Western Riverside County
Multiple Species Habitat Conservation Plan
Biological Monitoring Program

2018 Quino Checkerspot Butterfly
(Euphydryas editha quino)
Survey Report

29 March 2019

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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 2017 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 2018 Quino Survey Lead, Esperanza Sandoval. This report should be cited as:

Biological Monitoring Program. 2019. Western Riverside County MSHCP Biological Monitoring Program 2018 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 states that "within the MSHCP Conservation Area, biologists will document the distribution of Quino checkerspot throughout the Plan Area on an annual basis" (Dudek & Associates 2003). Biological Monitoring Program biologists attempted to meet this objective by focusing surveys within the six 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). The Lake Mathews/Estelle Mountain/Harford Springs Core Area was historically occupied by Quino but the species is now extirpated (Dudek & Associates 2003) and surveys were not conducted there in 2018. Additional surveys were conducted in two satellite (non-core) occurrence complexes where Quino are known to currently or historically occur: the southwestern portions of the San Bernardino National Forest (SBNF) and 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). A diagnostic characteristic of the adult Quino is the orange stripes (rather than white) across the top of the abdomen and the absence of white spots. Quino larvae can be recognized after their second molt by their black coloration and row of between eight and nine 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 one generation of adults per year, with a four to six week flight period (Emmel and Emmel 1973). Females mate soon after pupal emergence in 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 two egg clusters per day are laid for most of the butterfly's ten to 14 day adult life (Labine 1968). The grass- and shrublands that support the Quino checkerspot and its larval host plants dry rapidly in late spring, but drying may occur earlier in the absence of sufficient autumn or winter precipitation. The pre-diapause phase is the most vulnerable, and larval mortality commonly exceeds 99% (White 1974).

If host plants persist, larvae grow through three instars. 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 nine months. When host plants germinate the next spring in response to late autumn or winter rains, larvae break diapause and, if rains were sufficient, feed to maturity as solitary individuals. If rainfall was meager, it is believed many of the larvae feed for a few days and re-enter diapause (Singer and Parmesan 2010). Quino are likely to be found in barren spots surrounded by low-growing vegetation, especially their host plants and nectar sources. In Riverside County, the

largest populations are found in coastal sage scrub habitat and in openings in redshank (*Adenostoma sparsifolium*) chaparral vegetation communities.

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 Mediterranean grasses and forbs, provided better forage for livestock and rapidly outcompeted and replaced most native grassland vegetation (Seabloom et al. 2003). Thus, the butterfly's native 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.

The primary purpose of our Quino surveys is to monitor persistence of known populations and to ascertain the distribution of the species within apparently suitable habitat in the Conservation Area. Although we are not able to make an exhaustive search of this entire area, we endeavor to document the status of Quino at all of our established sites, and, as time and personnel allow, expand our search to include other suitable or potentially suitable habitat. As a result of annual surveys through 2018 we have gained a better understanding of the overall distribution of Quino in our Conservation Area, as well as the relative stability of Quino populations (i.e., which locations continue to regularly support adult Quino and which locations had lower numbers of observed Quino).

Goals and Objectives

1. Monitor Quino populations at sentinel sites.
    a. Determine the timing of the Quino flight season by surveying sentinel sites within 250 m x 250 m sampling station(s) to confirm presence/absence of Quino larvae and/or adults and their abundance.
    b. Track habitat conditions and species-specific resources on site.

2. Monitor Quino populations in areas with suitable habitat, with priority given to locations 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 the extent of occupation.
    c. Survey new areas with suitable habitat within designated critical habitat for Quino and surrounding areas.
    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. Survey goals in 2018 included monitoring the status of any locations with documented Quino populations within the last ten years. In addition to this goal, we monitored sites with historical Quino sightings and/or good potential for Quino occupancy in Core Areas, such as the Warm Springs Creek area. 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

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. Sentinel surveys occurred at sites which were geographically representative of the current distribution of Quino within the existing Conservation Area. We used ArcGIS (ESRI 2009) to delineate a 250 m x 250 m sampling station at each sentinel site. Sentinel site locations were: Southwestern Riverside County Multi-Species Reserve (MSR) in the Johnson Ranch/Lake Skinner Core Area; Oak Mountain in the Oak Mountain Core Area; and a site near Tule Peak Road in the Silverado/Tule Peak Core Area (Fig. 1). We assigned two sampling stations at the Oak Mountain sentinel site and one sampling station at both the MSR and Tule Peak Road sentinel sites.

Adult Quino Survey Sites

In addition to the sentinel sites, surveys for adult Quino were conducted throughout six Core Areas: Warm Springs Creek Core Area, Sage Core Area, Johnson Ranch/Lake Skinner Core Area, Oak Mountain Core Area, Wilson Valley Core Area, and Silverado/Tule Peak Core Area (Fig. 1). The Lake Mathews/Estelle Mountain/Harford Springs Core Area was not surveyed as Quino do not currently occupy this core. Using ArcGIS (ESRI 2009) we employed a grid of 250 m × 250 m sampling stations overlaid upon potentially suitable habitat in each Core Area. The number of sampling stations surveyed was variable depending on such factors as the degree of difficulty traversing the terrain, extent of suitable habitat, and the density of Quino in each sampling station.

