Western Riverside County
Multiple Species Habitat Conservation Plan
Biological Monitoring Program

2014 Quino Checkerspot Butterfly
(*Euphydryas editha quino*)
Survey Report

26 May 2015

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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 2014 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 2014 Quino Project Lead, Lynn Miller. This report should be cited as:

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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 states that "within the MSHCP Conservation Area, Reserve Managers will document the distribution of Quino checkerspot on an annual basis" (Dudek & Associates 2003). Biological Monitoring Program biologists help obtain this objective by focusing annual surveys in areas that were occupied within the last five years. Species-specific objective 1 identifies seven Core Areas: Lake Mathews/Estelle Mountain/Harford Springs, Warm Springs Creek, Johnson Ranch/Lake Skinner, Oak Mountain, Wilson Valley, Sage, and Silverado/Tule Peak (Dudek & Associates 2003). Additional surveys are also conducted in satellite (non-core) occurrence complexes where Quino are or were known to occur, such as the southwestern portions of San Bernardino National Forest (SBNF), Anza Valley, and Brown Canyon.

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 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. Quino larvae can be recognized after their second molt by their black coloration and row of eight to nine orange tubercles on their back (USFWS 2003). These larvae are most typically observed feeding on host plants, particularly *Plantago erecta*.

The life cycle of Quino usually includes one generation of adults per year, with a four to six week flight period (Emmel and Emmel 1973). Females are mated soon after pupal emergence in the early to mid-spring, which in western Riverside is generally in February in the low elevation areas and March at higher elevations. The female then lays masses of approximately 20-350 eggs in clusters averaging about 50 eggs, on or near patches of host plants (Labine 1968). One or two egg clusters per day are laid for most of its 10 to 14 day adult life (Labine 1968). Eggs also hatch in 10 to 14 days (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 one or two 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 grasslands and shrublands that support the Quino checkerspot and its larval host plants dry rapidly in late spring, or earlier, if insufficient rains fell the previous autumn or winter. Mortality of pre-diapause larvae commonly exceeds 99% (White 1974) and is their most vulnerable stage.

If host plants persist, larvae grow through three instars, then as summer drought commences and their host plants senesce, they molt into a fourth instar and enter diapause. First and second instar larvae cannot enter diapause (Erlich and Hanski 2004). The larvae that successfully entered diapause will remain in this dormant state for

nearly nine 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 if conditions are not met for their breaking aestivation (USFWS 2003).

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).

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. The non-native plants, particularly the aggressive Mediterranean grasses and forbs, provided better forage for livestock and rapidly outcompeted and replaced most native grassland vegetation. If climate change causes increased drought or increased variability of rainfall timing patterns in southern California, the ties between prediapausal larvae growth and host plant senescence may contribute to further declines in Quino populations.

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 were to estimate the detection probability of adult Quino and to calculate the proportion of area occupied by Quino (MacKenzie et al. 2006). Survey goals in 2014 were to include monitoring the status of any locations with documented Quino populations within the last five years. The collection of covariate data, such as temperature, wind speed, host plant distribution, and nectar plant presence, aids our understanding of resource selection by Quino.

As a result of annual surveys through 2014 we have accumulated meaningful representations of the broad-scale (Conservation Area-wide) distribution of Quino, and the results of periodic more intensive 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 2014 survey year was conducted under severe drought conditions in all of the Quino-occupied areas.

In 2014, we employed an efficient survey protocol aimed at meeting the species-specific objective described above. We continued monitoring established sentinel sites, as understanding within- and among-year differences in the timing of the Quino flight season is important to most proficiently direct overall survey efforts. The 2014 flight

season was very short and constricted, as the drought in southern California continued to worsen as the season progressed.

Goals and Objectives

The goals and objectives for 2014 Quino surveys were as follows:

1. Monitor Quino populations at established sentinel sites.
    a. Track the flight season of Quino at sentinel sites to determine presence/absence of Quino larvae and/or adults, relative abundance, and available species-specific resources.
2. Monitor Quino populations in areas that were occupied within the last five years.
    a. Conduct presence/absence surveys within suitable habitat at previously identified sites.
    b. Survey areas with known Quino populations to determine if sites are still occupied and extent of occupation.
    c. Map observations to track current distribution of Quino within the Conservation Area.

