Western Riverside County
Multiple Species Habitat Conservation Plan (MSHCP)
Biological Monitoring Program

Vegetation Community Survey Report 2008

17 APRIL 2009

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NOTE TO READER:

This report is an account of survey activities undertaken by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The Biological Monitoring Program monitors the distribution and status of the 146 Covered Species within the Conservation Area to provide information to Permittees, land managers, the public, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service. Monitoring Program activities are guided by the MSHCP species objectives for each Covered Species, the information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees.

We would like to acknowledge the land managers in the MSHCP Plan Area, who in the interest of conservation and stewardship facilitate Monitoring Program activities on the lands for which they are responsible. A list of the lands where this year's data collection activities were conducted is included in Section 7.0 of the Western Riverside County Regional Conservation Authority (RCA) Annual Report to the Wildlife Agencies.

Partnering organizations and individuals contributing data to our projects are acknowledged in the text of appropriate reports. We would especially like to acknowledge the Santa Ana Watershed Association, the Center for Natural Lands Management, and the Orange County Water District for their willingness to initiate or modify their data collection to complement our survey efforts in 2008.

While we have made every effort to accurately represent our data and results, it should be recognized that our database is still under development. Any reader who would like to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data. All Monitoring Program data, including original datasheets and digital datasets are stored in the Monitoring Program office in downtown Riverside, CA.

The primary author of this report was the 2008 Botany Program Lead, Diane Menuz. If there are any questions about the information provided in this report, please contact the Monitoring Program Administrator. If you have questions about the MSHCP, please contact the Executive Director of the RCA. For further information on the MSHCP and the RCA, go to www.wrc-rca.org.

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INTRODUCTION

One objective of the Biological Monitoring Program is to establish a long-term monitoring strategy to track changes in vegetation communities within the Conservation Area. Specifically, the MSHCP requires the Monitoring Program to evaluate the condition of vegetation communities by looking at attributes such as disturbance and percent cover of native and non-native plant species as well as documenting changes in these attributes through time (Dudek & Associates 2003). The MSHCP minimally requires that monitoring for each Covered Species and vegetation community occur at least once every 8 years, but a more refined monitoring timeline should be established to provide a level of sensitivity that will allow us to detect ecologically meaningful change through time and provide useful information to land managers. We should also choose a sampling frequency that allows us to understand how annual fluctuations in environmental parameters such as rainfall affect metrics like non-native grass cover and species richness, while allowing us to sample a substantial portion of the Conservation Area. Finally, we need to develop sampling methods that limit the amount of inter-observer variability and efficiently address MSHCP-defined objectives for monitoring vegetation communities.

We began a pilot vegetation monitoring study in 2008 to test the utility of different survey methods and to begin to understand natural variation within the target systems. We began our pilot work in chaparral and coastal sage scrub (CSS) because these are the 2 most abundant vegetation communities in the Western Riverside County MSHCP Conservation Area. Together, these communities comprise almost 72 percent of the vegetation in the Conservation Area, according to the most recent map of vegetation communities in western Riverside County (CDFG et al 2005). We were primarily interested in examining species richness and the percent cover of major functional groups, including native shrubs, native forbs, non-native forbs and non-native grasses. We used a protocol established by Dr. Douglas Deutschman and collaborators in his lab at San Diego State University (Deutschman lab). This allowed us to include our data in the Deutschman lab multi-county analysis aimed at examining spatial and methodological sources of variation in vegetation community data. We will use our results as well as the results from the Deutschman lab analysis to help determine the best monitoring strategy for tracking changes in vegetation communities within the Conservation Area.

The Deutschman lab began a study in 2007 to look at the utility of different survey methods for monitoring vegetation communities in San Diego County. They established sampling stations that consisted of point intercept sampling, 10-m x 10-m plots, and 1-m × 1-m quadrats to measure species richness and percent cover of individual plant species in grassland, CSS, and chaparral vegetation (Deutschman et al 2008). They repeated sampling at each station with different observer teams to assess observer bias. In their first year of data collection, they found that point intercept sampling was the fastest method of data collection, and 10-m x 10-m plots and quadrats tied for slowest. They also found that quadrats were the best method for assessing species richness and point intercept was the worst. Observers differed in their measures of species richness as well as in their ability to detect certain species. For most species and functional groups, a large component of the variability in the data was due to spatial variation. Based on these findings, they eliminated the 10-m x 10-m plots from their 2008 sampling protocol and added more stations at each site and more sites within their study area.

