

SENSITIVE BUTTERFLIES



OF SAN DIEGO COUNTY, CALIFORNIA

PRESENTED BY

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San Diego's Sensitive Butterflies

A Workshop Focusing on Nine Local Species

December 2012

Introduction

This Workbook details the biology of San Diego County's most sensitive butterflies. The Workshop will discuss in detail species that are either listed as protected under the Federal Endangered Species Act (ESA), narrow endemics or of special concern.

Each species' known biology; including larval host plants, diapause condition, adult flight season, and expected habitats and conditions are presented. Field markings are shown to help identify and separate these from similar butterflies. Additionally, any conservation issues will be addressed.

As you begin to understand the biology of these butterflies, we hope you have a better appreciation for invertebrate conservation, especially butterfly conservation, a topic which is not always black and white. Many natural and man enhanced factors affect the life cycle of insects. At times it is not one or two situations that affect their abundance but a combination of many factors. This makes conservation efforts difficult, leading to continued research and observation.

It is hoped that from this Workshop an interest and desire to document your observations with such data as temperature, time of day when there is butterfly activity, nighttime resting locations, parasitism, and possible nectar plant preferences, will result. This information is critical in developing better methodologies and guidelines for conservation.

San Diego County Butterflies

As a taxonomic Class, insects have the greatest species diversity in the world. Beetles (Order: Coleoptera) have the largest number of species with over 350,000. Second is Butterflies, Moths and Skippers (Order: Lepidoptera) with over 112,000 described species. In the United States and Canada there are an estimated 14,400 species of Lepidoptera with over 800 species of butterflies and skippers, and 13,600 species of moths. Within San Diego County, approximately 153 butterfly species and subspecies occur. Total County Lepidoptera species is estimated to be over 3,000, of which 2,800 are moths. Currently, there are 1,396 moth species documented in San Diego County, less than 50% of the estimate. More effort needs to be made in establishing actual moth diversity along with relative abundance.

Quino Checkerspot (*Euphydryas editha quino*)

The Quino checkerspot butterfly (QCB) was listed as federally endangered on 16 January 1997. It is a subspecies of Edith's checkerspot (*Euphydryas editha*), which is distributed from British Columbia and Alberta, Canada, south into Baja California, Mexico. All of the 26 subspecies utilize plants within **Plantaginaceae** or **Orobanchaceae** as larval host plants. Four subspecies occur in southern California. Two are found in the San Bernardino and San Gabriel Mountains and one is endemic to Santa Rosa Island. The subspecies *quino* is the only *editha* that occurs in San Diego County.

Taxonomy

The taxonomy of QCB was revised a number of times. Behr first described it as *Melitea quino* in 1863. William G. Wright (1905) in West Coast Butterflies placed it as *Melitea augusta*. William S. Wright (1907) in his Annotated List of the Diurnal Lepidoptera of San Diego County, California, based on collections during 1906 and 1907, identified it as *Lemonias quino* and noted that it has occasionally been misidentified as *Melita augusta*. Gunder (1929) incorrectly assigned “*quino*” to the *Editha chalcedona* complex. This was based on collections from eastern San Diego County that later became *Euphydryas chalcedona hennei*. Hoffmann (1940) placed “*quino*” as a subspecies of *editha* but named it subspecies *wrighti*. This remained until Emmel (1998) placed it under *editha*.

Distribution

The historic distribution of the QCB included Los Angeles, Orange, western Riverside, southwestern San Bernardino and San Diego Counties as well as locations in northern Baja California, Mexico. Distribution and abundance has declined steadily over the years, first disappearing from Los Angeles County and then Orange County by 1967. It was thought to be extirpated in Riverside County until rediscovered on Oak Mountain in 1990. Since that time, other populations have been found in western Riverside County. The San Diego populations have declined over the years but new colonies have been documented. In the southern part of the County, they are known from Otay Mesa east through Otay Mountain, Jamul, Barber Mountain, Marron Valley, Tecate Border Crossing, Potrero, Campo/Manzanita, La Posta, McCain Valley and Jacumba. Within the west-central part of the County observations are from Mission Trails Regional Park, Sycamore Canyon County Park, near San Vicente Reservoir, Poway, Miramar Air Station, Santee and Alpine. From the north County records are from the northeast slopes of the Cleveland National Forest near Oak Grove. Some of the observations have been reconfirmed and others have not. To date the south County observations within Otay Mountain through Jamul and Marron Valley have been the most consistent and contain the largest number of individuals. The other locations have fluctuated with low numbers of individuals. Potrero through McCain Valley are new observations but data is limited to a few locations. However, some have multiple years of observations to validate occupation.

Biology

The life cycle of the QCB is usually univoltine. That is, it needs about one full year to go from egg to adult. Published larval host plants are dot-seed or dwarf plantain (*Plantago erecta*), woolly plantain (*Plantago patagonica*), white snapdragon (*Antirrhinum coulterianum*), Thread-leaved bird's beak (*Cordylanthus rigidus*), purple owl's clover (*Castilleja exserta*) and southern Chinese houses (*Collinsia concolor*). Depending on timing and amount of annual rainfall, timing of the annual rains, elevation and temperatures, some of these plants can be utilized as pre-diapause (rest) or post-diapause plants. Looking at these same variables some will be primary or secondary host plants during the pre-diapause cycle of the caterpillars. If a host plant senesces (dries up) prior to the caterpillar reaching its third or fourth instar (molt) then they will move to a secondary host plant to complete its growth. Depending on timing of the annual rains and elevation, the host plant's phenology (timing of development) will dictate larval feeding. First and second instars move approximately 30 centimeters. Third or fourth instars could move up to one meter; therefore, primary and/or secondary host plant must be concentrated within that area for larvae to disperse and complete their growth prior to diapause.

Females lay eggs (oviposit) at the base of the plant. This occurs during the adult flight season between March and May depending on timing of annual rains, elevation and temperature. She will deposit an egg cluster containing 20 to 150 eggs and she will not necessarily lay all of her eggs on one plant but may distribute clusters to a number of host plants. Incubation is about 10 to 14 days.

First instar larvae eat voraciously and grow to the third or fourth instar. If the primary host plant(s) senesce, then the secondary host plant becomes important for larval development. It is important to remember that the success of the species depends on reaching the third or fourth instar. The two most important factors affecting suitability of host plants for the butterfly's oviposition are exposure to solar radiation and the plant's phenology.

The third or fourth instar larvae will look for a sheltered area, curl up and enter into diapause. There are only a few butterflies that diapause in the larval stage and even fewer that diapauses as third or fourth instars in North America. The sheltered areas they seek are not entirely known but could include leaf litter under scrub plants, cracks within the soil, beneath small rocks or other areas within the shelter of scrub plants. Annual observations have been within buckwheat approximately 5 cm above the ground by Gordon Pratt. It appears that buckwheat density is more important for the butterfly than previously known and should be looked at when assessing habitat conditions and suitability. Klein, in March 2004, observed seven post-diapause larvae on the northern slopes of Otay Mountain. The location was affected by the October 2003 wildfires. This same area re-burned in October 2007 and post-diapause larvae were observed in January 2008.

Larvae remain in diapause through the summer, fall and into mid-winter. If rainfall is adequate and timely, the larvae will break diapause and seek out its primary host plant, now germinated. This could happen as early as early January or early February. Depending on elevation, this

cycle may occur in late February or well into March. The trigger that stimulates larvae to break diapause is still unknown. With periodic droughts, not uncommon, or irregular rainfall in Southern California, larvae can remain in diapause for multiple years.

There are many scenarios where larvae remain in diapause or delay their emergence. Examples are as follows:

- Winter rains are deficient and diapause extends one year or longer.
- Winter rains are deficient larvae emerge looking for food, find none, and return to diapause.
- Winter rains are deficient, larvae emerge looking for food, find limited sources, feed for a bit, and return to diapause
- Winter rains are deficient early larvae emerge looking for food, find none and return to diapause. Later rains are sufficient larvae re-emerge and complete their development.
- Winter rains are late but sufficient, larvae emerge later than normal and complete their development.

For this workshop, let's say caterpillars emerge from diapause and continues there life cycle. In January or early February they are **post diapause larvae** eating new growth host plants.

The larvae will grow to a fifth, sixth, or seventh instar. Mature larvae are approximately 25-30 mm long. They are black with nine rows of black and orange branching spines called scoli. Mature larvae pupate. This should happen in mid-February to early March. Pupae are dull white and marked with black blotches and streaks, with orange spots. They are not easy to find and are located near the ground in silken shelters using leaf litter or concealed among small rocks. Pupation takes 10 to 15 days.

Adults usually emerge in March and fly through April with some early May records. Depending on elevation, winter rains and temperatures, adults could emerge from January through early April. Adults are considered a medium-sized butterfly about 21–27 mm in wingspan. As with all *editha*, the abdomen has orange bands. The dorsal fore and hindwings are banded with orange/red, cream and black. There is a slight variation in the size of the bands but the hindwings possess a thin cream margin followed by orange/red, then a thin black, cream, thin black and then thick orange/red band. It is important to note that the second (post-median) orange/red band is much thicker than any other *Euphydryas* found in the San Diego area. Also on the hindwing near the base is a cream cell almost entirely surrounded by orange/red. Again, this is different than any other *Euphydryas* found in the County.

Quino Checkerspot Butterfly Emergence Based on Winter Rainfall

Adults take nectar from low growing annuals such as popcorn flowers (*Plagybothrys* and *Cryptantha* sp.), lomatium (*Lomatium* sp.), goldenstar (*Muilla* sp.), yarrow (*Achillea millefolium*), fiddleneck (*Amsinkia* sp.), goldfields (*Lasthenia* sp.), gilia (*Gilia* sp.), and onion (*Allium* sp.). Flat-topped Buckwheat (*Eriogonum fasciculatum*) is also utilized. Flowers with deep corolla tubes are not visited by adults, i.e. monkey flowers (*Mimulus* sp.). Females are more selective in their nectar sources requiring flowers with high amino acid concentrations. This is important for egg maturity. Depending on emergence of low growing annuals and perennials, certain shrubs like sugar bush (*Rhus ovata*) or basket bush (*Rhus trilobata*) could be important sources of nectar early in the season, especially at higher elevations. Therefore, your search image may not be restricted to ground searches for adults.

QCB have been observed to “hilltop,” in which males and virgin females will go to a ridge or hilltop and court. There is documentation and observations where this behavior has occurred even in the absence of host plant, on or in close proximity to the top of the hill. There are differences of opinion in the literature about this but because the USFWS Protocols note it, it is important to be aware of this behavior. “Hilltopping” is also common by other species of butterflies as well as beetles, wasps, bees, and flies.

Habitat / Conditions

Where a species occurs or exists is considered its habitat. With insects, habitat can be very restrictive or broad. The QCB habitat is difficult to define because its recorded range in the early part of the 1900’s to the present has been altered dramatically. Historically, QCB were found in low elevation coastal open areas, near vernal pools with patches of *Plantago*. It was also known only from the San Diego coastal area. Today, the plant communities are not as restrictive as some species of butterflies. QCB can be found in coastal habitats of sage scrub, and inland chaparral. They can also be found in open meadows adjacent to coastal sage scrub, chaparral and oak woodland as well as juniper woodland and semi-desert scrub. An important aspect is that these habitats must have open areas with low growing and sparse vegetation. Thick or closed stands of sage scrub and chaparral are unsuitable for the larvae. Meadows that have thick continuous grasses with no open areas are also not suitable to the adult. As previously mentioned the female must deposit her eggs at the base of the host plant and needs open areas to maneuver and accomplish this task. Even though host plants can grow in thick vegetation, the larvae require plants to be in open or sparsely vegetated areas so that they can bask in sunlight and regulate their body temperatures.