METHODS

Sentinel Site Visits

Quino typically have a four to six week flight period beginning from late January and continuing to early May (USFWS 2003). This is the time period we conduct our surveys. 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, to track Quino habitat conditions on-site including host plant distribution and abundance, and to monitor available nectar plants that Quino feed on.

As in previous years, we monitored three sentinel sites: Southwestern Riverside County Multi-Species Reserve (MSR), Oak Mountain, and Anza (Fig. 1). The Anza site is located on Bureau of Land Management (BLM) land just south of our previous sentinel site called Silverado Ranch. We believe these sites are geographically representative of the current distribution of Quino within the existing Conservation Area.

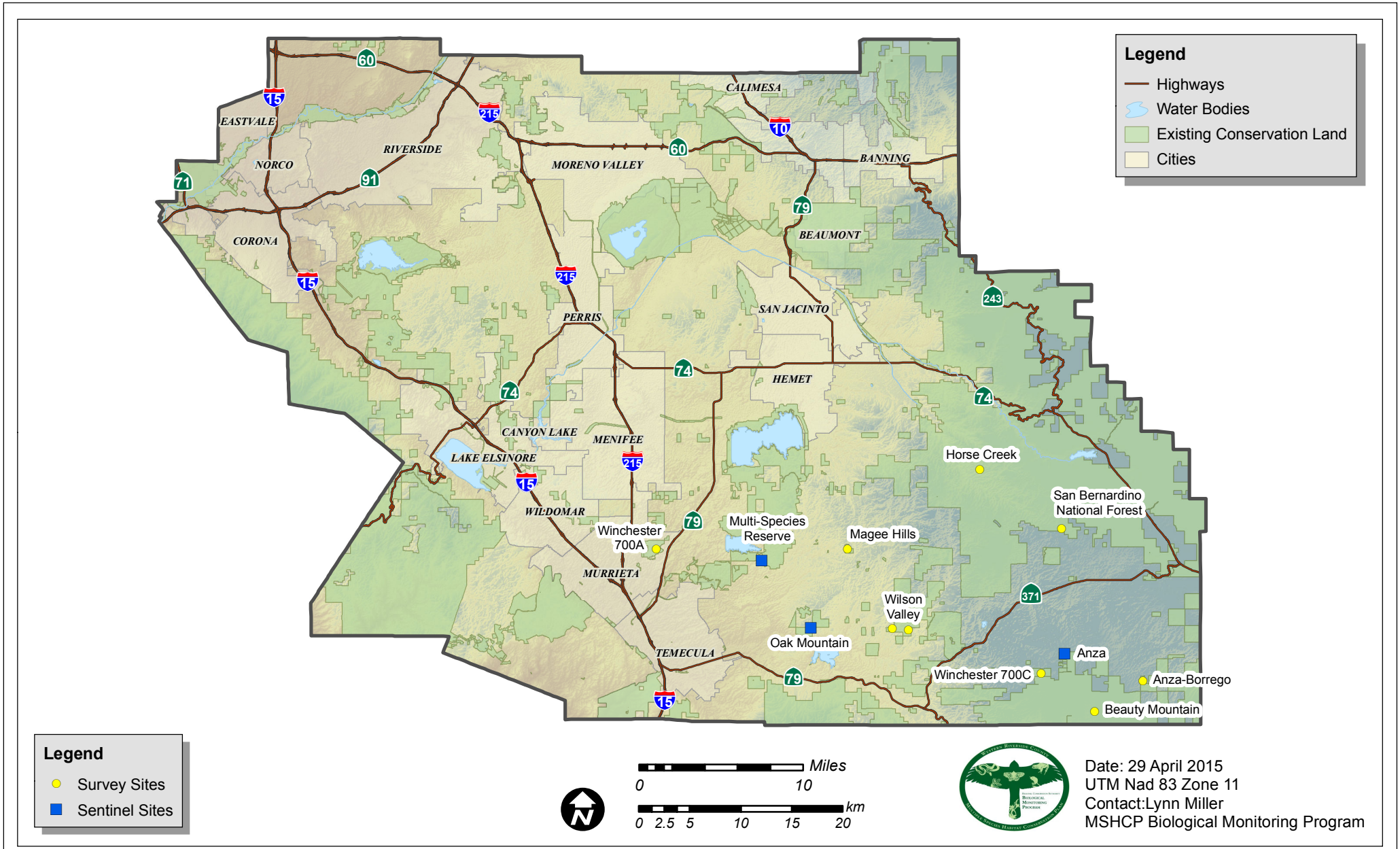

Figure 1. Quino checkerspot butterfly survey sites and sentinel sites in 2014.

Sentinel site visits commenced when spring conditions developed (i.e., sunny days with temperatures above 15 ºC). Surveyors visited each sentinel site to determine the presence/absence of Quino larvae or adults, and the commencement of the adult flight season. If Quino larvae are observed, adult Quino are typically seen on-site within 2-4 weeks.

Sentinel sites are defined by a single set of coordinates, but surveyors visit 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 >15 ºC on a clear, sunny day or >21 ºC on an overcast or cloudy day, and with sustained wind speeds ≤24 km per hr as measured 1.2–1.8 m above ground level. Sustained wind is 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 two 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 two 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. Visits are limited to no more than once per week to minimize impacts on the resources.

In previous years, sentinel site surveys would continue throughout the flight season until two consecutive visits returned no Quino observations. We assumed this indicated the approximate end of the flight season in a given area. In 2014, we did not follow this procedure as the flight season was almost non-existent, as described below. For a more complete description of survey methods see the *2014 Western Riverside County MSHCP Biological Monitoring Program Quino Checkerspot Butterfly Survey Protocol*, available from the Biological Monitoring Program.

Adult Quino Surveys