The pilot study initiated by the Monitoring Program in 2008 is intended to measure change within sites through time, not to compare the current condition of vegetation communities at different sites. We do not have a threshold for percent shrub cover or percent non-native species cover that allows us to determine whether the vegetation in an area is "healthy". We also cannot directly compare the condition of different sites to one another because each area has different environmental attributes, disturbance history, and species composition. Instead, we intend to look for changes in functional group cover and species richness across time to periodically determine the condition of vegetation communities in the Conservation Area. We may also be able to determine whether certain starting states are more susceptible to large-scale changes than others. For example, if we want to document whether CSS is converting to non-native grassland, we may be able to find a threshold for a starting state attribute (e.g., shrub cover) below which the likelihood of converting to non-native grassland increases dramatically.

Survey Goals:

A) Document current attributes of CSS and chaparral communities, including species richness and percent cover of functional groups such as non-native grasses and native shrubs.
B) Assess the amount of natural variability in CSS and chaparral communities.
C) Develop a long-term strategy for monitoring all vegetation communities.
D) Collaborate with Deutschman lab to better understand the benefits and costs of different sampling methods.

METHODS

Protocol Development

We followed the protocol developed by the Deutschman lab at San Diego State University under California Department of Fish and Game Local Assistance Grant #P0685105 for the Multiple Species Conservation Program in Southwestern San Diego County. We felt that the Deutschman lab protocol was appropriate for our purposes because it focused on measuring the same variables (species richness and percent cover of functional classes) that we were interested in measuring. Additionally, by collaborating with the Deutschman lab, we were able to contribute our data to an analysis that included data from Orange County and San Diego County, thus increasing our ability to detect differences in the 2 survey methods and between different teams of observers.

Personnel and Training

Spring Strahm (Project Scientist, San Diego State University, Deutschman lab) trained field crew in survey methods to ensure that data collected in Riverside County were consistent with data from other counties. Strahm used a slideshow presentation when training crews among counties to illustrate field methodologies and oversaw data collection on a mock sampling station. All Biological Monitoring Program staff that participated in this training had previous experience estimating percent cover and identifying plants in western Riverside County. The following Monitoring Program biologists conducted vegetation community surveys in 2008:

