

Rare Butterfly Management and Conservation Planning

TASK 3:

*HERMES COPPER ADULT SURVEYS AT SOUTH COUNTY SITES
(SENTINEL SITES & FIRE SITES)
29 September 2016*



Prepared for: San Diego Association of Governments

Contract: #5004388, Task Order #2

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Executive Summary

The Hermes copper (*Lycaena hermes*) is a rare butterfly endemic to San Diego County and northern Baja California. This species is threatened by recent urbanization and wildfires throughout its range in the United States. Since most individuals and larger populations are found in the southern portion of San Diego County, one large fire could nearly extirpate the species. Wildfires in 2003 and 2007 have already caused extirpations in this region and few recolonizations have been observed.

Monitoring of sentinel sites allows us to understand how climatic conditions influence variation in flight season phenology and adult densities. Using known populations to determine the phenology of annual flight season is used to guide surveys at other sites. These surveys also allow for proper interpretation of count data considering Hermes copper adult numbers tend to be correlated with precipitation and temperature. Assessment of the southern habitats that experience extirpations due to wildfire will allow for prioritization of management actions and lead towards encouraging recolonization.

In 2016, we conducted butterfly surveys at four sentinel sites (Boulder Creek, Lawson Peak, Roberts Ranch, and Sycuan Peak). Adult Hermes copper counts were similar to 2015 and low compared to 2010-2014. It is likely that the continued drought conditions are suppressing adult emergence. No Hermes copper adults were observed at sites that burned in 2003 or 2007 suggesting natural recolonization has not occurred. The one exception was an observation of a single male at Hollenbeck Canyon Wildlife Area where adults were previously released as part of a translocation experiment.

We mapped 108 spiny redberry patches and recorded an additional 30 lone spiny redberry shrubs across the 13 southern sites. Up to 180 spiny redberry shrubs were recorded in a single patch, but more patches were represented by a relatively low number of shrubs. We conducted an analysis of the habitat data from both the southern and northern sites in this report, placing sites into three groups: 1) northern, 2) southern that recently burned (2003 or later), and 3) southern that did not recently burn. Overall, the habitat characteristics we measured exhibited a relatively high level of variability though the percent cover of spiny redberry and California buckwheat each averaged less than 15 percent at each site.

When comparing vegetation structure across the three site groups, the sites varied most in the percent cover of bare ground. The northern sites and southern burned sites had little bare ground compared to the southern unburned sites. Vegetation cover varied among sites and no clear trend beyond the bare ground pattern was observed.

Additional Hermes copper surveys during years with near or above average precipitation are needed to better understand the population sizes of the northern locations. This area is

extremely important to the long-term persistence of this butterfly as the geographic separation from the southern locations reduces the risk of extinction due to fire. Additionally, these surveys will provide information about how the Hermes copper is able to survive prolonged droughts. The main opportunity for habitat management is to increase/restore nectar sources for adults (primarily California buckwheat). Nectar source restoration should occur at spiny redberry patches that have little or no nectar sources.

Introduction

The Hermes copper (*Lycaena hermes*) is a rare butterfly endemic to San Diego County and northern Baja California. This species is threatened by recent urbanization and wildfires throughout its range in the United States. In April of 2011 the United States Fish and Wildlife Service (USFWS) issued a 12-month finding which concluded that listing the Hermes copper butterfly as threatened or endangered was warranted, and is currently on the USFWS list of candidate species (USFWS 2011).

This report describes the field work conducted during the 2016 Hermes copper flight season at southern sites and a habitat analysis for southern and northern sites. We are continuing research on this rare endemic butterfly known only to occur in San Diego County and threatened with extinction. Monitoring populations provides an opportunity to understand how climatic conditions influence variation in flight season phenology and adult densities. Adult surveys are generally the most accurate and cost-effective way to monitor butterflies, using adapted Pollard walks through suitable habitat. Previous monitoring at multiple sites revealed that population changes tended to covary across sites (i.e. high degree of concordance). As a result, we have monitored only a handful of sites (called sentinel sites in this report) annually.

Monitoring of habitats that supported Hermes copper populations, but were extirpated due to recent (2003, 2007) wildfires, is important to update the current distribution of the species as well as to better understand recolonization processes (Figure 1). Assessment of these habitats will allow for prioritization of management actions. Most of the Hermes copper populations that were extirpated by the recent fires are adjacent to the sentinel sites.