In 2014 we surveyed sampling stations for presence/absence of adult Quino at nine survey sites. Survey sites vary in spatial extent but generally contain several sampling stations. There may be just one, or several, survey sites within a given Core Area, or within a geographical area outside of MSHCP-listed Core Areas. Seven survey sites were visited in four of the seven Core Areas: Winchester 700A (Murrieta), Magee Hills, Wilson Valley 1, Wilson Valley 2, Winchester 700C (Tule Peak), Beauty Mountain, and Anza-Borrego (Fig. 1).

Of the three remaining Core Areas, Johnson Ranch/Lake Skinner and Oak Mountain had sentinel sites that were surveyed, and no surveys were conducted at the Lake Mathews/Estelle Mountain/Harford Springs Core Area. Quino have never been observed in the Lake Mathews/Estelle Mountain/Harford Springs Core Area by Monitoring Program biologists and are believed to have been extirpated from that area.

Two of the nine sites surveyed in 2014 were not in designated Core Areas. Adult Quino have been observed at both sites within the last five years. These sites were within the San Bernardino National Forest (SBNF): Horse Creek (off of Bautista Rd) and a site specifically named SBNF that is approximately halfway between Cahuilla Mountain and Thomas Mountain. The SBNF site is referred to as a satellite occurrence complex in the MSHCP (Dudek & Associates 2003).

We overlaid a grid of 250 m × 250 m squares using Arc GIS (ESRI 2009) at Quino survey sites. The number of squares (i.e., sampling stations) at each survey site was variable depending on heterogeneity of the landscape and extent of suitable habitat. For all of the survey sites in 2014, we revisited sampling stations that had been established in previous years.

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., with 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 as described above (e.g., temperature, time of day) also applied to these surveys. In addition, we recorded Quino behavior and substrate used.

Most sites in 2014 were surveyed only one time during this short flight season. Not all sampling stations at survey sites were visited in 2014 due to the large size of some sites, the lack of high quality habitat, or inaccessibility of particular sampling stations. Sampling stations were not resurveyed once we confirmed the presence of Quino.

Training

All surveyors in 2014 had previously passed the USFWS Quino identification exam and had two to seven years experience surveying for Quino.

Data Analysis

Data from 2014 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 two of three sentinel sites in 2014 (Table 1). We did not observe larvae in the 2014 season at any of our sites. It was not until April that we had any Quino sightings at all, and then very few (Table 1).

