a translocation year) and the lowest number of adults was one adult observed in 2018. No larvae were translocated from 2017 through 2023.

In 2023 both March and April were cooler than average, with March being almost four degrees below average. Precipitation was high this year and lasted into May with above average rainfall. Unfortunately, *Plantago* dipped below the 10 plants/m^2 critical threshold around April 30, only two weeks after peak flight (April 15) and at about the same time as the moderate densities of *Castilleja* senesced. This year's limited availability of host plants for prediapause larval use, combined with another historically short adult flight season, does not bode well for next year's larvae and adult numbers on Tulare Hill.

We note that the number of butterflies estimated on Tulare Hill in 2023 is within the historical range of variability observed since 1987, and that this population has historically been vulnerable to crashes and local extirpation following poor weather. It remains to be seen how Bay checkerspots fare with the difficult climate conditions they are likely to face, with Tulare Hill being one of the driest and most difficult locations they inhabit.

At this point we do not anticipate translocating in 2024, although that decision could be changed based on dramatic increases in larvae at the source population or other factors.

Funding for this project was provided from the Metcalf Energy Center (Calpine), as procured through Land Trust of Santa Clara Valley (LTSCV) (formerly the Silicon Valley Land Conservancy). We remain grateful to our many partners who help with permitting, access, funding, management, and volunteer hours: Santa Clara County Parks, U.S. Fish and Wildlife Service, LTSCV, Calpine, and PG&E.

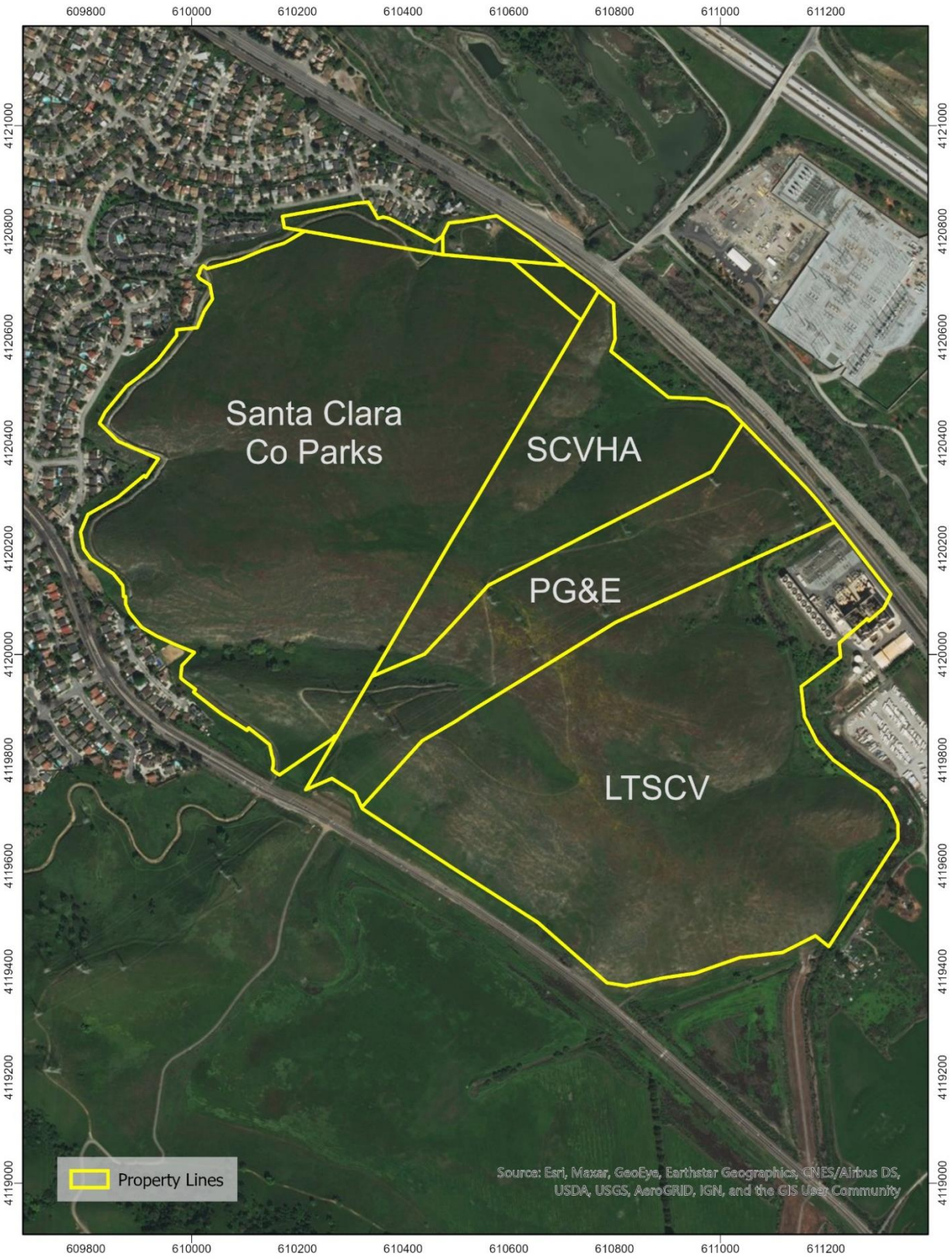
Tulare Hill Background

The 339-acre Tulare Hill is currently zoned A-20 (Agriculture, 20-acre minimum) and is divided into four parcels: the approximately 116-acre Metcalf Energy Center Ecological Preserve (owned by LTSCV); PG&E's approximately 45-acre transmission line corridor; Santa Clara Valley Habitat Agency's (SCVHA) approximately 37 acres (Hi-Tech/Wedge purchased in 2019 from Tony Duong); and Santa Clara County Park's approximately 141 acres (Map 1). PG&E's parcel includes 115-, 230-, and 500-kilovolt (kV) overhead electric transmission towers and lines that bisect Tulare Hill in a roughly east-to-west corridor.

From 2001 to mid-2008, grazing on Tulare Hill had been restricted to the LTSCV parcel, pending a Safe Harbor Agreement between the U.S. Fish and Wildlife Service and PG&E, which built a fence bordering their parcel and the LTSCV parcel. This fence eliminated grazing from the northern portions of the hill, leading to increased annual grass invasion, associated thatch increase, and reduction of Bay checkerspot host and nectar plants. This habitat degradation caused by lack of grazing has been well documented in LTSCV's annual monitoring reports. PG&E received their Safe Harbor Agreement in 2008, which requires PG&E to manage their property for Bay checkerspot butterfly habitat while releasing them from "take" liability during normal business operations. On June 25, 2008, cows were returned to the northern side of Tulare Hill.

In 2010, the northern parcel was acquired by Santa Clara County Parks. They have been informed about history and grazing management issues on Tulare Hill as a whole and have expressed positive responses to resource issues and adjacent checkerspot translocations. SCVHA owns the Wedge in fee title. They plan to transfer the property to Santa Clara County Parks but place a SCVHA conservation easement on it.

Improving habitat on all the parcels of Tulare Hill is critical to maintaining the large, topographically heterogeneous habitat the Bay checkerspot requires to survive. By 2011, the restored grazing regime improved conditions across the hill. Nonnative grass and thatch cover decreased and Bay checkerspot host and nectar sources increased to create high quality habitat. A checkerspot translocation effort appeared likely to succeed in bolstering the current population against extirpation.



Map 1. Tulare Hill property boundaries

Weather Summary

Average annual precipitation from 1981 to 2010 averaged 58.9 cm at the site and will be considered the baseline for the project (WestMap 2014). The project has spanned both dry and wet years, with 9 of the 12 years having below average rainfall (Table 1). Timing of precipitation affects Bay checkerspot butterfly development and survivorship more than just total precipitation. Details of precipitation timing in previous years can be found in previous reports. Conditions in 2022 and 2023 are described here because weather in both those years affected survivorship in 2023.

In 2022, precipitation was only about 63% of average, at 37.1 cm total. The pattern of precipitation was heavily weighted to the beginning of the water year, with 81% of the 2022 water year precipitation falling October-December 2021. Almost no rain fell January-March, but April rains extended the growing season for many taxa (Figure 1).