Aside from the Core Areas surveyed, there were two non-core satellite occurrence complexes (Dudek & Associates 2003) surveyed in 2018: San Bernardino National Forest and Cactus Valley. As our understanding of Quino habitat suitability and knowledge of Quino occupancy evolves, and as Quino populations shift over time, more study areas may be added in subsequent years.

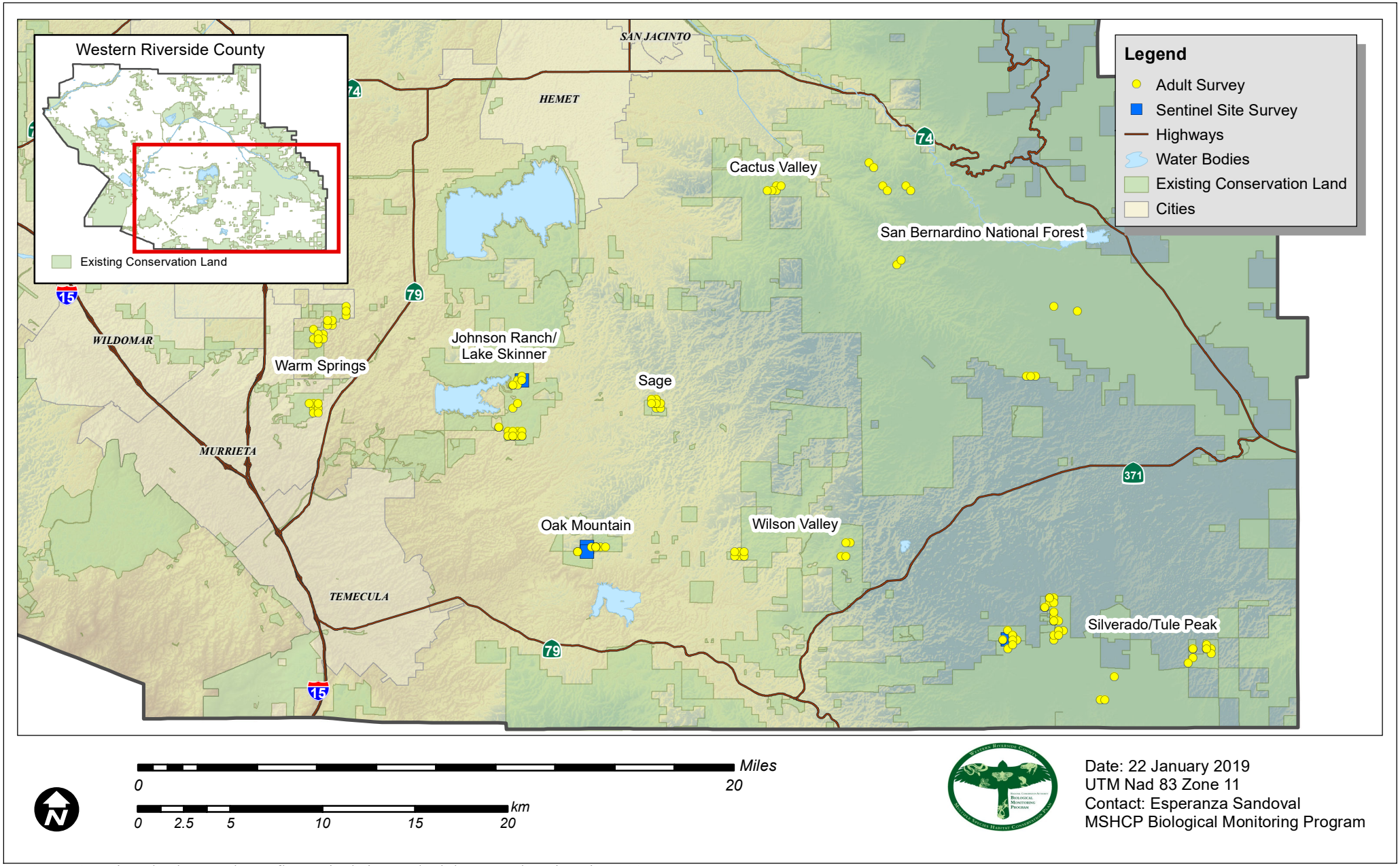

Figure 1. Quino checkerspot butterfly sentinel sites and adult survey locations in 2018.

Survey Methods

Sentinel Site Visits

The primary purpose of sentinel site monitoring is to determine the timing of the Quino flight season at their most productive sites, which helps efficiently direct overall survey efforts. Secondary purposes are to track Quino habitat conditions on-site, including host plant distribution and abundance, and to document presence of Quino larvae, thus confirming Quino reproduction.