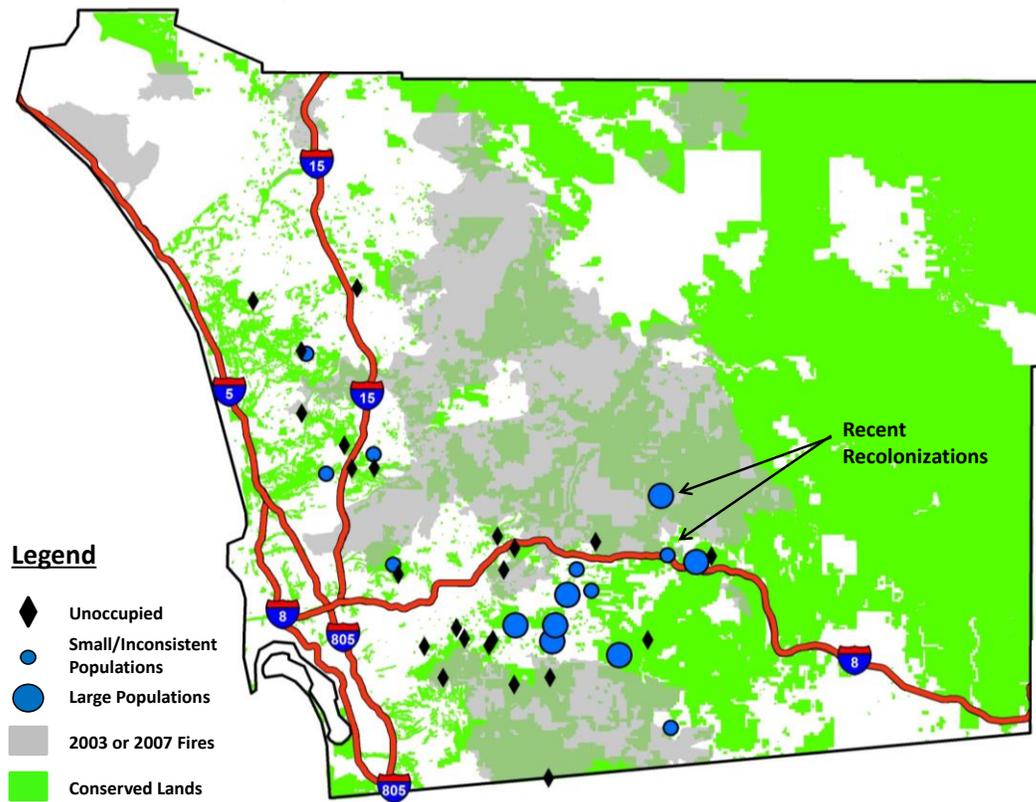


Figure 1. Detections of Hermes copper butterflies on conserved lands, 2010-2013. Sampling locations where Hermes copper was not detected are represented by black diamonds. Small and large Hermes copper populations are indicated by different sized circles.

Methods

Hermes Copper Surveys

In 2016, we conducted surveys for Hermes copper adults at four sites we previously designated as sentinel sites (Boulder Creek Road, Lawson Peak, Roberts Ranch North, and Sycuan Peak Ecological Reserve) (Figure 2). Our goal was to record the maximum number of Hermes copper adults present on a single day at each site (*maximum count*). All surveys were conducted during periods of appropriate weather (sunny or partly sunny, 20 to 35 degrees C, and modest wind speeds) unless stated otherwise. Initial surveys occurred about one time per week and started on 16 April at Sycuan Peak. This site was chosen because past survey efforts have shown this area to regularly produce the first adults of the season. This is an early date but Hermes copper adults were detected in 1 May in 2015 and the spring of 2016 was similarly warm. Once Hermes copper adults were found, we started surveys at the other three sentinel sites. Sampling occurred at shorter intervals (weather dependent) as counts increased. Once counts started to decline markedly, we stopped surveys at that site.

When Hermes copper adults were detected, we also initiated surveys at locations where populations had been extirpated due to the 2003 or 2007 wildfires (called post-wildfire or burned sites in this report). This included: Rancho Jamul Ecological Reserve, Anderson Road, Crestridge Ecological Reserve, Steele Canyon, Wildwood Glen Lane (Figure 2).

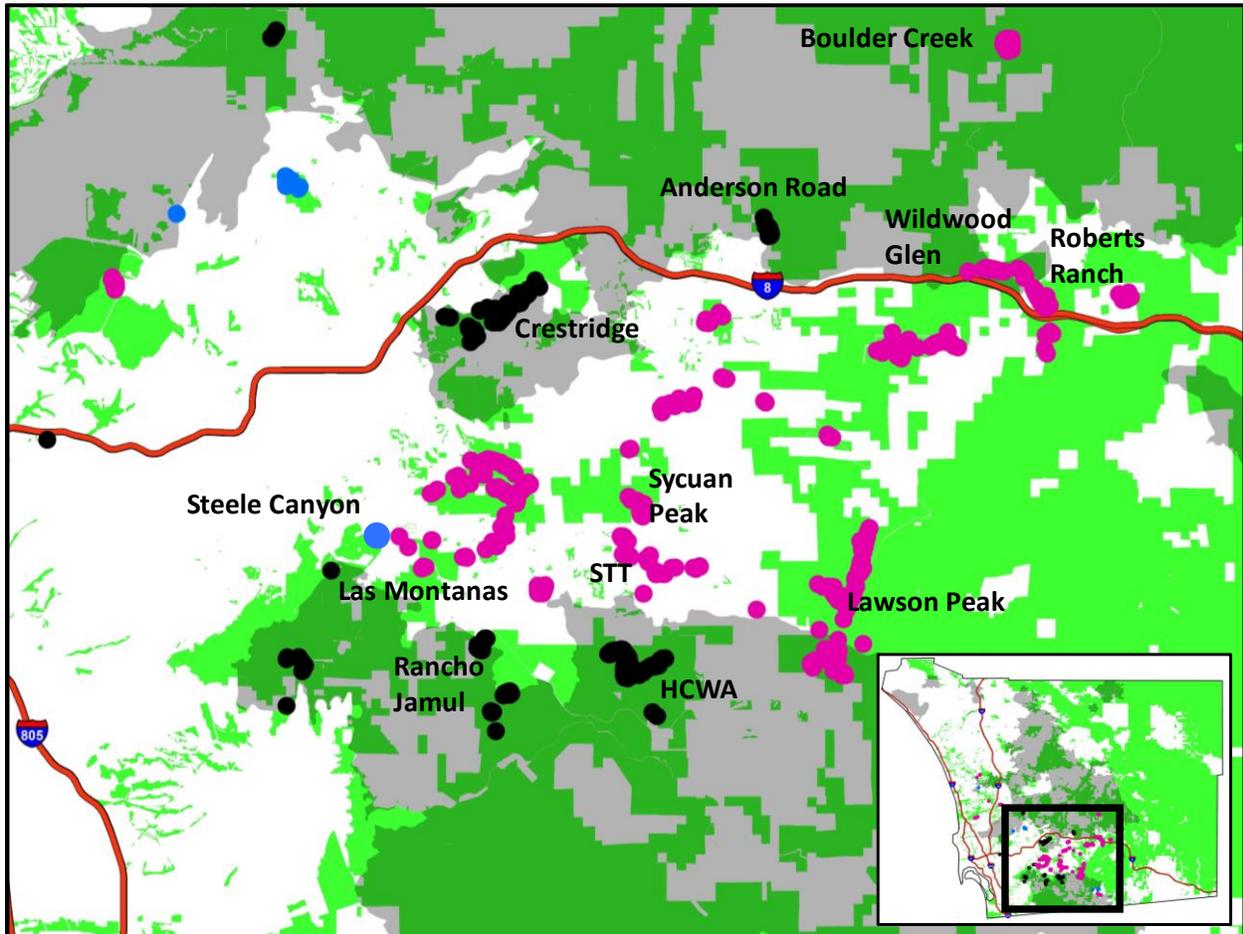


Figure 2. Map of 2016 southern Hermes copper population survey sites with an inset of San Diego County. Purple and black circles represent extant populations and extirpated populations, respectively. Blue circles denote sites of unknown status. Green shading are conserved lands (SANDAG) and dark gray shading maps the footprints of the 2003 and 2007 wildfires.

