# Western Riverside County
# Multiple Species Habitat Conservation Plan
# Biological Monitoring Program

## 2015 Quino Checkerspot Butterfly
## (*Euphydryas editha quino*)
## Survey Report

**16 September 2016**

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## NOTE TO READER:

This report is an account of survey activities conducted by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. Reserve assembly is ongoing and is expected to take 20 or more years to complete. The Conservation Area includes lands acquired under the terms of the MSHCP and other lands that have conservation value in the Plan Area (called public or quasi-public lands in the MSHCP). In this report, the term "Conservation Area" refers to these lands as they were understood by the Monitoring Program at the time the surveys were conducted.

The Monitoring Program monitors the status and distribution of the 146 species covered by the MSHCP within the Conservation Area to provide information to Permittees, land managers, the public, and the Wildlife Agencies [i.e., the California Department of Fish and Wildlife (CDFW, formerly California Department of Fish and Game) and the U.S. Fish and Wildlife Service]. Monitoring Program activities are guided by defined conservation objectives for each Covered Species, other information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees. A list of the lands where data collection activities were conducted in 2015 is included in Section 7.0 of the Western Riverside County Regional Conservation Authority (RCA) Annual Report to the Wildlife Agencies.

The primary author of this report was the 2015 Quino Project Lead, Lynn E. Miller. This report should be cited as:

Biological Monitoring Program. 2016. Western Riverside County MSHCP Biological Monitoring Program 2015 Quino Checkerspot Butterfly (*Euphydryas editha quino*) Survey Report. Prepared for the Western Riverside County Multiple Species Habitat Conservation Plan. Riverside, CA. Available online: http://wrc-rca.org/about-rca/monitoring/monitoring-surveys/.

While we have made every effort to accurately represent our data and results, it should be recognized that data management and analysis are ongoing activities. Readers wishing to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data.

Please contact the Monitoring Program Administrator with questions about the information provided in this report. Questions about the MSHCP should be directed to the Executive Director of the RCA. Further information on the MSHCP and the RCA can be found at www.wrc-rca.org.

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# INTRODUCTION

The Quino checkerspot butterfly (*Euphydryas editha quino*; "Quino") is federally listed as endangered and is sparsely distributed within the southeastern section of the Western Riverside County MSHCP Plan Area. Species-specific Conservation Objective 4 for Quino checkerspot states that "within the MSHCP Conservation Area, biologists will document the distribution of Quino checkerspot on an annual basis" (Dudek & Associates 2003). Biological Monitoring Program biologists attempted to meet this objective by focusing surveys within the 6 Core Areas identified in Conservation Objective 1: Warm Springs Creek, Johnson Ranch/Lake Skinner, Oak Mountain, Wilson Valley, Sage, and Silverado/Tule Peak (Dudek & Associates 2003). Surveys were conducted in the Lake Mathews/Estelle Mountain/Harford Springs Core Area over 8 years with no success, leading to termination of surveys there beginning in 2012. Local experts noted the abrupt decline of Quino colonies in the Gavilan Hills and near Lake Mathews during the early 1980's (Ballmer et a1. 1997). As of this writing, it is widely believed Quino have been extirpated from this Core Area; therefore, this area was again excluded from surveys in 2015. Additional surveys were conducted in satellite (non-core) occurrence complexes where Quino are known to currently or historically occur, such as the southwestern portions of the San Bernardino National Forest (SBNF), Anza Valley, and Brown Canyon in Cactus Valley.

The Quino checkerspot butterfly is a member of the checkerspot Euphydryas complex within the brush-foot butterfly (*Nymphalidae*) family. The term "checkerspot" refers to the repeated pattern of black, cream-colored, and orange spots that are the characteristic colors of the wings (Ehrlich and Hanski 2004). The adult Quino has a nearly 4 cm wingspan. A diagnostic characteristic of the adult Quino is the orange stripes across the top of the abdomen with no white spots. Quino larvae can be recognized after their second molt by their black coloration and row of 8-9 orange tubercles on their back (USFWS 2003). These larvae are most typically observed feeding on host plants, particularly *Plantago erecta* (California plantain).

The life cycle of Quino usually includes 1 generation of adults per year, with a 4 to 6 week flight period (Emmel and Emmel 1973). Females mate soon after pupal emergence in the early to mid-spring, generally in February (low elevation areas) and March (higher elevations) in western Riverside County. Females then lay masses of eggs in small clusters at the base of their host plants (Ballmer et al. 1997). One or 2 egg clusters per day are laid for most of the butterfly's 10 to 14 day adult life (Labine 1968). Eggs hatch 10 to 14 days after being laid (USFWS 2003). The young larvae from each egg mass often live communally in a silken tent (Erlich and Hanski 2004) and live gregariously, at least during the first 1 or 2 larval instars (Wahlberg 2000). Pre-diapause larvae are in a race to feed on their host plants to reach the diapause stage (aestivation) before their host plants senesce, or risk starvation (Singer 1972). The grass and shrub lands that support the Quino checkerspot and its larval host plants dry rapidly, typically in late spring, but drying may occur earlier in the absence of sufficient autumn or winter precipitation. Mortality of pre-diapause larvae commonly exceeds 99% (White 1974) and is their most vulnerable stage.

If host plants persist, larvae grow through 3 instars, then, as summer drought commences and their host plants senesce, they molt into a fourth instar and enter a summer diapause (Erlich and Hanski 2004). The larvae that successfully entered diapause will remain in this dormant state for nearly 9 months. When host plants germinate the next spring in response to late autumn or winter rains, larvae break diapause and feed to maturity as solitary individuals. Quino larvae can live for several years in diapause in the absence of conditions adequate for breaking aestivation (Ballmer et al. 1997).

