2016 Grassland Monitoring Report

Palo Corona Regional Park

August 2016

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Introduction

The Monterey Peninsula Regional Park District contracted Julia Fields (Applied Marine and Watershed Science Master's Student, California State University Monterey Bay) to conduct grassland monitoring surveys at Palo Corona Regional Park (PCRP) south of Monterey, CA. The monitoring was part of an ongoing adaptive management program to evaluate the effects of grazing on grassland vegetation structure and composition, as required by the *Grassland Management Plan for Palo Corona Regional Park* (Management Plan; McGraw 2007). The Management Plan was funded by The Big Sur Land Trust and The Nature Conservancy. Please see the *2012 Palo Corona Grassland Monitoring Report* (2012 Report; Harwayne 2012) for background information. The following report describes the implementation and analysis of grassland monitoring at PCRP in accordance with the monitoring objectives and adaptive management triggers.

Monitoring Goals and Objectives

The *Updated Grassland Monitoring Program* (Updated Plan; McGraw 2010) outlined biological effectiveness monitoring studies to "evaluate progress toward the biological goals and objectives" for grassland species. This report fulfills the requirement for:

- Quantitative monitoring of plant community composition and structure to evaluate effectiveness of the grazing prescriptions at enhancing native species diversity and abundance (McGraw 2010).

The monitoring objectives were to track grassland condition according to the following plant community structure and composition variables:

1. abundance and richness of native grassland plants,
2. frequency and abundance of invasive exotic plants, and
3. abundance of woody vegetation encroaching from adjacent shrubland and woodlands.

Methods

The methods used for monitoring grasslands followed protocol established by the 2007 Management Plan, the 2010 Updated Plan, and revisions noted in the 2012 Report. The changes made in the 2012 Report were:

- Only 29 paired plots (out of 30 intended plots) were surveyed because plot 4-5 Control and est could not be located.
- The Updated Plan used the term 'abundance' to refer to the calculation of percent cover by species or functional group. The 2012 report and this report use the terms 'absolute cover' and relative cover' instead.
- Stem counts of woody plants were not collected. Instead, cover of woody plants was calculated from point-intercept data.

Field Surveys

Field surveys were conducted over 12 days from April 18 to May 18, 2016. Field monitoring (not including time spent drying biomass samples) took a total of 90.75 hours per person, of

which 64.25 hours was data collection and 26.5 hours was travel between plots. Monitoring was conducted in pairs with one person measuring and the other recording data. All data for each paired plot was collected on the same day except plot 6-2 in which the test and control[1] plots were sampled on different days. Due to initial uncertainty with species identification, plots surveyed on the first 2 sample days (6-2, 6-3, 6-4, and 6-5) were revisited at the end to ensure the species list was complete.

Surveys were conducted by Julia Fields (CSUMB), Tim Jensen (Planning and Conservation Manager, Monterey Peninsula Regional Park District), Raymond Trabucco (Ranger, Monterey Peninsula Regional Park District), Nico de Paolo (Ranger, Monterey Peninsula Regional Park District), and student volunteers from CSU Monterey Bay: Leah MacCarter, Kaitlyn Chow, and Kristen Seuis. Michael Mitchell, Cindy Hudson, and Jim West assisted with plant identification.

Paired Plot Design

In 2012, 29 paired monitoring plots were installed, each with a fenced control and an unfenced test plot. Each plot measured 8x8 meters (m), including a 1 m buffer. Measurements were collected from within the center 6x6 m to avoid edge effects from cattle; however, plot edges were surveyed for species richness. A photo was taken from the southwest corner of each plot. If tall vegetation obstructed the photo, then a second photo was taken from a different corner.

Point-Intercept Transects (Plant Cover and Height)

Five permanent, parallel transects were marked by rebar in each plot, spaced 1.25 m apart at 1 m, 2.5 m, 4 m, 5.5 m, and 7 m (Figure 1). Point intercepts were collected every 0.25 m from 1 m to 7 m along a transect tape stretched between the rebar (25 points per transect, 125 points per plot). A ¼ inch wooden dowel with a meter tape attached was pushed into the vegetation at every point and the species code (first three letters of the genus and species, e.g. *Avena barbata* = AVEBAR) and height in centimeters (cm) were recorded for the tallest plant intercepted by the dowel. Height measurements were collected before litter depth or biomass to avoid trampling vegetation.

During data entry, each plant's origin (native or exotic), group (grass, forb, shrub, tree, vine, or fern[2]), and life cycle (annual or perennial[3]) were recorded (see Appendix C for a sample data sheet). "Thatch" was recorded if the tallest plant touching the dowel was dead and "Bare" was recorded if no vegetation was intercepted. Plot 1-1 Control was completely filled with blackberry (*Rubus ursinus*) and was not accessible; height measurements were taken 1 m in from each corner and percent cover of the dominant species were recorded.

Species were identified using *The Plants of Monterey County, an Illustrated Field Key, Second Edition* (Matthews and Mitchell 2016), *Wildflowers of Garland Ranch: a Field Guide* (Mitchell and Yeager 2011), and the *The Jepson Manual: Vascular Plants of California* (Baldwin *et al.* 2012). Species that could not be identified in the field were collected (not from along the transects) and keyed out in the office.

[1] The 2012 Report referred to fenced and control plots. For the 2016 analysis, "control" referred to the fenced plots, equivalent to 2012 fenced plots, and "test" referred to grazed/ unfenced plots, equivalent to 2012 control plots.
[2] Shrubs, trees, woody vines (*Rubus ursinus*), and ferns were all considered woody plants.
[3] Biennial species were considered perennial.

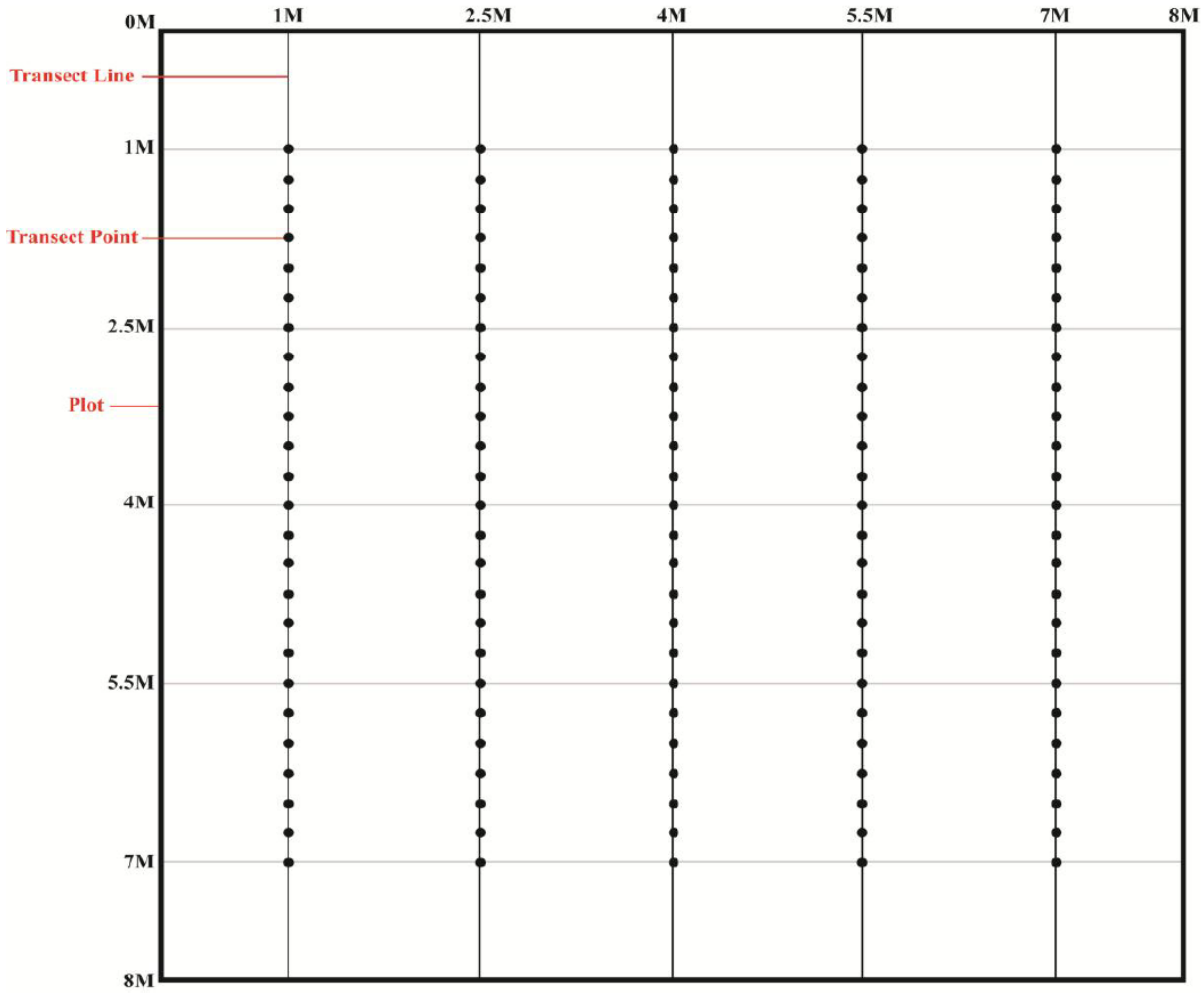

Figure 1. Layout of point-intercept transects in each plot. From the 2012 Report (Harwayne 2012).

Litter Depth

Litter depth was measured in four random locations in each plot. Once from each corner, we generated two random numbers in Microsoft Excel to represent x and y coordinates and used transect tapes to locate the point. Random numbers were restricted from 1.00 m to 7.00 m so that the outer 1 m of the plot was excluded. Litter depth in millimeters (mm) was measured by pushing a pointed ¼ inch wooden dowel down to the soil level and measuring to the top of the horizontal dead thatch layer. Litter depth was not collected from 1-1 Control because it was full of blackberries.

Species Richness

After collecting point-intercept, litter depth, and biomass data, all species not listed during the point-intercept transects were recorded to generate a complete species list for each plot. Species origin (native or exotic), group (grass, forb, shrub, tree, vine, or fern), and life cycle (annual or

perennial) were also recorded. Plants that could not be identified in the field were collected (not from along the transects) and keyed out in the office.

Woody Plants

Cover of woody plants (shrubs, trees, woody vines, and ferns) was collected with the point-intercept transects.

Biomass

Biomass samples were collected at two random locations within each plot. The random points were generated in the same way as for litter depth but only the southwest and northwest corners were used as starting points. If the random sample location fell on a point-intercept transect, it was moved to the side so that the transects were not affected. All the vegetation within a 13.5-inch diameter circle (0.1 m^2; a plywood cutout served as a template) was cut to the ground and collected. Thatch was included in the biomass sample; however, woody material and roots were not.

The two samples from within each plot were combined in a large paper bag and set in a well ventilated room to dry. Samples were air dried for 19 to 54 days. Once all the samples were collected, they were oven dried at 60°F for 24 hours. The samples were weighed (g) before and after oven drying to assess whether air drying was adequate. Biomass samples were not collected for 1-1 Control.

Data Analysis

Data collected was entered into Microsoft Excel for analysis. The R Statistical Package was used to conduct Welch's t-tests for plant height, litter depth, biomass, and species richness (R Core Team 2016).

Plant Community Composition

Absolute and relative percent cover were calculated for vegetation by origin, group, and life cycle from point-intercept data. Thatch and bare ground were included in the analysis of absolute percent cover, but only points that hit vegetation were included for relative percent cover.

Absolute percent cover was calculated by dividing the number of points of interest by the total number of points collected for control or test plots:[4]

$$\text{Absolute \% cover} = \frac{\text{\# points of interest for control or test plots}}{\text{3625 total points for control or test plots}}$$

Relative percent cover was calculated by dividing the number of points of interest in a specific category (origin, group, life cycle) by the total vegetation points for control or test plots (e.g. number of native forbs in test plots divided by total vegetation points in test plots):

$$\text{Relative \% cover} = \frac{\text{\# points of interest in a specific category for control or test plots}}{\text{Total vegetation points for control or test plots}}$$

[4] The SUM(COUNTIFS()) functions in Excel were used to calculate absolute and relative percent cover.

