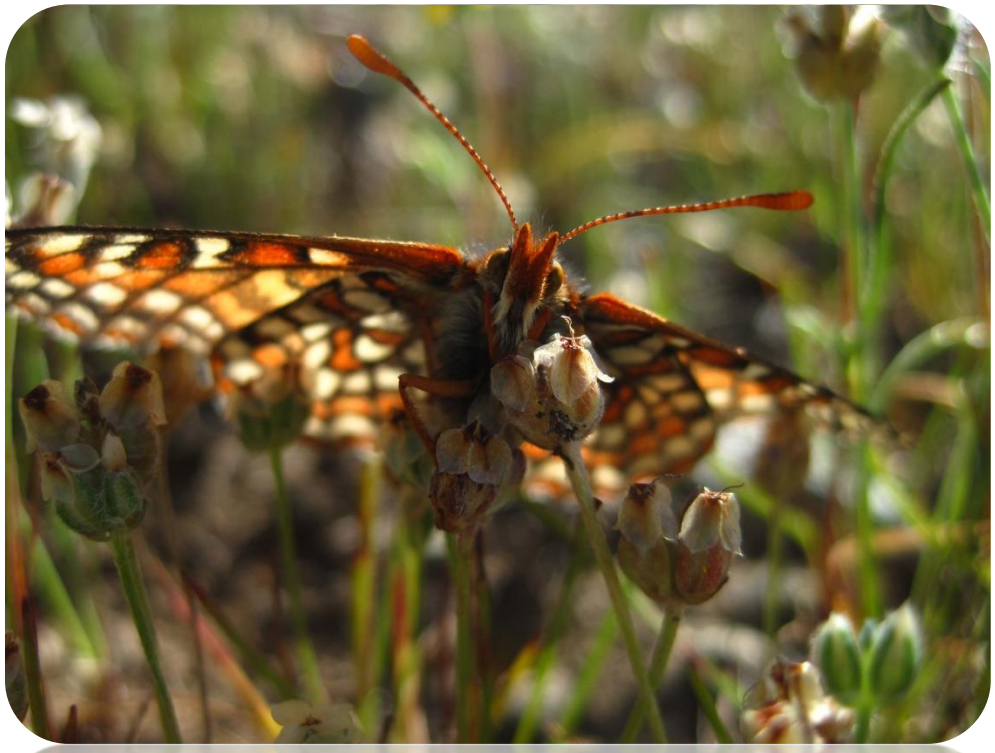
Bay Checkerspot Reintroduction

Coyote Ridge to Edgewood Natural Preserve



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Executive Summary

The main goal of this project is to re-establish a Bay checkerspot butterfly population in restored habitat in Edgewood Natural Preserve, where the population was extirpated in 2002. Extant populations from Coyote Ridge in Santa Clara County numbering in the hundreds of thousands were the source of these butterflies.

The Bay checkerspot larval population was estimated at about 300 larvae in February 2016, down from about 2,300 larvae in 2015, and about 4,000 in 214. Because this was below the replacement rate, habitat quality remained high, and source populations were also high, 5,000 larvae were released in February 2016. No adults were released in 2016.

This year monitors saw only 78 adults during timed transects, down from 451 in 2015 and 800 in 2014. Although the 2015 flight season was early, and host plant *Plantago erecta* remained fresh about six weeks past the peak of flight season, the drought year and above average March and April temperatures apparently caused the reduction in post-diapause larvae. The low number of adults after the 2016 relocation may have been caused by heavy rain after introduction, perhaps damaging the pupal stage.

While adult numbers were low, however, the cooler spring and the late senescence of the high numbers of *Castilleja* may mean high reproductive success for the low number of butterflies that were present this season.

Assuming source populations remain high, we plan to continue translocations in 2017.

We remain grateful to the following partners for financial support, volunteer time, and excellence on the job: USFWS, San Francisco Bay Wildlife Society, PGE, San Mateo County Parks, San Mateo County Parks Foundation, the Jiji Foundation, Friends of Edgewood, and of course the Edgewood Checkerspotters.

Project Background

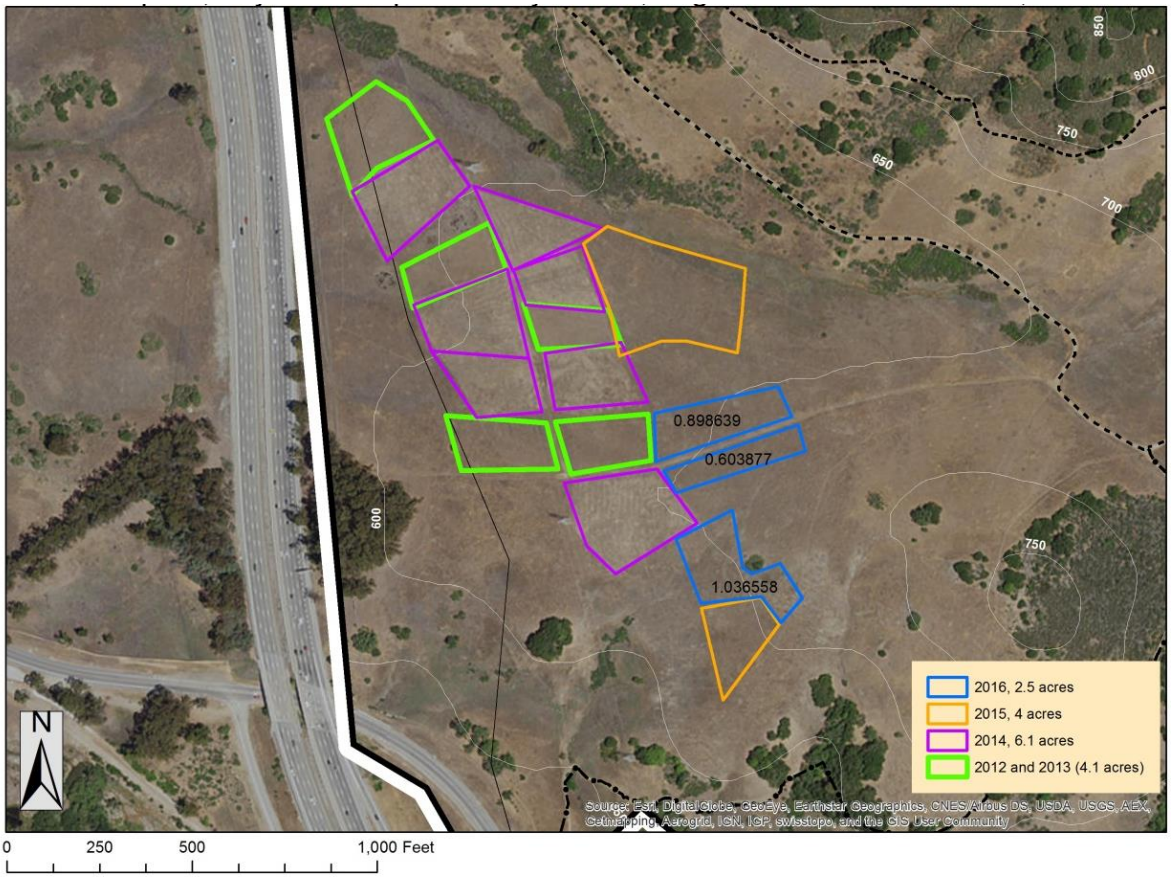
The nutrient poor serpentine grasslands at Edgewood Natural Preserve supported the last remaining population of the federally threatened Bay checkerspot butterfly on the San Francisco Peninsula, along with a dazzling diversity of native wildflowers and bunchgrasses. Maintenance of populations on the Peninsula is a high priority task in the 1998 USFWS Recovery Plan.

The Edgewood population was estimated at 4500 butterflies in 1997, but numbered less than 100 butterflies in 2000, and appeared to be extinct as of 2003. No butterflies or larvae were observed in 2003, 2004, 2005, and 2006. The major cause of the decline has been invasion by introduced annual grasses that choke out the larval hostplants of the butterfly, an invasion that has progressed rapidly since 1997. The grass invasion has been linked to emissions of ammonia and NO_x from 100,000+ cars traveling Highway 280 (Fenn et al. 2010). A reintroduction effort in 2007 was not successful, likely based on a single year effort, a low number of founders (1000 larvae), and a dry, warm, spring season.

