# 2006 Annual Report
# Year 1

## Ojai Meadows Preserve
## Savannah Wetland

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# INTRODUCTION

The project site is part of the Ojai Meadows Preserve Habitat Restoration and Flood Control Plan (2004) project that was created for the Ojai Meadows Preserve in Ventura County, California. In 2005 the Wetland Restoration and Enhancement Plan for the Ojai Meadows Preserve, Savannah Wetland was prepared to address portions of the preserve that would be restored and enhanced specifically with In Lieu Fee Mitigation Funds required by the US Army Corps of Engineers (ACOE). This plan was submitted to ACOE in 2005 and presented our strategy and philosophy for the restoration and enhancement of 2.588 acres of riparian wetlands.

Historic inflows were returned to the Savannah Wetland in 2004 with realignment of storm drains on an adjacent property (Nordhoff High School). As a result, small areas of the wetland had begun to re-vegetate on their own. Restoration and enhancement actions targeted removing weeds and increasing native diversity on the core of the site, creating a higher functioning riparian wetland.

Prior to project implementation, non-native vegetation predominated the project area with particularly invasive species such as Bermuda grass and Italian rye grass. Soil type and hydrology of the site, however, indicated riparian wetland species would be appropriate for the site.

# RESTORATION AND ENHANCEMENT ACTIVITIES

Efforts to restore 2.588 acres of riparian wetland began in October 2005. A Year One Vegetation Monitoring Report (Appendix A) was prepared by Coastal Restoration Consultants, Inc. in September 2006. This report describes restoration activities that have been completed thus far and presents results of vegetation monitoring and experimental plantings as well as plant lists and reference photographs.

Year One efforts primarily focused on weed control. Solarization using black plastic was chosen as an appropriate method given the need to minimize impact to the existing wetland. This method proved very effective at reducing non-native plant cover from ~90% to 12%. Bermuda grass persisted through solarization attempts. Consequently, herbicide will be used to control this particular invasive species.

Limited planting of native species occurred in Year One to test the feasibility of restoring the site without irrigation and to determine the most effective planting strategy for subsequent planting years. The condition of pilot plantings of small nursery stock, cuttings and direct seeding indicated a no-irrigation strategy would work effectively and helped refine the planting plan for the site overall. Cover of

native species increased minimally within Year One, from 14% to 16%, just below the first year goal. However, with successful weed control and the information provided by experimental plantings, we believe the project will meet its Year Five goals within the expected timeframe.

## MONITORING PROGRAM

The monitoring program was intended to provide information necessary for determining the success of the restoration effort. Increases in native percent cover, species richness and stature as well as significant decrease in non-native percent cover indicate efforts are on track.

Vegetation monitoring reports that document the progress of restoration efforts will be included in the Annual Report submitted to ACOE. Results to date, criteria success, and adaptive management actions will be discussed. The reports will present and analyze data collected during monitoring, summarize all methods utilized and their effectiveness.

The vegetation monitoring report for year one is included in Appendix A. It describes the results of this monitoring effort and discusses how monitoring information will be used to ensure the project achieves its Year Five goals. In summary, percent cover of non-native plants has decreased, and percent cover and mean maximum height of native plants has increased. Information from experimental plantings will be used to determine the most effective planting strategy for the project site.

## FINANCIAL REPORT

A budget for restoration efforts using in lieu mitigation fee funds was presented in the Restoration and Enhancement Plan prepared in 2005. Early in 2006 additional in lieu fees were added to the project and a revised budget was created based on restoration or enhancement of 2.588 acres of riparian wetland versus 2.18 acres discussed in the 2005 Plan. Amounts allocated for various tasks were revised to include the newly received funds and now total $201,596 (Table 1).

Presented in Table 2 are monies spent by project task for August 2005 through December 2006. As anticipated more than fifty percent of the total in lieu fee funds available were spent in this first year. Start up costs are typically high in the first two years as design consultation, weed control and plant propagation are initiated and the bulk of the equipment is purchased. Costs for project implementation will subside in subsequent years.

Table 1. Original and revised budgets for restoration efforts.

| | Original Amount | Revised Amount |
|---|---|---|
| Project management: | | |
| Plan preparation | 5,000 | 5,000 |
| Implementation | 64,000 | 84,200 |
| Administrative | 22,500 | 29,500 |
| Plant propagation | 20,000 | 26,300 |
| Monitoring and reporting | 13,000 | 17,100 |
| Bermuda grass spraying | 3,000 | 3,940 |
| General supplies | 5,000 | 6,580 |
| Plant protection supplies | 1,280 | 1,680 |
| Signage | 300 | 371 |
| Irrigation supplies | 2,500 | 3,280 |
| Indirect costs (13%) | 17,755 | 23,645 |
| **TOTAL** | 154,335 | 201,596 |

Table 2. Monies spent for in lieu fee mitigation on the Ojai Meadows Preserve 2005-06.

| | 2005 | 2006 | TOTAL | Amount Allocated | Amount Remaining |
|---|---|---|---|---|---|
| **Plan Preparation** | 4,886.76 | 1,082.98 | 5,969.74 | 5,000.00 | -969.74 |
| **Implementation** | 3,309.54 | 50,704.70 | 54,014.23 | 84,200.00 | 30,185.77 |
| **Administration** | 2,535.23 | 3,439.22 | 5,974.45 | 29,500.00 | 23,525.56 |
| **Propagation** | 8,241.76 | 12,893.37 | 21,135.13 | 26,300.00 | 5,164.87 |
| **Monitoring & Reporting** | 100.82 | 275.14 | 375.96 | 17,100.00 | 16,724.04 |
| **Bermuda Control** | 0.00 | 441.95 | 441.95 | 3,940.00 | 3,498.05 |
| **General Supplies** | 500.86 | 2,156.84 | 2,657.70 | 6,580.00 | 3,922.30 |
| **Plant Supplies** | 0.00 | 1,647.50 | 1,647.50 | 1,680.00 | 32.50 |
| **Signage** | 0.00 | 0.00 | 0.00 | 371.00 | 371.00 |
| **Irrigation Supplies** | 135.98 | 0.00 | 135.98 | 3,280.00 | 3,144.02 |
| **Administrative Overhead** | 0.00 | 9,443.42 | 9,443.42 | 23,645.00 | 14,201.58 |
| **TOTAL** | **19,710.95** | **82,085.11** | **92,352.64** | **201,596.00** | **99,799.94** |

# RECOMMENDATIONS

Restoration efforts thus far on the Ojai Meadows Preserve have initiated creation of 2.588 acres of riparian wetland. This acreage is comprised of:

0.26 acres of riparian willow woodland,
0.288 acres of freshwater marsh,
1.27 acres of riparian willow scrub and
0.77 acres of mulefat scrub.
**2.588 Total**

The focus of Year One restoration efforts was to control non-native invasive plants within the project area to allow native species a more conducive environment for establishment. Based on the decrease in non-native percent cover, our efforts have more than met the Year One goal. In Year Two, we will continue to control non-native plants within the project area using solarization, spot treatment with herbicide and hand weeding. We will continue with solarization in unplanted areas to achieve a greater level of weed control (preferably complete eradication) to decrease the amount of labor intensive hand weeding. We will spot treat with herbicide non-native species resistant to solarization.

