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

Vegetation Community Survey Report 2009

23 APRIL 2010

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NOTE TO READER:

This report is an account of survey activities conducted by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The 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, and the Wildlife Agencies (i.e., 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.

MSHCP reserve assembly is ongoing and it is expected to take 20 or more years to assemble the final Conservation Area. The Conservation Area includes lands acquired for conservation under the terms of the MSHCP and other lands that have conservation value in the Plan Area (called public or quasi-public lands in the MSHCP). In this report, the term "Conservation Area" refers to the Conservation Area as understood by the Monitoring Program at the time the surveys were planned and conducted.

We would like to thank and 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 data collection activities were conducted in 2009 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.

While we have made every effort to accurately represent our data and results, it should be recognized that data management and analysis are ongoing activities. Any reader wishing to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data.

The primary preparer of this report was 2009 Botany Program Lead, Jeff Galvin. 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. Further information on the MSHCP and the RCA can be found at 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 and wildlife habitats within the Conservation Area. Specifically, the MSHCP requires the Monitoring Program to evaluate changes in distribution, area, and condition (as determined by presence of invasive exotics, disturbance, grazing intensity, fire history, etc.) of vegetation communities and wildlife habitats at least every 8 years (Dudek & Associates 2003). We present here procedure and results from our 2009 effort to develop a sampling method that limits the amount of inter-observer variability and efficiently addresses MSHCP-defined objectives for monitoring vegetation communities and wildlife habitats.

We began a pilot study in 2008 to test the utility of different survey methods and to quantify natural variation in target vegetation communities. We focused our pilot effort on chaparral and coastal sage scrub (CSS) communities found at the Southwestern Riverside County Multi-Species Reserve (MSR), the land near the eastern edge of the city of Lake Elsinore (East Lake Elsinore), 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). We targeted chaparral and CSS because these are the most abundant vegetation communities in the MSHCP Conservation Area, comprising almost 72% of the vegetation within the Conservation Area according to the most recent map of vegetation communities in western Riverside County (CDFG et al. 2005). We used a protocol established by Dr. Douglas Deutschman and collaborators in his lab at San Diego State University (Deutschman lab) to examine species richness and percent cover of major functional groups (e.g., native shrubs, native forbs, non-native forbs and non-native grasses) using point-intercept and visual-estimation sampling methods (Deutschman 2008). This allowed us to include our data in the Deutschman lab multi-county (Riverside, San Diego, and Orange) analysis aimed at examining spatial and methodological sources of variation in vegetation community data.

The Deutschman lab found that inter-observer variance in 2008 was low when visually estimating percent cover of functional groups and species richness (Deutschman 2008), suggesting that natural variation in these attributes could be captured among survey plots 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 observation notes made during data collection in 2008 that some species present along sampling stations in western Riverside County were not captured using either method. Measuring species richness is a notoriously difficult task (Gotelli and Colwell 2001) and we believe that both sampling methods tested here underestimate the number of species in a given area. We also found that each type (alliance or association) of CSS and chaparral present at our sites were not sampled proportionally according to our Geographic Information System (GIS) -based (ESRI 2006) vegetation map (CDFG et al. 2005). We only sampled within 2 CSS types at MSR (California Buckwheat Alliance and Chamise - Coastal Sage Scrub Disturbance Mapping Unit), and did not sample at all within *Encelia farinosa* or *Artemisia californica* CSS, even though they compose over 20% of the total CSS cover at the site.

In 2009 we sampled all 4 sites established in 2008 and added an additional transect on BLM land adjacent to Potrero to balance sample size at each site. We intended 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 did not increase the number of transects at MSR from 6 to 24, as recommended in the *2008 Vegetation Community Report*, due to a limited field personnel. We also continued to sample quadrats along all transects despite contrary recommendations so that we could continue to contribute our data to the Deutschman lab for analysis.

Goals and Objectives
1. Document current attributes of CSS and chaparral communities.
   a. Record species richness and percent cover of functional groups at permanent transects.
2. Examine change in measured attributes across years.
3. Develop a long-term strategy for monitoring all vegetation communities.