Habitat Restoration

Experiments showed a single, well-timed mow and subsequent fall dethatching can be used on a rotational basis to reduce grass and thatch cover and increase Bay checkerspot host plant and nectar source cover (Weiss 2002). San Mateo County Parks continues to mow and dethatch portions of the butterfly habitat to reduce annual grass and thatch cover and increase native forb cover. In 2012, Creekside installed paired mowed and unmowed plots to better address the potential impact of critical habitat management on the diapausing larvae. About 4 of 30 acres were mowed in spring 2012 and 2013 and dethatched the subsequent fall. In April 2014 a different set of plots totaling about 6 acres was mowed. These plots were largely free of annual grass in spring 2015, so a different set of 4 acres was mowed. Again, these plots did not need retreatment in spring 2016, so an additional 2.5 acres was selected (Figure 1). Every plot mowed in spring was dethatched in fall.

Figure 1. Mow plots in Bay checkerspot butterfly habitat, Edgewood Natural Preserve



Plots mowed in 2012 and 2013 had an average of 18.5% *Plantago erecta* and 8.5% nonnative annual grass in 2015, while paired unmowed plots only had an average of 5.9% *Plantago* and 10.9% nonnative annual grass (Figures 2 and 3). Host plants are clearly responding positively to the management treatment, and nonnatives declining. Because this pattern has been repeatedly documented, plots were not read in 2016. An April 2016 photograph of a 2015 mow line shows the dramatic positive effect of the mowing on subsequent grass and forb cover (Photo 1).

Larval numbers were extremely low in the paired plots in both 2013 and 2014 (in both years the majority of larvae were found outside the paired plots), precluding statistical comparisons. Presence was noted in both mowed and unmowed plots. Larval numbers in mowed and unmowed plots were not compared in 2015 or 2016.

Figure 2. *Plantago* in mowed vs. unmowed plots.

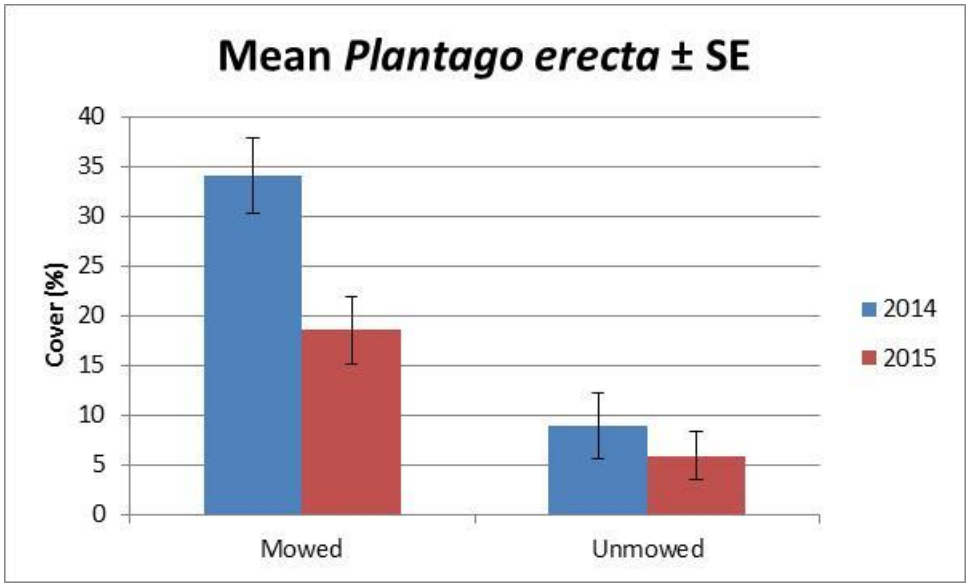


Figure 3. Nonnative grass in mowed vs. unmowed plots.

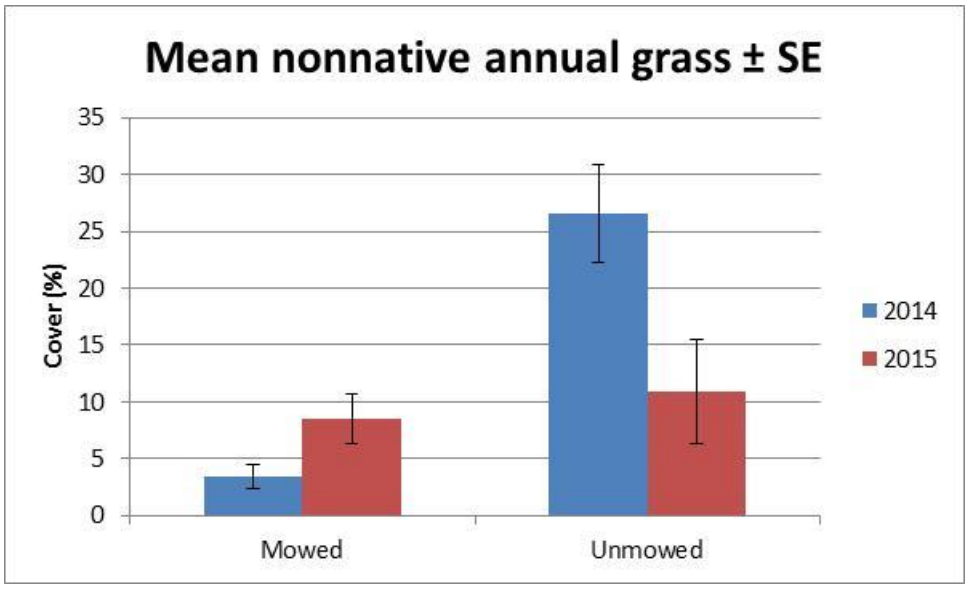


Photo 1. April 2016 photograph of spring 2015 mow line. The area to the left is mowed. The area to the right is unmowed, and is greener with more nonnative annual grass and fewer wildflowers.

Weather Summary

Annual precipitation from 1981 to 2010 averaged 48.1 cm (WRCC 2014) and will be considered the baseline for the project. October 2012 to September 2013 had 40.1 cm, 32.1cm of which fell between October and December (Table 1). While the rest of the water year was very dry, the early start to the growing season was considered to be advantageous to the spring 2013 larvae, which in turn is advantageous to the 2014 generation.

Only 23.3 cm fell October 2013 to September 2014. October-December 2013 saw only 2.7 cm, and January 2014 had zero measurable rainfall (WRCC 2014). By the end of January, the normally green grasslands at Edgewood were still eerily brown. Few annuals had germinated, and many that did died from moisture stress. Those that survived were usually shaded by rocks or small divots in the ground. This very late start to host plant germination is generally considered to be a large disadvantage. Rainfall in February greened up the Preserve, and by the end of spring things appeared more normal. Winter days were largely sunny. By mid-March, however, conditions had changed dramatically. With 11 cm of rain in February to recharge the soils, the host plants developed with little nonnative grass competition. It appeared that many of the nonnative grasses had germinated and then died during the dry January. Those that germinated in February generally lagged behind forbs in growth.

The 2015 water year had closer to average precipitation. Germination began at a fairly normal pace in November. Heavy rainfall occurred in December 2014, but there was no measurable precipitation in January 2015. The site received 10.1 cm in February 2015, and the rest of the spring saw below average precipitation.

The 2016 water year provided short-term relief from a four-year drought, with slightly above average rainfall (Table 1), with near average November-December, above average precipitation in January and March, and little in February, April or beyond. It may be that monthly precipitation patterns are more important than seasonal totals, which are provided as a point of reference.

Precipitation records for the source population are shown in Table 2 as reference. The source population at Coyote Ridge is about 65 km southeast of Edgewood. Edgewood is about 180 m elevation, and the source population about 360 m.

Unfortunately, our usual source of climate data for Coyote Ridge (WestMap) did not have complete 2016 climate data available as this report was being written. Note that we have instead used weather data from Weather Source, which reports on data from a weather station located near the San Jose airport.

Table 1. Yearly precipitation for nearby Pulgas Ridge, compared with the 1981-2010 baseline average of 48.1 cm (WRCC 2016).