Mean Recorded Height

Average vegetation heights (cm) for control and test plots were calculated from the point-intercept measurements.[5]

Mean Litter Depth

Average litter depths (mm) for control and test plots were calculated from the four recorded depths.[5]

Species Richness

The total number of species in each plot (on and off the transects) was counted to determine species richness. Mean species richness was calculated for control and test plots regarding species origin, group, and life cycle.[5]

Woody Plants

Absolute percent cover of woody plants (shrubs, trees, woody vines, and ferns) was calculated from the point-intercept data.[6]

Mean Above-Ground Plant Biomass

Biomass samples were converted from grams (g) to grams per square meter (g/m^2) using the following:

1 sample = 13.5 in diameter circle = 143.14 in^2 = 0.1 m^2

2 samples per plot = 0.2 m^2

$$\frac{\text{Biomass per plot (g)}}{0.2\ m^2} = \frac{g}{m^2}$$

Average biomass (g/m^2) for control and test plots was calculated by summing the biomass (g/m^2) and dividing by the number of samples for each treatment (29 Test, 28 Control).

Adaptive Management Analysis

The Updated Plan outlined three thresholds that would trigger adaptive management:

1. Mean abundance and/or richness of native grassland herbs is 20% lower in grazed plots.
2. Invasive exotic plant cover exceeds 5% in any one plot.
3. Woody plant cover exceeds thresholds set for each grassland associations in any one plot (30% for moist perennial grassland, 20% for subshrub grassland, and 10% for ridge grasslands).

[5] The AVERAGEIFS() function in Excel was used to calculate averages.
[6] The SUM(COUNTIFS()) functions in Excel were used to calculate absolute and relative percent cover.

The 2012 Report countered that the thresholds for invasive exotic plant cover and woody plant cover were not realistic and did not adequately describe the effects of grazing on grassland composition. More appropriate triggers are:

1. Invasive plant cover is 5% higher in test plots compared to control plots.
2. Woody plant cover is 5% higher in test plots compared to control plots.

Percent difference between test and control plots in 2016 was calculated using the formula:

$$\%\ \text{difference} = \left|\frac{\text{test} - \text{control}}{(\text{test} + \text{control})/2}\right| * 100$$

Recommendations for adaptive management from 2016 grassland monitoring data were based on the suggested triggers from the 2012 Report. Invasive species were ranked High, Moderate, or Limited using ratings from the California Invasive Plant Inventory (California Invasive Plant Council [Cal-IPC] 2006). Appendix A lists the exotic species encountered during monitoring and Cal-IPC ratings.

Changes Over Time

Changes in grassland composition from 2012 to 2016 were assessed by calculating the percent change between 2016 grassland monitoring results and results from the 2012 Report. The following formula was used to calculate percent change over time:

$$\%\ \text{change} = \frac{2016\ \text{value} - 2012\ \text{value}}{|2012\ \text{value}|} * 100$$

Results

Results compare control and test plots. A list of exotic species and a complete species list are included in Appendices A and B. Appendix D contains data summary tables.

Plant Community Structure and Composition

Absolute percent vegetative cover was 7% higher in test plots (Figure 2). Absolute cover of thatch was 72% less in test plots compared to control plots and absolute cover of bare ground was insignificant in both test and control plots (< 1%). From 2012 to 2016, absolute cover of bare ground decreased by 95.6% in test plots (11.6% to 0.5%) and 95.1% in control plots (4.1% to 0.2%); thatch cover decreased by 5.5% in test plots and increased by 0.1% in control plots (2012 Report Chart 1).

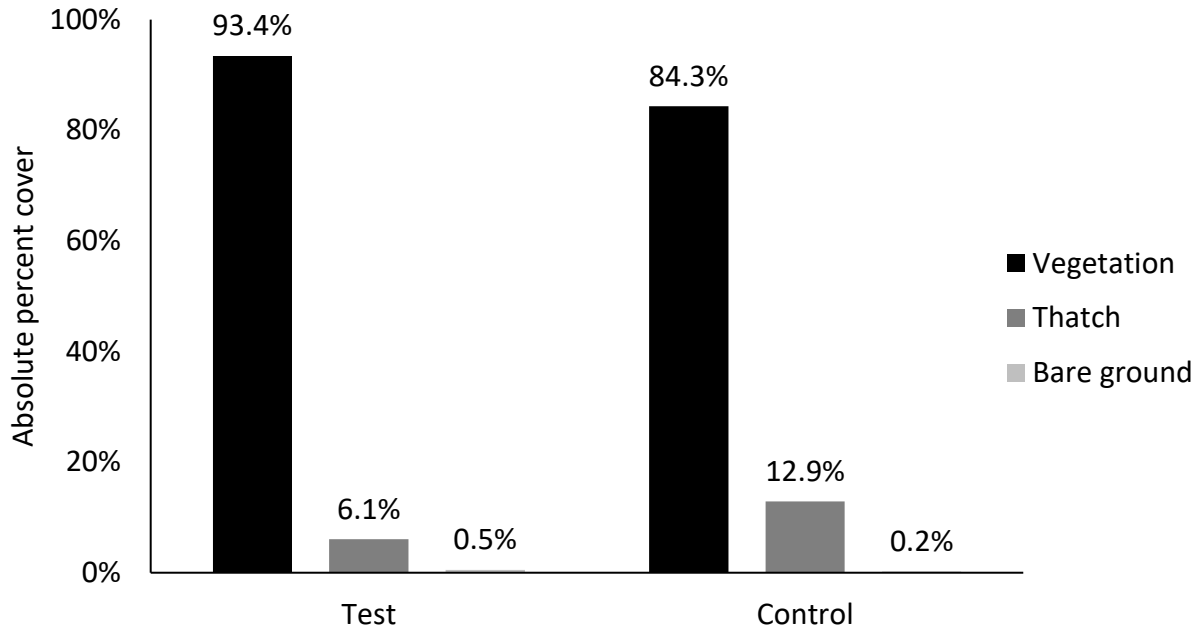

Figure 2. Absolute percent cover of vegetation, thatch, and bare ground for test and control plots.

Absolute cover of woody plants (trees, shrubs, woody vines, ferns) was 118% less in test plots compared to control plots (Figure 3). Since 2012, absolute cover of woody plants increased by 5.9% in test plots (from 1.7% in 2012 to 1.8% in 2016) and increased by 79.5% in control plots (from 3.9% in 2012 to 7.0% in 2016; 2012 Report Chart 2). Relative percent cover of vegetation (excludes bare ground and thatch) is represented by Figure 4.

Test plots had 18% more grass cover and 10% less forb cover than control plots (Figure 3). From 2012 to 2016, absolute grass cover increased by 80.5% in test plots (44.2% to 79.8%) and 60.0% in control plots (41.7% to 66.7%); forb cover decreased by 64.6% in test plots (33.6% to 11.9%) and 64.7% in control plots (37.4% to 13.2%; 2012 Report Chart 2).

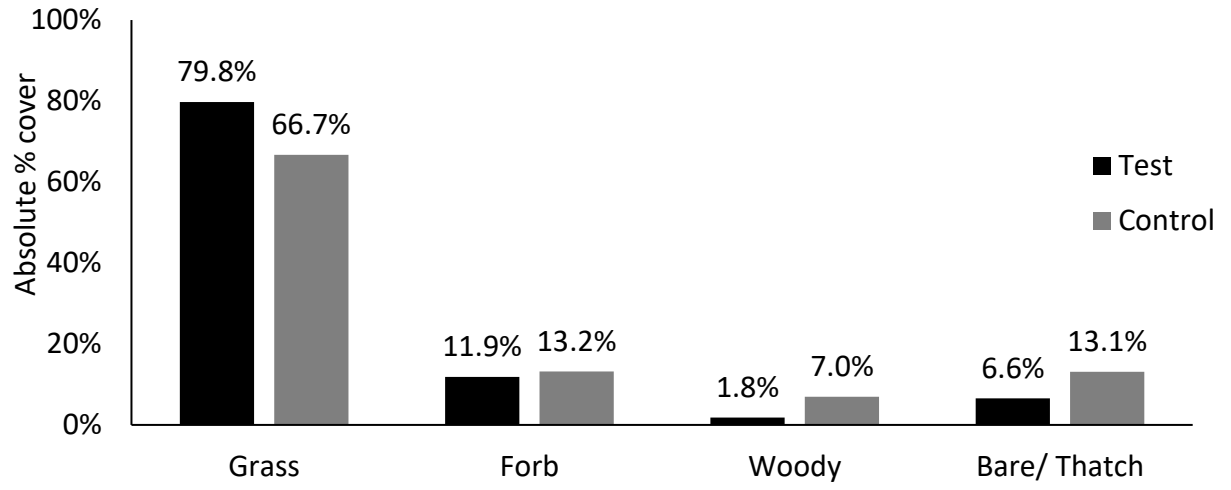

Figure 3. Absolute percent cover for grasses, forbs, woody plants, and bare ground/ thatch for test and control plots.

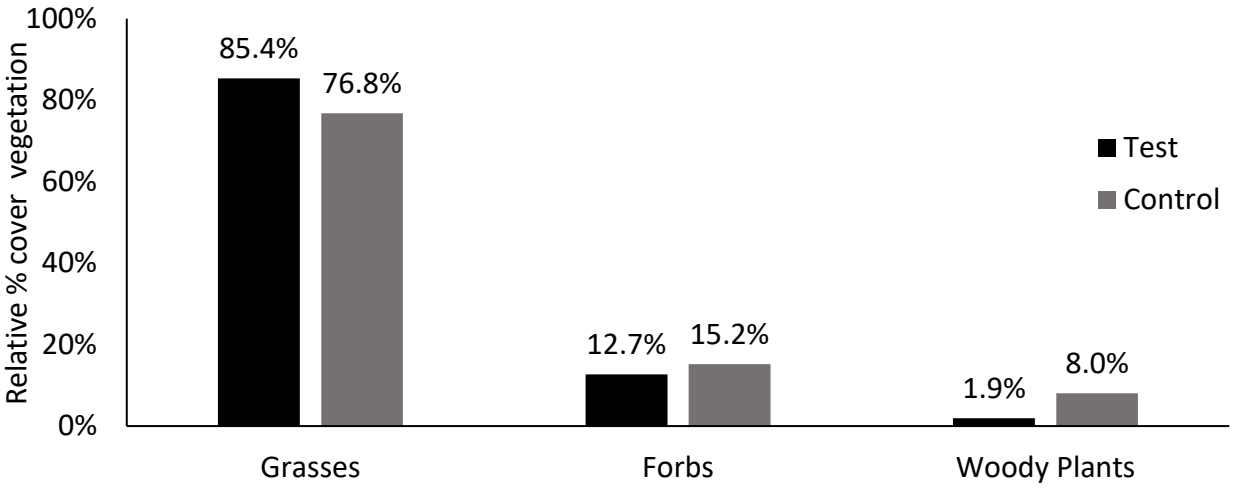

Figure 4. Relative percent vegetation cover by plant group for test and control plots.

Test plots had 9.7% higher relative cover of exotic species and 45.1% less relative cover of native species than control plots (Figure 5). Test plots had 13.3% greater cover of exotic annual species than control plots and less cover of native and exotic perennial species, 45.7% and 43.6% respectively; relative cover of native annuals was less than 1% for all plots.

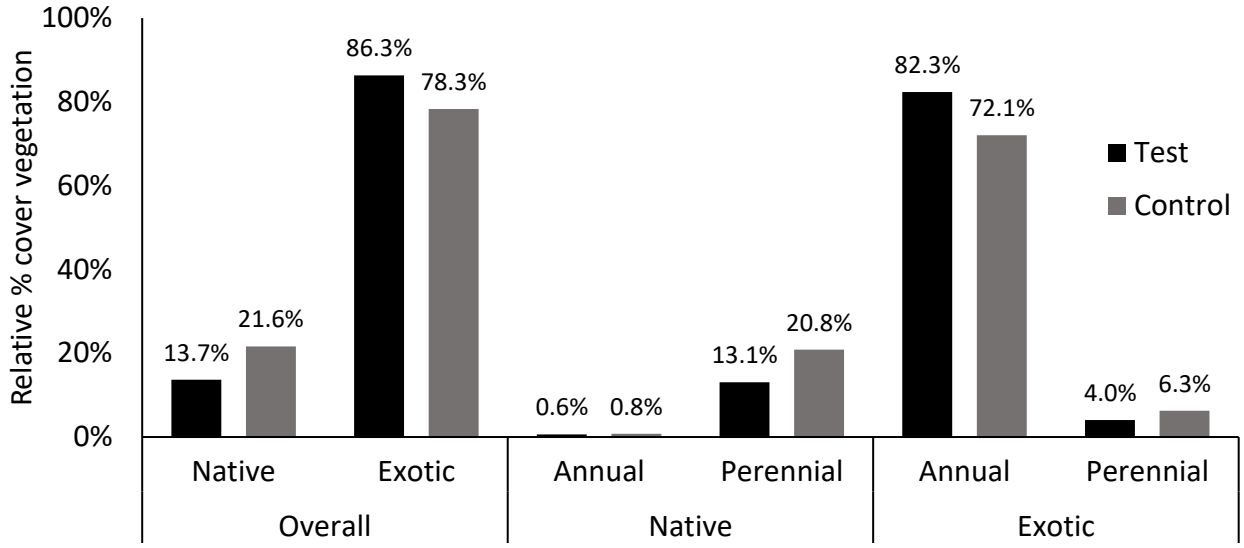

Figure 5. Relative percent cover of vegetation by origin for test and control plots.

