Western Riverside County
Multiple Species Habitat Conservation Plan
Biological Monitoring Program

2020 Quino Checkerspot Butterfly
(Euphydryas editha quino)
Survey Report

18 March 2021

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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 2020 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 2020 Quino Survey Lead, Esperanza Sandoval. 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 states that "within the MSHCP Conservation Area, biologists will document the distribution of Quino checkerspot butterflies 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 the past seven years. In 2020 one visit was made to the Lake Mathews/Estelle Mountain/Harford Springs Core area to assess the habitat for Quino. Additional surveys were conducted in three satellite (non-core) occurrence complexes where Quino are known to currently or historically occur: the southwestern portions of the San Bernardino National Forest (SBNF), Cactus Valley, and Aguanga (an area that had not been surveyed previously by the Biological Monitoring Program).

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). Quino larvae come out of diapause (post-diapause larvae) around February with the emergence of host plants to feed and molt into larger instars until pupating (Mattoni et al. 1997). Quino form their pupae low to the ground using their host plants or other vegetation as cover and remain in this stage for about ten days (Mattoni et al. 1997). Males emerge about 2-3 days before the females, once females emerge mating immediately follows (Pratt and Emmel 2010). Mating occurs 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 (Pratt and Emmel 2010). One or two egg clusters per day are laid for most of the butterfly's ten to 14-day adult life (Labine 1968). The egg clusters hatch in about two weeks and the newly emerged larvae (pre-diapause larvae) seek shelter on their host plant creating a web-like protective cover around them and begin feeding (Pratt and Emmel 2010). The grass- and shrub- lands 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, which is why 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). Quino larvae tend to seek shelter at the base of shrubs that surround the host plants, such as *Eriogonum fasciculatum* (Pratt and Emmel 2010). 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 (Murphy and White 1984). 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. High amounts of grass can affect Quino habitat negatively as post-diapause Quino larvae tend to prefer areas with low grass coverage (Osborne et al 2000), which allows for them to have more solar exposure necessary for basking. 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 pre-diapause 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 several years 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 2020 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 (Figure 1). We assigned one sampling station to all three sentinel sites: Oak Mountain, MSR, and Tule Peak Road.

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

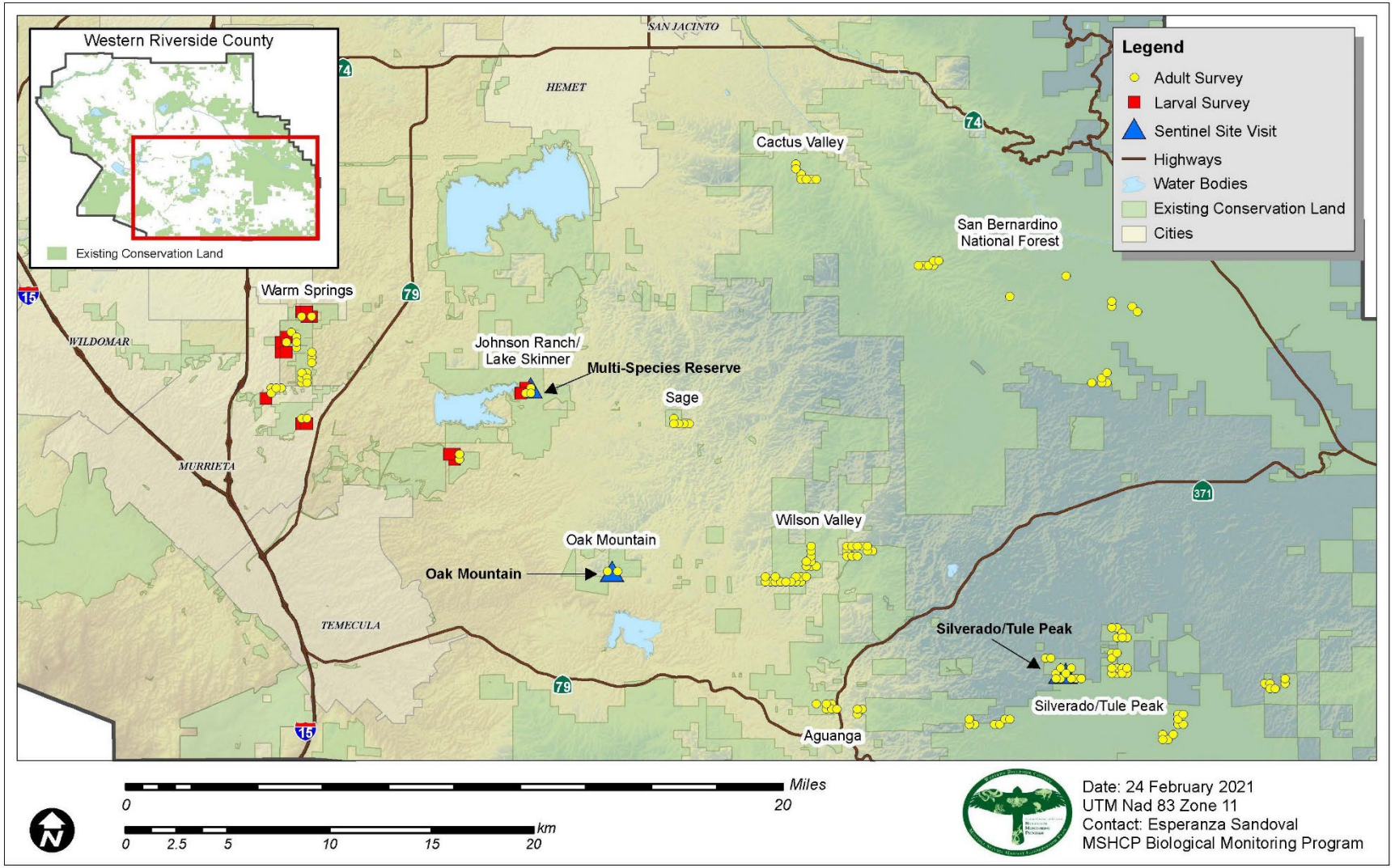

Figure 1. Quino checkerspot butterfly sentinel sites, larval surveys, and adult Quino locations in 2020.