Surveys for Quino began in late February and continued through late May (USFWS 2003), and were timed to coincide with their four to six week flight period. 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 two to four weeks.

Before departing to the field, surveyors uploaded waypoints into their handheld GPS units delineating the center of each sampling station at an assigned sentinel site. We conducted surveys between the hours of 0930 and 1600 when temperatures in the shade at ground level were >15°C on a clear, sunny day or >21°C on an overcast or cloudy day, and with sustained wind speeds ≤ 24 km/h as measured 1.2–1.8 m above ground level (approx. chest height). Sustained wind was determined by averaging observed values over a 1-minute period. We did not conduct surveys when there was fog or precipitation.

Unless the above conditions precluded a sentinel survey, the surveyor spent at least one hour searching the sampling station. Surveyors recorded number of Quino larvae and/or adults detected, host plant status, available nectar sources, co-occurring butterflies, weather conditions, and start and end time. Surveyors thoroughly covered each sentinel site using their knowledge of Quino ecology to maximize opportunities for detection. For instance, they spent time visiting hilltops and sandy washes, looking through patches of host plants, and scanning areas of flowering plants as part of the search effort.

Because Quino is a federally listed endangered species and because these sentinel sites represent some very good 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. In 2018, due to lack of time and personnel, we conducted fewer return visits than in previous seasons, but visits were strategically timed to gain information on the commencement of the Quino flight season. We conducted sentinel site surveys until host plants had senesced or Quino were no longer detected. The survey methods are more completely described in the *Western Riverside County MSHCP Biological Monitoring Program 2018 Quino Checkerspot Butterfly Survey Protocol*.

Adult Quino Surveys

The primary purpose of adult Quino surveys is to monitor persistence of known populations and to ascertain the distribution of the species within suitable habitat in the

Conservation Area. The secondary purpose is to collect sufficient environmental data that may contribute to a better understanding of any additional factors that influence the distribution, occurrence, and detectability of the species.

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 Survey Lead, surveyors were free to select sampling stations that they reasoned were more likely to be occupied by Quino based on a visual overview of habitat and previous knowledge of the area. All other necessary survey conditions identified for sentinel site surveys (e.g., temperature, time of day) applied to these surveys. 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; open areas, such as trails or washes; hilltops where Quino are known to congregate). These surveys were time-constrained to 45 minutes per sampling station to increase the amount of area surveyed per day. If Quino were observed, we recorded a waypoint using a Garmin GPS unit and documented Quino behavior (e.g., nectaring, ovipositing) and substrate used (i.e., species of plant where the behavior was observed). 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 or the lack of suitable habitat. Sampling stations were not resurveyed once we confirmed the presence of Quino.

Training

All surveyors had previously passed the USFWS Quino identification exam and had between five and eleven years of experience surveying for Quino. Additionally, surveyors had demonstrable experience identifying the six plant species currently recognized as Quino host plants (USFWS 2003; *G. Pratt, personal communication*): *Plantago erecta* (California plantain), *P. patagonica* (woolly plantain), *Castilleja exserta* (purple owl's clover), *Sairocarpus coulterianus* (Coulter's snapdragon), *Collinsia concolor* (Chinese houses), and *Cordylanthus rigidus* (bristly bird's beak).

Data Analysis

Data resulting from 2018 surveys were mapped and will be 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

We surveyed from 28 February until 30 May. Our first sighting was of seven adult Quino on 9 March at the Multi-Species Reserve. Our last sighting was of one adult Quino on 23 May at the Silverado/Tule Peak Core area. We detected a total of 79 individual Quino (Fig. 2). Out of 148 surveys completed, we detected Quino during 33 of those visits (22%). Our Quino observations occurred between the hours of 0940 – 1452, with temperatures ranging between 12.2 – 30°C. We recorded wind speeds during successful surveys between 0.9 – 8.6 km/h (average = 1.2 – 2.0 km/h). Skies were clear for 58% of the surveys.