In 2023, precipitation was 79.6 cm, about 35% higher than average (WestMap 2023). Considerably higher than last year's 37.1 cm, the 2023 rain year saw a definitive end to the streak of dry years. Rainfall in December, January, and March was roughly two times more than the overall average for these months. February was above average, April was fairly dry, and the season continued into May with above average rainfall also (Figure 2).

	Tulare Hill Yearly Precipitation (cm)
Oct 2011-Sep 2012	29.6
Oct 2012-Sep 2013	33.4
Oct 2013-Sep 2014	23.3
Oct 2014-Sep 2015	42.6
Oct 2015-Sep 2016	53.6
Oct 2016-Sep 2017	77.7
Oct 2017-Sep 2018	30.0
Oct 2018-Sep 2019	59.7
Oct 2019-Sep 2020	35.2
Oct 2020-Sep 2021	25.7
Oct 2021-Sep 2022	37.1
Oct 2022-June 2023	79.6
Average 1981-2010	**58.9**

Table 1. Yearly precipitation records for Tulare Hill, 58.9 cm average for 1981-2010 (WestMap 2023, 2022, 2021, 2020, 2019, 2014)

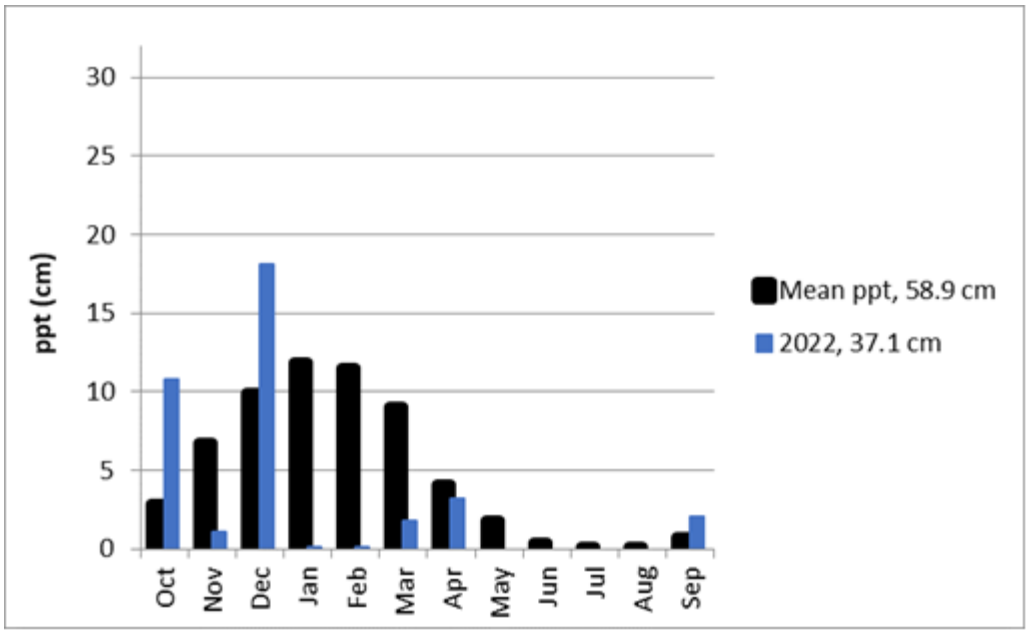


Figure 1. Monthly precipitation record for Tulare Hill in 2022, 58.9 cm average for 1981-2010 (WestMap 2022, 2014)

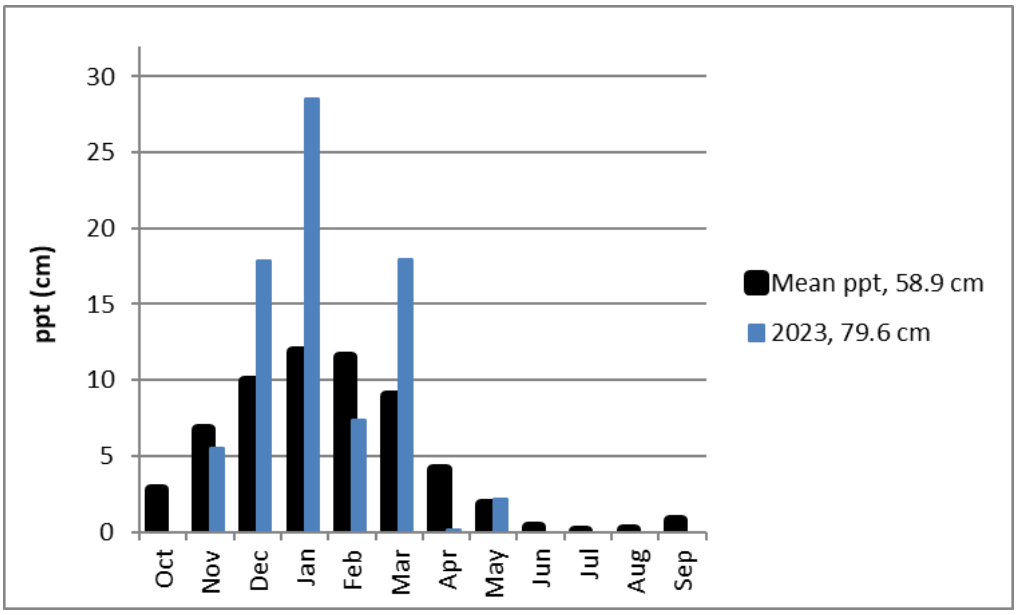


Figure 2. Monthly precipitation record for Tulare Hill in 2023, 58.9 cm average for 1981-2010 (WestMap 2023, 2014)

Cool March and especially April temperatures favor checkerspots, as they allow host plants to stay fresh longer as prediapause larvae race to the fourth instar when they can enter diapause. In 2022, both March and April were considerably warmer than average. In 2023, March was almost four degrees cooler than average, the coolest recorded for this project. April was also below average (Table 2).

	March	April
2012	15.9	18.5
2013	19.6	21.7
2014	19.9	20.3
2015	21.9	19.9
2016	18.5	20.7
2017	18.8	19.1
2018	16.5	20.2
2019	16.3	21.4
2020	16.1	20.3
2021	16.8	21.0
2022	20.3	21.1
2023	14.4	20.1
Average 1981-2010	**18.2**	**20.6**

Table 2. Tulare Hill average maximum temperature (˚C) (WestMap 2023, 2022, 2021, 2020, 2019, 2014)

Coyote Ridge Source Population

Larval numbers throughout the source population (Coyote Ridge) are shown in Table 3. The Kirby Canyon Butterfly Reserve within Coyote Ridge is still well above a historic low in 2018, but has shown decreases the last two years. The larger Coyote Ridge dropped to a historic low in 2023. The Kirby Canyon Butterfly Reserve was an important refuge against declining numbers throughout the rest of Coyote Ridge in 2022 and 2023.

	Kirby Canyon	**Coyote Ridge***
2011	94,399 ± 32,025	533,426
2012	131,627 ± 37,606	473,344
2013	246,697 ± 46,487	1,252,149
2014	91,755 ± 35,136	776,478
2015	190,756 ± 70,059	2,102,400
2016	45,281 ± 15,827	377,082
2017	11,882 ± 4,343	377,841
2018	5,457 ± 3,959	220,884
2019	15,568 ± 10,155	894,475
2020	108,148 ± 53,190	694,777
2021	186,547 ± 41,580	791,529
2022	170,149 ± 42,613	230,052
2023	108,722 ± 41,143	119,182

*Confidence intervals across Coyote Ridge have not been calculated.

Table 3. Kirby Canyon (the Kirby Canyon Butterfly Reserve) is 250 acres within the larger ~7000 acres of Coyote Ridge. The Kirby Canyon numbers are shown with 95% confidence intervals.

Previous Bay Checkerspot Butterfly Monitoring at Tulare Hill

Postdiapause larvae were detected during surveys in 2002 and 2003. One adult was observed in flight each year from 2005-2008. Larvae counts were not conducted on Tulare Hill in full from 2008 to 2013. (In 2008, some cool and very cool plots were surveyed.) No adults were observed from 2009-2010. In 2011, two adults were observed,

and in 2012 one adult was observed. The presence of these adults suggested the Tulare Hill population was persisting at very low density, on the order of <100 individuals. Even with habitat improvements, the Bay checkerspot population was not passively increasing.