Other conditions that are suitable for QCB are old foot trails and dirt roads, especially along hilltops. Open dirt roads provide a good environment for hilltopping males to rest from their patrolling. Another suitable condition is the presence of clay soils and cryptogamic soil crusts. Cryptogamic crusts usually consist of algae, lichens, liverworts, and mosses. These two soil types favor host plant growth.

Habitat suitable for QCB can vary, but with fragmentation (changes in the land use which disrupts adult movement, and isolates or reduces resource availability) their populations can be devastated. Because of these fragmented areas, connectivity between them becomes important

for dispersal and population movements for maintaining the gene pool. Dispersing adults are not high or long distance flyers. Basic flight behavior is from approximately three feet high from the ground. Natural barriers such as tall dense chaparral are impediments for dispersal to other populations or new sites. However, observations have confirmed they can fly over tall chaparral. Also, the average dispersal distance is between one and three kilometers. Recorded observations of the Bay Checkerspot (*Euphydryas editha bayenesis*) indicate dispersals further but that is not considered the norm. Suitable stop-off points (stepping-stones) along their dispersal route need adequate nectar plants, open areas and, scrub in which to rest.

Micro-habitat patches occupied by adults and immature stages, with adults dispersing to suitable 'satellite' patches within its known dispersal range, is known as a metapopulation. A metapopulation is a population of populations (Levin, 1970) in which distinct subpopulations occupy spatially separated patches of habitat. The FWS note three theoretical types of metapopulations: mainland-island, source-sink, and classic Levin's (FWS, 2003).

Levin defines a metapopulation as each population cycles in relative independence of the other populations and eventually goes extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the population, the more prone it is to extinction (Williams, 2012).

Source-sink is occupied by two patches of habitat. One patch, the source, is a high quality habitat that on average allows the population to increase. The second patch, the sink, is very low quality habitat that, on its own, would not be able to support a population. However, if the excess of individuals produced in the source frequently moves to the sink, the sink population can persist indefinitely.

The FWS believes QCB hold to the mainland-Island metapopulation type where a known core-population may 'blink-out' periodically and eventually re-colonize and the 'satellite' population(s) may in turn act like a core-population and in turn 'blink-out'. Whatever the distance a satellite habitat-patch is from a core-patch, the required corridor(s), and available nectar resources must always be present. If the corridor is altered, it will cause core or satellite patches to become un-occupied in the short-term to never being occupied again.

According to the FWS local habitat patches of Edith's Checkerspot populations are generally composed of a set of larval host plants 'micro-patches' within a typical flight range of adults which is about 50-200 meters (160 - 660 feet) therefore comprising a greater adult "habitat patch." Based on Quino host plant micro-patches for approximately 100 adults of which 50 would be females they would need 3 - 4 micro-patches of host plants each to lay their eggs. Therefore if we have 50 females in a habitat patch we would need 150 - 200 micro-patches of host plants to sustain a population. If micro-patches are spacially a few centimeters apart an occupied habitat patch could be about 50 - 200 meters. If micro-patches are further apart, sustainability of the population would be harder and 'blinking-out' of a population would be more expected. Timing and how long a population would blink-out for is still undetermined. Some populations have blinked-out to the extent that they are now extirpated, i.e. Lake Mathews, Riverside.

Even though the Quino Protocol provides a broad-base suitability of a sight, understanding rainfall and habitat-patches are critical to assessing a sight for higher or lesser expectation of finding adults.

Due to the wildfires of 2003 and 2007, it is unclear what the long term impacts will be. Benefits from the removal of exotic weedy vegetation would allow expansion of native nectar resources and host plants. The removal of dense vegetation may provide dispersal corridors or occupation by the butterfly. If the seed base is intact, then over time the tall dense vegetation would grow back and create a less suitable environment. If quino now occupy these open areas, they would eventually be displaced. Detriments would be the open areas displaced with exotic weedy vegetation and out-compete the native vegetation, making conditions unsuitable for the butterfly to occupy.

Other Butterflies Confused With QCB

There are a number of other butterfly species the QCB could be confused with in adult wing coloration, flight, behavior or larval appearance. These will be examined and the differences discussed.

Buckeye (*Junonia coenia*) – The adult would not be confused with QCB based on its wing markings, but the caterpillar can be challenging. Both QCB and Buckeye larvae use *Plantago erecta* as its host plant. The significant difference between the two larvae is that buckeyes have an orange head and QCB's is black. The Buckeye's body has all black tubercles with tiny blue spots at the base. QCB has nine orange tubercles.

Painted Lady (*Vanessa cardui*) – The main reason for misidentification is the orange in its wings. When the Painted Lady flies past you or is resting on a rock or the ground with its wings opened, you might mistake it for QCB. The Painted Lady does not have the black, orange and white checkering of QCB. It has spots in the hindwing and QCB does not. The flight behavior of the Painted Lady is more active and aggressive compared to QCB. There are times when this butterfly has large dispersal flights during the QCB flight season. Their flight behavior is more focused and mostly in a northerly direction. QCB will not have that type of a behavior as well as having significantly smaller numbers.

West Coast Lady (*Vanessa annabella*) – Conditions are the same as Painted Lady.

Virginia Lady (*Vanessa virginiensis*) – Conditions are the same as Painted Lady.

Mylitta Crescent (*Phycoides mylitta*) – Size is a distinct feature. Mylitta Crescents are usually smaller than QCB. They do not have the black, orange and white checkering but rather black spots in its hindwings and a cream colored crescent on the margin of its hindwing. This feature is more easily seen from the ventral.

Leanira Checkerspot (*Chlosyne leanira*) – This species is often confused with QCB. The differences, though, are quite significant. Leanira has white bands on the abdomen and QCB has orange. Its forewings, near the body, have an orange 'splash' effect where QCB has black. In a

worn specimen of QCB, the orange cell next to the black could appear to blend into the body like that of *Leanira*'s. *Leanira* has a cream colored third band whereas QCB is orange. The ventral is also diagnostic. *Leanira*'s ventral hindwing is all black and white. There is no orange. QCB has the similar banding on the ventral hindwing as its dorsal hindwing.

Gabb's Checkerspot (*Chlosyne gabbii*) – This butterfly has caused more confusion in identification than any of the others. The differences are Gabb's white bands on the abdomen and orange on QCB. Gabb's does not have the black, orange and white checkering like QCB but in males is more of a uniform orange throughout with thin black bands between the orange. The female may cause the greatest confusion. The lack of the intense orange/red bands will help. Also, the forewing will be scalloped (cut in) versus the rounded structure of the quino. Here again, worn specimens of QCB can be easily misidentified.

Chalcedon Checkerspot (*Euphydryas chalcedona chalcedona*) – As mentioned above, the QCB used to be taxonomically part of this species complex. Yet, the features that distinguish them are fairly easy to see. Chalcedon has white spots on the abdomen whereas QCB has orange bands. Chalcedon has mostly black and white bands in the hindwings with an orange margin. QCB has the orange, white, orange, black banding. Some of Chalcedon's third margin on its hindwing may vary with the amount of orange or sometimes be devoid of any orange speckling. Chalcedon's forewings are more angular whereas QCB's is more rounded. Larvae can also be confusing with Chalcedon having eight orange scoli to quino's nine. The overall color is more grayish due to the white speckling throughout versus quino's more blackish color.

Henne's Checkerspot (*Euphydryas chalcedona hennei*) – Like Chalcedon, the abdomen has white spots instead of orange bands. Also, the third band on the hindwing is more yellow whereas QCB is orange. They also have a tendency to be smaller than *chalcedona chalcedona*. A worn Henne's can cause frustration in its identification. Henne's is more of a desert edge species and overlap QCB in McCain Valley and Jacumba in San Diego County. Careful observation needs to be done to accurately separate these species.

Conservation

The QCB is threatened by urban and agriculture development, non-native plant invasion, off-road vehicle use, nitrogen deposition from internal combustion engines, grazing and fire management practices, and introduced exotic invertebrates, i.e. earwigs and pillbugs. Predation by Argentine ants (*Linepithema humilis*) and imported fire ants (*Solenopsis* sp.) has been observed, especially in areas that had previous historical occupation. Because of these factors, decline of habitat quality and extirpation of the butterfly will continue. Current known parasitoids are tachinid flies on the larvae. Further studies are being conducted on other possible parasites.

Since the QCB is a federally listed species, the US Fish and Wildlife Service has survey protocols for biologists who have a 10(a) permit. The permitted biologist who does a protocol survey will assess the habitat quality and identify which areas, if any are suitable to the butterfly. When announced by the Service, adult flight season surveys can then be conducted in accordance with the protocols. Sightings are mapped and hopefully photographed and provided to the Service in accordance with the protocols. The Service has finalized the Recovery Plan and

has designated critical habitat and core populations for the butterfly.

Stabilizing and recovery of the QCB is still very much in question. Defining habitat requirements, reducing fragmentation of colonies (metapopulations dynamics), and defining and establishing 'corridors' are going to be important for recovery. All we can presently do is continue to map appropriate areas and survey over both wet and dry seasons for its presence.

Laguna Mountains Skipper (*Pyrgus ruralis lagunae*)

The Laguna Mountains Skipper (LMS) was listed as federally endangered on January 16, 1997. It is a subspecies of the Two-banded Skipper (*Pyrgus ruralis*), which is widespread but not found in large numbers, from British Columbia and Alberta, Canada south through the Cascades and Sierra Nevada Mountain ranges. It is also found in Northern Utah and Colorado. When looking at range maps, LMS is an isolated subspecies separated by hundreds of miles from the nominate *ruralis*.

Taxonomy

The taxonomy is fairly straightforward. The species was first described by Boisduval in 1852 as *Syrichtus ruralis*. In Holland's (1898) The Butterfly Book – A Popular Guide To A Knowledge Of The Butterflies Of North America, he called it *Hesperia caespitalis*. It was placed in the genus *Pyrgus* in William G. Wright's book The Butterflies Of The West Coast (1906). Comstock (1926) in his Butterflies Of California puts it under *Urbanus ruralis* and notes "it is listed as *caespitalis* in the majority of collections." The Annotated List Of The Butterflies Of San Diego Co. by William S. Wright (1930) keeps the same name as Comstock. But this is the first account of the species being collected in San Diego County. It is also the first indication of a butterfly that may be different from the known species in central and northern California. Wright states, "One specimen taken on Palomar Mountain in July seems to represent this species. It is, however, somewhat lighter in color than more northerly captures." The specimen was collected 17 July 1927.

The subspecies was finally described by James Scott (1981). As he was working on his book, The Butterflies of North America, he published a paper establishing both common and scientific names to previously undescribed subspecies. This paper describes the Laguna Mountains Skipper, and Scott used specimens that Fred Thorne collected in 1956 from the Laguna Mountains. The type locality of this subspecies is Big Laguna Lake meadow.

Distribution

This skipper is endemic to San Diego County. Its distribution is restricted to the Palomar and Laguna Mountains. Other possible locations, based on host plant records, are the Cuyamaca and San Jacinto Mountains. The known locations are well documented and include a mixture of public and private lands. It has not been observed in the Laguna Mountains for a number of years even with annual surveys for the past ten years. On Palomar, they have been observed annually on the Mendenhal Ranch, Observatory Campground and the Girl Scout Camp (Iron Springs). In 2006 they were observed further north and west within the Lower French Valley area with reports to as many as fifty in one area.