Relative cover of grasses was similar for test and control plots (Figure 6). Test plots had 10.2% less cover of native perennial grasses and 0.8% greater cover of exotic annual grasses than control plots.

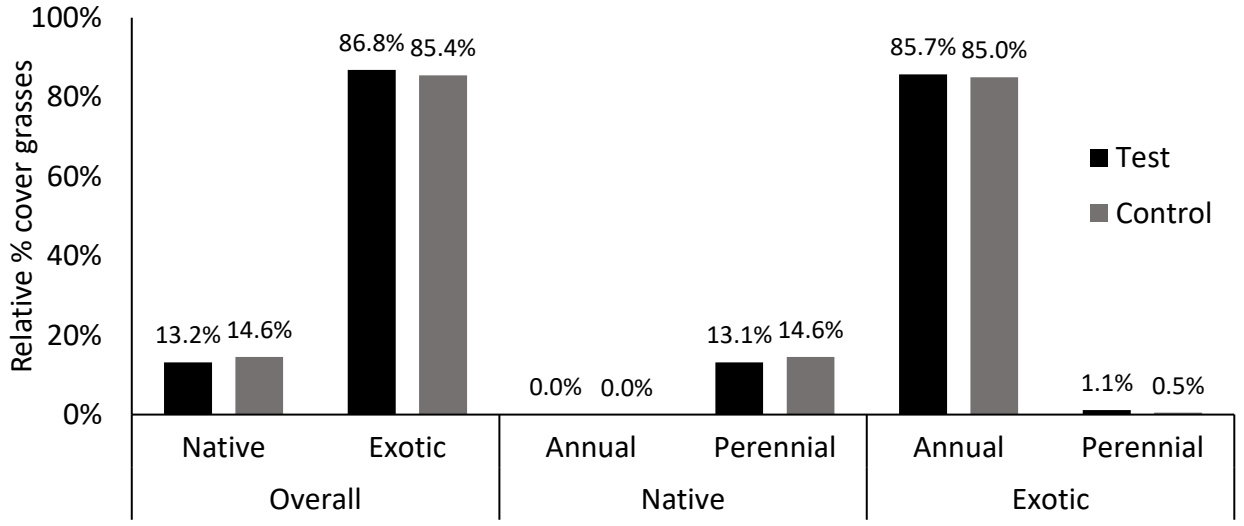

Figure 6. Relative percent grass cover for test and control plots.

Relative cover of forbs was variable (Figure 7); test plots had 47.1% greater cover of exotic annual forbs than control plots and less cover of native and exotic perennial forbs, 52.7% and 79.8% respectively.

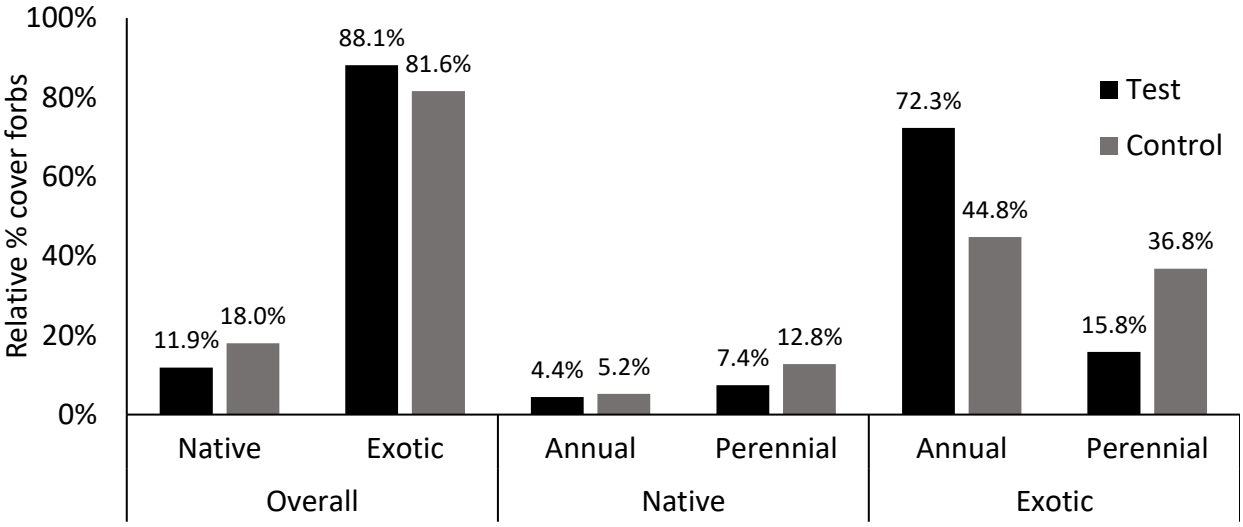

Figure 7. Relative percent cover of forbs for test and control plots.

Mean Recorded Height

Overall mean plant height was 27.0% less in test plots compared to control plots (Figure 8). The difference in plant height between control and test plots was statistically significant ($p = 0.036$). Native and exotic species were 71.3% and 15.3% shorter in test plots, respectively.

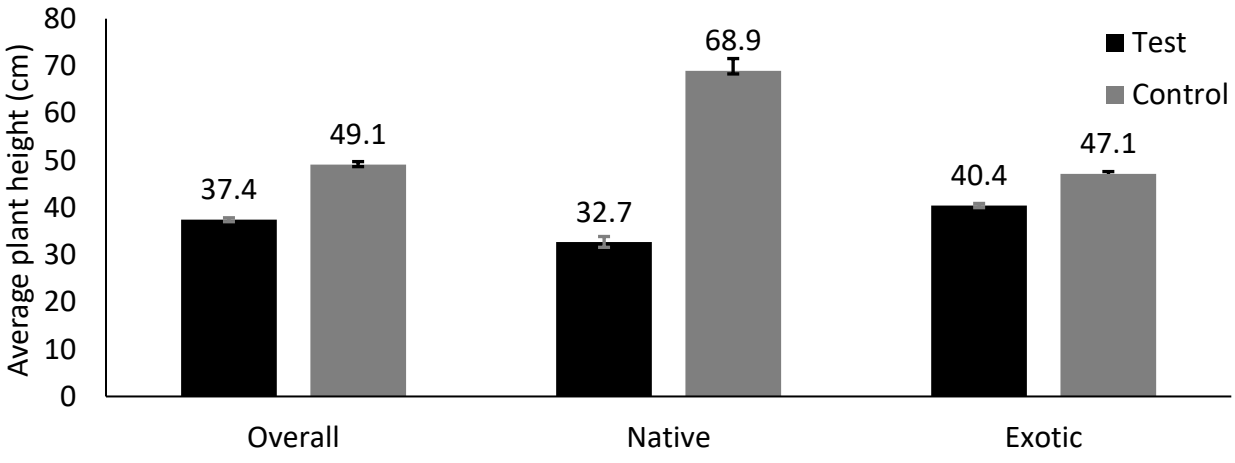

Figure 8. Average plant height (cm), recorded during point intercept sampling.

Mean Litter Depth

Average litter depth was 68.7% less in test plots compared to control plots (Figure 9). The difference in litter depth between control and test plots was statistically significant ($p < 0.001$).

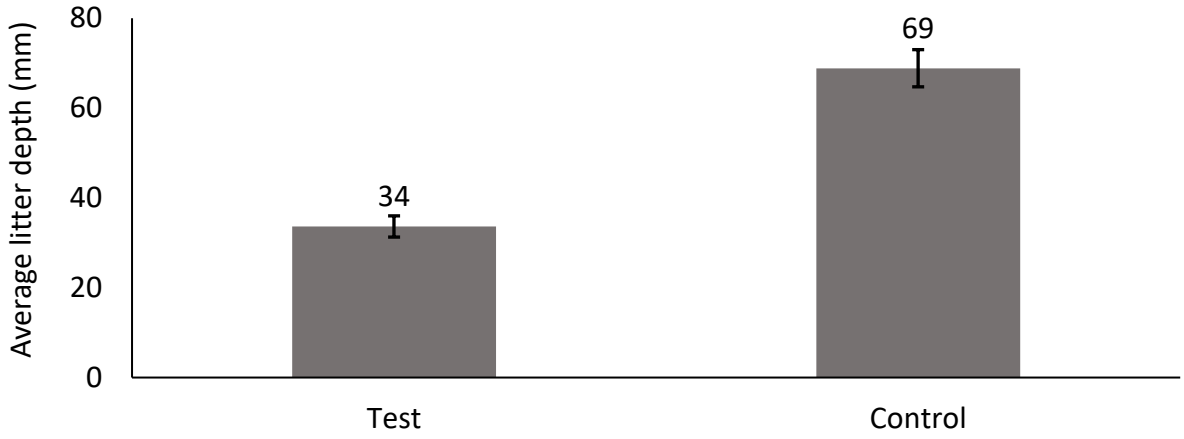

Figure 9. Average litter depth (mm) for test and control plots. Four litter depth measurements were collected randomly from each plot.

Mean Species Richness

Average species richness was comparable for test and control plots; the difference was not statistically significant ($p = 0.44$; Figure 10). On average, both treatments had similar numbers of native and exotic species (test plots had 9.3% more exotic species than control plots). 2016 monitoring found, on average, 9.4 more species in test plots and 7.8 more species in control plots than in 2012 (2012 Report Chart 5).

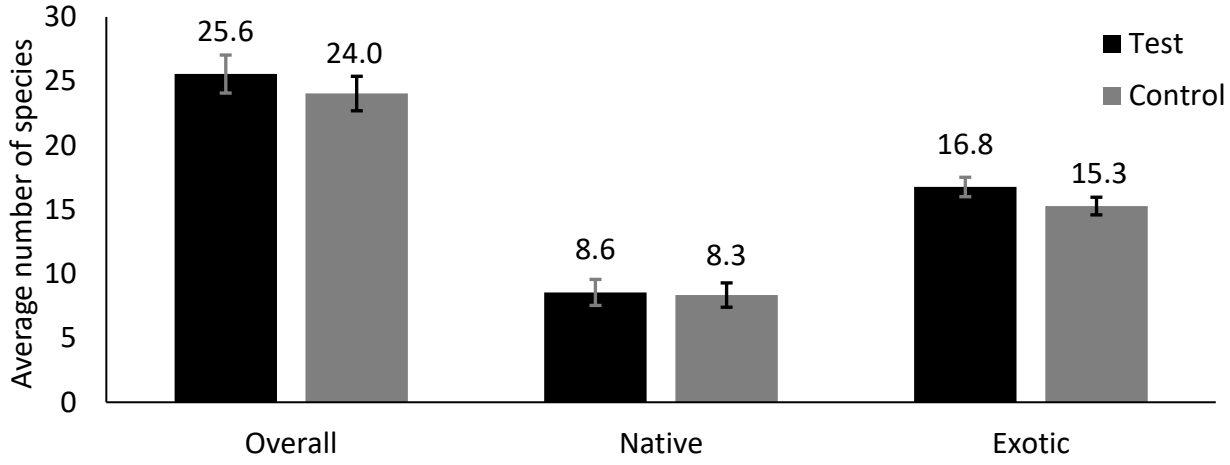

Figure 10. Average species richness (number of species) for test and control plots.

Woody Plants

Absolute cover of woody plants (trees, shrubs, woody vines, ferns) was 118.2% less in test plots compared to control plots (Figure 3).

Mean Above-Ground Plant Biomass

Average above-ground plant biomass was 33.9% less in test plots compared to control plots (Figure 11). The difference in biomass between control and test plots was statistically significant ($p = 0.012$).