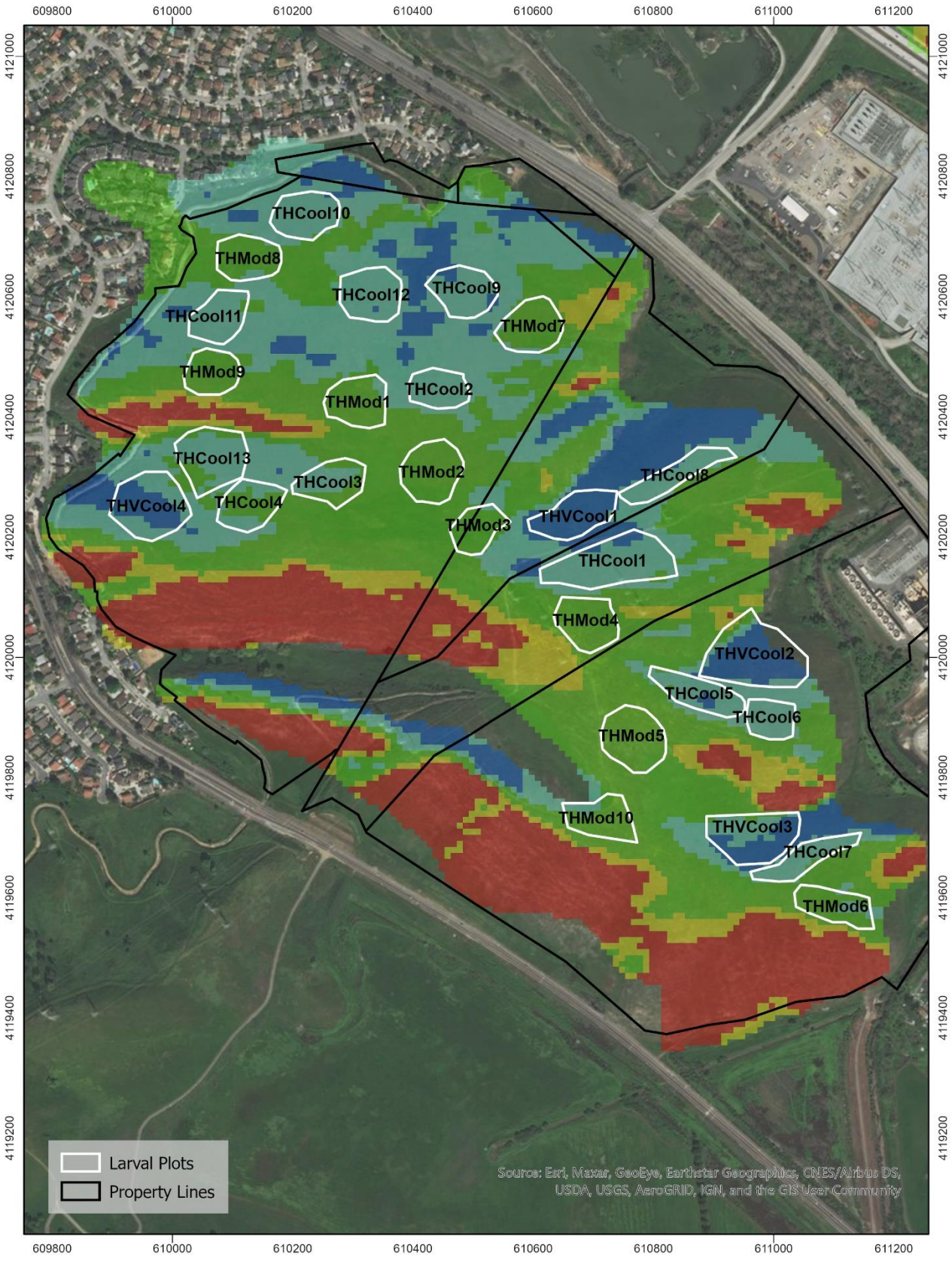
Larval Monitoring

Formal postdiapause larvae monitoring began in 2014 after larval introductions were initiated. In 2023, monitoring took place on February 14, February 17, March 17 and March 27. Monitors spend ten person-minutes searching for the first larva in a plot. Then the clock is reset and the official ten person-minute clock begins. If none are found, the monitors spend a full 20 person-minutes searching. There are 27 larval plots on Tulare Hill, stratified by topoclimate (very warm to very cool, based on spring equinox insolation). Areas of higher solar insolation (steep, south-facing slopes) are mapped in red, with low insolation (steep, north-facing slopes) shown in blue (Map 2).

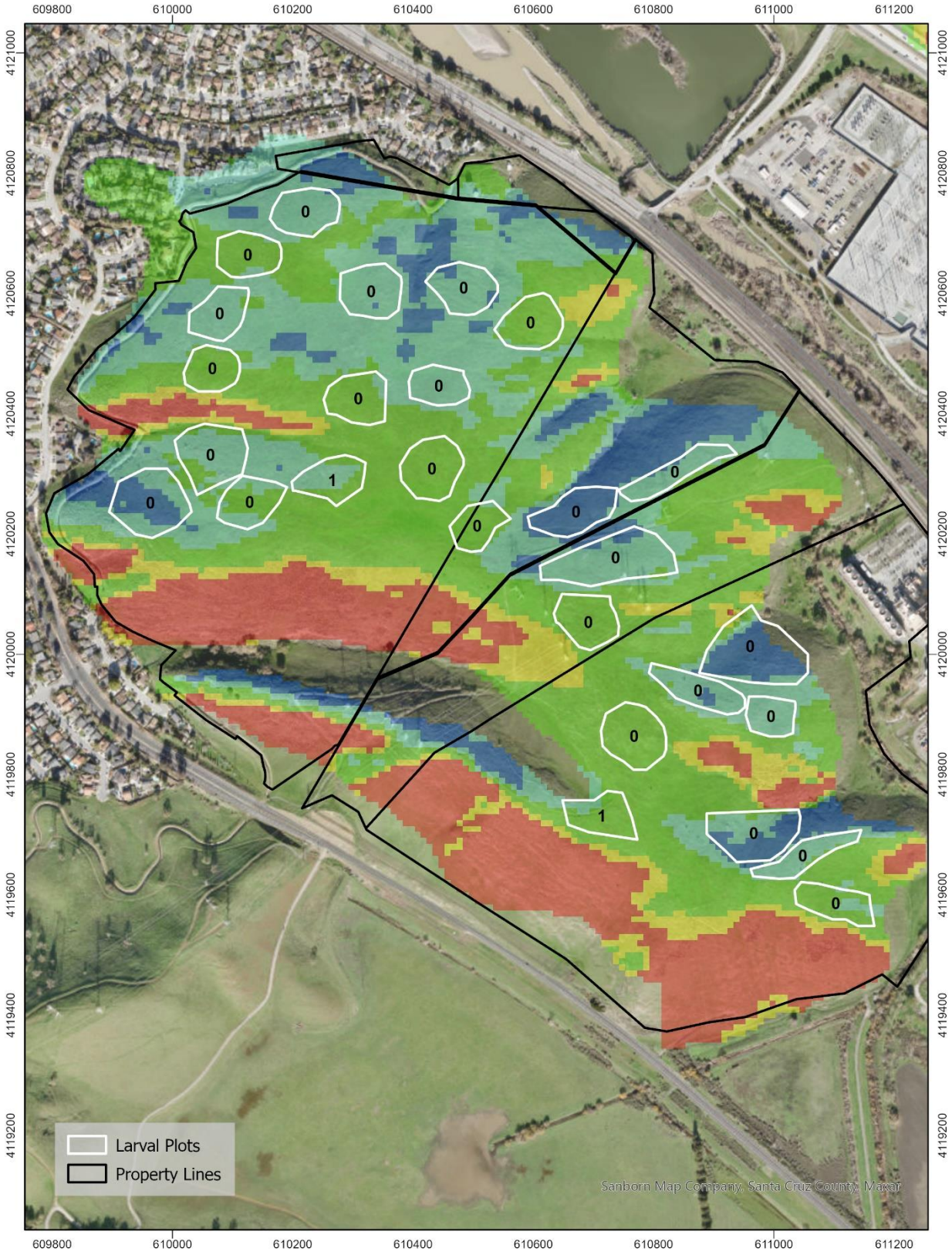
In 2023, two larvae were found (Map 3). This is one more larva than was observed in 2022 and is compared with a high of 44 larvae in 2015 (Table 4). Note that the absolute number of larvae found does not scale precisely with the population estimate: The estimates are affected by where the larvae are found. When two or fewer larvae are found on the entire hill, the estimates become very rough.