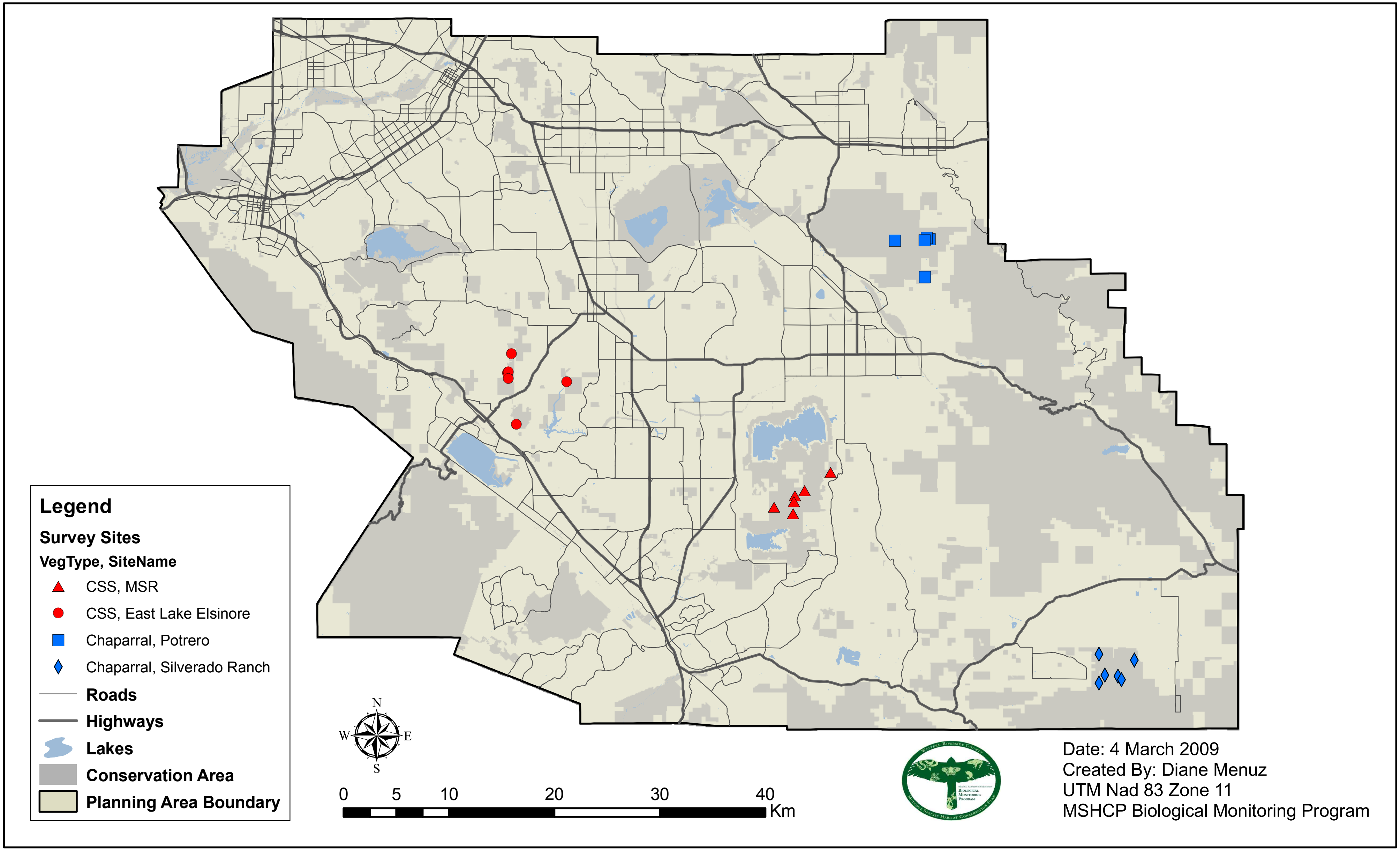
- Diane Menuz (Botany Program Lead, Regional Conservation Authority)
- Annie Bustamante (Regional Conservation Authority)
- Carol Thompson (Regional Conservation Authority)
- Christina Greutink (Regional Conservation Authority)
- Jeff Galvin (Regional Conservation Authority)
- Joseph Veverka (Regional Conservation Authority)
- Lee Ripma (Regional Conservation Authority)

Study Site Selection

We looked at the following factors when selecting our pilot study sites: abundance of chaparral and CSS, opportunity to permanently mark stations, and distribution of targeted vegetation communities within the Conservation Area. We used a Geographic Information System (GIS) map of vegetation communities in western Riverside County (CDFG et al 2005) to determine where chaparral and CSS communities were present. We selected the Southwestern Riverside County Multi-Species Reserve (MSR) and land near the eastern edge of the city of Lake Elsinore (East Lake Elsinore) as CSS sites (Figure 1). This latter site consists of conserved land to the north and south of state highway 74 between interstates 215 and 15, including North Peak Preserve, White Rock Preserve and land adjacent to Canyon Lake. We selected Silverado Ranch (southeast section of the Plan Area near Anza) and Bureau of Land Management (BLM) lands adjacent to the Potrero Unit of the San Jacinto Wildlife Area (Potrero) as chaparral sites (Figure 1). Stations at Potrero were recovering from the 2006 Esperanza fire.

We generated 10 random points per study site using Hawth's Tools in ArcGIS within the vegetation community of interest (Beyer 2004; ESRI 2006). We selected random points that were between 30 and 500 m from roads and field-verified each site in a random order. We discarded points that occurred on dangerously steep slopes or were within 30 m of a road not mapped in our GIS-based roads layer. We then established sampling stations by extending a 50-m tape in a randomly chosen bearing from the given point. We marked both ends of each station with stakes to allow for future identification. We established 6 stations at each site except at Potrero (n =5).

Figure 1. Survey Sites for 2008 Vegetation Monitoring.



Survey Methods

We provide a full explanation of survey methods in *Protocol for Vegetation Community Monitoring* (Appendix A) and field forms (Appendix B) and summarize our data collection procedure below. We surveyed between 8 April and 2 May 2008. We visited stations within Silverado Ranch, MSR, and East Lake Elsinore over a 2-week period to minimize species turnover during the sampling period at each site. However, personnel logistics dictated that Potrero was sampled over a 24-day period. We sampled sites in 3 teams of 2 observers each. At each site, 2 or 3 survey stations were surveyed by more than 1 team to measure inter-observer variability while the remaining stations were surveyed only once.

