Baseline Conditions Report
for
Ramona Grasslands Open Space Preserve
San Diego County
Volume 2—Technical Appendices

February 2007

"Funding for this project has been provided in full or in part through an Agreement with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Non-point Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use."

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San Diego County

Volume 2—Technical Appendices

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TABLE OF CONTENTS

APPENDIX A

Biological Survey Report for the Santa Maria Creek Restoration Project: Stephens' kangaroo rat (Spencer and Montgomery 2007)

Biological Survey Report for the Santa Maria Creek Restoration Project:

Stephens' Kangaroo Rat

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January 2007

Table of Contents

Contents **Page**

List of Figures

Figure **Page**

List of Tables

Table **Page**

Introduction

The presence of the federally endangered and state threatened Stephens' kangaroo rat (SKR; *Dipodomys stephensi*) within the Ramona Grasslands was documented in October 1997 with initial verification of the species on the Ramona Airport and adjacent lands within the airport planning area (Ogden 1998). Since then, a variety of surveys and observations have confirmed that SKR occupy well-drained loamy soils scattered throughout the grasslands north and east of Santa Maria Creek, which traverses the RGP in an east to west direction for approximately 4.5 miles (7.25 km).

Directed sign surveys were conducted in 2005 and 2006 to map the distribution and relative abundance of SKR in the grasslands and to identify those habitat areas of greatest importance to sustaining the population, as well as those areas most in need of active or passive management for the species. Limited trapping surveys were also conducted in select areas to confirm presence of SKR, as opposed to another, unlisted species of kangaroo rat – the Dulzura kangaroo rat (DKR; *Dipodomys simulans*).

Project Location

Surveys were conducted within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California. The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Hobbs, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities, although absence of SKR was confirmed for some of these properties based on existing information or reconnaissance from property boundaries.

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

Project Description

The County of San Diego Department of Parks and Recreation was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project. The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area, (hereinafter referred to as "Ramona Grasslands"),

to improve water quality and habitat conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition, increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters. The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system.

A second component of the project consists of collecting baseline biological data, which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek, ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas) and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the "typical" and historic conditions of the Grasslands are unknown.

The target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were surveyed for fairy shrimp, amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed. The following sections describe the methods and results of the SKR surveys in 2005-2006 as well as recommendations for future monitoring and management.

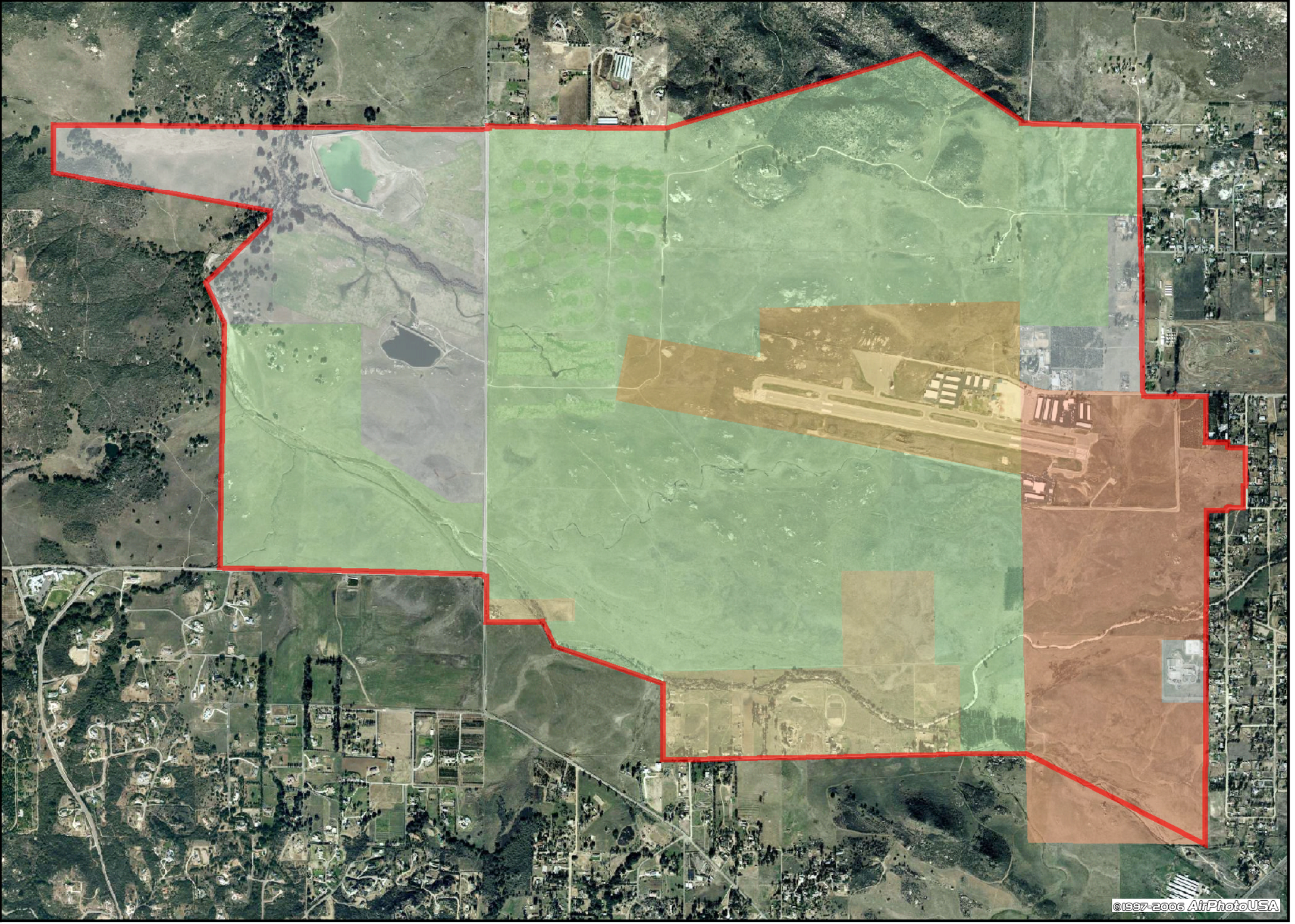
Methods

SKR Distribution

A primary aim of this study was to create a comprehensive SKR distribution map for the RGP to inform future management and monitoring actions. This was accomplished by surveying all properties we had access to for signs of kangaroo rat occupancy, supplemented by existing information from adjacent properties, most notably the Ramona Airport. Some adjacent properties are also known from previous surveys not to support SKR or suitable habitat (e.g., Cumming Ranch; O'Farrell 2000a, 2004). SKR absence was likewise inferred for some properties on which we were not granted access (e.g., Hobbs and the "Voorhes Lane properties") based on lack of suitable habitat, as indicated by inspection of aerial photographs and ground-truthing from property boundaries. However, we did not attempt to map SKR distribution on some properties that are known to support SKR based on previous trapping surveys (P. Vergne, unpublished data), but that we could not confidently map without access (e.g., Martz and Ramona Water District ownerships). Figure 1 summarizes these different forms of SKR assessment, including those areas surveyed in the field for this effort, those previously surveyed by others, and those areas on which SKR distribution was not mapped.

On RGP properties with access, distribution and relative abundance of SKR were mapped in the field by Wayne Spencer and Stephen Montgomery, with assistance from Esther Rubin and Scott Tremor (Table 1). During 2005, surveys covered properties included in the RGP at that time (Cagney, Hardy, and Oak Country Estates). Eagle Ranch was added to the reserve area in December 2005 and therefore surveyed for SKR during 2006. During 2006 we also spot-checked a number of areas previously surveyed during 2005 to confirm that SKR distribution had not changed notably from one year to the next, so that we could treat the composite 2005-6 map as one consistent baseline data source.

The mapping method involved walking meandering transects over the entire area (at no greater than 50-m spacing) searching for signs of SKR occupancy (burrows, scats, tracks, dust baths). Once signs of occupancy were found in a particular location, the biologists searched for the outer perimeter of the occupied area (where no further sign could be found, or where habitat clearly became unsuitable), enclosed it with a polygon, and classified the relative density of SKR burrows within the polygon using density classes originally developed by M. O'Farrell (1992) and modified by S. Montgomery for ease in mapping at finer resolution (Table 2). Results were marked onto 1:3200-scale, true-color aerial photographs. Mapping was aided by having the aerials divided into grids with 50 x 50-m cells and by use of GPS.



Legend

- Proposition 13 Project Area
- Ground Assessment
- Ground Edge Assessment
- Ground Edge Assessment and Previous Assessment
- Previous Assessment
- Not Assessed

N

0 750 1,500 Feet

0 250 500 Meters

Technology Associates
INTERNATIONAL CORPORATION

Document: SKRAssessment.mxd
Date: Jan 19, 2007

Figure 1 - Stephens' Kangaroo Rat Survey Areas

Table 1. SKR distribution survey dates and areas surveyed.

Date	Observers	Area Surveyed
2005		
23-Sep	WS, SJM	North and west Oak Country Estates
12-Nov	WS, SJM	East end Cagney, Hardy
19-Nov	WS SJM	Central Cagney
17-Dec	WS, ST	South Cagney, south and central Oak Country Estates
2006		
25-Aug	WS	Southwest Eagle Ranch and spot checks on Cagney
5-Sep	WS, SJM, ER	Central and north Eagle Ranch and spot checks on Oak Country Estates
6-Sep	WS, SJM, ER	North and northeast Eagle Ranch
8-Sep	WS, SJM, ER	South and central Eagle Ranch and spot checks
26-Oct	WS	West-central Eagle Ranch and spot checks on airport, Cagney
26-Oct	WS	Northwest Eagle Ranch and spot checks on Cagney

Table 2 SKR burrow density classes as originally defined by O'Farrell (1992) and as scaled down for finer-resolution mapping in the field by S. Montgomery.

Density Class	Burrows/ha (O'Farrell)	Burrows/200 m^2 (Montgomery)
Trace	<50	<1
Low	50-200	1-4
Moderate	200-700	4-14
High	>700	>14

Note that these density classes are often combined by field biologists into two broader classes (Trace/Low and Medium/High) to increase survey efficiency and repeatability (i.e., it is easier to confidently assign density estimates using broader classes). However, for this survey, we retained the finer-resolution categories, in part to better discriminate the baseline information for statistical comparisons, and in part because SKR densities were so low during the survey years that the difference between trace and low density seemed biologically significant. Most occupied habitat supported only trace SKR densities; moderate-density areas were very rare, and there were no high density areas to map.

We also mapped SKR density at the edges of the Ramona Airport, and incorporated and edge-matched distribution and density mapping performed on the Airport property in 2005 by Haas and O'Farrell (2005). In incorporating the airport data, we converted Haas and O'Farrell's polygons to a similar mapping resolution and applied the same density classes as done on RGP, calibrating and adjusting polygons near the Airport boundary as necessary based on our own observations.

In addition to survey dates listed in Table 1, which all reflect ideal sign-survey conditions during late summer-fall, W. Spencer also spot-checked portions of the study area during winter-spring conditions on 26 January and 28 April 2006. Considered together, all these observations indicated that SKR populations were very low but relatively stable over the study period, with little evidence of population expansion or contraction during 2005-6 (but following a dramatic contraction from 2004 to 2005; Haas and O'Farrell 2005). Note that the winter of 2004-5 was the wettest on record at the Ramona Airport (29.03 inches of rain), which led to extraordinary growth of grasses during 2005. As discussed in more detail below, the SKR population contracted in response to this change in vegetation, with SKR persisting only in the most well-drained and highly suitable soils. The population did not appear to expand significantly in the drier conditions of 2006. Consequently, although gathered over two consecutive years, the survey results can reasonably be treated as one uniform coverage that can serve as a baseline for future monitoring and management.

Trapping

Limited trapping surveys were performed in portions of the RPG to confirm which species of kangaroo rat was present, the endangered SKR or the non-listed Dulzura kangaroo rat (*Dipodomys simulans;* DKR; formerly *D. agilis*). Although these two species sometimes co-occur at a local scale, SKR are competitively dominant and almost always occupy the most open grassland habitats, whereas DKR are generally restricted to those areas with some scrub cover (Price et al. 1991). Previous intensive trapping surveys in the Ramona Grasslands (e.g., Ogden 1998, Spencer 2002, P. Vergne unpublished data) have repeatedly reinforced these observations, with only SKR found in the open grasslands but either species occupying grass/scrub interface areas, and predominantly DKR in open scrub habitats or oak savannahs.. Consequently, we sample-trapped to identify which of the two species was present in scrub interface areas and to refine our mapping of SKR-occupied habitat areas. These were not USFWS "protocol" surveys intended to verify absence of SKR, but rather spot-sampling efforts to refine our understanding of SKR distribution in areas of uncertainty. We did not attempt to use trapping surveys to quantify SKR density, because SKR are too highly variable in trap response to make this method reliable (Diffendorfer and Deutschman 2002, O'Farrell 1992), and such surveys are very expensive for the quantity and quality of data returns.

Trapping was performed under S. Montgomery's state and federal permits for SKR. Sherman live traps were baited with mixed bird seed and set at dusk in meandering transects where either or both species could be present. Trapping was done on the nights of September 6 and October 25-27, with traps checked both around midnight and again at dawn. Captured animals were sexed, aged, and measured with standard techniques, and released on site.

Delineation of Core SKR Management Areas

Once SKR distribution and relative density were mapped, W. Spencer delineated Core SKR Management Areas based on observed SKR occupancy patterns, habitat conditions,

and spatial context. The core areas enclose relatively large mosaics of mostly suitable habitat that are likely to continue supporting SKR in all years and which may be sources of dispersing SKR during years of population expansion. Vegetation management (e.g., prescribed burns) is therefore most likely to benefit the population if applied strategically within or between these core management areas, rather than in outlying areas where conditions may remain unsuitable even with management.

Habitat Analyses

Previous studies (e.g., Spencer 2003, O'Farrell and Uptain 1987) have established relationships between certain characteristics of grassland vegetation, measured during late summer-fall, and SKR habitat quality--at least during dry years. For this study, we attempted to further verify and expand on these previously established patterns (specifically, positive associations of SKR density with proportion of bare ground and forb:grass ratio, and negative associations with vegetation density and abundance of annual grasses). We also tried to derive an earlier spring measure of vegetation condition to inform management decisions. Early season indicators (or triggers) for management would be useful, so that management intervention to counter over-dense annual grass growth could be implemented before it is too late.

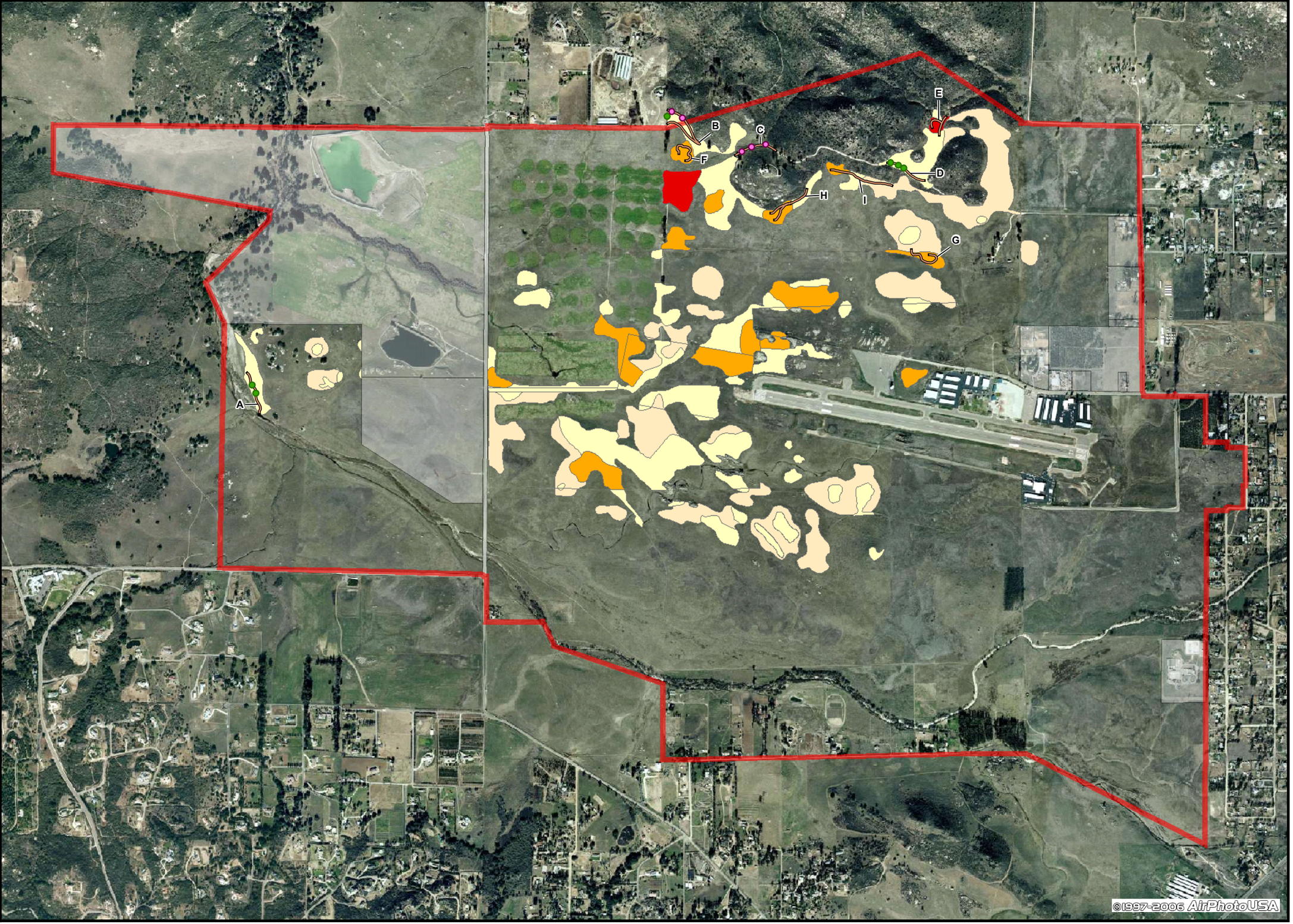
We first looked for statistical differences between observed SKR density classes (zero, trace, low, moderate) and between subjectively assigned habitat quality classes (no, low, high) using a variety of vegetation variables derived from the vegetation plot sampling data from 2005 and 2006 (CBI 2007). In addition to investigating the vegetation variables mentioned above, we also tested for differences among habitat classes using percent grass, percent forb, percent Erodium, percent thatch, and vegetation height. The vegetation plots were grouped by which SKR density class or habitat quality class they fell within, and statistical comparisons were made between classes for each independent variable using Kruskal-Wallis one-way analysis of variance.