Considering that in 2023 only two larvae were found, we estimate the larval population was around 200. This is down from an estimated high of 20,000 in 2015 (Table 4).

Maps of sightings from 2014 to 2022 can be found in previous reports.



Map. 2. The 27 larval plots on Tulare Hill



Map 3. Larval monitoring results, 2023

Plot	# larvae 2014	# larvae 2015	# larvae 2016	# larvae 2017	# larvae 2018	# larvae 2019	# larvae 2020	# larvae 2021	# larvae 2022	# larvae 2023
THCool1	0	1	0	0	0	0	0	0	0	0
THCool10	0	0	0	0	0	0	0	0	0	0
THCool11	0	2	0	0	0	0	0	0	0	0
THCool12	0	5	2	0	0	0	0	0	0	0
THCool13	0	0	0	0	0	0	0	0	0	0
THCool2	0	7	0	0	0	0	1	1	0	0
THCool3	0	3	0	0	0	0	0	0	0	1
THCool4	0	0	0	0	0	0	0	0	0	0
THCool5	0	3	0	0	0	0	0	0	0	0
THCool6	0	2	0	0	0	0	0	0	0	0
THCool7	1	1	0	0	0	0	0	0	0	0
THCool8	0	2	0	0	0	0	0	0	0	0
THCool9	0	1	0	0	0	0	0	0	0	0
THMod1	0	6	0	0	0	0	0	0	0	0
THMod10	0	0	0	0	0	0	0	0	0	1
THMod2	0	3	0	0	1	0	1	0	0	0
THMod3	0	2	0	0	0	0	0	0	0	0
THMod4	0	1	0	0	0	0	0	0	0	0
THMod5	0	0	0	0	0	0	0	0	0	0
THMod6	0	0	0	0	0	0	0	0	0	0
THMod7	0	0	0	0	0	0	0	0	0	0
THMod8	0	1	0	0	0	0	0	0	0	0
THMod9	0	0	0	0	0	0	0	0	0	0
THVCool1	3	2	0	0	0	0	0	0	1	0
THVCool2	0	0	1	0	0	0	0	0	0	0
THVCool3	2	2	0	0	0	0	0	0	0	0
THVCool4	0	n/a	1	0	0	0	0	0	0	0
Total	**6**	**44**	**4**	**0**	**1**	**0**	**2**	**1**	**1**	**2**
Larval estimate	**~3,000**	**~20,000**	**~2,300**	**<100**	**~100**	**<100**	**~200**	**~100**	**~100**	**~200**

Table 4. Locations of postdiapause larvae by year

Larval Transfers

No larvae were transferred in 2023. A total of 15,629 larvae have been released since 2013 (Table 5). Larvae were relatively easy to collect in all years, based on dense populations at Coyote Ridge. Postdiapause larvae are the focus of the translocation because they are the easiest life stage to locate, handle, and transfer. Larvae are captured by hand and placed in groups in vented plastic containers kept in coolers with ice until same day release.

Year	Estimated larval numbers prior to introduction	Larvae introduced
2013	0	5000
2014	~3,000	3450
2015	~20,000	3833
2016	~2,300	3346
2017	<100	0
2018	~100	0
2019	<100	0
2020	~200	0
2021	~100	0
2022	~100	0
2023	~200	0
Total		**15,629**

Table 5. Summary of larval introductions and population estimates

Adult Transfers

No adults were transferred to Tulare Hill from 2015 through 2023 (Table 6).

Year	Adult females	Adult males	Total adults introduced
2013	40	20	60
2014	40	20	60
2015-2023	0	0	0
Total	**80**	**40**	**120**

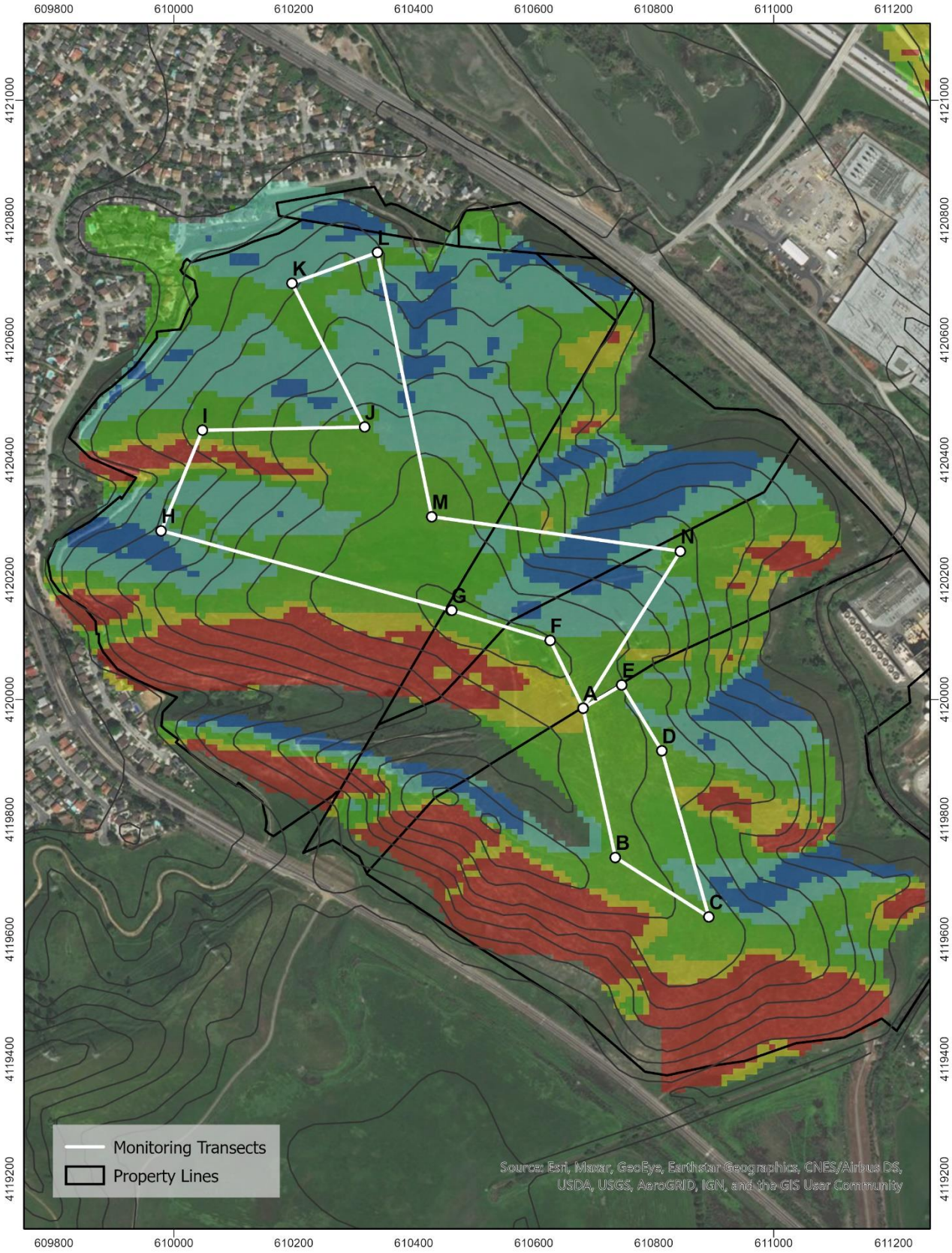
Table 6. Summary of adult transfers to Tulare Hill