We collected point-intercept and quadrat data at each sampling station. We first stretched a 50-m tape across each sampling station and recorded cover type at ground level (bare ground, rock, litter, basal stem, cryptogamic crust, moss) and plant species that intercepted a dowel placed perpendicular to the tape at 1 m intervals. We also placed a 1-m^2 frame every 5 m along alternating sides of the transect tape for a total of 10 frames (i.e., quadrats) per transect. We marked the side of the quadrat in 10 cm increments to aid in visual cover estimates. We then visually estimated percent cover of each cover type and plant species within each of the 10 quadrats. Field crew collected samples of any unknown plants encountered in the field for later identification.

Data Analysis

We calculated values for species richness and mean percent cover of functional groups, including native and non-native grasses, native and non-native forbs and native shrubs, recorded at the study sites. We report richness as the total number of species recorded across sampling stations at each site, or the number of genera for species that we could not reliably identify beyond their generic classification in the field. Specifically, we treated the following groups as 1 species: all *Camissonia* species, *Cryptantha intermedia* and *C. muricata,* both varieties of *Amsinckia menziesii*, *Collinsia heterophylla* and *C. concolor,* and *Thysanocarpus laciniatus* and *T. curvipes.* We could not assign some recorded species to a functional group, such as *Filago* sp., because local members of the genus can be either native or non-native. We recorded 2 observed fern species as “other species” for the sake of analysis. We used point intercept data to obtain percent cover estimates for functional groups because this data provided the most uniform sampling effort across the sampling station. We report mean cumulative values instead of mean absolute values for cover in order to show the contribution of more than 1 species per functional group towards the cover estimates. For example, we reported 140% total forb cover if there were 2 forb species, one with 90% cover and one with 50% cover.

We reported the most common species found across stations. For our CSS sites, we reported all native forb, non-native forb and non-native grass species found at ≥67% of

CSS stations (*n*=12) and the 2 most widespread shrub species. For our chaparral sites, we reported all species found at ≥64% (*n*=11) of stations as well as the 4 most widespread shrub species and 1 most widespread non-native forb species. We also reported the 4 most common native forb species by chaparral site because our 2 sites had different common forb species. We considered a sampling station occupied by a species regardless of whether we detected it using visual cover, point intercept, or both methods. For some of these species, we calculated the mean percent cover for the stations which it occupied, using the point intercept data.

The Deutschman lab pooled our observations with data collected in Orange County and San Diego County, and used variance components analysis to quantify variance due to temporal (inter-annual variation), spatial (vegetation community, site, and sample station), and methodological (inter-observer variation, point intercept versus quadrat,) variability in the dataset (Deutschman and Strahm 2009). They included Biological Monitoring Program data in analysis of spatial and methodological variation, while they only used sites that had been measured in both 2007 and 2008 to look at temporal variation. Complete explanation of the analysis can be found in Deutschman and Strahm (2009).

RESULTS

Surveyors took between 24 and 114 minutes to collect quadrat data (*n*=31, mean=70.13, standard error=3.68) and between 8 and 57 minutes to collect transect data (*n*=31, mean=26.93, standard error=2.24). Survey teams completed a mean of 1.67 (*n*=21, standard error=0.16) sampling stations per survey day and completed 3 stations in a single day on 3 occasions. Surveyors were prevented from surveying more stations per day in large part due to travel time both to study sites and between sampling stations.

We recorded a total of 150 plant species across our 4 study sites, consisting of 33 shrubs, 97 forbs, 18 grasses and 2 ferns (Table 1). We recorded the most species at Potrero and MSR, with 77 distinct plant species at each site. We found 66 species at Silverado Ranch and 58 at East Lake Elsinore. Both CSS sites had a higher component of their richness composed of non-native species than chaparral sites, with the former having between 20% and 26% non-native species and the latter having approximately 12% non-native species (Figure 2).

We recorded greater total, native grass, and non-native forb cover at our CSS sites compared to our chaparral sites (Table 2). The recently burned Potrero site had only 60% as much shrub cover as Silverado Ranch, our other chaparral site. Potrero also had more than 5 times as much non-native forb cover and over twice as much non-native grass cover than Silverado Ranch, while native forb cover was the same between sites. East Lake Elsinore and MSR had a similar number of non-native species, but there was more than double the non-native species cover at East Lake Elsinore than at MSR.