Silverado/Tule Peak Core area (Figure 1). The Lake Mathews/Estelle Mountain/Harford Springs Core area was only visited once since 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 three non-core satellite occurrence complexes (Dudek & Associates 2003) surveyed in 2020: San Bernardino National Forest, Cactus Valley, and Aguanga. 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.

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 January 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 2020, due to the safety restriction brought upon by covid-19 and by weather, we were not able to conduct regular return visits to all three sentinel sites. 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 2020 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

There were four surveyors in 2020. All four surveyors have passed the USFWS Quino identification exam. One surveyor has now ten years of experience surveying for Quino, a second surveyor has now two years of experience, and the other two surveyors just completed their first season surveying for Quino in 2020. All surveyors have had in house training, in office and in the field. 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 2020 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

Overall, we surveyed from 28 January until 28 May, which includes Sentinel site surveys, Quino surveys at the Core areas, and Quino surveys at the Satellite Occurrence complex areas. Our first sighting was of 10 adult Quino on 20 February at the Multi-Species Reserve (MSR; Table 1). Our last sighting was of two adult Quino on 11 May at the Silverado/Tule Peak Core area. We detected a total of 441 individual Quino (Figure 2) and surveyed a total of 239 sampling stations, which include every survey at the sentinel sites (*n* =21), every adult Quino survey at each sampling station (*n* = 179), and every repeated visit to the sampling stations where Quino was not detected on the first visit (*n* = 39). Out of the 239 sampling stations surveyed, Quino was detected during 40 of those surveys (17%). Our Quino observations occurred approximately between the hours of 0902 – 1453, with temperatures ranging between 18.7 – 34.6°C. We recorded wind speeds at the start and end of successful surveys to be between 0 – 10.0 km/h (average at start of survey = 2.29, average at end of survey= 2.52 km/h). In regard to cloud cover, including all 239 sampling stations surveyed, skies were clear from the start to the end of each survey 73.6% of the time. Out of the 40 sampling stations surveyed where Quino was detected, 29 sampling stations (70%) had clear skies at the start and end of each survey.

Sentinel Site Surveys

All three of the sentinel sites (MSR, Oak Mountain, and Silverado/Tule Peak) were occupied by Quino in 2020. Of the 21 visits we conducted at our three sentinel sites, we detected adult Quino during nine surveys (43%; Table 1). The Biological Monitoring Program visited the Multi-Species Reserve sentinel site seven times and observed 69 adult Quino during three visits (43%; Table 1) conducted on 20, 26 February, and 5 March (*n* =10, 25 and 34, respectively). Two Quino larvae observations were made on 7 February, about two and a half weeks before the Quino adults were detected. One larva was found resting on bare ground and the other was feeding on *Plantago erecta*. The host plants *Plantago erecta* and *Castilleja exserta* were abundant throughout the sentinel site during the Quino flight season. In terms of adult Quino behavior, several of them were seen flying and basking, four adult Quino were seen ovipositing on *Plantago erecta,* and 13 adult Quino were seen nectaring. Twelve adult Quino were seen nectaring on *Rhus ovata* and one on *Amsinckia* spp. Two others were found perched on *Eriogonum fasciculatum* and another two were perched on *Plantago erecta*.

The Oak Mountain sentinel site was visited six times in 2020 starting on 14 February and ending on 7 May. We observed 9 adult Quino during two visits (33%; Table 1) conducted on 21 February and 6 of March (*n* = 3 and 6, respectively). The host plant *Plantago erecta* was present this spring in large patches throughout the site during