Adult Monitoring

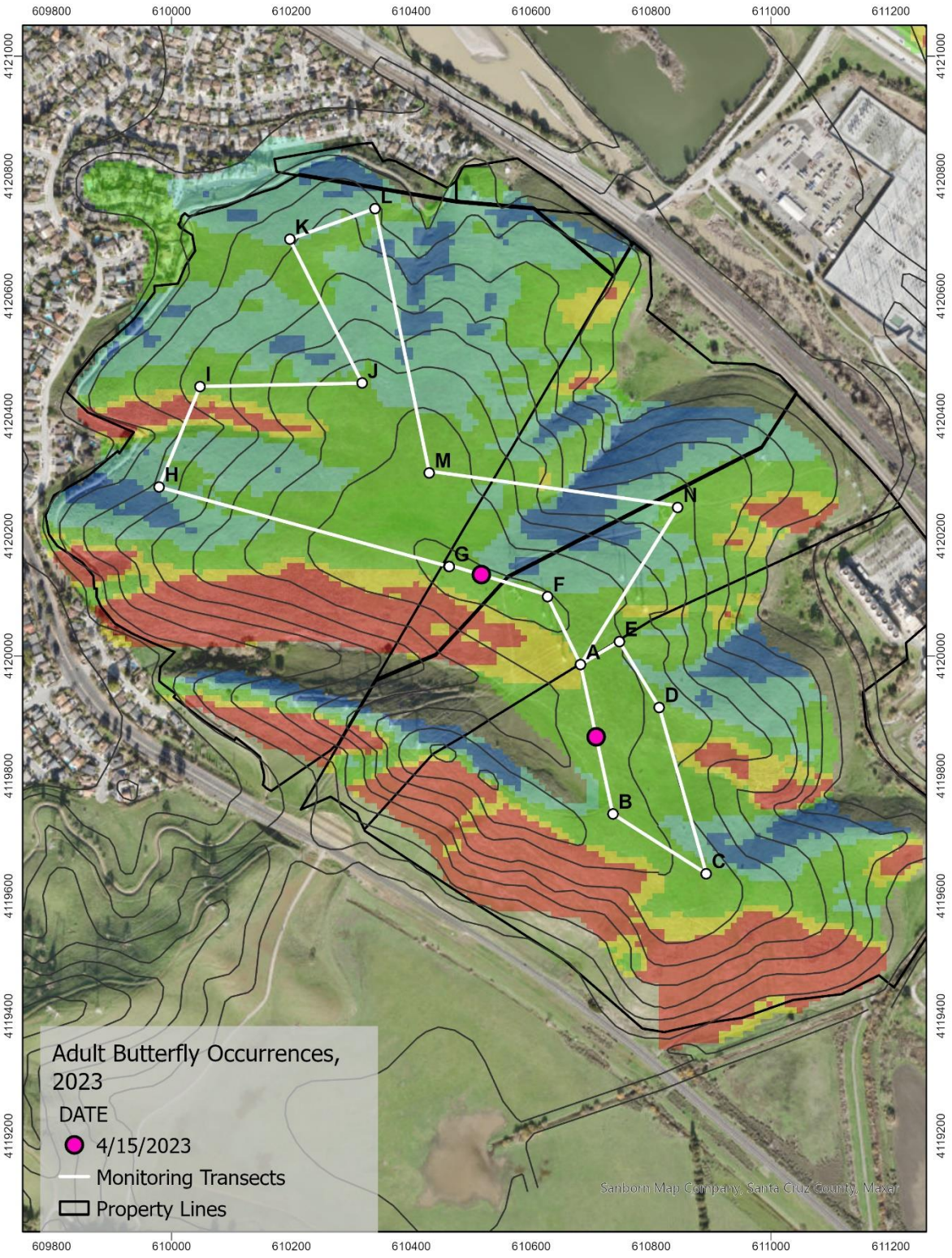
Over the course of the flight season, adults were surveyed weekly. The adult monitoring consisted of an observer walking a 4400-m long figure-8 pattern around a large portion of Tulare Hill over approximately one and a half hours, noting butterfly occurrences within 5 meters of each side of the transect (Map 4). Areas of higher solar insolation (steep, south-facing slopes) are mapped in red, with low insolation (steep, north-facing slopes) shown in blue. The observer works on calm, sunny days when possible.

Map 5 shows where adults were found in 2023. Maps of sightings from 2013 to 2022 can be found in previous reports.

In all translocation years, adults and larvae were released only on LTSCV and PG&E property. Table 7 shows how they dispersed throughout the hill on other properties during the project. They exhibit hilltopping behavior. Especially in 2013, they were more likely to be found on the steeper, cooler slopes later in the season.



Map. 4. Adult Bay checkerspot monitoring course at Tulare Hill



Map 5. Adult butterfly occurrences along the monitoring transects, 2023. One “incidental” adult was observed on April 26 and is not mapped here.

Segment	# BCB 2013	# BCB 2014	# BCB 2015	# BCB 2016	# BCB 2017	# BCB 2018	# BCB 2019	# BCB 2020	# BCB 2021	# BCB 2022	# BCB 2023
A-B	3	21	27	63	1		3				1
B-C	8	10	14	4	1						
C-D	4	0	13	21							
D-E	4	3	13	6	1		1				
E-A	1	5	8	12		1	1				
A-F	2	6	4	20	3		1			1	
F-G	6	6	17	17			4	2	2	1	1
G-H	7	9	15	12				2			
H-I		2	6								
I-J		13	3	3							
J-K	1	8	11					1		1	
K-L	1		2								
L-M	10	10	79	7							
M-N	17	9	13	3			2		3	1	
N-A	1	22	43	4							
Total	**65**	**124**	**268**	**172**	**6**	**1**	**12**	**5**	**5**	**4**	**2**

Table 7. Number of adults per transect segment by year (does not include incidentals)

In 2023, adult monitoring was conducted March 27 and April 5, 15, and 26. Adults were only found on transects on April 15. Two adult butterflies were observed on transects this year which is two less than last year, although this year's monitoring was conducted slightly less frequently, about once every ten days instead of weekly (Table 8). One additional adult was observed on the hill (off transects) during other monitoring activities on April 26. This observation is considered "incidental" and is not included in the official total. Encounter rates were also calculated. Encounter rates have been similarly low over the last seven years (Table 9). The protocol for calculating monitoring hours was standardized in 2020 across projects. Monitoring hours used for the encounter rate begin at the first sighting thru the last sighting, not including incidentals. Monitoring days before the first sighting or after the last sighting are not included in the encounter rates (because they are occurring outside the flight season), and incidental sightings are not included in the total adults observed. Days with incidentals can be important to establish the beginning and ending of the flight season, but are not included in the encounter rates.

Year	Total adults
2013	65
2014	124
2015	268
2016	172
2017	6
2018	1
2019	12
2020	5
2021	5
2022	4
2023	2

Table 8. Summary of adult sightings at Tulare Hill

Year	Total adults observed	Total monitoring hours	Butterflies/hour
2013	65	8	8.1
2014	124	9.3	13.3
2015	268	14	19.1
2016	172	11.75	14.6
2017	6	6	1.0
2018	1	6	0.2
2019	12	8.3	1.4
2020	5	2.9	1.7
2021	5	3.3	1.5
2022	4	2.3	1.7
2023	2	1.4	1.4

Table 9. Total number of adults sighted during timed monitoring sessions at Tulare Hill, with encounter rates

More total butterflies have been sighted at Kirby Canyon than at Tulare Hill every year. Both Kirby Canyon and Tulare Hill are monitored weekly, however Tulare Hill has a longer monitoring course. For this reason total adult sightings are not directly comparable, but the encounter rate of butterflies/hour shows that Kirby Canyon consistently has more butterflies observed (Table 10). As an additional comparison, the reintroduction effort at Edgewood Preserve ranged from a low of 0.2 butterflies/hour in 2020 to a high of 19.8 butterflies/hour in 2013 (Niederer et al. 2023). In contrast, the newer reintroduction at San Bruno Mountain has ranged from 5.0 butterflies/hour in 2020 to 32.8 butterflies/hour in 2019, although it should be noted translocations occurred both those years (Weiss et al. 2022).