Finally, in hopes that early season standing biomass might be a meaningful habitat measure, we also looked for correlations between SKR density (and habitat quality) classes and standing biomass measures made by Zach Principe (TNC vegetation management expert) during winter-spring conditions.

Results

SKR Distribution

Figure 2 shows the composite SKR distribution map for 2005-06, including SKR density classes for occupied areas, as well as potentially occupiable habitat areas within which we did not observe kangaroo rat sign. In total, 165.9 acres of occupied SKR habitat were mapped over the RPG, including the Airport property but excluding the Martz and Ramona Water District properties. Of this total occupied area, 115.3 acres were mapped as supporting trace densities, 43.7 acres as low, 7.0 as moderate, and zero as high.



Legend

- Proposition 13 Project Area
- Dulzura Kangaroo Rat
- Stephens' Kangaroo Rat
- Traplines

SKR Density Classes 2005-2006

- Moderate
- Low
- Trace
- Unoccupied (Potential)
- Not Assessed

N

0 750 1,500 Feet

0 250 500 Meters

Technology Associates
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Document: SKR_DensityClasses.mxd
Date: Jan 19, 2007

Figure 2 - Stephens' Kangaroo Rat Distribution and Capture Locations

An additional 112.7 acres were mapped as potential habitat that was not occupied during the surveys, or was occupied at such low levels that we did not detect kangaroo rat sign there.

The majority of suitable and occupied SKR habitat is distributed in a broad, arcing mosaic of mostly well-drained, hilly topography near the center of the grasslands, with smaller mosaics or isolated pockets of suitable habitat scattered in other areas. The largest, most contiguous concentration curves around the west end of the airport (which would have been SKR habitat prior to airport development and runway expansion) and extends west to Rangeland Road in those areas not used as effluent spray fields.

A second concentration of SKR habitat occurs in association with the northern fringe of the grasslands, where hills supporting coastal sage scrub rise up from the grasslands on the northern portion of Eagle Ranch. It appears that at least some of this "northern fringe" habitat was created or improved by previous disking or clearing of coastal sage scrub to increase grazing value for cattle (note, for example, the donut-shaped area of potential habitat surrounding a coastal sage scrub hill near the northeastern corner of the study area in Figure 2). Both SKR and DKR were captured in this northern fringe area (Figure 2), with SKR occurring in the more open or down-slope portions, and DKR more in the edges of the coastal sage scrub and along a dirt road through sage scrub. Some habitat polygons found to have sign of kangaroo rats in this area were therefore omitted from Figure 2 and from SKR habitat acreages, as we concluded they were unlikely to support SKR and highly likely to support DKR.

Smaller and more isolated pockets of habitat are found outside these two primary concentrations or core areas of habitat. On TNC/Oak Country Estates, we captured SKR on a broad sandy flood plain near Santa Maria Creek, which we mapped as occupied at trace densities (although it may qualify as occupied at low densities). We also mapped several small pockets of trace or potential SKR habitat on and around isolated rocky hills on Oak Country Estates (aka "Highland Valley Estates"), where M. O'Farrell has confirmed SKR presence during previous trapping surveys (O'Farrell 2000b, 2002). Other isolated pockets of trace-occupied or potential habitat are also associated with rocky hills rising out of less suitable clay soils on portions of Cagney and Eagle Ranch, including some between the effluent spray fields.

The most densely occupied areas we found (e.g., two moderate-density polygons in the northern fringe area) correspond with areas of highly suitable soils, presence of dirt roads, and other disturbances that reduce grass density, such as heavier than average grazing intensity. The largest polygon of moderate SKR density is on a well-drained rocky hill nestled in a bend in the main dirt road and near a watering trough and cattle trails.

Most areas mapped as unsuitable for SKR consist of heavier clay soils, such as eastern portions of Cagney and Eagle Ranch, much of Oak Country Estates, and all of the Hardy and Cummins properties. Heavier clay soils also separate the large mosaic of habitat in the middle of the grasslands from the occupied areas along the northern fringe.

Loose alluvial soils in the floodplain of Santa Maria Creek in the southern part of Cagney Ranch are also not occupied by SKR. This may be attributed to one or more of the following hypotheses: (1) these very loose, sandy soils may not be able to sustain SKR burrows, which may collapse easily in them; (2) occasional flooding by Santa Maria Creek may eliminate SKR from the area (drowning, wetting, and displacement); and (3) denser than average growth of annual grasses and associated thatch, perhaps due to lesser grazing intensity or elevated ground water.

Note that the creation of the effluent spray fields in the western portions of Eagle Ranch apparently rendered some previously suitable habitat unsuitable, due to saturation of the soil and creation of dense, irrigated vegetation. Previously the mosaic of occupied habitat patches was probably more contiguous through this area. Although a few pockets of well-drained soils between the sprayfields are currently occupied, and more areas are probably occupied in years of expanded SKR populations, for the most part the interstices between spray fields appear to be somewhat degraded in habitat quality due to drifting spray, which elevates soil moisture relative to natural conditions. Only the larger and better drained rises between spray fields are therefore likely to reliably support SKR from year to year.

Trapping

A total of 6 SKR and 6 DKR was captured during 3 nights of trapping (Figure 2 and Table 3). Capture locations confirmed prior expectations about the relative distribution of these species in the study area, with DKR found in or closer to areas of open coastal sage scrub, and the SKR in more open and extensive grasslands. Both species were captured on Trapline B (Figure 2), which winds in and out of the grassland-coastal scrub edge at the western-most extent of the "northern fringe" of habitat on Eagle Ranch. The SKR captured here was in the most open and heavily grazed part of the trapline, whereas the 2 DKR were captured in sparse coastal sage scrub slightly farther up the hill. P. Vergne (unpublished data) has also captured both species in this vicinity. Farther east along the northern fringe, only DKR were captured where the dirt road traverses coastal sage scrub (Trapline C); and only SKR were captured even farther east along the road, where coastal sage scrub appears to have been disked to increase pasturage (Trapline D).

Although the total number of kangaroo captures is limited, and no kangaroo rats were captured on some traplines, these results, in concert with previous trapping in various portions of the RGP, helped us to confidently delineate SKR habitat vs. DKR habitat. One exception to this is the easternmost portions of the "northern fringe," where occupied kangaroo rat habitat wraps around a coastal sage scrub hill. We suspect this area is mostly occupied by DKR, but SKR may also be present.

In addition to the kangaroo rats, two adult San Diego pocket mice (*Chaetodipus fallax*) and four deer mice (*Peromyscus maniculatus*) were captured in shrubby and rocky areas on various trap lines.

Table 3. Captures of SKR and DKR during 2006.

Date	Trapline	NUMBER OF TRAPS SET	ANIMALS CAPTURED SKR	ANIMALS CAPTURED DKR
6-Sep-06	A	30	0	0
	B	25	0	0
	C	30	0	1 adult male
	D	30	0	0
	E	25	0	0
26-Oct-2006	A	32	1 adult female, lactating 1 juvenile female	0
	B	23	0	1 adult female 2 adult males
	C	17	0	1 adult female
	D	15	1 adult female	0
	E	26	0	0
	F	25	0	0
	G	15	0	0
27-Oct-06	B	23	1 adult male, scrotal	1 adult male, scrotal
	D	15	1 adult male, scrotal 1 adult female	0
	E	26	0	0
	F	25	0	0
	G	15	0	0
	H	25	0	0
	I	25	0	0

Weather Conditions:

6/SEPT - ~0730, 70deg.F, 0-3mph, clear skies, moon ~full

25/26 OCT - ~1100 to 0100, 50-58F, 0mph, clear, moon near dark (new) ~0630, 60F, 4-10mph, clear

26/27 OCT - ~1045 to 0000, 66F, 5-15mph, clear, moon a sliver ~0630, 68F, 5-15mph, clear

Habitat Analyses

During 2005, there were no statistically significant correlations between any of the vegetation variables and either SKR habitat quality or density due to very low sample sizes (only four vegetation plots landed within occupied SKR polygons) and due to the extreme growth of grasses in nearly all areas (due to record winter rains). The proportion of vegetation plots in bare ground or forbs was exceptionally low across all plots in 2005, as grasses grew extremely dense, thus swamping out forb growth and obscuring differences among plots in those variables most predictive of SKR habitat value, such as percent bare ground and the forb:grass ratio (O'Farrell and Uptain 1987, Spencer 2003).

Table 4. Means and standard errors for vegetation measurements on sample plots falling within polygons of different SKR density classes (top) or habitat quality classes (bottom) during 2005. No vegetation plots fell within low, medium, or high density classes.

2005	SKR Density Class						
Variable	none		trace		low	medium	high
	Mean	SE	Mean	SE			
Biomass (lbs/ac)	2910	877	2724	1218			
%Grass	58.1%	0.022	53.7%	0.028			
%Forb	37.9%	0.018	40.7%	0.024			
Forb:Grass Ratio	0.67	0.054	0.77	0.089			
% Bare Ground	3.6%	0.007	4.0%	0.005			
% Erodium	25.4%	0.014	29.6%	0.015			

	Habitat Quality					
Variable	High		Medium		Low	
	Mean	SE	Mean	SE	Mean	SE
Biomass (lbs/ac)	1915	723	2564	1147	30410	1075
%Grass	49.8%	0.036	55.0%	0.017	59.2%	0.025
%Forb	43.0%	0.047	40.4%	0.012	37.0%	0.021
Forb:Grass Ratio	0.88	0.157	0.74	0.043	0.65	0.062
% Bare Ground	4.4%	0.006	4.4%	0.008	3.3%	0.008
% Erodium	32.1%	0.005	25.9%	0.012	25.5%	0.017

Table 5. Means and standard errors for vegetation measurements on sample plots falling within polygons of different SKR density classes (top) or habitat quality classes (bottom) during 2006. No vegetation plots fell within low, medium, or high density classes.

2006	SKR Density Class						
Variable	none		trace		low	medium	high
	Mean	SE	Mean	SE			
Biomass (lbs/ac)	2457	614	2349	959			
%Grass	47.8%	0.025	35.1%	0.056			
%Forb	9.0%	0.019	16.5%	0.043			
Forb:Grass Ratio	0.28	0.131	0.67	0.252			
% Bare Ground	3.4%	0.007	6.7%	0.019			
% Thatch	38.8%	0.010	40.0%	0.013			
% Erodium	7.7%	0.020	15.2%	0.038			

	Habitat Quality					
Variable	High		Medium		Low	
	Mean	SE	Mean	SE	Mean	SE
Biomass (lbs/ac)	2256	1128	2310	1155	2510	671
%Grass	33.2%	0.077	35.2%	0.082	50.1%	0.013
%Forb	17.8%	0.052	15.7%	0.075	7.8%	0.012
Forb:Grass Ratio	0.78	0.352	0.79	0.507	0.16	0.030
% Bare Ground	6.1%	0.029	6.0%	0.018	3.2%	0.008
% Thatch	41.2%	0.014	41.8%	0.027	37.8%	0.008
% Erodium	16.9%	0.047	14.5%	0.071	6.3%	0.012

In contrast, significant or nearly significant differences were found for some predictor variables in 2006 (Figure 3) despite very low sample sizes (only six vegetation plots fell within trace-occupied SKR areas and eight within suitable habitat, with no plots falling within areas occupied at higher than trace densities). Vegetation plots falling within areas occupied by SKR had significantly less grass cover than those not occupied by SKR ($P = 0.039$). Although the very low sample sizes also resulted in non-significant ($P > 0.1$) differences for other variables, the trends tend to support prior findings for differences in habitat quality and SKR density (O'Farrell and Uptain 1987, Spencer 2003). For example, during 2006, plots in areas occupied by SKR averaged twice as much bare ground as those unoccupied by SKR(6.7% vs. 3.4%; Figure 3 top), although bare ground was relatively rare nearly everywhere and low sample sizes resulted in non-significant statistical tests. Likewise, the average forb:grass ratio averaged 0.67 in occupied areas versus only 0.28 in unoccupied areas, although again this difference was not statistically significant ($P = 0.122$). Similar weak or not-quite-significant results were found between areas of low vs. medium-high SKR habitat quality as for SKR density. For example, the forb:grass ratio for medium- and high-value habitats were 0.79 and 0.78, compared with average forb:grass ratio of only 0.16 for low-value habitats (Figure 3 bottom), although again the difference was not statistically significant ($P = 0.116$) using Kruskal-Wallis analysis of variance.

Finally, no statistically significant contrasts were possible for the winter-spring biomass measurements (due to small sample sizes and large inter-plot variance), although visual inspection of the results suggest that a threshold biomass of about 3,000 lbs/ac is indicative of poor quality habitat, particularly in 2006 (Figure 4). Note that although there is wide overlap in biomass measurements between density and quality classes, there are clear trends in increasing quality and density with decreasing standing biomass. Perhaps more important, the variance in biomass measurements declines with habitat quality, such that, while poor quality habitats cover the full range of biomass measurements, the better SKR habitats tend to be confined to the low end of the spectrum (below about 3,000 lbs/ac).

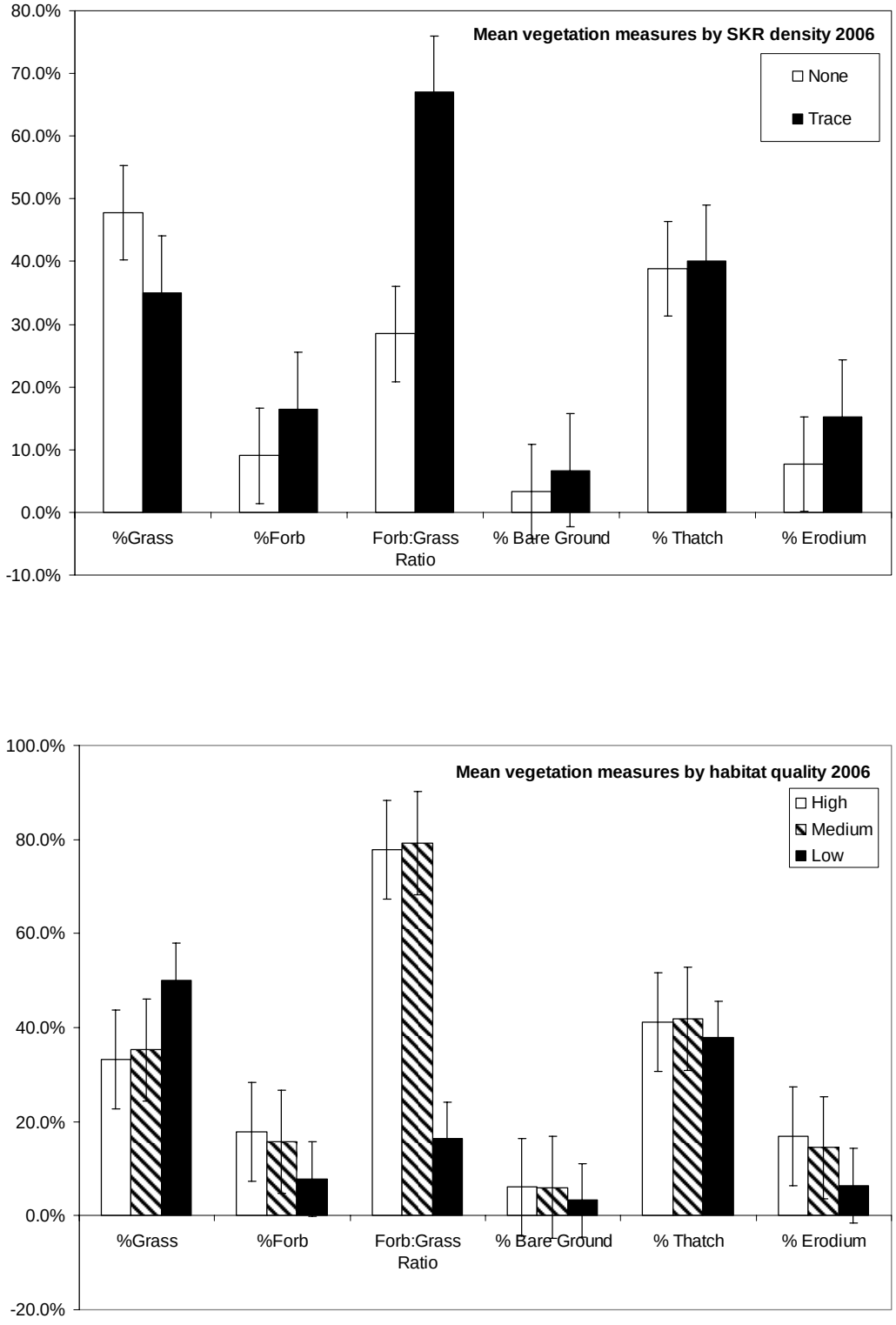
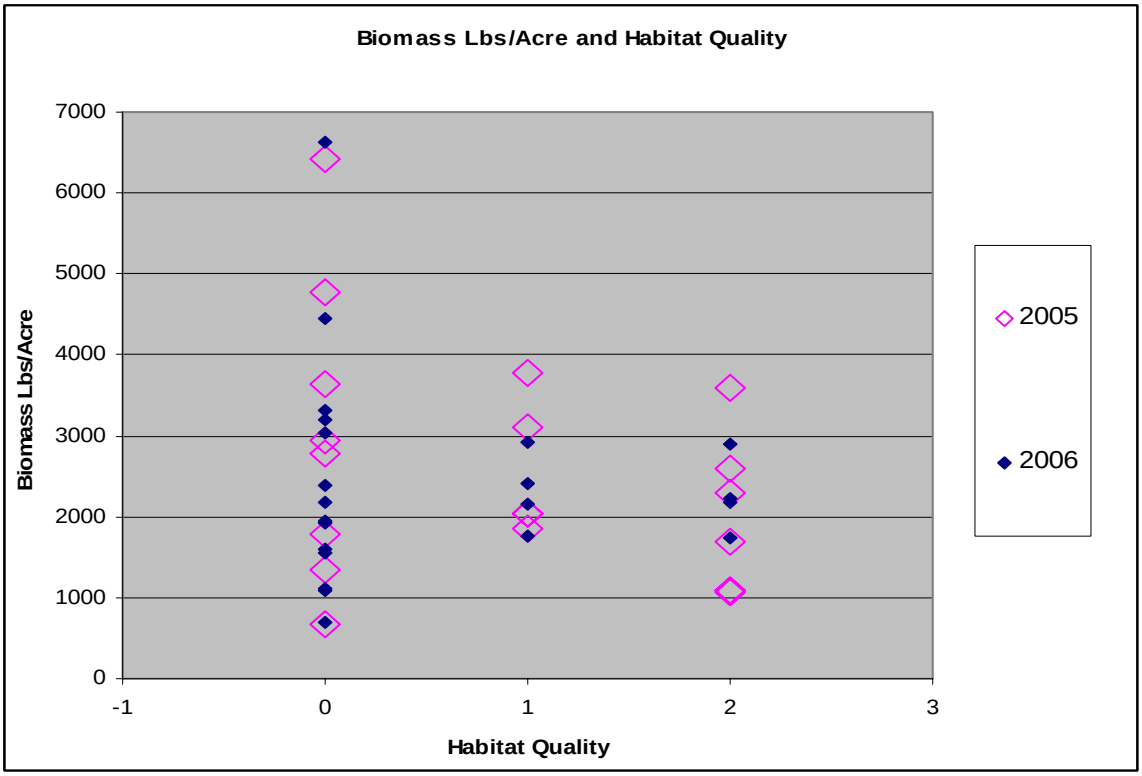


Figure 3. Vegetation measures from sample plots within areas differing in SKR density (top) and habitat quality (bottom) during 2006 (means $\pm$ SE).