Table 1. Adult Quino checkerspot butterflies observed during sentinel site visits in 2014.

	Dates of Visits		Total # of Visits	Dates Quino Observed		Total # Quino Observed
Sentinel Site	**First**	**Last**		**First**	**Last**	
Multi-Species Reserve	16 Dec	03 Apr	4	-	-	0
Oak Mountain	30 Dec	15 Apr	7	03 Apr	15 Apr	4
Anza	07 Mar	10 Apr	2	10 Apr	10 Apr	2

Visits to the MSR sentinel site were conducted by Reserve Manager Christine Moen on 16 Dec, 07 Jan, 07 Mar, and 03 Apr 2014 with no success. We surveyed the Oak Mountain sentinel site every three weeks at the start of the season, then approximately every two weeks. Quino were only observed on the last two visits in April (Table 1). Three Quino were detected on 15 Apr which was also our last visit there due to time constraints. Therefore, we cannot state with confidence when the flight season ended on Oak Mountain in 2014. The same can be said for the Anza sentinel site where we observed Quino only on the last visit of the season (Table 1). Due to the late emergence of Quino in 2014, once adults were observed at sentinel sites, we prioritized surveys at other nearby survey areas to attempt to confirm other occupied areas before the season ended.

Adult Quino Surveys

Monitoring Program biologists surveyed 29 sampling stations at nine survey sites in western Riverside County in 2014 (Table 2). Only Beauty Mountain was confirmed as occupied with just one adult Quino observed on 22 Apr 2014 (Fig. 2).

No Quino were observed on our 27 Mar visit to survey site Winchester 700A in the Warm Springs Creek Core (Table 2). In the last seven flight seasons (2007-2014), we have not observed Quino in this Core (Table 3), despite healthy patches of *P. erecta* being present.

On 21 Jan and 25 Mar, we surveyed Magee Hills in the Sage Core (Table 2). We anticipated success as last year 12 Quino were observed in this area, but none were observed in 2014.