While percent cover of native species did not meet the Year One goal, we are confident the project is on track and will meet the Year Five goal. Now that non-native species are declining, we can step up our planting efforts to increase native percent cover. Additionally, individuals planted in Year One will have had more time to establish and grow. In Year Two, we will continue to cultivate Year One plantings and increase the number of individuals planted. We will revise our planting plan to include lessons learned from experimental plantings by modifying locations for particular species.

Overall, restoration progress within the project area meets our expectations. We feel our approach of experimentation and observation has been very effective and will pay off well with the creation and enhancement of 2.588 acres of functioning riparian wetland.

# APPENDIX A – Year One Vegetation Monitoring

# APPENDIX B – Site Photographs

Figure 1. In lieu fee mitigation area on the Ojai Meadows Preserve October 2005. Much of the area has been tarped with black plastic to solarize weeds. The project area includes the emerging freshwater marsh and the tarped area behind.

Figure 2. In lieu fee mitigation area on the Ojai Meadows Preserve October 2006. Based on the success of solarization efforts, planting of native species progressed in Year One.

# Year One Vegetation Monitoring: Restoration and Enhancement of the Ojai Meadows Preserve, Savannah Wetland

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## FIGURES

# INTRODUCTION

## SITE HISTORY

The 58-acre Ojai Meadows Preserve (OMP) is a permanently protected open space managed by the Ojai Valley Land Conservancy (OVLC) in Ventura County, California. In 2004, a habitat restoration and flood control plan was prepared for the property (Condor 2004). The plan outlined a general strategy for restoring native habitats and reducing flooding in adjacent areas.

To help alleviate flooding on Highway 33, stormwater runoff from Nordhoff High School was diverted into the Savannah Wetland project area in October 2004 (Fig. 1). The re-direction of stormwater probably created more natural hydrologic functioning for the eastern half of the OMP. Older aerial photographs of the sites show a drainage network through the area (see Condor 2004). With the restoration of hydrology at the Savannah Wetland, it became possible to restore native riparian and associated wetland vegetation in a landscape dominated by non-native plants.

## PROJECT SITE DESCRIPTION

The US Army Corp of Engineers (USACE) In Lieu Fee program provided funding to the OVLC for 2.588 acres (as of 10/06) of riparian restoration at the OMP. In October 2005, USACE and OVLC staff and restoration ecologists from Coastal Restoration Consultants (CRC) decided that the restoration could best be accomplished in the Savannah Wetland site (Fig. 1). A Wetland Restoration and Enhancement Plan was prepared by CRC in December 2005 and submitted to USACE staff by the OVLC also in December 2005(CRC 2005). The plan outlined the project goals and the actions needed to accomplish those goals as well as monitoring protocols and criteria for considering the project successful at the end of five years. The restoration and enhancement plan outlined habitat restoration that is compatible with the physical and biological processes of the site.

Based on field visits by CRC ecologists it was determined that the physical processes at the site (especially hydrology and soils) were appropriate for restoration of riparian and freshwater marsh habitats. The major impediment to the natural establishment of these communities was the abundance of non-native plants and the lack of seed sources of appropriate native plants (see Appendix A for species lists).

The hydrology of the Savannah Wetland was altered considerably in October 2004 with the re-direction of storm water runoff from Nordhoff High School. During storm events, water flows from the culverts near the property line (Fig. 1) in a generally westward direction via diffuse surface flow. The runoff eventually enters the Maricopa Drain, which flows to the Happy Valley Drain (Fig. 1) and on to the Ventura River, 0.7 miles to the west. There is also considerable irrigation runoff into the Savannah Wetland in the dry season. These episodic flows are captured in the Savannah Wetland once or twice per week in the dry season.

In addition to surface flows, sub-surface movement of water through the site is an important factor that will control vegetation patterns. The upper soil layers are relatively porous sandy loams. Impermeable clay layers occur at depths from about 1 foot to 3 feet below the surface throughout the site. These clay layers support a shallow perched water table. The perched water is fed by winter rain, storm water and dry-season runoff, and will allow the site to support hydrophytic vegetation.


1986 Aerial Photo
Fig.1
Oct., 2006
Ojai Valley Land Conservancy
Ojai Meadows Preserve
Coastal Restoration Consultants, Inc.
0
275
550
1,100 Feet
N
Approximate location of vegetation monitoring transects
Savannah Wetland (6 acres)
Project area (2.48 acres)
Area for potential future In Lieu projects (3.52 acres)
Future riparian and other wetland restoration
Future oak forest, woodland, and savanna restoration
Highway 33
Storm Drain
Savannah Wetland
Malcolpe Drain
Taormina Drain
Happy Valley Drain
Cuyama Meadow Property
Nordhoff High School
St. Thomas Aquinas Church
Mariners Oaks School
Besant Meadows
Palmer Property

Before the project began, the only native plant species with significant cover on the site were cattail (*Typha sp.*) and willow herb (*Epilobium ciliatum*). These plants colonized the wettest areas on the project site soon after the drainage was re-directed in October 2004. Cattail has steadily expanded over the last year. Other native plants on the site were very sparse and included narrow-leaved milkweed (*Aesclepias fascicularis*), Mexican sprangletop (*Leptochloa uninervia*), tall sedge (*Cyperus eragrostis*), and willows (*Salix sp.*)

Non-native plants dominated the site. Many of the species were highly invasive: Bermuda grass (*Cynodon dactylon*), Italian ryegrass (*Lolium multiflorum*), vetches (*Vicia sp.*) and ripgut brome (*Bromus diandrus*). There was also a thick layer of thatch (dead annual weeds) over much of the site.