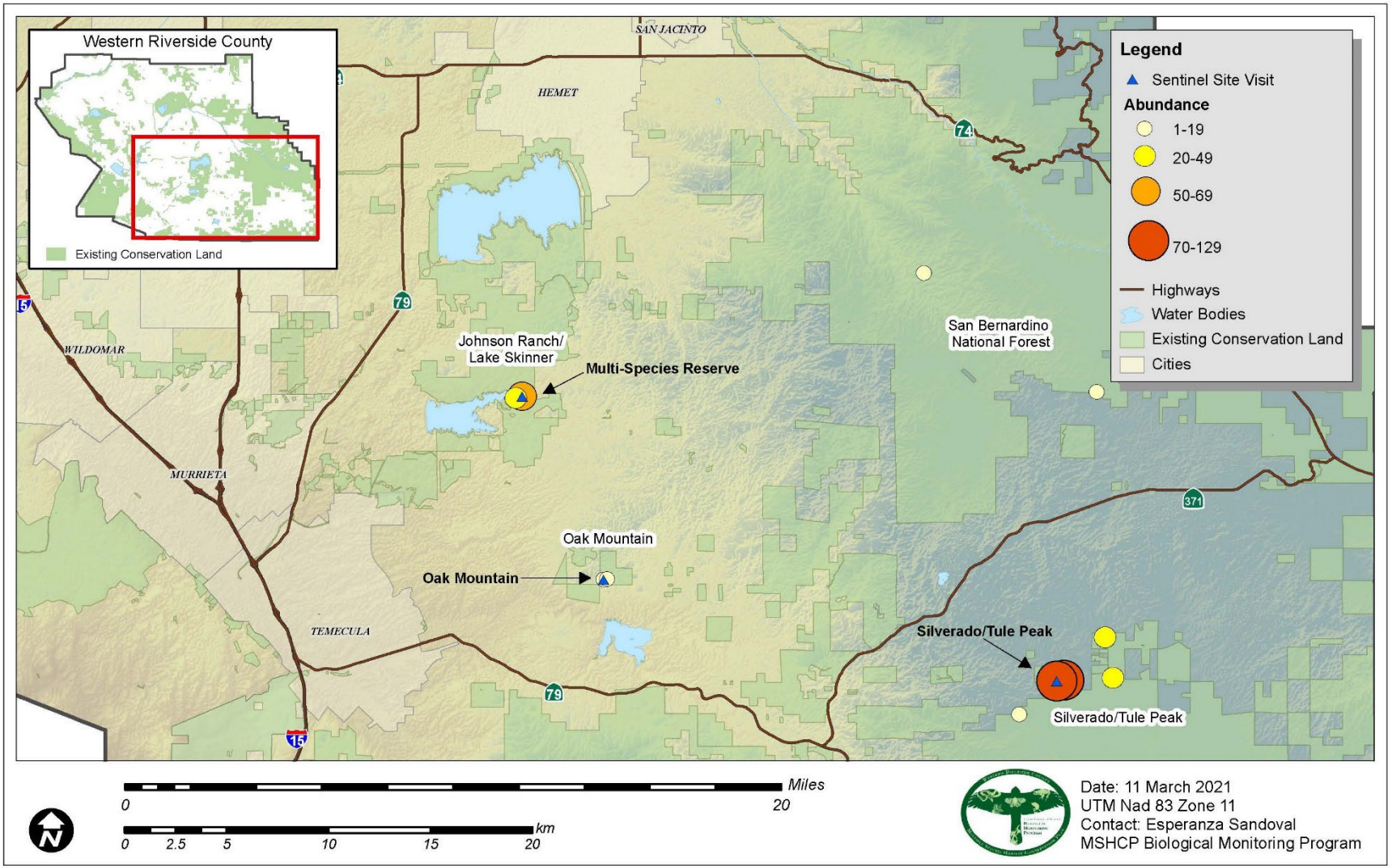

Figure 2. Quino checkerspot butterfly occupied survey sites and sentinel sites in 2020.

the Quino flight season. *Plantago erecta* began senescing by early March and by 30 April, during our last visit, many were senesced. There were plenty of nectaring plants for the adult Quino to nectar and one adult Quino was observed nectaring on *Rhus ovata.* Three adult Quino were found perched on *Eriogonum fasciculatum* and one adult Quino was perched on *Salvia mellifera*. *Lepidium nitidum* (shining pepperweed), which is suspected to compete with other plants considered beneficial to Quino, was also present.

We visited the sentinel site in the Silverado/Tule Peak Core area eight times in 2020. We observed 111 adult Quino during five visits (63%; Table 1) conducted on 31 March, 15, 22 and 28 of April, and 6 May (*n* = 34, 41, 21, 12 and 3 Quino, respectively). A total of 13 pre-diapause Quino larvae, with an approximate length range of 3mm-6mm, were detected on 20 May feeding and resting on a *Sairocarpus coulterianus* (*n* = 8 and 5, respectively). The five resting pre-diapause Quino larvae were located at the base of the plant protected by webbing. In addition to *Sairocarpus coulterianus* we also detected two other host plants throughout the sentinel site, *Collinsia concolor and Castilleja exserta.* Plenty of nectaring sources were also available for the butterflies this year. Nine adult Quino were seen nectaring on *Cryptantha* spp., one switched from *Cryptantha* spp. to *Nemophila menziesii*, one on *Camissoniopsis* spp., and one on *Eriophyllum wallacei*. One adult Quino was detected perched on *Cryptantha* spp. and another on a non-native grass.

The nectaring behavior in adult Quino was detected in all three sentinel sites in 2020. Overall, a total of 26 adult Quino was observed nectaring at the three sentinel sites (13 at MSR, 12 at Silverado/Tule Peak, and 1 at the Oak Mountain). Plants that we observed Quino utilizing as nectar sources, in order of frequency of utilization, were *Rhus ovata* (*n* = 13), *Cryptantha* spp. (*n* = 9), *Camissoniopsis* spp. (*n* = 2), *Amsinckia spp.* and *Eriophyllum wallacei* (*n* = 1). One adult Quino nectaring on *Camissoniopsis* spp. also nectared on *Nemophila menziesii*. Other co-occurring butterflies were observed throughout the sentinel sites, including one species of checkerspot (Appendix A). The chalcedon checkerspot butterfly (*Euphydryas chalcedona chalcedona*) was observed at the Multi-Species Reserve. The common buckeye (*Junonia coenia*), whose larvae host plant include *Plantago* sp., was detected at the Multi-Species Reserve and the Silverado/Tule Peak sentinel site.

Table 1. Adult Quino checkerspot butterflies observed during sentinel site visits during the 2020 flight season.

	Dates of Visits		**Total # of Visits**	**Dates Quino Observed**		**Total # Quino Observed**
Sentinel Site	**First**	**Last**		**First**	**Last**	
Multi-Species Reserve	29 Jan	17 April	7	20 Feb	05 Mar	69
Oak Mountain	14 Feb	07 May	6	21 Feb	6 Mar	9
Silverado/Tule Peak	31 Mar	27 May	8	31 Mar	06 May	111

Adult Quino Surveys

We observed Quino at three of the seven Core areas surveyed (Figure 2, Table 2) in 2020. The San Bernardino National Forest satellite occurrence complex was also occupied. Of the 252 total Quino individuals observed during the 2020 adult Quino surveys, the largest number (n = 197) were found in the Silverado/Tule Peak Core area, followed by the Johnson Ranch/Lake Skinner Core area (n = 44; Table 2), and then the San Bernardino National Forest Satellite Occurrence Complex (n =10; Table 2). Quino larvae were detected at the Johnson Ranch/Lake Skinner Core area and at Silverado/Tule Peak Core area.