Adult Quino spend time searching for mates, defending territories, nectaring, basking in the sun to thermoregulate, and, in the case of females, searching for host plants to deposit their eggs. Quino are likely to be found in barren spots surrounded by low-growing vegetation, especially their host plants and nectar sources. They are also found in openings in shrublands, such as red-shank chaparral *(Adenostoma sparsifolium*). Quino tend to be low fliers, avoiding objects taller than about 2 m, but natural vegetation does not constitute a barrier to dispersal (USFWS 2003). In fact, Quino have been observed flying over red-shank chaparral 3 m tall (*Lynn Miller, Biological Monitoring Program, personal observation*).

The distribution of Quino once spanned from the Santa Monica Mountains south to the northern parts of Baja California (USFWS 2003). However, nearly all of the butterfly's former range in California's native grasslands has been converted into a landscape dominated by human habitation or non-native plant species. Non-native plants, particularly the aggressive Mediterranean grasses and forbs, provided better forage for livestock and rapidly outcompeted and replaced most native grassland vegetation (Seabloom 2003). Thus, the butterfly's grassland-associated larval host plants have been severely reduced in population size and are now restricted to a few localized areas. If climate change causes increased drought or increased variability of rainfall patterns, as has been predicted for southern California (Seager et al. 2007; Diffenbaugh et al. 2008), the ties between prediapausal larvae growth and host plant senescence may contribute to further declines in Quino populations.

As a result of annual surveys through 2015 we have accumulated meaningful representations of the broad-scale (Conservation Area-wide) distribution of Quino, and the results of more recent surveys serve to better delineate the fine-scale (reserve-level) distribution of Quino at particular survey areas. With time we have also gained insight into the relative stability of various Quino populations within the Conservation Area (i.e., which locations regularly support adult Quino and which locations appear to produce observable Quino only in years with presumably favorable environmental and/or habitat conditions). The 2015 survey year was conducted under drought conditions in all of the Quino-occupied areas.

## Goals and Objectives

1. Monitor Quino populations at the sentinel sites.
    a. Determine the flight season of Quino at sentinel sites to confirm presence/absence of Quino larvae and/or adults, relative abundance, and available species-specific resources.

2. Monitor Quino populations in areas that were recently occupied.

a. Conduct presence/absence surveys within 250 m × 250 m sampling stations at survey sites identified as having suitable habitat.
b. Survey areas with known Quino populations to determine if sites are still occupied and extent of occupation.
c. Survey new sites with suitable habitat near known Quino populations.
d. Map current observations to track distribution of Quino within the Conservation Area.

# METHODS

## Protocol Development

The Monitoring Program began developing a survey protocol in 2005 to determine the distribution of Quino across the Conservation Area. Additional goals during previous survey years included estimating the detection probability of adult Quino and calculating the proportion of area occupied by Quino. Survey goals in 2015 included monitoring the status of any locations with documented Quino populations within the last 5 years. An exception to this goal was the monitoring of the Winchester 700A site (Warm Springs Creek) and Winchester 700B site (Wilson Valley). These sites were surveyed in 2015 but have not produced any detectable Quino in 8 or more years. The collection of covariate data, such as temperature, wind speed, host plant distribution, and nectar plant presence during each survey aids our understanding of Quino resource selection.

## Study Site Selection

*Sentinel Sites*

In 2015 we continued monitoring 2 of the established sentinel sites, Southwestern Riverside County Multi-Species Reserve (MSR) and Oak Mountain (Fig. 1), because understanding within- and among-year differences in the timing of the Quino flight season is important to most efficiently direct overall survey efforts. The third established sentinel site, Silverado Ranch, was not monitored, however, due to access restrictions. Instead, we substituted an area within our Winchester 700C site which was located near the Silverado Ranch site and is reliable for Quino occupancy. We called this new site Tule Peak Road sentinel site (Fig. 1). We believe these sites are geographically representative of the current distribution of Quino within the existing Conservation Area. In the future, as Quino populations shift, sentinel site locations may change as well.

The primary purpose of sentinel site monitoring is to document adult Quino in flight so that monitoring at nearby survey sites can be conducted with a reasonable chance of success. This assumes that Quino flight status at the sentinel site is indicative of flight status in nearby areas. Secondary purposes of sentinel site monitoring are to document presence of larvae, to approximately estimate abundance trends of adult Quino from year to year, and to track Quino habitat conditions on-site, including host plant distribution and abundance, and availability of nectar plants for Quino foraging.