Year	Total adults observed	Total monitoring hours	Butterflies/hour
2013	637	2	318.5
2014	235	2	117.5
2015	412	2	206
2016	257	2.8	91.8
2017	21	1.6	13.1
2018	6	1.2	5.0
2019	62	2	31.0
2020	267	2.4	111.3
2021	399	1.6	249.4
2022	402	3.2	125.6
2023	294	2	147.0

Table 10. Total number of adults sighted during timed monitoring sessions at Kirby Canyon on Coyote Ridge, with encounter rates

The timing of the flight season relative to host plant growth and senescence is critical. An early start and/or an early finish increase the likelihood the new generation of larvae will grow large enough to enter diapause before their host plants dry out. The flight season is compared with a reference site at Kirby Canyon on Coyote Ridge in Figures 3 and 4. In 2023, Tulare Hill's flight season peaked on April 15 and Kirby's flight season peaked at about the same time on April 13 (Table 11). This peak is considered relatively late for both our Tulare Hill and Kirby Canyon records.

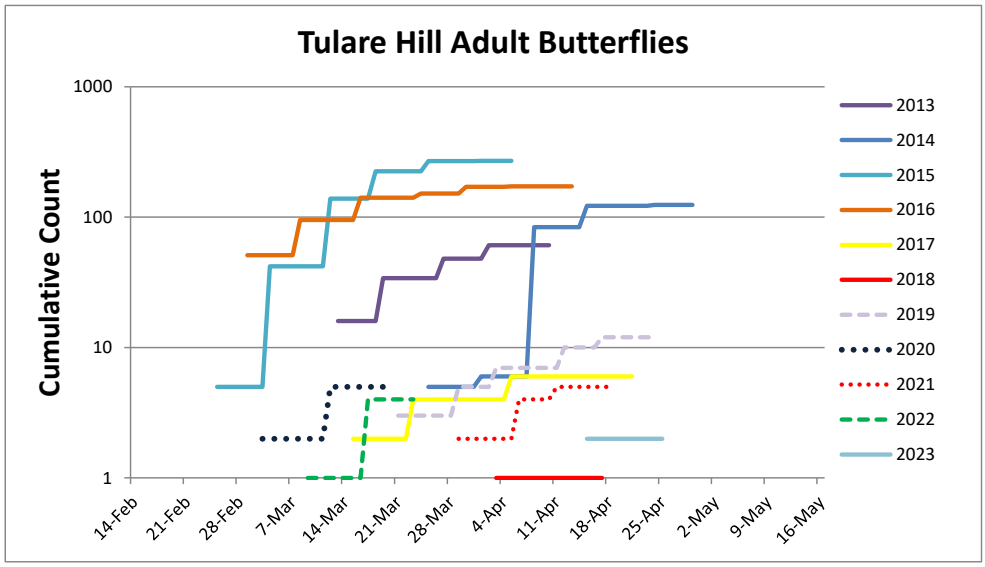


Figure 3. Tulare Hill adult butterflies

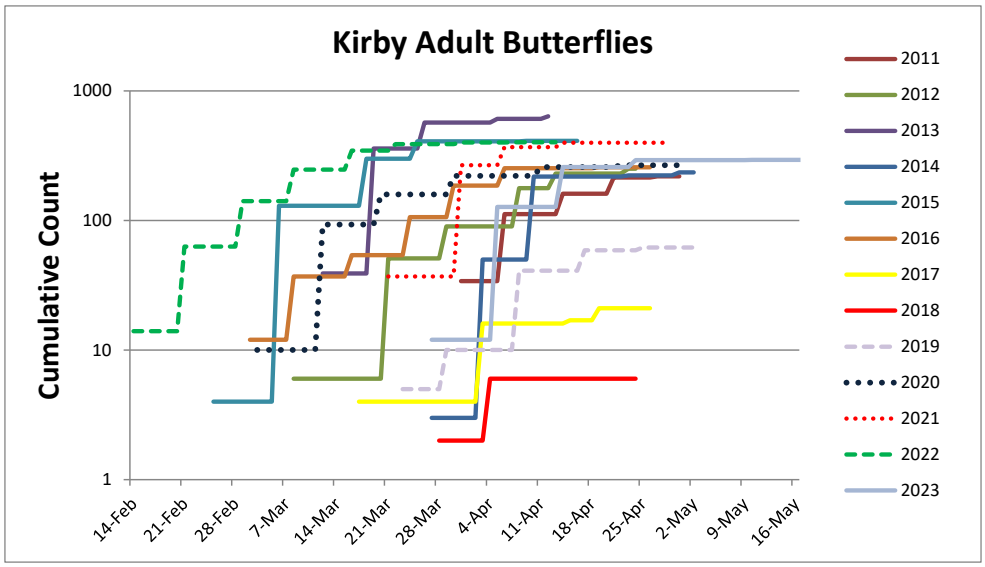


Figure 4. Kirby Canyon adult butterflies.

This year Tulare Hill butterflies had a two-week flight season and Kirby Canyon butterflies had an eight-week flight season, which is the same as last year for both sites. This is a critical indicator of lower quality habitat at Tulare Hill. Table 11 shows total weeks of flight and peak flight for both sites.

Year	Weeks of flight, Tulare Hill	Weeks of flight, Kirby Canyon	Peak flight, Tulare	Peak flight, Kirby Canyon
2013	4	4.5	19-Mar	19-Mar
2014	4	5	8-Apr	10-Apr
2015	7	6.5	12-Mar	18-Mar
2016	7	7	8-Mar	30-Mar
2017	3	5	23-Mar	3-Apr
2018	3	2	3-Apr	3-Apr
2019	5	5	2-Apr	8-Apr
2020	4	6	12-Mar	20-Mar
2021	3	4	6-Apr	31-Mar
2022	2	8	17-Mar	8-Mar
2023	2	8	15-Apr	13-Apr

Table 11. Flight season comparisons at Tulare Hill vs. Kirby Canyon.

Host Plant Phenology Monitoring

Again, the timing of the flight season relative to host plant growth and senescence is critical. An early start and/or an early finish increase the likelihood the new generation of larvae will grow large enough to enter diapause before their host plants dry out. Hostplants and nectar sources are monitored along transects at different topoclimates (warm to very cool) to determine how long they are available to adult butterflies and prediapause larvae. These data are compared with flight season data to estimate whether most individuals survived to diapause. Low rainfall is less of a concern than continuing cool temperatures.

As a general rule, prediapause larval survivorship increases substantially if host plants remain fresh three weeks or more after the midpoint of flight season. The longer the plants stay fresh, the better. We compare Tulare Hill to Kirby Canyon on Coyote Ridge, which has a large checkerspot population. We use its host plant phenology as a reference.

In 2023, Tulare Hill had moderate densities of *Plantago* although densities were still higher than Kirby Canyon which is often the case. *Plantago* dipped below the 10 plants/m^2 critical threshold around April 30 at Tulare Hill, and lasted into the third week of May at Kirby Canyon (Figures 5-6).

Tulare Hill has traditionally had lower densities of *Castilleja* compared with Kirby Canyon. This year, *Castilleja* was at moderate densities at Tulare Hill while Kirby Canyon *Castilleja* densities were moderate to high. *Castilleja* was present at Tulare Hill for about five weeks. The plants senesced completely during the fourth week of April (around April 25), about the same time as the *Plantago* this year. At Kirby Canyon, *Castilleja* stayed fresh into the first week of June, senescing about three weeks later than the *Plantago* here. Kirby Canyon has steeper high elevation north-facing slopes, which allow host plants to stay fresh longer than other sites (Figures 7-8).

The main nectar source, *Lasthenia californica*, stayed fresh beyond the end of the flight season at both Tulare Hill and Kirby Canyon. It was present at high densities at Tulare Hill and moderate densities at Kirby Canyon. *Layia* spp. hit a historical low at Kirby Canyon this year and was only fresh for about one week during the flight season. It is not found along phenology transects on Tulare Hill (Figures 9-11). Nectar tends not to be limiting for Bay checkerspots. This is because they use a wide range of nectar sources and because females can lay their first cluster of more than 100 eggs very soon after eclosing, i.e., they can complete a significant portion of their reproductive effort without using nectar.