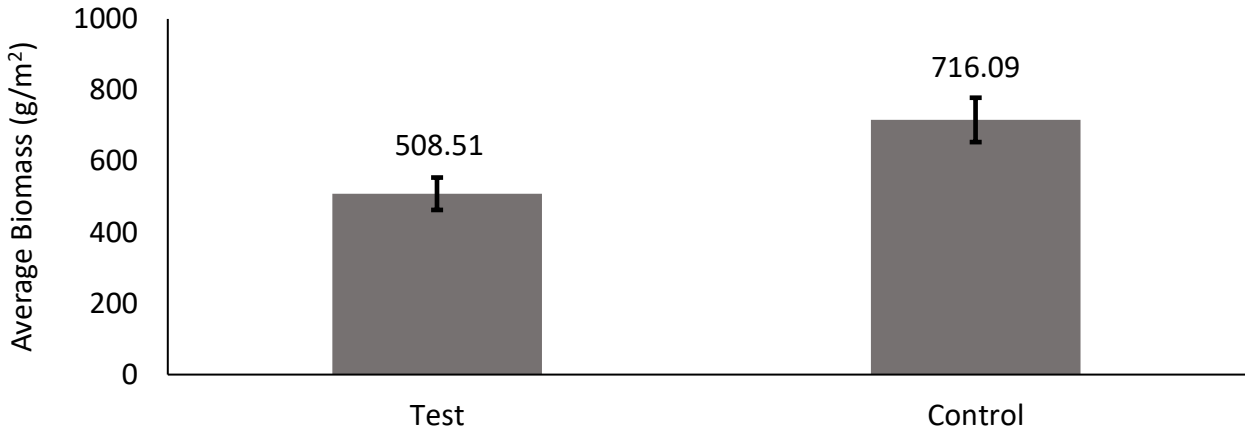

Figure 11. Average above-ground biomass for test and control plots. Two samples were collected from each plot and combined.

Adaptive Management

The triggers evaluated for implementing adaptive management from the Updated Plan and the 2012 Report are:

1. Mean abundance and/or richness of native grassland herbs is 20% lower in test plots.
3. Invasive plant cover is 5% higher in test plots compared to control plots.
4. Woody plant cover is 5% higher in test plots compared to control plots.

Mean Abundance of Herbs

The relative percent cover of native herbaceous species (grasses and forbs) was 1.4% less in test plots compared to control plots (Figure 12). No adaptive management is required according to the triggers; however, relative percent cover of native herbaceous species in the 2012 Report was 11.8% greater in test plots compared to control plots (2012 Report Chart 7). From 2012 to 2016, relative percent cover of native herbaceous species decreased by 37.2% in test plots (20.7% to 13.0%) and 17.9% in control plots (18.4% to 15.1%) while relative percent cover of exotic herbaceous species increased by 9.8% in test plots (79.2% to 87.0%) and 3.9% in control plots (81.6% to 84.8%). Management should consider why native cover decreased and exotic cover increased to a greater degree in test plots. One possible explanation is that annual grasses

dominated in 2016 due to favorable environmental conditions and native forbs were not successful; since grazing promotes annual grasses, the effects were more noticeable in test plots (Hayes and Holl 2003).

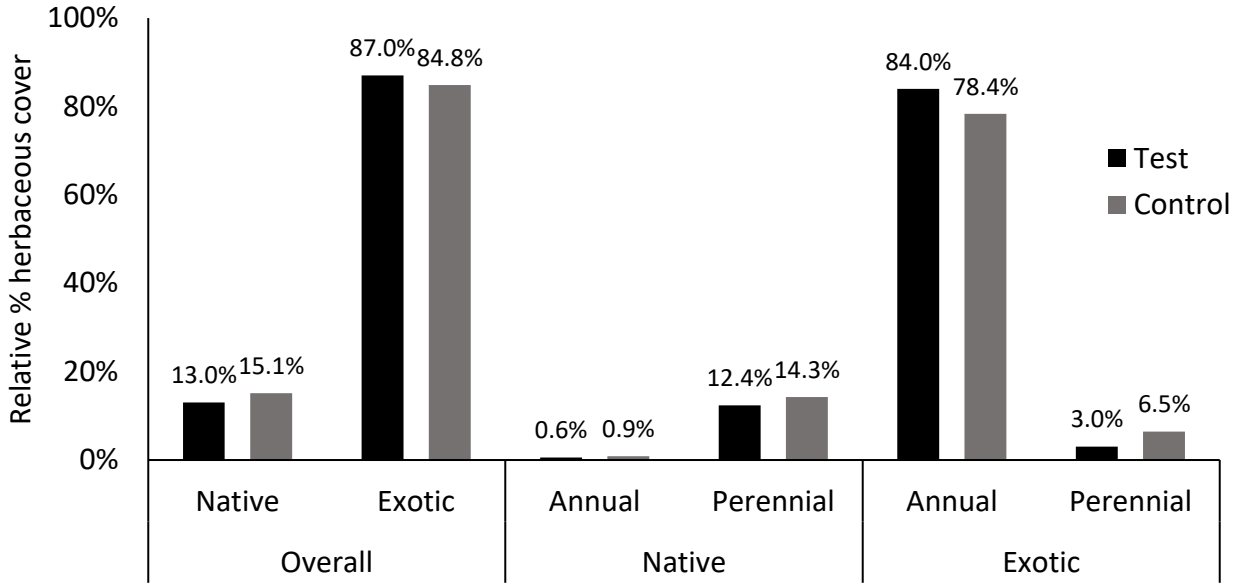

Figure 12. Relative percent cover of herbaceous species (grasses and forbs).

Mean Species Richness of Herbs

Average species richness of native herbs (grasses and forbs) was 4.0% greater in test plots compared to control plots (Figure 13). No adaptive management is required.

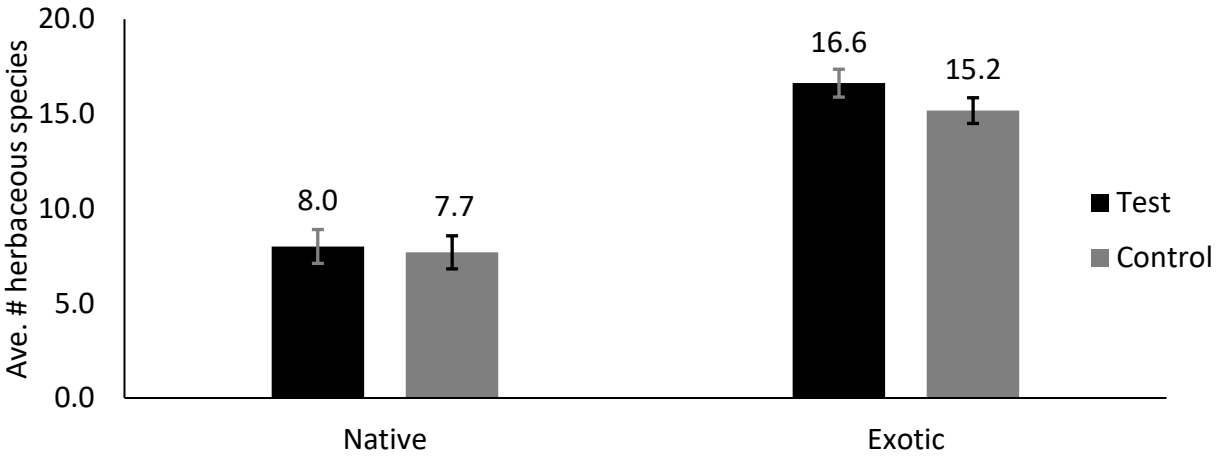

Figure 13. Average number of herbaceous species (grasses and forbs) for test and control plots.

Invasive Exotic Plant Cover

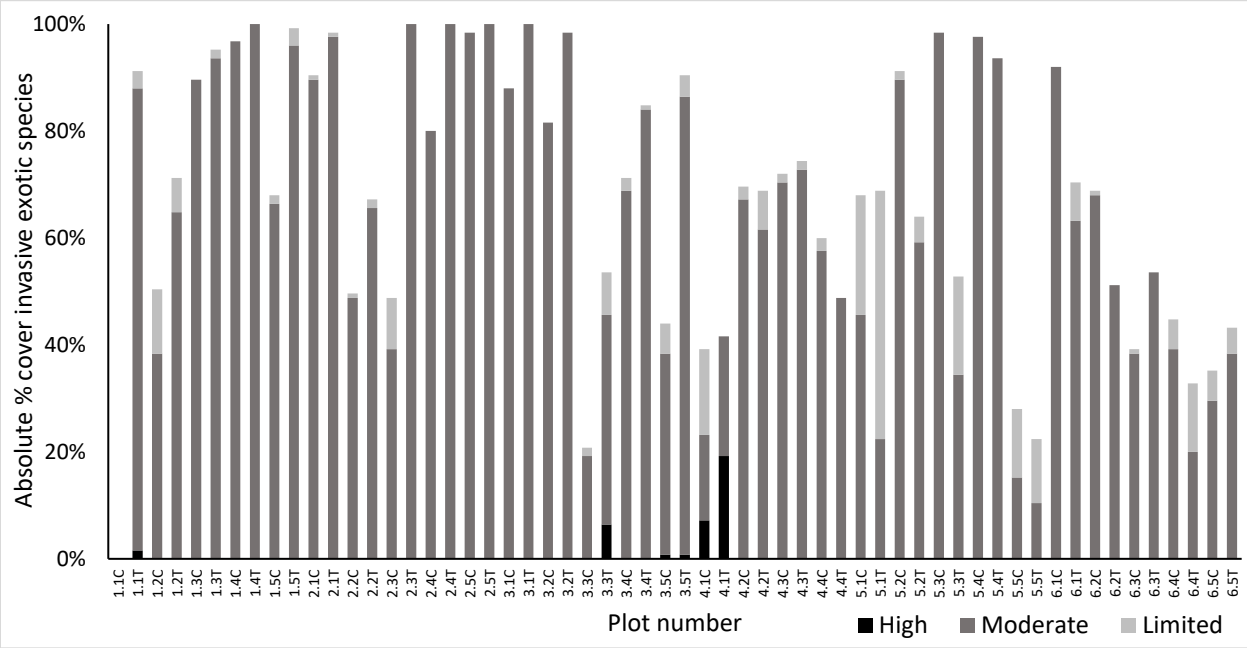

Figure 14. Absolute percent cover of invasive exotic species. Invasive species were designated as high, moderate, or limited by Cal-IPC ratings.

Invasive exotic cover exceeded the 5% threshold from the Updated Plan in every plot (Figure 14). Invasive exotic plant cover was 5.3% higher in test plots compared to control plots when weeds rated High, Moderate, and Limited were considered (Figure 15). Relative percent cover of invasive exotic species increased from 2012 to 2016 in test plots by 7.5% (73.3 to 78.8%) and control plots by 1.8% (73.4% to 74.7%; 2012 Report Chart 10). **The 2012 Report trigger for invasive exotic plant cover was met and adaptive management is recommended.**

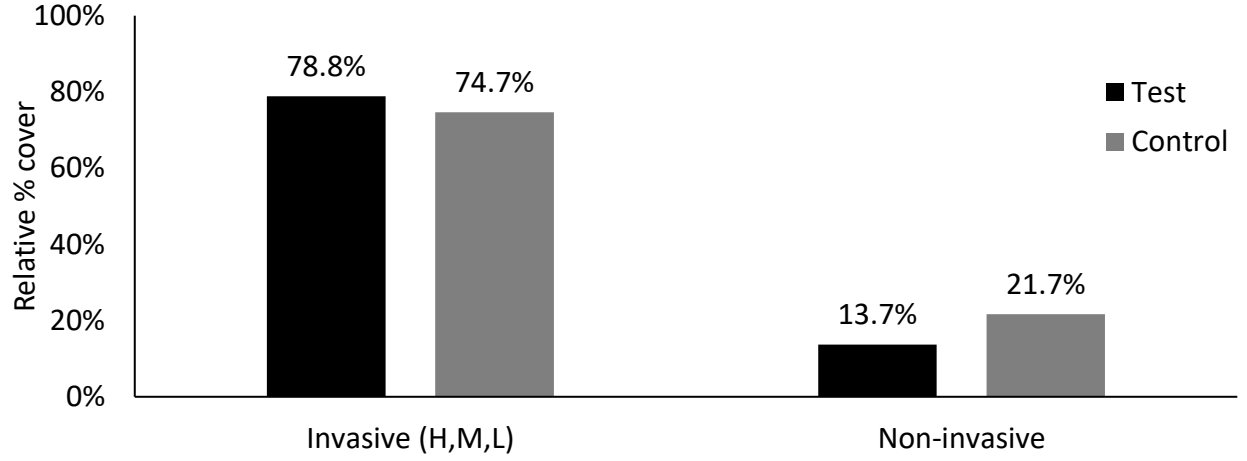

Figure 15. Relative percent cover of invasive exotic species (rated High, Moderate, or Limited by Cal-IPC) and non-invasive species for test and control plots.