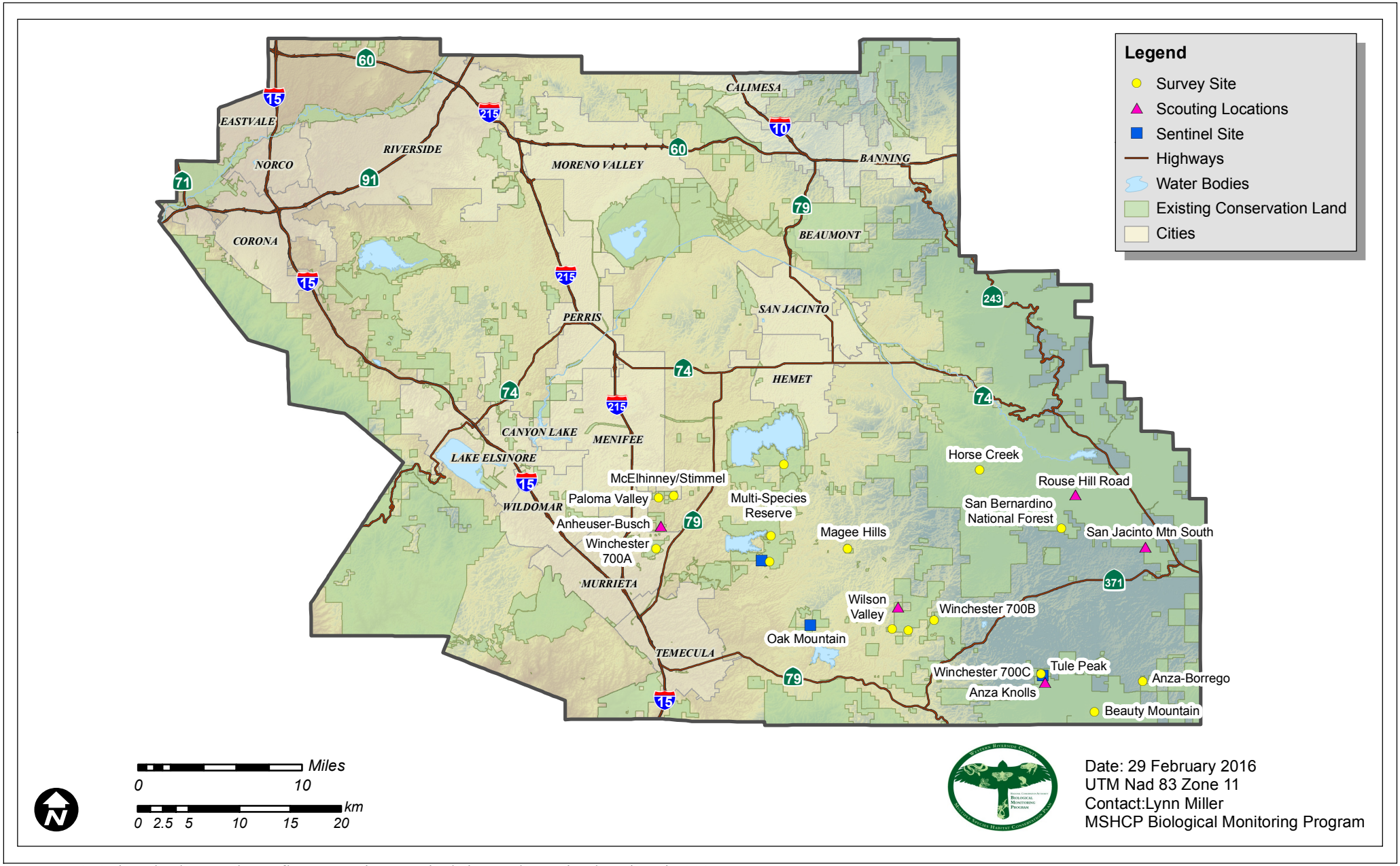


**Figure 1.** Quino checkerspot butterfly survey sites, sentinel sites and scouting locations in 2015.

*Adult Quino Survey Sites*

At the inception of our Quino monitoring effort in 2008, potential study sites were chosen using GIS layers of USFWS-designated critical habitat for Quino and lands accessible to the Monitoring Program. As our understanding of Quino habitat suitability and knowledge of Quino occupancy evolved, more study sites were added in subsequent years. We then employed a grid of 250 m × 250 m squares using Arc GIS (ESRI 2009) for adult Quino survey sites to record the location of Quino sightings. The number of squares in each grid was variable depending on heterogeneity of the landscape and suitability of the habitat for Quino.

In 2015 we surveyed 97 sampling stations for presence/absence of adult Quino at 15 survey sites. Survey sites varied in spatial extent but generally contained several sampling stations. For example, there may have been just 1, or several, survey sites within a given Core Area, or within a geographical area outside of the species-specific Core Areas defined by the MSHCP. Thirteen sites were visited in 5 of the 7 Core Areas: Winchester 700A (Murrieta), McElhinney/Stimmel, and Paloma Valley in the Warm Springs Creek Core Area; Magee Hills in the Sage Core Area; MSR 1, MSR 2, and MSR 3 in the Johnson Ranch/Lake Skinner Core Area; Wilson Valley 1,Wilson Valley 2 and Winchester 700B in the Wilson Valley Core Area; Winchester 700C (Tule Peak Road), Beauty Mountain, and Anza-Borrego in the Silverado/Tule Peak Core Area (Fig. 1).

Of the 2 remaining Core Areas, Oak Mountain does not have an established adult survey site but includes the Oak Mountain sentinel site which was surveyed in 2015. The Lake Mathews/Estelle Mountain/Harford Springs Core Area was not surveyed.

Two of the 15 sites surveyed in 2015 were not in designated Core Areas but are surveyed regularly because of recent Quino observations. They were within the San Bernardino National Forest (SBNF), a non-core satellite occurrence complex (Dudek & Associates 2003): Horse Creek (off of Bautista Rd) and a site specifically named SBNF (approximately halfway between Cahuilla Mountain and Thomas Mountain).

When possible, we surveyed additional areas (scouting sites) for any Quino detections to expand the area documented as occupied. We made 1 visit each to 5 scouting sites in 2015: Anheuser-Busch QCB (Warm Springs Creek Core Area), Wilson Valley Road QCB (Wilson Valley Core Area), Rouse Hill Road QCB and San Jacinto Mountain South QCB (SBNF), and Anza Knolls QCB (Silverado/Tule Peak Core Area).

**Survey Methods**

*Sentinel Site Visits*

Surveys for Quino were conducted during their 4 to 6 week flight period, beginning from late January and continuing to early May (USFWS 2003). Flight start and end dates depend on the elevation of the site, temperature and rainfall. Sentinel site visits commenced when spring conditions developed (i.e., sunny days with temperatures above 15°C). Surveyors visited each sentinel site to determine the commencement of the adult flight season. If Quino larvae were documented, adult Quino were typically observed on-site within 2-4 weeks.

Sentinel sites were defined by a single set of coordinates, but surveyors visited several surrounding hilltops or areas with appropriate Quino habitat. We conducted surveys between the hours of 0930 and 1600 when temperatures in the shade at ground level were >15ºC on a clear, sunny day or >21ºC on an overcast or cloudy day, and with sustained wind speeds ≤ 24 km/hr as measured 1.2–1.8 m above ground level. Sustained wind was defined as the wind speed determined by averaging observed values over a two-minute period. We did not conduct surveys when there was fog or precipitation.

Unless the above conditions precluded a sentinel survey, the surveyor spent approximately 2 hours searching the site. Surveyors recorded number of Quino larvae and/or adults seen, host plant status, available nectar resources, co-occurring butterflies, weather conditions, and start and end time. If after at least 2 hours no Quino were observed, the survey ended. Surveyors thoroughly covered the area surrounding the sentinel site waypoint, using their knowledge of Quino ecology to maximize opportunities for detection. For instance, visiting hilltops, looking through patches of host plants, and scanning vegetation with open flowers were all part of the search effort.