No directed animal monitoring was carried out at the site prior to the restoration project. During the first year of the restoration, numerous wildlife species have been observed using the Savannah Wetland and adjacent buffer areas. The diverse reptile and amphibian fauna includes Pacific tree frog, western toad, alligator and western fence lizards, western skink and king and gopher snakes. Mammals using the site include raccoon, mice, pocket gopher, ground squirrel and coyote. Dozens of bird species have been observed including several shorebirds (killdeer, Wilson's snipe, greater yellowlegs, least sandpiper and whimbrel), raptors (red-tailed hawk, red-shouldered hawk, sharp-shined hawk, Cooper's hawk, peregrine falcon, kestrel, northern harrier and white-tailed kite) and wetland/riparian associated passerine birds (red-winged blackbird, common yellowthroat and song sparrow). The Savannah Wetland site provided food sources for breeding birds including red-winged blackbird, Anna's hummingbird, Cassin's and western kingbirds and red-tailed hawk, and mud for nesting swallows.

## RESTORATION ACTIONS IN YEAR ONE

In consultation with the OVLC and USACE, CRC developed a strategy of weed control that protected the existing wetland resources by avoiding soil disturbance and herbicide use. CRC was hired by the OVLC to prepare a restoration and enhancement plan and to implement the plan. Project implementation started in October 2005 to take advantage of the 2005 – 2006 rain season.

The restoration plan called for restoration of native habitats without supplemental watering, a major effort to control weeds early in the project, planting in the rainy season, and introducing appropriate native plants from seed, cuttings, and nursery stock. Most of the transplanted stock was from 2-inch pots, because these small plants are more drought-tolerant than older plants from larger containers. The plan called for limited planting in the first year to test the feasibility of restoring the site without irrigation, and to determine the most appropriate plant species in different areas of the site. Weed control will continue in the second year and extensive planting would occur in years two and three.

The primary method of weed control is solarization with large sheets of black plastic. This method is very effective on all annual weeds and many perennials, does not harm wildlife and does not disturb the soil surface (limiting the possibility of erosion or sedimentation in the wetlands). Weeds were killed within weeks of sprouting through the winter, spring and early summer of 2005 – 2006, by shifting 27 sheets of plastic (each 20 x 100 feet) around the site. While half the site was covered with plastic, weed seeds in the other half were allowed to germinate. The sheets were then flipped onto these new weeds while germination occurred on the other half. Two to four rounds of these "grow-kills" were carried

out over all areas of the site not already dominated by cattail. Follow-up hand-weeding, especially around the trial plantings, allowed for almost complete control of weeds. There was very little seed production by weeds on the site.

Two species of perennial weed, Bermuda grass (*Cynodon dactylon*) and bindweed (*Convolvulus arvensis*), were not reliably controlled by solarization. Trials showed that Bermuda grass could be killed under plastic left in place for five or six months though this approach was deemed impractical considering the large areas this species is covering. Bermuda grass may be controlled using an appropriate herbicide. We are testing the effectiveness of solarization on bindweed.

Pilot plantings of a variety of species were installed in relatively small areas of the site (including wetland, riparian and buffer species) using nursery stock, cuttings, rooted cuttings and direct seeding. The plantings are being monitored for survival and growth to determine the most effective and appropriate planting strategy for planting seasons #2 and #3. The condition of plantings in September 2006 indicated that the no-irrigation strategy worked effectively on the site in a year with at least average rainfall and above-average temperatures.

## METHODS

The goal of the vegetation monitoring was to describe the cover, diversity and stature of the vegetation within the project area before the project and after one year of weed control and planting. We measured vegetation characteristics along five transects. Each transect was randomly placed in one of five 40 m wide zones which, together, spanned the entire project area. All transects were oriented approximately north to south and ran from the highest (southern) edge of the site down through the drainage to the northern boundary of the project area (50 to 70 m). We measured vegetation in one-square-meter quadrats placed every 5 m along each transect.

On 7 and 8 September 2006, we estimated the cover of each species of plant and of bare ground in a total of 63 quadrats. Total plant cover could exceed 100% where there were multiple layers of vegetation. We also measured the height of the tallest green stem of any native plant to the nearest tenth of a meter in each quadrat. We used species richness (number of plant species per square meter) as a description of plant diversity. We summarized the vegetation data to determine overall native and non-native plant cover. We also carried out photo monitoring (see Appendix B for examples), and measured survival and growth of oak trees and cuttings (see Appendix C for some results).

## RESULTS

We observed 26 species of plants in 63 one-meter square quadrats (12 native species and 14 non-native species, Appendix D). There were no plants in 28 of the 63 quadrats. Plants covered 21.5% of the area surveyed and bare ground accounted for the remaining 78.5%. The total percent cover for native (13.6%) and non-native plants (12.1%) exceeds 21.5% due to overlap of canopy layers.

The estimated cover of non-native species was 12.1% (Fig. 2) after the first year of the project. In September 2006, Bermuda grass (*Cynodon dactylon*) occurred in 6 out of 63 plots,

covered 8.6% of all sampled areas, and accounted for 71% of the non-native species cover. Bermuda grass was growing in large patches near the drainage, in and around cattail stands. Curly dock (*Rumex crispus*) was more widespread, growing in 11 plots, but accounted for only 9% of the estimated non-native species cover.

Native plant cover (estimated 13.6%, Fig. 3) was dominated by two species that recruited on the site after the drainage pattern was altered in October 2004. Cattail (*Typha* sp.) accounted for 10.3% of the cover in the sampled areas, and 66% of the sampled native plant cover. Willow herb (*Epilobium ciliatum*) had the second highest cover (2.9% of the sample area) and accounted for 18.6% of the sampled native plant cover.

Mean species richness (average number of species in one square meter) for 63 sample quadrats was 0.6 for native species, 0.8 for non-native species (Fig. 4) for a total of 1.4 plant species per square meter.

The mean stature of the tallest native plant in each sample was 0.6 m (Fig. 5), but this was an average of 30 samples that had native plants and 33 that did not. The average stature of native plants in quadrats where they occurred was 1.6 m. Cattail (*Typha* sp.) was the tallest native plant in 14 quadrats (averaging 2.1 m tall).