Biology

The skipper is bivoltine (two generations per year). The first adult flight season is between early April to late May with the second from late June to late July. After the second generation, mature caterpillars will pupate and diapause. It has been observed that the final instar weaves

leaves together where pupation occurs.

Females oviposit on the underside of the larger, outer fresh green leaves of Cleveland's *Horkelia* (*Horkelia clevelandii*), its primary larval host plant. The plants selected are usually within a group of several plants. Oviposition has been found on plants in rocky or thin soils approximately 90 to 100 feet from the forest edge. For the first generation, the locations of host plants are in areas where the vegetation density is less than 50%. Open bare ground in association with rocks is important for adults to thermoregulate. Oviposition during the second generation is still on the underside of *Horkelia* with less grouping due to grazing and drying plant leaves.

Once mated, females immediately begin to lay eggs. Gordon Pratt performed a study in 1999 to test hypotheses from work performed by others in 1994 through 1998. One of the tests provided preliminary host plant patch size females would select. His results for the Mt. Palomar area were anywhere from .02 to .7 square meters. Once ovipositing is completed, females will usually die within the week. Males, though, continue to seek out receptive females and have a life span of approximately 20 days.

Eggs hatch within 10 days. Larvae begin eating the healthier leaves of its host plant. Evidence of larval feeding will be the damaged leaves. Leaves rolled and turned is evidence of the larvae's evening resting spot. They roll the *Horkelia* leaf and close it with silk leaving it open at both ends. Certain species of moths that feed on *Horkelia* or *Drymocallis* will roll the leaf into a tight ball and are opened at one end only. The rolled leaf of the last instar becomes its shelter for pupation. Larval development takes anywhere from 20 to 40 days depending on seasonal rains and temperatures. Pupation within the rolled leaf lasts about four weeks for the first flight season and is the winter diapause condition for the second flight season.

Mature larvae are cylindrical, yellowish – greenish-white and covered with fine hairs. The capsulated head is black, width larger than the thorax. LMS has five instars and will overwinter as pupae in the second generation.

From current accounts known, adult males patrol meadow areas near the forest edges looking for receptive females. Females tend to remain near the host plant. On average, most adults will live up to 20 days after emerging. During the first generation, adults are seen nectaring on goldfields, *Pentachaeta*, buttercups, *Ranunculus*, checker, *Sidalcea*, and mustard. During the second generation, adults prefer *Horkelia* and *Lotus*, since they flower into the summer.

Adults are white and brown with a wingspan of anywhere from 3 to 4.5 cm. The adult male looks different from the nominate *Pyrgus ruralis ruralis* male with more white markings on the wings as well as banding patterns in the hindwings. This gives an overall whitish appearance whereas *P. ruralis ruralis* is darker in appearance.

Habitat / Conditions

LMS has a fairly restricted habitat and set of conditions for its survival. This skipper is specifically a mountain meadow species with its primary host plant being *Horkelia clevelandii*.

Two alternative host plants are *Drymocallis glandulosa* and *D. gracilis*. *Drymocallis* is the primary host plant for *Prygus ruralis ruralis*. In a controlled laboratory experiment with all three plants available, females laid eggs on *glandulosa* with one egg laid on *gracilis* and none on *clevelandii*. Captive reared larvae also feed on other *Horkelia* species.

In 1998 Mattoni theorized that LMS could have three host plants. His theory also provides specific conditions where the larvae would be found. *Horkelia clevelandii* is a meadow species associated with a meadow–forest interface. *Drymocallis glandulosa* is largely associated with forest understory and *Drymocallis gracilis* is exclusively associated with meadows. We mention this because management of the skipper will most probably include all three plants as well as factors affecting skipper movement and dispersal.

In either of the above cases, optimum oviposition was on plants where vegetation coverage was 50% or less. When surveying for appropriate habitat, thick grassy meadows would be inappropriate for this skipper to oviposit. It is still possible to observe adults nectaring in areas where vegetation is thick.

Since there is the possibility of LMS using *D. glandulosa*, discussions have come up about amount of sun to percent of shade. Studies still need to be conducted to determine how much or how little direct sunlight is needed.

For this workshop, we consider *Horkelia* the primary larval host plant and present the conditions needed for this skipper. We also note these conditions for each generation since they are going to be slightly different. *Horkelia* is found in the mountains of San Diego County, the San Jacinto Mountains and northwestern Baja California, Mexico. The plant is found at elevations between 1,200 and 2,500 meters (4,000 and 8,000 feet). The first generation LMS as it emerges from pupation will actively seek mates. Females will be on or near their larval host plant attracting males for mating. The *Horkelia* selected will be thick patches within a meadow that has vegetation density of about 50%, which includes the *Horkelia*. Many studies have been done on the grizzled skipper (*Pyrgus malvae*) in England and its relationship to ovipositing on *Horkelia* sp. there. The studies appear to show that ovipositing was preferred on thick patches of plants, surrounded by bare ground.

The second generation begins with adult emergence from the previous generation. As before, females and males will behave in similar fashion but the *Horkelia* is now more sparse and dry. Therefore, conditions are more difficult to define. You will still be looking for 50% vegetation coverage and thick patches of host plant. But your search image will increase because you are not going to have larger, greener leaves to guide you except for drainages with permanent water. You will have some assistance because the primary nectar plant for LMS is *Horkelia*. By July, many of the flowering annuals have dried up and the major insect activity will be on *Horkelia*. So, as you find more flowering *Horkelia*, chances are better at finding adult LMS along with eggs and larvae. Non-flowering *Horkelia* would be less appropriate for the butterfly. Egg and larval cycles are approximately the same as the first generation. Diapause occurs in the pupal stage. Your search image would remain the same as with the initial generation.

Other Butterflies Confused With LMS

There are three common skippers with which LMS could be confused. A fourth one, the Common checkered skipper (*Pyrgus communis*) is mentioned but there are no records of this skipper in San Diego County and one record in northern Riverside County.

Large (Northern) white skipper (*Heliopetes ericetorum*) – Upon seeing this skipper in the field, you can easily distinguish it from LMS. This skipper is larger and whiter than LMS. Its flight behavior can, at times, appear similar and its habitat is also similar. But once you observe it, the amount of white, even while flying, would make this skipper easier to identify.

Small checkered skipper (*Pyrgus scriptura*) – Range makes this skipper of little concern. This skipper is more likely to be found down the eastern slopes into the desert. LMS is not expected to travel down the slopes. There is always a possibility of weather conditions pushing this skipper up the canyons and observing it at higher elevations. If there is a chance for overlap, a couple of the distinguishing features are the smaller size and the hindwing lacks the two bands. This is really the feature to focus on. The hindwing is much browner with a white cell in the center of each hindwing. The forewing is not as white-checked as LMS but this can sometimes be deceiving. The hindwing will be the main diagnostic feature to look for.

Western checkered skipper (*Pyrgus albescens*) – This skipper will cause the greatest confusion. Their flight seasons overlap. Habitat conditions also overlap and LMS's second generation can be found nectaring on the same plants. Male *albescens* are similar in size to LMS but *albescens* will have more white throughout the fore and hind-wings. The female *albescens* look very similar except *albescens* will usually be larger. The hindwing in LMS has the diagnostic two-bands. Band one on LMS is thicker whereas in *albescens* it is much thinner. The second band in both looks similar. The forewing is where you will identify this species. *Albescens* has the 'traditional' checkered patterning where in LMS there is a wavy pattern that creates the appearance of an 'X'. When you see the 'X', you have *ruralis*. If you are in San Diego, it can only be *lagunae*.

Conservation

Since this skipper is federally listed, capturing individuals or impacting habitat without a permit is illegal. As with the QCB, more research is needed. For example, under certain environmental conditions, pupae could remain in diapause for years. It is anticipated that the existing locations will be maintained as core populations. Without a recovery plan in place it is not known what areas are suitable for reintroduction. A recovery group has formed and is working with the FWS to develop such a plan. The FWS is finalizing Critical Habitat designation and anticipates it will soon be released.

There is considerable discussion about the effects of cattle grazing on this skipper. Jack Levy, in USFS reports from 1994 and 1997, takes a cautious approach. He notes the historical range of LMS and how cattle grazing as well as deer grazing have in some ways promoted more succulent *Horkelia*. But he notes that grazing can also be detrimental because cattle will eat the plants including larvae as well as cattle stepping on larvae. He concludes that grazing should not be

excluded or promoted but perhaps implementing a managed grazing regime would be best.

Another land management change that has apparently resulted in a decline is fire management. Historically nature and Native Americans had a more active approach to fire. Today fire suppression is the guiding management principle. There are many plants that are 'fire enhanced' and *Horkelia* is one of them. History has shown that when a more natural fire management regime is in place, meadows are more native in plant inventory and *Horkelia* appears to be larger and more succulent. Studies by botanists over the past 50 years on *Horkelia* sp. have noted plant succession in relation to disturbances. It has also been noted that when disturbing influences are removed, the plant may persist longer in areas with poor soil, where later stages of plant succession invade more slowly. More studies in the San Diego area needed since host plant succession is be critical for the skipper's success.

Water management can significantly impact LMS habitat. Removal of ground water will lower the water table and dry out meadows and permanent streams. This directly impacts the health of LMS larval host plants and adult nectar sources. Unregulated water use in the Laguna Mountains and on Palomar Mountain needs to be addressed in any LMS conservation plan.

Parasitism is also a concern. In the egg stage, *Trichogramma* wasps cause significant mortality. From the 1998 studies, between 30-40% of the eggs were parasitized by *T. brevicappellus* (Mattoni and Longcore, 1998). During the same survey time, some empty larval shelters (rolled leaves) contained braconid wasp cocoons. In the larval stage, bird predation and grazing impact is a concern. In the adult stage, habitat fragmentation could reduce and isolate small populations.

In conclusion, LMS is one of the County's rarest resident skippers. Monitoring existing populations and assessing fire and grazing management schemes is critical for recovery. But we should not exclude the possibility of locating new colonies.

Hermes Copper (*Lycaena hermes*)

The Hermes copper is one of region's endemic butterflies and now a Candidate species for listing by the Fish and Wildlife Service (FWS) under the Endangered Species Act (ESA). In a way, it is the signature butterfly for the area. Outside of a few records in northern Baja California, it has never been recorded anywhere else in North America. The northern most record is near the Bonsall / Fallbrook area. There are a couple of records from Bernardo Mountain adjacent to Lake Hodges from 1981 and 1982. There are records near the Harmony Grove and Del Dios areas. From there you have to go south to Black Mountain on the north and east side of Penasquitos Canyon, then south to the border. The western range is broadly defined as Miramar Marine Air Station and then east to Pine Valley.

Taxonomy

W. H. Edwards (1870) first described this butterfly as *Chrysophanus hermes*. Scudder (1876) placed this species in the genus *Tharsalea* as well as Comstock (1927) but considered it as species *hermes*. W. S. Wright (1905) re-described it as *delsud* but in the genus *Chrysophanus*. Freeman (1936) and McDunnough (1938) placed *hermes* in the *xanthoides* group within the genus *Lycaena*, Hoffman (1940) placed it as its own species. More recently, Miller and Brown (1979) erected the monotypic genus *Hermelycaena* on the basis of *hermes*' unique morphology and ecological characteristics. This genus was not generally accepted but is widely used as a subgenus. We use the classification provided by Pelham (2008) which places the Hermes copper in the genus *Lycaena* and subgenus *Hermelycaena*.