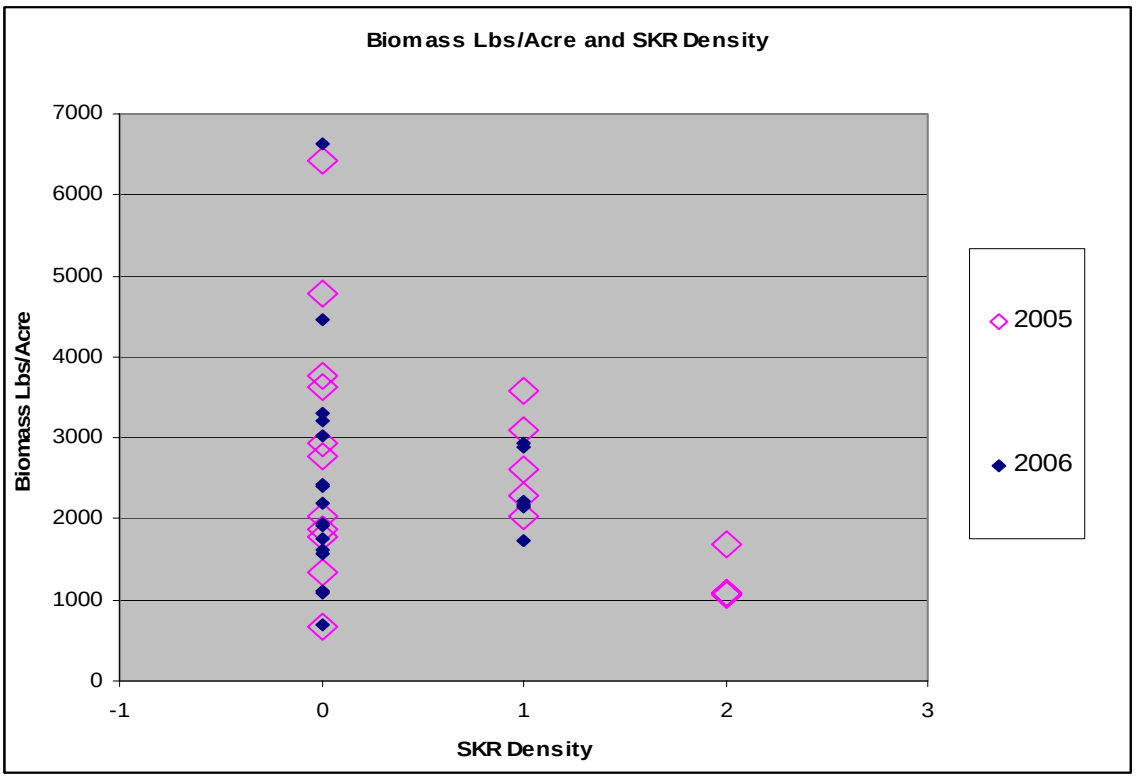


Figure 4. Standing biomass at plots falling within different SKR density classes (top) and habitat qualities (bottom) in 2005 and 2006. (For habitat quality, 0 = low, 1 = moderate, and 2 = high; for SKR density, 0 = none, 1 = trace, 2 = low.)

Discussion

SKR Distribution and Abundance

Observations and quantitative measurements of SKR populations over the past decade in the RGP (especially on the airport property) paint a consistent picture of how SKR distribution and abundance change in relation to precipitation, vegetation growth, soil characteristics, and disturbance factors (Haas and O'Farrell 2005, Spencer 2003, Conservation Biology Institute 2004): Both distribution and density tend to shrink during periods of high vegetation growth (high soil moisture) due to increases in the density of grass and associated thatch, which impede SKR movements and may decrease food availability by out-competing annual forbs that provide preferred seeds. Those areas occupied by SKR during such years tend to be those on the best-drained soils (and/or more heavily disturbed areas), which tend to be reliably occupied year after year. In drier years with more sparse vegetation, SKR populations tend to expand and may re-occupy areas of less well-drained soils or lesser disturbance, only to shrink back again when vegetation again becomes too dense in these areas.

On the airport property, some areas of highly suitable soils have been occupied by moderate to dense SKR populations every year since 1997 (e.g., highly suitable soils and vegetation northwest of the airport runway). Other areas, of intermediate soils quality (e.g., loams with a higher proportion of clays), are occupied in good years, but not in bad years (especially if grazing pressure or other vegetation disturbance is low). Areas with the most heavy clay or hydric soils are never or very rarely occupied, regardless of weather patterns or disturbance history. Thus, even in the wettest years on record, SKR populations appear to persist in scattered areas possessing the most suitable, well-drained soils (generally sandy loams on the upper portions of hills, around rocky outcrops). These "core" habitat areas appear to serve as sources of dispersing individuals to colonize intermediate-value areas during dry years, or even during wet years if they are properly managed to reduce invasions by annual grasses and thatch (using grazing, fire, or other disturbance). Since conditions appear to be most limiting to SKR in wet years, those areas occupied by SKR following a wet winter appear to be occupied fairly continuously in wet as well as dry years, and therefore seem to contribute most to population persistence.

The record rains of 2004-5 resulted in the lowest observed distribution and abundance of SKR on the Ramona Airport property since SKR were discovered there in 1997 (Haas and O'Farrell 2005, CBI 2004). The survey years 2005-06 were therefore ideal for mapping the distribution and relative abundance of SKR at their lowest levels, when SKR distribution appears to most accurately reflect habitat quality. Even areas found to support low densities during this study period appear to be indicative of high habitat values, and are expected to support moderate to high densities of SKR in years of population increase. Areas mapped as potential habitat, but where we could find no sign of SKR occupancy during this population low, are also likely occupied during some years, especially when population levels are higher. Indeed some areas mapped as potential habitat, as well as some mapped as non-habitat during this study, were occupied

by SKR in previous years (Ogden 1998). Consequently we believe the 2005-6 distribution map (Figure 2) serves as a useful baseline for future monitoring and management efforts, recognizing that populations are likely to expand into areas outside those we found to be suitable during 2005-6.

Grazing, fire, or other disturbance factors appear to moderate the severity of population fluctuations on the areas of intermediate soils quality, by reducing the density of annual grasses and thatch and favoring growth of annual forbs (such as *Erodium* spp.), which provide SKR a favored food source while not impeding movements as severely as annual grasses do (because they dry and disarticulate by late spring to create the open conditions SKR prefer during breeding season). Thus, grazing or fire promote good habitat quality and relatively high SKR densities on moderately well-drained soils even during wet years, and can help maintain larger populations in and surrounding the best, "core" habitat areas.

SKR have also benefited to some degree by creation of roads and heavily used cattle trails in the RGP (see for example, the linear area of occupied habitat connecting east-west from west of the airport runway to Rangeland road, which corresponds with the main access road used by the ranchers). The fairly large polygon of moderate-density SKR occupancy on Eagle Ranch (the highest recorded density during this study) is on a well-drained rocky hill nestled in a bend in the main dirt road and near a watering trough (the red polygon at the western end of the "northern fringe" in Figure 2). This area combines highly suitable soils with higher than average cattle use, and with good connectivity to other habitat areas via dirt roads and cattle trails. Such confluences of positive factors appear to create high quality and relatively densely occupied pockets of SKR habitat.

Core SKR Management Areas

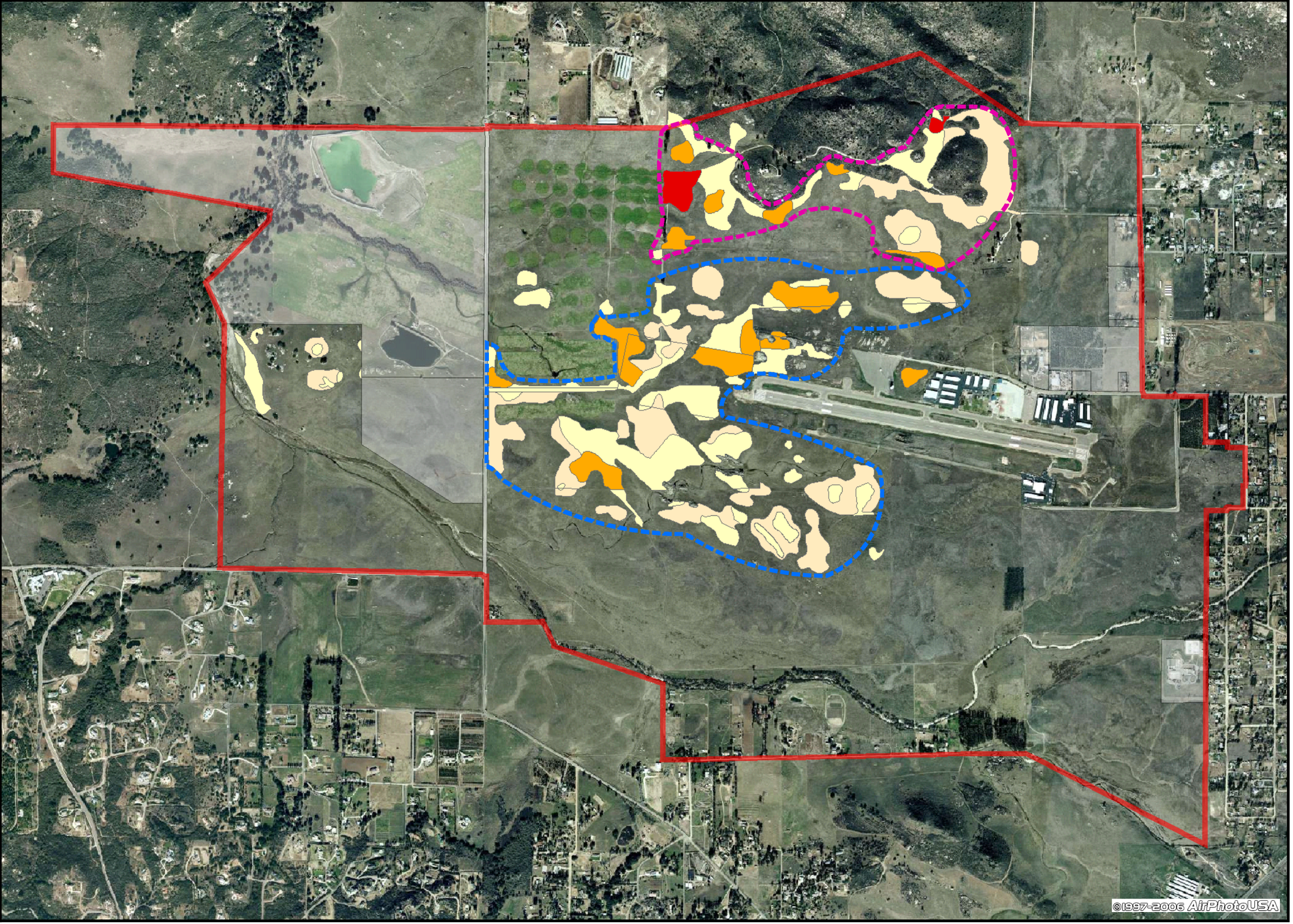
The two core SKR management areas delineated in Figure 5 should be focal areas for monitoring SKR populations and habitat and for instituting vegetation management measures when conditions suggest this is necessary. Vegetation management (e.g., managed grazing or prescribed burns) is most likely to benefit the population if applied strategically within these core management areas, rather than in outlying areas where conditions may remain unsuitable even with management, or where suitable habitat is distributed in smaller and more isolated patches. Thus, although SKR are found outside these core areas (especially during periods of SKR population expansion), vegetation management outside the core areas is less likely to contribute to overall SKR population viability or long-term persistence, since SKR in such locations will apparently always be vulnerable to extirpation during poor (e.g., wet) years.

Although the two core areas share many similarities, they differ somewhat in ecological context and may require slightly different management approaches. The larger core area 1 (with about 182 acres of suitable habitat) occupies the heart of the grasslands, on hills and around rocky outcrops that rise up from lower lying grasslands on soils higher in clay content. Although portions of this core area support sparse coastal sage scrub (e.g., on

the northwest portions of the airport property), for the most part the high quality SKR habitats in this core will likely continue supporting grassland vegetation (and suitable SKR conditions) under most grazing regimes and weather conditions. However, a significant decrease in SKR habitat quality here (for example, if consecutive wet years and reduced grazing pressure led to greatly increased grass and thatch density) could greatly increase the potential for SKR extirpation from the RGP and would need to be countered by active management.

The smaller core area 2 (with about 74 acres of suitable habitat) is associated with the coastal sage scrub-grassland interface at the northern fringe of the RGP. Much of the high quality SKR habitat in this core appears to have resulted from previous clearing of coastal sage scrub to increase cattle pasturage. Unless grazing pressure remains relatively high in this area, or vegetation is occasionally disked or otherwise managed to resist shrub encroachment, some occupied habitats in this area may revert to a denser sage scrub community—thus excluding SKR. Although this may incrementally reduce the amount of available SKR habitat and SKR population size in the RGP, it may not significantly reduce SKR population viability in the RGP. Management that allows for some natural increase in coastal sage scrub vegetation in this core area may not be overly detrimental to SKR, and may benefit other species living in the area, such as California gnatcatchers (*Polioptila californica*).

The land between these two management cores consists of lower lying, heavier clay soils that are generally unsuitable for SKR. Heavy thatch in this intervening swath would probably prevent inter-core dispersal by SKR in most years, except for the presence of a north-south dirt road that connects the cores at the west end of core area 2 (along the eastern edge of the effluent spray fields). This dirt road is associated with relatively dense concentrations of SKR and is likely used as a dispersal corridor connecting the two core areas. If the road were ever removed in the future, greater consideration would need to be given to managing vegetation and thatch between the cores to facilitate inter-core movements.



Legend

- Proposition 13 Project Area

Core SKR Management Areas

- Area 1
- Area 2

SKR Density Classes 2005-2006

- Moderate
- Low
- Trace
- Unoccupied (Potential)
- Not Assessed

N

0 750 1,500 Feet

0 250 500 Meters

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Figure 5 - Core Stephens' Kangaroo Rat Management Areas

Habitat Analyses

Although they had low statistical power due to the low number of vegetation plots that happened to fall within SKR habitat, the analyses of habitat factors reinforced findings of previous studies. During drier years, SKR density is positively correlated with the proportion of bare ground and forb:grass ratio during late summer-fall, and negatively associated with shrub cover and grass cover (O'Farrell and Uptain 1987, Spencer 2003). To a large degree, these vegetation characteristics reflect differences in soil characteristics and degree of disturbance (especially grazing): better-drained soils (and more heavily grazed areas) tend to have more bare ground, less dense grasses, and higher forb:grass ratios than soils with greater clay content (or receiving lesser grazing pressure). However, following winters with heavier than average precipitation, the prolific growth of annual grasses can obscure these differences in habitat quality, as the dense grass growth tends to out-compete forbs and build up a dense thatch layer on a greater range of soil types.

Stronger correlations would likely have been found if not for the following factors:

- Low number of vegetation sample plots that happened to fall within SKR suitable and occupied polygons, and especially for plots falling within higher-value habitat areas. Only 4 vegetation plots in 2005 and 6 in 2006 fell within areas mapped as occupied by SKR, and all of those were mapped at only trace densities. The lack of sample plots falling within higher density and higher quality SKR polygons severely limited the power of statistical tests.
- The extreme growth of annual grasses during 2005, due to heavy rainfall, swamped out the ability to detect habitat differences, especially for measures like bare ground or percent forbs that are known to correlate with habitat value in dry years. The proportion of vegetation plots with bare ground and forbs was exceptionally low during the study period (particularly during 2005) across all plots. During drier years, proportion bare ground generally exceeds 40% and forb:grass ratio exceeds 2:1 during late summer-fall (Spencer 2003).
- Non-linear relationships for some variables may also obscure differences in habitat quality. For example, standing biomass does not increase linearly with the quality of soils to support SKR populations: biomass was higher on loamy soils than on heavy clay soils, so a correlation between biomass and habitat quality was not evident. A more appropriate test would be to have more samples across all classes of loam soils, while eliminating the heaviest clay soils from analysis. In this case, biomass would be expected to increase more linearly with clay content and provide a more meaningful metric for determining thresholds for vegetation management intervention.

Future Monitoring Recommendations

We recommend annual monitoring of the SKR population in the Ramona Grasslands with sufficient rigor and repeatability to trigger vegetation management actions when active management intervention may be required to benefit the population. This need not be overly intensive or expensive. Although it would be ideal to obtain quantitative measures of SKR distribution and abundance at least annually, this could be costly without proportional benefits to the population.

The approach we recommend is to perform sign surveys at many small (or "diffuse") sampling plots or points that can be revisited annually to determine species presence or absence (along with a visual estimate of burrow density around the point sign is present). This is a form of Percent Area Occupied (PAO) survey, which has become a prominent technique in wildlife population sampling due to its efficiency (Mackenzie et al. 2002, MacKenzie 2005).