Because Quino is a federally listed endangered species and because these sentinel sites represent some of the best remaining habitat, surveyors were instructed to be extremely careful to avoid trampling larvae or host plants, disturbing cryptogamic soil crusts, or otherwise adversely impacting the resources at the site. Surveyors were instructed to walk on existing roads and trails when possible. On any given year, visits are limited to no more than once per week to minimize impacts on the resources. In 2015, sentinel sites were not visited as regularly as in past years. We had gaps of approximately 3 weeks between surveys during a timeframe when Quino were likely to be found. This certainly impacted our Quino detections.

Sentinel site surveys continued, even if sporadically, throughout the flight season until 2 consecutive visits returned no Quino observations. We assumed this indicated the approximate end of the flight season in a given area. The survey methods are more completely described in the *Western Riverside County MSHCP Biological Monitoring Program 2015 Quino Checkerspot Butterfly Survey Protocol*.

*Adult Quino Surveys*

Before departing for the field, surveyors uploaded a series of waypoints into their handheld GPS units delineating the center of each sampling station at an assigned survey site. Surveyors also took a map of the survey site to use in the field.

Once assigned a given survey site by the Quino Project Lead, surveyors were free to select sampling stations that they reasoned were more likely to be occupied by Quino based on a visual overview and previous knowledge of the area. Surveyors methodically searched for adult Quino within sampling stations giving preference to those portions that appeared more likely to support Quino (e.g., occurrence of host plants, suitable nectar sources, or hilltops where Quino are known to congregate). These surveys were not time-constrained; rather, surveyors spent as much time as required to search all potentially suitable habitat within a given sampling station. If Quino were observed, we recorded a waypoint using a Garmin GPS unit. All other necessary survey conditions identified for sentinel site surveys (e.g., temperature, time of day) applied to these surveys. In addition,

we recorded Quino behavior (e.g., nectaring, ovipositing) and substrate used (e.g., species of plant where the behavior was observed).

Even though the flight season was not very promising due to continuing drought conditions, we surveyed a total of 23 sites in 2015. We visited 3 sentinel sites on multiple occasions, 15 survey sites, and 5 scouting sites. With a few exceptions, most of the survey and scouting sites were visited only once or twice. Not all sampling stations at survey sites were visited due to the large spatial extent of some sites, the lack of suitable habitat, or inaccessibility of the station. Sampling stations were not resurveyed once we confirmed the presence of Quino.

### Training

All surveyors in 2015 had previously passed the USFWS Quino identification exam and had 2-8 years of experience surveying for Quino.

### Data Analysis

Data from 2015 will be mapped and used to track distribution trends over time with the objective of understanding spatial and temporal fluctuations in the Quino population within the Conservation Area.

## RESULTS

### Sentinel Site Visits

We observed adult Quino at all 3 of our sentinel sites in 2015 (Fig. 1). We did not observe any larvae in the 2015 season. Our first adult Quino was observed on 18 Feb and our last on 9 April (Table 1).

**Table 1.** Adult Quino checkerspot butterflies observed during sentinel site visits in the 2015 flight season.

| | Dates of Visits | | Total # of Visits | Dates Quino Observed | | Total # Quino Observed |
|---|---|---|---|---|---|---|
| **Sentinel Site** | **First** | **Last** | | **First** | **Last** | |
| Multi-Species Reserve | 6 Jan | 3 Apr | 11 | 18 Feb | 18 Feb | 1 |
| Oak Mountain | 22 Jan | 16 Apr | 8 | 26 Feb | 3 Apr | 22 |
| Tule Peak Road | 12 Feb | 4 May | 6 | 31 Mar | 9 Apr | 13 |

Christine Moen (*Riverside County Regional Park and Open-Space District*) conducted most of the visits to the Multi-Species Reserve (MSR) sentinel site. It wasn't until her fifth visit (18 February) that she spotted a Quino, the only individual found at the MSR sentinel site in 2015. Despite the presence of healthy stands of *Plantago erecta*, a major Quino host plant, at the site for the 3 weeks before and after the observation, no additional Quino were detected. After mid-March, the *Plantago* senesced and the site became very dry. Site visits to this location in 2015 were terminated after 2 additional unsuccessful surveys.

Of the 8 visits made to Oak Mountain, there was a 1-3 week gap in between these visits. After the first observation of 2 Quino on 26 February, we returned 12 March and detected 18 Quino. Our third visit was on 3 April at which time we observed only 2

Quino. The *Plantago erecta* was nearly all senesced and the site was quite dry by this date. We did survey Oak Mountain once per week after 3 April, but no Quino were detected during subsequent visits (Table 1).

Our new Tule Peak Road sentinel site was chosen from the most productive area for Quino sightings of our already established Winchester 700C site. This location has consistently produced Quino observations throughout our survey years. Two of the 6 visits made to this site resulted in observable Quino (31 March and 9 April). After 9 April we did not survey over a 3 week period, which most likely resulted in missed Quino observations. Our final surveys at this site were conducted over 2 consecutive weeks with no Quino observations, which concluded our season at this location. Because there were 3 week gaps in between surveys at the Oak Mountain and Tule Peak sentinel sites (due to personnel limitations) when the flight season appeared to be at or nearing a peak, we are not able to estimate what the total number of Quino might have been at these sites in 2015; however, we can reasonably assume the total population was greater than the total number of Quino we detected.

In summary, we observed 36 Quino over a total of 25 sentinel site surveys (Table 1). Of the 25 surveys, we were successful in detecting Quino during 6 surveys (24%), resulting in an average of 6 Quino per successful visit.

**Adult Quino Surveys**

Monitoring Program biologists observed Quino at 5 of the 15 (33%) established survey sites in western Riverside County in 2015 (Table 2). We surveyed 97 sampling stations at these 15 survey sites. A total of 26 Quino were detected: 10 individuals at MSR 1, 3 individuals at Magee Hills, 9 individuals at Horse Creek, 1 individual at Beauty Mountain, and 3 individuals at Winchester 700C (Fig. 2, Table 2).