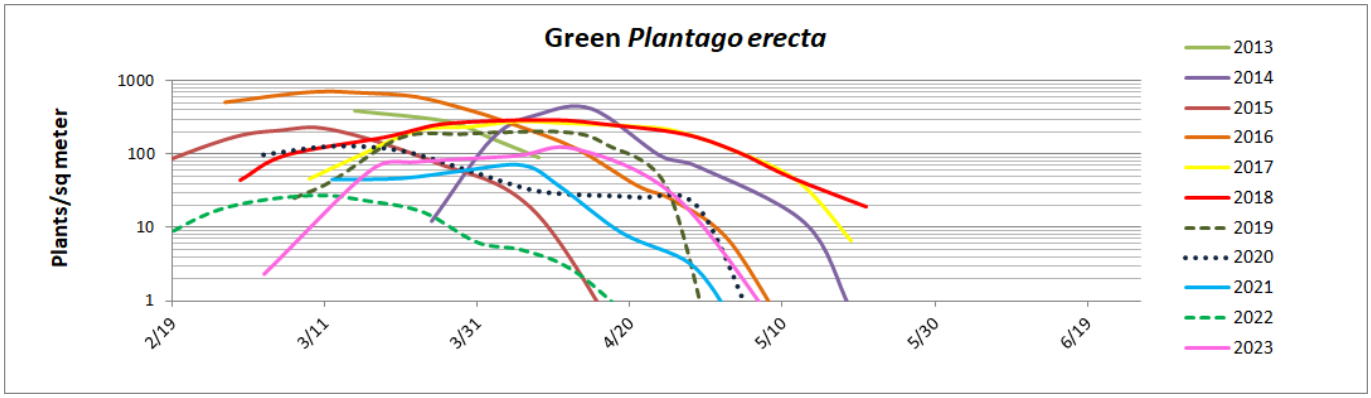


Figure 5. Tulare Hill host plant phenology- *Plantago erecta*. Ten *Plantago* plants/sq meter is a critical threshold for Bay checkerspot larval use.