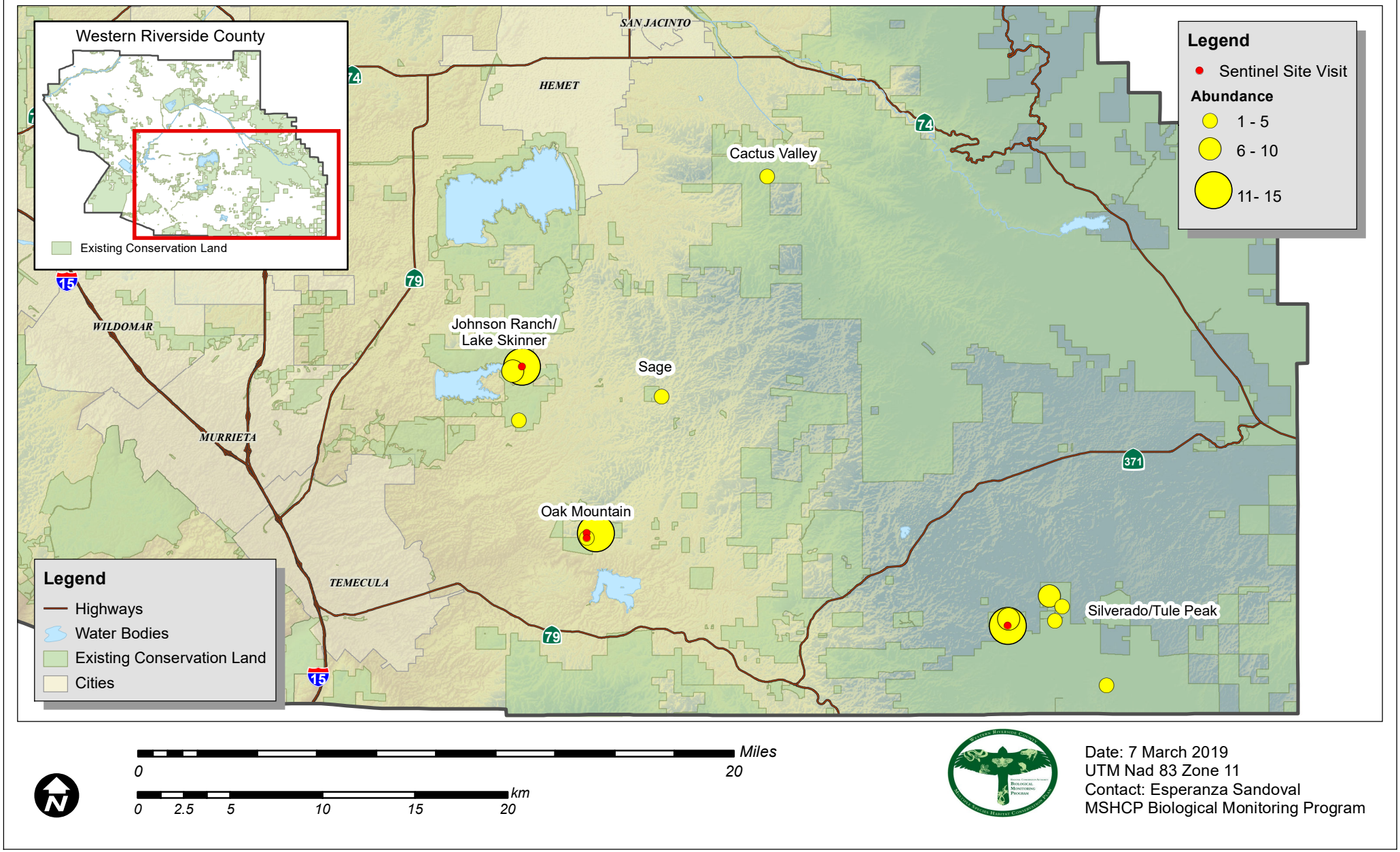

Figure 2. Quino checkerspot butterfly abundance at occupied sentinel sites and adult survey sites in 2018. Includes data contributed by Riverside County Regional Park and Open-Space District.

Sentinel Site Surveys

We observed Quino at all three sentinel sites in 2018. Of the 16 surveys (*n* = 12 visits) we conducted at our three sentinel sites, we detected adult Quino during seven surveys (44%; Table 1). The Biological Monitoring Program visited the Multi-Species Reserve sentinel site twice and observed ten adult Quino and an abundance of *Plantago erecta*, a host plant. Five Quino were observed during a third visit to the site in mid-March (*Robert Williams, Natural Resources Manager, MSR, personal communication*).

In the past, the Oak Mountain Core Area had a single sentinel site sampling station that included the whole Oak Mountain Core; this year, two specific 250 m x 250 m sampling stations in Oak Mountain were designated as sentinel sites. We made six visits to these sites in 2018 and observed Quino on two visits, 27 March and 13 April (*n* = two adult quino on each day). The *Plantago* patches this spring were large and healthy, but senesced by late April. The *Lepidium nitidum* (shining pepperweed), which is suspected to compete with other plants considered beneficial to Quino, was also present but not as dense and robust as it had been in 2017.

We visited the sentinel site in the Silverado/Tule Peak Core Area four times in 2018. We observed adult Quino during three visits conducted on 3, 16 and 23 of May (*n* = eight, two, and one Quino, respectively). A quino host plant, *Collinsia concolor,* was scattered throughout the sentinel site and three adult Quino were seen nectaring on *Ericameria linearfolia*.

Table 1. Adult Quino checkerspot butterflies observed during sentinel site visits during the 2018 flight season.