We also conducted surveys at Las Montanas South since it required little time and was geographically close to other sites, and at Loveland Reservoir to assess another larger population in the vicinity of Jamul/Sycuan Peak.

Habitat Assessment

At each site, spiny redberry patches were mapped in the same areas where we conducted surveys for adult Hermes copper. The abundance and cover of spiny redberry and California buckwheat was recorded, as well as general vegetation composition (Table 1). The site assessments were designed to be rapid and detect large differences in habitat. Individual spiny redberry shrubs were also recorded but associated habitat data were not collected for single, isolated shrubs.

Table 1. Habitat assessment variables.

Variables	Categories
Spiny Redberry	Number of shrubs, mapped extent
California Buckwheat	Distribution (evenly distributed, most along road, and/or few patches)
Vegetation Composition (% cover)	Spiny redberry, California buckwheat, shrubs (includes redberry and buckwheat), non-native grasses, non-native forbs, bare soil
Trees	Distance to spiny redberry patch, tree species

Results

Sentinel Sites

The first Hermes copper was observed on 3 May at Sycuan Peak Ecological Reserve. Two weeks later, following two weeks of cool and cloudy weather, adults at Boulder Creek and Lawson Peak started emerging (mid-May). Emergence at Roberts Ranch North started a couple weeks later, with the first adult observed in early June. In general, counts were similar to 2015 although the maximum count at Boulder Creek nearly doubled (6 to 11) (Table 2). No Hermes copper adults were observed at Loveland Reservoir; a site we had observed at least 10 individuals during a single day in 2011 (Deutschman et al. 2011). No Hermes copper were seen at the Las Montanas South site.

Table 2. Maximum counts of Hermes copper adults at four sentinel sites and an additional site that received frequent visits, 2010-2016. Sampling at sentinel sites consisted of repeated transects to obtain an accurate maximum count. Sampling at the Skyline Truck Trail site was focused on locating females and did not follow a strict protocol for determining the number of Hermes copper present.

Sentinel Sites	2010	2011	2012	2013	2014	2015	2016
Boulder Creek	---	---	18	29	17	6	11
Lawson Peak	2	15	5	17	5	4	2
Roberts Ranch North	4	9	6	8	4	5	3
Sycuan Peak	12	27	14	41	11	1	1
Other Visited Site	2010	2011	2012	2013	2014	2015	2016
Skyline Truck Trail 1	9	---	7	6	7	1	0
Skyline Truck Trail 2	---	---	12	27	9	2	1

" --- " indicates no survey

Post-Wildfire Sites

We did not detect any new recolonizations following the 2003 or 2007 wildfire extirpations (Table 3). The single observation at Hollenbeck Canyon Wildlife Area was likely due to translocation efforts (Marschalek and Deutschman 2016b). Boulder Creek, one of our sentinel sites, was recolonized following a 2007 fire.

Table 3. Hermes copper survey data from sites that experienced wildfires in 2003 and/or 2007.

Sites	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2016
Crestridge ER	49	---	0 (1)	---	0 (1)	0	0	0	0	0	0	0
Anderson Road	73	---	---	---	0	0	0	0	0	0	0	0
Wildwood Glen Lane	13	---	---	---	1	1 (3)	0 (2)	1	2	0 (3)	0	0
Hollenbeck Canyon WA	---	---	90	13+	45	0	---	0	0	---	0	1 ^B
Rancho Jamul ER (2003)	42	---	---	---	0	0	0	0	0	---	0	0
Rancho Jamul ER (2004)	---	10	20	5	4	0	0	0	0	---	0	0
Sycamore Canyon Co Park	7	---	---	---	---	0	---	---	---	---	0	---
San Diego National Wildlife Refuge ^A	---	present	present	present	present	---	---	0	---	---	0	0

Notes:

"---" indicates no survey

(#) Numbers in parentheses include those observed, but not on the historical transect.

^A data from John Martin (USFWS)

^B Translocation project to reintroduce Hermes copper

Survey efforts were similar from 2003-2012 at each site if sampled (see note below)

but efforts (transect length) increased at some sites in 2013.

At Hollenbeck Canyon WA, survey efforts were similar in 2005, 2007, 2013, and 2016, but reduced in 2006.

Habitat Assessment

We mapped 108 spiny redberry patches and recorded 30 single spiny redberry shrubs across the 13 southern sites. Up to 180 spiny redberry shrubs were recorded in a single patch, but

more patches were represented by a relatively low number of shrubs. We conducted an analysis of the habitat data from the southern sites (this report) as well as the northern sites (Marschalek and Deutschman 2016a) to provide a more complete picture. The sites are placed into three groups: 1) northern, 2) southern that recently burned (2003 or later), and 3) southern that did not recently burn (the northern sites did not completely burn recently).

Overall, the habitat characteristics we measured exhibited a relatively high level of variability. The average number of spiny redberry shrubs in each patch varied, as each of the three site categories had locations with few spiny redberry shrubs and locations with many spiny redberry shrubs (Figure 3). Even though measurements were restricted to redberry patches, the percent cover of spiny redberry for each site generally averaged less than 15 percent. The percent cover of California buckwheat was also generally under 15 percent.