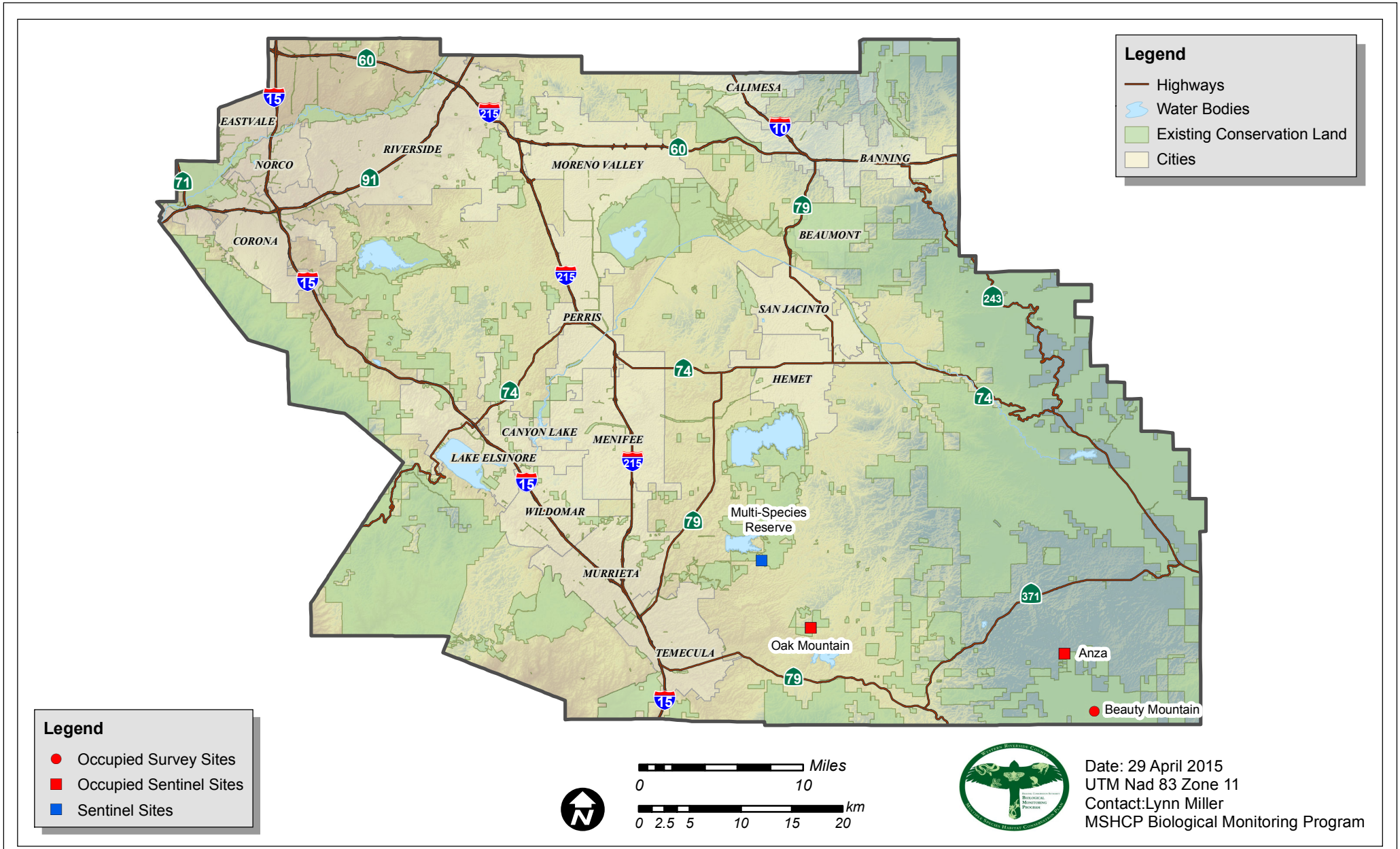

Figure 2. Quino checkerspot butterfly occupied survey sites and sentinel sites in 2014.

Table 2. Occupancy of sampling stations at survey sites in 2014. Cumulative results for all core and non-core areas are in bold. Site-specific observations are listed according to core and non-core areas.

Core Areas Survey Sites	**Number of stations or locations surveyed**	**Number of visits**	**Number of occupied stations or locations**
Warm Springs Creek	**2**	**1**	**0**
Winchester 700A	2	1	0
Wilson Valley	**4**	**2**	**0**
Wilson Valley 1	2	1	0
Wilson Valley 2	2	1	0
Sage	**8**	**2**	**0**
Magee Hills	8	2	0
Silverado/Tule Peak	**8**	**3**	**1**
Winchester 700C (Tule Peak)	2	1	0
Beauty Mountain	4	1	1
Anza-Borrego	2	1	0
Non-Core Areas Survey Sites			
San Bernardino National Forest	**7**	**2**	**0**
Horse Creek	1	1	0
SBNF	6	1	0
Total	**29**	**10**	**1**

Within the Wilson Valley Core, we surveyed two separate locations on 28 Apr. No Quino were sighted in either area, although we have observed Quino in Wilson Valley as recently as 2013 and these sites appear to continue to offer relatively good habitat. It is very possible the timing of our visit was past the peak of the flight season as many of the host plants and nectar sources were desiccated. We have found the *Plantago* patches at these sites to be relatively small in the last five years, presumably due to drought conditions. We have detected Quino in the Wilson Valley Core in four out of the last seven survey years, although usually few in number (Table 3).

We surveyed three sites in the Silverado/Tule Peak Core in 2014: Anza-Borrego on 19 Mar, Winchester 700C (Tule Peak) on 10 Apr, and Beauty Mountain on 22 Apr. As stated above, we only found one Quino at Beauty Mountain. On 10 Apr we observed two Quino at the Anza sentinel site, which is the same day we visited Winchester 700C, less than 3 km away, but didn't find any Quino.

Outside of Core Areas, in the San Bernardino National Forest, we surveyed Horse Creek on 09 May and the site near Thomas Mountain we call "SBNF" on 02 May. We did not observe Quino at either location in 2014 (Table 2).