	Dates of Visits		Total # of Visits	Dates Quino Observed		Total # Quino Observed
Sentinel Site	**First**	**Last**		**First**	**Last**	
Multi-Species Reserve	9 Mar	26 Mar	3*	9 Mar	26 Mar	15*
Oak Mountain	13 Mar	11 May	6	27 Mar	13 Apr	4
Silverado/Tule Peak	11 Apr	23 May	4	3 May	23 May	11

*Includes observations contributed by R. Williams

Adult Quino Surveys

We observed Quino at four of the six Core Areas surveyed (Fig. 2, Table 2). The Cactus Valley satellite occurrence complex was also occupied. Of the 54 total Quino individuals observed during the 2018 survey season, the largest number (*n* = 22) were found in the Silverado/Tule Peak Core, followed by the Oak Mountain Core (*n* = 15; Table 2). No larvae were detected in 2018.

No Quino were detected during our three visits (*n* = 21 sampling stations surveyed) in the Warm Springs Creek Core Area (Table 2), despite the presence of robust patches of *Plantago erecta* in many areas. No Quino were detected during our two visits

in the Wilson Valley Core Area (*n* = ten sampling stations surveyed) and *Plantago erecta* only occurred in a few patches.

We visited the Sage Core Area three times and detected Quino on our third visit, 30 March (Table 2). Despite plentiful non-native grass cover, Quino host plants (*Plantago erecta and Castilleja exserta*) were present at this site and the native wildflowers were very diverse. Two Quino were seen flying and one was nectaring on a *Plagiobothrys spp*.

A total of 10 adult Quino were detected within the Johnson Ranch/Lake Skinner Core (Table 2). The Quino were observed from 9 March through 26 March and Quino occupied four of the 15 sampling stations surveyed (27%). These locations produce Quino detections regularly. Quino were observed flying, perched, basking, exhibiting agonistic behavior, and one pair of Quino was seen mating. *Plantago erecta* was abundant and robust at the sampling stations surveyed.

Table 2. Quino occupancy at Core Areas in 2018.

Core Areas	No. of Visits	No. of Sampling Stations Surveyed	No. of Sampling Stations Occupied	No. of Adult Quino Present
Warm Springs Creek	3	21	0	0
Sage	3	7	3	4
Johnson Ranch/Lake Skinner	5	15	4	10
Oak Mountain	6	5	3	15
Wilson Valley	2	10	0	0
Silverado/Tule Peak	13	31	11	22
Satellite Occurrence Complex Areas				
Cactus Valley	2	5	2	3
San Bernardino National Forest	3	13	0	0
Total	**37**	**107**	**23**	**54**

We surveyed five sampling stations at the Oak Mountain Core Area in 2018 and detected 15 adult Quino. Quino were seen basking, flying, and exhibiting agonistic behavior. There were large patches of *Plantago erecta* throughout the sampling stations surveyed and it was the second most productive Core Area in 2018 in terms of Quino abundance.

We detected 22 Quino in the Silverado/Tule Peak Core Area. The areas that were surveyed include sampling stations located near Beauty Mountain, Anza-Borrego, Tule Peak Road and Bowers Road. We surveyed 21 sampling stations at the latter two locations as these sites were occupied during surveys conducted in collaboration with USFWS range-wide monitoring efforts in 2008. We surveyed the Anza-Borrego site too late in the survey season. The herbs observed in this area were mostly desiccated and no host plants or Quino were detected. Out of 31 sampling stations surveyed in this Core

Area, eleven were occupied by Quino (35%). Quino host plants (*Castilleja exserta, Sairocarpus coulterianus, Collinsia concolor,* and *Plantago patagonica*) were plentiful onsite. Quino were observed flying, perched, exhibiting agonistic behavior, and nectaring. Quino were found nectaring (*n* = 10 occurrences) on *Ericameria linearfolia, Eriophyllum wallace,* and *Cryptantha spp*. Although the numbers of Quino observed were much lower compared to 2017 (*n* = 275), this Core Area continues to be one of the most productive areas for Quino.

In the satellite occurrence complex area, San Bernardino National Forest, we did not detect Quino at our SBNF and Horse Creek sites. We also surveyed the higher elevations off Rouse Hill Ridge in light of recent publications stating Quino are believed to be colonizing higher elevation sites (Parmesan 1996). We detected one Adult Quino in this area last year, but none in 2018.

This year we visited the Cactus Valley satellite occurrence complex (Brown Canyon site) twice. We surveyed five sampling stations and detected three adult Quino. Two Quino were seen nectaring on *Plagiobothrys spp.* and *Amsinckia spp.* The other Quino was ovipositing on *Plantago erecta*. The Quino host plant *Plantago erecta* was found in large patches on most of the sampling stations surveyed and Cas*tilleja exserta* was found in small patches but was present in all the sampling stations surveyed.