Woody Plant Cover

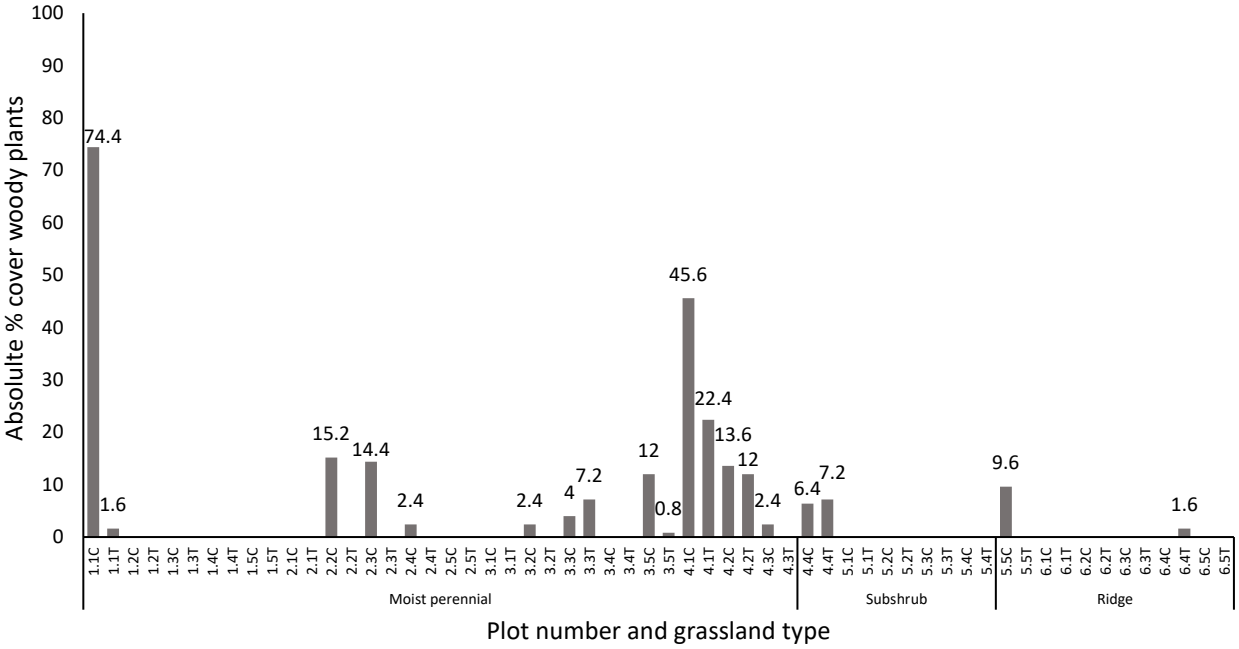

Figure 16. Absolute percent cover of woody plants (trees, shrubs, woody vines, ferns) by grassland type.

Woody plant cover was highest in plots 1.1C (entirely *Rubus ursinus*), 4.1C, and 4.1T (Figure 16). Percent cover of woody plants (relative to the total amount of vegetation) was 123.2% less in test plots compared to control plots (Figure 17). No adaptive management is required.

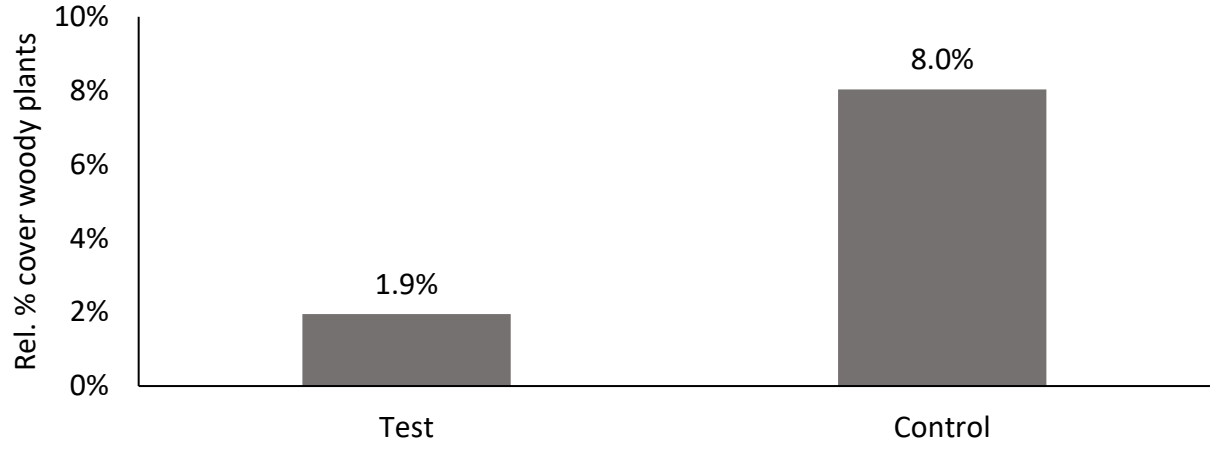

Figure 17. Relative percent cover of woody plants (trees, shrubs, woody vines, ferns) for test and control plots.

Discussion

Grassland Structure

Average biomass, plant height, and litter depth were lower and bare ground was slightly higher in test plots compared to control plots, similar to 2012 (2012 Report Charts 3, 4, 6). Grazing prevented thatch accumulation and reduced vegetation height. From 2012 to 2016, relative cover of woody plants decreased by 9.5% in test plots (2.1 % to 1.9%) and increased by 70.2% in control plots (4.7% to 8.0%), reinforcing the 2012 Report claim that grazing limits "the ability of woody plants to colonize and thrive." Grazing in PCRP supported the goals and objectives of the Management Plan to limit woody plant encroachment and remove thatch from the grasslands.

Plant Community Composition

Absolute vegetation cover was similar for test and control plots, although control plots had less vegetation cover and more thatch (Figure 2). Test plots had higher relative cover of exotic annual species while control plots had greater cover of native and exotic perennial species (Figure 5). The relative cover of grasses and forbs in control and test plots shifted from being fairly similar in 2012 (grasses ~50%, forbs ~43%) to grass dominating in 2016 (grasses ~80%, forbs ~14%) (Figure 4, 2012 Report Chart 14). The shift occurred in both test and control plots indicating that it was not an effect of grazing. From 2012 to 2016, the relative cover of exotic annual grasses increased by ~20.4% in test and control plots while the relative percent cover of native perennial grasses decreased by 41.8% and 30.5% in test and control plots respectively (Figure 6, 2012 Report Chart 15). Grass cover was similar for test and control plots, indicating that the shift to favor exotic annual over native perennial grasses was not due to grazing. 2016 had an El Niño climate pattern with more rainfall than previous years; the plots were likely grass-dominated because grasses outcompete forbs in years with early and consistent rainfall (Heady 1958; Pit and Heady 1978; Corbin et al. 2007).

Exotic perennial grasses decreased by 82.5% in test plots (6.3% to 1.1%) and 93.9% in control plots (8.3% to 0.5%) from 2012 to 2016. The dominant perennial grass found in 2012 was velvet grass (*Holcus lanatus*) in plots 4.4C and 4.4T. In 2016, velvet grass was not found in plots 4.4C or 4.4T, instead ripgut brome (*Bromus diandrus*) was the dominant grass; 4.4T was heavily grazed prior to monitoring making plant identification difficult. Since velvet grass is an extremely persistent perennial grass, it is likely that the decreases in exotic perennial grass cover from 2012 to 2016 were due to misidentification of one of these species, not environmental factors.

The patterns for native and exotic forb cover reversed from 2012 to 2016 (Figure 7). In 2012, test plots had higher cover of native forbs overall, higher cover of native and exotic perennial forbs, and less cover of exotic annual forbs than control plots (2012 Report Chart 16[7]). In 2016, the opposite was true: test plots had less cover of native forbs overall, less cover of native and exotic perennial forbs, and greater cover of exotic annual forbs. The 2016 results suggest that grazing

[7] Note that the relative cover values in 2012 Report Chart 16 do not total 100% as they should. There was a calculation error and the values were not divided by the true number of forbs for test and control plots (values used: test 2406, control 2688; correct values: test 1203, control 1344). The ratios between native and exotic annual and perennials are accurate, but the percent cover should be higher so the change from 2012 to 2016 is not as dramatic as it appears.

promotes exotic annual forbs and discourages native and exotic perennial forbs. Continued monitoring is necessary to determine the long-term effects of grazing at Palo Corona Regional Park.

Conclusion

According to the 2016 grassland monitoring, grazing results in:

- Reduced plant height, thatch, and biomass,
- Less woody plant cover, and
- Slightly more grass than forb cover compared to ungrazed areas.

These results are consistent with the 2012 Report and the goals and objectives of the Management Plan. Contrary to the 2012 Report, analysis of 2016 grassland monitoring did NOT find that grazing significantly affected the ratio of native to exotic perennial grasses or that grazing promoted native cover over exotic cover.

Recommendations

Grazing should continue in Palo Corona Regional Park to prevent grassland conversion to shrublands or weedy perennials. Additional, long-term monitoring is necessary to determine whether the shifts in species composition from 2012 to 2016 are the result of grazing or the effect of varied environmental conditions.

The adaptive management trigger was met for invasive exotic plant cover because cover of exotic annual forbs was 62% higher in test plots compared to control plots (cover of exotic grasses was similar for test and control plots; cover of exotic perennial forbs was 57% less in test plots). Management should consider how to modify grazing practices to promote native species and reduce the following invasive exotic annual forbs:

- Italian thistle (*Carduus pycnocephalus*),
- Red-stemmed filaree (*Erodium cicutarium*),
- Cut-leaved geranium (*Geranium dissectum*),
- Bristly ox-tongue (*Helminthotheca echioides*),
- Smooth cat's ear (*Hypochaeris glabra*),
- Hairy cat's ear (*Hypochaeris radicata*),
- Bur clover (*Medicago polymorpha*),
- Radish (*Raphanus sativus*),
- Milk thistle (*Silybum marianum*), and
- Rose clover (*Trifolium hirtum*).

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Appendix A. Exotic Species List

2016 PCRP Grassland Monitoring Exotic Species List

Family	Species	Species Code	Cal-IPC Rating	Origin	Group	Cycle	Common Name
Fabaceae	*Genista monspessulana*	GENMON	High	Exotic	Shrub	Perennial	French broom
Poaceae	*Avena barbata*	AVEBAR	Moderate	Exotic	Grass	Annual	Oat grass
Poaceae	*Avena fatua*	AVEFAT	Moderate	Exotic	Grass	Annual	Wild oat
Brassicaceae	*Brassica nigra*	BRANIG	Moderate	Exotic	Forb	Perennial	Black mustard
Poaceae	*Bromus diandrus*	BRODIA	Moderate	Exotic	Grass	Annual	Ripgut brome
Asteraceae	*Carduus pycnocephalus*	CARPYC	Moderate	Exotic	Forb	Annual	Italian thistle
Asteraceae	*Cirsium vulgare*	CIRVUL	Moderate	Exotic	Forb	Perennial	Bull thistle
Apiaceae	*Conium maculatum*	CONMAC	Moderate	Exotic	Forb	Perennial	Poison hemlock
Poaceae	*Cynosaurus echinatus*	CYNECH	Moderate	Exotic	Grass	Annual	Dogtail grass
Poaceae	*Festuca myuros*	FESMYU	Moderate	Exotic	Grass	Annual	Rattail fescue
Poaceae	*Festuca perennis*	FESPER	Moderate	Exotic	Grass	Annual	Italian rye grass
Brassicaceae	*Hirschfeldia incana*	HIRINC	Moderate	Exotic	Forb	Perennial	Summer mustard
Poaceae	*Holcus lanatus*	HOLLAN	Moderate	Exotic	Grass	Perennial	Velvet grass
Poaceae	*Hordeum murinum ssp. leporinum*	HORMUR	Moderate	Exotic	Grass	Annual	Foxtail barley
Asteraceae	*Hypochaeris radicata*	HYPRAD	Moderate	Exotic	Forb	Annual	Hairy cat's ear
Poaceae	*Phalarais aquatica*	PHAAQU	Moderate	Exotic	Grass	Perennial	Harding grass
Polygonaceae	*Rumex acetosella*	RUMACE	Moderate	Exotic	Forb	Perennial	Sheep sorrel
Poaceae	*Briza maxima*	BRIMAX	Limited	Exotic	Grass	Annual	Big quaking grass
Poaceae	*Dactylis glomerata*	DACGLO	Limited	Exotic	Grass	Perennial	Orchardgrass
Scrophulariaceae	*Digitalis purpurea*	DIGPUR	Limited	Exotic	Forb	Perennial	Foxglove
Geraniaceae	*Geranium dissectum*	GERDIS	Limited	Exotic	Forb	Annual	Cutleaved geranium
Asteraceae	*Helminthotheca echioides*	HELECH	Limited	Exotic	Forb	Annual	Bristly ox-tongue
Asteraceae	*Hypochaeris glabra*	HYPGLA	Limited	Exotic	Forb	Annual	Smooth cat's ear