METHODS

Protocol Development

We followed a protocol developed by the Deutschman lab at San Diego State University for the Multiple Species Conservation Program in southwestern San Diego County. We modified the Deutschman protocol by controlling for vegetation type and distance from roads when distributing points in-office with ArcGIS 9.3 (ESRI 2006), and discarded points in the field when they were < 30 m from an unmapped road, crossed into another vegetation community, or when slope was sufficiently steep to be dangerous to surveyors (i.e., > 25°). These modifications were designed to ensure crew safety and reduce noise in the data due to edge effects from roads or adjacent vegetation communities, while also contributing valid data to the Deutschman lab.

The Deutschman protocol has been used across 3 counties in southern California (Orange, Riverside, and San Diego) for the last 2 years. Adopting the Deutschman lab protocol allowed us to contribute data to a multi-county project, resulting in a robust analysis of survey method given a relatively limited Biological Monitoring Program effort due to staff availability. The 2009 vegetation-condition protocol did not differ from 2008.

Personnel and Training

Spring Straum (Graduate Student, San Diego State University, Deutschman lab) conducted a training session at the Biological Monitoring Program office in Riverside, CA in the spring of 2008. Straum presented the history of the project, described the survey protocol, and had Biological Monitoring Program staff set up and sample mock transects using the Deutschman protocol. In 2009, Jeff Galvin (Botany Program Lead, Biological Monitoring Program) trained field crew in survey methods to ensure that data collected in Riverside County were consistent with data from other counties. Inexperienced surveyors were paired with crew members that worked on the project in 2008. This allowed for training inexperienced surveyors in the field while transects were

being sampled. Inexperienced surveyors recorded data and watched experienced crew members until they were proficient enough to collect data according to protocol. Monitoring Program staff were funded by the California Department of Fish and Game or the Regional Conservation Authority; volunteers are noted. The following Monitoring Program biologists conducted vegetation community surveys in 2009:

- Jeff Galvin (Project Lead, Biological Monitoring Program)
- Diane Menuz (former Project Lead, Biological Monitoring Program)
- Ana Hernandez (Biological Monitoring Program)
- Annie Bustamante (Biological Monitoring Program)
- Karyn Drennen (Biological Monitoring Program)
- Kelly Schmoker (Volunteer, California Department of Fish and Game)
- Rose Cook (Biological Monitoring Program)

Study Site Selection

When selecting study sites for this pilot project we considered the distribution and abundance of chaparral and CSS at potential sites and whether or not selected transects could be semi-permanently marked in the field. We used a GIS-based 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 conserved lands in the Gavilan Hills east of Lake Elsinore (North Peak Preserve, White Rock Preserve, and land adjacent to Canyon Lake) as CSS monitoring sites (Figure 1). 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 monitoring sites (Figure 1). The Potrero site was recovering from the 2006 Esperanza fire.

In 2008, we used ArcGIS v.9.3 (ESRI 2006) and the Hawth's Tools extension (Beyer 2004) to generate 10 random points per site between 30 m and 500 m from roads. We then field-verified each point in random order until 6 points were selected at each site, with the exception of Potrero ($n = 5$). We discarded points that occurred on dangerously steep slopes (i.e., > 25°), that were within 30 m of a road not mapped in our GIS-based roads layer, or that crossed into a different vegetation community. We established transects by extending a 50-m tape in a randomly chosen bearing from the given point, and marked the ends with wooden stakes to allow for future identification. We established an additional transect at Potrero in 2009 using a point randomly generated in 2008 so that all study sites ($n = 4$) contained 6 transects.

Survey Methods

We surveyed between 16 March and 19 May 2009, visiting transects at each site over a 2-week time span to minimize species turnover during the sampling period. We first stretched a 50-m tape across each transect, 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 ($n = 10$), and visually

estimated percent cover of each plant species and cover type within individual frames. We constructed frames from PVC piping, and marked each side in 10-cm increments to aid in visual cover estimation. Field crew collected samples of any unknown plants encountered in the field for later identification.

Data Analysis

We focused our analysis on detecting change in non-native grass and shrub cover over time because we considered them to be the best indicators of community condition and type conversion. We excluded visual estimates of percent cover because these data tend to contain large observer bias, and removed observations where the nativity of the species could not be determined (i.e., the genus contained native and non-native species) and assigned to an appropriate functional group (e.g., native versus non-native). We used program R 2.5.1 (R core development team 2007) to calculate mean absolute percent cover for targeted functional groups in each vegetation community, based on 2008 and 2009 point-intercept data. We then pooled data across sites when 95% confidence intervals overlapped.