	Yearly Precipitation (cm)
Oct 2006-Sep2007	31.1
Oct 2007-Sep2008	46.1
Oct 2008-Sep2009	50.2
Oct 2009-Sep2010	70.1
Oct-2010-Jun 2011	72.8
Oct 2011-Sep2012	41.4
Oct 2012-Sep2013	40.1
Oct 2013-Sep2014	23.3
Oct 2014-Sep2015	44.9
Oct 2015-Sep2016	59.1

Table 2. Precipitation records for San Jose, 39.6 cm average for 1981-2010 (Weather Source 2016)

	Yearly Precipitation (cm)
Oct 2006-Sep2007	24.8
Oct 2007-Sep2008	25.4
Oct 2008-Sep2009	29.8
Oct 2009-Sep2010	43.0
Oct-2010-Jun 2011	39.6
Oct 2011-Sep2012	18.1
Oct 2012-Sep2013	25.6
Oct 2013-Sep2014	15.3
Oct 2014-Sep2015	34.0
Oct 2015-Sep2016	37.9

Cool March and especially April temperatures also favor checkerspots, as they allow host plants to stay fresh longer as prediapause larvae race to the fourth instar when they can enter diapause. Edgewood had a particularly warm March 2007, and March 2008, 2013, 2014, and 2015 were also above the 30-year average. April temperatures were high in 2013 and 2014, and slightly above average in 2015. Again, these high temperatures are not favorable to checkerspots because they speed up host plant senescence. March was below average in 2016, and April was average (Table 3). Reference temperatures for San Jose are given in Table 4.

Table 3. March and April temperature data for nearby Pulgas Ridge, compared with the 1981-2010 baseline average (WRCC 2016).

	March (°C)	April (°C)
2007	21.2	20.1
2008	19.1	20.1
2009	18.5	20.4
2010	18.9	18.3
2011	15.8	17.6
2012	16.0	19.5
2013	19.7	22.4
2014	20.4	21.6
2015	22.6	21.0
2016	18.0	20.7
Average 1981-2010	18.6	20.7

Table 4. San Jose average maximum temperature (˚C) (Weather Source 2016)

	March	April
2007	21.1	17.8
2008	19.6	20.9
2009	17.9	20.8
2010	18.5	18.5
2011	17.2	19.4
2012	17.8	21.2
2013	19.4	22.9
2014	21.2	22.3
2015	22.6	21.5
2016	19.5	22.4
Average 1981-2010	19.2	21.3

Coyote Ridge Source Population

The 2016 larval population is a relic of the previous season's conditions. The previous year had below average rainfall, with the majority of rain falling in December. March and April 2015 were dry and warm. While a large population of post diapause larvae emerged at a normal time, spring conditions were not favorable for the next generation of pre-diapause larvae.

Larval numbers throughout the source population (Coyote Ridge) are shown in Table 5. Coyote Ridge supported 380,000 larvae in 2016. Peak numbers on Coyote Ridge were >2,000,000 larvae in 2015. The Kirby Reserve is shown as an example of a subarea with the longest population record.

Table 5. Kirby Canyon is 250 acres within the larger ~7000 acres of Coyote Ridge. The Kirby numbers are shown with 95% confidence intervals.

	Kirby Reserve	**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

*Confidence intervals across Coyote Ridge have not been calculated.

Larval Monitoring at Edgewood

Monitoring at Edgewood was conducted in February 2016, with estimates of 400 larvae, down from 2,300 larvae in 2015, and about 4,000 in 2014. The habitat is still high in host plant and nectar source cover. In order to achieve the high number of butterfly encounters that encourage more sedentary

behavior, and because source populations were still very high, additional larvae were transferred to Edgewood in 2016.

Table 6. Summary of larval estimates

Year	Resident larvae estimate	Mean # of larvae observed in standard surveys
2007	0	0
2011	0	0
2012	1900	20
2013	2900	28
2014	4200	53
2015	2300	24
2016	400	3

Larval Transfers

A total of 28,423 larvae have been released since 2007 (Table 7). Larvae were relatively easy to collect, especially in recent years when the source populations at Coyote Ridge were extremely dense.

Table 7. Summary of larval introductions

Year	Larvae introduced
2007	1,000
2011	4,003
2012	4,852
2013	5,000
2014	4,105
2015	4,463
2016	5,000

Post diapause larvae are the focus of the introduction because they are the easiest life stage to locate, handle, and transfer. Larvae are captured by hand or with a spoon, and placed in groups in vented plastic containers kept in coolers until same day release (Table 8).

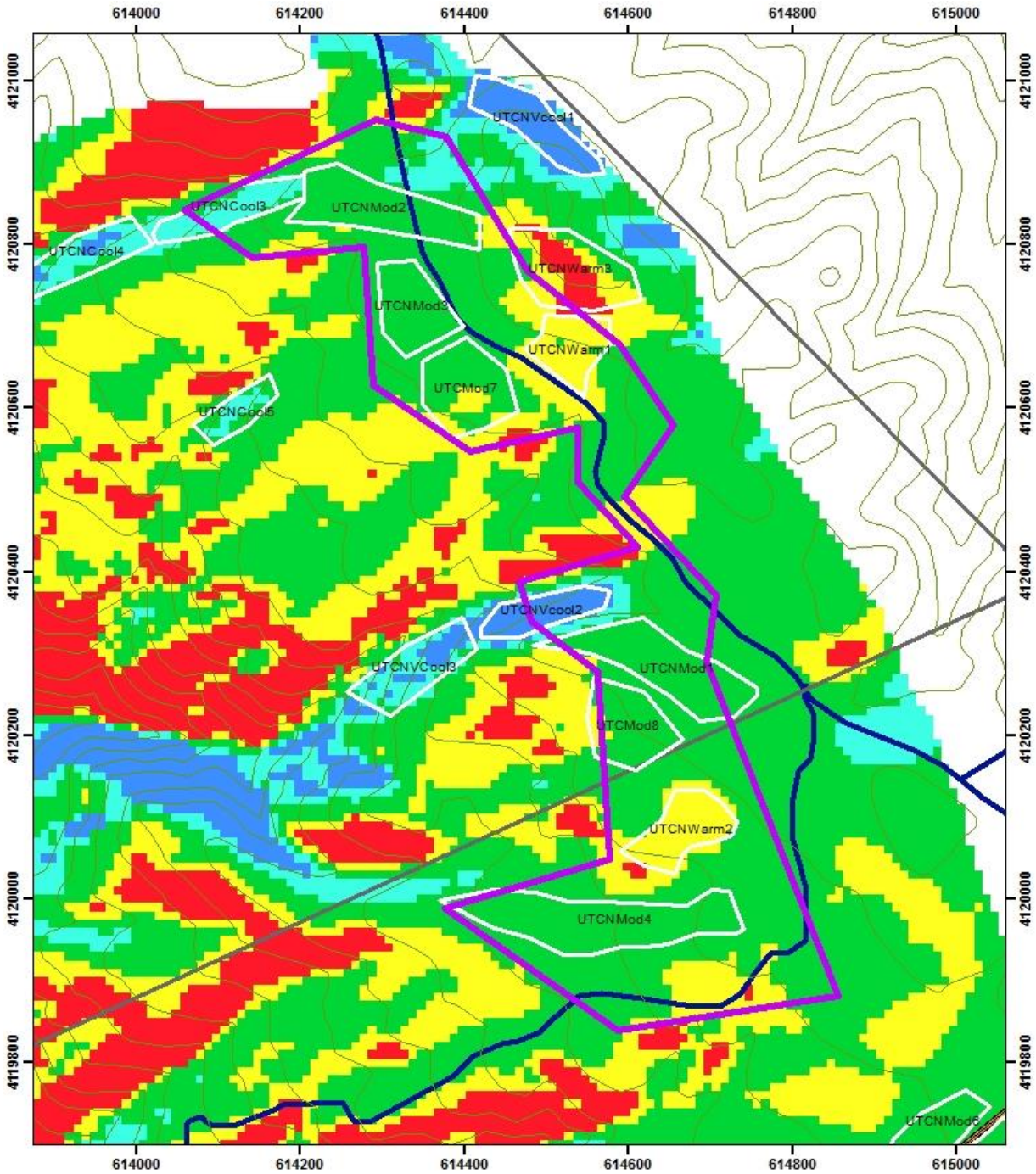
Table 8. Larval Transfers from Coyote Ridge to Edgewood Natural Preserve, 2016

Date	Adults observed	Larvae transported and released at Edgewood	Number injured	Number killed
2/10/2016	0	2931	0	0
2/13/2016	0	2069	0	0