**Figure 2.** Mean cover of non-native plants

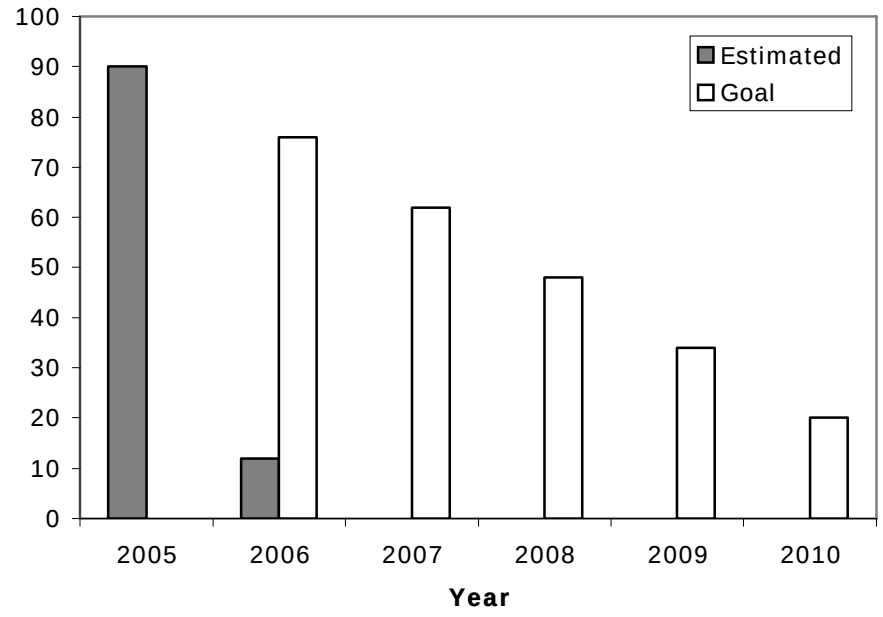


**Figure 3.** Mean cover of native plants

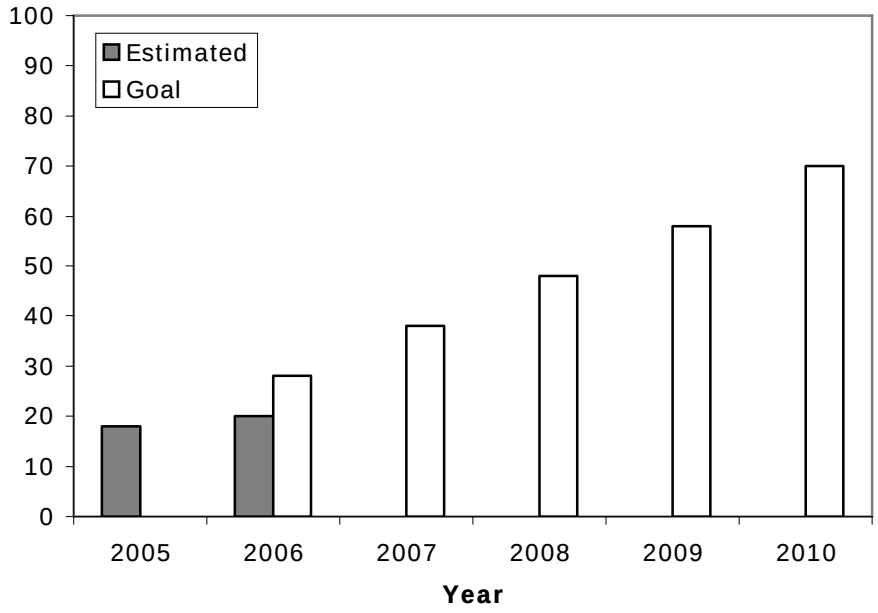



**Figure 4.** Mean number of native species

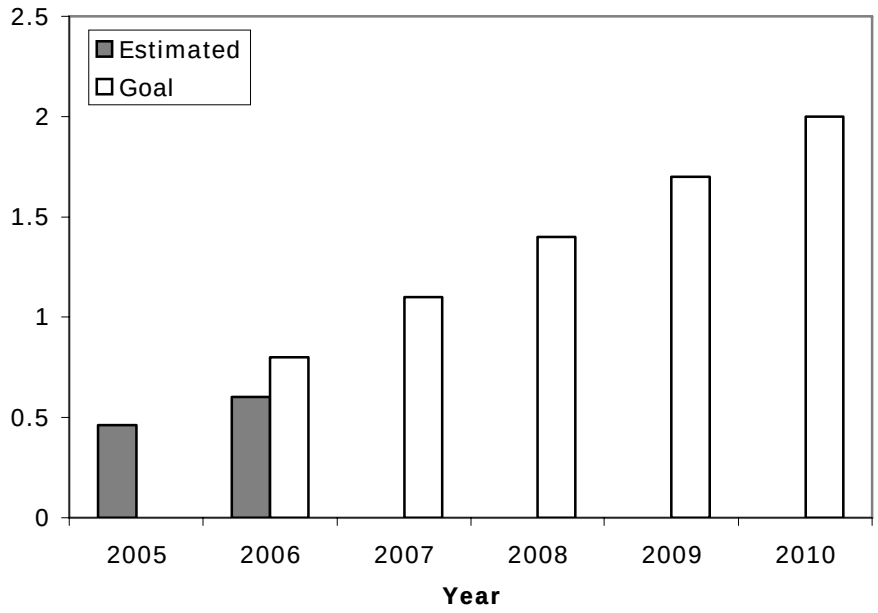
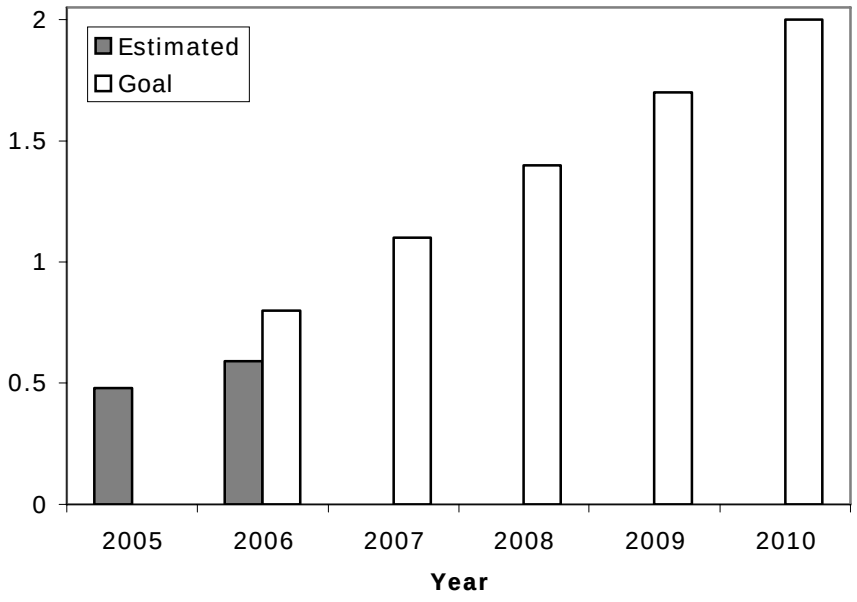