Distribution

The Hermes copper is considered a narrow endemic. Its range is very restricted. In Baja California there have been observations near Ensenada in 2001. Prior to that, the last record was June 22, 1983 (Faulkner, per comm.). In Butterflies of California, Comstock (1927) restricted its distribution to "the canyons adjacent to the City of San Diego." W. S. Wright (1930) in Annotated list of the butterflies of San Diego, 1930 notes, "I am told that Chris Henne of Los Angeles County, captured specimens in the vicinity of Ensenada, Mexico, which seems to indicate that we are on the northern extremity of its range." This is an interesting statement since historical records indicate small disjunct populations in Mexico. Historically it is estimated that its range could extend to approximately 50 miles into Baja California, along the coastal ranges and west to the ocean.

Biology

The most extensive published research on the biology of this butterfly is by Fred Thorne (1963). He was the first person to induce a female to oviposit in captivity. This occurred in June 1932, but the eggs did not hatch. In April 1935, F. Thorne was able to get a single larva and raise it to maturity. The details of these events are recorded in the Bulletin So. Cal. Academy of Sciences, #34, vol. 2 by Comstock and Dammers (1935). Recent studies have been published by Marschalek and Deutschman (2008) and Marschalek and Klein (2010).

Hermes copper is univoltine with the adult flight period from mid-May through mid-July depending on elevation and annual rainfall. Its peak flight time is around June 10 for males and June 20 for females (Thorne, 1963). Recent studies shift peak flight up to a couple of weeks after adult emergence (Marschalek and Deutschman, 2008). Winter diapause is in the egg stage. Eggs are laid singly on stems of its only larval host plant, spiny redberry (*Rhamnus crocea*). Thorne (1963) noted how unique it was for *hermes* to use *Rhamnus* as a host plant given that the rest of the known North American *Lycaena* use *Polygonaceae* extensively and *Rosaceae*, *Saxifragaceae*, and *Ericaceae* intermittently. The egg is white echinoid covered with deep pits and surrounded by high irregular walls.

Larvae have four or at most five instars with the mature larvae appearing apple green. It has a mid-dorsal band of darker green bordered with yellowish-green. Larvae feed on the new succulent leaves of *Rhamnus*. The best way to establish presence of larvae is to lightly beat the branches and they will fall off onto a collecting sheet. The time from egg to mature larva is about 14 days. Mature larvae are about 13 mm.

Pupation is 10 to 14 days. A cremaster and silken girdle attach the pupa to the hostplant. The pupa, a grass green with olive brown spots, is very difficult to find because it is at the base of the plant. Pupae are about 11 mm in length.

When adults emerge the males begin to seek out females for mating. Males and females are similar in appearance. They are a brown and yellow butterfly about 3 to 4.5 cm in wingspan. The upperside forewings are brown with a yellow center and small brown spots within that cell. The upperside hindwings are also brown with a small tail that has yellow within it. The underside forewings are yellow with 4-6 brownish spots and the underside hindwings are also yellow with 3-6 brownish spots. Adults prefer to nectar on California or flat-topped buckwheat (*Eriogonum fasciculatum*) but have been observed nectaring on chamise (*Adenostoma fasciculatum*), golden yarrow (*Eriophyllum confertiflorum*), slender sunflower (*Helianthus gracilentus*), poison oak (*Toxicodendron diversilobum*) and short-podded mustard (*Hirshfeldia incana*). Males are territorial and perch on plants along the edge of trails and will confront any intrusion into their territory. Adults appear to become active when air temperature reaches 70-72°F and become more active as the air temperature reaches the mid-70's. They become less active and prefer perching on vegetation within shaded areas when temperatures reach the mid-90's. The seasonal marine layer which blocks the morning sun also limits their activities and adults may be more inclined to remain perched on vegetation until the sun burns off the marine layer.

An observation in 2002 – 03 seasons is the diapausing eggs apparently have an extended drought adaptation. Even though San Diego County recorded lower than normal winter rains, the 2001 rainy season was timely and stimulated a significant adult emergence with about thirty-seven colonies consisting of up to 1,000 adults. 2002 recorded the lowest rainfall in the region's 150-year history of maintaining weather records. Insect diversity and abundance were impacted, including *hermes*. On the Crestridge Ecological Reserve only one adult male was observed the entire flight season. The 2003 winter rains were average with late winter and early spring temperatures cool, wet, and timely. The number of *hermes* observed this year was approximately 400. This total was down from 2001, but it did reveal an early emergence record, May 16th. Based on this 3-year observation at Crestridge it seems this butterfly has the ability to extend its winter diapause during times of extreme drought.

Since 2003, mid-May emergence seems to be more the norm.

- 2004 – Rancho Jamul Ecological Reserve on May 12th
- 2005 – San Diego National Wildlife Refuge at Sweetwater on May 14th
- 2006 – San Diego National Wildlife Refuge at Sweetwater on June 4th
- 2007 – Rancho Jamul Ecological Reserve on May 24th
- 2008 – Lawson Valley near Barber Mountain on May 14th
- 2009 – Wright’s Field and Mission Trails Regional Park on May 25th
- 2010 – Lawson Valley on May 28th
- 2011 – Sycuan Peak on May 31st
- 2012 – Wright’s Field and Sycuan Peak on May 28th

The 2004 season even though was below average was similar to the 2001 season with timely seasonal rains. The 2005 season follows one of the wettest winters on record. The 2006 and 2007 seasons saw some of the driest winters on record and the 2008 season was below average but produced timely rains. The 2009 season above average winter rain early but the later winter was dry and affected emergence. 2010 was an unusual season. El Nino rains were good and should have indicated a mid-May emergence. However, significant marine layer influence couple with cooler than average temperatures appears to effect the entire season. The 2011 season showed near average rainfall and therefore would indicate a near mid-May emergence. The 2012 season was overall dry with below average rainfall but rain events came in clusters and at times there were long periods of no rain. Emergence was considered a ‘typical’ historical timeline. Further investigation on how a flight season could be predicted is ongoing through funding by SANDAG in conjunction with San Diego State University.

Hermes coppers are rarely seen far from their host or nectar plants and these butterflies form distinct ‘colonies’ (Thorne 1963). These colonies are independent from each other, even in close proximity. Populations in each colony are around 50 butterflies (Thorne 1963). However, recent observations indicate significant decline in numbers ranging from a couple of adults to as many as a couple of dozen (SANDAG 2011). Studies conducted in 2010 and 2011 by San Diego State University (SANDAG 2011) show generic similarity as well as disparity throughout the County. For example, populations on McGinty Mountain showed generic differences even though populations were separated by 3 miles. There were genetic similarities between populations at Rancho Jamul and Descanso even though they were separated by over 20 miles. Even though the research is on-going, SDSU’s initial conclusion is that man-made or natural barriers can cause genetic differences however, as long as the landscape is left fairly undeveloped, dispersal of the butterfly appears to occur.

Marschalek and Klein (2010) recently looked at the butterfly’s dispersal behavior. Two locations were selected for the study and over four years of data, the medium dispersal distance was between ~ 11- 44 meters. Some were significant longer and some shorter. Studies of other lycaenids indicated this is not an unusual occurrence. So even though Hermes Copper has the ability to disperse long distances, they prefer to maintain a sedentary behavior.

Mitochondrial DNA work has just been completed with some enlightening results (Yago, in

press). The results by Dr. Yago of Japan indicate Hermes' nearest genetic relative is in the genus *Phoenicurusia*. Also, hostplants are Polygonaceae where Hermes is Rhamnaceae. Yago said, "... the ancestor arrived in North America first and spread and evolved. Then the ancestor of *Hemelycaena* spread to Asia and evolved to *Phoenicurusia* and other genera."

Habitat / Conditions

Since the host plant is *Rhamnus crocea*, its habitat is coastal sage scrub, southern mixed chaparral. A note about *R. crocea*: this is a common plant ranging from about 200 miles south into Baja California north to Mt. Diablo in the coastal ranges to the foothills of the Sierra Nevada to Santa Barbara Island. Yet the butterfly is restricted to San Diego County and located within areas where the temperature extremes are greater than other areas where the plant is found. It is unknown as to why and research needs to address this mystery.

Appropriate Hermes habitat is continuous stands of mixed chaparral/sage scrub in well-drained soil. This soil type is usually found on canyon bottoms or on hillsides with a northern exposure (Marschalek and Deutschman 2008). Host and nectar plants should be either side by side or in very close proximity to one another (Marschalek and Klein 2010).

The redberry needs to be mature. Densities have not been systematically studied but it is possible that a mature dense habitat adjacent to open dirt roads might be more suitable for maintaining the butterfly. Vegetation densities for most occupied Hermes habitat indicate it to be 60 – 95% (Klein per. obs.). The percentage of redberry and nectar sources within that density have not been systematically studied either. However, nectar sources, like buckwheat are usually no more than 3-4 meters from redberry shrubs. If a single redberry shrub is surrounded by non-native grasses and mustards and no buckwheat is present, then the likelihood of it being occupied is very low. The important point for defining suitable Hermes habitat is dense vegetation, a reasonable percentage of redberry within that vegetation and nectar sources at most 3-4 meters from the redberry. This will likely be occupied as well as having the potential for a higher concentration of adults than a habitat of very sparse shrubs with little to no nectar sources surrounded by extensive exotic grasses and mustards.

It is also important to note that these more sparse areas may provide some level of suitability as corridors for dispersing butterflies moving to adjacent colonies. It is necessary to document and map all stands of redberry along with the preferred nectar sources starting with buckwheat followed by chamise. From there, other historic nectar sources observed can be weighted and included. With this data a clearer definition of a habitat patch can be developed.

New growth redberry, especially after a fire, appears to be incompatible for sustaining the larvae (Marschalek and Klein 2010). Since the October 2003 fires, only one previously occupied area has been re-colonized. In this case it took about 4-5 years. Many other locations since the 2003 Fires have not re-colonized. Reasons are many as well as unknown. Some areas show extensive competition from now native annuals where others have good Redberry and buckwheat re-growth, yet no coppers are observed. Research is continuing in order to establish baselines.

Other Butterflies Hermes Can Be Confused With

There really is no other butterfly in the region that Hermes can be confused with. Its markings are unique, even for coppers. Once seen in the field, it is difficult to forget.

There are other butterflies common within the same habitats that would be helpful to know.

They are:

Behr's Metalmark (*Apodemia virgulti*)
Acmon Blue (*Plebejus acmon*)
Bernardino Blue (*Euphilotes bernardino*)
Gray / Common Hairstreak (*Strymon melinus pudica*)
Mountain Mohogany Hairstreak (*Satyrium tetra*)
Hedge-Row Hairstreak (*Satyrium saepium*)
Gold Hunter's Hairstreak (*Satyrium auretorum spadix*)
Funereal Duskywing (*Erynnis funeralis*)
Rural Skipper (*Ochlodes agricola*)

Conservation

Since this butterfly is limited in its range and habitat requirements, conservation is very important. To date, no papers have reported specific parasites or predators. However, spiders were specifically observed preying on adults (SANDAG, 2011).

Fire is an unknown for the survival of the butterfly however, "... is a large and potentially catastrophic force acting on Hermes copper populations (SANDAG, 2011)." Some areas are showing butterflies and some are not. The areas having adults are within ½ to 1 km of habitat not impacted by recent fires and contain mature redberry. Habitats without current sightings are isolated from habitat patches containing mature redberry, i.e. mature redberry patches in excess of 1 km. Redberry is adapted to intermittent fires, a normal component of this habitat, and regular brush fires have not extirpated the species. Frequency of fires should be studied to see what Redberry sprouts, and how invasive grasses and mustards out-compete previously native scrub areas.