Total larvae transferred: 5000

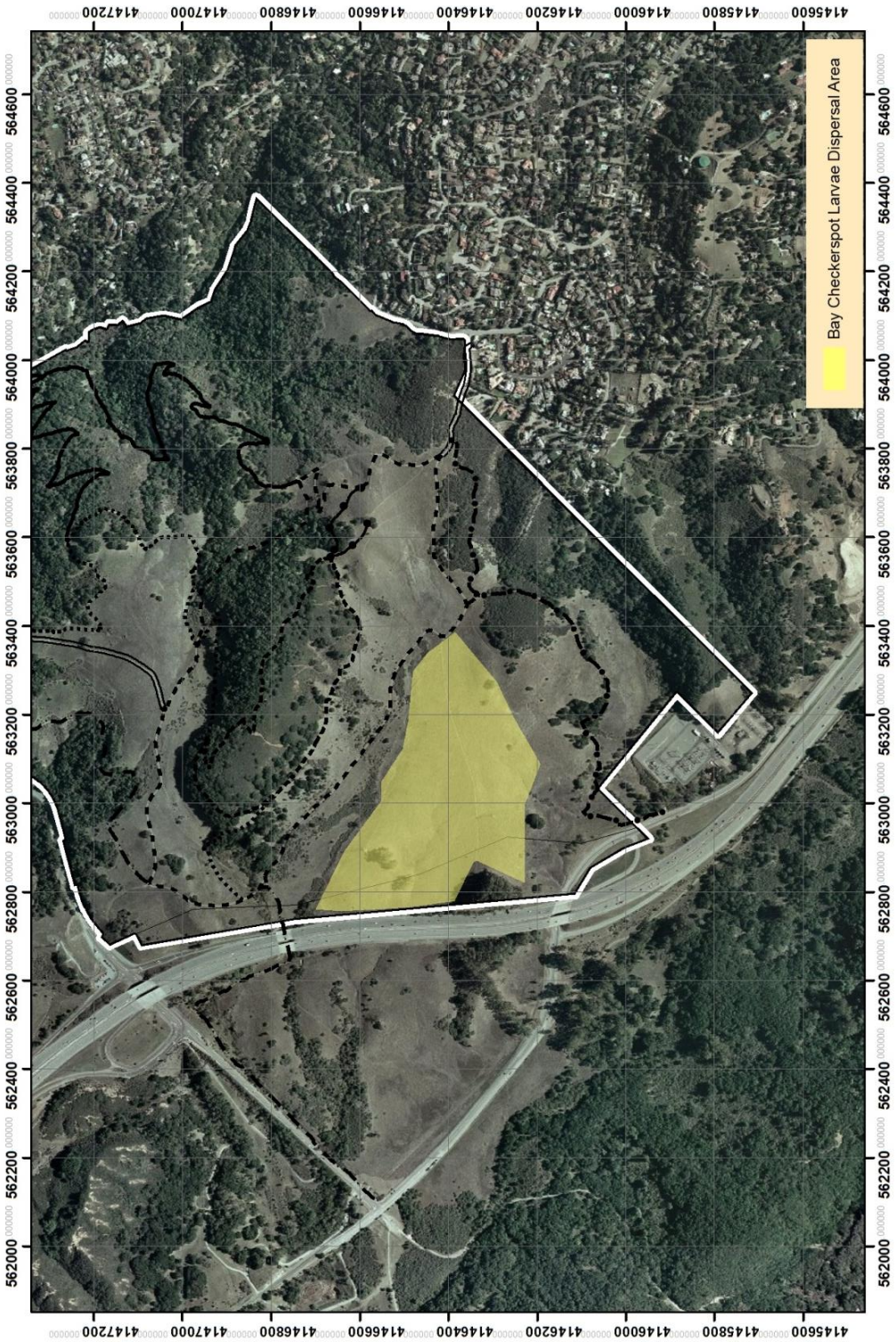
In 2016, 5000 larvae were collected from the area below, estimated to have more than 250,000 larvae. All coordinates are NAD83 (Figure 4). (Additional larvae were collected from a nearby location for the related Tulare Hill translocations.)

Figure 4. Collection location



As in previous years, larvae were dispersed in the area below at Edgewood Natural Preserve (Figure 5).

Figure 5. Dispersal location



After release, larvae were observed basking, crawling, or eating *Plantago erecta*.

Adult Transfers

No adults were transferred to in 2016 (Table 9).

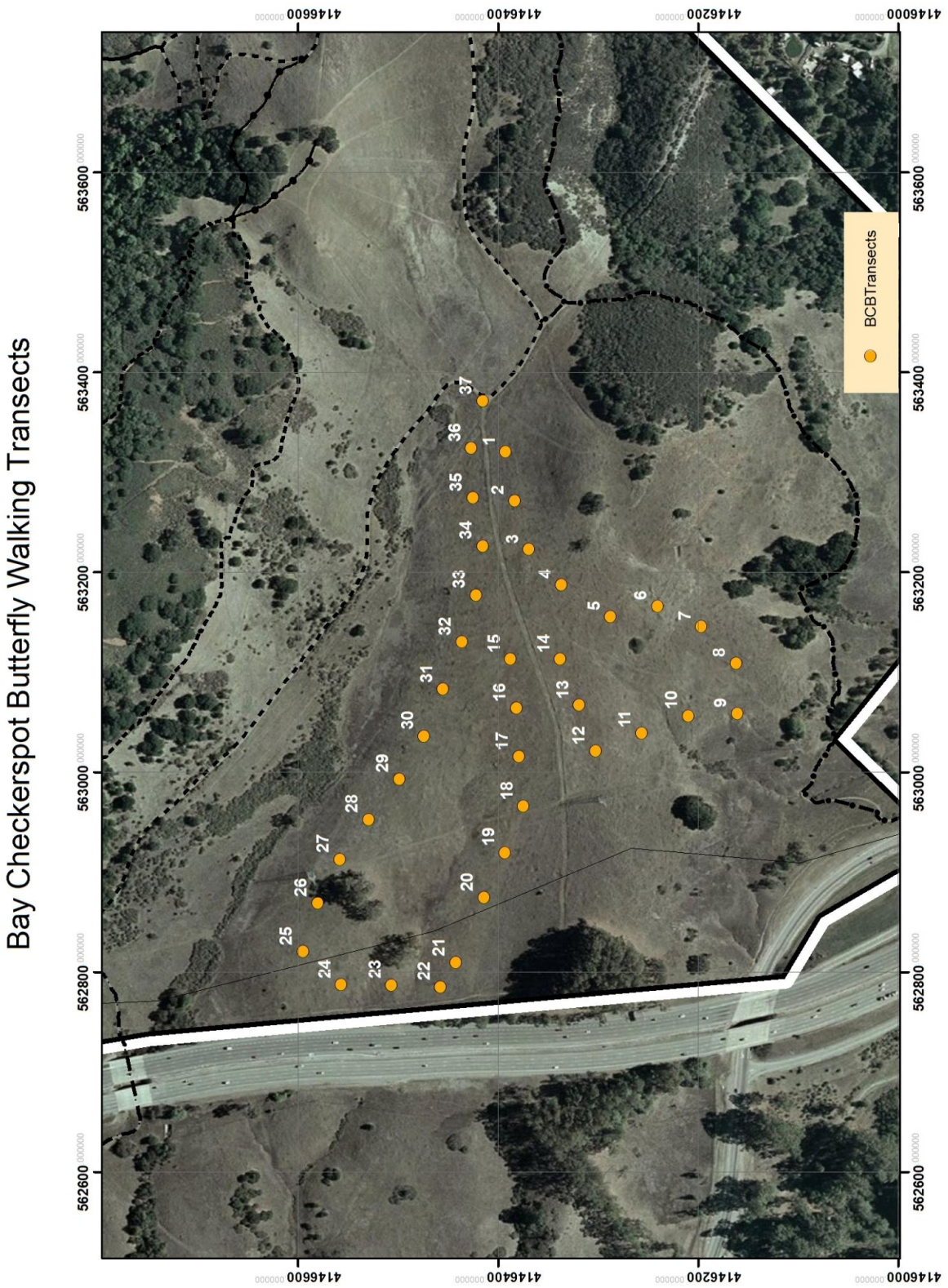
Table 9. Summary of adult introductions

Year	Adults introduced	Females	Males
2007	12	12	0
2011	60	40	20
2012	46	26	20
2013	0	0	0
2014	0	0	0
2015	60	40	20
2016	0	0	0

Adult Monitoring

Over the course of the flight season, adults are surveyed daily, weather permitting. The adult monitoring consists of a volunteer observer walking through 36 50-m transects set up in the butterfly habitat. The monitoring consists of counting how many Bay checkerspots are seen along each transect. The monitor walks slowly, covering the 50 meters in about 1.5 minutes, looking 5 meters to each side of the transect. The monitor may step off the transect to confirm a sighting (stopping the timer). The course takes about 1.5 hours to walk (Figure 6).