We examined pooled datasets for normality using the shapiro-wilk test and program R 2.5.1. We then used 2009 data and a single-sample T-test power analysis to investigate the ability of our survey design to capture at least 20% ($p = 0.05$) variation of targeted functional groups across survey sites in each vegetation community. We also used a paired-sample T-test power analysis to quantify our ability to detect at least a 20% ($p = 0.05$) change in mean percent cover of targeted functional groups across years. We removed one 2009 chaparral transect from the pair-sample analysis, because it was not surveyed in 2008.

RESULTS

Quadrat-level estimates of shrub cover on CSS sites were greatest at MSR, while non-native grass and non-native forb estimates were greatest at Railroad Canyon. (Table 1) We recorded the highest quadrat-based estimates of native grass over all sites (e.g., CSS and Chaarral) at MSR, comprised mostly of *Vulpia octoflora* (Appendix A). Railroad Canyon had the highest percent cover of non-native species, dominated by *Bromus madratenis* ssp. *rubens, Erodium cicutarium, Erodium brachycarpum,* and *Erodium mochatum*. Chaparral sites had higher native shrub cover and lower non-native grass cover at Silverado than at Potrero (Table 1). Percent cover estimates of dominant shrub species were twice as high as the next most dominant species at both sites (Silverado: *Cercocapus betuloides*; Potrero: *Adenostoma fasciculatum*) (Appendix A).

Table 1. Quadrat-based estimates of percent cover (SE) for functional groups at survey sites.

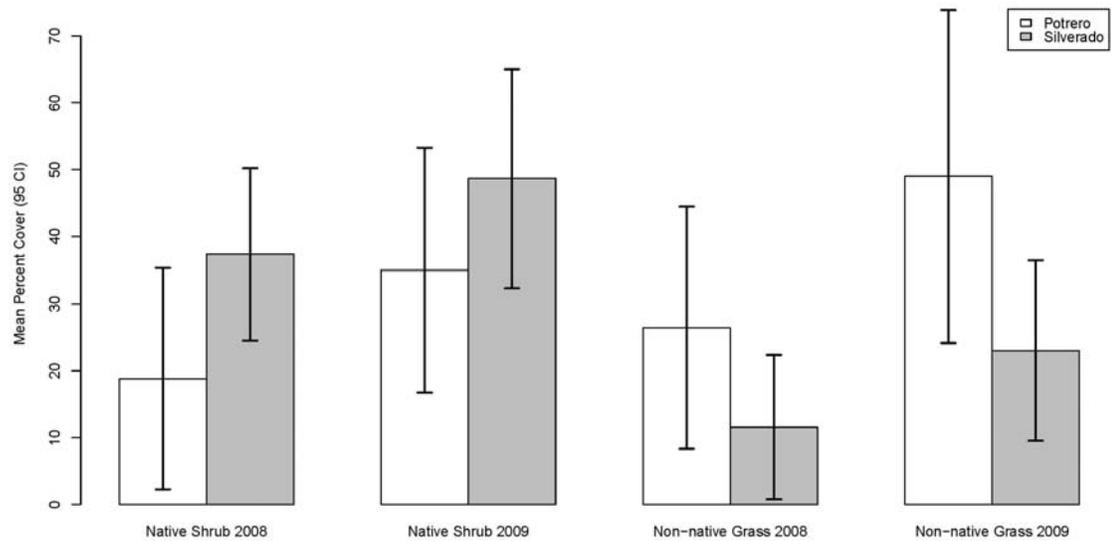|	Chaparral		CSS	
	Potrero	**Silverado**	**MSR**	**Railroad Canyon**
Native Grass	0.59 (0.35)	0.87 (0.53)	2.06 (0.52)	0.01 (0.00)
Non-native Grass	15.63 (1.93)	2.34 (0.45)	6.02 (0.94)	18.68 (2.25)
Native Forb	5.39 (0.93)	6.48 (1.07)	6.34 (0.89)	10.33 (1.52)
Non-native Forb	2.83 (0.67)	0.18 (0.06)	3.00 (0.90)	13.89 (1.61)
Native Shrub	23.97 (2.98)	40.91 (4.63)	31.00 (4.16)	12.51 (2.24)

Figure 2. Mean percent cover (95 CI) of native shrubs and non-native grasses at chaparral sites (Silverado and Potrero) in 2008 and 2009.