No Quino were detected during our 11 visits (n = 33 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 11 visits in the Wilson Valley Core area (n = 35 sampling stations surveyed, Table 2). At the Wilson Valley Core area, we detected a few large and small patches scattered throughout the sampling stations of *Plantago erecta.* We also detected scattered patches of *Collinsia concolor* and *Castilleja exserta* throughout the area. *Sairocarpus coulterianus* was only found in one area of Wilson Valley Core by Thomas Road and Wilson Valley Rd.

We visited the Sage Core area three times, and no Quino were detected (n = 5 sampling stations surveyed, Table 2), despite the presence of *Plantago erecta* and *Castilleja exserta* patches. There were also large patches of native wildflowers throughout the grids which provided plenty of nectaring sources for butterfly species. We also detected non-native grass cover which is not ideal for Quino habitat.

Table 2. Adult Quino occupancy at Core areas in 2020.

Core areas	No. of Visits	No. of Sampling Stations Surveyed	No. of Sampling Stations Occupied	No. of Adult Quino Present
Warm Springs Creek	11	33	0	0
Sage	3	5	0	0
Johnson Ranch/Lake Skinner	8	09	4	44
Oak Mountain	2	2	1	1
Wilson Valley	11	35	0	0
Silverado/Tule Peak	16	54	22	197*
Lake Mathews/Estelle Mountain/ Hartford Springs	1	5	0	0
Satellite Occurrence Complex areas				
Cactus Valley	2	7	0	0
San Bernardino National Forest	6	19	3	10
Aguanga	3	10	0	0
Total	**64**	**179**	**30**	**252**

*Includes 14 adult QCB observation contributed by James Gannon, 3 by Ana Sawyer, and 38 incidental observations by MSHCP staff

A total of 44 adult Quino was detected within the Johnson Ranch/Lake Skinner Core (Table 2) as well as two Quino larvae. Four out of the nine sampling stations surveyed were occupied (44%; Table 2). One Quino larva was detected during our second visit on 7 February and was found feeding on *Plantago erecta* and the second was detected on 20 February crawling on vegetation. Adult Quino was detected on two visits to the Johnson Ranch/Lake Skinner Core, 17 on 26 February and 27 on 5 March. Adult Quino was observed ovipositing on *Plantago erecta* and nectaring on *Amsinckia* spp. *Plantago erecta* and *Castilleja exserta* were detected in this Core area but *Plantago erecta* was more abundant throughout the sampling stations surveyed.

One adult Quino was detected within the Oak Mountain Core area in 2020 (Table 2). The adult Quino was seen on 21 February and was detected in one out of the two sampling stations surveyed (50%). The adult Quino was seen perched on a grass in the family Poaceae. Large patches of *Plantago erecta* were detected throughout the sampling stations surveyed as well as other nectaring sources.

We detected 197 adult Quino in the Silverado/Tule Peak Core area in 2020 (Table 2). Adult Quino were seen from 31 March through 11 May. The areas that were surveyed include sampling stations located near Beauty Mountain, Anza-Borrego, Misty Meadows Drive, Tule Peak Road, and Bowers Road. We surveyed a total of 54 sampling stations, 28 of them at the latter two locations as these sites were occupied during surveys conducted in collaboration with USFWS range-wide monitoring efforts in 2008. Of these 54 sampling stations, 22 (40.7%) were occupied by adult Quino. The areas in the Silverado/Tule Peak Core that resulted with no Quino detections, despite the presence of host plants, were Beauty Mountain and Anza-Borrego. Quino host plants (*Castilleja exserta, Sairocarpus coulterianus*, and *Collinsia concolor*) were present throughout the Silverado/Tule Peak Core area. Throughout the 22 sampling stations occupied adult Quino were observed flying, perched, basking, exhibiting agonistic behavior, and nectaring. Adult Quino were found nectaring (n = 30 occurrences) on *Lasthenia, Camissoniopsis* spp., *Layia glandulosa*, *Ericameria* spp., *Chaenactis glabriuscula*, and *Cryptantha* spp. A total of 55 adult Quino was observed as incidental observations in the Silverado/Tule Peak Core, 14 on 01 April (*James Gannon, BLM Rx Fire and Fuels Specialist, personal communication*), three on 01 April (*Ana Sawyer Natural Resource Specialist, RCA, personal communication*), and 38 more from the end of March to the end of April by MSHCP staff. The numbers of Quino observed in 2020 (n = 197, Table 2) were higher compared to 2019 (n = 78) and 2018 (n = 22). The Silverado/Tule Peak Core area continues to be one of the most productive areas for Quino.

In the satellite occurrence complex area, San Bernardino National Forest, we detected a total of 10 adult Quino in 2020 (Table 2). The areas that were surveyed include sampling stations located at our Horse Creek site (ranges in elevation between 820-900 meters), the Hog Lake Truck Trail site (ranges in elevation between 1220-1400 meters), and the higher elevation SBNF site by Rouse Hill Road (ranges in elevation between 1600-1900). Of the 19 sampling stations that were surveyed, three (16%) were occupied by adult Quino. We visited each area twice and detected one Quino perched on *Eriogonum fasciculatum* at the Horse Creek site on 9 March. We detected nine Quino at the Hog Lake Truck Trail site on the 24 April, five were seen nectaring and four were

exhibiting agonistic behavior. Quino were seen nectaring on *Senecio californicus* and *Layia glandulosa*. We visited the higher elevation areas twice at the SBNF site in light of publications stating Quino are believed to be colonizing higher elevation sites (Parmesan 1996) but were unable to detect any Quino. We detected one Adult Quino at an approximate elevation of 1831 meters at the SBNF site in 2017, but none in 2018, 2019, or 2020.

This year we visited the Cactus Valley satellite occurrence complex (Brown Canyon site) twice and did not detect any Quino. During those two visits, on 28 February and 14 April, we surveyed seven sampling stations. The Quino host plants *Castilleja exserta* and *Plantago erecta* were found in both small and large patches on all the sampling stations surveyed. Nectaring sources were also available throughout the area.