This sampling, best done consistently during late summer, would document SKR presence/absence and/or burrow density classes at a sampling of small plots (using GPS) located based on the baseline distribution map (Figure 2). This method primarily utilizes readily obtained presence/absence records for each plot, and plots are typically randomly located in target occupied habitat areas. If, during a particular monitoring year, all or most of these plots were found to be occupied by SKR, lands lying adjacent to original target habitat areas would be inspected to determine if the population had expanded beyond the original area sampled. If a population expansion was confirmed, additional monitoring plots would be established in the newly occupied lands, and future monitoring sessions would include the new plots. This monitoring method, using 50m x 50m plots, has been used to track SKR distribution and abundance at Fallbrook Naval Weapons Station since 2002 (Montgomery et al. 2005). Details of the sampling design should be developed by spring of 2007 and implemented during summer-fall 2007.

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APPENDIX B

Wintering Raptors of the Cagney Ranch and Surrounding Ramona Grasslands (2003-2006) (Wildlife Research Institute 2007)

Wintering Raptors of the Cagney Ranch and Surrounding Ramona Grasslands (2003-2006)

For

County of San Diego
Department of Parks and Recreation
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Contact: Jennifer Haines

By

Wildlife Research Institute, Inc.
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on behalf of

TAIC
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January 2007

EXECUTIVE SUMMARY

The Wildlife Research Institute (WRI) provides a detailed study of the Wintering Raptors of the Ramona Grassland with an emphasis on the Cagney Ranch. This approximately 5,000-acre grassland is what remains of over 15,000 acres of grassland, which existed in the Santa Maria Valley until the 1970's. Historical records of the area and its use are presented in the Introduction section and as known by the authors at the time of this writing. This study is intended to present a baseline for subsequent monitoring of raptors. Since wintering raptors move continuously and quickly throughout the grassland it is not practical to count only those on the Cagney Ranch. Therefore, wintering raptors were counted wherever they occurred in the grassland that was available to the WRI researchers.

WRI conducts a free public educational program called "Hawk Watch" each winter from 9-20 times and some of the data in this report is derived from those weekly observation periods. Observations not recorded as part of this study or Hawk Watch are also presented in the results section of this report. Recommendations and suggestions for future management practices are included in the Recommendations section and form the potential basis for managing the entire Ramona Grasslands.

Table of Contents

Contents **Page**

List of Figures

Figure **Page**

List of Tables

Table **Page**

INTRODUCTION

Project Location

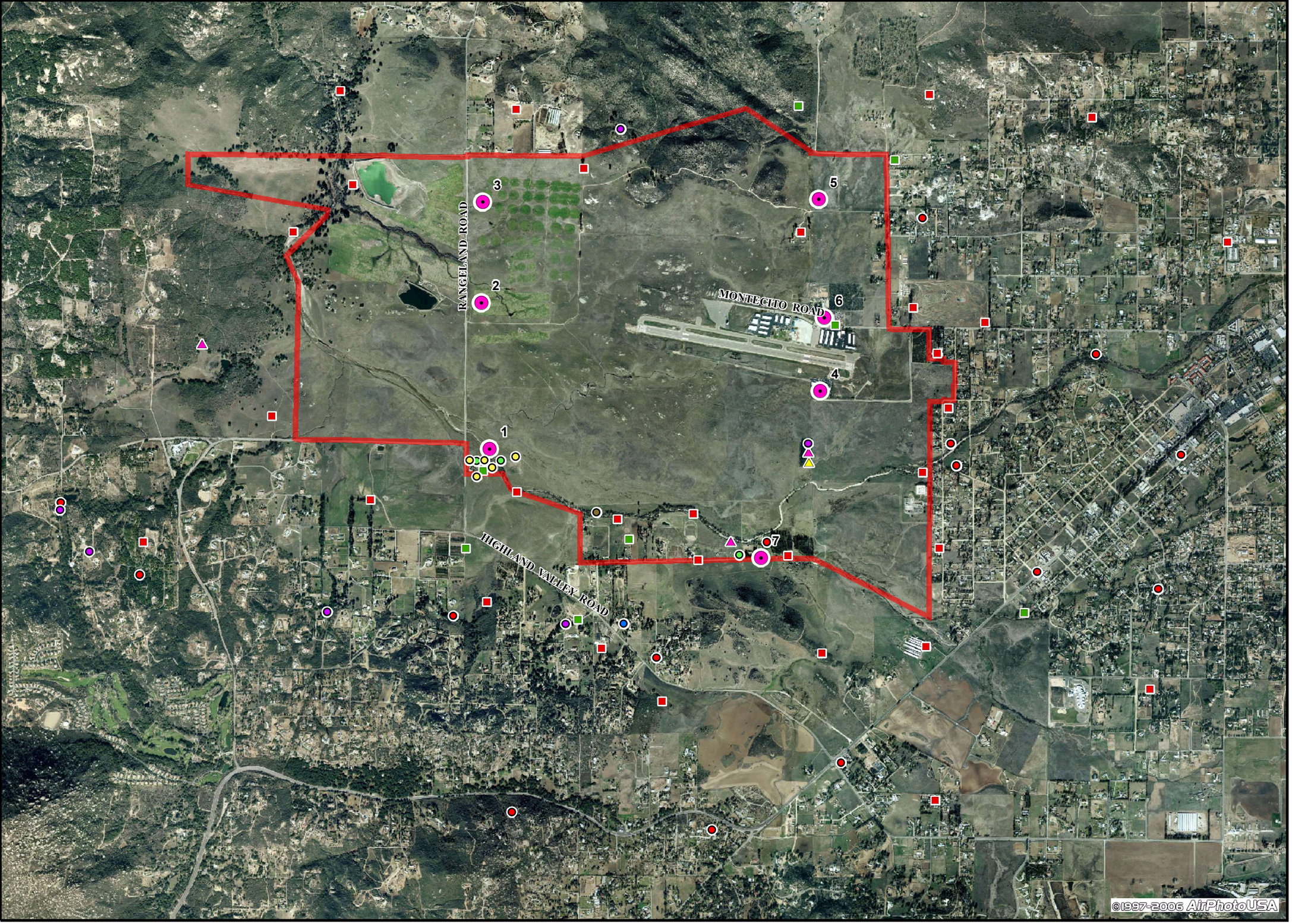
The proposed project will take place within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California (Figure 1). The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Hobbs, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities.

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

History of the Ramona Grasslands

The Ramona Grasslands have been grazed since at least the 1850s by white settlers. Prior to that, Mexican Rancheros allowed cattle and horses to roam freely throughout the area. Sometimes the density of cattle and horses exceeded the carrying capacity, and during drought years, great numbers of animals, especially horses, were slaughtered to assure that some, especially cattle, would survive the droughts. During the 1860s, one such drought occurred and as a result of the animal losses many of the Mexican Rancho owners sold out to white settlers and land speculators. Pamo Valley, Ballena Valley, Warner Ranch and Santa Ysabel Valley were also known to be grasslands at the time of white settlers arriving in San Diego County. Historical records indicate that Pronghorn populations existed in these grasslands; therefore, the grasslands had to have existed as somewhat similar habitat for long periods prior to recorded times.

Native Americans used fire to maintain the grasslands. Whether intentional or accidental, the result was the same with grasslands being maintained. Prior to white settlement, the Spanish (Mexican) settlement in San Diego sent soldiers out to stop Indian uprisings in Ramona and in particular Pamo Valley. Indian settlements existed in and around the



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Proposition 13 Project Area

Nesting Locations

- American Kestrel
- Barn Owl
- Burrowing Owl
- Cooper's Hawk
- Great Horned Owl
- Red-shouldered Hawk
- Red-tailed Hawk
- Stick Nest
- Turkey Vulture
- White-tailed Kite
- Winter Monitoring Locations

N

0 750 1,500 Feet

Technology Associates INTERNATIONAL CORPORATION

Document: Raptors.mxd

Date: Dec 15, 2006

Figure 1 - Winter Monitoring Locations, and Identified Raptor Nest Locations

Ramona Grasslands. Published books on the history of the area recorded that Mr. Etcheverry, an early rancher, grazed 15,000 sheep in the 1850's throughout the Ramona Grasslands and hired local Indians, living in the oaks at the edges of the Grasslands, to tend to the sheep.

Golden Eagles, primarily a grassland species, have declined in San Diego County from a recorded 104 pairs in the late 1800's to approximately 46 breeding pair in 2006 (WRI 2005; D. Bittner, pers. comm.). This is a loss of 56% of the Golden Eagle population. This extirpation is primarily due to lost habitat, including grasslands or combinations of grassland and other open plant communities. Fire was a primary contributor to maintaining these plant communities. In the 1970's, agriculture went from grazing to citrus and avocado groves in the western sections of the county. Ranches became housing and industrial developments, which were easily built in the flat and treeless grasslands; and it followed that soon grasslands became a rare ecosystem of specific plants and animals.

Project Description

The County of San Diego Department of Parks and Recreation, with assistance from The Nature Conservancy (TNC), Wildlife Research Institute (WRI), and Conservation Biology Institute (CBI), was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project (see also Appendix A). The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area (hereinafter referred to as "Ramona Grasslands"), to improve water quality and habitat conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition, increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters. The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system.

A second component of the project consists of collecting baseline biological data, which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek, ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas), and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the "typical" and historical conditions of the Grasslands are unknown.

The target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were surveyed for fairy shrimp, amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed. The following sections describe the methods and results of the baseline raptor surveys that were conducted by biologists of the Wildlife Research Institute (WRI) as part of their annual Hawk Watch Program during the winters of 2003 through 2006, and the results of nesting surveys conducted by WRI in the spring and summer of 2005 and 2006, on behalf of TAIC. The significance of these results and recommendations for future monitoring will be discussed as well.

METHODS

Historical Data

Raptor observational data have been compiled from WRI's winter Hawk Watch (held January through February) from 2003, 2004, 2005, and 2006. These observations focus primarily on the grasslands around WRI and along Rangeland Road, just north of WRI, with supplemental observations north of Voorhes Lane and surrounding the airport.

For the years of 2003, 2004, and 2005 only sites 1-3 (at WRI and two sites along Rangeland Road, north of WRI) were utilized for collecting data (Figure 1). All three years contain some weeks in which two days of observation data were collected. Few documented observations were made at sites 4-7 during these years. For 2003 only, observations started in December and covered the time frame between December 28, 2002 and February 2, 2003. Although observations were made for ten weeks in 2005, written documentation for that year is limited. Often apparently individual birds could be identified over time (i.e., within or between years). WRI observers recognize and identify some of the individual ferruginous hawks that winter in the Grasslands. Some have unique colors and behavior; others arrive early, while others are observed on the exact same poles, rocks, or other structures for every observation.

Current Data Collected (Year 2006)

Data collection specific to the Santa Maria Creek Restoration project was completed during the winter months of January and February 2006, when migrating raptors are most likely to be in the area and all raptors are more visible due to decreased foliage.

For observations that could be compared over time (i.e., for monitoring purposes), WRI established the below-described "viewshed" sites and conducted specific surveys to create a complete grassland survey. For 2006, data were collected from 3 predetermined sites (sites 1-3) in the Ramona Grasslands. Surveys were performed on one day per week from January 1 through February 28, 2006. Sites 1-3 are the same sites used for WRI's Hawk Watch and, therefore, the 2006 dataset is comparable to the dataset collected during historic surveys. Between January 14 and January 28, 2006, data were collected on three days at sites 1-3 and at sites 4-7 in the Ramona Grasslands. Figure 1 illustrates the locations of all seven observation sites in the Ramona Grasslands.

For sites 1-3, observations were made from 0900 to 1200 hours, with approximately one hour spent observing at each site. Multiple observers performed the initial spotting of raptors and one experienced raptor biologist identified and recorded observations. Observations were recorded on a standard observation form. Both Kowa 10 x 42 binoculars and 10 x 20-60 zoom scopes were used in raptor identification.

The data from sites 4-7 (Figure 1) were collected on three separate surveys conducted between January 14 and January 28, 2006. The surveys were conducted for two hours between 1200 and 1400. A total of fifteen minutes of observations were collected at each of the three sites. Observations were made by one raptor biologist utilizing the above ocular equipment.

Survey Constraints

Multiple counting is always a concern when dealing with a species that is highly mobile. For this study, we used several methods to avoid multiple counting of the same individuals during an observation period.

1. Multiple observers were used to track the movements of birds that had been previously recorded.
2. Two-way radios and cellular phones were used if monitoring was being conducted simultaneously at multiple sites.
3. If observations were conducted simultaneously, biologists compared records. Field data forms were used to record useful information. In situations, where a bird could have been double-counted, the entry was removed. at a debriefing session immediately after the observations and noted and corrected any obvious duplication.

The historic data for 2005 do not reflect the true raptor population of the Grasslands for that year. Because some data were compromised, only the information resulting from January is presented.

RESULTS

Tables 1-4 present data for years 2003-2006, respectively. The year 2003 was the worst year of a several year drought, but in the winter of 2005 the Santa Maria Creek flooded over of its banks. During the 2006 research season, the Grasslands were dry and the winter rains didn't arrive until late in the winter. The migrant hawks were low in number and those that arrived early moved on

when prey became hard to find. Tables 1-4 and Figure 2 reflect these variables and provide some insight to normal variation. The ability to recognize some individual birds allowed the observation that a number of ferruginous hawks arrived in Ramona's Grasslands early, and then moved on potentially due to a low prey base.

Historic Data

For 2003, each week is represented by two days of data collection. Table 1 displays observations made from January through February 2003, by date, with a total count for each date. This table displays the total of each week's observations combined as well as the average for each species for each week.

Table 1. Total number of birds of prey observed wintering in Ramona Grasslands (Site 1-3) through 2003.

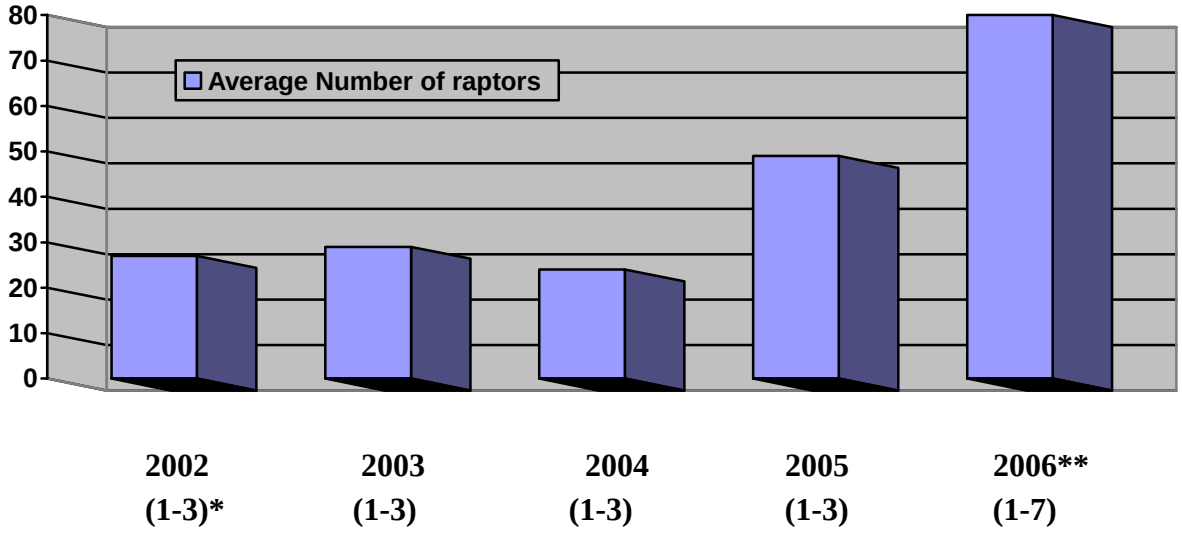
Species*	4-Jan	5-Jan	11-Jan	12-Jan	18-Jan	19-Jan	25-Jan	26-Jan	1-Feb	2-Feb
AK	6	7	5	3	4	5	3	4	4	5
BE	0	0	0	0	0	0	0	0	0	0
BO	1	2	2	2	1	2	2	1	1	0
BR	0	0	0	0	0	0	0	0	0	0
CH	0	0	0	0	0	0	0	0	1	1
FH	3	8	5	5	5	6	3	3	3	6
GE	0	0	2	1	1	1	3	2	2	2
GO	0	0	0	0	0	0	0	0	0	0
MR	0	0	0	0	0	0	0	0	0	0
NH	0	0	0	0	0	0	0	0	0	0
OS	0	0	0	0	0	0	0	0	0	0
PF	0	0	0	0	0	0	0	0	0	0
PR	0	1	0	1	1	0	1	1	1	0
RS	0	0	1	0	0	0	1	0	0	0
RT	5	4	8	5	6	6	4	5	8	11
SH	0	0	0	0	0	0	0	0	0	0
SS	0	0	0	0	0	0	0	0	0	0
TV	8	15	2	17	7	12	16	12	12	12
WK	0	0	0	0	0	0	0	0	0	0
ZT	0	0	0	0	0	0	0	0	0	0
Total by Date	**23**	**37**	**25**	**34**	**25**	**32**	**33**	**28**	**32**	**37**

* Abbreviations and terms are contained in Appendix B

In 2003**,** all of San Diego County experienced a severe drought (by some believed to have been the worst drought in 164 years (pers. comm., T. Oberbauer)). Golden Eagles in Southern

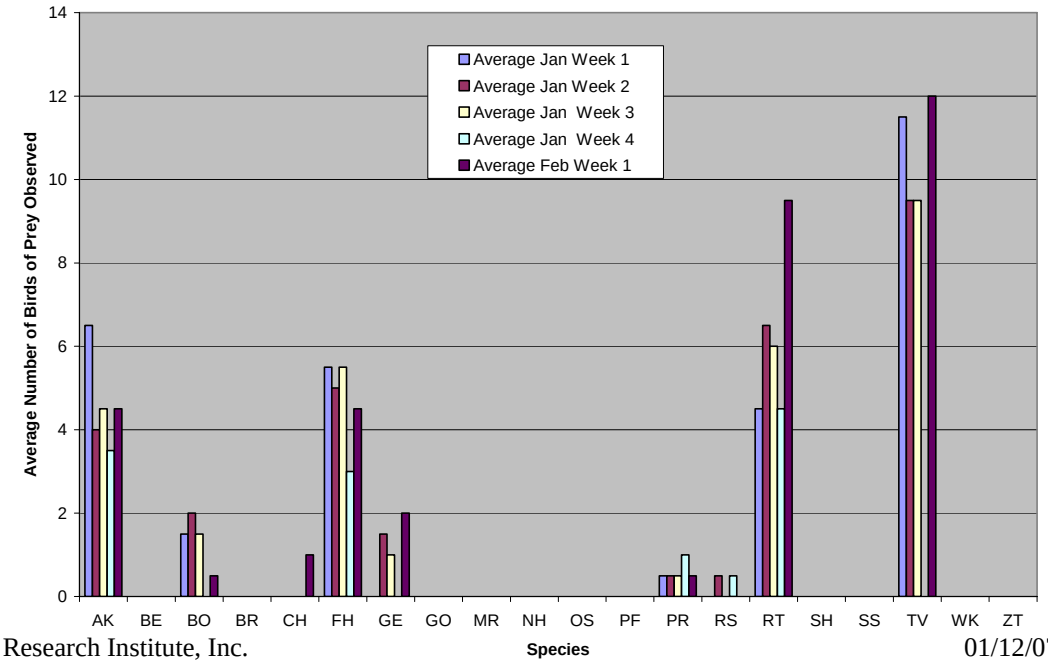
California dropped to an all time low reproductive rate of 12% (Bittner, Oakley, Lincer, 2003). The largest fires in California history occurred in the county in the fall of 2003 (i.e., Cedar, Paradise, and Otay fires in October 2003). The corresponding low numbers of wintering hawks in 2003 was expected (Table 1, Figure 3).