No Quino were observed during our visits to 4 survey sites in the Warm Springs Creek Core Area (Table 2). In the last 8 flight seasons (2008-2015), we have not had a Quino detection in this Core Area (Appendix A), despite the presence of *Plantago erecta* in many areas. The Anheuser-Busch QCB scouting area has been surveyed 2 years (2013 and 2015), but so far there has been no success at this site either, despite the fact that it has good stands of Quino host plants, especially *Plantago erecta*.

On 13 March, we surveyed Magee Hills in the Sage Core, successfully locating Quino (Table 2). In 8 years surveying this site, we have been successful at detecting Quino 50% of the time (Appendix A). Although persistent, numbers of Quino are never high at this site, which is our only Sage Core Area site. Of our 3 MSR survey locations within the Johnson Ranch/Lake Skinner Core, only MSR 1 (northeast of Lake Skinner), produced Quino sightings in 2015. In fact, this location is now producing more Quino detections than our MSR sentinel site. The *Plantago erecta* is more numerous and robust at MSR 1 than the sentinel site at this time.

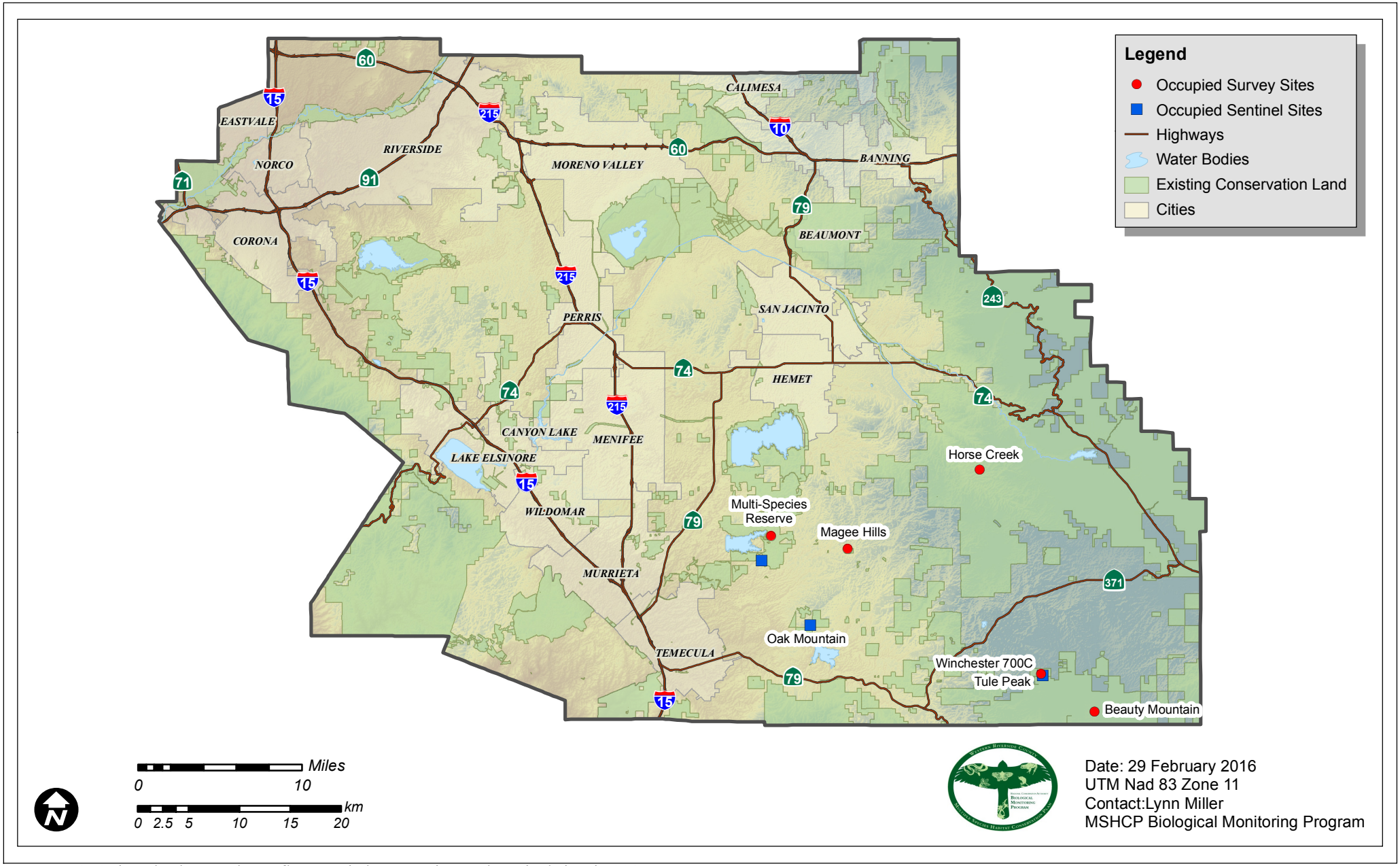


**Figure 2.** Quino checkerspot butterfly occupied survey sites and sentinel sites in 2015.

Within the Wilson Valley Core Area, we surveyed Wilson Valley 1, Wilson Valley 2, Winchester 700B, and a scouting site named Wilson Valley Road QCB. No Quino were sighted at any of these 4 sites, although these sites appear to offer suitable habitat for Quino occupation, and have supported populations in the past. That being said, the Wilson Valley 1 and 2 sites are becoming drier each year, especially Wilson Valley 1. Cacti are becoming more dominant (e.g. Cylindropuntia spp.) and the deciduous shrubs more stressed with each passing year. The *Plantago erecta* patches are fewer and the plants smaller. Of course, this situation could be reversed if and when the drought conditions end. We have detected Quino in this Core Area during 4 out of 8 survey years (50%; Appendix A), although they are usually few in number. We expanded our search area in this Core by adding a scouting site, but this did not result in additional Quino observations. In the past, areas adjacent to Wilson Valley Road have been quite reliable for Quino sightings.