Table 3. Core Area and satellite occurrence complex detections from 2008-2014. (0: no detections; 1: detections; --: no surveys).

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

We confirmed that adult Quino were present at only one of nine survey sites visited in 2014 (11%). Two of seven Core Areas were occupied (29%): Oak Mountain and Silverado/Tule Peak. Quino were detected during four out of a total 23 surveys conducted in 2014 (17%). For the first time since 2007, no Quino were detected in the Johnson Ranch/Lake Skinner Core (Table 3). The Lake Mathews/Estelle Mountain/Harford Springs Core Area was dropped from our surveys in 2013 as Quino appear to have been extirpated from this area. No Quino were observed by Monitoring Program biologists during surveys in this core from 2005-2012, nor have any been reported by other field surveyors. We have surveyed extensively in the Warm Springs Creek Core Area without finding Quino in the last seven flight seasons (Tables 2 and 3). The distribution of Quino in 2014 ranged from Oak Mountain to the west (~ 800 m) and Beauty Mountain to the southeast (~ 1,400 m).

Of all the sites surveyed in 2014, Winchester 700A was the lowest elevation site at 400 m and Beauty Mountain the highest. The Quino sites in the western portion of the Plan Area are all lower in elevation (400 m – 850 m) than the southeastern and SBNF sites (900 m – 1,400 m).

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 nine of the 12 combined survey and sentinel sites in 2014, this does not preclude the possibility of Quino being present. Surveys of these sites were limited due to the drought conditions and extremely low numbers of observable individuals at even the most dependable survey sites. It is likely that most larvae stayed in diapause. However, the probability of any Quino being observed in either the Warm Springs Creek or Lake Mathews/Estelle Mountain/Harford Springs Core Areas seems more remote with each subsequent year.

Two Core Areas, Sage and Wilson Valley, do not produce Quino detections every year, and neither did this year (Table 3). The Wilson Valley Core Area has good apparent habitat for Quino and has been historically occupied, but observations in recent years have been declining, both in the number of successful surveys and total number of Quino detected.

Quino are reliably observed most years in the three remaining Core Areas: Johnson Ranch/Lake Skinner, Oak Mountain, and Silverado/Tule Peak. However, no Quino were detected at the Lake Skinner core this 2014 flight season. The Multi-Species Reserve sentinel site was the only site visited in the Lake Skinner core this year (Table 1).

Surveyors were successful with the SBNF non-core area in five out of seven survey years, but not this latest one (Table 3). Cactus Valley (Brown Canyon site) and Anza Valley were not surveyed. Again, observations in 2014 were extremely scarce, with a total of seven Quino observed in the entire Plan Area: four at the Oak Mountain sentinel site, two at the Silverado/Tule Peak sentinel site, and one at the Beauty Mountain site.

Surveyors noted host plant species and nectar plant availability, and assessed habitat suitability in general when surveying. Nectar plants did not appear to be as numerous at many sites in 2014 as in wetter years, and Quino host plant species were not found at many survey sites. The one Quino observed at Beauty Mountain was in a sampling station where no host plants were located, suggesting that host plants were present in the surrounding area. During previous surveys, host plants have been located in this area, especially *Castilleja exserta* and *Collinsia concolor*. The Warm Springs Creek Core Area generally has an abundance of host plants, especially *P. erecta*, but no recent Quino observations.

DISCUSSION

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 years. This was once again true in 2014 (Table 1), although the total number of Quino observed was extremely few throughout the Plan Area, and the effort at sentinel sites varied.

The Oak Mountain sentinel site is owned and managed by the BLM. The Monitoring Program has provided recent Quino location coordinates and maps to BLM 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 we have witnessed less activity at this location since gate installation. Occasionally, members of the public have inquired about Quino 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.

Host plants were very sparse at the MSR sentinel site in 2014. On 07 January, it was noted the site was extremely dry, without even grasses growing. The sustained drought conditions in southern California were likely a primary factor contributing to relatively low abundances of any plants. It was the third year in a row of drought conditions.