Figure 6. Adult monitoring course



This year, the number of adult butterflies declined substantially (Table 10).

Table 10. Summary of adult sightings during timed monitoring sessions at Edgewood

Year	Adults sighted
2007	9
2011	120
2012	310
2013	625
2014	800
2015	451
2016	78

While it is too early to determine whether the reintroduction effort will be a longterm success, the relocation effort has been successful based on the following:

1. Sufficient larvae are encountered in source populations and captured for release.
2. Larvae are collected from multiple locations and topoclimates. A range of larval sizes are represented.
3. Larvae are relocated with minimal impact on individuals.
4. Larvae and adults are dispersing beyond initial release sites.
5. The Edgewood habitat has dense amounts of both host and nectar sources.
6. Bay checkerspot butterflies are completing their life cycle at Edgewood Preserve.

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 Butterfly Reserve on Coyote Ridge in Figures 7 and 8. The asterisk denotes the midpoint of the flight season, when 50% of the year's butterflies had been encountered. Both sites hit their flight season midpoint in late March, which is neither particularly late nor early. Also note another relatively short flight season this year at Edgewood, which reduces mating opportunities and may increase risk relative to extreme weather events (Table 11).

Note that Kirby is monitored weekly, while Edgewood is monitored daily. Kirby therefore has a much larger population in 2016 and previous years compared with Edgewood.

Figure 7. Cumulative counts of adult Bay checkerspots, daily monitoring. * marks the midpoint of the flight season

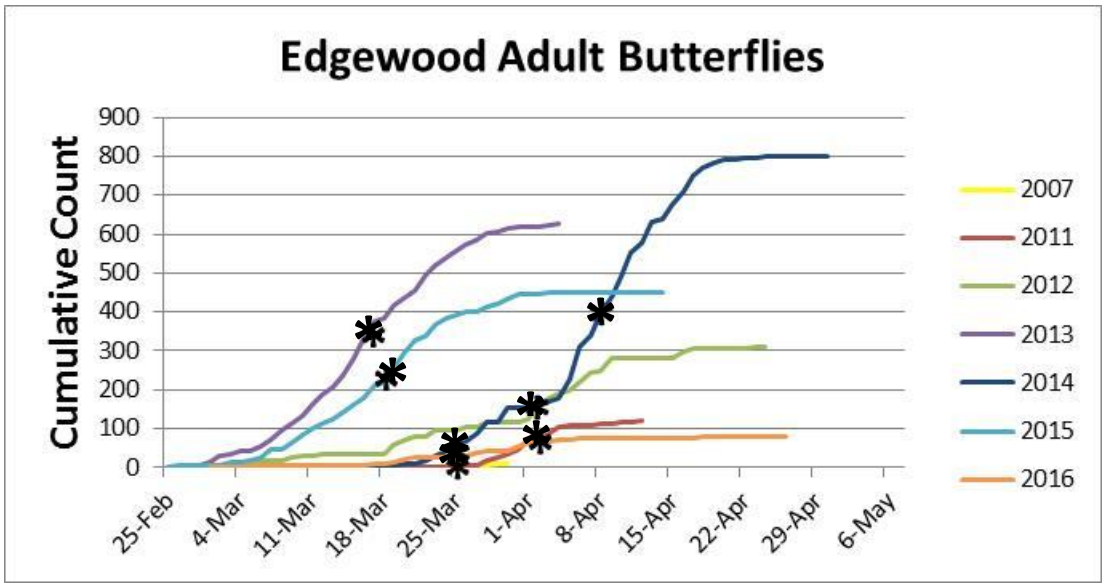


Figure 8. Cumulative counts of adult Bay checkerspots at the reference site, weekly monitoring

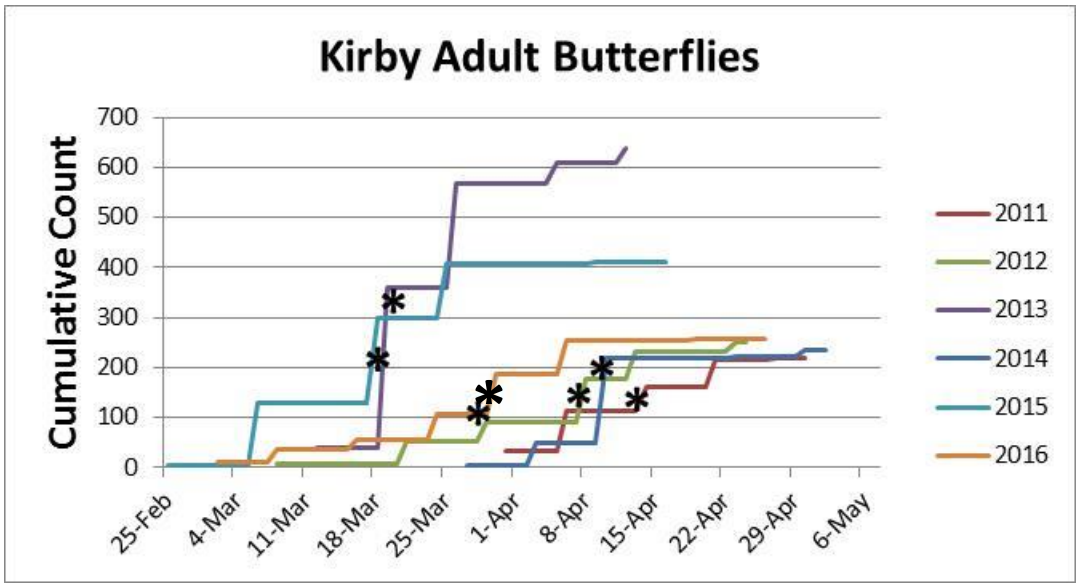


Table 11. Flight season comparisons at Edgewood vs. Kirby. Note 2014 is the latest peak flight recorded for Edgewood.

Year	Weeks of flight, EW	Weeks of flight, Kirby	Peak flight, EW	Peak flight, Kirby
2007	2	n/a	24-Mar	n/a
2011	4	4	1-Apr	14-Apr
2012	7.5	7	2-Apr	8-Apr
2013	6	4.5	18-Mar	19-Mar
2014	7	5	8-Apr	10-Apr
2015	7	6.5	17-Mar	18-Mar
2016	6	7	25-Mar	30-Mar

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 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 butterflies 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 phenology at Edgewood with phenology at Kirby Canyon Butterfly Reserve on Coyote Ridge, which has a large checkerspot population. We use its host plant phenology as a reference.

Plantago densities are usually comparable between Edgewood and Kirby, although Kirby was lower again this year. *Plantago* at Edgewood was on a nearly identical trajectory in 2016 as it was in 2015. *Plantago* at Edgewood dried out during the last week of April, while Kirby Canyon dipped below the 10 plants/m^2 critical threshold in the first week of May. This is a more common pattern, with Kirby's *Plantago* staying fresh longer than Edgewood, because Kirby has more steep, north-facing slopes. Castilleja numbers were high this year at Edgewood, and they stayed fresh into the second week of May. Castilleja numbers were also high at Kirby, where plants stayed fresh into late May. Both sites had a longer Castilleja season than 2015 (Figures 9-12).

The main nectar source, *Lasthenia californica,* again stayed fresh beyond the end of the flight season at both Edgewood and Kirby. *Layia* spp. also stayed fresh beyond the end of the flight season at both sites (Figures 13-16). Nectar tends not to be limiting for Bay checkerspots.

Figure 9. Edgewood host plant phenology. Ten *Plantago* plants/sq meter is a critical threshold for Bay checkerspot larval use.