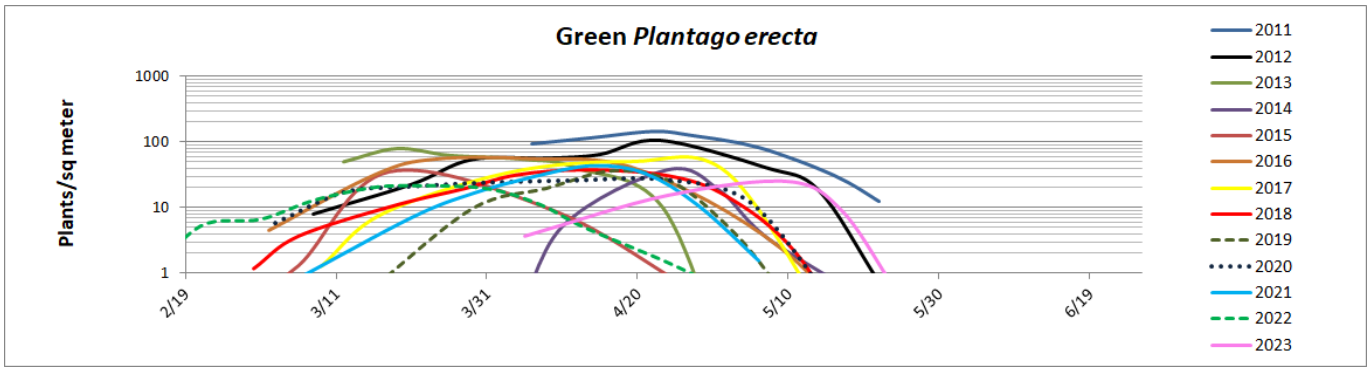


Figure 6. Kirby Canyon host plant phenology-*Plantago erecta.*

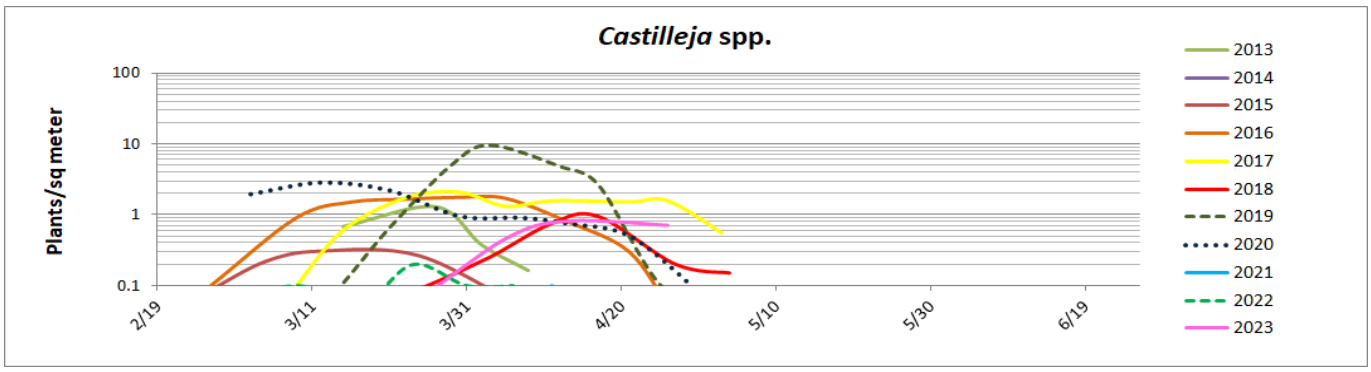


Figure 7. Tulare Hill host plant phenology- *Castilleja spp.*

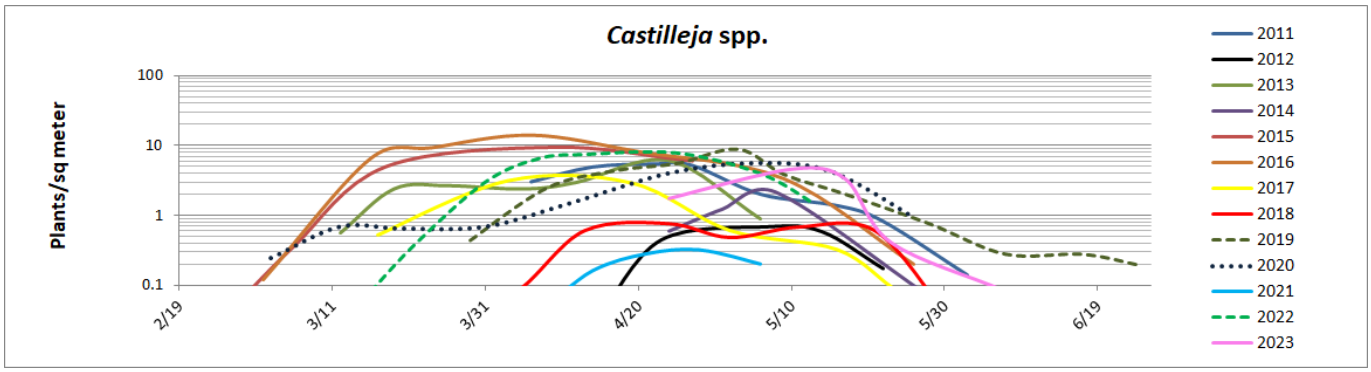


Figure 8. Kirby Canyon host plant phenology- *Castilleja spp.*

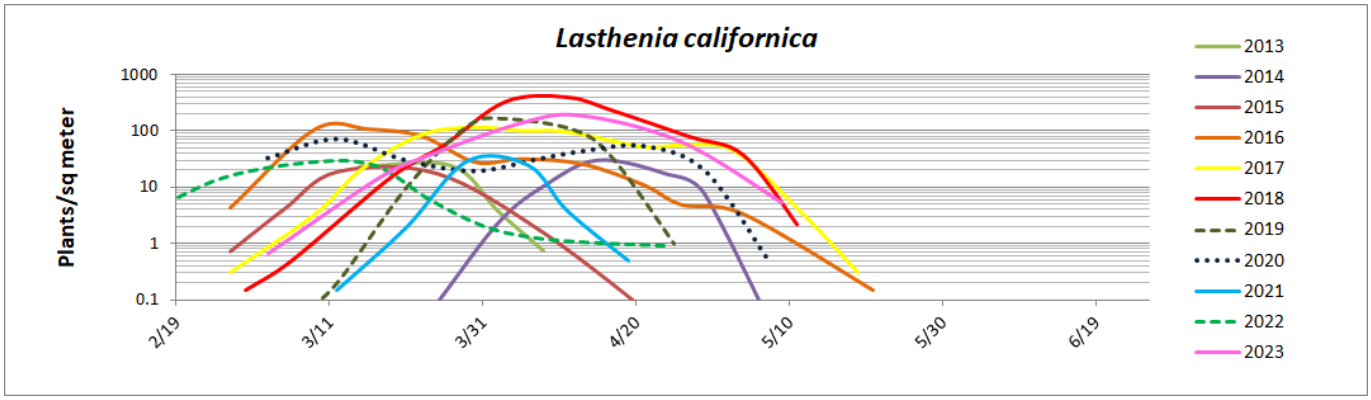


Figure 9. Tulare nectar phenology- *Lasthenia californica.*

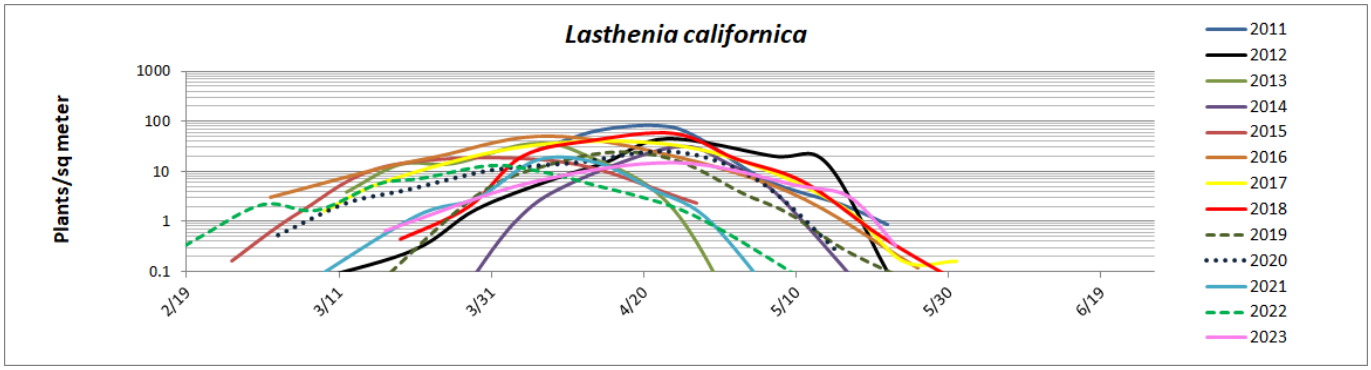


Figure 10. Kirby Canyon nectar phenology- *Lasthenia californica.*

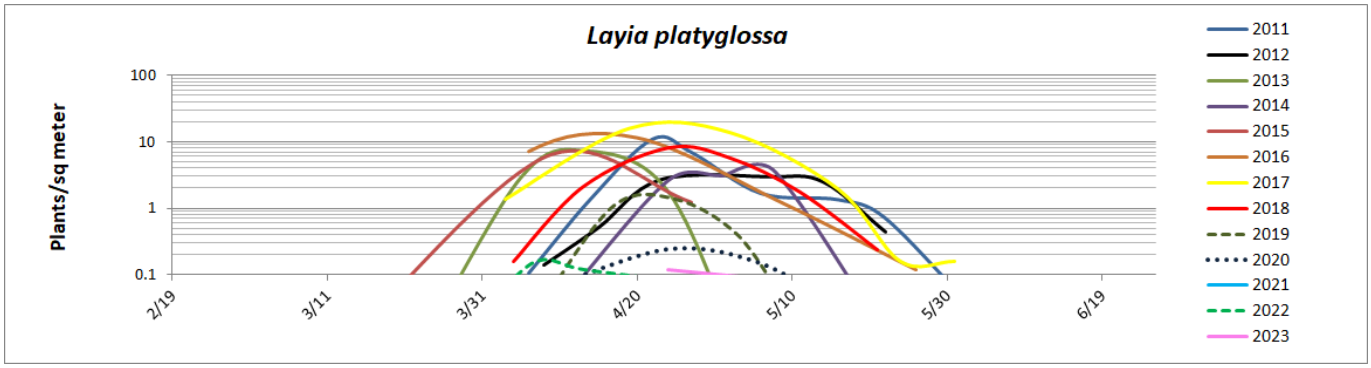


Figure 11. Kirby Canyon nectar phenology- *Layia platyglossa*. Note that this nectar source is not found along phenology transects on Tulare Hill.

Discussion and Next Steps

The grazing regime on Tulare Hill continues to support high quality Bay checkerspot habitat, with cover of the key host plant *Plantago erecta* comparable with (or higher than) that of the reference site at Kirby Canyon. However, this year again had disappointingly low numbers of larvae and adults, suggesting a population of about two hundred larvae persisting. We are concerned that despite the abundance of host plants and the presence of some steep north-facing slopes, the low elevation and overall trend of increasingly warm spring temperatures may lead to premature host plant senescence here. Climate change could render this site inhospitable to Bay checkerspots. The low cover of *Castilleja* on Tulare Hill, which generally stays fresh much longer in the season (with this year being an unfortunate exception), may be a key obstacle to checkerspot recovery. However, we have observed Bay checkerspots persisting at low densities at the lower elevations of nearby Coyote Ridge, so it's possible this population can persist indefinitely without further human intervention. Due to proximity of source populations, however, the low Coyote Ridge metapopulations are more likely to receive immigrants from denser metapopulations just on the top of the ridge, rather than serve as sources for Tulare Hill.

The reference larval population at Kirby Canyon dropped from the previous year, although larval populations throughout the larger Coyote Ridge declined even more to extremely low numbers. Meanwhile Tulare Hill has been maintaining low numbers for several years now. This site has not been recovering in sync with Kirby Canyon and the larger Coyote Ridge.

The 2022 flight season was very short at only two weeks long. In addition, *Plantago* and *Castilleja* densities were low and available for a very limited time for prediapause larval use. The combination of these factors resulted in very little change in the low number of observed larvae and adults from 2022 to 2023.

The 2023 flight season was also only two weeks long and there were only two adults observed which was less than last year (4). Both March and April were cooler than average, with March being almost four degrees below average. This is an excellent indicator, but about the only one. Precipitation was high this year and lasted into May with above average rainfall. Unfortunately *Plantago* dipped below the 10 plants/m^2 critical threshold around April 30, only two weeks after peak flight (April 15) and at about the same time as the moderate densities of *Castilleja* senesced. This year's limited time availability of host plants for prediapause larval use, combined with another historically short adult flight season, does not bode well for next year's larvae and adult numbers on Tulare Hill. This contrasts with high adult numbers and a very long (8 week) although historically late flight season at Kirby, which also had host plants available to prediapause larvae at least three weeks later into the year than Tulare Hill.

We note that the number of butterflies estimated on Tulare Hill in 2023 is within the historical range of variability observed since 1987, and that this population has historically been vulnerable to crashes and local extirpation following poor weather.

In the long-term, it is important to realize that the Bay checkerspot population on Tulare Hill has historically been quite volatile, with an observed local extinction following the 1987-1992 drought years. At the other end of the spectrum, the large increase to 20,000 larvae from 2014 to 2015 (after 8450 larvae were translocated over the previous two years) shows that habitat can afford prime conditions for Bay checkerspot. The translocation in 2016 augmented the population in response to the crash of 2015-2016, and has given the population a chance to persist through that weather extreme. Low numbers seen since 2016 create a troubling trend, but are not outside the realm of fluctuations seen in other populations. It remains to be seen how Bay checkerspots fare with the difficult climate conditions they are likely to face, with Tulare Hill being one of the driest and most difficult locations they inhabit.

At this point we do not anticipate translocating in 2024, although that decision could be changed based on dramatic increases in larvae at the source population or other factors.

We also wish to reiterate that the entire Tulare Hill is unified Bay checkerspot habitat, as evidenced in previous years by adults dispersing beyond release properties throughout the whole hill. It will remain important to continue working cooperatively with all landowners to see this project succeed.

We remain grateful to our many partners who help with permitting, access, funding, management, and volunteer hours: Santa Clara County Parks, U.S. Fish and Wildlife Service, Land Trust of Santa Clara Valley, Calpine, and PG&E.

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