Figure 2. Average Total Number of Raptors Observed Per Survey by Year



- *Site numbers for which data are combined.
- ** More data were collected in 2006; therefore, the number of raptors reported in 2006 reflects a higher number of observations; the 2006 column should not be compared with the columns from years 2002-2005.

Figure 3.
Average Number of Birds of Prey Observed Wintering in Ramona Grasslands - 2003*



In 2004**,** light winter rains allowed new growth of vegetation and the wintering hawks responded to the increased prey base with more hawks wintering in the Grasslands. However, the hawks didn't reach what would be considered high numbers (Table 2, Figure 4). Table 2 displays the total count by day, with only some weeks having two days of data collection. For 2005, Table 3 displays data collected from one day's observation per week for each week in January.

Table 2. Total number of birds observed wintering in the Ramona Grasslands (Sites 1-3) – 2004

Species	3-Jan	10-Jan	17-Jan	18-Jan	24-Jan	31-Jan	1-Feb	14-Feb
AK	2	3	7	8	5	4	5	2
BE	0	0	1	1	1	0	0	0
BO	0	1	1	0	0	0	1	1
BR	0	0	0	0	0	0	0	0
CH	0	0	2	0	0	0	0	1
FH	3	4	6	8	6	7	8	5
GE	2	1	2	2	2	0	4	1
GO	0	0	0	0	0	0	0	0
MR	0	0	2	2	0	0	0	0
NH	0	0	0	0	0	0	2	1
OS	0	0	0	0	0	0	0	0
PF	0	0	0	0	0	0	0	1
PR	1	0	1	1	0	0	2	0
RS	0	0	0	0	0	1	1	0
RT	7	4	12	13	6	7	11	8
SH	0	0	0	0	0	0	0	0
SS	1	0	1	1	0	2	0	0
TV	7	6	25	30	8	8	7	0
WK	0	2	0	2	1	0	2	1
ZT	0	0	0	0	0	0	0	0
Totals	**23**	**21**	**60**	**68**	**29**	**29**	**43**	**21**

Figure 4.
Number of Birds of Prey Observed Wintering in Ramona Grasslands - 2004*

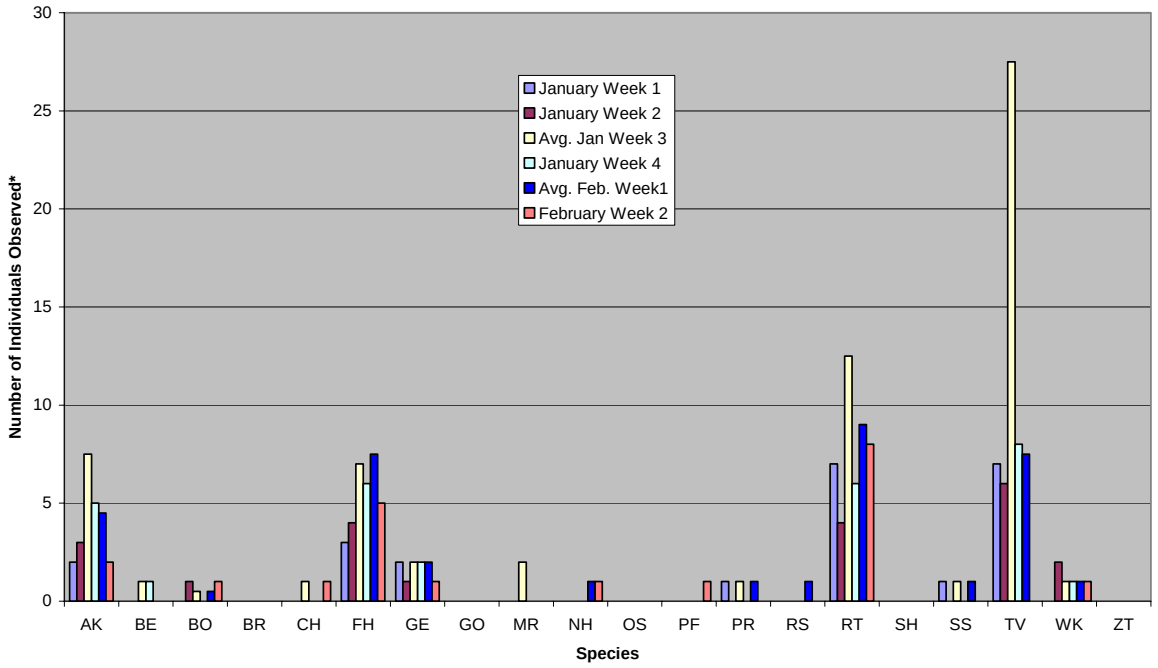
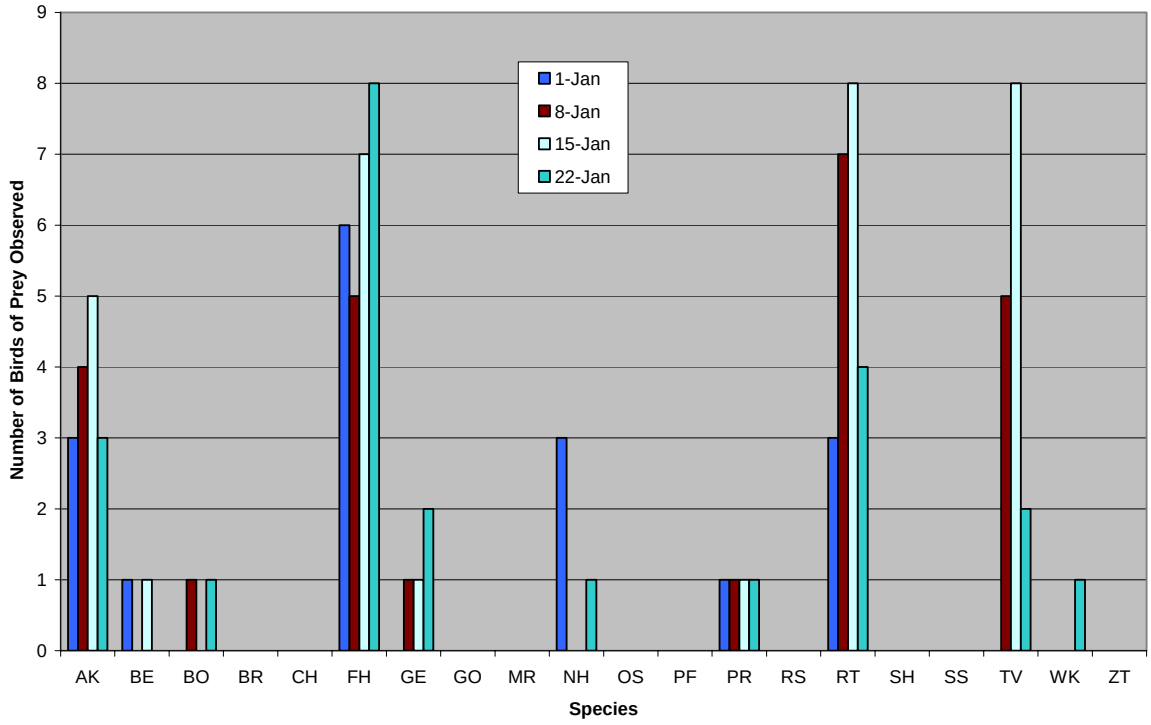


Figure 5.
Number of Birds of Prey Observed Wintering in Ramona Grasslands - 2005*



In 2005**,** large number**s** of ferruginous hawks wintered in the Ramona Grasslands (Table 3, Figure 5). The prey base had rebounded and the ferruginous hawks spent the entire winter in the Grasslands. In one non-Hawk Watch survey in early February 2005, D. Bittner, recorded 16 ferruginous hawks and 17 red-tailed hawks from site**s** 1-3. The WRI estimate for ferruginous hawks, based on the entire year's counts, was 22 ferruginous hawks wintering on the Ramona Grasslands (D. Bittner, pers. comm.).

Table 3. Total number of birds of prey observed in the Ramona Grasslands (Sites 1-3) in 2005

Species	1-Jan	8-Jan	15-Jan	22-Jan
AK	3	4	5	3
BE	1	0	1	0
BO	0	1	0	1
BR	0	0	0	0
CH	0	0	0	0
FH	6	5	7	8
GE	0	1	1	2
GO	0	0	0	0
MR	0	0	0	0
NH	3	0	0	1
OS	0	0	0	0
PF	0	0	0	0
PR	1	1	1	1
RS	0	0	0	0
RT	3	7	8	4
SH	0	0	0	0
SS	0	0	0	0
TV	0	5	8	2
WK	0	0	0	1
ZT	0	0	0	0
Total by Week	**17**	**24**	**31**	**23**

Current Data (2006)

As stated before, the historic data for 2005 do not reflect the true raptor population of the Grasslands for that year. Because some data were compromised, only the information resulting from January is presented. If the additional data were available, 2005 would be seen as an exceptional year with high numbers of raptors observed throughout February and through, at least, mid-March.

The 2006 data were collected for a different purpose and are more specific, and more reproducible, than the historic data. Therefore, the 2006 data have been broken down into independent categories. Table 4 displays observations made from January through mid-March 2006, by date. Data listed in each dated column represent combined, non-duplicated, information collected at sites 1-3. Data listed in each 4-7 column represent similarly combined information collected at sites 4-7.

In 2006, the number of ferruginous hawks dropped to an estimated 7-8 birds wintering in the same Grasslands areas (Table 4, Figures 6a and 6b). The numbers for years 2003 and 2006 should be considered low for the Ramona Grasslands. Since the early 1990s, when casual records were kept by the Raptor Watch, 7-8 wintering ferruginous hawks are the lowest numbers of any year we have memory or records of in the Grasslands. WRI's best estimate from all the years of Hawk Watch observation (1988-2006) is an average of 15-17 ferruginous hawks wintering in the Ramona Grasslands.

Figure 6a.
Number of Birds of Prey Observed at Sites 1-3 in Ramona Grasslands - 2006*

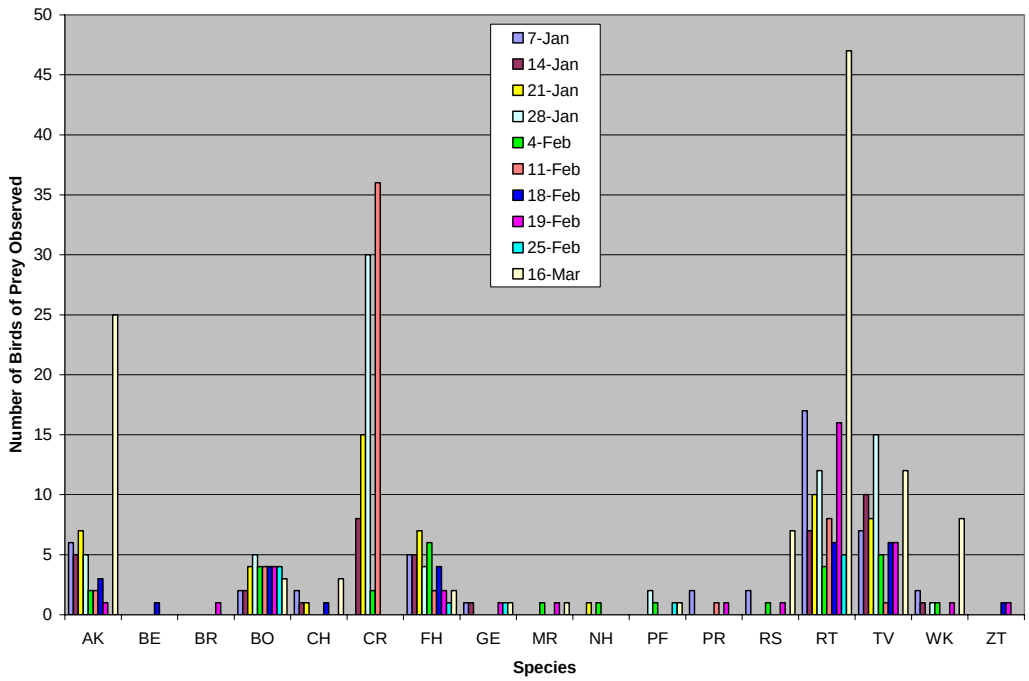


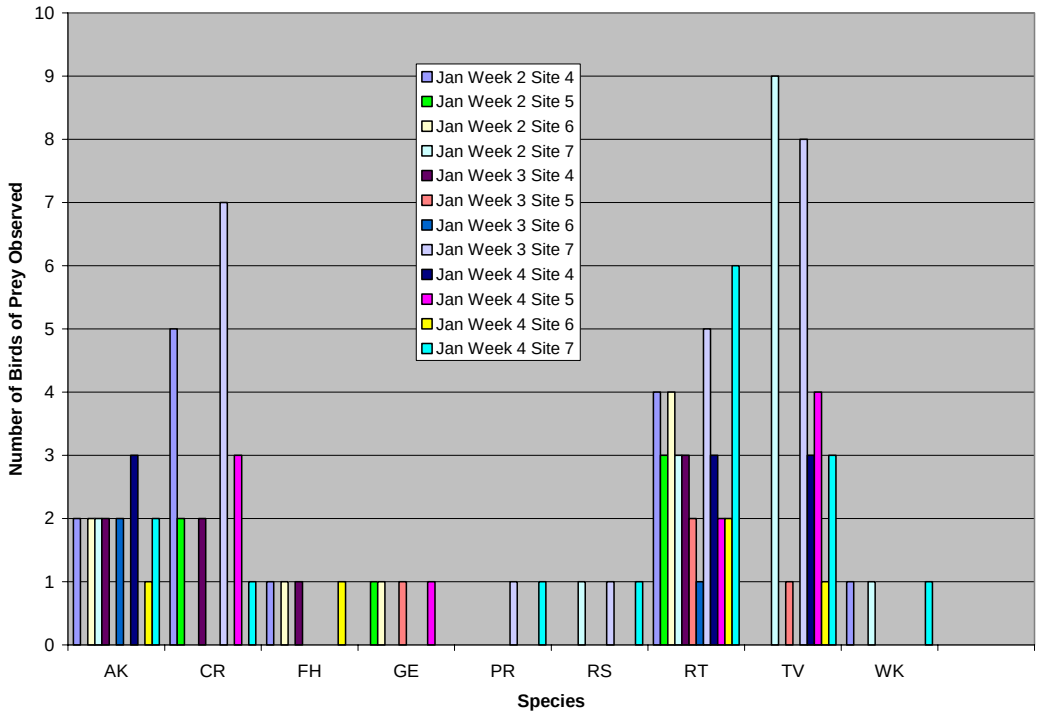
Table 4. Total number of birds of prey observed wintering in Ramona Grasslands (Sites 1-7) – 2006*

Date	7-Jan	14-Jan		21-Jan		28-Jan		4-Feb	11-Feb	18-Feb	19-Feb	25-Feb	16-Mar
Species /Sites	1-3	1-3	4-7	1-3	4-7	1-3	4-7	1-3	1-3	1-3	1-3	1-3	1-3, 7
AK	6	5	6	7	4	5	6	2	2	3	1		25
BE										1			
BR											1		
BO	2	2		4		5		4	4	4	4	4	3
CH	2	1		1						1			3
CR		8	7	15	9	30	4	2	36				
FH	5	5	2	7	1	4	1	6	2	4	2	1	2
GE	1	1	2		1		1				1	1	1
GO													
LO													
MR								1			1		1
NH				1				1					
OS													
PF						2		1				1	1
PR	2				1		1		1		1		
RS	2		1		1		1	1			1		7
RT	17	7	14	10	11	12	13	4	8	6	16	5	47
SO													
SS													
SH													
TV	7	10	9	8	9	15	11	5	1	6	6		12
WK	2	1	2			1	1	1			1		8
ZT										1	1		
Total	**46**	**40**	**43**	**53**	**37**	**74**	**39**	**28**	**54**	**26**	**36**	**12**	**110**

***Notes:**

- Data surveys include three hours of observations by at least three biologists from 0900 – 1200
- 1-3 and 4-7 indicates observation at those numbered sites. Fifteen minutes of observations were conducted at each site during the period from 1200 – 1400 for site**s** 4-7.
- **The** 16 Mar survey was conducted by seven biologists from 0730 – 1200.
- Total number of observation hours for 2006: 34.5.

Figure 6b.
Number of Birds of Prey Observed at Sites 4-7 in Ramona Grasslands - 2006*



In 2006, a final survey was done on March 16 with seven biologists. This survey may not be truly comparable to others in the same year since it was later in the season when some spring migrants may have been passing north**,** many females who were incubating in January and February may have been off the nest and flying with their mates, and it represented an increased level of effort relative to the previous surveys. These are possible explanations for the larger totals of March 16 (Figure 7; Sites1-3 and 4-7). Figure 8 provides a breakdown of raptors observed over 3 weeks in January, at sites 4-7.