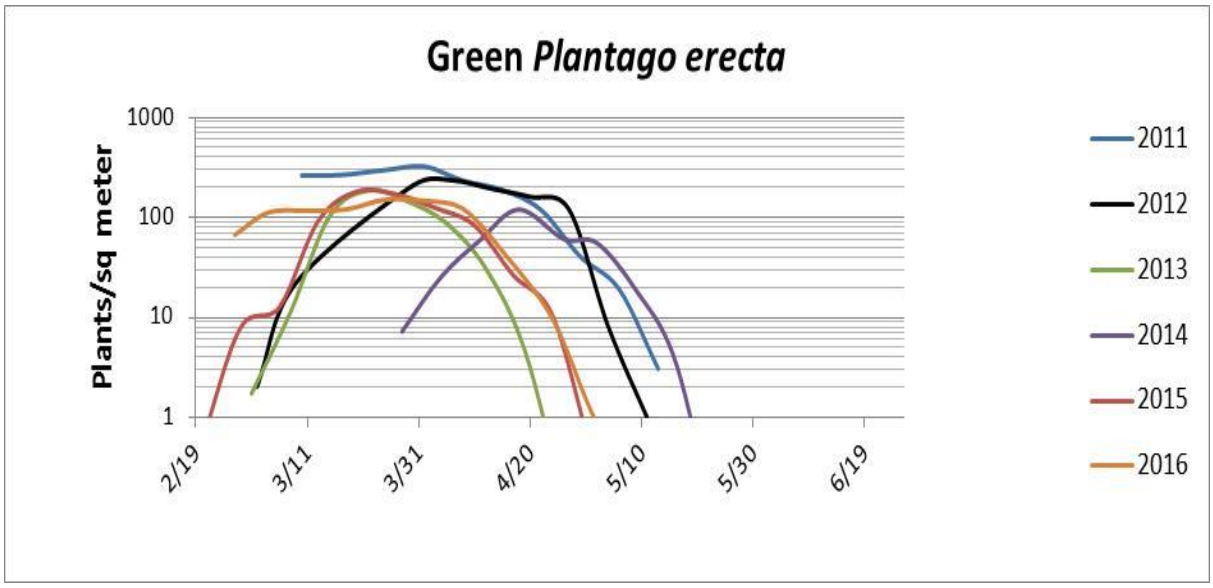


Figure 10. Kirby Canyon host plant phenology

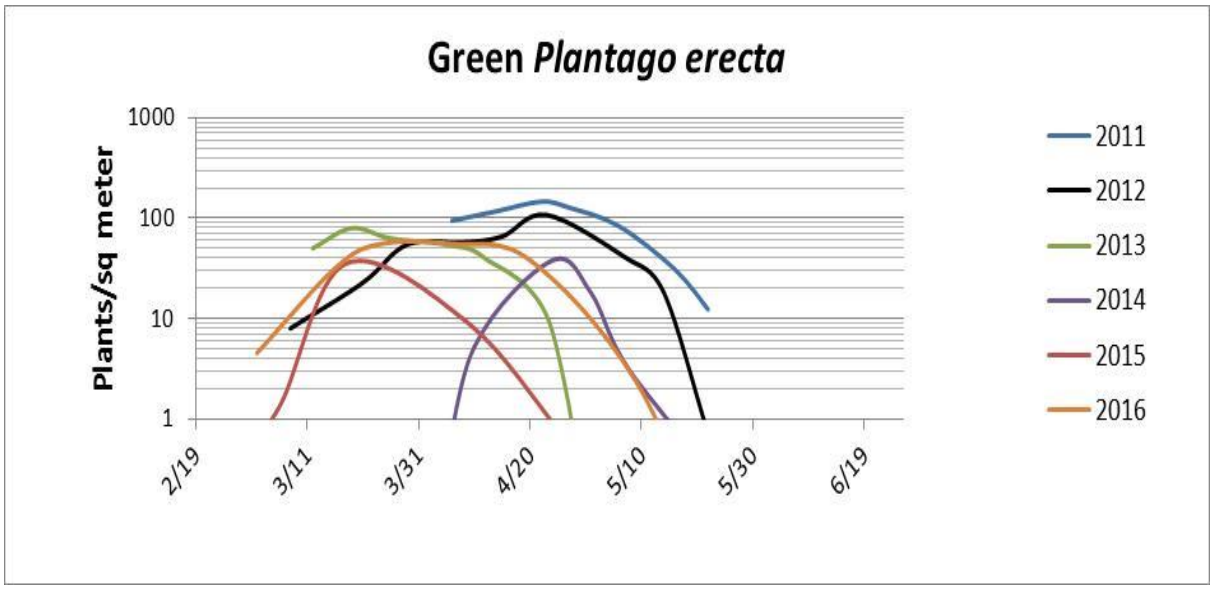


Figure 11. Edgewood host plant phenology

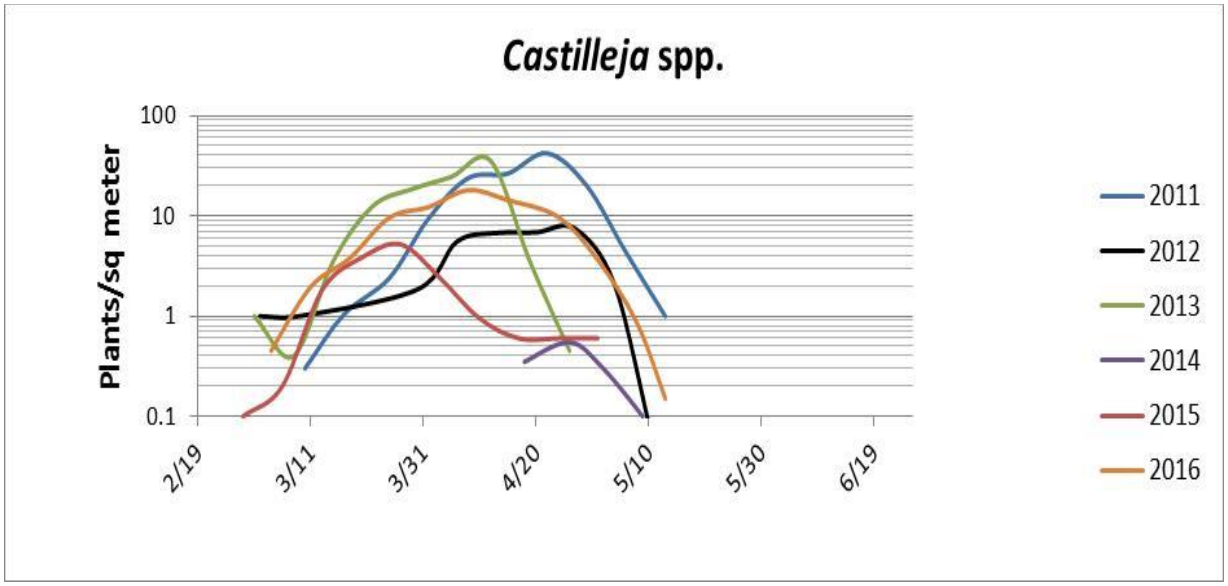


Figure 12. Kirby Canyon host plant phenology

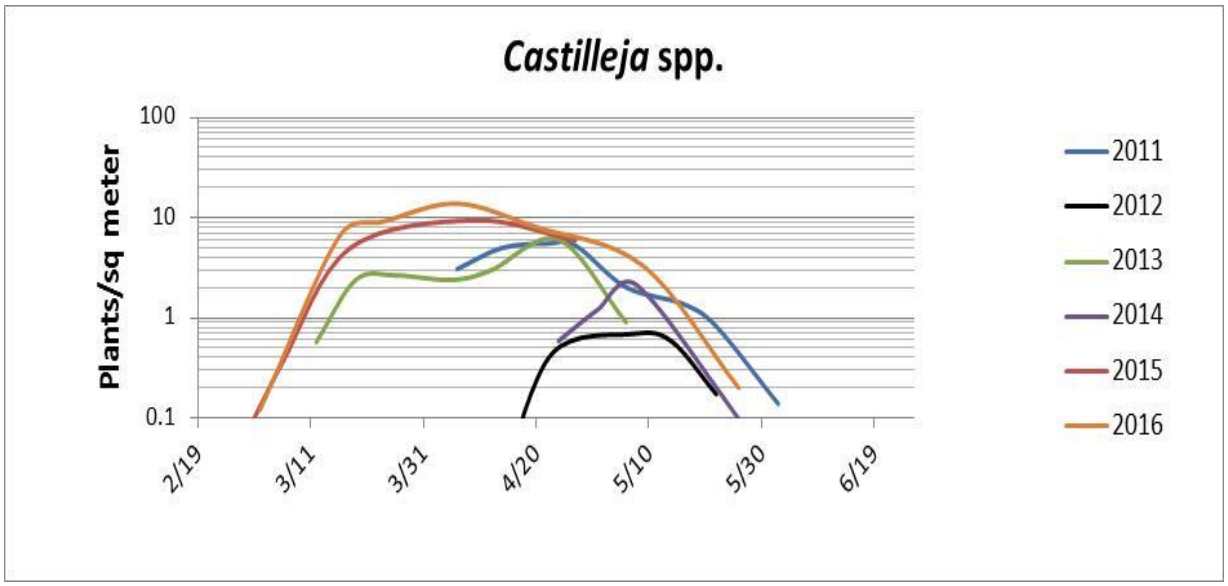