**Figure 5.** Mean of maximum native plant height per quadrat




## DISCUSSION

Quantitative vegetation monitoring was not carried out in 2005 (*i.e.*, before the project began) so there is no baseline data for the project. However, due to the simple vegetation patterns we observed at the site in 2005, we are able to make what we believe are reasonably accurate estimates of the plant cover before weed control and planting began. Only the wettest areas of the project, where cattail and willow herb were colonizing, had significant cover of natives. We estimate the cover of these species was slightly lower than what we measured in 2006. The rest of the project area was characterized by virtually 100% cover of non-native annuals. Bermuda grass occurred in large patches in and around the cattails. There was essentially no bare ground on the site in 2005.

The vegetation of the project site changed dramatically between 2005 and 2006 due to the substantial control of non-native plants. Multiple rounds of solarization through the rainy season and into the summer of 2006, along with raking and removal of thatch, converted much of the site to bare ground (~ 0% in 2005 vs. 78.5% in 2006).

In 2005, the project site had more than 90% cover of non-native plant species (Fig. 2). In 2006, non-native plant cover had been reduced to12% (Fig. 2) with Bermuda grass accounting for 8.6% of the total. Bermuda grass accounted for 71% of the total non-native cover in 2006 vs. approximately 10% in 2005. Though there was some expansion in area of Bermuda grass, this proportional change mostly represents the limited success we had in killing this perennial species and the great success we had in killing annual plants.

The cover of native plants increased slightly between 2005 and 2006, from an estimated 14% to 16% (Fig. 3). This increase is due to the trial plantings that were installed

and the fact that almost no native plants were killed during weed control. Native stature probably changed little between 2005 and 2006.

In addition to the multiple grow-kills and hand removal of non-native plants, there was virtually no seed production by non-natives on the site this year. We expect that the seed bank of non-natives on the site was greatly diminished by our actions this year. We will have a better understanding of the remaining seed bank after multiple rainfall events in the winter of 2006-07.

As expected, most of our measures of vegetation on the site in 2006 are well below the Year 5 goals that were set for the project (Figs. 2 – 5). We believe, however, that given our success with weed control and the results of the trial plantings, that the project will meet its Year 5 goals. The goal of less than 20% non-native cover was attained this year (12%, Fig. 2). Continued control efforts will be necessary to keep non-native plant cover at low levels.

The biggest challenges in the upcoming year will center on eradication of non-natives resistant to solarization. We are currently working on an herbicide-based program to kill Bermuda grass. Bindweed, though not extensive in coverage on the site in 2006 (it was not recorded in the vegetation sampling), may be expanding. Given its relatively low cover, we feel it is still practical to control this species by long-term solarization.

Based on our trial plantings and observations of hydrology and soils, we expect the project will support self-sustaining riparian and wetland communities within the 5-year scope of the project. We are encouraged by wildlife use of the site and the rapid growth and expansion of existing native vegetation.

## REFERENCES

Coastal Restoration Consultants, Inc. 2005. Wetland Restoration and Enhancement Plan for the Ojai Meadows Preserve, Savannah Wetland.

Condor Environmental Planning Services. 2004. Habitat Restoration and Flood Control Plan: Ojai Meadows Preserve.

**Appendix A. Plants of the Ojai Meadows Preserve** (Condor 2004) with additions by CRC.

# NATIVE PLANTS (57 species)

| SPECIES | COMMON NAME | PLANTED AS PART OF RESTORATION? |
|---|---|---|
| *Alisma plantago-aquatica* | Water plantain | |
| *Asclepias fascicularis* | Narrow-leaved Milkweed | |
| *Baccharis pilularis* | Coyote Bush | Planted |
| *Baccharis salicifolia* | Mule Fat | Planted |
| *Calandrinia ciliata* | Red Maids | |
| *Castilleja densiflora* | Owl's Clover | |
| *Ceanothus sp.* | California Lilac | Planted |
| *Centaurium venustum* | Canchalagua | |
| *Cyperus eragrostis* | Yellow Nutsedge | Planted |
| *Eleocharis macrostachya* | Common Spikerush | Planted |
| *Epilobium ciliatum* | Willow Herb | |
| *Eremocarpus setigerus* | Doveweed | |
| *Eschscholzia californica* | California Poppy | Seed |
| *Euthamia occidentalis* | Western Goldenrod | Planted |
| *Gnaphalium calitornicum* | Green Everlasting | |
| *Heteromeles arbutifolia* | Toyon | |
| *Heterotheca grandiflora* | Telegraph Weed | |
| *Holocarpha heermannii* | Heermann's Tarweed | |
| *Hordeum brachyantherum* | Meadow Barley | |
| *Juglans californica* | California Walnut | Planted |
| *Juncus bufonius* | Toad Rush | |
| *Juncus mexicanus* | Mexican Rush | |
| *Juncus phaeocephalus* | Brown-headed Rush | |
| *Keckiella cordifolia* | Heart-leaved Penstemon | Planted |
| *Leptochloa uninervia* | Mexican Sprangletop | |
| *Leymus triticoides* | Alkali Ryegrass | Planted |
| *Lupinus bicolor* | Bicolored Lupine | |
| *Lupinus succulentus* | Succulent Lupine | Seed |
| *Malvella leprosa* | Alkali Mallow | |
| *Mimulus longiflorus* | Monkeyflower | Planted |
| *Plantanus racemosa* | Western Sycamore | Planted |
| *Populus balsamifera* | Black Cottonwood | Cuttings |
| *Prunus ilicifolia* | Holly-leaf Cherry | |
| *Quercus agrifolia* | Coast Live Oak | Acorns |
| *Quercus lobata* | Valley Oak | Acorns |
| *Rhamnus ilicifolia* | Holly-leaf Coffeeberry | |