During all the above fluctuation in wintering raptors, the local resident population remains, basically, the same. Therefore, some of the numbers don't reflect the high variability from year to year in wintering birds (e.g., comparing red-tailed hawks vs. ferruginous hawks). Ferruginous hawks, therefore, are probably a better indicator of annual changes in the grasslands, in general, than are the resident red-tailed hawks. However, one must recognize that the numbers of ferruginous hawks we see wintering on the Ramona Grasslands are, to some unknown degree, a reflection of reproductive success on their more northern breeding grounds and survival during migration.

Figure 7.
Total Number of Birds of Prey Observed in the Ramona Grasslands - 2006

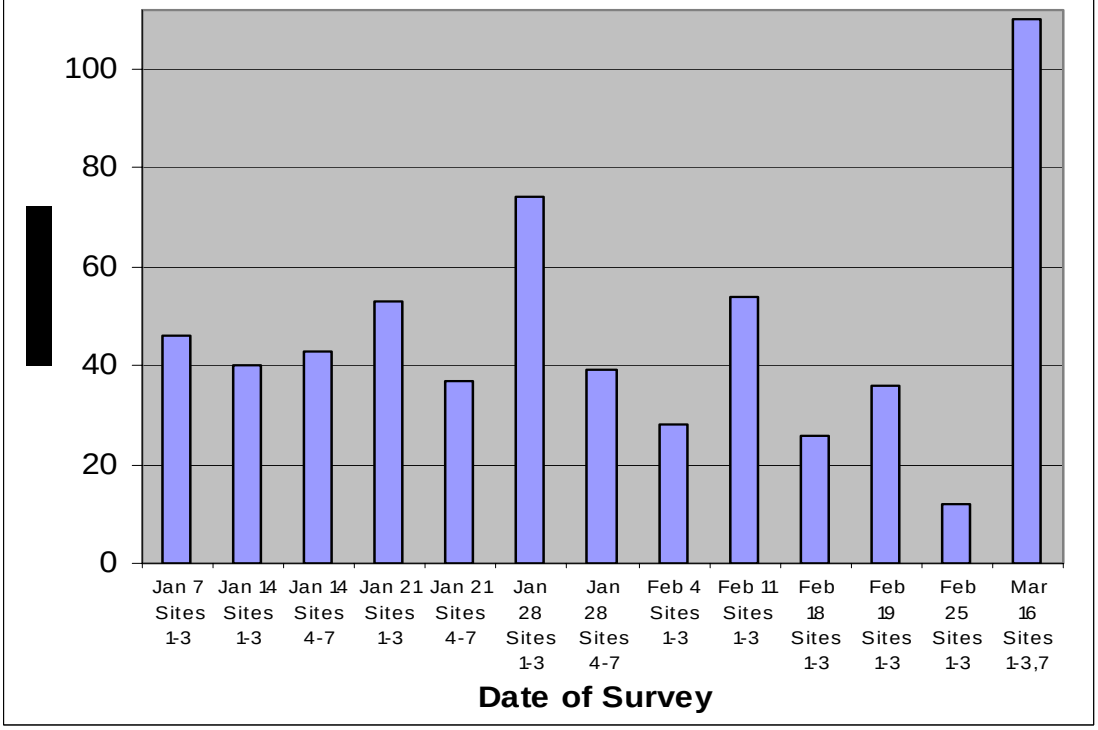
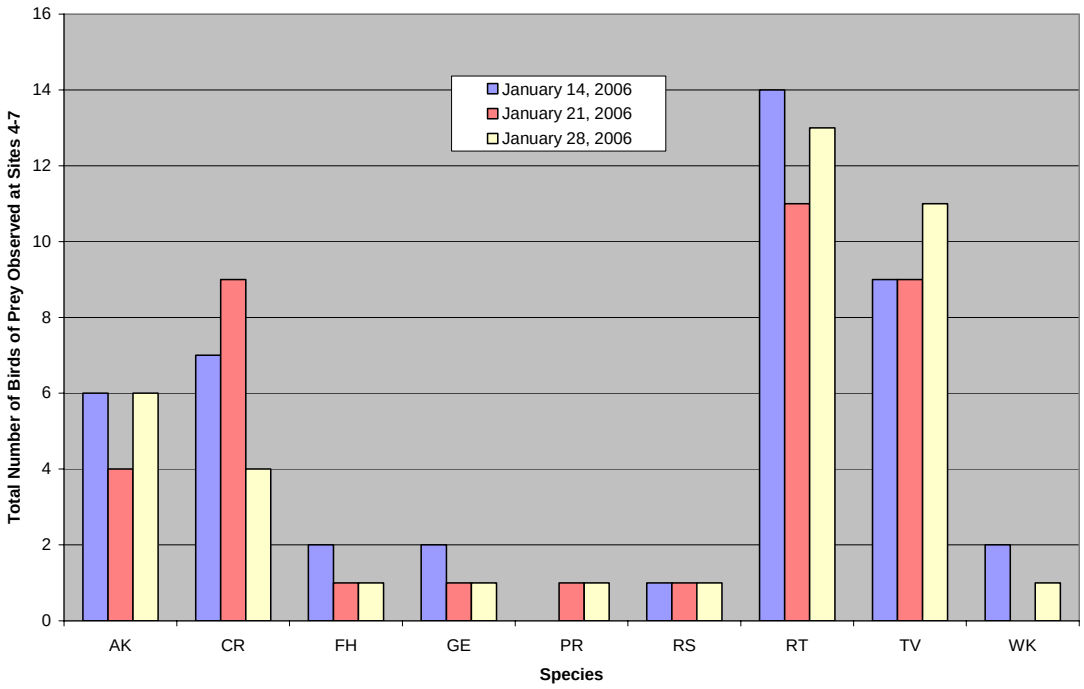


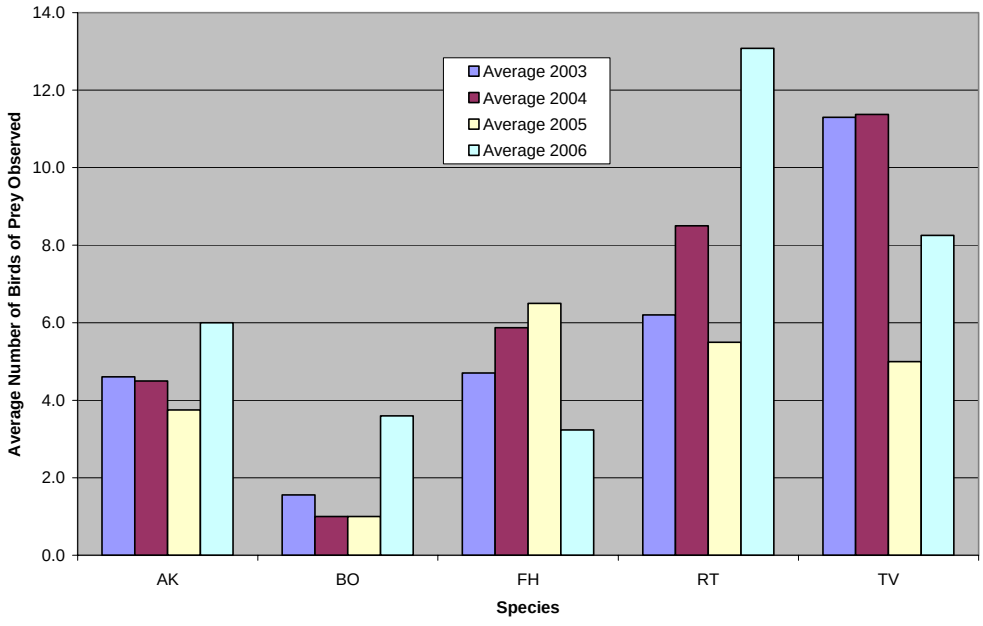
Figure 8.
Number of Birds of Prey Observed in Ramona Grasslands at Sites 4-7 by Week - 2006



Breeding surveys done for this project, and others done by WRI (WRI 2005a,b), all indicate that the resident breeding population remains relatively stable from year to year. Drought may lower the expectation of fledgling survival but preliminary data (Lincer and Bittner, 2005) from the 2003 Cedar Fire indicate drought and fire combined delayed nesting dates by 3-4 weeks but not fledging success of active nests. Neither did the drought change the breeding population of breeding pairs of hawks in either the drought-only areas and or the drought and fire areas (Lincer and Bittner, 2005).

Some San Diego eagles and some hawks begin courtship and nest building in December. This is a month before WRI begins their winter Hawk Watches. Wintering raptors on the Grasslands are a combination of resident and non-resident hawks, eagles, falcons, kites, owls, and vultures. The number of wintering hawks and eagles found on the Grasslands is limited, in part, by resident raptor territoriality (D. Bittner, pers. comm.). Figure 9 displays the average number of selected raptor species during WRI winter Hawk Watches for 2003-2006 (please note that the data collection methods for each survey year were slightly different).

Figure 9.
Average Number of Five Selected Raptor Species Observed Wintering in Ramona Grasslands During Hawk Watch (Sites 1-3) - 2003 through 2006

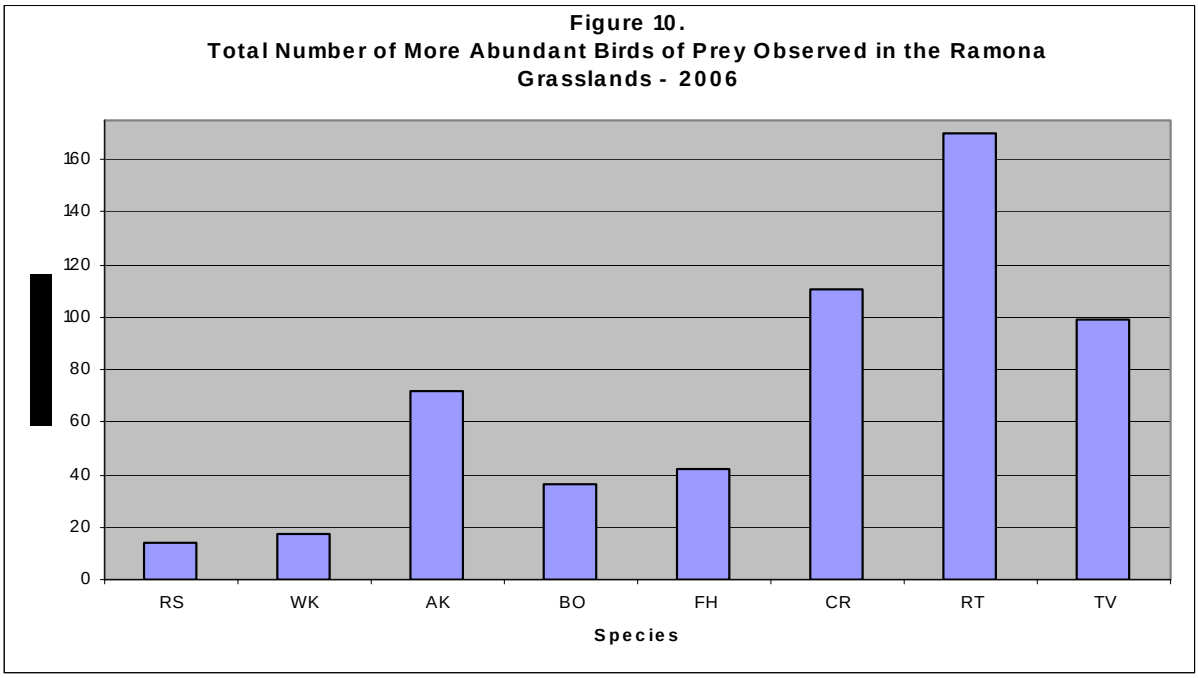


DISCUSSION

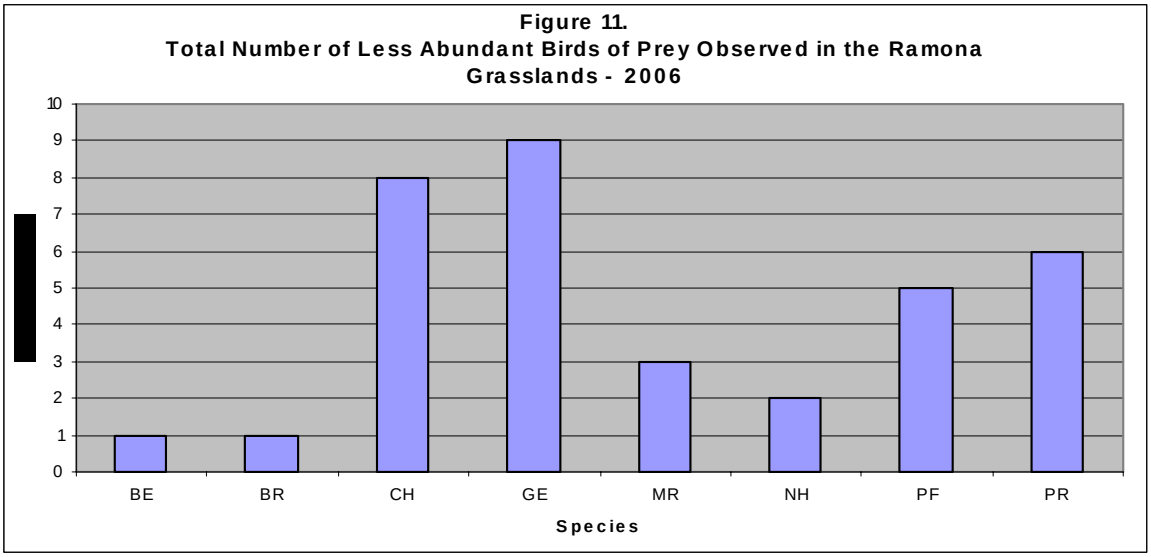
No survey of the wintering raptors of the Ramona Grasslands should be based on a single year of observation but should be an average of multiple years, which allows for variations in weather and other environmental variables. During the years that we are reporting on (2003-2006), the weather alone varied considerably.

Individual Species Considerations

Figures 10 and 11 display the numbers for the more and less abundant raptors, respectively, that were observed in the Ramona Grasslands.



Very few juvenile **red-tailed hawks** are present in the winter counts because the adult breeding pairs occupy almost all the available territories and drive out all other red-tailed hawks from their territories (D. Bittner, pers. comm.). This leaves little room for non-resident red-tailed hawks. Therefore, almost all the redtails counted in the Ramona Grasslands are breeding adults. This scenario is applicable to the red-shouldered hawk as well.



The **red-shouldered hawk** is a woodland species and occasionally frequents the open Grassland but more often occupies habitat all around the Grassland. Therefore, the frequency of red-shouldered hawks being observed is low in most of the tables. However, we can often hear these birds calling from the riparian woodlands while standing in the Grasslands. **Th**is hawk is a valuable (D. Bittner, pers. comm.) raptor to the Grassland community but will never be revealed as abundant in any survey done in the Grassland because it is not usually observed in the open areas.

The **ferruginous hawks** are not seen as competition by the abundant nesting red-tailed hawks so the red-tails do not show much interspecific aggression towards them. This allows a dense wintering population, as in 2005, when at least 22 ferruginous hawks were present at one time. These migrants from Montana, Utah, Northern Nevada and Northern California are the largest hawk in North America. The Ramona Grasslands is likely to become more important as this species continues to decline at both the regional and local level. Early research work in progress indicates that loss of good wintering grounds is a significant contributor to the decline (Bechard et al.1995).

Golden eagles are defending their territory against all potential competition during the winter Hawk Watches and winter survey time. Aggression has been observed any time a non-resident eagle appears in the Grasslands. The resident golden eagles usually chase others out within hours or days of their arrival in the Grasslands. Juveniles that are easily distinguished by their partial white tails and wing patches will be tolerated longer but all adults or sub adults are pursued

immediately upon sight. By February, the resident female is incubating; therefore, only one golden eagle will be seen in the Ramona Grasslands for at least half of the winter surveys.

Bald eagles are, occasionally seen wintering in the grasslands; most-recently, juveniles have been documented. This eagle is tolerated by the resident golden eagles better than other golden eagles since interspecific competition is not as strong as intraspecific competition. However, when bald eagles are feeding, the golden eagles will try to take away their food. Therefore, conflicts do arise over food and may cause some bald eagles to seek other foraging areas. In wet years, when there is an abundance of waterfowl on the Ramona Grasslands, bald eagles are seen more frequently.

Peregrine falcons are highly transient in their migration and wintering. Migrant peregrine falcons arrive in the Ramona Grasslands in August and continue to show up in small numbers throughout the fall and winter. Most peregrines continue on to Mexico, Central America or South America in migration for over-wintering. However, approximately 15-20 peregrines winter in San Diego County (WRI 2005) at the present time. Two or three of these will frequent the Ramona Grasslands on a regular basis. In 2006, two separate peregrine falcons were seen pursuing killdeer over the Ramona Grasslands.

The **American kestrel** is the smallest and most numerous of the falcons that occur in the Grasslands. During the winter months, several resident pairs and a few migrants take up territory and remain for the season.

Turkey vultures have a roost in the Ramona Grasslands in which about 30 individuals roost each night. These vultures fan out each day in a radius of about 15 miles searching for dead animals. Therefore, unless we count the roost just before dark**,** we are likely to only see 7-12 turkey vultures at a time in the Grasslands. When a large dead animal is in the grassland such as a stillborn calf or shot coyote there may be 25 or more vultures feeding on the carcass. During fall and spring migration, the roost may temporarily swell to 60 or more vultures then drop back to 30 in just a few days when those migrant birds move on. In the Ramona Grasslands, turkey vultures are year round residents. The fall migrants pass over San Diego and head to Baja and mainland Mexico in September and October. These same birds return back over San Diego in March.

The **merlin**, another true migrant, nests in northern pine forest and spends the winter in San Diego and points south. The Ramona Grasslands supports only a few of these fast flying, bird-eating hawks that are constantly on the move. Easily overlooked by the casual observer or mistaken for the smaller kestrel, merlins winter in numbers that are between zero and four in the

Ramona Grasslands. For several years, a light colored Merlin frequented the WRI headquarters. This merlin was seen by many at Hawk Watch during at least three winters.

White-tailed kites are highly variable in both their breeding and in wintering numbers in San Diego County, including the Ramona Grasslands. During the 2006 survey, they were in low numbers and just starting a breeding comeback. In 2005, as many as 29 white-tailed kites were observed roosting at one time on the Country Oaks Ranch in the Ramona Grasslands. More typically, two or three are seen if the entire Grasslands area is surveyed. In March of 2006, three pairs of kites produced at least nine young for a total of 15 kites in the Ramona Grasslands. This is the highest numbers since 2001.