Three of the Quino-occupied Core Areas (Johnson Ranch/Lake Skinner, Oak Mountain, and Sage) had *Plantago erecta* as the major Quino host plant, as did the two unoccupied Cores (Warm Springs Creek and Wilson Valley). The host plants *Sairocarpus coulterianus, Collinsia concolor, Castilleja exserta,* and *Plantago patagonica* were present at the remaining occupied Core Area (Silverado/Tule Peak). We found *Castilleja exserta* and *Plantago erecta* in the occupied Cactus Valley satellite occurrence complex. *Cordylanthus rigidus* was not encountered during survey efforts.

Plants that we observed Quino utilizing as nectar sources, in order of frequency of utilization, were: *Ericameria linearifolia* (utilized *n* = 3 times), *Eriophyllum wallacei* (Wallace's woolly daisy), *Plagiobothrys* spp., *Cryptantha* spp., and *Amsinckia* spp. A total of 13 adult Quino were observed nectaring. Other co-occuring butterflies were observed throughout the Core Areas, including two species of checkerspots (Appendix A). The chalcedon checkerspot butterfly was observed at the Johnson Rank/Lake Skinner Core, the Oak Mountain Core, the Wilson Valley Core, the Silverado/Tule Peak Core, and the SBNF satellite occurrence complex. The Leanira checkerspot was observed at the Silverado/Tule Peak Core. The common buckeye, whose larvae host plant include *Plantago sp*., was detected at the Wilson Valley Core.

DISCUSSION

The 2018 flight season was not as productive as the previous year, both in terms of survey effort (includes sentinel site surveys, adult surveys, and scouting surveys when conducted) and numbers of Quino detected. In the two most recent years, we observed 84 adult Quino during 131 surveys in 2018 (mean = 0.64 Quino per visit) and 359 adult Quino during 165 surveys in 2017 (mean = two Quino per visit).

The low numbers of Quino in 2018, compared to the year prior, may be a result of environmental conditions. Relative to 2018, California experienced more precipitation in 2017 which promoted an abundance of Quino host plant populations on our sites. The more optimal environmental conditions we had in 2017 may have triggered greater amounts of Quino larvae to break diapause. An additional factor that may have contributed to the lower number of Quino observed in 2018 was the limited availability of qualified surveyors. We were not able to visit all the locations that had been previously surveyed in 2017.

Over the last eight years, the flight season extended over a 14-week time period (26 January to 11 May). In 2018, the first adult Quino observed was on 9 March and the last observation occurred on 23 May, resulting in an approximate eleven-week flight period. We did not detect Quino larvae in 2018 which may be due to the timing of our Quino survey start date. We started surveys on 28 February at Warm Spring Core Area (no Quino detections) and our second survey was on 9 March at Johnson Ranch/Lake Skinner Core Area (first adult Quino observation). Our survey effort began as soon as the adult Quino was detected at the Johnson Ranch/Lake Skinner Core Area so we missed the opportunity of detecting larvae. Larvae most likely broke diapause in mid-February.

Distribution of Quino in 2018 was within the southern half of the Plan Area, bounded by the SBNF satellite occurrence complex Area to the east, Silverado/Tule Peak Core Area to the southeast, and the MSR sites and Oak Mountain sentinel site to the west. Of the sites surveyed in 2018, Anheuser-Busch (in the Warm Springs Creek Core Area) was the lowest elevation site (approx. 400 m) and Rouse Hill Ridge (in the SBNF satellite occurrence complex area) was the highest (approx. 2000 m). If Quino shift to higher elevation habitat, this area could support new Quino populations in the future. Quino have been documented in this area at approximately 1,707 meters in elevation (*James Gannon, Bureau of Land Management, personal communication*) and as high as 1,854 meters in elevation (observed during 2017 adult Quino surveys). This became the highest elevation Quino sighting ever recorded, and is the highest elevation site documented by the Monitoring Program. 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 – 2000 m).

Of the sites occupied by Quino in 2018, the lowest in elevation were the sampling stations at Johnson Ranch/Lake Skinner core area (approx. 525 m); next lowest was Sage Core Area (approx. 700 m); followed by Oak Mountain Core Area and Cactus Valley satellite occurrence complex, which are both at nearly 800 m in elevation. The highest elevation occupied site was Silverado/Tule Peak Core Area (approx. 1300 m). We did not detect any Quino at the Rouse Hill Ridge site in 2018 but we will continue to document the elevations at which Quino are detected within the Plan area to track distributional shifts over time, especially in light of a hypothesis that suggests Quino will shift north and to higher elevations due to climate change.

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 three of the eight Core areas and satellite occurrence complexes in 2018, this does not preclude the

possibility of Quino being present at most of them because not all potentially suitable habitat was surveyed.

Over the past eleven flight seasons (2008-2018), we have not detected Quino in the Warm Springs Creek Core Area (Appendix B) despite the presence of robust patches of *Plantago erecta* in many areas, and large expanses of suitable habitat. Within this Core Area, we have surveyed the Anheuser-Busch site five years (2013, 2015, 2016, 2017, and 2018) with no success despite the fact that it contains very suitable habitat, including abundant stands of Quino host plants. If Quino were to re-colonize this area at some time in the future, or if Quino were to be translocated here, there may be good likelihood of successful establishment.