| SPECIES | COMMON NAME | PLANTED AS PART OF RESTORATION? |
|---|---|---|
| *Ribes aureum* | Golden currant | Planted |
| *Rorippa nasturtium-aquatica* | Water-cress | |
| *Rubus ursinus* | California Blackberry | |
| *Rumex salicifolius* | Green Dock | |
| *Salix exigua* | Sandbar Willow | Planted |
| *Salix laevigata* | Red Willow | |
| *Salix lasiolepis* | Arroyo Willow | Cuttings |
| *Salix lucida* ssp. *lasiandra* | Yellow Willow | Cuttings |
| *Salvia apiana* | White sage | Planted |
| *Salvia mellifera* | Black sage | Planted |
| *Salvia leucophylla* | Purple sage | Planted |
| *Sambucus mexicana* | Mexican Elderberry | |
| *Scirpus californicus* | California Bulrush | |
| *Sidalcea malvaeflora* | Checker-bloom | |
| *Toxicodendron diversilobum* | Poison oak | |
| *Trichostema lanceolatum* | Turpentine Weed | |
| *Typha domingensis* | Southern Cat-tail | |
| *Veronica anagallis-aquatica* | Water Speedwell | |
| *Vulpia octoflora* | Six-weeks Fescue | |
| *Xanthium strumarium* | Cocklebur | |
| Unidentified rush | | |

## NON-NATIVE PLANTS (103 species)

| SPECIES | COMMON NAME | WEED STATUS |
|---|---|---|
| *Acacia baileyana* | Bailey's Acacia | |
| *Acroptilon repens* | Russian Knapweed | Noxious weed |
| *Agave americana* | Century Plant | |
| Amaranthus albus | Pigweed Amaranth | |
| Anagallis arvensis | Scarlet Pimpernel | |
| *Arundo donax* | Giant Reed | Noxious weed, CALIPC High |
| *Avena barbata* | Slender Wild Oats | CALIPC Moderate |
| *Avena fatua* | Wild Oats | CALIPC Moderate |
| *Brassica nigra* | Black Mustard | Noxious weed, CALIPC Moderate |
| *Brassica rapa* | Field Mustard | Noxious weed, CALIPC Limited |
| *Bromus diandrus* | Ripgut Brome | CALIPC Moderate |
| *Bromus hordeaceus* | Soft Chess | |
| *Bromus madritensis* | Red Brome | CALIPC High |

| SPECIES | COMMON NAME | WEED STATUS |
|---|---|---|
| *Capsella bursa-pastoris* | Shepherd's Purse | |
| *Carduus pynocephalus* | Italian Thistle | Noxious weed, CALIPC Moderate |
| *Centaurea solstitialis* | Yellow Star-thistle | CALIPC High |
| *Cerastium glomeratum* | Mouse-eared Chickweed | |
| *Chamaesyce serpylifolia* | Thyme-Ieaved Spurge | Noxious weed |
| *Cichorium intybus* | Chickory | |
| *Cirsium vulgare* | Bull Thistle | Noxious weed |
| *Conium maculatum* | Poison-hemlock | CALIPC Moderate |
| *Convolvulus arvensis* | Bindweed | |
| *Conyza canadensis* | Horseweed | |
| *Conyza bonariensis* | Flax-1eaved Fleabane | |
| *Cupressus sempervirens* | Italian Cypress | |
| *Cynodon dactylon* | Bermuda Grass | Noxious weed, CALIPC Moderate |
| *Daucus pusillus* | Rattlesnake Weed | |
| *Echinochloa crusgalli* | Barnyard Millet | |
| *Eichhornia crassipes* | Water Hyacinth | Noxious weed |
| *Erodium botrys* | Broad-leaved Filaree | |
| *Erodium cicutarium* | Redstem Filaree | |
| *Erodium moschatum* | Whitestem Filaree | |
| *Eucalyptus camaldulensis* | Red Gum Eucalyptus | |
| *Eucalyptus polyanthemos* | Silver Dollar Gum | |
| *Eucalyptus globulus* | Blue Gum Eucalyptus | Noxious weed, CALIPC Moderate |
| *Eucalyptus sideroxylon* | Red Ironbark | |
| *Euphorbia peplus* | Petty Spurge | |
| *Foeniculum vulgare* | Fennel | Noxious weed, CALIPC High |
| *Gaura drummondii* | Drummond's Gaura | Noxious weed |
| *Geranium dissectum* | Cut-leaf Geranium | CALIPC Moderate |
| *Hirshfeldia incana* | Summer Mustard | CALIPC Moderate |
| *Hordeum marinum* | Mediterranean Barley | |
| *Hordeum murinum* | Foxtail | CALIPC Moderate |
| *Hypochaeris glabra* | Smooth Cat's Ears | |
| *Juglans regia* | English Walnut | |
| *Kickxia elatine* | Kickxia | |
| *Lactuca serriola* | Prickly Lettuce | |
| *Lavatera cretica* | Cornish Mallow | |
| *Lobularia maritima* | Sweet Alyssum | |
| *Lolium multiflorum* | Italian Rye | CALIPC Moderate |
| *Lonicera japonica* | Japanese Honeysuckle | |
| *Lotus purshianus* | Spanish Clover | |
| *Lythrum hyssopifolium* | Hyssop Loosestrife | |
| *Malva parviflora* | Cheeseweed | |