Currently, Klein is looking at pollination of Redberry as well as determining any differences between male and female shrubs. Also, he is continuing assessing baseline habitat requirements for all phases of the butterfly's life cycle.

Finally, edge effects and fragmentation from development or fire is key for Hermes' continued survival and continuity. Comstock (1927), in Butterflies of California, states, "It will always be a rarity, and may in fact, someday become extinct, if San Diego continues to expand at its present rate." W. S. Wright (1930), in Annotated list of the butterflies of San Diego County, states that, "Its trysting places are being rapidly taken over by realtors and the species may soon become extinct, unless colonies yet undiscovered are located in other regions."

New colonies have been discovered and the species still exists. Flight seasons following recent

fires indicate a significant impact to Hermes along with drought and fragmentation. Continued diligence is needed to better understand Hermes coppers and its survival requirements.

Thorne's Hairstreak (*Callophrys [Mitoura] thornei*)

This butterfly is indigenous to San Diego County and is the most localized butterfly in the area. There is one unconfirmed report of "Thorne's" in Orange County on private land and also observations from Coal Canyon in Orange County and Tecate Peak but no photographs or voucher specimens exist to substantiate these observations as Thorne's or another Juniper-feeding hairstreak. Based on collected specimens from Coal Canyon it was determined to be Skinner's hairstreak (*Callophrys loki*) (per. comm. G. Ballmer).

Fred Thorne collected one of the first specimens on 26 February 1972 near Lower Otay Lake while working with Paul Ehrlich's *Euphydryas editha* population study group from Stanford University. John Brown described it as a new species in 1983 in the genus *Mitoura*. Since that time, there has been lots of discussion as to its justification as a separate species or a subspecies of a super-group of juniper feeding *Callophrys*.

Taxonomy

The butterfly was described by J.W. Brown (1983) as *Mitoura thornei*. It has been accepted as such by Tilden and Smith (1986), A Field Guide to Western Butterflies; Garth and Tilden (1986), California Butterflies; Ferris (1989), Supplement to the Catalogue/checklist of the butterflies of America north of Mexico; Ballmer and Pratt (1989), A survey of last instar larvae of the Lycaenidae of California; Emmel (1998), Systematics of Western North American Butterflies and Pelham (2008), A Catalogue of the Butterflies of the United States and Canada. There have been disagreements with this classification. Shields (1984) believes it to be a subspecies of Skinner's hairstreak in his paper, Comments on recent papers regarding western Cupressaceae-feeding *Callophrys (Mitoura)* and Scott (1986) in Butterflies of North America lists it as a subspecies of Cedar hairstreak (*Callophrys gryneus*). The Committee on Scientific Names of North American Butterflies met on October 29, 1999 and discussed this issue. Bob Robbins argued that it was related to Cupressaceae-feeding *Callophrys* and should all be treated as belonging to *Callophrys gryneus*, a superspecies. John Brown maintained his original position but also believed further genetic research needed to be done to confirm this. Paul Opler's position was that juniper-feeding *Callophrys* should be treated as subspecies within *gryneus* and that *nelsoni*, *muiri*, and *thornei* should be treated as separate species. In the end, the Committee took a conservative approach and went with Robbins' recommendation with the understanding that further genetic work is needed.

A paper (*in press*) indicates that *loki*, *nelsoni*, and *thornei* do not fit into the *gryneus* super-complex (Pratt, pers. comm.). Mitochondrial DNA recently conducted indicates *loki*, and *thornei* split from *nelsoni* approximately 100,000 years ago. It also confirms the allozyme work performed by Pratt that *loki* and *thornei* are genetically the same (Yago, *in press*). So what we have is a butterfly separated by range and now isolated from its relative. It has selectively moved onto another host plant from its relative and now evolving into its own species.

Distribution

Conifer eating larvae within the Lycaenidae are unusual. Only three butterfly genera are known

to use Pinaceae and Cupressaceae: *Neophasia* (Family Pieridae), *Incisalia* [*Callophrys*], and *Mitoura* [*Callophrys*]. Within the genus *Mitoura* [*Callophrys*], host specificity is common. This leads to restriction of range to small areas of acceptable habitat.

Presently, known and accessible locations for this butterfly are the Otay Mountain area and recently near Alta Road and the Otay River area. This location was discovered by Travis Copper in July 2010. There is an observation from a few years back of a hairstreak within the cypress area on the north-facing slope of Tecate Peak (per. comm. Riggan). No photographs or other documentation are presented to indicate this is Thorne's. Further investigation is warranted to confirm these sightings and whether they are Thorne's or not. Unfortunately, the 2007 Harris Fire burned the entire host plant patch on Tecate Peak.

They are found where its host plant, Tecate cypress (*Callitopsis* [*Cupressus*] *forbseii*), is located. There are a total of eight locations where Tecate cypress is found in the world; on the ridge tops east of Descanso, Tecate Peak (lost in October 2007), in Orange County within Coal Canyon, Otay Mountain, near the Otay River/Alta Road, and the remainder in Baja California.

Biology

Eggs are light green in color and echinoid in shape. They are laid singly on the new growth of established host plants and will incubate in 7-14 days.

First instar larvae initially bore from the end of the young stems of the host plant but later instars become external feeders. Mature larvae are vivid green with two irregular white crescents on each segment, one on each side of the middorsal crest. The markings form a longitudinal white stripe above the prolegs on each side of the larvae. Close inspection of mature larvae will reveal minute brown hairs covering its entire body. Larval stage is 26-35 days.

Pupae are dark chestnut brown with fine mottling, and are covered with fine brown hairs. Pupation is in the duff and leaf litter at the base of the host plant. The butterfly is bivoltine and overwinters in the pupal stage. Pupation time for the first generation is about 10-15 days.

First generation emergence is late February through March and possibly early April, depending on winter rainfall. There is a second generation emerging in late-May or early June. Many field guides indicate a single brood of February through June. Our understanding of this butterfly is that it has 2 broods with a possible third one in September if summer monsoon rains occur on Otay Mountain. Adults are approximately 3 – 4 cm in wingspan. The dorsal forewing and hindwings are a reddish-brown with darker brown shading on the costal margins. It has two tails, one very short near the C_{u1} and a longer one near C_{u2} . The ventral forewing is a mahogany brown with a faint lavender overscaling. Second generation may also have a greenish overscaling instead of the lavender. A white submarginal line consisting of five dashes runs along near the edge of the forewing. The hindwing is grayish lavender with a broad maroon-to-brown discal band. An irregular white postmedian line is at the outer edge of the discal band. There is also a submarginal row of about six black terminal spots in the light limbal zone.

Habitat / Conditions

Habitat is southern interior cypress forest where Tecate cypress is found. This closed-cone conifer grows on mesic slopes and drainages in chaparral. The butterfly does not require 'mature' cypress for feeding. In this case we define 'mature' as a tree old enough to be seed-producing. Observations since 2004 show adults mating on trees as young as six or seven years old. In 2008 and 2009 larvae were observed feeding on trees potentially as young as three to four years old. Based on published papers, seed producing trees are usually 20 – 25 years of age.

Following the October 2003 wildfires, visits have been made to Otay Mountain to document all potentially occupied stands of trees. Five significant locations have been mapped which contain trees ranging from four years old to over eighty years old. Numbers of adults have fluctuated over the years due mostly to deficient winter rains. The 2005 season produced an early emergence and good numbers both in its first and second brood. Bivoltine hairstreaks are known to have significantly smaller second broods and Thorne's appears to follow this. The 2006 and 2007 seasons were so deficient in winter rains that adults observed in the first brood were very low in total numbers as well as no second brood ever being observed. The 2009 and 2010 seasons fared better with adult emergence following an average timeline with the first adults observed around the 20th and 25th of February. A second brood was observed sometime around the middle of May with numbers significantly smaller than the first brood. Second broods appear to be as much as 80% smaller in numbers.

Nectar resources appear to play an important role between broods. First generation adults have been observed using Ramona lilac (*Ceanothus tomentosus*) and deerweed (*Lotus scoparius*) and borages. The deerweed observation is from February 2002 and the plants were up to ¼ mile from the nearest cypress. Also within the first generation, the butterflies were either observed perched somewhere on the cypress or feeding on *Ceanothus* within one to three meters of the tree. Second generation adults were observed using California or flat-topped buckwheat only. During these observations adults were seen as much as sixty meters away from cypress trees. There were also observations of adults using the buckwheat when it was adjacent to the cypress trees. Since conditions are drier during the second generation available nectar resources are limited and buckwheat is a preferred resource.

Other Butterflies Thorne's Hairstreak Can Be Confused With

Because of its limited habitat, the following butterflies could be confused with *thornei*.

Brown elfin (*Callophrys augustus iroides*) – In flight this may be one that would confuse the casual observer. But as a rule, identification can be made once a butterfly comes to rest. The dorsal view could prove a bit of a problem for the untrained eye. The brown elfin is browner than the reddish-brown of *thornei* and has a tendency to have lighter forewing centers. Also, *augustus* does not have tails but nubs at the C₁₂ location. If *thornei* has lost its tails then the best identification markings will be the ventral. *Augustus* is uniformly brown while *thornei* has the white dashes and postmedian line as well as being lavender.

Hedgerow hairstreak (*Satyrium saepium*) – This hairstreak will overlap during the second generation. Observations in June 2004 reported adult Thorne's on buckwheat along with Hedge-

row hairstreaks. The dorsal is more mahogany than reddish-brown to brown. The other differences will be the ventral. Again, *thornei* has the white dashes and lines whereas *saepium* lacks these.

Mountain mahogany hairstreak (*Satyrium tetra*) – This hairstreak could overlap during the second generation. The dorsal is darker gray and therefore would be hard to confuse with *thornei*.

Nelson's hairstreak (*Callophrys [Mitoura] nelsoni*) – Biologically there are similarities. The differences are, single versus double brooded, Incense cedar (*Libocedrus decurrans*) for larval host plant versus Tecate cypress, and restricted to higher elevations versus cismontane. They are structurally similar except for the following: the ventral forewing white dashes are not nearly as pronounced, the ventral hindwing postmedian line is faint and almost non-existent on worn specimens.

Skinner's hairstreak (*Callophrys [Mitoura] loki*) – Since it has been recently decided to regroup *thornei* into the *loki* complex, it would make sense that this could cause the greatest confusion. *Loki* is better known in the Jacumba area and its host plant is California juniper (*Juniperus californica*). The ventral fore and hind-wings have a tendency to be lighter green to lavender, but there is variation. The rest of the ventral in *loki* is the same as *thornei*. Unfortunately, the best way to tell them apart is the genitalia. Suffice it to say that for this workshop, their ranges do not overlap.

Conservation

Other than birds feeding on the larvae, there are no recorded parasites or predators. In April of 2004 Klein spent time looking at some of the recovering cypress trees from the 1996 fire and observed some brachonid wasps moving throughout the cypress branches. It is possible brachonids would parasitize the larvae. A potential predator from the 2007 season was large numbers of the introduced seven-spotted ladybird beetle (*Coccinella septempunctata*).