Our only survey site in the Sage Core Area, Magee Hills, is rather isolated from other occupied areas. The most proximal occupied site is 7.5 km distant. The open areas for Quino to bask and mate at this site are becoming smaller every year due to encroaching non-native grasses and, more recently, *Brassica tournefortii* (Sahara mustard) and *Oncosiphon piluliferum* (stinknet). In the absence of management to reduce the cover of these invasive species, Quino may become extirpated from this area. Over eleven years surveying this site, we have been successful at detecting a small but persistent population of Quino approximately 50% of the time (Appendix B).

In the Johnson Ranch/Lake Skinner Core Area, the most productive site has been adjacent to our current Multi-Species Reserve sentinel site (Fig. 2). This year there were large patches of *Plantago erecta* found throughout the sampling stations surveyed. The sampling stations that were surveyed south of the Multi-Species Reserve sentinel site, still have some large, open areas, but many other areas are now filled in with non-native grasses. Habitat suitability has been decreasing in this area over the past decade.

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 11 years the Biological Monitoring Program has conducted surveys. Unique to 2018, rather than treating the whole Oak Mountain Core Area as a sentinel site, we constrained our efforts to two sampling stations where sentinel surveys were conducted which impacted the number of adult Quino that were detected during sentinel surveys. In 2018 we detected more Quino in the Silverado/Tule Peak area (n = 11) and in the Multi-Species Reserve (n = 15) than we did in Oak Mountain (n = 4) (Table 1). Another difference between survey years was the amount of *Lepidium nitidum* growing onsite. There was high cover of *Lepidium nitidum* in 2017 that buried host plants in some areas and decreased the amount of open-ground; but in 2018 the cover of *Lepidium nitidum* had decreased. This change may have been attributed to lower precipitation in 2018 compared to 2017.

We did not find Quino in the Wilson Valley Core Area in 2018. Only one Quino has been detected in this Core Area over the past seven survey years (Appendix B). We were not able to survey the sampling stations where Quino were last documented due to lack of time and personnel, however we did survey just west of the area. We cannot claim to have thoroughly searched this entire area, which is extensive, however 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 in recent years affects Quino's host plants and nectar sources.

This is the eleventh continuous survey year that the Silverado/Tule Peak Core Area has been occupied; it continues to support the greatest number of Quino relative to other Core Areas, with a total of 22 Quino detected (Table 2). The sites along Tule Peak Road and Bowers Road were the most productive and have very suitable habitat. Some of these sites have not been surveyed since 2009, but were re-confirmed as being occupied in 2017 and in 2018, which bodes well for the persistence of this meta-population. We did not find Quino at the Anza-Borrego site, east of Tule Canyon Road. We did not survey this area until later in the season due to lack of time and personnel. More Quino may be found in the area if we expand our survey effort during future site visits.

We detected Quino in Brown Canyon in the Cactus Valley satellite occurrence complex area in 2018. Quino had not been detected in this area since 2010 despite several survey attempts (Appendix B). In 2018 we were able to survey new sampling stations in the area with suitable habitat. We plan to expand our survey efforts in this area to determine the extent of Quino distribution.

According to the Species Account (Dudek & Associates 2003), Quino have been extirpated from the Lake Mathews/Estelle Mountain/Harford Springs Core Area. Quino were historically abundant in the Harford Springs subunit, but were last documented in Harford Springs Park in 1998 (Krofta and Anderson 2002) and 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). Surveys were conducted over eight years by Program biologists with no success, leading to termination of surveys there beginning in 2012 (Appendix B). Until there is sufficient justification to restart surveys in this Core Area in the future (e.g., active translocation of butterflies, reported incidental observations), we will continue to exclude it from our survey efforts in an effort to prioritize more productive areas.

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, and therefore we will prioritize monitoring at this scale. We should continue to monitor recently occupied sites and areas with apparently suitable habitat, or areas that are adjacent to known occupied habitat. As Quino meta-populations and suitable habitat shift, which is happening at the present time, sentinel site locations will need to shift accordingly.

We have not detected Quino in the Warm Springs Creek Core Area over the past 11 years of survey efforts. If drought conditions continue, future survey efforts in this core may be unproductive; however, since our knowledge of Quino ecology is incomplete, there is a chance that Quino will re-colonize these sites in the future. A

wildlife brdige that spans Clinton Keith road has recently been constructed which may facilitate Quino movement between formerly fragmented habitat. The Biological Monitoring Program has proposed a plan to conduct five years of surveys at sampling stations near the overcrossing to detect Quino occupancy and document habitat attributes. Aside from this location, it may be appropriate to only survey at locations that were historically occupied once per season in an attempt to locate Quino within this core. We recommend that survey efforts be expanded to other areas with suitable habitat within this core only following years with average or above-average rainfall.