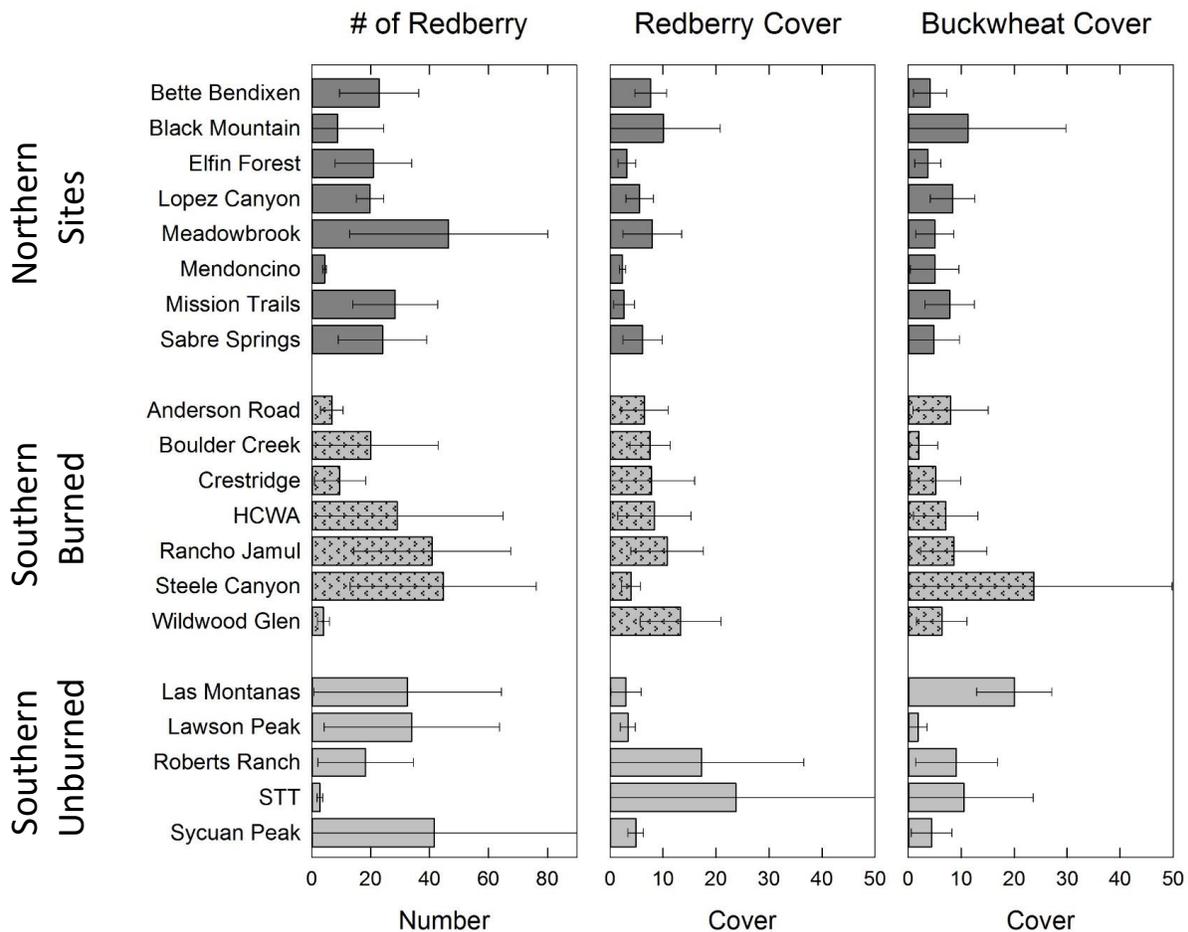


Figure 3. Comparison of spiny redberry and California buckwheat at northern and southern Hermes copper sites, including southern sites that did and did not experience recent wildfires. Site averages are reported with error bars representing 1 standard deviation.

When comparing vegetation structure across the three site groups, the sites varied most in the percent cover of bare ground. The northern sites and southern burned sites had little bare ground compared to the southern unburned sites (Figure 4). Vegetation cover varied among sites and no clear trend beyond the bare ground pattern was observed (Figure 5).

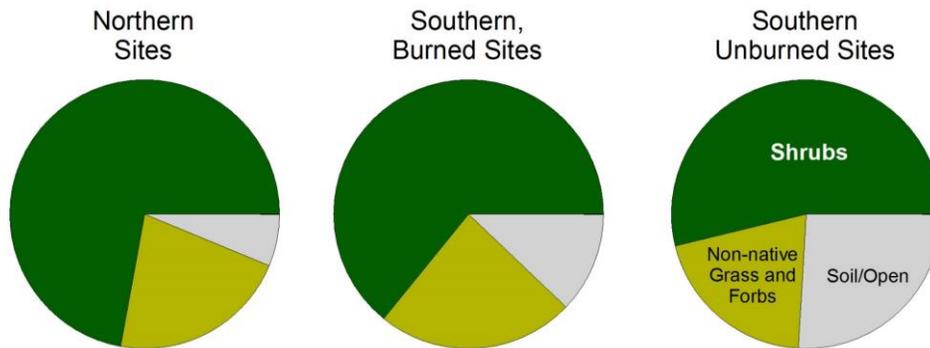


Figure 4. Comparison of vegetation structure at northern and southern Hermes copper sites, including southern sites that did and did not experience recent wildfires.

Discussion

In 2016, Hermes copper adults started emerging the first few days of May as they did in 2015, likely due to the abnormally warm spring. However, the sentinel sites experienced cool and cloudy weather for the majority of May. Temperatures rarely exceeded 70F (the minimum threshold for Hermes copper adult behavior). When the temperature threshold was exceeded, it was often later in the day (after 2:00pm) when the detection rate tends to be much lower. For this reason, few adult emergences occurred in May and survey times were limited. When suitable conditions prevailed, maximum counts of Hermes copper adults were similar to those in 2015. Although there was greater winter precipitation prior to the 2016 flight season, most of the rain occurred early and the spring (February-April) was very dry.