Family	Species	Species Code	Cal-IPC Rating	Origin	Group	Cycle	Common Name
Fabaceae	*Medicago polymorpha*	MEDPOL	Limited	Exotic	Forb	Annual	Bur clover
Plantaginaceae	*Plantago lanceolata*	PLALAN	Limited	Exotic	Forb	Perennial	English plantain
Brassicaceae	*Raphanus sativus*	RAPSAT	Limited	Exotic	Forb	Annual	Radish
Fabaceae	*Trifolium hirtum*	TRIHIR	Limited	Exotic	Forb	Annual	Rose clover
Poaceae	*Bromus hordaceus*	BROHOR	Limited*	Exotic	Grass	Annual	Soft chess
Geraniaceae	*Erodium cicutarium*	EROCIC	Limited*	Exotic	Forb	Annual	Red-stemmed filaree
Asteraceae	*Silybum marianum*	SILMAR	Limited*	Exotic	Forb	Annual	Milk thistle
Poaceae	*Aira caryophyllea*	AIRCAR	Not rated	Exotic	Grass	Annual	Silver hairgrass
Apiaceae	*Anthriscus caucalis*	ANTCAU	Not rated	Exotic	Forb	Annual	Bur chervil
Poaceae	*Brachypodium distachyon*	BRADIS	Not rated	Exotic	Grass	Annual	Purple false brome
Poaceae	*Briza minor*	BRIMIN	Not rated	Exotic	Grass	Annual	Little quaking grass
Poaceae	*Bromus catharticus*	BROCAT	Not rated	Exotic	Grass	Annual	Rescue grass
Poaceae	*Bromus madritensis*	BROMAD	Not rated	Exotic	Grass	Annual	Spanish brome, red brome
Poaceae	*Bromus madritensis ssp. madritensis*	BROMADMAD	Not rated	Exotic	Grass	Annual	Foxtail chess
Poaceae	*Bromus madritensis ssp. rubens*	BROMADRUB	Not rated	Exotic	Grass	Annual	Foxtail brome
Caryophyllaceae	*Cerastium glomeratum*	CERGLO	Not rated	Exotic	Forb	Annual	Sticky chickweed
Geraniaceae	*Erodium botrys*	EROBOT	Not rated	Exotic	Forb	Annual	Broad leaf filaree
Geraniaceae	*Erodium moschatum*	EROMOS	Not rated	Exotic	Forb	Annual	White-stemmed filaree
Rubiaceae	*Galium parisiense*	GALPAR	Not rated	Exotic	Forb	Annual	Wall bedstraw
Poaceae	*Gastridium phleoides*	GASPHL	Not rated	Exotic	Grass	Annual	Nit grass
Geraniaceae	*Geranium core-core*	GERCOR	Not rated	Exotic	Forb	Perennial	Alderney crane's bill
Geraniaceae	*Geranium molle*	GERMOL	Not rated	Exotic	Forb	Annual	Dovesfoot
Asteraceae	*Lactuca serriola*	LACSER	Not rated	Exotic	Forb	Annual	Prickly lettuce
Linaceae	*Linum bienne*	LINBIE	Not rated	Exotic	Forb	Perennial	Narrow leaved flax
Asteraceae	*Logfia gallica*	LOGGAL	Not rated	Exotic	Forb	Annual	Narrowleaf cottonrose
Fabaceae	*Lotus corniculatus*	LOTCOR	Not rated	Exotic	Forb	Perennial	Bird's-foot trefoil
Myrsinaceae	*Lysimachia arvensis*	LYSARV	Not rated	Exotic	Forb	Annual	Scarlet pimpernel

Family	Species	Species Code	Cal-IPC Rating	Origin	Group	Cycle	Common Name
Malvaceae	*Malva parviflora*	MALPAR	Not rated	Exotic	Forb	Annual	Cheeseweed
Polygonaceae	*Rumex conglomeratus*	RUMCON	Not rated	Exotic	Forb	Perennial	Clustered dock
Caryophyllaceae	*Silene gallica*	SILGAL	Not rated	Exotic	Forb	Annual	Catchfly
Asteraceae	*Sonchus asper*	SONASP	Not rated	Exotic	Forb	Annual	Prickly sow thistle
Asteraceae	*Sonchus oleraceus*	SONOLE	Not rated	Exotic	Forb	Annual	Common sow thistle
Caryophyllaceae	*Stellaria media*	STEMED	Not rated	Exotic	Forb	Annual	Common chickweed
Fabaceae	*Trifolium angustifolium*	TRIANG	Not rated	Exotic	Forb	Annual	Narrow leaved clover
Fabaceae	*Trifolium campestre*	TRICAM	Not rated	Exotic	Forb	Annual	Low hop clover
Fabaceae	*Trifolium subterraneum*	TRISUB	Not rated	Exotic	Forb	Annual	Subterrannean clover
Fabaceae	*Vicia hirsuta*	VICHIR	Not rated	Exotic	Forb	Annual	Hairy vetch
Fabaceae	*Vicia sativa ssp. nigra*	VICSATNIG	Not rated	Exotic	Forb	Annual	Common vetch
Fabaceae	*Vicia sativa ssp. sativa*	VICSATSAT	Not rated	Exotic	Forb	Annual	Common vetch
Fabaceae	*Vicia villosa*	VICVIL	Not rated	Exotic	Forb	Annual	Hairy vetch

* Cal-IPC rating increased from Limited to Moderate for this study based on local abundance and impacts.

Appendix B: Species List

2016 PCRP Grassland Monitoring Species List

Family	Species	Species Code	Origin	Group	Cycle	Common Name	Notes
Agavaceae	*Chlorogalum pomeridianum*	CHLPOM	Native	Forb	Perennial	Soap plant	
Anacardiaceae	*Toxicodendron diversilobum*	TOXDIV	Native	Shrub	Perennial	Poison oak	
Apiaceae	*Anthriscus caucalis*	ANTCAU	Exotic	Forb	Annual	Bur chervil	
Apiaceae	*Conium maculatum*	CONMAC	Exotic	Forb	Perennial	Poison hemlock	
Apiaceae	*Daucus pusillus*	DAUPUS	Native	Forb	Annual	Rattlesnake weed	
Apiaceae	*Lomatium parvifolium**	LOMPAR	Native	Forb	Perennial	Coast parsnip	
Apiaceae	*Sanicula arctopoides*	SANARC	Native	Forb	Perennial	Footsteps of spring	
Apiaceae	*Sanicula bipinnatifida*	SANBIP	Native	Forb	Perennial	Purple sanicle	
Apiaceae	*Sanicula crassicaulis*	SANCRA	Native	Forb	Perennial	Gambleweed	
Asteraceae	*Achillea millefolium*	ACHMIL	Native	Forb	Perennial	Yarrow	
Asteraceae	*Artemisia californica**	ARTCAL	Native	Shrub	Perennial	California sagebrush	
Asteraceae	*Baccharis pilularis*	BACPIL	Native	Shrub	Perennial	Coyote brush	
Asteraceae	*Carduus pycnocephalus*	CARPYC	Exotic	Forb	Annual	Italian thistle	
Asteraceae	*Cirsium occidentale var. occidentale*	CIROCC	Native	Forb	Perennial	Cobweb thistle	
Asteraceae	*Cirsium vulgare*	CIRVUL	Exotic	Forb	Perennial	Bull thistle	
Asteraceae	*Corethrogyne filaginifolia*	CORFIL	Native	Forb	Perennial	Common sand aster	
Asteraceae	*Deinandra corymbosa*	DEICOR	Native	Forb	Annual	Coastal tarweed	
Asteraceae	*Grindelia stricta**	GRISTR	Native	Forb	Perennial	Gum plant	
Asteraceae	*Hazardia squarosa*	HAZSQU	Native	Shrub	Perennial	Sawtooth goldenbrush	
Asteraceae	*Helminthotheca echioides*	HELECH	Exotic	Forb	Annual	Bristly ox-tongue	Picris echioides
Asteraceae	*Heterotheca sessiliflora ssp. sessiliflora*	HETSESSES	Native	Forb	Perennial	Sessile false goldenaster	Silvery, low, dense clump
Asteraceae	*Hypochaeris glabra*	HYPGLA	Exotic	Forb	Annual	Smooth cat's ear	
Asteraceae	*Hypochaeris radicata*	HYPRAD	Exotic	Forb	Annual	Hairy cat's ear	
Asteraceae	*Lactuca serriola*	LACSER	Exotic	Forb	Annual	Prickly lettuce	Probably SONOLE
Asteraceae	*Logfia gallica*	LOGGAL	Exotic	Forb	Annual	Narrowleaf cottonrose	
Asteraceae	*Madia elegans*	MADELE	Native	Forb	Annual	Common madia	
Asteraceae	*Madia gracilis*	MADGRA	Native	Forb	Annual	Grassy tarweed	
Asteraceae	*Madia radiata**	MADRAD	Native	Forb	Annual	Golden madia	
Asteraceae	*Microseris paludosa*	MICPAL	Native	Forb	Perennial	Marsh silverpuffs	
Asteraceae	*Pseudognaphalium californicum*	PSECAL	Native	Forb	Perennial	California cudweed	

Family	Species	Species Code	Origin	Group	Cycle	Common Name	Notes
Asteraceae	*Silybum marianum*	SILMAR	Exotic	Forb	Annual	Milk thistle	
Asteraceae	*Sonchus asper*	SONASP	Exotic	Forb	Annual	Prickly sow thistle	
Asteraceae	*Sonchus oleraceus*	SONOLE	Exotic	Forb	Annual	Common sow thistle	
Boraginaceae	*Amsinckia menziesii var. intermedia*	AMSMEN	Native	Forb	Annual	Small flowered fiddleneck	
Boraginaceae	*Cryptantha sp.**	Cryptantha sp.	Native	Forb	Annual	Popcorn flower	
Brassicaceae	*Brassica nigra*	BRANIG	Exotic	Forb	Perennial	Black mustard	
Brassicaceae	*Hirschfeldia incana**	HIRINC	Exotic	Forb	Perennial	Summer mustard	
Brassicaceae	*Raphanus sativus*	RAPSAT	Exotic	Forb	Annual	Radish	
Caryophyllaceae	*Cerastium glomeratum*	CERGLO	Exotic	Forb	Annual	Sticky chickweed	
Caryophyllaceae	*Silene gallica*	SILGAL	Exotic	Forb	Annual	Catchfly	
Caryophyllaceae	*Stellaria media*	STEMED	Exotic	Forb	Annual	Common chickweed	
Convulvulaceae	*Dichondra donelliana*	DICDON	Native	Forb	Perennial	California ponysfoot	
Cucurbitaceae	*Marah fabacea*	MARFAB	Native	Forb	Perennial	Wild cucumber/manroot	
Cyperaceae	*Carex globosa*	CARGLO	Native	Grass	Perennial	Round fruit sedge	CAREX on datasheet
Cyperaceae	*Carex tumulicola*	CARTUM	Native	Grass	Perennial	Foothill sedge	
Dennstaediaceae	*Pteridium aquilinum*	PTEAQU	Native	Fern	Perennial	Bracken fern	
Euphorbiaceae	*Croton setiger*	CROSET	Native	Forb	Perennial	Turkey-mullein	CROSEG in notes
Fabaceae	*Acmispon americanus*	ACMAME	Native	Forb	Annual	American bird's foot trefoil	
Fabaceae	*Acmispon brachycarpus**	ACMBRA	Native	Forb	Annual	Short-podded lotus	
Fabaceae	*Acmispon glaber var. glaber*	ACMGLA	Native	Forb	Perennial	Deerweed	
Fabaceae	*Acmispon parviflorus*	ACMPAR	Native	Forb	Annual	Hill lotus	
Fabaceae	*Acmispon strigosus*	ACMSTR	Native	Forb	Annual	Strigose lotus	
Fabaceae	*Acmispon wrangelianus*	ACMWRA	Native	Forb	Annual	California lotus	
Fabaceae	*Genista monspessulana*	GENMON	Exotic	Shrub	Perennial	French broom	
Fabaceae	*Lathyrus sp.*	Lathyrus	NA	Forb	Annual	unknown pea	
Fabaceae	*Lotus corniculatus**	LOTCOR	Exotic	Forb	Perennial	Bird's-foot trefoil	
Fabaceae	*Lupinus arboreus**	LUPARB	Native	Shrub	Perennial	Tree lupine/yellow bush-lupine	
Fabaceae	*Lupinus bicolor*	LUPBIC	Native	Forb	Annual	Bicolor lupine	
Fabaceae	*Lupinus nanus*	LUPNAN	Native	Forb	Annual	Sky lupine	
Fabaceae	*Lupinus variicolor*	LUPVAR	Native	Shrub	Perennial	Lindley's varied lupine	
Fabaceae	*Medicago polymorpha*	MEDPOL	Exotic	Forb	Annual	Bur clover	
Fabaceae	*Trifolium angustifolium*	TRIANG	Exotic	Forb	Annual	Narrow leaved clover	
Fabaceae	*Trifolium campestre*	TRICAM	Exotic	Forb	Annual	Low hop clover	
Fabaceae	*Trifolium depauperatum*	TRIDEP	Native	Forb	Annual	Dwarf sac clover	
Fabaceae	*Trifolium gracilentum*	TRIGRA	Native	Forb	Annual	Graceful clover	