After the 2003 wildfires, there was a concern large fires have a negative impact both on Tecate Cypress and the butterfly. There was a symposium in June 2010 with Cypress experts throughout the country which looked at the 2003 and 2007 fires affecting the Cypress' on Otay Mountain. The overall conclusion was that Tecate Cypress will not likely become extirpated even with continuous fires. Also, SDSU with funding from SANDAG shows the butterfly utilizes fairly young Cypress trees for larval feeding. Based on recent research Thorne's Hairstreak recovery appears to be fine and appears to be stable.

Presently, development does not have much impact. Since its known location is the Otay Mountain area, most of this land is under BLM management. It is recommended that increased awareness of this butterfly's needs, particularly by those individuals and agencies that manage locations with existing colonies, be included in future management decisions.

Harbison Dun Skipper (*Euphyes vestris harbisoni*)

There was a question for quite some time about the status of a distinct southern California population of dun skipper (*Euphyes vestris*). Through the research of John Brown and William McGuire, it is now an accepted subspecies. This is truly a unique sub-species found in San Diego. As many of the Region's sensitive butterflies, Harbison larvae are host specific and habitat specific and may have been impacted from the 2003 and 2007 wildfires.

Taxonomy

Boisduval (1852) first described the species. At that time he was unclear as to its affinities and assigned it to the genus *Hesperia*. It was eventually classified as *Hesperia vestris*. Wright (1906), in The Butterflies of the West Coast, placed it in the genus *Pamphila* and makes this interesting statement, "This species is set down for the Pacific Coast, in California. I have not seen it during the twenty-five years that I have hunted butterflies, and I very much doubt that it comes from here; but it is possible that it does, and so I figure it, for the benefit of some lucky man who may perhaps come upon it unexpectedly. It comes from Florida and Colorado." In Comstock's (1927) Butterflies of California, he has it listed under the genus *Atrytone*. It is unclear when *vestris* was considered to be part of the genus *Euphyes*; however, it is possible this distinction was made by Evans (1955). Within the *Euphyes* genus, the eastern population is *metacomet* and the western population is *vestris*. From there a discussion came up about a southern California population that was distinct from a more northern population. The northern population became known as *kiowah* and the southern population as *harbisoni*.

Distribution

The northern most record of this skipper is in Silverado Canyon in Orange County from collections in 1940 and 1972. The Silverado Canyon population was impacted in the 2007 wildfires and flooding. At this point in time it is unclear as to its status. Besides Orange County, its only other known records in the United States are for San Diego County. In July 2009 there was a confirmed sighting in La Mission, Baja California. The original type locality was to have been Flinn Springs. Due to that locality's development, the new location for the type specimen is Tecate Peak near Barrett Junction. This location was also impacted in the 2007 wildfires. At this time the skipper's host plant is coming back but below average winter rains is delaying significant growth of the plant. December 2000 again confirmed the presence of overwintering larvae within the Rios Canyon (Crest/Flinn Springs) drainages. This is important to note since the original specimens were collected within a few hundred yards from the now confirmed locality. Other past locations have been, Hellhole Creek, Fallbrook, Blossom Valley, Poway, El Monte Oaks, Old Viejas Grade, Gooden Ranch, San Pasqual Academy, Crestridge Ecological Preserve and drainages within Wild Bill Canyon on the south side of Otay Mountain near the Mexican border. It is recommended that further investigation be done to identify additional locations, especially within the range of its host plant, San Diego Sedge (*Carex spissa*). This plant's range is from northern Baja California, up to San Luis Obispo County.

Biology

Eggs are hemispherical, pale yellow-green with an irregular red splotch on the apex. There is also a red band encircling the entire egg. Eggs are laid singly, usually on the undersurface of the leaf blades near the base of the plant.

Larval growths require five instars with the third, fourth and even fifth instar overwintering. They overwinter by ‘sewing’ two to four blades of *Carex* and bending the blades at approximately a 90° angle. When the caterpillar is not feeding, it will remain in the blades of *Carex* up through pupation. The fifth instar’s head is caramel-brown with two cream colored vertical bands. The body is green with very thin longitudinal white dashes on the dorsal surface.

The pupa is dark brown with finely covered bristles. Pupation takes 18-21 days.

Emergence of the adult is as early as the middle of May and continues to the middle of July. The adult’s primary flight period is late June . One of the diagnostic features of *harbisoni* is that it is much larger than the northern United States populations. There is also orange over-scaling throughout. Adults are overall a paler brown than the eastern species *metacomet*. There is a slight dimorphism between male and female. Female’s forewings are darker than the male. There are also two moderately well-defined hyaline post median spots just below the discal cell. The female’s forewings are also more rounded. Males will patrol canyons never far from the host plant. Females will perch on *Carex* basking in the late morning/early afternoon sun. Both sexes are attracted to nectar sources such as, morning glory, *Calystegia macrostegia tenuifolia*, red thistle, *Cirsium occidentale*, and loosestrife, *Lythrum californicum*. Other less frequented plants are golden yarrow, *Eriophyllum confertiflorum*, and black mustard, *Brassica nigra*.

Habitat / Conditions

Harbisoni has very different requirements from the other subspecies. They generally are found in chaparral or riparian areas that have narrow canyons or narrow drainages. There must be a seep or spring present for the host plant to grow. Oak riparian seems to be a preferred location providing enough shade and sun for the butterfly to bask.

Search image for the adult season is the patrolling males near the host plant and females perched on the host plant. The search image for overwintering larvae is locating the host plant, and looking for evidence of the eaten *Carex* blades. Once you find eaten blades, look along that blade for two, three or four blades ‘sewn’ together. The blades may be bent at almost a 90° angle or not bent due to the blades being eaten fairly far down. This is called a hibernaculum. Once you find the ‘sewn’ blades, carefully pull open the blades. If the caterpillar is there, you will see the head about 7–12 cm down the blade. About the only other invertebrates you could encounter with these ‘sewn’ blades are spiders.

Other Butterflies Harbison Dun Skipper Can Be Confused With

There are only two skippers that may cause some confusion. But when looked at carefully and becoming familiar with its habitat, this should be eliminated.

The first one is the northern *kiowah* subspecies. This is easily resolved because their ranges do not overlap and *kiowah* has never been collected in San Diego County.

The second is the **umber skipper** (*Poanes melane*). Its host plants are grasses and *Carex spissa* and the adult flight season overlaps that of *harbisoni*. They are similar in size but the California subspecies *melane* has a reddish-brown coloration throughout its fore and hind-wings. *Harbisoni* is brown throughout with females having some white spots in the central cell of the forewing. *Melane* has much more extensive white spots in its forewings for both male and female. The hindwing of *melane* has a small yellowish patch in the hindwing, while *harbisoni* has a solid brown hindwing in both male and female.

Another difference is that their habitats are slightly different. *Harbisoni* is found in drainages within scrub habitat that is fairly undisturbed. *Melane* is found within gardens and landscaped yards as well as more disturbed moist areas.

Conservation

Habitat loss, fragmentation and water quality are the biggest concerns for this skipper. The loss of coastal wetlands is well documented but the loss of inland riparian and drainages is not well documented. Observation shows that these are dumping grounds for trash and reduces the ability for the skipper's host plant to survive. With the implementation of the Multiple Species Conservation Plan (MSCP) and other HCP's developed within the County, it is hopeful that these 'wetland' areas will survive. The skipper has not shown significant population decline from urbanization other than people using the areas as dumpsites. Strong educational and interpretive programs on preserved locations would help in guiding people who live near these habitats to become more sensitive to conservation.

The fire events from 2003 and 2007 may have impacts on this skipper's habitat. The Sedge is a crown sprouter and therefore the plant will re-grow as long as there are sufficient rains. Since the region has only recorded above average annual rains once in the last ten years many of the riparian areas where the sedge grows are showing signs of drought stress. When the fire events come through these riparian areas there is limited moisture and therefore fire damage is extensive. This was evident after the 2007 fires. Many of the burned riparian areas are re-growing. However there is also clear evidence of exotic plants establishing and appears to be causing competition. Since the winter diapause is a mature caterpillar within the Sedge, mortality from the recent fires is significant. Currently research is limited on how far adults will move through riparian corridors and re-establish. This will become important over the next few years.

Parasitism is not well documented, but in February 2002 at the Crestridge Ecological Reserve, Klein was showing some Workshop participants evidence of overwintering larvae. Klein pulled the *Carex* blades apart and observed a dead larva. An adult braconid wasp was also observed crawling around the dead larvae. Since braconids are known parasites of Lepidoptera, it is not surprising that this is a possible candidate. Further observations need to be documented.

Wandering Skipper (*Panoquina errans*)

This coastal skipper can be seen in marsh habitats not far from its larval host plant, Salt Grass (*Distichlis spicata*). It was petitioned for listing over fifteen years ago and was declined due to populations being numerous and sustainable. The coastal marshes especially in the southern part of the county do not appear to have sustainable populations. Some of this could be from misidentification or not being familiar with the species. Because of its restricted habitat requirements, this skipper is a Covered, Narrow-endemic species under the San Diego Multiple Species Conservation Plan (MSCP).

Taxonomy

Henry Skinner (1892) first described this skipper. He placed it under the genus *Pamphila*. William G. Wright (1907) placed the species in the genus *Prenes*. We were not able to find a reference where it went from *Pamphila* to *Prenes*. But it appears that it remained in this genus until 1941 when Hoffman in his Mexico butterfly checklist placed it in the genus *Panoquina*. Rindge (1948) and MacNeill (1962) held to the same name as Hoffman. Interestingly though, MacNeill followed others and placed this skipper as a subspecies of *panoquinoides* within the genus *Panoquina*. He did change his position in 1975 to keep it as a separate species. The first time we see it as a subspecies is by Powell (1958). He was describing additional butterflies for Baja California Norte and noted it as a subspecies. Any papers reclassifying this skipper from species to subspecies and back to species have not been found. Howe (1975) considers *panoquinoides* as the east coast species and *errans* the west coast counterpart.

Distribution

This skipper is strictly a coastal salt marsh species. It is found from Santa Barbara to the tip of Baja California Sur on both sides of the peninsula. Even though its host plant, Saltgrass, *Distichlis spicata* is fairly common in salt marshes this skipper is limited in its distribution. In San Diego County, numbers appear to be small and stable throughout the coastal marshes from Buena Vista Lagoon south to the International Border. Wright (1907) states that it is, "probably more plentiful than any other butterfly of this region during its season. In favorable localities along the bay shore it flies in great numbers. Some idea of its abundance may be gained when it is known that a collector can net two hundred in a couple of hours if he attends to his business."

Biology

Spherical eggs are either pale yellow or white and are laid on the host plant or plants adjacent to the host plant. Nothing has been recorded as to how or where they are laid on the plant. However many grass skippers lay eggs in the seam grass blades. As with most skippers in the Family *Hesperiidae*, incubation is about 10 days.

First instar larvae are either whitish with a blackish head or vivid green, semitransparent with a dark brown head. There are two fine lateral cream-colored lines on each side of the dorsal midline. There are five instars and at the third and fourth instar, they become more yellowish green with yellowish white longitudinal dorsal stripes. Fifth instar larvae are reddish-brown with

a dark dorsal line and a thin lateral stripe, or they could be green with four longitudinal dorsal greenish white stripes and a yellowish lateral stripe with a bright green head. Instar growth could take up to 45 days. One of the interesting features of this skipper and with most skippers in this subfamily *Hesperinae*, Branded Skippers, is that the larvae are nocturnal feeders.

The pupa can be pale whitish green on the head and wing pads and the abdomen is pale brownish yellow, or it is a translucent green with whitish dorsal stripes on the abdomen. Pupation can be anywhere from 20-30 days.