The **Cooper's hawk** is not considered a grassland species. They are birds of the woods but are common in all the surrounding brush and woodland canyons around the Grasslands. The Cooper's hawk is one of the more common hawks observed between 7:00AM and 9:00AM in the areas surrounding the Grasslands. Even though the winter survey data counts indicate low numbers observed for this species, there are more around the edges of the grassland than the surveys indicate (J. Lincer and D. Bittner, pers. comm.).

Prairie falcons, like the peregrine falcon, are transient and mobile and only two or three winter in the Grasslands in any given winter. These falcons have responded to the presence of a trained falcon or a hawk flapping in the hand, which they are drawn to for competitive reasons or think they may have food. Most falcon observations have been of birds perched or low to the ground in pursuit of prey. However, most of the falcons high overhead are probably never counted.

Zone-tailed hawks are considered a rare breeding bird for San Diego County but are a casual visitor and show up in the Grasslands each year, usually in the company of turkey vultures. They probably occur more often than reported, since they mimic turkey vultures and are dismissed as such by many observers.

Northern harriers do not breed in the Grasslands at this time but they are a true grassland species and a winter migrant but they occur in low numbers in the Ramona grasslands. Individuals are present for only a day or two, which suggests that something in the Ramona Grasslands is missing at the present time for this to be a good wintering environment for the species.

The **great-horned owl** is the largest owl present in the Grasslands. There are only three pairs of great horned owls breeding in the grasslands. These owls are associated with red-tailed hawk pairs from which they extract a nesting platform each year by taking over the hawk's nest from

the previous year. Additionally, there are several other pairs in the Oak Woodlands surrounding the Grasslands. These residents and their young also make up the wintering population. These owls, like the eagles, nest early and prevent migrant owls from establishing winter territories.

Barn owls are mostly established due to artificial nest boxes, which are abundant in the study area. Ten boxes are known to WRI researchers, eight of which are occupied by owls. Barn owls do not responded to calls well and are difficult to count. They typically have three to five young usually in January or February. The best estimate for a wintering population is about 50 owls including young.

Burrowing owls are a native resident and a migrant. The population in the Grasslands is currently a combination of three to four wild migrants and WRI-introduced and wild-bred young from the introduced owls (J. Lincer and D. Bittner, pers. comm.). WRI reintroduced 16 (formerly captive and captive-bred) individuals into artificial burrows (ABs) in the spring of 2005. Two pairs produced 14 eggs and both clutches were predated. A third clutch (possibly, a recycling of one of the predated clutches) produced 5 eggs and 4 young, which we color-banded. Most over-wintered in the Grasslands. In the winter of 2006, there were at least ten burrowing owls in the Ramona Grasslands, forming at least 3 pairs in the spring of 2006, which used the ABs at WRI. Two pairs bred again in the WRI ABs, producing 9 young which WRI biologists color-banded banded this spring (2006).

The **goshawk** is a rare bird in the Ramona Grasslands. In March of 2002, one adult goshawk flew over the WRI headquarters in the Grasslands during the spring migration. On March 24, 2006, observers identified a juvenile and an adult goshawk on the Monte Vista Ranch Preserve just two miles south of the Ramona Grasslands. These hawks are only seen at rare intervals in migration in the Ramona Grasslands.

The **sharp-shinned hawk,** like the Cooper's hawk, is a woodland, bird eating, hawk that would not be expected to be seen in a Grasslands. The occurrence of sharp-shinned hawks is rare and quick. They are usually in migration or passing across the Grasslands to reach a wooded valley.

Management Considerations and Practices

The Ramona Grasslands support a unique assemblage of plants and animals that is important to the biodiversity of San Diego County. While hawks, owls and eagles are the subject of this report, several other sensitive and listed plants and animals also occur in these same habitats. One endangered animal is a rodent, the Stephens' Kangaroo Rat, which is occasionally eaten by owls.

One raptor species that is in decline and is listed as of special concern is the **ferruginous hawk**, which winters in the Ramona Grasslands in densities of up to 22 hawks in just over 5,000 acres. This is likely the highest density known in Southern California. The number of these hawks observed wintering in the Ramona Grasslands varies from 6-22 depending on weather, rain, and therefore food supply of appropriate rodents.

Another unique raptor to the grasslands is the **burrowing owl**. This species is in serious decline throughout its range with the exception of Imperial County, where roughly 70 percent of the remaining state's population can be found living under man-made and potentially ephemeral conditions. After 1999, no burrowing owls were known to breed in the Ramona Grasslands. Currently**,** there are 8-13 burrowing owls in the Ramona Grasslands. Most of these are as a result of owl reintroduction by WRI in cooperation with CDFG and the Service over the past two years.

During 2005-2006, 13 wild young burrowing owls were produced from four pairs with partial or total captive-bred history. Prior to that, WRI (2004-2005) breed 3 pairs in captivity released 7 adults and 9 young into artificial burrows in the Grasslands near their headquarters. WRI installed 30 artificial burrows to assist the reintroductions and all nesting has taken place in these burrows. Each year, at least three or four wild adults winter in the grasslands and, although the wintering owls were not banded, it appears that at least two may have stayed and bred with the WRI-released burrowing owls. Automobile collisions are currently the highest known cause of mortality with at least 5 car impacts from high speed driving on Highland Valley and Rangeland Roads.

High speed driving has a number of management concerns for wildlife and cattle, as well as for humans. Several cars wreck each year and break through the fences. Numerous utility poles and fences have to be replaced annually. In July of 2006, a grass fire of approximately 15 acres was started by a high-speed driver who lost control on two turns then broke through a wooden fence, colliding with a well causing the car to catch fire. In August 2006, another car hit an electric pole then crashed through a barbed wire fence. Each year hundreds of small mammals and birds are

killed by automobiles on Highland Valley Road, alone. Among these are the already-mentioned burrowing owls, great-horned owls, red-tailed hawks, turkey vultures, and long-tailed weasels. Wildlife and school crossings, in addition to the Grasslands Preserve status, should give some leverage to getting the speed reduced on Highland and Rangeland Roads. We feel that much of the danger to wildlife and humans can be significantly reduced and most local residents would support such an effort.

The Ramona Grasslands supported two pairs of golden eagles until 2003. The Santa Maria Creek on the Cagney Ranch was the approximate boundary between the two pairs. One pair, known as the Iron Mountain Pair, nested on Sole Peak, which is in Poway but overlooks the Ramona Grasslands. This pair foraged on Cagney Ranch, Esquilargo, the ranches south of State Route 67, and Cumming Ranch in the Ramona Grasslands. Due to continuous nest disturbance on Sole Peak by climbers and hikers since1996 and the 2003 Cedar fire, which burned the nest sites, no nesting attempts have occurred since 2003 (D. Bittner, pers. comm.). The last successful year when young were fledged was 1998. After that, each nesting attempt was met with human disturbance (D. Bittner, pers. comm.)., leading to nest failure. WRI, under contract, will reconstruct the nests on Sole Peak in 2006 to stimulate new eagles to assume the territory.

The second pair of golden eagles nests on private land in Bandy Canyon. The future of this pair's primary foraging area is being secured by the grassland acquisitions lead by TNC. The nest cliffs are being secured by legal negotiations with the landowner and the county to place a conservation easement on the cliffs. Planning proposals currently being considered for future implementation will jeopardize the golden eagles nesting success. Trails proposed through Bandy Canyon will expose to the general public a beautiful waterfall and an impressive set of cliffs. These two natural wonders will act as magnets to attract climbers and swimmers. The word of mouth club and books like Jerry Shads "Afoot and Afield in San Diego" will encourage people to recreate and hike in these areas. Once the public is exposed to, and has knowledge of, these areas, enforcement to prevent access to climbers and swimmers will be impossible.

Two young eagles were "hacked out" by WRI in 2006 in the Ramona Grasslands. The initial hacking effort was supported by The Nature Conservancy, Institute for Wildlife Studies, The National Park Service, and CDFG. One of the eagles was brought from Santa Cruz Island as part of an effort to preserve the endangered Island Fox while the second was a runt being starved by an older sibling. It is possible that this effort could start some new nest area fidelity if these eagles survive to maturity.

Poisoning of ground squirrels has been, and still is, a significant factor in the mortality of some raptor species. Poisoning under the guise of agriculture is legal and also lethal to squirrels and

those animals unfortunate enough to capture and eat a recently-poisoned squirrel. Even at the Wild Animal Park, several eagles and vultures have been accidentally killed by the poisoning of ground squirrels (D. Bittner, pers. observation). In San Diego County, WRI has found poisoned eagles in the nest and in fields after ingesting a squirrel with a mouth and belly full of poisoned grain. The Ramona Grasslands has a long history of poisoning ground squirrels and poison on nearby private land affects raptors throughout the Grasslands. Cooperative agreements should be made so that all understand the need and feel that they are doing a good deed by cooperating. Providing barn owl boxes and establishing other raptor artificial nesting and perching structures might be a way to get cooperation and avoid poisoning by letting nature's predators control the rodent population.

Often the fear of regulatory constraints, as a result of having a sensitive species on the land will lead to landowner actions that decrease the suitability of that land. For instance, after WRI suggested using a city-owned mitigation site for the City of San Diego to reintroduce burrowing owls, the local tenant farmer, not wanting to be restricted by burrowing owls, poisoned the site, killing hundreds of ground squirrels in a few days. Where there was a colony of hundreds of squirrels there now exist none. What could have been a successful reintroduction of burrowing owls on City-owned land is now a biological desert.

Ground squirrels and gophers make up the significant biomass that supports the large raptor population in the Ramona Grasslands. Good management of the grasslands will allow for the expansion of the ground squirrel population so that the coyotes, bobcats, and raptors have a chance to eat and help maintain a balanced ecosystem. Eventually, enough ground squirrel burrows will exist such that artificial burrows for burrowing owls may not be necessary.

Shooting coyotes and bobcats, although legal in the state, has changed the balance of nature in the Grasslands. Individuals have claimed to shoot over 35 per year in the grasslands (D. Bittner, pers. comm.). Due to the efforts of WRI and several citizen volunteers, shooting has declined but not stopped completely. Since foxes, bobcats and other animals have been found shot it is assumed that badgers and other species that occasionally appear in the grasslands may be held back from developing a population by frequent shooting. One incident reported and photographed by a WRI member even involved scalping of the coyote. There are local individuals who feel that this area is their life long hunting area and it is going to take vigilance, consequences, and enforcement to change their habits.

Electrocution on distribution power lines has been, and continues to be, a leading cause of death for many raptor species especially the larger species. In the Ramona Grasslands, the San Diego Gas and Electric Company (SDG&E) has cooperated by placing insulators on the center

conductors and placing insulating rubber over jump wires leading to transformers. Poles with transformers are responsible for 67% of all raptor electrocutions (*in* WRI 2000, APLIC 1996). Poles with transformers make up less than 15% of all poles. However, the Ramona Grasslands still have electrocutions and line strikes that occasionally kill hawks and eagles. Poles should continue to be identified and reported to SDG&E if they pose a threat to any raptors.

Tree removal/replacement to eliminate exotics should be planned over a long period of time to allow for native trees to attain a size large enough to accommodate nesting raptors. The Hardy Ranch, at the east end of the Cagney Ranch, for example, has red-tailed hawks, red-shouldered hawks, white-tailed kites, Cooper's hawks and great-horned owls nesting in eucalyptus trees in two woodlots. Even Vermillion flycatchers occur in the southeastern portion of the woodlot. Rapid removal of these exotics would leave these species without a nesting substrate. Planting of native oaks and cottonwoods among the eucalyptus and selective thinning would eventually allow for the total removal of the eucalyptus trees. This may be a 40-50 year management plan but allows all wildlife species to thrive as Man tries to undue 200 years of his mismanagement.

Artificial nesting structures are desirable for many species and some raptors can thrive in these structures. American kestrels, barn owls, great-horned owls and screech owls all suffer from Man's cutting and removal of big dead trees with hollows. Unfortunately, it takes decades and centuries to produce new trees with these natural hollows. Burrowing owls also take well to artificial structures and reintroductions at WRI are proving their worth in reintroducing the owls to the Grasslands. Additional structures should be considered throughout the Grasslands to help this and other species regain a foothold and stabilize a self-sustaining population.

Reintroduction of extirpated species should be considered for select species that have a high degree of probable success. In addition to the burrowing owl, another possible raptor species for consideration is the Swainson's hawk. This is a species listed in the MSCP as a species to monitor and is no longer a breeding bird in San Diego County. The Swainson's hawk was once a common hawk in San Diego County's grasslands. This, and other species, merit consideration for reintroduction.

Trails for public access need to be carefully considered *before* they are located and opened. Once a trail is opened the public, the public will not so easily take to closing them. Wildlife should take first priority before trails and the public's right to access the Grasslands. The Grasslands, like all San Diego County lands will be part of the MSCP, and eventually protected under permits from the U.S. Fish and Wildlife Service and the California Fish and Game, and County of San Diego ordinances. The goal of the MSCP and other HCPs is to provide sufficient space and habitat so that San Diego County will have all of its wildlife and plant species in 50

years and still have development in other designated, but less environmentally sensitive, locations. In reviewing the San Diego MSCP, which is the model for the North County MSCP, under which the Ramona Grasslands will be preserved, preservation of wildlife and plant diversity is the stated goal. Losing sight of this master goal could cause great legal and ethical repercussions.

The Grasslands have seasonal requirements that apply to raptors as well as other sensitive species. Wintering hawks and owls and resident nesting golden eagles will not continue to use the Grasslands if they are harassed from perch to perch by hikers, horseback rider, or bikers. Some resident nesting hawks such as red-tailed hawks are much more tolerant of people but it is contrary to the MSCP goals to limit the raptor species in this preserve to a few people-tolerant species at the exclusion of all others.

Species such as the ferruginous hawk arrive from their northern nesting grounds as early as September but most arrive in November/December and stay until late March. During these five months, these hawks should be allowed to rest and forage without disturbance by public access across the grasslands. Currently, observation of almost the entire grasslands can be made from public roads on both the east and west ends of the valley. Therefore**,** if a few carefully placed viewing locations were established, no one would be denied the privilege of observing the Grasslands and its biodiversity if there was no new trail access.

Limited, hosted excursions into the grasslands might also be a possibility that could satisfy the public access issue. Seasonal closures are another possibility but these would not solve the disturbance at the golden eagle nesting area. WRI is engaged in a long-term monitoring project of the San Diego golden eagle population (now going into its 18th year). One of the facts we have learned is that golden eagles will often fly from the nest at a distance of ½ mile if a person on foot approaches a nest site. Three temporally related things happen when eagles are disturbed at a nest site.

- First, from December through January, nest building is occurring. During this period, disturbance can cause nest site abandonment and the loss of reproduction for a year.

- Second, from late January through March, eagles are incubating (42-day incubation). Disturbance during this time can cause chilling of the egg resulting in embryonic development problems and death of the embryo. Ravens can also see the female leave the nest and eat the eggs while she is off the nest. These actions, again, result in the loss of reproduction for the entire nesting season.

- Third, from March through May, very small eaglets are in the nest and are subject to chilling and death if really small, predation by hawks, ravens and even great-horned owls if the eagle is flushed late in the day. In late May and June, the eaglets are big enough to thermoregulate and protect themselves but are entirely dependent on the adults for food until July.

Therefore, the only time that the eagles would not be disturbed at the nest site would be August through November and even then they roost on the same cliffs on which they nest. There is a reason that golden eagles have declined by 50% in San Diego County and that is, of course, people**.** Failure of the Ramona Grasslands managers to recognize the problems people will create by having too much access will result in a net loss of wildlife species, decreased diversity, and the failure of the preserve to provide the wildlife reserve environment for which it was established.

Fencing is necessary for many reasons but the goal should be to minimize all fencing to that which is absolutely necessary. They say good fences make good neighbors. However, two reasons for minimizing fencing is to keep the Ramona Grasslands aesthetically pleasing to the viewing public, and second to allow wildlife to move freely throughout the grasslands. Barbed wire fencing can be lethal to wildlife and we have documented golden and bald eagles, pronghorn mule deer, white-tailed deer coyotes and dogs all hung to die by getting their legs and wings wrapped in barbed wire while jumping over or pursuing prey through the fence (D. Bittner, pers. comm.). Grazing should be controlled in certain areas but permanent fences may not be the answer in all cases.

RECOMMENDATIONS

The following recommendations are meant to be applicable to more than just the Cagney Ranch and environs. If initially applied to the more limited Cagney area, however, the techniques can be fine-tuned, as part of a pilot effort, before they are applied to the Ramona Grasslands, as a whole.

1. Reduce vehicular speed limits on major roads that traverse the Grasslands.
2. Discourage the poisoning of California ground squirrels and other small mammals. Provide natural control alternatives through the installation of nest boxes for barn owls, screech owls, and kestrels and artificial burrows for burrowing owls. Provide guidelines for proper application of chemicals, where they are absolutely necessary, with the objective of minimizing mortality to non-target species.

3. Minimize shooting of coyotes, raptors (e.g., red-tailed hawks, turkey vultures, golden eagles), and other wildlife by posting "No Hunting" signs and encouraging the public to report those who are observed needlessly killing protected wildlife.
4. Post educational signs that explain what is being done to properly manage the Grasslands and why.
5. Continue to work with SDG&E to make relevant utility poles "raptor safe."
6. Establish a local public call-in program, which would allow the citizenry to report raptor electrocutions, illegal shooting, and other management problems that need to be dealt with in a timely manner.
7. Develop a long term Tree Management Plan that would address the timely planting of native oaks, cottonwoods, willows, sycamores, etc. and the scheduled removal of eucalyptus and other exotics, as these natives achieved a functional size. There are several other potential actions, but the carrying capacity of the Grasslands for tree-nesting raptors could be substantially increased by simply adding several well-placed, and well-separated, trees throughout the open spaces
8. Consider comprehensive re-introduction programs for burrowing owls, ferruginous hawks, golden eagles, Swainson's hawks, badgers, black-tailed jackrabbits, and perhaps other species that where previously more common throughout the Grasslands.
9. Do not commit to any trail system prematurely. Locate pedestrian and equestrian trails that are consistent with MSCP permitting, only *after* the appropriate site-specific and species-specific risk assessment analyses have been conducted by professionals and reviewed by third-party peers and/or a Scientific Advisory Committee.
10. Limit fencing to that absolutely necessary to implement resource management.
11. Continue the acquisition of Grasslands properties (and adjoining habitats that provide a management buffer) from willing sellers.
12. Initiate a coordinated public education program, which would include the above concepts. Presentations should be made through the local school programs, field trips, the Ramona Country Fair, the Ramona Rodeo, WRI's annual Hawk Watch, etc.