Chaparral sites had similar percent shrub and non-native grass cover based on the results of the point-intercept transects, and sites did not differ in 2008 (Figure 2, Table 2). Pooled datasets were normally distributed in 2008 (shrub: $W = 0.97$, $p > 0.05$; non-native grass: $W = 0.90$, $p > 0.05$ and 2009 (shrub: $W = 0.97$, $p > 0.05$; non-native grass: $W = 0.97$, $p > 0.05$), and power for capturing natural variation in non-native grass and shrub cover across transects was generally low (Table 3). Power for detecting change in non-native grass and shrub cover across years was also low, and did not exceed 0.12 for either functional group.

Table 2. Mean (SE) percent cover of functional groups at all survey sites. Estimated using 50-m point-intercept transects.

	Chaparral		CSS	
	Potrero	Silverado	MSR	Railroad Canyon
Native Grasses	0.67 (0.67)	3.00 (2.62)	11.33 (5.36)	0.00 (0.00)
Non-native Grasses	49.00 (12.68)	23.00 (6.87)	49.33 (7.51)	60.67 (11.70)
Native Forbs	21.33 (7.07)	29.33 (5.88)	42.67 (4.97)	34.67 (9.43)
Non-native Forbs	10.67 (5.74)	1.33 (0.99)	14.33 (5.38)	46.33 (8.55)
Native Shrubs	35.00 (9.32)	48.67 (8.34)	51.67 (4.66)	23.33 (6.94)

Coastal sage scrub sites had similar percent non-native grass cover based on point-intercept transects, but shrub cover differed between MSR and Railroad Canyon. Shrub cover also differed between CSS sites in 2008, and non-native grass cover was again similar (Figure 3, Table 2). Pooled data for non-native grass cover was normally distributed (2008: $W = 0.91$, $p > 0.01$; 2009: $W = 0.97$, $p > 0.05$), as was non-pooled shrub cover for MSR (2008: $W = 0.94$, $p > 0.5$; 2009: $W = 0.76$, $p > 0.05$) and Railroad Canyon (2008: $W = 0.93$, $p > 0.05$; 2009: $W = 0.96$, $p > 0.05$). Power to detect change across sites and years was again low for all analyses (Table 3).

Table 3. Results for single-sample and paired-sample power analyses to detect a 20% change (0.05 significance) in mean percent cover of non-native grass and shrub cover at chaparral and coastal sage scrub sites. Power (β), value of 20% change in mean percent cover (Δ), and standard deviation (SD) reported for each analysis.

	Single-sample T-test[a]			Paired-sample T-test[b]		
	β	Δ	SD	β	Δ	SD
Chaparral						
Non-native grass	0.13	27.41	7.2	0.12	2.56	9.86
Shrub	0.23	8.37	21.85	0.12	2.58	9.81
Coastal Sage Scrub						
Non-native grass	0.31	11	23.72	0.15	4.88	16.38
Shrub - MSR	0.43	10.33	11.41	0.05	2.27	13.41
Shrub - Railroad Canyon	0.06	4.66	17	0.06	2.47	12.68

[a] 2009 data, represents power to detect variation among transects in a single year.
[b] 2008 and 2009 data, represents power to detect change in paired transects between years.
[c] Data pooled across sites.