Table 1. Species richness by functional group at CSS and chaparral sites.

Sites	All Spp.	Native Grass	Native Forb	Native Shrub	Non-native Grass	Non-native Forb	Other Spp.
All Sites	150	7	86	33	11	11	2
CSS Sites	97	6	56	14	11	10	0
MSR	77	6	45	10	9	7	0
East Lake Elsinore	58	1	34	8	9	6	0
Chaparral Sites	107	4	60	29	6	6	2
Potrero	77	2	42	20	6	4	3
Silverado Ranch	66	3	37	17	5	3	1

We found that 60% of the total cover at East Lake Elsinore consisted of non-native species (Figure 2). MSR had higher shrub cover, native forb cover, and total species cover than any other site. We recorded non-native *Erodium cicutarium* (29% mean cover) and *Bromus madritensis rubens* (18% mean cover) at every CSS station (*n*=12) that we sampled. Other common non-native grasses included *Bromus hordeaceus* and *Vulpia myuros*. The most abundant native forbs at CSS stations were *Gilia angelensis*, with a mean of 14% cover across 11 stations, and *Cryptantha intermedia,* with a mean of 8% cover across 8 stations. Other common forbs in CSS included *Dichelostemma capitatum, Crassula connata,* and *Emmenanthe penduliflora*. We detected the native shrub *Eriogonum fasciculatum* at 9 of 12 CSS stations, where it averaged 13% cover. The second most common shrub species in CSS, *Adenostoma fasciculatum*, was only found at MSR, with 24% cover at 4 stations.

For data collected in Orange County, San Diego County, and Riverside County, Deutschman and Strahm (2008) reported that sampling method accounted for between 6.6% and 15.8% of the variance in the data with respect to species richness and different functional groups. Inter-observer variability accounted for 3.6% of the total variance for native shrub cover and less than 1% of the total variance for every other group. In general, point intercept provided higher estimates of total species cover than quadrats, and quadrats provided higher estimates of species richness and were better at detecting less common species than point intercept. The Deutschman lab found that over 75% of the variance for percent cover of functional groups and species richness for stations analyzed in 2008 was related to spatial variability. Plot and site were the largest contributors to spatial variance, with vegetation community generally having a much