Adults fly from July to September and November and December in Baja California Sur. Males usually perch on grass blades awaiting females. Both sexes are nectar feeders on flowers. Unlike the east coast species, this skipper is darker with usually larger yellowish spots, most of that are hyaline, on the upper surface of the forewing. Ventral hindwings are brown with yellow veins. It also has an irregular diffuse band of about four pale spots.

Diapause is in the mature larval stage. It also forms a hibernaculum like *Euphyes vestris harbisoni*.

Habitats / Conditions

As mentioned above, it is strictly a coastal salt marsh skipper. Marshes with tidal flow are the more likely occupied areas. Wherever saltgrass grows along the coast and within a tidal salt marsh environment, you are potentially in the area where *errans* could be found. Along San Diego County, all of our coastal marshes, Buena Vista, Bataquitos, Agua Hedionda, San Elijo Lagoons, Penasquitos, Famosa Slough, San Diego River Flood Channel, Sweetwater Marsh, D Street Fill and Tijuana Estuary, *errans* will be found.

Other skippers *errans* might be confused with

Salt marsh skipper (*Panoquina panoquinoides*) – This skipper would cause the greatest confusion. The yellowish forewing spots are not as pronounced as with *errans*. As far as we know, their ranges do not overlap.

Eufala skipper (*Lerodea eufala*) – This skipper can be confused with *errans*, but the forewing spots on *eufala* are white instead of yellowish and smaller. The overall color of *eufala* is grayish versus brown. *Eufala* is not restricted to the coastal salt marshes and can be found throughout the County, even into the desert. Flight periods are similar, August to October and both use saltgrass.

Umber skipper (*Poanes melane*) – Here again *melane* can cause a lot of confusion. Differences though are that *melane* is larger than *errans* and the yellowish spots in the forewings of *melane* are significantly larger. Also *melane* has a yellowish wash in the dorsal hindwing whereas *errans* does not have any spots. *Melane* is not restricted to the coastal marshes and will use grasses other than salt grass. Flight season is in two broods, one from April to June and the other is July to September.

Sandhill skipper (*Polites sabuleti*) – Host plants are the same but *sabuleti* is not restricted to coastal salt marshes. This skipper can be found wherever saltgrass grows. Also, the physical features are very different. *Sabuleti* is much more yellow with thick dark gray margins. Ventral is light yellow with cream-colored spots throughout. Flight period is April to September.

Conservation

Because over 90% of California's coastal marshes are gone, this skipper, like other wildlife, feels the stress of trying to maintain its existence with limited space and resources. The biggest boost to its survival is eliminating habitat loss. Any coastal salt marsh habitat that is restored would provide an excellent laboratory for observation and study.

Peninsular Metalmark (*Apodemia mormo peninsularis*)

The Mormon Metalmark complex is one of the more phenotypically and biologically diverse genera in the western United States. Male and female wings may have varying degrees of brown, rust and white and dimensions. This can cause confusion in the field. Added to the confusion, this subspecies was originally found only in the Laguna and Palomar Mountains. Research over the past few years indicates the butterfly may have a much larger distribution.

Taxonomy

Felder and Felder (1859) first described *Apodemia*. Because of geographic variation in wing pattern and color, various segregates of the species were considered separately by early lepidopterists. But by the turn of the twentieth century, the butterfly was considered to be five subspecies; *mormo* in Utah, Nevada and northern California; *virgulti* in southern California; *cythera* in Arizona; *mejicanus* in New Mexico and Sonora; and *maxima* in the southern half of Baja California. Since then many people considered it to be one species. As collecting continued throughout the twentieth century, this idea became more accepted with an addition of two more subspecies restricted to California, *deserti* and *langei*. Research over the past few years indicates taxonomy is unclear between the coastal, montane and desert *Apodemia*. Continued research is ongoing to resolve this issue.

Distribution

The type locality for *peninsularis* is the northeast edge of El Prado Meadow of the Cleveland National Forest in the Laguna Mountains. All of the type specimens are recorded from the Laguna Mountains. But the range could be as far as the San Jacinto Mountains through the Palomar Mountains and south and east through Campo and into northern Baja, Mexico. This is due to the range of the host plant *Eriogonum wrightii* spp. *membranaceum*. More field study needs to be done to verify additional populations. Specimens taken from Campo through McCain Valley show that *peninsularis* may be present in these areas. The difficulty is that these collected specimens were taken off of California buckwheat with Wright's buckwheat hundreds of yards away.

Biology

There is little published about the early stages but it is assumed that there are minor differences from other *Apodemia*. This butterfly is single brooded and flies from mid-May to late June. We used to think it was never far away from its host plant. With recent collections in Campo and McCain Valley we have *peninsular* looking *Apodemia* but on California buckwheat with Wright's buckwheat being hundreds of yards away. So at this point we do not know if we are dealing with a variety of *virgulti* or *penninsularis* but utilizing California buckwheat.

The males are about 24 mm in wingspan with the traditional brownish-orange to dull orange. Costal margin edged with dark gray scaling fused posteriorly into the orange ground color. The outer margin is broadly dark gray and broader in the apical area. The white spots of the basal area and postbasal area are reduced in size from the typical *mormo*, with the posterior subbasal

spot half the diameter of the anterior postbasal spot. Again, as compared to the typical *mormo* the postmedian row of white spots reduced in size with the first, fourth and fifth spots are reduced even more. The hindwing is ground color dark gray, with orange-brown covering between postmedian row of white spots. The white spots of the basal area are again greatly reduced as well as the postbasal white spots. White spots of the postmedian are either reduced or absent.

The females are larger than males but the brownish-orange is more extensive through the dark gray to sometimes becoming completely orange. The white spots throughout are diminished like the males.

Habitat / Conditions

This butterfly is described from the Laguna Mountains. The host plant *Eriogonum wrightii* spp. *membranaceum* is found in mountain meadows usually near the edges of the woods, Great Basin Sagebrush and montane buckwheat scrub. Because of its location, dry years may result in an early emergence, possibly late April. Therefore, adults might be found near rock outcrops with the host plant nearby or within the rocks. This will provide the butterflies a rest area on the warmer rocks. No specific predators or parasites have been recorded for this species.

Other Butterflies confused with *peninusularis*

When flying, this butterfly can look like blues, but as always, let the butterfly come to rest before trying identification. The only other butterfly that can cause confusion is its closest regional subspecies.

Behr's metalmark (*Apodemia virgulti*). First of all, they have a different host plant, *Eriogonum fasciculatum*. Secondly they are multivoltine instead of single brooded. Finally the white spots are different. The blending of the orange and dark gray between males and females are similar between both. But the white spots are significantly smaller to absent versus *virgulti*.

Conservation

Since the designation is so new, concerns of decline to extinction are not identified. Possibly the most pressing concern would be fire management. Since the host plant is common it does not appear that the butterfly is in jeopardy.

Harbison's Giant Skipper (*Megathymus yuccae harbisoni*)

No common name has been assigned to this recently described subspecies so we have assigned it Harbison's because of the subspecific name. This is a very restricted skipper due to the availability of its only host plant, *Yucca schidigera*.

Taxonomy

Scudder (1872) gave a clear description of the genera *Megathymus*. Boisduval and Le Conte (1833) described the species *yuccae*. From this point, there are references from many different authors of *yuccae* and the description of subspecies depending on range and larval host plant. This is mentioned because one of our main resources for field guides is Butterflies of Southern California, Emmel and Emmel (1973). In their book, they have the Common Giant Skipper (*Megathymus coloradensis*). They mention two described subspecies from southern California and one undescribed subspecies in San Diego County. The two described subspecies, *martini* and *maudae* were described by Stallings and Turner (1956, and 1966) respectively.

The history of this skipper's classification has been fairly straightforward. Riley (1877) described *coloradensis* as a subspecies of *yuccae*. This classification was retained by Comstock (1927), Howe (1975); Pyle (1981); and Scott (1986). Other references that followed Emmel and Emmel (1973) were, Miller and Brown (1981), Tilden and Smith (1986), and Garth and Tilden (1986).

Emmel and Emmel made note of this undescribed subspecies, and it wasn't described until 1998. The species *coloradensis* was dropped and the classification *yuccae* was established.

Distribution

The distribution is unclear. When Emmel and Emmel (1973) published the Butterflies of Southern California they mentioned that its distribution was restricted to coastal San Diego County. But in Systematics of Western North American Butterflies, Emmel (1998) notes the distribution is widespread throughout San Diego County and extends north to Beaumont in Riverside County and east to the Santa Rosa Mountains' eastern slopes. He believes that this distribution is correct based on rearing studies and field observations. It was felt they more closely resembled *harbisoni* instead of *martini*. In Butterflies of Baja California (1992), there was one record of *Megathymus* and it was found at the western edge of the Colorado Desert. It is assumed that its range could go as far south as Valle de la Trinidad. In Butterflies of Baja California Brown (1992) states that this *Megathymus* is *coloradensis martini*. Brown (pers. comm.) believes this is really *yuccae harbisoni* due to the location of the record. The only *Yucca* in the area was *schudigera*.

According to Stallings, *martini* or *maudae* will use *Yucca schidigera* but the preferred plants are *brevifolia* and *baccata* respectively. The coastal San Diego record used *schidigera* because there was no other *Yucca* along the coast except *whipplei*. Does this mean that *harbisoni* is located throughout the County? Not necessarily. When Stallings first described *martini* he stated this subspecies as exclusively feeding on *brevifolia*. When he described *maudae* he noted a

similarity to *martini* based on genetalic structure. But he did state that *maudae* used *Yucca baccata* exclusively. Emmel and Emmel though noted in Butterflies of Southern California that *martini* and *maudae* use *schidigera* as secondary plants. This leaves the question as to whether *harbisoni* is countywide or limited to the coast and the *Megathymus* in the desert is either *martini* or *maudae*. Current position is that *harbisoni* is found from coastal San Diego to at least In-Ko-Pah.

Biology

All *Megathymus* are yucca borers. The larvae bore into the root system during at least the last three instars.

Eggs are pale bluish-green, becoming pinkish-white, and then yellowish-brown. They are laid on suckers or new shoots of the *Yuccae* plant. Eggs need about 10 days to hatch.

First instar larvae begin feeding on the tips of the plant's new growth. They eat their way down the shoot through the second instar. These two instars could take up to 20 days total. As a third instar, it bores a hole into the stem near the base of one of the shoots and begins to eat its way down into the root system. It appears that it will shed through a total of seven instars. This phase could take over four months to develop a mature larva when it then diapauses.

Pupation will take place in late winter. Prior to pupation, mature larvae move up the cavity near the entrance that the third instar created. The pupa is brown-black with an enlarged bristly cremaster.

The adult is single brooded and emerges in March or no later than April. Males and females are slightly different. The dorsal on both are ground color with a yellowish spot at the distal end of the discal cell in the forewing. There are a total of 9 submarginal spots varying from oval to quadrate and from pale yellow to cream in color. The hindwings are ground color with no spots on the male and four small spots forming a macular band in the postmedian area on the female. Ventral surface of both are similar in the fore and hind-wing, ground color to a grayish-brown with small light spots throughout. There is more of a pale gray along the margins with the fringe checkered and alternate dark brown to light tannish gray.

Females do not feed and males are usually found perched at the tips of the *Yucca* awaiting females. When males are seen away from its perch they are usually "mud puddling."