**Table 2**. Occupancy of sampling stations at survey sites in 2015. Cumulative results for all core and non-core areas are in bold.

| Core Areas | No. of locations/stations | No. of Visits | No. of occupied locations/stations | No. of Quino |
|---|---|---|---|---|
| Survey Sites | | | | |
| **Warm Springs Creek** | **7** | **4** | **0** | **0** |
| Winchester 700A | 2 | 1 | 0 | 0 |
| McElhinney/Stimmel | 2 | 1 | 0 | 0 |
| Paloma Valley | 2 | 1 | 0 | 0 |
| Anheuser-Busch QCB* | 1 | 1 | 0 | 0 |
| **Sage** | **5** | **2** | **2** | **3** |
| Magee Hills | 5 | 2 | 2 | 3 |
| **Johnson Ranch/Lake Skinner** | **19** | **6** | **4** | **10** |
| MSR 1 | 6 | 3 | 4 | 10 |
| MSR 2 | 4 | 1 | 0 | 0 |
| MSR 3 | 9 | 2 | 0 | 0 |
| **Wilson Valley** | **18** | **6** | **0** | **0** |
| Wilson Valley 1 | 6 | 2 | 0 | 0 |
| Wilson Valley 2 | 9 | 2 | 0 | 0 |
| Winchester 700B | 2 | 1 | 0 | 0 |
| Wilson Valley Road QCB | 1 | 1 | 0 | 0 |
| **Silverado/Tule Peak** | **38** | **13** | **3** | **4** |
| Winchester 700C | 2 | 1 | 2 | 3 |
| Beauty Mountain | 18 | 5 | 1 | 1 |
| Anza-Borrego | 17 | 4 | 0 | 0 |
| Anza Knolls QCB | 1 | 3 | 0 | 0 |
| **Non-Core Areas** | | | | |
| **San Bernardino National Forest** | **16** | **5** | **2** | **9** |
| Horse Creek | 4 | 1 | 2 | 9 |
| SBNF | 10 | 2 | 0 | 0 |
| Rouse Hill Road QCB | 1 | 1 | 0 | 0 |
| San Jacinto Mtn South QCB | 1 | 1 | 0 | 0 |
| **Total** | **98** | **36** | **11** | **26** |

* Scouting site locations end in "QCB"

We surveyed 4 sites within the Silverado/Tule Peak Core Area: Winchester 700C, Beauty Mountain, Anza-Borrego, and Anza Knolls QCB. We observed 3 Quino at Winchester 700C (located approximately 400-500 m from our Tule Peak Road sentinel site) and only 1 Quino at the Beauty Mountain site despite 5 surveys at this location. No Quino were observed after 4 visits completed at the Anza-Borrego site and none observed at the Anza Knolls QCB over 3 visits (Table 2).

In the non-core area, San Bernardino National Forest, we surveyed Horse Creek once on 20 March and the SBNF site twice (24 March and 16 April). Of our regular sites, Horse Creek produced 9 adult Quino, second only to the MSR 1 site in regards to the number of Quino detected in 2015. In the light of recent publications stating Quino are believed to be colonizing higher elevation sites (Parmesan 2003), we surveyed 2 sites: Rouse Hill Road QCB (approx. 1665 m elev) and San Jacinto Mountain South QCB (approx. 1550 m elev). We did not find Quino at either of these sites, but Rouse Hill Road QCB does have an impressive variety of butterflies, with 4 species of swallowtails, including Edwards' Swallowtail (*Papilio indra pergamus*) a species rarely seen by Program biologists (Table 3). We did not find any Quino host plants at this location, but we have not surveyed the area extensively. Surveyors successfully detected Quino in the SBNF non-core area 6 out of 8 survey years, including in 2015 (Appendix A). Cactus Valley (Brown Canyon site) and Anza Valley were not surveyed in 2015 due to personnel limitations.

Observations in 2015 were relatively scarce everywhere surveyed, but more Quino were found this year than in 2014. A total of 62 adult Quino were observed in the entire Plan Area in 2015 in a 7-week period, from 26 February – 17 April. All of our observations were between the hours 10:00 – 14:30 with temperatures ranging between 20.5 – 29°C. We confirmed that adult Quino were present at 5 of 20 survey sites visited in 2015 (25%). Out of a total of 29 survey visits, we had 6 surveys with Quino observations (21%). Including our 5 scouting sites, we had a success rate of 18% (6 occupied sites out of 34). Four of 7 Core Areas were occupied (57%) – Sage, Johnson Ranch/Lake Skinner, Oak Mountain, and Silverado/Tule Peak Cores. The only other Core Area we reasonably expected Quino observations but did not detect any is the Wilson Valley Core. Every year, we attempt to locate Quino in the Warm Springs Creek Core Area without success. The Lake Mathews/Estelle Mountain/Harford Springs Core Area was last surveyed in 2012 as Quino appear to have been extirpated from this area, as previously noted.

Nectar plants were more numerous in 2015 than in 2014, which was an even drier year, and Quino host plant species were also more plentiful compared to last year at many survey sites. We noted *Plantago erecta* was more abundant and robust at the MSR 1 survey site than the MSR sentinel site. At the Beauty Mountain site, two important host plants, *Castilleja exserta* and *Collinsia concolor*, were present in the surveyed locations. The Tule Peak Road sentinel site had an abundance of *Collinsia concolor* and *Antirrhinum coulterianum*, the important host plants for Quino in this area. The Warm Springs Creek Core Area generally has an abundance of host plants, especially *Plantago erecta*, but no Quino have been documented there by the Monitoring Program between 2005 and 2015. Plants that we observed Quino utilizing as nectar sources were

*Calandrinia ciliata*, *Camissoniopsis bistorta*, *Chaenactis glabriuscula*, *Cryptantha* spp, *Layia platyglossa*, and *Pectocarya* spp.