Figure 13. Edgewood nectar phenology

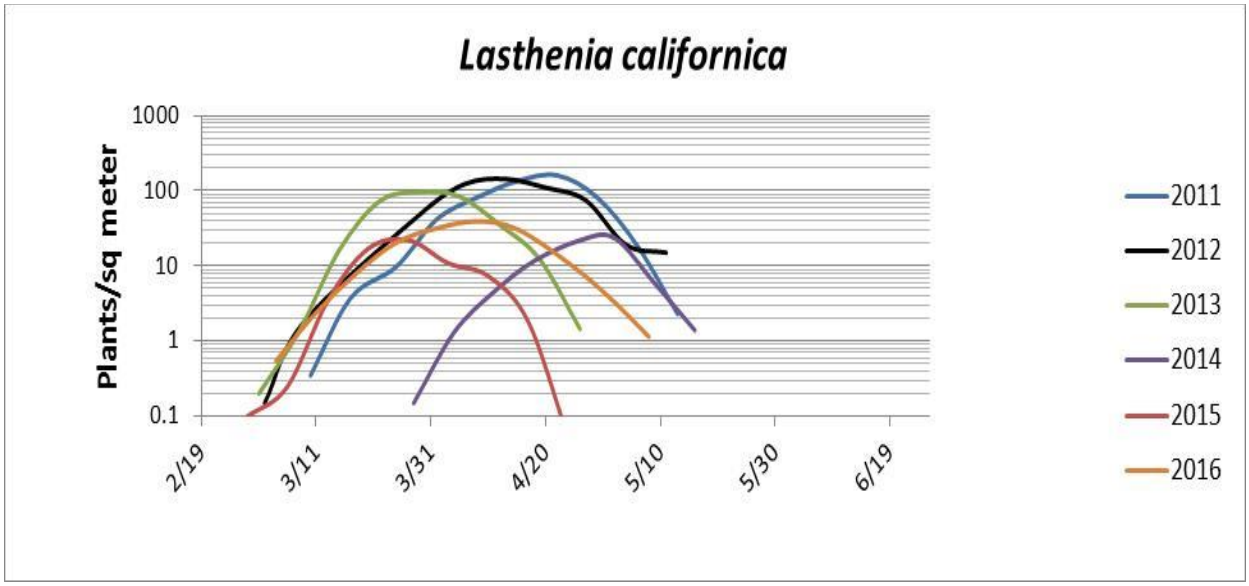


Figure 14. Kirby Canyon nectar phenology

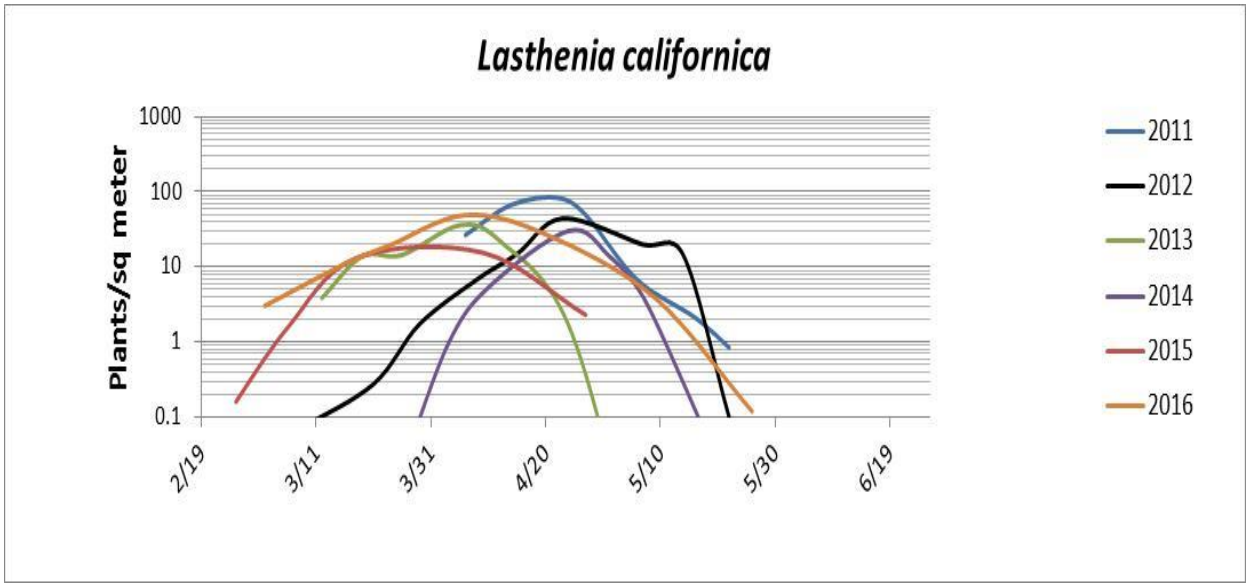


Figure 15. Edgewood nectar phenology

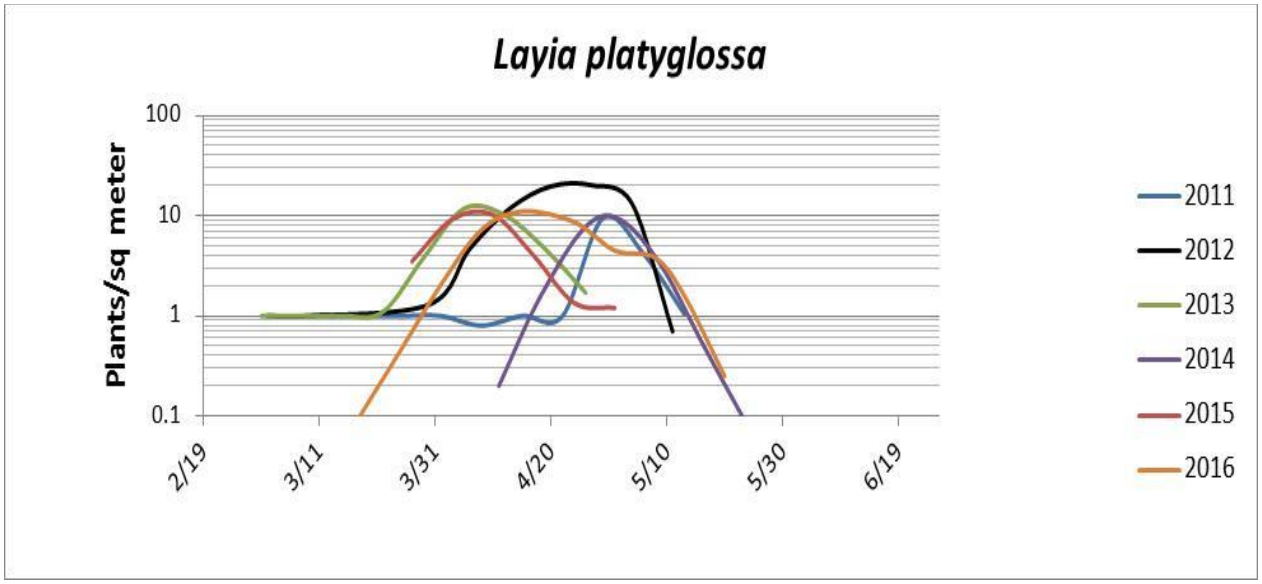
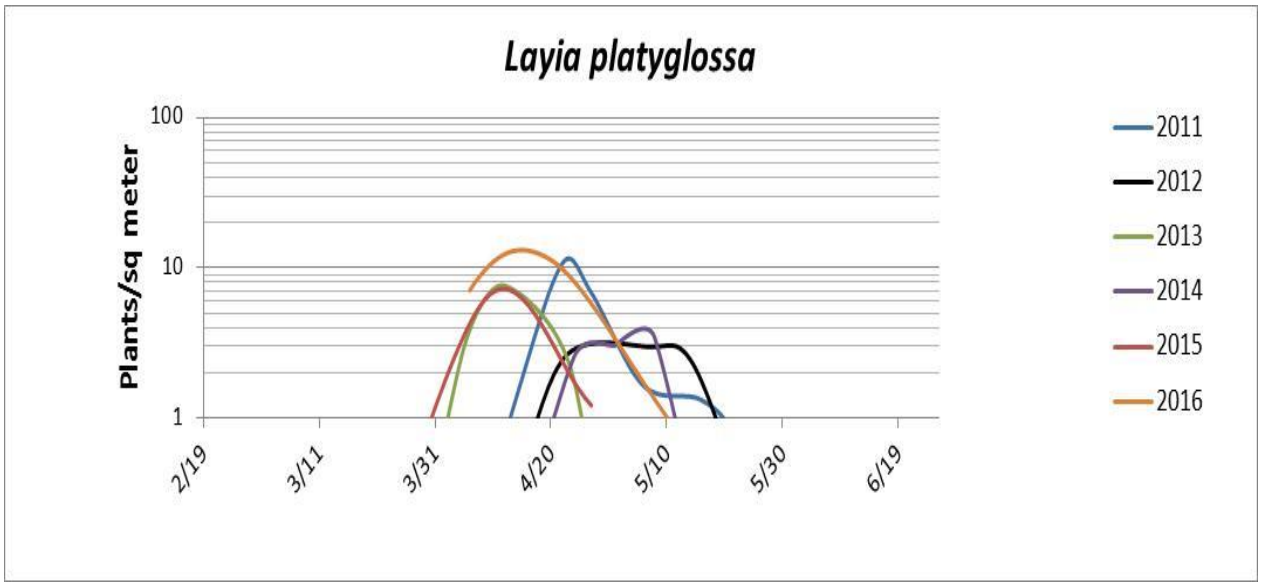