Family	Species	Species Code	Origin	Group	Cycle	Common Name	Notes
Fabaceae	*Trifolium hirtum*	TRIHIR	Exotic	Forb	Annual	Rose clover	
Fabaceae	*Trifolium macraei*	TRIMAC	Native	Forb	Annual	Macrae's clover	
Fabaceae	*Trifolium microcephalum*	TRIMIC	Native	Forb	Annual	Maiden's clover	
Fabaceae	*Trifolium subterraneum*	TRISUB	Exotic	Forb	Annual	Subterrannean clover	
Fabaceae	*Trifolium wildenovii*	TRIWIL	Native	Forb	Annual	Tomcat clover	
Fabaceae	*Vicia hirsuta*	VICHIR	Exotic	Forb	Annual	Hairy vetch	
Fabaceae	*Vicia sativa ssp. nigra*	VICSATNIG	Exotic	Forb	Annual	Common vetch	
Fabaceae	*Vicia sativa ssp. sativa*	VICSATSAT	Exotic	Forb	Annual	Common vetch	
Fabaceae	*Vicia sp.*	VIC sp.	Exotic	Forb	Annual	Vetch	
Fabaceae	*Vicia villosa*	VICVIL	Exotic	Forb	Annual	Hairy vetch	
Geraniaceae	*Erodium botrys*	EROBOT	Exotic	Forb	Annual	Broad leaf filaree	
Geraniaceae	*Erodium cicutarium*	EROCIC	Exotic	Forb	Annual	Red-stemmed filaree	
Geraniaceae	*Erodium moschatum*	EROMOS	Exotic	Forb	Annual	White-stemmed filaree	
Geraniaceae	*Geranium core-core*	GERCOR	Exotic	Forb	Perennial	Alderney crane's bill	
Geraniaceae	*Geranium dissectum*	GERDIS	Exotic	Forb	Annual	Cutleaved geranium	
Geraniaceae	*Geranium molle*	GERMOL	Exotic	Forb	Annual	Dovesfoot	
Iridaceae	*Sisyrinchium bellum*	SISBEL	Native	Forb	Perennial	Blue-eyed grass	
Juncaceae	*Juncus bufonius var. bufonius*	JUNBUF	Native	Grass	Annual	Toad rush	
Juncaceae	*Juncus effusus**	JUNEFF	Native	Grass	Perennial	Common rush	
Juncaceae	*Juncus mexicanus*	JUNMEX	Native	Grass	Perennial	Mexican rush	Could be Carex tumulicola
Juncaceae	*Juncus occidentalis*	JUNOCC	Native	Grass	Perennial	Slender rush	
Juncaceae	*Juncus patens*	JUNPAT	Native	Grass	Perennial	Spreading rush	
Juncaceae	*Juncus phaeocephalus*	JUNPHA	Native	Grass	Perennial	Brown-headed rush	
Juncaceae	*Luzula comosa**	LUZCOM	Native	Grass	Perennial	Common wood rush	
Lamiaceae	*Clinopodium douglasii*	CLIDOU	Native	Forb	Perennial	Yerba buena	SATDOU on data sheets
Lamiaceae	*Monardella villosa*	MONVIL	Native	Shrub	Perennial	Coyote mint	
Lamiaceae	*Stachys bullata*	STABUL	Native	Forb	Perennial	Wood mint	
Liliaceae	*Calochortus albus*	CALALB	Native	Forb	Perennial	White globe lily	
Linaceae	*Linum bienne*	LINBIE	Exotic	Forb	Perennial	Narrow leaved flax	
Malvaceae	*Malva parviflora**	MALPAR	Exotic	Forb	Annual	Cheeseweed	
Malvaceae	*Sidalcea malviflora*	SIDMAL	Native	Forb	Perennial	Checkerbloom	
Melanthiaceae	*Toxicoscordion fremontii*	TOXFRE	Native	Forb	Perennial	Fremont's star lily/ death camas	
Myrsinaceae	*Lysimachia arvensis*	LYSARV	Exotic	Forb	Annual	Scarlet pimpernel	ANAARV on datasheets
Onagraceae	*Clarkia lewisii*	CLALEW	Native	Forb	Annual	Lewis' clarkia	
Onagraceae	*Clarkia purpurea ssp. quadrivulnera*	CLAPUR	Native	Forb	Annual	Winecup clarkia	
Onagraceae	*Taraxia ovata*	TAROVA	Native	Forb	Perennial	Suncup	Camissonia ovata
Orobanchaceae	*Castilleja affinis*	CASAFF	Native	Forb	Perennial	Indian paintbrush	

Family	Species	Species Code	Origin	Group	Cycle	Common Name	Notes
Orobanchaceae	*Triphysaria pusilla*	TRIPUS	Native	Forb	Annual	Dwarf owl's clover	
Oxalidaceae	*Oxalis pilosa*	OXAPIL	Native	Forb	Perennial	Hairy wood-sorrel	
Papaveraceae	*Eschscholzia californica*	ESCCAL	Native	Forb	Perennial	California poppy	
Phrymaceae	*Mimulus aurantiacus var. aurantiacus*	MIMAUR	Native	Shrub	Perennial	Sticky monkeyflower	
Pinus	*Pinus radiata*	PINRAD	Native	Tree	Perennial	Monterey pine	
Plantaginaceae	*Plantago erecta*	PLAERE	Native	Forb	Annual	California plantain	
Plantaginaceae	*Plantago lanceolata*	PLALAN	Exotic	Forb	Perennial	English plantain	
Poaceae	*Agrostis pallens*	AGRPAL	Native	Grass	Perennial	Leafy bent grass	
Poaceae	*Aira caryophyllea*	AIRCAR	Exotic	Grass	Annual	Silver hairgrass	
Poaceae	*Avena barbata*	AVEBAR	Exotic	Grass	Annual	Oat grass	
Poaceae	*Avena fatua*	AVEFAT	Exotic	Grass	Annual	Wild oat	
Poaceae	*Brachypodium distachyon*	BRADIS	Exotic	Grass	Annual	Purple false brome	hairy nodes
Poaceae	*Briza maxima*	BRIMAX	Exotic	Grass	Annual	Big quaking grass	
Poaceae	*Briza minor*	BRIMIN	Exotic	Grass	Annual	Little quaking grass	
Poaceae	*Bromus carinatus*	BROCAR	Native	Grass	Perennial	California bromegrass	
Poaceae	*Bromus catharticus*	BROCAT	Exotic	Grass	Annual	Rescue grass	
Poaceae	*Bromus diandrus*	BRODIA	Exotic	Grass	Annual	Ripgut brome	
Poaceae	*Bromus hordaceus*	BROHOR	Exotic	Grass	Annual	Soft chess	
Poaceae	*Bromus madritensis*	BROMAD	Exotic	Grass	Annual	Spanish brome	
Poaceae	*Bromus madritensis ssp. madritensis*	BROMADMAD	Exotic	Grass	Annual	Foxtail chess	
Poaceae	*Bromus madritensis ssp. rubens*	BROMADRUB	Exotic	Grass	Annual	Foxtail brome	
Poaceae	*Cynosaurus echinatus*	CYNECH	Exotic	Grass	Annual	Dogtail grass	
Poaceae	*Dactylis glomerata*	DACGLO	Exotic	Grass	Perennial	Orchardgrass	
Poaceae	*Danthonia californica*	DANCAL	Native	Grass	Perennial	California oatgrass	
Poaceae	*Deschampsia elongata**	DESELO	Native	Grass	Perennial	Slender hair-grass	
Poaceae	*Distichlis spicata**	DISSPI	Native	Grass	Perennial	Salt grass	
Poaceae	Elymus elymoides**	ELYELE	Native	Grass	Perennial	Squirreltail	
Poaceae	*Elymus glaucus*	ELYGLA	Native	Grass	Perennial	Western ryegrass	
Poaceae	*Elymus triticoides*	ELYTRI	Native	Grass	Perennial	Beardless wild rye	
Poaceae	*Festuca myuros*	FESMYU	Exotic	Grass	Annual	Rattail fescue	
Poaceae	*Festuca perennis*	FESPER	Exotic	Grass	Annual	Italian rye grass	
Poaceae	*Festuca rubra*	FESRUB	Native	Grass	Perennial	Red fescue	
Poaceae	*Gastridium phleoides*	GASPHL	Exotic	Grass	Annual	Nit grass	
Poaceae	*Holcus lanatus**	HOLLAN	Exotic	Grass	Perennial	Velvet grass	
Poaceae	*Hordeum brachyantherum*	HORBRA	Native	Grass	Perennial	Meadow barley	
Poaceae	*Hordeum murinum ssp. leporinum*	HORMUR	Exotic	Grass	Annual	Foxtail barley	
Poaceae	*Koeleria macrantha*	KOEMAC	Native	Grass	Perennial	June Grass	

Family	Species	Species Code	Origin	Group	Cycle	Common Name	Notes
Poaceae	*Phalarais aquatica*	PHAAQU	Exotic	Grass	Perennial	Harding grass	
Poaceae	*Phalaris arundinacea**	PHAARU	Native	Grass	Perennial	Reed canary grass	
Poaceae	*Stipa pulchra*	STIPUL	Native	Grass	Perennial	Purple needlegrass	
Polygonaceae	*Eriogonum latifolium**	ERILAT	Native	Shrub	Perennial	Coast buckwheat	
Polygonaceae	*Eriogonum nudum*	ERINUD	Native	Shrub	Perennial	Naked buckwheat	
Polygonaceae	*Rumex acetosella*	RUMACE	Exotic	Forb	Perennial	Sheep sorrel	
Polygonaceae	*Rumex conglomeratus*	RUMCON	Exotic	Forb	Perennial	Clustered dock	
Portulacaceae	*Calandrinia ciliata**	CALCIL	Native	Forb	Annual	Red maids	
Portulacaceae	*Claytonia perfoliata*	CLAPER	Native	Forb	Annual	Miner's lettuce	
Primulaceae	*Primula clevelandii*	PRICLE	Native	Forb	Perennial	Shooting star	formerly Dodecatheon clev.
Ranunculaceae	*Ranunculus californicus*	RANCAL	Native	Forb	Perennial	California buttercup	
Rosaceae	*Acaena pinnatifida var. californica*	ACAPIN	Native	Forb	Perennial	California acaena	
Rosaceae	*Fragaria chiloensis*	FRACHI	Native	Forb	Perennial	Beach strawberry	FRACAL on datasheets
Rosaceae	*Fragaria vesca*	FRAVES	Native	Forb	Perennial	Wood strawberry	
Rosaceae	*Rubus ursinus*	RUBURS	Native	Vine	Perennial	California blackberry	
Rubiaceae	*Galium aparine*	GALAPA	Native	Forb	Annual	Common bedstraw	
Rubiaceae	*Galium parisiense*	GALPAR	Exotic	Forb	Annual	Wall bedstraw	
Rubiaceae	*Galium porigens*	GALPOR	Native	Forb	Perennial	Climbing bedstraw	
Rubiaceae	*Galium sp.*	GAL SP.	NA	Forb	Annual	Bedstraw	
Rubiaceae	*Galium trifidum ssp. columbianum**	GALTRI	Native	Forb	Perennial	Threepetal bedstraw	
Saxifragaceae	*Lithophragma affine*	LITAFF	Native	Forb	Perennial	Woodland star	
Scrophulariaceae	*Digitalis purpurea*	DIGPUR	Exotic	Forb	Perennial	Foxglove	
Scrophulariaceae	*Scrophularia californica*	SCRCAL	Native	Forb	Perennial	Bee plant	
Themidaceae	*Brodiaea terrestris ssp. terrestris*	BROTERTER	Native	Forb	Perennial	Dwarf brodiaea	
Themidaceae	*Dichelostemma capitatum*	DICCAP	Native	Forb	Perennial	Blue dicks	
Themidaceae	*Triteleia ixioides*	TRIIXI	Native	Forb	Perennial	Pretty face	
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	VERLASLAS	Native	Forb	Perennial	Verbena/western vervain	
Violaceae	*Viola pedunculata ssp. pedunculata*	VIOPED	Native	Forb	Annual	Johnny jump-up	
	Bare ground	BARE	0	Bare	0		
	Moss	MOSS					
	Thatch	THATCH	0	Thatch	0	Dead plant material	
	Unknown forb	UNK 2	NA	Forb	Annual		fuzzy, opposite leaves, swollen nodes
	Unknown forb	UNK 4	NA	Forb	Annual		tiny, silvery with beaked seeds
	Unknown forb	UNK FORB	NA	Forb	Annual		