Shrubs, Herbs, and Soil Cover

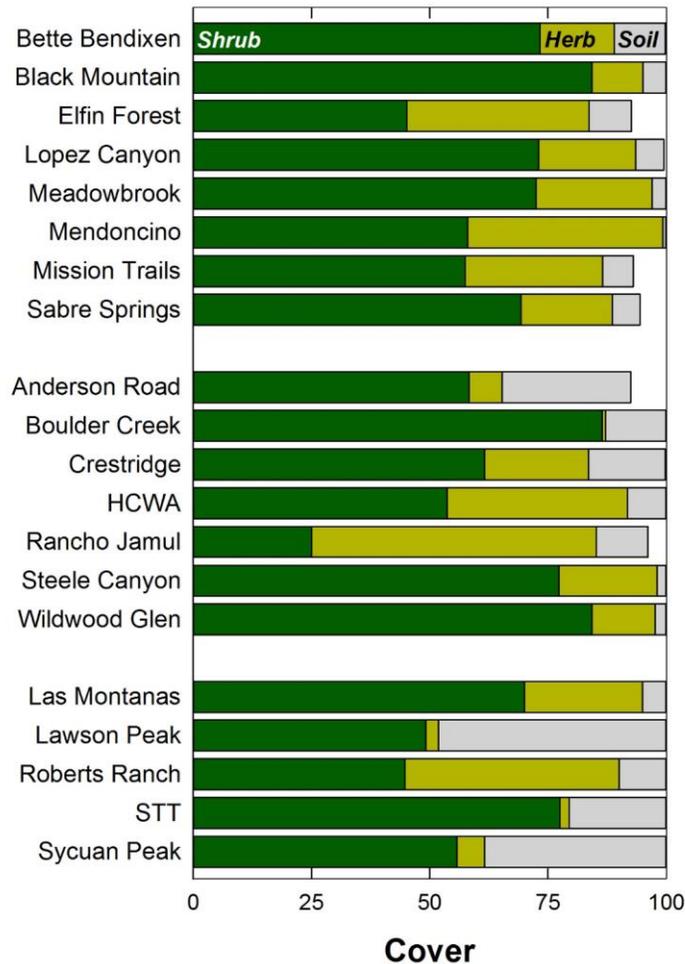


Figure 5. Vegetation structure at each site. Dark green bars represent shrub cover, light green bars represent a combination of grasses and forbs (“Herbs”), and gray bars represent bare ground (“Soil”).

Hermes copper adults were not detected at the sites extirpated by the 2003 or 2007 wildfires. This was expected due to: 1) the low rate of post-wildfire recolonizations observed over the last decade, 2) the small annual adult population sizes during the last couple years provided few opportunities (individuals) for long-distance dispersal events, and 3) dry conditions suppressed adult emerge in 2016. We have observed adult numbers rebounding following a one-year drought (2002 drought and high counts in 2003; discussion in Marschalek and Deutschman 2015) but it is unclear how multiple years of extremely dry conditions will impact the species. Surveys during years of closer to average, or above average, precipitation will be required to adequately assess occupancy of habitat patches and relative population sizes.

Vegetation composition, including spiny redberry and California buckwheat, was variable across sites, regions (north and south), and fire history. The only consistent pattern observed was that the northern and burned southern sites had less bare ground than the unburned southern sites. This was a relatively rapid assessment without strict mapping units or assessment of the habitat outside of the redberry patch so small differences or changes will be difficult to detect. In addition, samples sizes are low due to the rarity of Hermes copper and there is an elevational and latitudinal gradient across the sites, also making it difficult to interpret changes in habitat. It is possible that the presence of spiny redberry, which appears to be relatively robust to disturbance, is the only habitat requirement. This was the conclusion of more intense habitat assessments at only a few sites (Marschalek 2004).

The habitat assessment data, including redberry mapping, should be included in site-specific vegetation maps to determine opportunities for restoration to enhance the populations (increase number and/or extent of redberry and buckwheat). Reduction of non-native herbaceous cover may also be beneficial, as we have observed Hermes copper adults nectaring on native forbs at Sycuan Peak Ecological Reserve and Boulder Creek Road. These two sites have more bare ground so native annual plants are not outcompeted by non-native grasses. The frequent wildfire cycle (some areas burned in both 2003 and 2007) and those areas already compromised by non-native vegetation may have experienced type conversion. In particular, buckwheat can experience high mortality after fire (Zedler et al. 1983, Keeley 2006) and this has been observed in San Diego County (Rochester et al. 2010) and at some of the Hermes copper sites (this report).

Additional Hermes copper surveys during years with near or above average precipitation are needed to better understand the population sizes of the northern locations. This area is extremely important to the long-term persistence of this butterfly as being geographically separate from the southern locations reduces the risk of extinction due to fire. These surveys will provide information about how the Hermes copper is able to survive prolonged droughts. Restoration of adult nectar sources (primarily California buckwheat) should occur at spiny redberry patches that have little or no nectar sources.

Acknowledgements

We would like to thank many people for assistance with this project, including permits, and access to reserves. These include, but are not limited to (alphabetically): California Department of Fish & Wildlife (Richard Burg, Esther Burkett, Justin Garcia, Tracie Nelson, Jason Price), City of San Diego (Betsy Miller, Kim Roeland, Matt Sanford), County of San Diego (Erica Mills, Mary Niez), Endangered Habitats League (Michael Beck), Escondido Creek Conservancy (Ann Van

Leer, Leonard Wittwer) , Sweetwater Authority (Pete Famolaro), United States Fish & Wildlife Service (John Martin, Jill Terp), and United States Forest Service (Amy Reid, Kirsten Winter).

Also, much appreciation to our field crew (Allan Cabrero, Chase James, Kalee Koeslag, Suba Sudarsan), volunteers (Gabriel Deutschman-Ruiz, Giovanna Dowell, Lauren Lopez, and María Vila Duplá), and Korey Klutz for assistance conducting butterfly surveys and/or habitat assessments.

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Appendix A. GPS coordinates of Hermes copper adults in 2016.