It would be appropriate to expand our scouting efforts to the Aguanga area and other areas within Wilson Valley. Quino continue to occupy the Wilson Valley Core Area in small numbers, but our present sites are no longer highly suitable. Because Quino occur as meta-populations, it is very possible we are missing currently occupied habitats when we survey at historically occupied locations; exploring other potential areas may be fruitful. Habitat adjacent to Wilson Valley Road has been quite reliable for Quino sightings in the past, and we intend on surveying this area more thoroughly during future survey efforts.

As climate change effects continue, we believe it is important to survey areas at higher elevations, such as Rouse Hill (1700 m elevation), as these may serve as expansion areas, or refugia, 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 Quino distribution and population size. Additionally, we would like to increase our survey efforts near the currently occupied Beauty Mountain site in the Silverado/Tule Peak Core Area, which is at approximately 1400 m in elevation.

It may be productive to scout Bautista Canyon, including our original Horse Creek site in the SBNF satellite occurrence complex, which was surveyed from 2006-2010 and was found to be occupied by a small number of 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 full extent of this Quino population and other populations in Bautista Canyon.

Lastly, in the Oak Mountain Core Area we do not survey down-slope towards Vail Lake, primarily due to a lack of time and personnel. It would be appropriate to re-survey this area to update our current knowledge of Quino distribution. We do know there is *Plantago* in this area and that Quino occupied these areas as recently as 2009.

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, 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 or when the

continuing drought or other unfavorable conditions are relieved, Quino will re-occupy other areas with suitable habitat.

The Oak Mountain Core Area is one of the best remaining areas for Quino occupancy. As Oak Mountain continues to be developed, the remaining open land is very crucial to Quino persistence. If possible, the land on the top of Oak Mountain and along the ridgeline should be considered for conservation as this is where some of the best Quino habitat is located.

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 two of our sites in this area, SBNF and Horse Creek, during several survey seasons.

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, or participated in, surveys in 2018 were Tara Graham, Lynn Miller, Michelle Murphy-Mariscal, Esperanza Sandoval (Quino Survey Lead), 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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Appendix A. Butterfly species, listed by family, observed during 2018 survey efforts

Swallowtails (Papilionidae)
Western tiger swallowtail (*Papilio rutulus*)
Pale swallowtail (*Papilio eurymedon*)
Anise swallowtail (*Papilio zelicaon*)
Whites and Sulphurs (Pieridae)
Cabbage white (*Pieris rapae*)
Checkered white (*Pontia protodice*)
Spring white (*Pontia sisymbrii*)
Sara orangetip (*Anthocharis sara*)
Harford's sulphur (*Colias harfordii*)
Coopers, Hairstreaks, & Blues (Lycaenidae)
California Hairstreak (*Satyrium californica*)
Hedgerow Hairstreak (Satyrium saepium)
Brown elfin (*Callophrys augustinus*)
Perplexing hairstreak (*Callophrys perplexa*)
Silvery blue (*Glaucopsyche lygdamus*)
Echo Azure (*Celastrina echo*)
Acmon blue (*Plebejus acmon*)
Boisduval's blue (*Plebejus icarioides*)
Metalmarks (Riodinidae)
Wright's metalmark (*Calephelis wright*)
Behr's metalmark (*Apodemia virgulti*)
Brushfoots (Nymphalidae)
Leanira checkerspot (*Chlosyne leanira*)
Chalcedon checkerspot (*Euphydryas chalcedona chalcedona*)
Painted lady (*Vanessa cardui*)
Common buckeye (*Junonia coenia*)
California sister (*Adelpha bredowii*)
Queen *(Danaus gilippus)*
Skippers (Hesperiidae)
Funereal duskywing (*Erynnis funeralis*)
Northern white-skipper (*Heliopetes ericetorum*)

Appendix B. Core Area and satellite occurrence complex detections from 2008-2018

Core Area	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Lk Mathews/Estelle/ Harford Springs	0[†]	0	0	0	0	--	--	--	--	--	--
Warm Springs Creek	0	0	0	0	0	0	0	0	0	0	0
Johnson Ranch/Lake Skinner	1	1	1	1	1	1	0	1	1	1	1
Oak Mountain	1	1	1	1	1	1	1	1	1	1	1
Wilson Valley	1	0	1	1	0	1	0	0	0	0	0
Sage	1	0	1	0	0	1	0	1	0	1	1
Silverado/Tule Peak	1	1	1	1	1	1	1	1	1	1	1
Satellite Occurrence Complex (Non-Core Area)											
SBNF	1	0	1	1	1	1	0	1	1	1	0
Cactus Valley	0	0	1	0	0	0	--	--	--	0	1
Anza Valley	--	--	--	--	--	0	--	--	--	--	--

[†]no detections = 0, detections = 1, no surveys = --