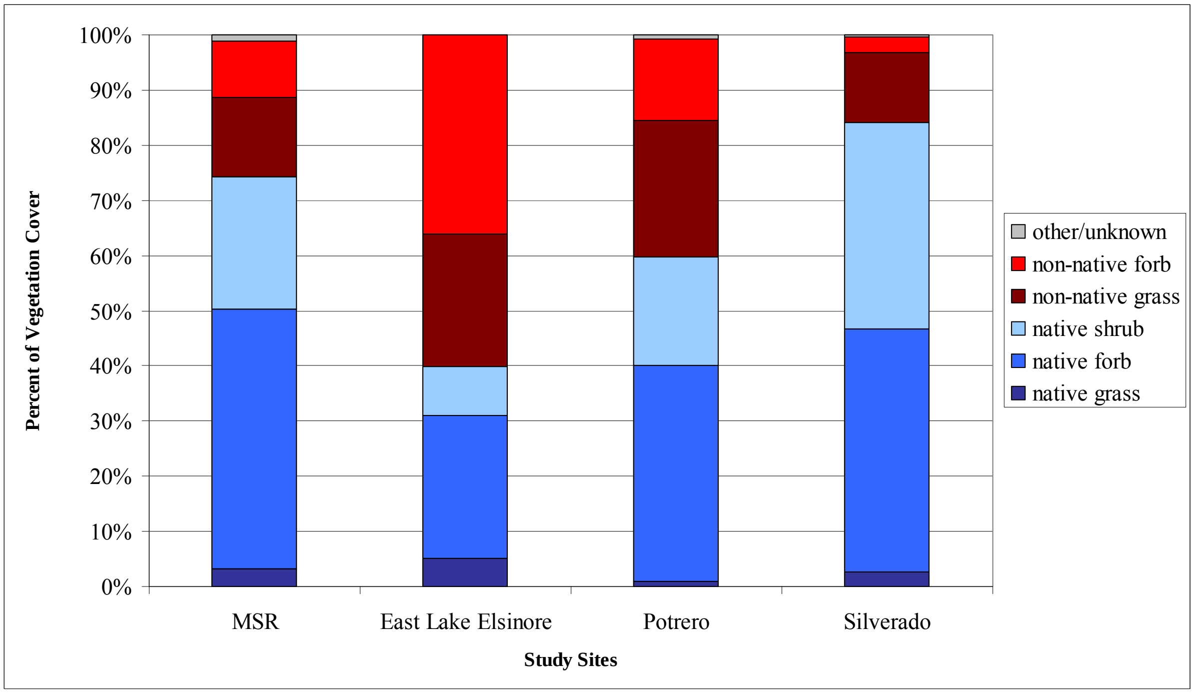


Figure 2. Percent of total plant cover composed of different functional groups at study sites. Sites include Southwestern Riverside County Multi-Species Reserve (MSR), land along Highway 74 between interstate highways 215 and 15 (East Lake Elsinore), BLM land adjacent to the Potrero Unit of San Jacinto Wildlife Area (Potrero), and Silverado Ranch.

smaller role. A more thorough presentation of the multi-county results can be found in Deutschman and Strahm (2009).

DISCUSSION

Our goals for the pilot vegetation community condition survey were to document current attributes of our target vegetation communities and assess the natural variability within the communities. Additionally, we wanted to use our collaboration with the Deutschman lab to help us develop a long-term monitoring strategy that will allow us to detect changes in species richness and functional groups through time. We collected data on the starting state of 23 stations across the Conservation Area in 2008. The Deutschman lab found that inter-observer variance was low for measuring percent cover of all functional groups and species richness, suggesting that we have the ability to detect change in these attributes across years with different observers. The Deutschman lab also found that quadrat-based sampling methods provided consistently higher estimates of species richness than point intercept methods. However, we know from observational notes that some species present along the sampling station were not captured using either method. Measuring species richness is a notoriously difficult task (e.g., Gotelli and

Table 2. Mean % cover (standard error) for major functional groups at CSS and chaparral sites.

		Native			Non-native		
Site	**All Spp.**	**Grass**	**Forb**	**Shrub**	**Grass**	**Forb**	**Other Spp.**
MSR	191.67 (16.14)	6.33 (3.84)	90.00 (11.00)	46.00 (7.87)	27.67 (3.91)	19.33 (8.14)	2.33 (1.67)
East Lake Elsinore	162.33 (15.34)	8.33 (3.91)	42.00 (13.38)	14.33 (4.42)	39.00 (9.04)	58.67 (12.41)	0
Potrero	118.00 (13.67)	1.20 (1.20)	46.00 (6.03)	23.20 (9.77)	29.20 (9.89)	17.60 (10.80)	0.80 (0.80)
Silverado Ranch	103.33 (17.01)	2.67 (1.98)	45.67 (12.62)	38.67 (6.79)	13.00 (5.84)	3.00 (1.91)	0.33 (0.33)

Colwell 2001) and we believe that both sampling methods tested here underestimate the number of species in a given area.

We learned that we were not able to sufficiently capture the natural variation within the study area with our study design. We found that we did not sample proportionally within each type of CSS and chaparral present at our sites according to the California Native Plant Society (2005) vegetation map of the Plan Area. At MSR, we only sampled within 2 CSS types and did not sample at all within *Encelia farinosa* or *Artemisia californica* CSS, though the vegetation map shows that each of these types constitutes over 20% of the total CSS cover at the site. Additionally, the Deutschman lab found that the majority of the variance in the percent cover of functional groups and species richness was related to study site and individual sampling station location. If we do not capture the natural variation at our study sites, we will not be able to generalize what we document at our sampling stations to CSS and chaparral across the Conservation Area. There seems to be more variation within sites than we were able to capture with 6 sampling stations per site.

Recommendations for Future Surveys

To finalize our long-term vegetation monitoring strategy, we need to decide how many sampling stations to survey per site, what data we can realistically collect at the stations, and how frequently to survey the stations. We need more than 6 sampling stations per study site in order to better capture the variation in the vegetation communities. While we could capture the variation with a large number of randomly placed sampling stations, we should stratify our station selection using the vegetation types found in the vegetation map in order to more efficiently capture the among-site variation. We recommend increasing the number of sampling stations at 1 site in 2009 to approximately 25 stations to get a better idea of how many stations are needed to depict this variation.