* Not found in 2016

** Found in 2016, not in plot

Appendix C. Sample Data Sheet

PCRP 2016 Grassland Monitoring Date: Photo #:

Plot Type (T/C): Time: Initials:

Line 1.0 m		Height (cm)	Origin (N/E)	Growth G/F/W	Cycle (A/P)
m	Species				
1.00					
1.25					
1.50					
1.75					
2.00					
2.25					
2.50					
2.75					
3.00					
3.25					
3.50					
3.75					
4.00					
4.25					
4.50					
4.75					
5.00					
5.25					
5.50					
5.75					
6.00					
6.25					
6.50					
6.75					
7.00					

Line 2.5m		Height (cm)	Origin (N/E)	Growth (G/F/W)	Cycle (A/P)
m	Species				
1.00					
1.25					
1.50					
1.75					
2.00					
2.25					
2.50					
2.75					
3.00					
3.25					
3.50					
3.75					
4.00					
4.25					
4.50					
4.75					
5.00					
5.25					
5.50					
5.75					
6.00					
6.25					
6.50					
6.75					
7.00					

Litter Depth

	X (m)	Y (m)	Depth (mm)
NE	6.53	1.00	
SE	5.45	5.44	
SW	5.85	4.43	
NW	5.01	5.11	

Biomass

	X (m)	Y (m)	Dry Wt.
NE	4.62	1.93	
SW	1.53	6.37	

Other Species:

Species	Photo	Origin	Growth	Cycle	Notes

Line 4.0 m		Height	Origin	Growth	Cycle
m	Species	(cm)	(N/E)	(G/F/W)	(A/P)
1.00					
1.25					
1.50					
1.75					
2.00					
2.25					
2.50					
2.75					
3.00					
3.25					
3.50					
3.75					
4.00					
4.25					
4.50					
4.75					
5.00					
5.25					
5.50					
5.75					
6.00					
6.25					
6.50					
6.75					
7.00					

Line 5.5m		Height	Origin	Growth	Cycle
m	Species	(cm)	(N/E)	(G/F/W)	(A/P)
1.00					
1.25					
1.50					
1.75					
2.00					
2.25					
2.50					
2.75					
3.00					
3.25					
3.50					
3.75					
4.00					
4.25					
4.50					
4.75					
5.00					
5.25					
5.50					
5.75					
6.00					
6.25					
6.50					
6.75					
7.00					

Line 7.0 m		Height (cm)	Origin (N/E)	Growth (G/F/W)	Cycle (A/P)
m	Species				
1.00					
1.25					
1.50					
1.75					
2.00					
2.25					
2.50					
2.75					
3.00					
3.25					
3.50					
3.75					
4.00					
4.25					
4.50					
4.75					
5.00					
5.25					
5.50					
5.75					
6.00					
6.25					
6.50					
6.75					
7.00					

Other species (cont.)

Species	Photo	Origin	Growth	Cycle

Notes:

Appendix D: Data Summary Tables

Table 1. Summary of Palo Corona Regional Park grassland monitoring data by plot (continued on next page).

Plot	Ave. Plant Height (cm)	Ave. Litter Depth (mm)	Number Species	Biomass (g/m^2)	Abs. % Cover Woody Plants	Abs. % Cover Invasive Species		
						High	Moderate	Limited
1.1C	93.4	NA	12	NA	74.4	0.0	0.0	0.0
1.1T	66.6	55	30	536.8	1.6	1.6	79.2	10.4
1.2C	36.4	90	24	599.3	0.0	0.0	36.8	13.6
1.2T	42.8	16	24	574.4	0.0	0.0	62.4	8.8
1.3C	58.6	56	19	1038.4	0.0	0.0	89.6	0.0
1.3T	53.9	55	19	536.7	0.0	0.0	93.6	1.6
1.4C	79.0	63	16	768.8	0.0	0.0	96.8	0.0
1.4T	39.7	33	11	887.2	0.0	0.0	100.0	0.0
1.5C	44.1	40	15	1037.3	0.0	0.0	66.4	1.6
1.5T	56.9	36	21	864.2	0.0	0.0	92.0	7.2
2.1C	57.3	125	14	963.7	0.0	0.0	89.6	0.8
2.1T	69.7	83	18	1176.1	0.0	0.0	97.6	0.8
2.2C	99.6	65	27	841.6	15.2	0.0	48.8	0.8
2.2T	46.6	29	25	504.1	0.0	0.0	65.6	1.6
2.3C	67.6	33	23	906.0	14.4	0.0	35.2	13.6
2.3T	54.0	47	16	581.4	0.0	0.0	99.2	0.8
2.4C	76.3	124	23	1505.0	2.4	0.0	80.0	0.0
2.4T	44.6	27	16	537.1	0.0	0.0	100.0	0.0
2.5C	43.3	81	11	957.5	0.0	0.0	98.4	0.0
2.5T	48.7	43	13	542.2	0.0	0.0	100.0	0.0
3.1C	54.5	79	24	672.5	0.0	0.0	86.4	1.6
3.1T	56.4	34	23	735.7	0.0	0.0	96.0	4.0
3.2C	63.1	75	22	1063.6	2.4	0.0	78.4	3.2
3.2T	44.9	36	24	688.0	0.0	0.0	85.6	12.8
3.3C	35.3	41	32	253.7	4.0	0.0	17.6	3.2
3.3T	23.5	8	39	171.0	7.2	6.4	39.2	8.0
3.4C	35.9	39	33	586.4	0.0	0.0	64.0	7.2
3.4T	39.6	24	31	302.6	0.0	0.0	79.2	5.6
3.5C	38.1	61	40	381.3	12.0	0.8	36.8	6.4
3.5T	52.2	33	35	714.1	0.8	0.8	84.0	5.6
4.1C	72.6	19	33	402.5	45.6	7.2	14.4	17.6
4.1T	67.7	29	32	401.5	22.4	19.2	21.6	0.8
4.2C	50.3	67	29	173.4	13.6	0.0	60.8	8.8
4.2T	43.2	34	32	358.5	12.0	0.0	50.4	18.4
4.3C	40.7	45	27	665.5	2.4	0.0	65.6	6.4
4.3T	40.0	46	32	703.8	0.0	0.0	50.4	24.0
4.4C	25.3	37	28	452.0	6.4	0.0	57.6	2.4
4.4T	7.5	8	25	124.9	7.2	0.0	47.2	1.6

Table 1 (continued). Summary of Palo Corona Regional Park grassland monitoring data by plot.

Plot	Ave. Plant Height (cm)	Ave. Litter Depth (mm)	Number Species	Biomass (g/m^2)	Abs. % Cover Woody Plants	Abs. % Cover Invasive Species		
						High	Moderate	Limited
5.1C	37.6	82	18	766.1	0.0	0.0	44.8	23.2
5.1T	26.7	28	23	387.0	0.0	0.0	22.4	46.4
5.2C	47.6	121	27	681.4	0.0	0.0	84.0	7.2
5.2T	16.6	28	29	391.1	0.0	0.0	53.6	10.4
5.3C	68.6	48	29	638.3	0.0	0.0	97.6	0.8
5.3T	15.1	23	42	203.0	0.0	0.0	24.0	28.8
5.4C	53.0	101	15	1115.8	0.0	0.0	97.6	0.0
5.4T	41.4	39	17	874.5	0.0	0.0	82.4	11.2
5.5C	20.1	39	34	708.3	9.6	0.0	12.8	15.2
5.5T	8.2	19	33	164.5	0.0	0.0	8.8	13.6
6.1C	44.5	140	22	1375.0	0.0	0.0	92.0	0.0
6.1T	25.0	48	38	448.7	0.0	0.0	58.4	12.0
6.2C	33.2	95	26	470.7	0.0	0.0	67.2	1.6
6.2T	13.0	43	26	304.4	0.0	0.0	43.2	8.0
6.3C	16.8	34	26	191.0	0.0	0.0	37.6	1.6
6.3T	16.1	39	23	253.6	0.0	0.0	52.0	1.6
6.4C	19.3	97	30	626.1	0.0	0.0	30.4	14.4
6.4T	14.1	14	29	395.6	1.6	0.0	16.8	16.0
6.5C	11.1	34	18	210.0	0.0	0.0	28.0	7.2
6.5T	10.0	23	16	384.8	0.0	0.0	38.4	4.8

Table 2. Average litter depth, biomass, and plant height.

Type	Ave. Litter Depth (mm)	Biomass (g/m^2)	Ave. Plant Height (cm)				
			Overall	Native	Exotic	Annual	Perennial
Test	34	508.5	37.4	32.7	40.4	39.6	38.1
Control	69	716.1	49.1	68.9	47.1	46.6	65.9

Table 3. Average height of native and exotic plants.

Type	Ave. Native Height (cm)		Ave. Exotic Height (cm)	
	Annual	Perennial	Annual	Perennial
Test	7.9	33.9	39.9	51.9
Control	40.4	70.0	46.7	52.1

Table 4. Average species richness by origin and life cycle.

Type	Overall	Native	Exotic	Annual	Perennial
Test	25.6	8.6	16.8	17.8	7.8
Control	24.0	8.3	15.3	15.5	8.5

Table 5. Average native and exotic species richness by life cycle.

	Ave. Native Species		Ave. Exotic Species	
Type	**Annual**	**Perennial**	**Annual**	**Perennial**
Test	3.7	5.8	14.6	2.2
Control	2.9	6.3	13.0	2.2

Table 6. Summary of point data from point-intercept survey.

			Point Intercept Vegetation Summary			
Type	**Total Points**	**Total Veg Points**	**Native**	**Exotic**	**Annual**	**Perennial**
Test	3625	3387	463	2924	2808	579
Control	3625	3150	681	2467	2297	853

Table 7. Total native and exotic points from point-intercept survey.

	Number Native Points		Number Exotic Points	
Type	**Annual**	**Perennial**	**Annual**	**Perennial**
Test	20	443	2788	136
Control	25	656	2270	197

Table 8. Absolute percent cover by group.

Type	**Total Vegetation**	**Grasses**	**Forbs**	**Woody**	**Bare Ground**	**Thatch**
Test	93.4%	79.8%	11.9%	1.8%	0.5%	6.1%
Control	84.3%	66.7%	13.2%	7.0%	0.2%	12.9%

Table 9. Absolute percent cover of native and exotic vegetation by life cycle.

	Absolute Percent Cover of Vegetation**				Abs. % Cover Native		Abs. % Cover Exotic	
Type	**Native**	**Exotic**	**Annual**	**Perennial**	**Annual**	**Perennial**	**Annual**	**Perennial**
Test	12.8%	80.7%	77.5%	16.0%	0.6%	12.2%	76.9%	3.8%
Control	18.8%	68.1%	63.4%	23.5%	0.7%	18.1%	62.6%	5.4%

** Bare ground and Thatch included as part of absolute cover

Table 10. Absolute percent cover of grasses and forbs by origin and life cycle.

	Absolute % Cover Grasses				Absolute % Cover Forbs			
	Native		Exotic		Native		Exotic	
Type	Annual	Perennial	Annual	Perennial	Annual	Perennial	Annual	Perennial
Test	0.0%	10.5%	68.3%	0.9%	0.5%	0.9%	8.6%	1.9%
Control	0.0%	9.7%	56.7%	0.3%	0.7%	1.7%	5.9%	4.9%

Table 11. Relative percent cover by plant group.

	Total Veg	Rel. % Cover				
Type	Points	Grasses	Forbs	Woody Plants	Invasive	Non-invasive
Test	3387	85.4%	12.7%	1.9%	78.8%	13.7%
Control	3150	76.8%	15.2%	8.0%	74.7%	21.7%

Table 12. Relative percent cover of native and exotic vegetation by life cycle.

	Relative Percent Cover of Vegetation*				Native		Exotic	
Type	Native	Exotic	Annual	Perennial	Annual	Perennial	Annual	Perennial
Test	13.7%	86.3%	82.9%	17.1%	0.6%	13.1%	82.3%	4.0%
Control	21.6%	78.3%	72.9%	27.1%	0.8%	20.8%	72.1%	6.3%

* Excludes Bare ground and Thatch because they are not vegetation.

Table 13. Relative percent cover of grasses by origin and life cycle.

	Total Grass	Relative Percent Cover Grasses			
Type	Points	Native	Exotic	Annual	Perennial
Test	2891	13.2%	86.8%	85.7%	14.3%
Control	2419	14.6%	85.4%	85.0%	15.0%

Table 14. Relative percent cover of forbs by origin and life cycle.

	Total Forb	Relative Percent Cover Forbs			
Type	Points	Native	Exotic	Annual	Perennial
Test	430	11.9%	88.1%	76.7%	23.3%
Control	478	18.0%	81.6%	50.4%	49.6%