**Table 3.** Butterfly species, listed by family, observed during 2015 survey efforts.

| |
|---|
| **Swallowtails (Papilionidae)** |
| Western Tiger Swallowtail (*Papilio rutulus*) |
| Pale Swallowtail (*Papilio eurymedon*) |
| Anise Swallowtail (*Papilio zelicaon*) |
| Edward's Swallowtail (*Papilio indra pergamus*) |
| **Whites and Sulphurs (Pieridae)** |
| Cabbage White (*Pieris rapae*) |
| Checkered White (*Pontia protodice*) |
| Becker's White (*Pontia beckerii*) |
| Spring White (*Pontia sisymbrii*) |
| Hyantis Marble (*Euchloe hyantis*) |
| Sara Orangetip (*Anthocharis sara*) |
| Cethura Orangetip (*Anthocharis cethura*) |
| Orange Sulphur (*Colias eurytheme*) |
| Harford's Sulphur (*Colias harfordii*) |
| Dainty Sulphur (*Nathalis iole*) |
| **Coppers, Hairstreaks, & Blues (Lycaenidae)** |
| Gray Hairstreak (*Strymon melinus*) |
| Hedgerow Hairstreak (*Satyrium saepium*) |
| Brown Elfin (*Callophrys augustinus*) |
| Perplexing Hairstreak (*Callophrys perplexa*) |
| Western Tailed-Blue (*Cupido amyntula*) |
| Silvery Blue (*Glaucopsyche lygdamus*) |
| Marine Blue (*Leptotes marina*) |
| Ceraunus Blue (*Hemiargus ceraunus*) |
| Bernardino Blue (*Euphilotes bernardino*) |
| Acmon Blue (*Plebejus acmon*) |
| **Metalmarks (Riodinidae)** |
| Behr's Metalmark (*Apodemia virgulti*) |
| **Brushfoots (Nymphalidae)** |
| California Patch (*Chlosyne gabbii*) |
| Chalcedon Checkerspot (*Euphydryas chalcedona chalcedona*) |
| Red Admiral (*Vanessa atalanta*) |
| American Lady (*Vanessa virginiensis*) |
| Painted Lady (*Vanessa cardui*) |
| West Coast Lady (*Vanessa Annabella*) |
| Common Buckeye (*Junonia coenia*) |
| **Skippers (Hesperiidae)** |
| Funereal Duskywing (*Erynnis funeralis*) |
| Mournful Duskywing (*Erynnis tristis*) |
| White Checkered-Skipper (*Pyrgus albescens*) |

# DISCUSSION

The flight season of Quino occurred at a fairly typical time at sentinel sites in 2015 (Table 1) and surveying began shortly thereafter. All the established survey sites were visited in 2015, with the exception of Brown Canyon in the Cactus Valley non-core area. It was decided that time and personnel were better spent on survey sites with a better chance of success. The 2015 flight season overall was more productive than 2014, but had the second fewest Quino observed at our sentinel sites in the last 7 years. The continuing drought conditions most likely contributed to this outcome. Year to date (01 July 2014 to 11 May 2015) rainfall in Temecula was 9 in. (22.9 cm), far short of the annual average for this area of 16 in. (40.6 cm; RCFCWCD 2015).

Distribution of Quino in 2015 was within the southern half of the Plan Area, bounded by Horse Creek to the northeast, Beauty Mountain to the southeast, and MSR sentinel site to the west. Of the sites surveyed in 2015, Winchester 700A and Anheuser-Busch QCB were the lowest elevation sites (approx. 400 m) and Rouse Hill Road QCB site was the highest (approx. 1665 m). The Quino sites in the western portion of the Plan Area are lower in elevation (400 m – 850 m) than the southeastern and eastern sites (925 m – 1665 m). Of the sites occupied by Quino in 2015 the lowest in elevation were the 2 MSR sites (approx. 500 m); next lowest were Oak Mountain and Magee Hills (approx. 800 m). The Horse Creek site was approx. 935 m in elevation, followed by the Tule Peak Road area at approx. 1300 m in elevation; the highest (approx. 1400 m) was the Beauty Mountain site.

The number of sampling stations surveyed per site varied due to the amount of accessible conserved land, the suitability of habitat within sampling stations, and the number of survey days available. Although no Quino were observed at 15 of the 20 survey sites in 2015, this does not preclude the possibility of Quino being present as not all potentially suitable habitat was surveyed. As with the Lake Mathews/Estelle Mountain/Harford Springs Core, the likelihood of any Quino being found in the Warm Springs Creek Core Area seems more remote with each subsequent year. We surveyed our 4 sites in this core (Table 2) with negative results, even though it has very suitable habitat. Future survey efforts in this core may be unproductive. Until there is sufficient reason to restart surveys in the Lake Mathews/Estelle Mountain/Harford Springs Core Area in the future (e.g., active relocations of butterflies, reported incidental observations) we will continue to exclude this area from our survey efforts (Appendix A). Quino were historically abundant in the Harford Springs subunit, but were last documented in Harford Springs Park in 1998 (Krofta and Anderson 2002).

While the protocol for monitoring sentinel sites is not directed at determining abundance, the significant difference in approximate total number of observed adult Quino at Oak Mountain compared to other sentinel sites has been consistent over the 10 years the Biological Monitoring Program has conducted surveys. This was once again true in 2015 (Table 1), although the number of Quino observed was relatively few throughout the Plan Area. As stated previously, due to personnel limitations the Oak Mountain and Tule Peak Road sentinel sites had a 3 week gap in between visits during the peak Quino flight season; it is likely that numbers of Quino were higher at these 2 sites than were observed.

The Quino flight season at Oak Mountain lasted 5 weeks, a much shorter flight season than is typical for the species. This appears to be attributable to the drier conditions at the site in 2015. The Monitoring Program has provided recent Quino location coordinates and maps to the Bureau of Land Management (BLM), who owns the Oak Mountain sentinel site location, to aid in site management. In 2012, BLM installed locked gates at the entrances to the site and erected signs to educate the public about Quino and this fragile and important ecosystem. This appears to have aided in the prevention of habitat degradation as less activity has been witnessed at this location since gate installation. Occasionally, members of the public have inquired about Quino presence on the mountain and how not to harm the species or their habitat as they walk through. This is an encouraging step toward a better educated and concerned public.