Figure 16. Kirby Canyon nectar phenology



Discussion and Next Steps

Bay checkerspot larval numbers at Edgewood crashed from 2015 to 2016, by an order of magnitude. Large declines were seen across all Bay checkerspot populations; even the most robust population in topographically diverse terrain on Coyote Ridge exhibited 5-fold declines. The early flight season in 2015 was apparently not early enough to counter the effects of the warm spring, which dried out host plants before larvae could enter diapause.

Adult numbers also sharply decreased in 2016, even with the influx of additional larvae. Heavy extended rains over two weeks in early March, just as the flight season was beginning may have greatly increased mortality of chrysalises (White 1984).

Looking forward to 2017, we have some reasons to project that, at the very least, the population will not severely crash again. As a general rule, prediapause larval survivorship increases substantially if host plants remain fresh three weeks or more after the midpoint of flight season, which was on March 25. April 15 is three weeks from that, and *Plantago erecta* plants at Edgewood were fresh until the end of the month, a positive sign. Even better was high numbers of *Castilleja*, the secondary host, staying fresh into the second week of May. Nectar again appeared abundant during the flight season.

While adult numbers were low, however, the cooler spring and the late senescence of the high numbers of *Castilleja* may mean high reproductive success for the low number of butterflies that were present this season.

The rotational mowing program continues to maintain high quality habitat. Decisions on mow areas are made in the field each spring and executed when grasses (primarily Italian ryegrass) are at the proper phenological stage, and after the vast majority of hostplants have senesced. Mowing is executed by County Parks staff using string-cutters that allow for great precision in targeting the denser stands of grass.

Funding for additional translocations has been secured through the USFWS. Assuming Bay checkerspot densities are high at Coyote Ridge, translocations will occur. Coyote Ridge densities will be sampled in late January-early March depending on weather.

Larger numbers do create a buffer against declines, which can be part of any boom and bust cycle. Having observed the reintroduced population over six years now, we have not seen a year of positive population growth (prior to translocation) yet, and stopping translocation is risky if there are not sufficient numbers to allow for some population decline over several years before the population locally adapts. Our target for the reintroduced population (prior to translocations) has been 9,000 larvae, the number estimated in 1997 prior to the crash to extinction. We may revisit this number in conjunction with USFWS and San Mateo County Parks after another year of translocations.

Local adaptation is a hallmark of *Euphydryas editha* populations (Ehrlich and Hanski 2004). The process of local adaptation to the smaller Edgewood habitat (15 ha vs. 2000 ha on Coyote Ridge) and lack of topographic diversity (the steepest north-facing slopes at Edgewood are ~ 15° compared with >30° on Coyote Ridge) creates a bottleneck for the re-establishment of a self-

sustaining population. The small habitat selects strongly for highly sedentary butterflies – movements of 100 meters or more can place butterflies off the Edgewood habitat, especially if they do not recognize the sharp edge of the serpentine grassland. At Coyote Ridge such movements are unlikely to lead butterflies off the habitat, even if butterflies encounter local area with few hostplants and nectar sources. The lack of topographic diversity at Edgewood reduces the buffering capacity of the coolest slopes where hostplants senesce late, as well as the early flight afforded by warmer slopes in certain years (Weiss et al. 1988, 1993). The impacts of the 2012-2015 drought years have been exacerbated by the lack of topography at Edgewood.

Despite these limitations of the Edgewood habitat compared with Coyote Ridge, it is important to note that a population of thousands to tens of thousands of Bay checkerspots persisted there for decades, until the habitat deteriorated in the late 1990s from nitrogen deposition from Highway 280 that drove intensified grass growth. Now that the habitat deterioration has been addressed through mowing, giving the population a chance to locally adapt over several years, without the influx of Coyote Ridge larvae, is critical.

We remain grateful to our many partners who help with permitting, funding, management, and volunteer hours: the Edgewood Checkerspotters, U.S. Fish and Wildlife Service, San Francisco Bay Wildlife Society, San Mateo County Parks, Friends of Edgewood, California Native Plant Society, PG&E, Jiji Foundation, and San Mateo County Parks Foundation.

References

Ehrlich, P.R. and I. Hanski. (eds.) 2004. *On the Wings of Checkerspots*. Oxford University Press, New York, New York.

Fenn, M.E., E.B. Allen, S.B. Weiss, S. Jovan, L.H. Geiser, G.S. Tonnesen, R.F. Johnson, L.E. Rao, B.S. Gimeno, F. Yuani, T. Meixner, A. Bytnerowicz. 2010. Nitrogen critical loads and management alternatives for N-impacted ecosystems in California. Journal of Environmental Management. Vol. 91, pp. 2404-2423.

Weather Source. 2016. Weather Warehouse monthly weather data for San Jose, CA. Accessed on November 3, 2016.
http://weather-warehouse.com/WeatherHistory/PastWeatherData_SanJose_SanJose_CA_September.html

Weiss, S.B. 2002. Final Report on NFWF Grant for Habitat Restoration at Edgewood Natural Preserve, San Mateo County, CA Available online at: http://www.co.sanmateo.ca.us/vgn/images/portal/cit_609/14232740Edgewood-NFWFFinalReport.pdf

Weiss, S.B., D.D. Murphy, P.R Ehrlich, and C.F. Metzler. 1993 Adult emergence phenology in checkerspot butterflies: the effects of macroclimate, topoclimate, and population history. Oecologia 96:261-270.

Weiss, S.B., D.D. Murphy, and R.R. White. 1988. Sun, slope, and butterflies: topographic determinants of habitat quality for Euphydryas editha bayensis. Ecology 69:1486-1496.

Western Regional Climate Center (WRCC). 2016. Monthly current rain data taken from Pulgas Ridge. Accessed on October 18, 2016. http://www.raws.dri.edu/cgi-bin/rawMAIN.pl?caCPUL.

Westmap. 2015. Climate Analysis and Mapping Tool. Accessed on November 16, 2015. http://www.cefa.dri.edu/Westmap/Westmap_home.php

White, R.R. 1986. Pupal mortality in the Bay checkerspot butterfly (Lepidoptera: Nymphalidae). Journal of Research on the Lepidoptera 25:52-62

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