We began this pilot study with the goal of comparing species richness and percent cover of functional groups in vegetation communities through time. Given our limited resources, we must evaluate whether we can realistically continue measuring all of these attributes while achieving the coverage we want across the Conservation Area. On average, surveyors spent more than two-thirds of their time at sampling stations collecting quadrat-based data. If we eliminated the quadrat-based sampling from our study design, we may be able to more than double the number of stations surveyors are able to sample in a day. According to Deutschman and Strahm (2008), point intercept sampling alone would be an appropriate method to measure the percent cover of shrubs, non-native grasses, and non-native forbs taken as a group. However, they suggest that quadrats are necessary to measure species richness, detect the spread of non-native species into new areas, or detect any single fairly common plant species. We must decide whether we want to continue to measure these latter variables, given our personnel constraints. As noted above, we are not certain that we are accurately measuring species richness, even using quadrats. Also, species richness data are particularly sensitive to survey timing because certain ephemeral species are difficult to detect and/or identify when they are not at peak phenology. We can attempt to time surveys to capture peak phenology by looking for the presence of particular indicator species. However, we do not know how reliable this method will be, and with a large sampling effort across the Conservation Area, it may be impossible to appropriately time all surveys for peak phenology. Measures of cover of functional groups are also sensitive to survey timing, but are probably reliable from near-peak plant growth to several months later when most species are desiccated. We should determine how the timing of our survey effort within a season affects our ability to record species richness and functional species cover to determine whether we can reliably measure these attributes. We should also determine the degree to which eliminating quadrat-based sampling increases the number of stations we can sample in a day, given the amount of time it takes surveyors to travel between sampling stations. With this information, we can select the attributes we want to measure, given their costs and benefits.

We can determine how frequently we need to sample stations based on what we know about inter-annual variation in the data caused by environmental conditions and what attributes we are interested in collecting. The Deutschman lab looked at inter-annual variation from 16 sampling stations that they surveyed in both 2007, one of the driest winters on record, and 2008, a year with rainfall that was still below average, but closer to the mean. They found a large increase in species richness at sites in 2008, with most of the new species consisting of native forbs. Inter-annual variation was the single largest component of variance for species richness and percent cover of native forb species, with over 40% of the variance explained by year for both measures. Native shrub cover had very little variance explained by year. We should continue this pilot work for at least 1 more year so that we can contribute our data to the Deutschman lab analysis to look for inter-annual variation. We can use this information to help understand how differences in yearly conditions affect our survey results. We can then decide how frequently we need to survey in order to distinguish between true loss of functional group cover and differences caused by seasonal fluctuations.

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Appendix A. Western Riverside County MSHCP Biological Monitoring Program Protocol for Vegetation Community Monitoring

Goals: Collect baseline information on the condition of Vegetation Communities within the Conservation Area. Develop and refine long-term monitoring strategy for Vegetation Communities.

Objectives: To achieve the above goals, survey plots will be established in 2 vegetation communities in western Riverside County: chaparral and coastal sage scrub. Data will be collected on the percent cover of all plant species using both point intercept and 1 m x 1 m quadrats. Data collected in surveys will follow the protocol established by San Diego State University under LAG #P0685105 for the Multiple Species Conservation Program in Southwestern San Diego County.

Timing: Surveys will initially be conducted in spring 2008. We will decide on the appropriate interval for re-sampling sites based on analysis of this pilot data, analysis of multi-year data made by Deutschman et al. and our monitoring goals.

Survey Locations: Surveys will be conducted at 4 sites in western Riverside County, chosen to represent coastal sage scrub and chaparral communities broadly distributed across the Plan Area. Coastal sage scrub sites include the Multi-Species Reserve (Skinner) and lands in the vicinity of East Lake Elsinore. Chaparral sites include Potrero and Silverado Ranch. At each site, we chose 10 random points within the vegetation community of interest and between 30 and 500 meters from roads. Surveyors will visit the points at a site in a randomly chosen order, and will decide either to establish a plot at a point or discard it due to safety issues. Plots will extend 50 meters in a randomly chosen direction from the given point. A total of 6 plots per site will be established.