Date	Site	Latitude	Longitude
3-May-16	Sycuan Peak	32.748520	116.800680
18-May-16	Boulder Creek	32.929198	116.630985
19-May-16	Hollenbeck Canyon	32.68971104	116.7949589
19-May-16	Lawson Peak	32.713797	116.705677
19-May-16	Lawson Peak	32.715715	116.710568
28-May-16	Lawson Peak	32.71752589	116.7125515
28-May-16	Boulder Creek	32.926845	116.631491
28-May-16	Boulder Creek	32.92725	116.631513
31-May-16	Boulder Creek	32.926167	116.63108
31-May-16	Boulder Creek	32.926851	116.631501
31-May-16	Boulder Creek	32.926883	116.631488
31-May-16	Boulder Creek	32.926941	116.631483
31-May-16	Boulder Creek	32.927129	116.631568
31-May-16	Boulder Creek	32.927269	116.631504
31-May-16	Boulder Creek	32.927641	116.631344
31-May-16	Boulder Creek	32.927814	116.63134
31-May-16	Boulder Creek	32.928224	116.631257
31-May-16	Boulder Creek	32.928912	116.634779
31-May-16	Boulder Creek	32.927672	116.635006
31-May-16	Boulder Creek	32.92586	116.632258
31-May-16	Boulder Creek	32.926271	116.631744
31-May-16	Roberts Ranch North	32.827042	116.615516
31-May-16	Roberts Ranch North	32.827496	116.614878
31-May-16	Lawson Peak	32.713863	116.705589
31-May-16	Lawson Peak	32.713995	116.705472
1-Jun-16	Boulder Creek	32.927324	116.631486
1-Jun-16	Boulder Creek	32.927324	116.631486
1-Jun-16	Boulder Creek	32.927456	116.631408
1-Jun-16	Boulder Creek	32.927611	116.631364
1-Jun-16	Boulder Creek	32.927818	116.631338
1-Jun-16	Boulder Creek	32.92922	116.630992
1-Jun-16	Boulder Creek	32.929861	116.63408
1-Jun-16	Boulder Creek	32.929553	116.634412
1-Jun-16	Boulder Creek	32.929553	116.634412
1-Jun-16	Boulder Creek	32.925844	116.632276
1-Jun-16	Boulder Creek	32.925844	116.632276
1-Jun-16	Boulder Creek	32.926	116.632103
1-Jun-16	Boulder Creek	32.926	116.632103
1-Jun-16	Boulder Creek	32.926056	116.632059
1-Jun-16	Boulder Creek	32.926169	116.63188
1-Jun-16	Boulder Creek	32.926169	116.63188

Appendix A. GPS coordinates of Hermes copper adults in 2016 continued.

Date	Site	Latitude	Longitude
2-Jun-16	Skyline Truck Trail 2	32.72930757	116.7968356
3-Jun-16	Lawson Peak	32.713819	116.705655
3-Jun-16	Boulder Creek	32.926175	116.631094
3-Jun-16	Boulder Creek	32.926881	116.63148
3-Jun-16	Lawson Peak	32.714645	116.709436
3-Jun-16	Boulder Creek	32.92724	116.631508
3-Jun-16	Boulder Creek	32.927299	116.631466
3-Jun-16	Boulder Creek	32.927396	116.63143
3-Jun-16	Boulder Creek	32.927611	116.631333
3-Jun-16	Boulder Creek	32.927814	116.631328
3-Jun-16	Boulder Creek	32.92826	116.631215
3-Jun-16	Boulder Creek	32.928364	116.631138
3-Jun-16	Boulder Creek	32.929871	116.634039
3-Jun-16	Boulder Creek	32.929603	116.634365
3-Jun-16	Boulder Creek	32.928118	116.634876
3-Jun-16	Boulder Creek	32.928129	116.634881
3-Jun-16	Boulder Creek	32.927917	116.634925
3-Jun-16	Boulder Creek	32.925426	116.633116
3-Jun-16	Boulder Creek	32.925462	116.632951
3-Jun-16	Boulder Creek	32.925677	116.632521
3-Jun-16	Boulder Creek	32.925852	116.632261
3-Jun-16	Boulder Creek	32.926157	116.631914
3-Jun-16	Boulder Creek	32.926199	116.63185
6-Jun-16	Boulder Creek	32.926239	116.631165
6-Jun-16	Boulder Creek	32.926275	116.631214
6-Jun-16	Boulder Creek	32.926532	116.631376
6-Jun-16	Boulder Creek	32.927126	116.631568
6-Jun-16	Boulder Creek	32.927231	116.631519
6-Jun-16	Boulder Creek	32.927297	116.631485
6-Jun-16	Boulder Creek	32.927752	116.631299
6-Jun-16	Boulder Creek	32.927934	116.631307
6-Jun-16	Boulder Creek	32.928296	116.631204
6-Jun-16	Boulder Creek	32.929814	116.634103
6-Jun-16	Boulder Creek	32.929815	116.634107
6-Jun-16	Boulder Creek	32.929557	116.634381
6-Jun-16	Boulder Creek	32.929453	116.634693
6-Jun-16	Boulder Creek	32.929244	116.634701
6-Jun-16	Boulder Creek	32.928326	116.634874
6-Jun-16	Boulder Creek	32.928282	116.634895
6-Jun-16	Boulder Creek	32.928096	116.634902
6-Jun-16	Boulder Creek	32.928058	116.634918

Appendix A. GPS coordinates of Hermes copper adults in 2016 continued.

Date	Site	Latitude	Longitude
6-Jun-16	Boulder Creek	32.927921	116.63496
6-Jun-16	Boulder Creek	32.926189	116.631846
6-Jun-16	Boulder Creek	32.926391	116.631603
6-Jun-16	Boulder Creek	32.926224	116.631148
6-Jun-16	Boulder Creek	32.926204	116.631077
6-Jun-16	Roberts Ranch North	32.828521	116.617831
6-Jun-16	Roberts Ranch North	32.828472	116.617737
6-Jun-16	Roberts Ranch North	32.827505	116.614839
8-Jun-16	Skyline Truck Trail 2	32.7309003	116.7971579
9-Jun-16	Boulder Creek	32.926441	116.6313
9-Jun-16	Boulder Creek	32.926939	116.631528
9-Jun-16	Boulder Creek	32.926904	116.631481
9-Jun-16	Boulder Creek	32.926897	116.63148
9-Jun-16	Boulder Creek	32.927108	116.631605
9-Jun-16	Boulder Creek	32.927138	116.631611
9-Jun-16	Boulder Creek	32.927265	116.631527
9-Jun-16	Boulder Creek	32.92761	116.63135
9-Jun-16	Boulder Creek	32.92806	116.631267
9-Jun-16	Boulder Creek	32.929846	116.634059
9-Jun-16	Boulder Creek	32.92958	116.634417
9-Jun-16	Boulder Creek	32.929446	116.634694
9-Jun-16	Boulder Creek	32.929279	116.634728
9-Jun-16	Boulder Creek	32.928087	116.634935
9-Jun-16	Boulder Creek	32.92795	116.634967
9-Jun-16	Boulder Creek	32.926176	116.631872
9-Jun-16	Boulder Creek	32.926204	116.631855
9-Jun-16	Boulder Creek	32.92639	116.631593
9-Jun-16	Boulder Creek	32.926422	116.631513
9-Jun-16	Boulder Creek	32.926189	116.631156
9-Jun-16	Roberts Ranch North	32.828481	116.617751
13-Jun-16	Boulder Creek	32.926802	116.631542
13-Jun-16	Boulder Creek	32.926893	116.631506
13-Jun-16	Boulder Creek	32.926884	116.631506
13-Jun-16	Boulder Creek	32.927068	116.631595
13-Jun-16	Boulder Creek	32.927577	116.631382
13-Jun-16	Boulder Creek	32.927794	116.63135
13-Jun-16	Boulder Creek	32.928292	116.631215
13-Jun-16	Boulder Creek	32.929928	116.633969
13-Jun-16	Boulder Creek	32.929549	116.634391
13-Jun-16	Boulder Creek	32.928651	116.634853
13-Jun-16	Boulder Creek	32.928448	116.634859