Chaparral sites had similar percent shrub and non-native grass cover based on the results of the point-intercept transects, and sites did not differ in 2008 (Figure 3, Table 2). Pooled datasets were normally distributed in 2008 (shrub: W = 0.97, $p > 0.05$; non-native grass: W = 0.90, $p > 0.05$ and 2009 (shrub: W = 0.97, $p > 0.05$; non-native grass: W = 0.97, $p > 0.05$), and power for capturing natural variation in non-native grass and shrub cover across transects was generally low (Table 3). Power for detecting change in non-native grass and shrub cover across years was also low, and did not exceed 0.12 for either functional group.
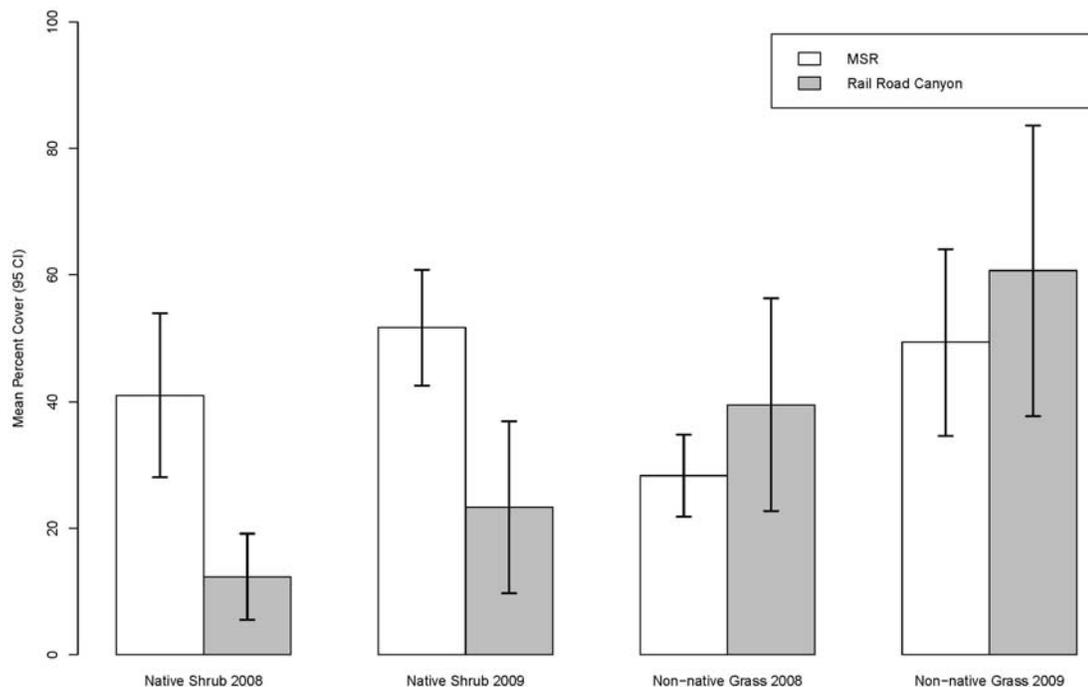

Figure 3. Mean percent cover (95 CI) of native shrubs and non-native grasses at CSS sites (MSR and Railroad Canyon) in 2008 and 2009.

DISCUSSION

A primary goal of the ongoing vegetation community condition pilot is to measure the change in mean percent cover of functional groups, specifically non-native grasses and forbs, across years. The pilot project's results thus far show that the current protocol and sample size are inadequate to detect what we assume to be ecologically significant changes in percent cover of functional groups through time. On average, we had a power of 23% to detect a 20% change in percent cover based on 2009 data and 10% based on both years of data. These values show that we have very little power to detect change in percent cover of functional groups. In order to have a power of 80% (the minimum power we are willing to accept) we would need to increase the detectable change to almost 93% for shrub cover in chaparral and 77% for non-native grass cover in chaparral. While the target percentage of detectable change is an arbitrary value, 77% and 93% are too large to meet the goals of this project.

Another goal of this project is to develop a long-term strategy for monitoring all vegetation communities within the Plan Area. In order to achieve this goal, we need the flexibility to modify our protocol when necessary. After the 2008 surveys, we determined that our sample size was too small to capture the natural variation within the targeted vegetation communities and recommended increasing the sample size at 1 survey site. Because of personnel constraints, we were unable to increase the sample size at any of the sites, and, as a result; we have come to the same conclusion as last year, our sample size is too small. We also recommended that we only use 1 method to measure percent cover, point-intercept. Not only will this drastically decrease the time requirement per transect, it will provide us with a less subjective measurement of cover. In 2009, because we are collaborating with the Deutschman lab which has established standard protocols that are to be followed across the multi-county study area, we made no changes to the protocol.

Recommendations for Future Surveys

We began this pilot with the goal of comparing species richness and percent cover of functional groups in vegetation communities across years. Currently, we are meeting that goal, but because of our low power the amount of change that we are able to detect is practically ecologically meaningless. We need to write more detailed goals that specify an amount of change that is both feasible to detect and ecologically meaningful and stipulate the desired confidence that the detected change is real. The results of the power analyses using data from the pilot vegetation community monitoring project show that there is too much variation from our sample mean. To remedy this, we need to drastically increase our sample size to provide more precise estimates of target variables given the amount of natural variation in our study system.