Two of the Quino-occupied Core areas (Johnson Ranch/Lake Skinner and Oak Mountain) had *Plantago erecta* as the major Quino host plant, as did the three unoccupied Cores (Warm Springs Creek, Sage, 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 unoccupied Cactus Valley satellite occurrence complex. *Cordylanthus rigidus* was not encountered during survey efforts.

Of the 252 adult Quino observations in 2020, 55 detections were made incidentally and 197 were observed during surveys across all sampling stations (n = 179, Table 2). Of the 197 adult Quino observed during surveys, a total of 42 of them were observed nectaring, 27 were exhibiting agonistic behavior, 66 were flying, 58 were either perched or basking, three were observed ovipositing, and one was caught by a spider. Plants that we observed Quino utilizing as nectar sources, in order of frequency of utilization, were: *Cryptantha* spp. (n = 13), *Camissoniopsis spp.* (n = 9), *Amsinckia* spp. *(*n = 7), *Layia glandulosa* (n = 6), *Ericameria* spp. (n = 3), *Senecio californicus* (n = 2), *Chaenactis glabriuscula*, and *Lasthenia* spp. (n = 1). Other co-occurring butterflies were observed throughout the Core areas, including two species of checkerspot butterflies (Appendix A). The Chalcedon checkerspot butterfly (*Euphydryas chalcedona chalcedona*) was observed at the Johnson Rank/Lake Skinner Core, the Wilson Valley Core, the Sage Core, the Silverado/Tule Peak Core, the Warm Springs Core, the Lake Mathews/Estelle Mountains/Hartford Springs Core, and the SBNF and Aguanga satellite occurrence complex. The Gabb's checkerspot (*Chlosyne gabbii*) was observed at the Silverado/Tule Peak Core and in the Aguanga satellite occurrence complex. The Leanira's checkerspot (*Chlosyne leanira*) was observed at the San Bernardino National Forest satellite occurrence complex. The common buckeye (*Junonia coenia*), whose larvae feed on *Plantago* sp., was detected at the Oak Mountain Core, the Silverado/Tule Peak Core, the Wilson Valley Core, the Johnson Ranch/Lake Skinner Core, the Warm Springs Core, and the SBNF and Cactus Valley satellite occurrence complex.

DISCUSSION

The 2020 flight season was more productive than the previous two years, both in terms of survey effort (includes sentinel site surveys, adult surveys, and scouting surveys when conducted) and numbers of Quino detected. In the four most recent years, we

observed a total of 441 adult Quino during 239 surveys (includes sentinel sites, adult survey sites, repeat visits, and incidental observations) in 2020 (mean = 1.85 Quino per visit), we observed a total of 199 adult Quino during 168 surveys in 2019 (mean = 1.18 Quino per visit), 84 adult Quino during 148 surveys in 2018 (mean = 0.57 Quino per visit) and 359 adult Quino during 165 surveys in 2017 (mean = 2.18 Quino per visit).The higher numbers of Quino in 2020, compared to the past two years, might be due to our higher number of qualified field surveyors. In 2019 and 2018 there were 1-2 qualified Quino surveyors available throughout the season and this year, in 2020, we had 2-4 qualified Quino surveyors. The number of people involved with the Quino surveys doubled in 2020. With the increase in surveyors, we were able to cover more area, which led to a higher number of surveys completed and possibly to a higher number of Quino detections. 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 six of the ten Core areas and satellite occurrence complexes in 2020, this does not preclude the possibility of Quino being present at most of them because not all potentially suitable habitat was surveyed.

Differences in flight season have been evident throughout the years. Aside from environmental factors some of these differences could be due to adjustments in survey effort and survey methods throughout the years. In 2010-2012, the flight season extended over a 12-14 - week time period. Similar to the previous two years, the 2020 Quino flight season resulted in an approximate eleven and a half-week flight period, with the first adult Quino observed on 20 February and the last observation occurred on 11 May (Figure 3).