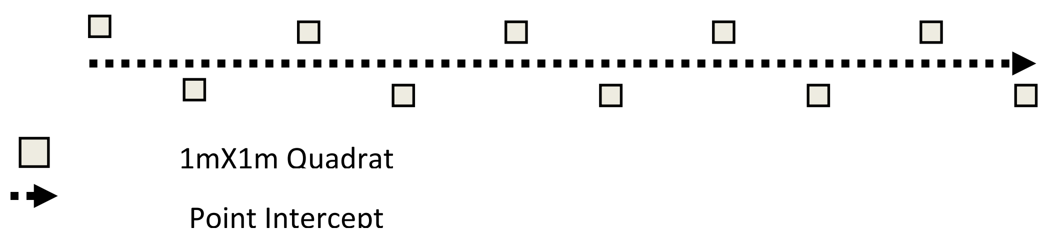
Equipment

- 100m transect tape
- Clipboard
- 3 stakes per plot
- Plant identification aides
- Handheld GPS unit
- Digital camera
- Declinated compass
- 1x1 m PVC quadrat frame
- Topographic map
- Mallet
- Tags

Methods:

Plot Setup:

Using a handheld GPS unit, find the predetermined plot location. If this plot location requires navigating around an area with greater than 40° slope or otherwise has unsafe terrain, it can be discarded. Otherwise, this point will be the beginning of the sampling station, even if the station is not in the intended vegetation community. The point should be marked with two rebar stakes to aid in relocation and a tag labeled with the transect ID and MSHCP Biological Monitoring Program. Next, choose a random bearing for the transect from the list of random bearings. Only discard those bearings that will lead the transect across a road, trail or building, make the transect head into a vegetation community besides the intended community, or would make a transect dangerous for sampling. Using a declinated compass, line up your partner with the chosen bearing and have them walk 50 meters in that direction, keeping the transect tape as straight as possible. Mark the 50 meter point with one rebar stake, pull the tape tight, and attach to rebar. On your way back to the 0 end, try to straighten the transect as much as possible–tighten if necessary.



Sampling:

Point Intercept Transect: Using the transect data sheet record the transect ID, transect bearing, field crew, date, and 24hr/military start time. Starting at 0, place the dowel on the left side of the transect next to the appropriate point, making sure it is perpendicular to the ground. First, record the ground cover directly below the dowel: bare, rock, litter, stem, crypto, or moss. Rock is defined as gravel or rock 2 cm or greater in diameter. Gravel less than 2 cm in diameter will be counted as bare. If two or more ground covers are present record the one that is most dominant. Next, record all the plant species that are touching the dowel, using 6 digit plant codes. The first time a plant species is recorded, write the full scientific name on the quadrat sheet, followed by a 6 letter code in parenthesis. The code will consist of the first 3 letters of the genus and the first 3 letters of the species, so, for example, *Eriogonum fasciculatum* would be ERIFAS. If any of the species have repeating codes within a transect, add a number after the code to make it unique. Collect samples from species that are unknown and record on the datasheet your unique collection number instead of a species code (i.e. DRM 394).

Repeat this process every meter from 0 to 49. After completing the transect make sure to record the end time in military format.

Quadrats: Using the quadrat data sheet record the transect ID, field crew, date, and 24hr/military start time. Make sure to use consistent team and site codes. On the left side of the transect place the 1x1 meter quadrat frame from 0 to 1 meter so that two sides of the frame are running parallel to the tape. First, estimate and record the percent of each ground cover present in the frame: bare, rock, litter, stem, crypto, or moss. The percentages for each ground cover should add up to 100 percent. Next, estimate absolute cover–can be greater that 100%, for all plant species within the quadrat. Create a list of species present, with the species names written out, in the left column of the data sheet under species/cover type and record the percentage in the column representing the current quadrat (1 = 0-1m., 2=5-6m., etc.). For plants near the edge of the frame, count anything that touches the inside of the frame regardless of whether it is rooted within the quadrat. Repeat this process every 5 meters from 0 to 45 making sure to switch sides after every quadrat (see plot diagram). After completing the quadrats make sure to record the end time in 24hr/military format.

Appendix B. Vegetation Community Monitoring Survey Forms

TRANSECT		
Transect ID		Date
Bearing		**Start Time**
Field Crew		**End Time**
	Ground Cover	**Plant Species**
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
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TRANSECT, cont.

Transect ID		Date	
Bearing		**Start Time**	
Field Crew		**End Time**	

	Ground Cover	Plant Species
25		
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Quadrats

Transect ID		Date	
Field Crew		**Start Time**	
		End Time	

Species/Cover Type	1	2	3	4	5	6	7	8	9	10
Bare										
Rock										
Litter										
Stem										
Crypto Crust										
Moss										

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