The major obstacle to increasing the sample size of the study is the limited availability of crew members to sample additional transects. In 2009, we took over 2 months and 40 surveyor-days to sample 24 transects. We could decrease the time commitment for each sampling unit by only recording point-intercept data. According to Deutschman and Strahm (2008), point-intercept sampling is an appropriate method to measure the percent cover of functional groups, including shrubs, non-native grasses, and non-native forbs. Also, on average, we spent 2/3 less time collecting point-intercept data

than quadrat-based data. The only downside would be the adverse effect on measuring species richness. Although quantifying species richness is an objective of this pilot project, it is not specifically mentioned in the long-term vegetation monitoring and habitat condition portion of section 5.0 of the MSHCP. Therefore, it is recommended that we stop using quadrats to quantify percent cover and solely rely on data obtained using point-intercept sampling along transects. Because our already imperfect measurement of species richness would only suffer without the increased area covered by the quadrats, we recommend that species richness no longer be recorded. Instead, we can lump forbs and grasses into functional groups such as native grass, non-native grass, native forbs, and non-native forbs.

For future surveys, we need to create an accessibility model to better delineate our survey area so that we are able to survey every transect that we randomly distribute. The current protocol for transect selection essentially de-randomizes the distribution of transects by allowing the surveyor to discard a transect they feel cannot be surveyed. While it may be impossible to entirely avoid this problem, it needs to be minimized as much as possible. Therefore, we recommend that variables such as slope and distance from drivable roads be accounted for before distributing points.

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Appendix A. Quadrat-based estimates of percent cover for dominant species at each survey site.

Scientific Name	Functional Group	% Cover (SE)
Multi-Species Reserve		
Adenostoma fasciculatum	Native Shrub	17.92 (3.89)
Lotus scoparius	Native Shrub	5.23 (1.51)
Eriogonum fasciculatum	Native Shrub	4.44 (2.04)
Bromus madratensis rubens	Non-native Grass	3.59 (0.81)
Salvia mellifera	Native Shrub	2.61 (1.00)
Erodium bracycarpum	Non-native Forb	1.77 (0.89)
Vulpia octoflora	Native Grass	1.59 (0.51)
Vulpia myuros	Non-native Grass	1.48 (0.40)
Mirabilis laevis	Native Forb	0.78 (0.67)
Hypocareous glabra	Non-native Forb	0.76 (0.18)
Railroad Canyon		
Bromus madratensis rubens	Non-native Grass	16.31 (2.13)
Erodium cicutarium	Non-native Forb	6.40 (1.34)
Eriogonum fasciculatum	Native Shrub	6.40 (1.94)
Erodium bracycarpum	Non-native Forb	4.07 (1.46)
Encelia farinosa	Native Shrub	3.66 (1.19)
Amssickia menziesii	Native Forb	3.41 (1.04)
Erodium moschatum	Non-native Forb	3.34 (0.74)
Salvia mellifera	Native Shrub	1.58 (0.77)
Avena sp.	Non-native Grass	1.23 (0.62)
Mirabilis laevis	Native Forb	1.07 (0.45)
Silverado		
Cercocarpus betuloides	Native Shrub	15.86 (3.80)
Adenostoma fasciculatum	Native Shrub	6.49 (2.69)
Adenostoma sparsifolium	Native Shrub	5.19 (2.30)
Ceanothus greggii	Native Shrub	3.55 (1.81)
Eriogonum fasciculatum	Native Shrub	3.49 (1.81)
Bromus techtorum	Non-native Grass	1.89 (0.42)
Ceanothus leucodermis	Native Shrub	1.58 (1.58)
Prunus ilicifolia	Native Shrub	1.58 (1.58)
Claytonia perfoliata	Native Forb	1.18 (0.41)
Arctostaphylos sp.	Native Shrub	1.18 (1.01)
Potrero		
Adenostoma fasciculatum	Native Shrub	11.64 (2.31)
Vulpia myuros	Non-native Grass	5.61 (1.37)
Bromus madratensis rubens	Non-native Grass	5.05 (1.02)
Eriodictyon crassifolium	Native Shrub	2.85 (0.97)
Bromus tectorum	Non-native Grass	2.34 (0.72)
Avena barbata	Non-native Grass	1.84 (0.77)
Erodium cicutarium	Non-native Forb	1.79 (0.55)
Eriophyllum confertiflora	Native Shrub	1.69 (0.55)
Dendromecon rigida	Native Shrub	1.47 (1.18)
Arctostaphylos glandulosa	Native Shrub	1.35 (0.79)