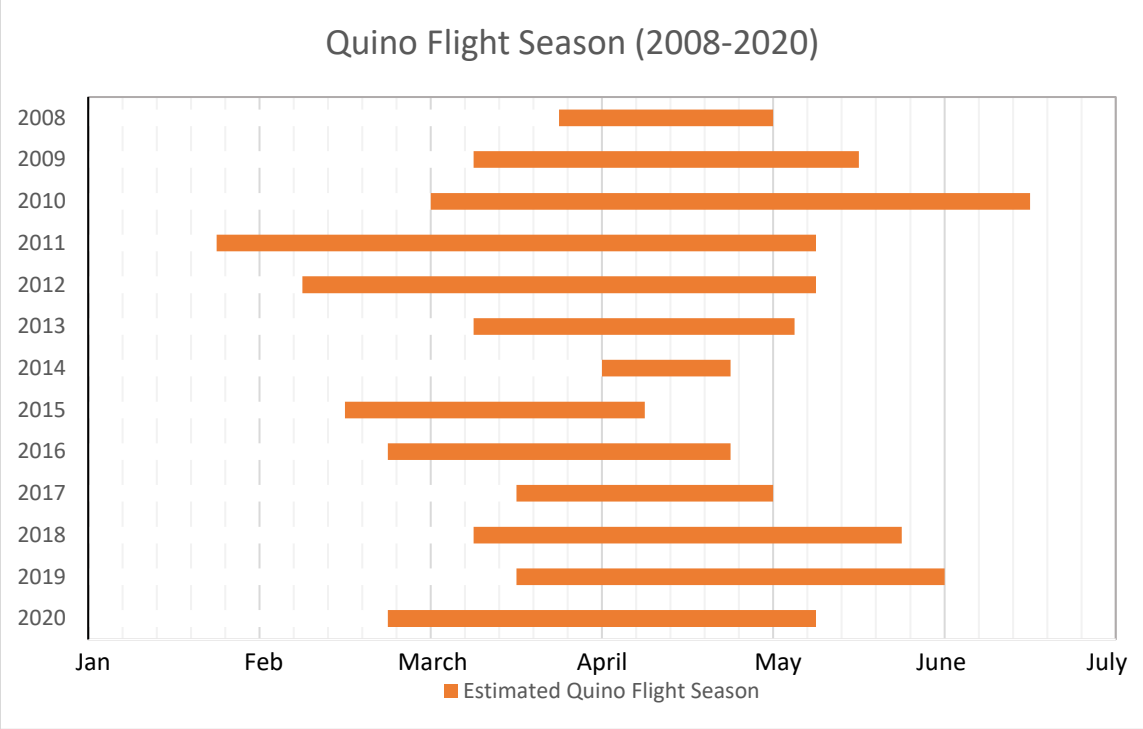

Figure 3. Quino checkerspot butterfly estimated observed flight season from 2008-2020. The survey efforts

may have differed from year to year. Reports are available online: https://www.wrc-rca.org/species-surveys/

Distribution of Quino in 2020 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. 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 surveyed in 2020, Anheuser-Busch and Winchester 700A (in the Warm Springs Creek Core area) were the lowest elevation sites (approx. 400 m) and the higher elevation SBNF site by Rouse Hill Road (in the SBNF satellite occurrence complex area) was the highest (approx. 1900 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 1,854.7 meters in elevation (observed during 2017 adult Quino survey). This became the highest elevation Quino sighting ever recorded and is the highest elevation site documented by the Monitoring Program.

Of the sites occupied by Quino in 2020, the lowest in elevation were the sampling stations at Johnson Ranch/Lake Skinner Core area (approx. 525 m); followed by Oak Mountain Core area and the Horse Creek site in the San Bernardino satellite occurrence complex, which are both about 800 m in elevation. The highest elevation occupied site was Silverado/Tule Peak Core area (approx. 1399 m). We did not detect any Quino at the Rouse Hill Ridge site in 2020, 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 (Parmesan 1996).

In 2020, we were able to detect three stages of the Quino life cycle but only in a few sites, which was most likely due to the timing of the surveys. The larvae stage of the Quino checkerspot butterfly was detected in two Core areas, the adult stage was seen in 4 Core areas and Satellite Occurrence Complex, and egg clusters were seen in one Core area (MSR sentinel site). Post-diapause Quino larvae was detected at the Johnson Ranch/Lake Skinner Core area since we began surveys in late January, then adults a couple weeks later and egg clusters soon after, since females oviposit their egg clusters within a day after emergence (Pratt and Emmel 2010). In Oak Mountain we detected adult Quino during the second visit on 21 February, one week after the first visit (14 February), so we missed the window for detecting Quino post-diapause larvae. By the time the Silverado/Tule Peak Core area was surveyed on 31 March, adult Quino were already flying, and no post-diapause larvae was observed. During our last visits to this Core area, we detected pre-diapause larvae, but by that time no more adult Quino were observed. We did not see any Quino larvae at the San Bernardino Satellite occurrence complex (include the Horse Creek site, the Hog Lake Truck trail site, and the higher elevation SBNF site) also due to the timing of the surveys and because during the initial survey we did not come across host plants at the Horse Creek site. Adults were detected at the Horse Creek site during our second visit (9 March) and at our Hog Lake Truck trail site during the first visit (24 April). In both of these sites it would have been late to detect any larvae. Unfortunately, due to time and people we were not able to return to those two

sites in the San Bernardino National Forest. We also visited the higher elevation sites twice with no detections. All other sites surveyed during the 2020 survey effort did not have Quino larvae or adult presence, despite some areas having the presence of host plants and nectaring sources.

Over the past twelve flight seasons (2008-2019), 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 seven years (2013, 2015, 2016, 2017, 2018, 2019, 2020) with no success despite the fact that it contains suitable habitat, including abundant stands of Quino host plants, but it also has seen an increase in non-native grasses covering up the nectaring sources. With the addition of the Clinton Keith overcrossing in the Anheuser-Busch site we have been paying closer attention to the overcrossing itself and the area that surrounds it. It currently has young growth of *Eriogonum fasciculatum* and *Acmispon glabrus* growing on the overpass as well as host plants such as *Plantago erecta* and *Castilleja exserta*. Once *Eriogonum fasciculatum* matures, the overcrossing will be more promising for Quino. 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. In 2020 we did not detect Quino in this area, which could be due to the timing of the surveys and the encroaching non-native grasses that are taking over the open areas where Quino bask and mate. Our visits to Magee Hills were somewhat scattered. Our first two visits were about nine days apart, on 25 February and 6 March, but our third and last visit was a month later on 3 April. On the first two visits *Plantago erecta* was starting to flower and by the time we returned on the third visit, the host plant was already senescing. There were open areas filled with nectaring sources but the open areas are becoming smaller due to the non-native grasses and *Brassica tournefortii* (Sahara mustard). In the absence of management to reduce the cover of these invasive species, Quino may become extirpated from this area, especially if their basking and mating sites disappear with the increase in non-native vegetation. Over 13 years surveying this site, we have been successful at detecting a small but persistent population of Quino approximately 46% 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 (Figure 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, had a few patches of *Castilleja exserta* and had large, open areas. Several areas around these sampling stations are continuing to see non-native grass growth and habitat suitability has been slowly decreasing over the past decade. The Johnson Ranch/Lake Skinner Core area continues to be one of the best areas to find Quino in Western Riverside County and we plan to expand our search in this Core area next Quino season.