As it is our normal protocol to visit adult survey sites only after Quino have been detected at the corresponding sentinel sites, and Quino were not detected at any of the sentinel sites until early April, not all established survey sites were visited in 2014. With very limited time, personnel were dispatched to survey sites with the best presumed chance of success. Therefore, we did not visit two of the Warm Springs Creek survey sites where Quino have not been found since Monitoring Program surveys began in 2005. Brown Canyon in Cactus Valley was also omitted from 2014 surveys, as only one Quino was detected here in 2010 and the likelihood of detecting Quino at that site in a year with such a limited flight season seemed extremely remote. The three sites in the Johnson Ranch/Lake Skinner core: MSR 1, 2, and 3, were not surveyed as no Quino were detected at the MSR sentinel site.

The Warm Springs Creek Core Area once again appears to be unoccupied. The Winchester 700A site was surveyed again in 2014 with negative results, even though it appears to support suitable habitat. Future surveys efforts in this core may be suspended unless new land is conserved or there is reason to believe that Quino is present again.

Until there is a 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 the area from our survey efforts (Table 3). Quino were historically abundant in the Harford Springs subunit, but were last documented in Harford Springs Park in 1998 (Krofta and Anderson 2002).

The Wilson Valley core was not occupied (Table 3). Just one Quino has been observed by our biologist in the core in the last three survey years. Host plants, mainly *P. erecta*, were not abundant and senesced rapidly as the season progressed. Our survey results suggest Quino are becoming scarcer in this area. Climate change may be adversely impacting this region as the hotter and drier climate of the last three years affects Quino's host plants and nectar sources. As stated by Parmesan (1996): "The host plants on which Edith's checkerspot larvae feed may be senescing sooner, starving the insects before they can become adults. As a result, the checkerspot's range has shifted north by approximately 63 miles, perhaps threatening the southern subspecies, Quino."

The Silverado/Tule Peak Core Area continues to be occupied, but in 2014 only at the Anza sentinel site and Beauty Mountain site. At ~ 1,400 m, survey sites in this core are at higher elevation than others surveyed, reinforcing the hypothesis that Quino populations may be moving to higher elevations and possibly in decline at lower elevations.

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 prioritize monitoring at the scale of the Conservation Area as a whole, but attempt to supplement this with the finer scale site-level monitoring every five to eight years.

Recommendations

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 habitat that is potentially suitable for Quino are not occupied due to barriers to dispersal, predator abundance, present drought conditions, or other factors preventing Quino from occupying the site. More research is needed to determine if the present distribution of Quino will persist or if and when the continuing drought or other unfavorable conditions are relieved, Quino will re-occupy additional areas with suitable habitat.

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 2014. We also plan to scout two additional areas in 2015 named Aguanga West QCB and San Jacinto Mountains South QCB. Both locations serve to expand our potential survey area; San Jacinto Mountains South QCB will be the farthest southeast survey site in the San Bernardino National Forest. As climate change effects continue, we believe it is important to survey areas at higher elevations, such as Rouse Hill QCB at ~ 1,700 m, as these may serve as population expansion areas for Quino.

We should re-evaluate our approach to two of the areas we have surveyed regularly. Quino appear to be absent from the Warm Springs Creek Core Area. Even though Warm Springs Creek was surveyed this year, once again, no Quino were detected by our program. It may be reasonable to reduce or eliminate the surveys in this area. Secondly, in the Cactus Valley non-core area, just one Quino adult was observed in Brown Canyon in six survey years, suggesting that Quino are extremely scarce if still present at all. Given this uncertainty we recommend that the site either be surveyed thoroughly numerous times in order to have a high confidence of detecting individuals if they are there, or excluded from surveys to focus on other areas more likely to be occupied. However, if conditions for a strong flight season appear to be developing, these areas should be thoroughly monitored to determine if Quino are re-establishing populations at these locations.

ACKNOWLEDGEMENTS

Funding for the Biological Monitoring Program is provided by the Western Riverside Regional Conservation Authority and the California Department of Fish and Wildlife. Program staff who conducted surveys in 2014 were Lynn Miller (Project Lead), Esperanza Sandoval, and Ana Sawyer. We thank the land managers in the MSHCP Plan Area, who in the interest of conservation and stewardship facilitate Monitoring Program activities on the lands for which they are responsible.

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