It is worth noting the MSR sentinel site had the highest number of survey visits out of the 3 sentinel sites, but produced only 1 Quino observation. It was the fourth year in a row of drought conditions and host plants were sparse at the MSR sentinel site. The sustained drought conditions in southern California were likely a primary factor contributing to relatively low abundances of any plants. It appears to be holding true that the MSR sentinel site is becoming drier as the drought continues. As a consequence, the present sentinel site is becoming less indicative of Quino occupancy than other areas of MSR (i.e., our MSR 1 survey site). Although Quino have not been observed by Monitoring Program biologists at MSR 2, located south of Diamond Valley Lake, this survey site was added in 2012 as a result of 3 adult Quino detected here in 2011 by Tom Ash, biologist (*Christine Moen, Riverside County Regional Park and Open-Space District, personal communication*). Because MSR 3 is a very large area to survey, and certainly not all of it is surveyed in any given year, we believe it is possible that we would detect Quino at this site if our survey efforts were greater, such as in 2009 when we detected >100 adult Quino in this area.

The Wilson Valley Core was not occupied in 2015. Only 1 Quino has been detected at our survey locations in this core in 4 survey years (Appendix A). Host plants, mainly *Plantago erecta*, were not abundant within this Core Area and senesced rapidly as the season progressed. Our survey results continue to suggest Quino are becoming scarcer in this area. Climate change appears to be adversely impacting this region as the hotter and drier climate of the last 4 years affects Quino's host plants and nectar sources.

The Silverado/Tule Peak Core Area continued to be occupied. We found a total of 17 Quino this flight season. This Core Area is at a higher elevation than others surveyed, possibly reinforcing the hypothesis that Quino populations may be shifting to higher elevations and declining at lower elevations.

## Recommendations

### *Future Surveys*

Both the extent of occupied area within each survey site and the number of occupied sites across the Conservation Area vary from year to year. Mapping the extent of occupied area within each survey site is more time-consuming, while determining the distribution of Quino across the Conservation Area as a whole is the more relevant

MSHCP monitoring goal. We will prioritize monitoring at the scale of the Conservation Area as a whole.

We should continue to monitor recently occupied sites and areas with apparently suitable habitat, or that are adjacent to known occupied habitat, with the same survey protocol employed in 2015. It seems appropriate to add the Anza Knolls QCB scouting site to our established survey sites as this area has been occupied by Quino in the past and is adjacent to a reliable source of Quino observations. We also believe it would be useful to survey the Aguanga area and other Wilson Valley areas as scouting sites. Quino continue to occupy the Wilson Valley Core, but our present sites do not appear to be the most suitable at this time. It is possible we are not surveying the area with the highest potential for Quino detections.

As climate change effects continue, we believe it is important to survey areas at higher elevations, such as Rouse Hill QCB (1700 m elevation), as these may serve as expansion areas for Quino populations no longer occupying habitats at lower elevations. Where Quino host plant locations are known, especially in the higher elevations, it may be useful to scout these areas for Quino occupancy. This could serve to increase our knowledge of range and population size of Quino.

It may be productive to scout our original Horse Creek site that we surveyed from 2006-2010 and found Quino. At present we survey an area north of the Horse Creek drainage where the Monitoring Program discovered a new, reliable location for Quino in 2011. Our present site is close enough in proximity to the original known location to be part of the same meta-population, but we have not surveyed the original site since that time. It would be interesting to know the status of this Quino population.

There is currently only 1 site surveyed in the Oak Mountain Core Area. It may be appropriate to add an additional survey site here, as this area has been one of our most productive for Quino.

Lastly, our Brown Canyon site should be included in 2016 surveys as this site is now accessible via vehicle due to new property acquisitions. According to knowledge gained by our past surveys, this area has very good potential for Quino occupancy, therefore it would be appropriate to survey numerous times in a flight season until we establish the present status of Quino at this location.

*Conservation and Management*

It is likely there are important differences in vegetative and other habitat conditions at occupied areas compared to unoccupied areas. It is also possible that some areas with habitats that are entirely suitable for Quino are not occupied due to barriers to dispersal, development projects, predator abundance, present drought conditions, or other factors preventing Quino from occupying the site. More research is needed to determine if the present restricted distribution of Quino is a condition that will persist or, if and when the continuing drought or other unfavorable conditions are relieved, Quino will re-occupy other areas with suitable habitat.

The Warm Springs Creek Core Area is being actively managed by the MSHCP Management Program to maintain suitable habitat (e.g. mowing to maintain low

vegetation cover) and decrease anthropogenic disturbance in this area (*Jonathan Reinig, RCA MSHCP Management Program, personal communication*). It may be appropriate to survey here at least once per season in an attempt to locate Quino. Although Quino appear to be extirpated from this Core at the present time, it is not unreasonable to believe Quino could re-populate this Core in the future if the habitat remains suitable.

*Core Area Definitions and Species Objectives*

Adding the San Bernardino National Forest to our Core Areas designation may be a worthy consideration for this species. Quino have been observed at 2 of our sites in this area, SBNF and Horse Creek, during several survey seasons.

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# Appendix A. **Core Area and satellite occurrence complex detections from 2008-2015**

| **Core Area** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| Lk Mathews/Estelle/ Harford Springs | 0* | 0 | 0 | 0 | 0 | -- | -- | -- |
| Warm Springs Creek | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Johnson Ranch/Lake Skinner | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Oak Mountain | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Wilson Valley | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| Sage | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| Silverado/Tule Peak | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Satellite Occurrence Complex (Non-Core Area)** | | | | | | | | |
| SBNF | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| Cactus Valley | 0 | 0 | 1 | 0 | 0 | 0 | -- | -- |
| Anza Valley | -- | -- | -- | -- | -- | 0 | -- | -- |

*no detections = 0, detections = 1, no surveys = --