As the Protocol continued evolving throughout the years, in 2019 came a change that defined all sentinel sites equally. In 2018 rather than treating the whole Oak Mountain Core area as a sentinel site (as was done prior to 2018), 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 2019, we constrained our efforts further by selecting one sampling station as our sentinel survey, which can impact the number of Quino once more. All three of our sentinel sites are now defined by one sampling station each. In 2020 we detected more adult Quino in the Silverado/Tule Peak area (n = 111) and in the Multi-Species Reserve (n = 69) than we did in Oak Mountain (n = 9) (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. In 2018 the cover of *Lepidium nitidum* decreased, probably due to the lower annual precipitation compared to 2017 (Appendix B). In 2019 and 2020 *Lepidium nitidum* was still present throughout the sampling station.

In 2020, Oak Mountain's Quino detections were low. A total of 10 adult Quino was detected, nine at the sentinel site and 1 at the neighboring sampling station (Table1, Table 2). These low observations of Quino could have been due to how the visits were spread out. If we would have continued to visit the area weekly, our adult Quino detections could have been higher. We detected adult Quino on the second, 21 February, and fourth visit, 6 March, to Oak Mountain. The third visit to Oak Mountain (26 February) was cut short due to cool temperatures and windy conditions. There was a gap of almost two months before we scheduled the fifth, 30 April, and sixth visit, 7 May. The large gap between the fourth and fifth visit was due to the Corona Virus pandemic. The pandemic had us stop and reassess our survey efforts. We could no longer share the use of company vehicles to help avoid the spread of the virus so during this time we could not travel to Oak Mountain. It is almost essential to use a 4-wheel drive vehicle to commute to the sentinel site and surrounding sampling stations. Hiking the road is possible but would take plenty of survey time to do so. Instead, we chose to survey other areas until we had once again access to a 4-wheel drive vehicle to then visit Oak Mountain two more times.

We did not find Quino in the Wilson Valley Core area in 2020. Only one Quino has been detected in this Core area over the past nine survey years (Appendix B). We were able to survey the sampling stations where Quino was last documented but we cannot claim to have thoroughly searched this entire area, which is extensive. We did find some large patches of *Plantago erecta* and *Collinsia concolor* but also non-native vegetation encroaching on some open areas. We did expand our search in other areas of the Wilson Valley Core and found potential habitat, even though some of our visits were a little late in the season and the host plants were senescing. There could be a complexity of reasons as to why Quino might not be present in some areas such as urbanization, climate change, and a decrease in wildflower production (Preston et al., 2012). As the habitat keeps changing, we want to make sure we survey our historical sites as well as surrounding areas and continue expanding the search for Quino in the Wilson Valley Core area.

This is the 13 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 197 adult Quino detected (Table 2) during the adult Quino surveys (includes incidentals). 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 from 2017through 2020 which bodes well for the persistence of this meta-population. Our first Quino observations in this area were during our first visit on 31 March and we were unable to return until 15 April. The one-week gap of surveys between the first and second visit was due to rain. The cold and rainy weather conditions would not be suitable for butterflies, so it was decided not to survey at that time. After the second visit we were able to visit weekly. We did not find Quino at the Anza-Borrego site, east of Tule Canyon Road, and at the Beauty Mountain site. We visited the Anza-Borrego site four times on 15, 23, and 29 of April and 8 May. We visited the area close to weekly and no Quino were found, despite the presence of host plants and nectaring sources. The Beauty Mountain site was visited three times on 12, 15, and 22 May. We didn't visit Beauty Mountain until later in the season and it is possible we missed the Quino flight season in that area. More Quino may be found in these areas if we expand our survey effort during future site visits.

We did not detect Quino in Brown Canyon in the Cactus Valley satellite occurrence complex in 2020. 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 Brown Canyon area with suitable habitat and were successful at detecting Quino (Appendix B). We returned to those sampling station in 2020 twice on 28 February and 14 April and detected large patches *of Plantago erecta* and *Castilleja exserta* but no Quino. There is about a month and a half gap between both visits to Brown Canyon, which was largely due to the Corona Virus pandemic and the lack of 4-wheel drive vehicles. On the 14 April we hiked in as a last effort to detect Quino but were unsuccessful. There is a possibility that we missed Quino in this area completely due to not visiting the area regularly. The presence of non-native grasses is dominant in some areas but there is still good suitable habitat and we cannot claim to have thoroughly searched this entire area. We plan to continue to survey the Cactus Valley satellite occurrence complex in this area to determine the extent of Quino distribution.

The new area surveyed this year was the Aguanga satellite occurrence complex. Surveys were done early in the season on 24 February then again until 22 April and a third visit on the 24 April. No Quino was detected in this area. A reason for this could be due to timing of the surveys. We waited too long to survey between our first and second visit that we most likely missed the Quino flight season. We plan to continue surveying in this area next year.

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 (USFWS 2002, 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). In 2020 we decided to visit the northern area of Hartford Springs Park, mainly for training purposes, and did not detect any Quino. There was plenty of non-native grass throughout the area surveyed and did not detect any host plants. It is not likely that we will be visiting this area in the near future.

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, sentinel site locations will need to shift accordingly.

We have not detected Quino in the Warm Springs Creek Core area over the past 12 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 bridge that spans Clinton Keith Road (completed in 2018), 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 starting in 2020. During our first year of monitoring the wildlife bridge, we detected host plants on the overcrossing as well as some young shrubs, such as *Eriogonum fasciculatum*. *Eriogonum fasciculatum* seems to play an important role in habitat restoration for Quino in dry areas (Pratt and Emmel, 2010), such as the Warm Springs Core. We recommend that survey efforts be expanded to other areas with suitable habitat within this Core and for encroaching non-native grasses to be removed.