Appendix A. GPS coordinates of Hermes copper adults in 2016 continued.

Date	Site	Latitude	Longitude
13-Jun-16	Boulder Creek	32.928243	116.634873
13-Jun-16	Boulder Creek	32.928186	116.634871
13-Jun-16	Boulder Creek	32.927954	116.634955
13-Jun-16	Boulder Creek	32.927949	116.634958
13-Jun-16	Boulder Creek	32.92665	116.634599
13-Jun-16	Boulder Creek	32.926326	116.631554
13-Jun-16	Roberts Ranch North	32.827863	116.614304
13-Jun-16	Roberts Ranch North	32.827853	116.614298
22-Jun-16	Roberts Ranch North	32.82698	116.615539

Appendix B: Vegetation data associated with spiny redberry (*Rhamnus crocea*) patches at northern Hermes copper populations.

Site	# Redberry							Distribution of					
		Redberry	Buckwhea	Shurbs	NN Grass	NN Forbs	Soil	Buckwheat	Trees	Tree 1	Tree 2	Tree 3	Tree Distance
Anderson Road	2	7	0	90	5	5	0		No				300 ft
Anderson Road	6	15	5	30	5	5	15	most along road	No				300 ft
Anderson Road	7	5	3	45	0.5	0.5	54	few patches	No				300 ft
Anderson Road	4	5	10	45	5	5	45		No				
Anderson Road	13	5	20	70	1	3	26	most along road	No				
Anderson Road	9	2	10	70	2	5	23		No				
Boulder Creek	5	5	10	97	0	0	3	most along road	Yes	Coast Live Oak			
Boulder Creek	20	4	1	88	1	1	10	most along road	No				150 ft
Boulder Creek	70	5	0	88	1	1	10		No				200 ft
Boulder Creek	10	7	2	99	0	0	1	most along road	No				500 ft
Boulder Creek	5	15	1	97	1	0	2	most along road	No				500 ft
Boulder Creek	20	7	0	83	0	0	17		No				600 ft
Boulder Creek	10	10	0	53	0	0	49		No				600 ft
Boulder Creek	5								No				
Crestridge	5	3	2	91	1	3	5	few patches	No				.25 mi
Crestridge	6	5	7	60	0	2	38	few patches	No				200 ft
Crestridge	3	10	5	80	0	10	10	few patches	No				300 ft
Crestridge	5	5	10	80.5	5	0.5	15		No				
Crestridge	10	5	2	69	5	6	20		No				0.25
Crestridge	10	5	7	90	2	7	2	few patches	No				50 ft
Crestridge	3	35	0	45	20	0.2	34.8	none	No				60 ft
Crestridge	5	7	7	50	2	43	5	few patches	Yes	Coast Live Oak			
Crestridge	20	5	7	60	15	17	8	evenly distributed	Yes	Engelman Oak			
Crestridge	7	13	5	70	5	24	1	few patches	No				70 ft
Crestridge	3	5	0	15	70	5	10	none	Yes	Coast Live Oak	Engelman Oak		
Crestridge	8	7	5	45	3	15	30	few patches	Yes	Coast Live Oak			
Crestridge	3	7	1	95	0	0	5	mostly along road	No				25 ft
Crestridge	25	5	10	39	5	1	55	mostly along road	Yes	Eucalyptus			
Crestridge	3	2	8	54	1	5	40	few patches	No				100 ft
Crestridge	8	30	1	90	5	2	3	few patches	Yes	Engelman Oak	Coast Live Oak	Eucalyptus	
Crestridge	5	15	10	90	5	5	0	mostly along road	Yes	Engelman Oak	Coast Live Oak		
Crestridge	20	1	2	40	15	5	40	mostly along road	No				100 ft
Crestridge	6	5	1	70	25	4	1	mostly along road	No				40 ft
Crestridge	40	2	20	30	10	5	55	mostly along road	Yes	Engelman Oak			
Crestridge	17	5	7	48	40	2	10	evenly distributed	Yes	Engelman Oak			
Crestridge	4	1	0	20	50	20	10		Yes	Coast Live Oak			
Crestridge	15	5	12	80	3	7	10	mostly along road	No				200 ft
Crestridge	8	2	1	70	10	5	15	mostly along road	No				40 ft
Crestridge	4	15	0	85	10	5	0		No				.25 mi
Crestridge	6	3	5	35	40	25	0	evenly distributed	No				.5 mi

Appendix B: Vegetation data associated with spiny redberry patches continued.