| SPECIES | COMMON NAME | WEED STATUS |
|---|---|---|
| *Marrubium vulgare* | Horehound | CALIPC Limited |
| *Medicago polymorpha* | Bur-clover | CALIPC Limited |
| *Medicago sativa* | Alfalfa | |
| *Melaleuca armillaris* | Bracelet Honey Myrtle | |
| *Melilotus indica* | Yellow sweet-clover | |
| *Mentha spicata* | Spearmint | |
| *Nerium oleander* | Oleander | |
| *Oxalis corniculatus* | Creeping Wood-sorrel | |
| *Oxalis pes-caprae* | Bermuda-Buttercup | |
| *Paspalum dilitatum* | Dallis Grass | |
| *Pennisetum clandestinum* | Kikuyu Grass | Noxious weed |
| *Phalaris aquatica* | Harding grass | CALIPC Moderate |
| *Phalaris minor* | Littleseed Canary grass | |
| *Phalaris paradoxa* | Hooded Canary-crass | |
| *Picris echioides* | Bristly Ox-tongue | Noxious weed |
| *Pinus halapensis* | Aleppo Pine | |
| *Piptatherum miliaceum* | Smilo grass | CALIPC Limited |
| *Plantago lanceolata* | English Plantain | |
| *Poiygonum arenastrum* | Knotweed | |
| *Polypogon interruptus* | Ditch Beardgrass | |
| *Polypogon monspeliensis* | Rabbit's foot grass | |
| *Populus nigra* | Lombardy Poplar | |
| *Portulaca olearacea* | Common Purslane | |
| *Punica granatum* | Pomegranate | |
| *Pyracantha angustitolia* | Firethorn | |
| *Raphanus sativus* | Wild Radish | CALIPC Limited |
| *Ricinus communis* | Castor-bean | CALIPC Limited |
| *Rosa* cultivar | Rose | |
| *Rumex crispus* | Curly Dock | Noxious weed, CALIPC Limited |
| *Schinus molle* | Peruvian Pepper Tree | CALIPC Limited |
| *Schinus terebinthifolius* | Brazilian Pepper Tree | |
| *Spergula arvensis* | Starwort | |
| *Silene gallica* | Windmill Pink | |
| *Silybum marianum* | Milk Thistle | Noxious weed |
| *Solanum nigrum* | Black Nightshade | |
| *Sonchus asper* | Prickly Sow-thistle | |
| *Sonchus oleraceus* | Common Sow-thistle | |
| *Sorghum halapense* | Johnson Grass | |
| *Tamarix* sp. | Tamarisk | CALIPC High |
| *Torilis nodosa* | Knotted Hedge Parsley | |
| *Tribulus terrestris* | Puncture Vine | |
| *Triticum aestivum* | Cultivated Wheat | |
| *Ulmus parvifolia* | Chinese Elm | |

| SPECIES | COMMON NAME | WEED STATUS |
|---|---|---|
| *Ulmus pumila*? | Elm | |
| *Vicia sativa* | Common Vetch | |
| *Vicia villosa* | Winter Vetch | |
| *Vulpia myuros* | Rattail Fescue | CALIPC Moderate |
| *Washingtonia robusta* | Fan Palm | CALIPC Moderate |
| Unidentified annual grass | | |

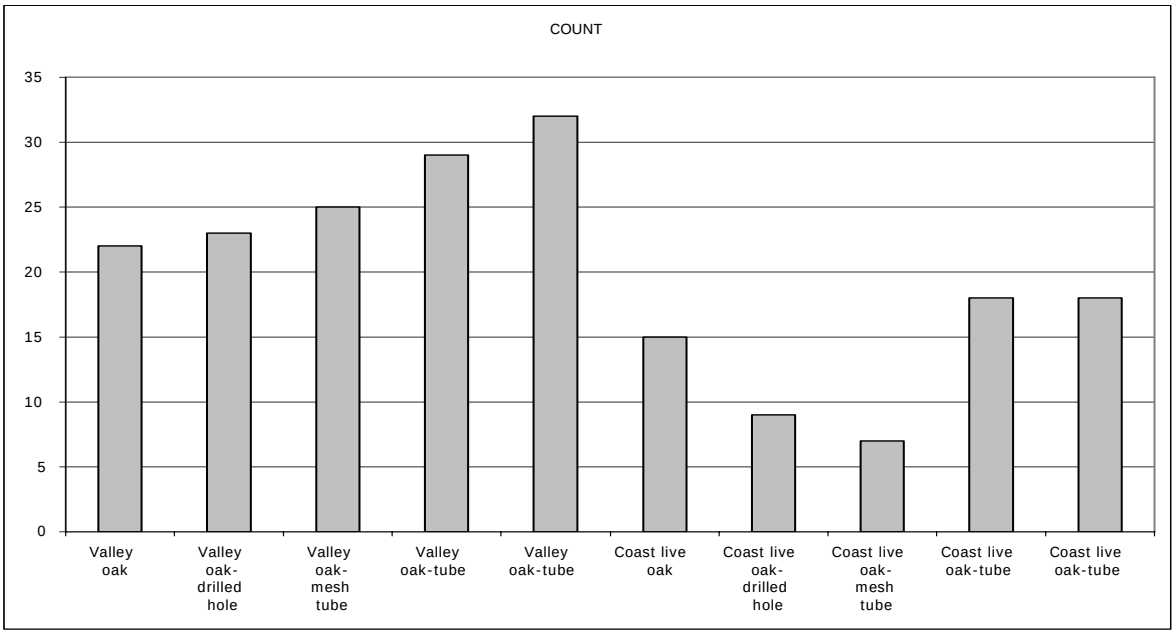
## Appendix B. Year One planting reference photographs

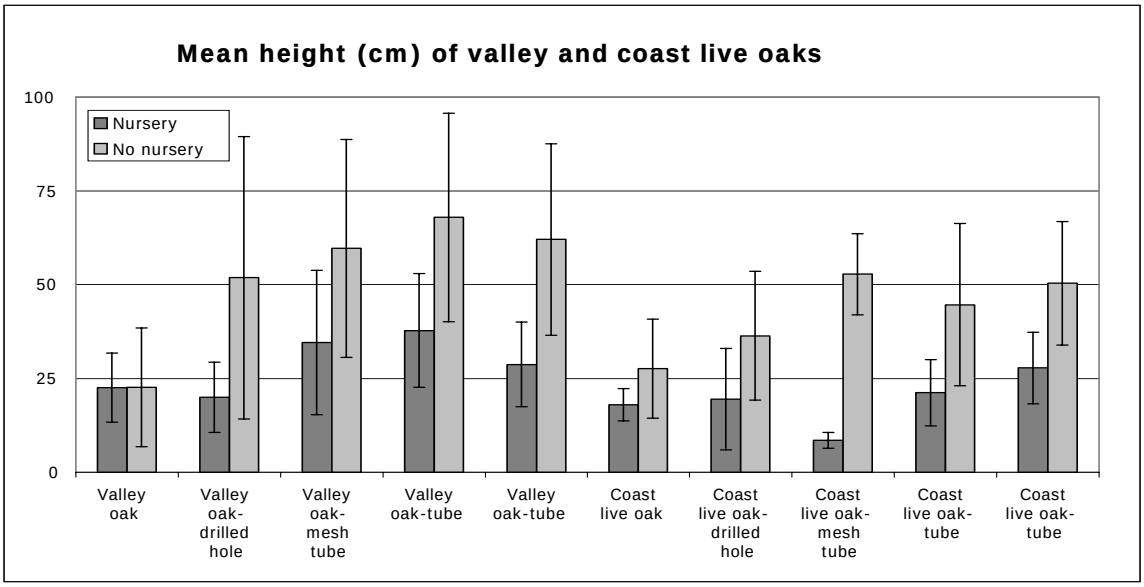
Western goldenrod and creeping wild rye planted in Feb (above) and in Jul 2006 (below)

Experimental oak planting grid with anti-herbivory tubes and coyote brush nursery shrubs in February 2006 (above) and September 2006 (below).