Habitats / Conditions

The southwestern subspecies have been synonymous with a dry desert scrub environment with an influence of the higher chaparral on the east facing slopes. That is, wherever *Yucca schidigera* is found. For *martini* it would make sense that its habitat would be high Mojave Desert at elevations where *brevifolia* would be found. For *maudae* you would be considering the moister desert regions since it would be using *baccata*. But *harbisoni* has a very unique habitat when along the coast. *Yucca schidigera* is found in coastal sage scrub as well as maritime chaparral scrub. This is very different from the expected dry desert regions. Adults have been

recorded at Torrey Pines State Park.

For a search image, anytime you find *schidigera* it is worth the time to look more closely at the plant for evidence of basal larval penetration. You would particularly look for a hole that has a 'tent' covering the entrance. This 'tent' may be a silken cover with frass over it, or it may be just silken webbing. If you find this, it does not necessarily confirm presence of the skipper. It could be an abandoned tunnel now occupied by any number of insects including yucca weevils or spiders.

Other skippers *harbisoni* might be confused with

Since it is not fully established that the subspecies *martini* and *maudae* could overlap its ranges, these are possible. Paying careful attention to the plants that they are using will be helpful, if you have other yuccas present other than *schidigera*. Outside of that, the adults are virtually identical. Genetalic structures will help in identification but again this is not always going to be the case.

As an adult, there is no other skipper that can be confused with this one. Any of the Agave feeders, *Agathymus*, do not fly until the fall. This is a spring flyer. The Long-tailed Skipper (*Urbanus proteus*) from a standpoint of the overall brownish color would be a concern but it has tails and its habitat is more in the agricultural areas. So habitat wise they do not overlap.

So, if you have a large quick flying ground color skipper around yucca and in scrub habitat along the coast or desert scrub inland and in spring, it is most likely a *Megathymus*.

Conservation

Since so little is known about this skipper, there are no documented parasites or predators. If we consider that they are similar to *Agathymus*, then there could be some Hymenoptera that parasitize the larvae. Coleoptera and Diptera are also possibilities. More research needs to be done on this if there are coastal populations and a management plan in place for them.

The main threat to the coastal population would be elimination of *Yucca schidigera* due to development. If the population extends into the desert, then threats again would be development.

Sonoran Blue (*Philotes sonorensis*)

This is possibly one of the most beautiful blues in the United States. The nearly iridescent dorsal wings with orange to reddish patches are unique to any blue in the country.

Taxonomy

The first known description was by Felder and Felder (1865) to which they classified it as *Lycaena sonorensis*. Others who have used this taxonomy have been Strecker (1875), W.G. Wright (1906), Draudt (1924), and Holland (1931). Boisduval (1868); Strecker (1874 & 1878); and Edwards (1875); had it classified as *Lycaena regia*. Scudder (1876) called it *Philotes regia* and was later established as a generotype of *Philotes*. The first use of our current classification was by Dyar (1902) then Comstock (1927); McDunnough (1938); Mattoni (1954) and finally Ehrlich (1961). So it appears that it was finally settled to our current classification sometime after 1931.

The “type” specimen is supposedly from Sonora, Mexico, yet there have never been any records from that state. According to Brown, F. M. (1967), butterflies named by the Felders are all found within the present limits of California. J. M. Lorquin took a specimen in 1852 from San Diego County. Oakley Shields (1973) believed the type location from San Diego because of Lorquin’s specimen. Emmel (1998) in Systematics of Western North American Butterflies based on Boisduval’s and Felders’ collections to be La Tuna Canyon in the Verdugo Mountains of Los Angeles County modifies this. So as to where the real type location is from is unclear as well as the name. Based on published information the name *sonorensis* has no logical fit to type location.

Distribution

William G. Wright (1883) in a diary of a Southern California trip he was taking with other scientists’ notes only one location where they were collected. He does not give an exact location but based on his description, it appears to be either northern Baja or San Diego County. Wright (1906) notes in Butterflies of the West Coast of the United States, that its range is, “as far north as Gilroy, and to Yosemite, in the mountains.” He also notes that the butterfly becomes more abundant as your travel south, especially into the peninsula of Lower California. Langston notes records in central California in San Luis Obispo, Monterey, San Benito, Santa Clara and Stanislaus Counties. He also notes records from Placer, Tuolumne, Mariposa, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside, Imperial and San Diego Counties.

Biology

Eggs are a sharply flattened at the base and turban-shaped. They are pale green and eventually turn chalky white. They are laid singly on upper or underside of the plant leaves. Females can lay up to 100 eggs. Eggs hatch in about 10 days.

William Wright (1883), in his diary notes females ovipositing on *Erodium cicutarium* within a dense patch of cactus. But in 1906 in Butterflies of the West Coast of the United States, Wright

notes the eggs on cotyledon. Cotyledon as an old world plant and is where dudleya's were first placed. Is it assumed his first observation is in error.

Larvae are *Dudleya* feeders and bore into the leaves but are not considered "leaf miners." Observations note the larvae crawling within the stems with several of its posterior segments protruding. When they molt to the next instar they withdraw from the leaf and crawl to the undersurface. In Southern California they utilize *Dudleya lanceolata* in Los Angeles and San Diego Counties. Fred Thorne (1949) found 20 larvae on *Dudleya saxosa* in Sentenac Canyon. At Torrey Pines the only *Dudleya* is *edulis*. This is also the only known *Dudleya* in the Sweetwater area. So, it is assumed that they utilize this plant. In Orange County it appears to be *stolonifera*. Langston has observed them feeding on *Dudleya cymosa setchellii*, *cymosa cymosa*, and *cymosa minor* in central California but never on *Dudleya farinosa* and *caespitosa* even though the plants were present. On Cedros Island a single larvae was taken on *Dudleya pachyphytum*.

First instars are 0.9 mm with a dark chestnut brown head and the first thoracic segment having a bluish tinge. The second instar looks the same as the first but is up to 3.75 mm in size. The third instar again looks the same with evidence of studded hairs and is 5 mm. The fourth instar has the similar head and thoracic coloration with the remainder of the body being rosaceous in color and about 9 mm in length. Fifth instar is about 14 mm and now has a retractile conical neck and is studded with hairs. Mature larvae can be quite variable in color. They can be as a pale yellow-white or greenish-gray larval form. If they are this color, then the mid-dorsal band is red with red lateral dashes. If they are greenish-yellow, the mid-dorsal line is bluish and has bluish-white lateral dashes. They could also be a solid pale yellow.

Another interesting aspect of this butterfly is that the larvae are myrmecophilic or associated with ants. We have found published studies related to certain species of blues and their relationships with ants. Based on other studies it appears that the relationship is what is called mutualistic. This is where the larvae will secrete honeydew as a reward for the ants providing protection from parasites and predators. Based on other studies with *lycaenids* it appears the myrmecophilic association takes place at the later stage of instar growth probably 4th and 5th instars. Since the butterfly is located within California, the native ants of this State would be the more likely candidates to provide the mutualistic relationship. Ballmer and Pratt (1991) found that in lab experimentation *Formica pilicornis* tended to the larvae but in the field they believed the primary species of ant was *Crematogaster mormonum*. Their paper believed that *Crematogaster* would be the principle ant throughout the butterfly's range. It is unclear as to the impacts exotic ants have on the native ant species but it is possible they have an impact. More research needs to be done in both of these areas to ascertain effects and impacts.

The pupa is plump and stout and olive-green and is usually on the debris at the base of the plant. Diapause is at this stage.

Adults are single brooded and fly January through July, depending on the area, elevation, amount of sun exposure and winter rains. They are most common in March and April. They do very little nectaring. In Plum Canyon in the Anza Borrego Desert they have been observed nectaring on *Chamaesyce* spp. Males are not usually found too far from their host plant. Wing span is 21 –

25 mm. Dorsal fore and hind-wings are iridescent blue. Males have orange to reddish spots in the forewings only. Females have the orange to reddish spots on both the fore and hind-wings. The ventral is a mottled dark and light gray with rounded submarginal black dots in the forewings.

Habitats / Conditions

In all of the documented material, *sonorensis* is observed in and around sunny areas that open to lightly forested slopes as well as in canyons with a preference for steep slopes. This is in association to the host plant. *Dudleya*'s, in general, have a preference for canyon walls, walls along cuts in the roads or within canyons that have steep cuts with the potential for large increases in elevation. Shields also observed that there was a correlation with soil type to butterfly presence. In central California he noted that even though the host plants were common in certain areas no butterflies were present because the soil type was different from occupied areas where host plant varied from uncommon to common. We have not found any such reports for Southern California. Although it appears that soil type may have an effect on the butterfly's presence, more research needs to be done in this area.

As with any butterfly, lack of host plant will usually limit the butterfly's presence. The butterfly is a low flyer and usually not observed flying above waist high. Its wing beat is slow and somewhat lazy. Occupied areas usually contain areas where sun is present most of the day. The canyons provide suitable protection from springtime winds and with the sun have a tendency to be fairly warm compared to other more open areas, i.e. mountaintops.

Other Butterflies *sonorensis* might be confused with

Silvery (southern) blue (*Glaucopsyche lygdamus australis*) – possibly the only butterfly that might cause initial confusion. Flight behaviors may be similar, especially on cooler days. If daytime temperatures were warm, then southern blues would have a tendency to fly about waist high and alight on vegetation up to a few feet above the ground. Sonoran blues are low flyers and have a preference to alight on vegetation up to one foot above the ground.

From there, there are no other butterflies that *sonorensis* could be confused with. However, to assist you, these are the other possible butterflies that would be flying in San Diego County during *sonorensis*' flight season:

Desert Swallowtail (*Papilio polyxenes coloro*)
Spring White (*Pontia sisymbrii*)
Becker's White (*Pontia beckerii*)
Grinnell's Marble (*Anthocharis lanceolata*)
Desert Orangetip (*Anthocharis cethura*)
Pacific Sara Orangetip (*Anthocharis sara*)
Sleepy Orange (*Abaeis nicippe*)
Dainty Sulphur (*Nathalis iole*)
Great Purple Hairstreak (*Atlides halesus*)
Bramble Hairstreak (*Callophrys dumetorum*)

Brown Elfin (*Callophrys augustinus iroides*)
Skinner's Hairstreak (*Callophrys [Mitoura] loki*)
Gray Hairstreak (*Strymon melinus pudica*)
Western Pygmy-Blue (*Brephidium exilis*)
Western Tailed-Blue (*Cupido amyntula*)
Melissa Blue (*Lycaeides melissa paradoxa*)
Wright's Metalmark (*Calephelis wrighti*)
Desert Metalmark (*Apodemia mormo deserti*)
Imperial Checkerspot (*Dymasia dymas imperialis*)
Painted Lady (*Vanessa cardui*)
West Coast Lady (*Vanessa annabella*)
Common California Ringlet (*Coenonympha californica californica*)
Funereal Duskywing (*Erynnis funeralis*)

Conservation

Conservation for this butterfly is more related to protection of its host plants and habitats. In the Anza Borrego Desert, they have been known to move up the mountainside and recorded on Garnet Peak. Therefore, corridors of canyons and upslope drainages will assist this butterfly in dispersal and movement to adjacent suitable habitats. More research needs to be conducted on its dispersal behavior.

As mentioned earlier, exotic ant species may have a long range impact due to their ability to out-compete native ants to which the larvae need for protection. The primary ant which could cause problems are the Argentine ant. Further research needs to be done to see if this is true. Either way, the removal of native ants does cause concerns for management.

Comstock (1930) noted that a tachinid fly parasitizes them. Therefore inventorying tachinid flies would be helpful in identifying whether it is a specific or generalized species.

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