In 2020, we were able to expand our scouting and surveying efforts to include the Aguanga Satellite Occurrence Complex and the Wilson Valley Core area. We were only able to visit the Aguanga area three times and two of those visits were late in the Quino flight season. Quino continue to occupy the Wilson Valley Core area in small numbers, but these occupied 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. In 2019, we expanded our surveys to a new area of Wilson Valley, adjacent to Wilson Valley Road, and those areas were again surveyed in 2020 but it was a little late in the Quino season and no Quino were detected. Suitable habitat was detected in these new sampling stations in Wilson Valley so it would be appropriate to return to survey these areas and others during the Quino flight season. Habitat adjacent to Wilson Valley Road has been quite reliable for Quino sightings in the past. We intend on surveying both the Aguanga and Wilson Valley areas 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 (ranges in elevation between 1600-1900 m), 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. Also, we have to remember that in order for Quino to move to areas of higher elevation there needs to be connectivity to facilitate their movement, and not blocked by urban environments (Parmesan et al., 2014). 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 more areas of 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 Biological Monitoring Program discovered a new, reliable location for Quino in 2012. In 2018-2020 we surveyed a Wash just north of Horse Creek and found Quino in 2020. Due to lack of time and personnel we have not been able to survey our original Horse Creek site. 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 2010. It would be interesting to know the full extent of this Quino population and other populations in Bautista Canyon.

We also should focus our attention at Magee Hills in the Sage Core area since we detected Quino on and off in this area in the past. The last year Quino was detected at Magee Hills was in 2018. Too much growth of non-native grasses and other invasive plant species is changing the habitat in this area. Management is necessary for Quino to continue the use of Magee Hills. We intend to continue surveys in this area during future survey efforts.

The Lake Mathews/Estelle Mountain/Harford Springs Core area has not been surveyed since 2012. In 2020, we surveyed an area north of Harford Springs Park and found large amounts of non-native grass. This area did not seem suitable for Quino but there is much more area to consider. We cannot say this area has no suitable habitat since only a small portion of the Park was surveyed. There is no sufficient justification to restart surveys in this Core area (e.g., active translocation of butterflies, reported incidental observations), but if time allows, a revisit to re-evaluate for potential suitable habitat could be useful information.

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 vegetation and other habitat conditions at occupied areas compared to unoccupied areas. It is also possible that some areas with habitats that are suitable for Quino are not occupied due to barriers to dispersal, development projects, drought conditions, or other factors preventing Quino from occupying the site. More research is needed to determine if the restricted

distribution of Quino is a condition that will persist or, if 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. Almost annually we have Quino detections in this area from the Biological Monitoring Program biologists and CNLM.

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.

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Appendix A. Butterfly and Moth species, listed by family, observed during 2020 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*)
- Desert orangetip (*Anthocharis cethura*)
- Sara orangetip (*Anthocharis sara*)
- Cloudless sulphur (*Phoebis sennae*)
- Southern dogface (*Zerene cesonia*)

Coopers, Hairstreaks, & Blues (Lycaenidae)
- Gray hairstreak (*Strymon melinus*)
- California hairstreak (*Satyrium californica*)
- Brown elfin (*Callophrys augustinus*)
- Perplexing hairstreak (*Callophrys perplexa*)
- Silvery blue (*Glaucopsyche lygdamus*)
- Marine blue (*Leptotes marina*)
- Acmon blue (*Plebejus acmon*)
- Lupine blue (*Plebejus lupinus*)
- Echo azure (*Calastrina echo*)
- Western tailed-blue (*Cupido amyntula*)
- Western pygmy-blue (*Brephidium exile*)

Metalmarks (Riodinidae)
- Behr's metalmark (*Apodemia virgulti*)
- Wright's metalmark (*Calephelis wrighti*)

Brushfoots (Nymphalidae)
- Gabb's checkerspot (*Chlosyne gabbii*)
- Chalcedon checkerspot (*Euphydryas chalcedona chalcedona*)
- Leanira checkerspot (*Chlosyne leanira*)
- West coast lady (*Vanessa annabella*)
- Painted lady (*Vanessa cardui*)
- American lady (*Vanessa virginiensis*)
- Red admiral (*Vanessa atalanta*)
- Lorquin's admiral (*Limenitis lorquini*)
- California tortoiseshell (*Nymphalis californica*)
- Mourning cloak (*Nymphalis antiopa*)
- Common buckeye (*Junonia coenia*)
- California sister (*Adelpha bredowii*)
- Mylitta crescent (*Phyciodes mylitta*)
- Queen *(Danaus gilippus)*
- Common ringlet (*Coenonympha tullia*)

Skippers (Hesperiidae)
- Funereal duskywing (*Erynnis funeralis*)
- Propertius duskywing (*Erynnis propertius*)
- Pacuvius duskywing (*Erynnis pacuvius*)
- Mournful duskywing (*Erynnis tristis*)
- White checkered skipper (*Pyrgus albescens*)
- Northern white skipper (*Heliopetes ericetorum*)
- Juba skipper (*Hesperia juba*)
- Sandhill skipper (*Polites sabuleti*)

Night Moths (Noctuidae)
- Unidentified night moths

Geometer Moths (Geometridae)
- Unidentified geometer moth

Tortricid Moths (Tortricidae)
- Leafroller moth (Tortricidae)

Appendix B. Core area and satellite occurrence complex detections and average precipitation (inches) from 2008-2020

Core area	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Lk Mathews/Estelle/ Harford Springs	0[†]	0	0	0	0	--	--	--	--	--	--	--	0
Warm Springs Creek	0	0	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	1	1
Oak Mountain	1	1	1	1	1	1	1	1	1	1	1	1	1
Wilson Valley	1	0	1	1	0	1	0	0	0	0	0	0	0
Sage	1	0	1	0	0	1	0	1	0	1	1	0	0
Silverado/Tule Peak	1	1	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	1	1
Cactus Valley	0	0	1	0	0	0	--	--	--	0	1	0	0
Anza Valley	--	--	--	--	--	0	--	--	--	--	--	--	--
Aguanga	--	--	--	--	--	--	--	--	--	--	--	--	0
Estimate annual precipitation (NOAA, 2021)	17.5”	15”	20"	30”	15”	12.5”	12.5”	15”	16.25”	30”	8.7”	25”	15.0”

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