## Appendix C. Selected results of other monitoring

**OAKS**. Two species of oaks were planted as acorns into an experimental grid on 26 Feb 2006 to test the effects of herbivore protection tubes and nursery plants on survival and growth. The area was not irrigated. Valley oaks were more numerous and generally taller than coast live oaks by 22 Sep 2006. Few herbivores (gophers and ground squirrels) were present. Tree protection tubes may have increased survival and height of both species. Heights of both species were lower in the presence of nursery plants



**CUTTINGS**. Four species of un-rooted cuttings were planted in different areas of the project site. Our goal was to find out which elevations (lower = wetter) would support which species best so as to guide planting in years two and three. The cuttings were approximately 1.5 m long and stripped of almost all leaves and side branches. They were planted in March 2006 and never irrigated.

Arroyo willow prefers the wettest areas. Sandbar willow prefers wet areas too but will tolerate the middle elevations of the site. Mulefat will grow well in the middle area but tolerate the driest areas as well. Cottonwood tolerates the middle areas but will likely do better in the lower areas (where it wasn't planted this year).

We also found that larger diameter cuttings survived better where conditions were stressful and tended to grow more on average wherever they were planted.

**CUTTING SURVIVAL IN DIFFERENT ZONES**

| **ARROYO WILLOW** | | <--- Wetter Drier ---> | | |
|---|---|---|---|---|
| | **TOTAL** | LOW | MID | HIGH |
| COUNT | **72** | 26 | 46 | N/A |
| DEAD | **40** | 0 | 40 | N/A |
| ALIVE | **32** | 26 | 6 | N/A |
| **% Alive ==>** | **44%** | 100% | 13% | N/A |

| **SANDBAR WILLOW** | | <--- Wetter Drier ---> | | |
|---|---|---|---|---|
| | **TOTAL** | LOW | MID | HIGH |
| COUNT | **74** | 27 | 47 | N/A |
| DEAD | **20** | 0 | 20 | N/A |
| ALIVE | **54** | 27 | 27 | N/A |
| **% Alive ==>** | **73%** | 100% | 57% | N/A |

| **COTTONWOOD** | | <--- Wetter Drier ---> | | |
|---|---|---|---|---|
| | **TOTAL** | LOW | MID | HIGH |
| COUNT | **64** | N/A | 64 | N/A |
| DEAD | **34** | N/A | 34 | N/A |
| ALIVE | **30** | N/A | 30 | N/A |
| **% Alive ==>** | **47%** | N/A | 47% | N/A |

| **MULEFAT** | | <--- Wetter Drier ---> | | |
|---|---|---|---|---|
| | **TOTAL** | LOW | MID | HIGH |
| COUNT | **94** | N/A | 64 | 30 |
| DEAD | **8** | N/A | 0 | 8 |
| ALIVE | **86** | N/A | 64 | 22 |
| **% Alive ==>** | **91%** | N/A | 100% | 73% |

PERCENT SURVIVAL OF CUTTINGS WITH ABOVE AND BELOW AVERAGE DIAMETER AND PLANTING DEPTH

| | Arroyo Willow | Sandbar Willow | Cottonwood | Mulefat |
|---|---|---|---|---|
| < Mean Diam | 44.7% | 54.8% | 36.8% | 84.4% |
| > Mean Diam | 44.1% | 96.9% | 61.5% | 98.0% |
| < Mean Depth | 36.7% | 71.4% | 53.6% | 92.0% |
| > Mean Depth | 50.0% | 74.4% | 41.7% | 90.9% |

**Appendix D. Estimated percent cover and sample frequency of all plants**

| Native Species | Percent Cover | % of Native | Count (63 quadrats) |
|---|---|---|---|
| *Typha* sp. | 10.254 | 65.8% | 14 |
| *Epilobium ciliatum* | 3.651 | 23.4% | 4 |
| *Bacharis pilularis* | 1.048 | 6.7% | 3 |
| *Cyperus eragrostis* | 0.256 | 1.6% | 6 |
| *Baccharis salicifolia* | 0.095 | 0.6% | 2 |
| *Leymus triticoides* | 0.095 | 0.6% | 2 |
| *Salix exigua* | 0.063 | 0.4% | 1 |
| *Asclepias fascicularis* | 0.048 | 0.3% | 2 |
| *Euthamia occidentalis* | 0.048 | 0.3% | 1 |
| *Holocarpha heermanii* | 0.016 | 0.10% | 1 |
| *Quercus lobata* | 0.016 | 0.10% | 1 |
| *Trichostema lanceolatum* | 0.003 | 0.02% | 2 |
| **TOTAL NATIVE** | **15.6** | | |

| Non-Native Species | Percent Cover | % of Non-Native | Count (63 quadrats) |
|---|---|---|---|
| *Cynodon dactylon* | 8.6 | 70.6% | 6 |
| *Rumex crispus* | 1.1 | 9.3% | 11 |
| *Lolium multiflorum* | 1.0 | 8.0% | 2 |
| *Vulpia sp.* | 0.9 | 7.2% | 2 |
| *Plantago lanceolata* | 0.3 | 2.1% | 8 |
| *Lythrum hyssopifolium* | 0.1 | 0.7% | 4 |
| *Raphanus sativus* | 0.1 | 0.6% | 5 |
| *Convolvulus arvensis* | 0.1 | 0.5% | 2 |
| *Erodium sp.* | 0.0 | 0.15% | 3 |
| *Sonchus asper* | 0.0 | 0.14% | 2 |
| *Medicago polymorpha* | 0.0 | 0.13% | 2 |
| *Picris echioides* | 0.0 | 0.13% | 1 |
| *Silene gallica* | 0.0 | 0.13% | 1 |
| Weed A | 0.0 | 0.03% | 2 |
| *Vicia sp.* | 0.0 | 0.001% | 1 |
| **TOTAL NON-NATIVE** | **12.1** | | |