Site	# Redberry	Redberry	Buckwhea	Shurbs	NN Grass	NN Forbs	Soil	Distribution of Buckwheat	Trees	Tree 1	Tree 2	Tree 3	Tree Distance
Hollenbeck Canyon Wildlife Area	3	20	5	40	30	20	10	few patches	No				100 ft
Hollenbeck Canyon Wildlife Area	10	10	2	70	20	5	5	few patches	Yes	Quercus agrifolia			
Hollenbeck Canyon Wildlife Area	5	2	5	40	30	23	7	evenly distributed	No				30 ft
Hollenbeck Canyon Wildlife Area	2	25	20	75	0	0	25	most along road	No				50 ft
Hollenbeck Canyon Wildlife Area	3	10	8	80	10	10	0	few patches	No				100 ft
Hollenbeck Canyon Wildlife Area	15	3	2	60	25	10	5	all three categories	No				100 ft
Hollenbeck Canyon Wildlife Area	112	2	1	70	20	5	5	first two categories	No				120 ft
Hollenbeck Canyon Wildlife Area	2	5	3	55	15	10	20	few patches	No				200 ft
Hollenbeck Canyon Wildlife Area	15	5	7	35	30	15	20	evenly distributed	No				100 ft
Hollenbeck Canyon Wildlife Area	85	10	8	40	50	8	2	evenly distributed	No				180-300 ft
Hollenbeck Canyon Wildlife Area	25	7	15	38	50	10	2	evenly distributed	No				200 ft
Hollenbeck Canyon Wildlife Area	35	5	15	35	55	5	5	evenly distributed	No				200 ft
Hollenbeck Canyon Wildlife Area	65	5	1	60	34	5	1	most along road	No				110 ft
Las Montanas South	55	5	15	60	15	20	5	evenly distributed	No				10 ft
Las Montanas South	10	1	25	80	5	10	5	evenly distributed	Yes	Oak			
Lawson Peak	6	2	3	90	1	1	8	most along road	No				200 ft
Lawson Peak	17	3	2	30	1	5	64	most along road, few patches	No				200 ft
Lawson Peak	32	5	1	40	1	1	58	most along road, few patches	No				200 ft
Lawson Peak	81	5	1	45	1	1	53	most along road, few patches	No				300 ft
Lawson Peak	10	3	5	78	1	1	20	most along road	No				400 ft
Lawson Peak	61	5	3	40	2	2	56	most along road	No				400 ft
Lawson Peak	4	2	0	25	1	1	73		No				400 ft
Lawson Peak	61	2	0	45	1	0.5	53.5		No				300 ft
Rancho Jamul	25	3	7	15	74	1	0.5	evenly distributed	No				0.25 mi
Rancho Jamul	78	15	1	25	73.5	0.5	1	few patches	No				300 ft
Rancho Jamul	30	10	5	25	30	5	40	few patches	Yes	Quercus agrifolia			
Rancho Jamul	12								No				
Rancho Jamul	11	15	45	60	38	2	0	evenly distributed	No				0.25 mi
Rancho Jamul	30	6	15	25	50	2	2		Yes	Willow			
Rancho Jamul	9	25	30	55	30	5		evenly distributed	No				0.25 mi
Rancho Jamul	70	20	15	35	60	5			Yes	Willow			
Roberts Ranch	15	30	1	40	60	0	0	few patches	Yes	Engelman Oak	Coast Live Oak		
Roberts Ranch	7	7	2	40	54	1	5		Yes	Engelman Oak			
Roberts Ranch	3	55	0	55	35	5	10		Yes	Engelman Oak			
Roberts Ranch	25	50	10	65	30	0	5	evenly distributed	Yes	Engelman Oak			
Roberts Ranch	50	20	20	50	15	5	30	most along road	Yes	Engelman Oak			
Roberts Ranch	2	5	5	20	75	0	5	most along road	Yes	Engelman Oak			
Roberts Ranch	5	5	25	35	63	0	2	evenly distributed	Yes	Engelman Oak			
Roberts Ranch	40	3	10	18	67	0	15	evenly distributed	Yes	Engelman Oak	Coast Live Oak		
Roberts Ranch	25	3	7	20	72	2	6	evenly distributed	Yes	Engelman Oak			
Roberts Ranch	25	4	10	59	4	0	37	most along road	Yes	Engelman Oak			
Roberts Ranch	4	8	10	90	10	0	0	evenly distributed	Yes	Engelman Oak			

Appendix B: Vegetation data associated with spiny redberry patches continued.

Site	# Redberry	Redberry	Buckwhea	Shurbs	NN Grass	NN Forbs	Soil	Distribution of Buckwheat	Trees	Tree 1	Tree 2	Tree 3	Tree Distance
Skyline Truck Trail 1	2	7	30	60	1	1	38	evenly distributed	No				200
Skyline Truck Trail 1	2	5	2	95	3	0	2	few patches	No				200
Skyline Truck Trail 1	3	3	5	60	2	1	37	most along road	Yes	Engelman Oak			
Skyline Truck Trail 1	4	80	5	95	0	0	5		Yes	Engelman Oak			
Steele Canyon	8	5	50	55	40	5	0	evenly distributed	No				100 ft
Steele Canyon	13	5	70	75	15	10	0	evenly distributed	No				80 ft
Steele Canyon	6	6	35	40	30	30	0	evenly distributed	No				100 ft
Steele Canyon	80	5	40	80	5	5	10	evenly distributed	No				80 ft
Steele Canyon	70	7	10	85	10	5	0	evenly distributed	No				50-70 ft
Steele Canyon	25	3	1	90	5	4	1	few patches	No				320 ft
Steele Canyon	70	3	2	80	10	5	5	few patches	No				100 ft
Steele Canyon	50	2	1	90	5	5	0		No				200 ft
Steele Canyon	30	1	10	80	7	8	5	evenly distributed	No				200 ft
Steele Canyon	78	5	5	90	6	2	2	few patches	No				200 ft
Steele Canyon	100	3	5	85	12	3	0	few patches	No				300 ft
Steele Canyon	20	2	10	75	20	5	1	evenly distributed	No				300 ft
Steele Canyon	30	5	70	80	7	10	3	evenly distributed	No				100 ft
Sycuan Peak	2	5	7	40	3	10	47	evenly distributed	No				200 ft
Sycuan Peak	2	5	2	70	0	0	30	few patches	No				400 ft
Sycuan Peak	4	2	5	25	0	1	74	most along road	No				300 ft
Sycuan Peak	3	7	10	99	0	0	1	evenly distributed	No				350 ft
Sycuan Peak	81	5	7	51	2	7	40	most along road	No				800 ft
Sycuan Peak	20	5	0	50	5	3	42		No				1500 ft
Sycuan Peak	180	5	0	55	7	3	35		No				3000 ft
Wildwood Glen	4	20	8	61	18	20	1	most along road	Yes	Engelman Oak			
Wildwood Glen	6	5	10	99	0	0	1	most along road	No				100 ft
Wildwood Glen	2	15	1	93	2	0	5	few patches	No				120 ft