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APPENDIX A

WRI's Involvement In The History Of The Ramona Grasslands Preserve

From the first days of preservation efforts for the Ramona Grasslands it has been about Birds of Prey (i.e., raptors). These raptors still are a driving force for most of the people working many thousands of annual volunteer hours to make the Ramona Grasslands a preserve.

In 1988, Dave Bittner arrived in Ramona looking for a house. Being totally unfamiliar with the area he was just driving around when, on what is now Esquilargo, he observed two juvenile Golden Eagles foraging and being attacked by red-tailed hawks. Across the road two adult Golden Eagles were soaring over the Oak Country Ranch then proceeded to Cagney Ranch and, after being joined by the two juveniles, all four departed for Davis-Eagle Ranch. Further down Highland Valley Road, he saw four more Golden Eagles on the Cummings Ranch (2 adults and 2 juveniles). This total of 8 Golden Eagles, which were from the Bandy and Iron Mountain Golden Eagle territories, has not been seen since. The year 1988 appears to be the last year both Bandy and Iron Mountain Golden Eagles pairs fledged two young each in the same year. This day marked the beginning of Mr. Bittner's and WRI's interest in saving the Grasslands for future generations.

In the late 1980s Fred Sproul, botanist and naturalist, and Tom Stephen, a falconer, started a Raptor Watch under a non-profit called the Iron Mountain Conservancy. This modest public event started with four people and grew. In 1990, Dave Bittner, wildlife biologist, joined them in their efforts and the crowds grew to as many as 30 people and the press started to pick up on their efforts. The seeds of public awareness were beginning to be planted.

When Dave Bittner and Dr. Jeff Lincer, wildlife biologist, formed the Wildlife Research Institute, Inc. (WRI) in 1996, they were approached by Fred Sproul and Tom Stephen to take over the raptor watch. The name was changed to "Hawk Watch" and is now conducted 10-20 times a year and in 2006 had as many as 219 people at a single Hawk Watch, with a season's total in excess of 1400 people. Newspapers, TV and radio cover the event each year. Because hawks and eagles are visible to the public during daylight hours, Hawk Watch has become the principle public awareness vehicle for preserving the grasslands.

In the early 1990s, the County of San Diego proposed an expansion of the Ramona County Airport. This included an expansion of the airports infrastructure, expansion of service levels of the airport, an extension of the runway, industrial parks, new roads that would traverse the grasslands, and other developments that were found by the local people of Ramona to be very objectionable. Carol Angus, a local resident, organized a citizens' group to fight this development by the county and hired an attorney.

After several years of negotiations and compromises, the County of San Diego backed down on some of their plans and limited the development and runway expansion to that necessary for safety. Then the U.S. Fish and Wildlife Service (Service) was advised by a local Ramona biologist that the endangered Stephens' Kangaroo Rat was present on the site and this further altered the county's plans for airport expansion.

In 1996, WRI and Carol Angus's citizens' group combined efforts to begin a coordinated effort to preserve the area now known as the "Ramona Grasslands." Preliminary wildlife and plant studies were gathered and a plan with maps was put together. This was first presented to The Nature Conservancy in their Temecula Office in 1996. No immediate action resulted from that meeting but a long campaign began to get out the word and educate local authorities of the Grassland's importance.

In June of 2000, WRI called a meeting of all agencies and interested parties to hear a presentation about the Ramona Grasslands. The attendees at this meeting, held at the California Fish and Game (CDFG) office on Viewridge Dr., included CDFG, the Service, Trust for Public Lands, The Nature Conservancy, Endangered Habitat League, County of San Diego, Vernal Pool Society, Wildlife Research Institute, National Wildlife Refuge System, California State Parks, and others. After the WRI formal presentation, The Nature Conservancy representative asked if they could take the lead on the effort to preserve the Grasslands and from that meeting a cooperative effort began between several governmental agencies and non-profits to preserve the Grasslands.

That same year, Tom Carr and Janet Gilbert, local concerned Ramona residents, bought the 10-acre Carlson residence in the middle of the Cagney Ranch. Tom and Janet then offered to sell the property to WRI as a location to continue our efforts to preserve the Ramona Grasslands. In October of 2000, WRI purchased the now WRI Grassland Headquarters on Highland Valley Road and turned it into their headquarters for wildlife research, public education, and preserving the Ramona Grasslands. The Cagney Ranch was the first large parcel bought for the Ramona Grasslands. WRI is currently in the process of accepting fee-simple ownership, and assuming long-term management and monitoring, of lands within the Ramona Grasslands.

Appendix B
ACRONYMS and DEFINITIONS

Raptor and Corvid Species

AC American crow
AK American kestrel
*BE** *BALD EAGLE*
BH black hawk
BR barn owl
*BO** *BURROWING OWL*
*CH** *COOPER'S HAWK*
CR common raven
FH* **FERRUGINOUS HAWK**
GE* **GOLDEN EAGLE**
GO ***great-horned owl***
HH Harris' hawk
LO long-eared owl
MR merlin
*NH** *NORTHERN HARRIER*
OS osprey
*PF** *PEREGRINE FALCON*
PR prairie falcon
RS red-shouldered hawk
RT red-tailed hawk
SE short-eared owl
SO screech owl
SS sharp-shinned hawk
*SH** *SWAINSON'S HAWK*
TV turkey vulture
UA unidentifiable accipiter
UB unidentifiable buteo
UF unidentifiable falcon
UR unidentifiable raptor
WK white-tailed kite
ZH zone-tailed hawk
WH white-tailed hawk

Other Abbreviations

AB active burrow
Ad adult
CN cavity nest
F female
HY hatching year (when a bird is in its first year; i.e., the same calendar year as hatched).
Imm immature (a non-specific term that means "not adult").
M male
Mel melanistic (black/dark)
Ruf rufous/reddish
Sa subadult (plumage that precedes adult plumage and appears much like it but with some characters that are not in adult plumage; used only for species, like the golden eagle, that can be distinguished at this age).
SN stick nest.
U unknown (e.g., unknown age or sex).

APPENDIX C

Biological Survey Report for the Ramona Grasslands Preserve (RECON 2005)

Biological Survey Report for the Ramona Grasslands Preserve, in Ramona, California

Prepared for

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TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS (CONT.)

ATTACHMENTS

1.0 Summary of Findings

In accordance with the Management and Monitoring Plan for Ramona Grasslands Open Space Preserve (Preserve), RECON conducted Year 1 removal of invasive non-native plants on the Cagney, Hardy, Hobbs, Ramona Airport, Cummings, Oak Country Estates, and a portion of the Voorhes Lane properties. In addition, RECON measured vernal pool hydrology and conducted focused surveys for fairy shrimp and amphibians (including arroyo toad) on the Cagney, Hardy, and Oak Country Estates properties.

The target species for invasive plant removal included artichoke thistle (*Cynara cardunculus*), intermediate wheatgrass (*Elytrigia intermedia*), giant reed (*Arundo donax*), and salt cedar (*Tamarix* sp.). Additional invasive species treated include milk thistle (*Silybum marianum*), Italian thistle (*Carduus pycnocephalus*), and perennial pepperweed (*Lepidium latifolium*). These species were treated using various combinations of hand removal and herbicides to achieve the best results, while protecting many sensitive flora and fauna on the Preserve.

Fairy shrimp were observed in 12 of the 19 vernal pools studied, 11 of which contained the federally endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*). The remaining pool contained immature fairy shrimp too young to identify, but were most likely San Diego fairy shrimp.

Arroyo toads (*Bufo californicus*) were observed or detected at five locations in Santa Maria Creek. These locations were west of Rangeland Road, on the Oak Country Estates property. Western spadefoot toad (*Spea hammondii*) tadpoles were observed in 9 of the 19 vernal pools studied. Pacific tree frog (*Hyla regilla*) tadpoles were observed in three pools, and western toad (*Bufo boreas*) tadpoles were observed in eight pools. Many of these tadpoles successfully matured to toadlets prior to the pools drying.

In addition to the invasive plant species removal and focused wildlife species surveys, vernal pool hydrology was monitored. Vernal pool water depth was monitored weekly, water temperature was measured bi-weekly (in conjunction with the fairy shrimp surveys), and dissolved oxygen levels were measured monthly.

2.0 Introduction

In 2003, the State Water Resources Control Board awarded a Proposition 13 grant for the Santa Maria Creek Protection and Restoration Project, to the County of San Diego for the protection and restoration of a portion of the Santa Maria Creek that flows through the grasslands of the Santa Maria Valley, downstream and west of the community of Ramona (Attachment 1: Figures 1 and 2). The grant provides funds for

acquisition of the former 390-acre Cagney Ranch, which supports grasslands, 23 alkali playas, 45 vernal pools, and 0.6 mile of riparian habitat. The Cagney Ranch acquisition will form the nucleus of San Diego County's Ramona Grasslands Preserve. The grant also funds restoration of the wetland habitats and their watersheds within the Preserve. Overall, the project aims to maximize the spatial and temporal scale of the resource protection and restoration in the grasslands area.

The grant required that a restoration and a habitat monitoring and management plan be developed. The Conservation Biology Institute (CBI) prepared the Framework Management and Monitoring Plan for Ramona Grasslands Open Space Preserve (2004a) and a Restoration Plan for Santa Maria Creek Watershed Management Unit (CBI 2004b), through funding provided by The Nature Conservancy. In accordance with these Plans, RECON conducted Year 1 removal of invasive non-native plants on the Cagney, Hardy, Hobbs, the Ramona Airport, Cummings, Oak Country Estates, and a portion of the Voorhes Lane properties (Attachment 1: Figure 3). In addition, RECON measured vernal pool[1] hydrology, and conducted focused surveys for fairy shrimp and amphibians (including arroyo toad) on the Cagney, Hardy, and Oak Country Estates properties.

3.0 Survey Methods

3.1 Invasive Non-native Plant Removal

Invasive plant species (and their locations) to be treated were previously identified under the Framework Management and Monitoring Plan for Ramona Grasslands Open Space Preserve (CBI 2004a) and a Restoration Plan for Santa Maria Creek Watershed Management Unit (CBI 2004b). These species, or target species, previously identified for removal included artichoke thistle, intermediate wheatgrass, giant reed, and salt cedar. In addition to the target species' locations previously identified, RECON mapped and treated new locations.

Other invasive plants species identified by RECON to be treated included milk thistle, Italian thistle, and perennial pepperweed. These species' locations were mapped and treated in addition to the target species.

[1] Throughout this document, unless otherwise specified, the term "vernal pool" or "pool" includes the vernal swales and alkali playas that were included in the study.

3.1.1 Invasive Plant Removal Restrictions/Limitations

On a project that requires the cooperation of many different landowners, significant coordination and communication is required to insure that all parties understand the process and accept the benefits and risks of spraying herbicide. As this was the first year of invasive plant removal, coordinating with the landowners took some time. Consequently, many of the Voorhes Lane properties were not treated until August and September.

Another issue encountered this spring was the frequency of rainfall occurrences. Herbicide spraying was not conducted when vegetation was wet, or when precipitation was anticipated within 48 hours. The field crew had to reschedule treatments a number of times due to unsuitable spraying conditions, which delayed the overall treatment schedule.

3.1.2 Methodology

Invasive plants were found throughout the Preserve properties, often times along-side sensitive or rare biological resources. Due to the sensitive nature of many flora and fauna on-site, extra care was taken when determining what methodologies for invasive plant removal would be used. RECON restoration biologist Bruce Hanson met and consulted with Mike White (from CBI) and Mike Kelly (Kelly and Associates) on a number of occasions to discuss the most efficient and effective methods of invasive species removal, while considering the sensitive biological resources on-site.

A mixture of weed removal by hand and herbicide use was employed to accomplish the invasive plant removal objectives. The target species for removal included artichoke thistle, intermediate wheatgrass, giant reed, and salt cedar. The properties with the largest numbers of these species, such as the Ramona Airport property, Cagney Ranch, Hardy, and Oak Country Estates, were treated first. The remaining invasive species, including milk thistle, Italian thistle, and pepperweed, were removed as time allowed.

Herbicides used for invasive plant removal included Transline® and AquaMaster™. Transline®, or clopyralid, is a selective, broadleaf herbicide that provides excellent control of many tough broadleaved invasive plants, yet is tolerant to a wide variety of herbaceous and woody plants, including grasses. It is applied as a foliar spray and translocates throughout the plant to the root system, thereby reducing the potential for re-sprouting in perennial plants. It is active in controlling invasive plants, particularly in the Asteraceae and Fabaceae families (Carrithers 1997).

AquaMaster™, a glyphosphate isopropyilamine salt herbicide, is a non-selective aquatic herbicide that controls emerged vegetation in and around bodies of fresh and salt water. When applied correctly, AquaMaster™ can be used without unreasonable adverse effects to human health or the environment (Monsanto 2002).

3.1.1.1 Artichoke Thistle (*Cynara cardunculus*)

Artichoke thistle, a California Invasive Plant Council (Cal-IPC) List A-1[2] species, is a spiny thistle of the sunflower family, crowned by a cluster of showy, bright purple thistle flower heads (Bossard et al. 2000). This species is native to the Mediterranean and was introduced to California for ornamental and culinary uses; artichoke thistle spreads in the wild through rapid seed dispersal.

A pilot herbicide treatment study was conducted on the Ramona Airport, Hobbs and Hardy properties to determine the most effective herbicide concentration and/or mixture to control artichoke thistle, while protecting the sensitive resources nearby. Treatment types studied included: 2 percent AquaMaster™; a Transline® (0.25 percent) and AquaMaster™ (2 percent) mixture; 0.25 percent Transline®; and 0.50 percent Transline®. On the Cagney Ranch, both 0.25 percent and 0.50 percent concentrations of Transline® were used. On the Oak Country Estates, the Transline®/AquaMaster™ mixture was used.

3.1.1.2 Intermediate Wheatgrass (*Elytrigia intermidia*)

Intermediate wheatgrass is a sod forming wheatgrass introduced from Russia. This species was introduced to the U.S. as a crop for pasture and hay production (Magness et al. 1971 as cited in Purdue University 2005).

One large patch of intermediate wheatgrass was found on the eastern edge of the Hardy property. This patch was immediately adjacent to a vernal swale, and was also intermixed with southern tarplant (*Centromadia parryi* ssp. *australis*). Much of the annual grasses surrounding the intermediate wheatgrass were removed by hand, and then the intermediate wheatgrass was sprayed with AquaMaster™.

A second small patch of intermediate wheatgrass was found on the Cummings parcel. At the time of removal, the property owner allowed weed removal as long as no herbicides were used. This patch of intermediate wheatgrass was removed by hand.

3.1.1.3 Giant Reed (*Arundo donax*)

Giant reed, a Cal-IPC List A-1 species, is a robust perennial grass nine to thirty feet tall, growing in many-stemmed, cane-like clumps (Bossard et al. 2000). Native to the Mediterranean, this species was introduced to North America where it was harvested for roofing material and musical instruments. Giant reed spreads vegetatively, either by rhizomes or fragments.

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[2] List A-1 includes the most invasive and damaging species that are widespread in California.

Giant reed was removed from Santa Maria Creek on two Voorhes Lane properties, Osbourne and Leggitt, using hand removal and herbicide treatment. The giant reed was first cut off at the base and the removed material was hauled away from the site. The remaining stumps were then coated with AquaMaster™ to prevent re-sprouting.

3.1.1.4 Salt cedar (*Tamarix* sp.)

Salt cedar, a Cal-IPC List A-1 species, is many-branched tree less than 26 feet tall with small scale-like leaves that have salt glands (Bossard et al. 2000). Native to central Asia, this species was used widely in the western United States for erosion control, windbreaks, shade, and ornamental purposes.

Salt cedar was removed from Santa Maria Creek on four Voorhes Lane properties, Dorrah, Berthiaume, Osbourne and Leggitt, using hand removal and herbicide treatment. The salt cedar was first cut off at the base and the removed material was hauled off-site. The remaining stumps were then coated with AquaMaster™ to prevent re-sprouting from occurring.

3.1.1.5 Milk thistle (*Silybum marianum*)/Italian thistle (*Carduus pycnocephgalus*)

Milk thistle, a noxious weed, is a biennial thistle with stout, ridged, and generally branching stems up to six feet tall (Whitson et al. 1996). Native to Europe, this weed was introduced for medicinal purposes and has become widely distributed throughout the western U.S.

Italian thistle, a Cal-IPC List B[3] species, is an annual thistle with pink to purple flowers and leaves that are white-wooly below and hairless-green above (Bossard et al. 2000). Native to the Mediterranean, southern Europe, North Africa to Pakistan, this species was accidentally introduced to the U.S. in the 1930s.

Treatment of milk thistle and Italian thistle took place in August and September 2005, after the primary invasive species of concern were treated. At the time of treatment, after the thistle had set seed, physical removal of the plant material was determined to be the most effective method of treatment as it was too late in the annual reproductive cycle of the thistle for herbicide to be effective. All aboveground plant material was removed, including seed that was raked from the ground in the surrounding areas, and disposed of off-site.

[3] List B includes less invasive species that move into and degrade wildlands.

3.1.1.6 Pepperweed (*Lepidium latifolium*)

Perennial pepperweed, a Cal-IPC List A-1 species, is a multi-stemmed herb that grows three to eight feet tall. Native to Eurasia, this species may have been introduced to California in the 1930s as a contaminant of sugar beet seed (Bossard et al. 2000).

Two patches of pepperweed were mapped in August 2005. One patch was found on the Ramona Airport property, east of Airport Road. The second patch was on the Cummings property. These patches were sprayed with AquaMaster™ in September, after the Cummings property owner consulted with a biologist and allowed spraying to be conducted on his property.

3.2 Fairy Shrimp

3.2.1 Survey Methodology

Prior to initiating surveys, RECON biologist Cheri Kim attended an on-site kick-off meeting with representatives from the County of San Diego Department of Public Works and Parks Departments, CBI, and the Wildlife Research Institute. During this meeting, specific vernal pools, alkali pools, and vernal swales were identified for study. For continuity, RECON used the existing numbers created by EDAW to identify the individual pools. Vernal pools studied included: r24, e44, e45, e46, e52, e53, e54, e56, e58, e59, e62, and e77. Pools within vernal swales include ev1, ev2, vs1, vs2, vs3, and vs4. Alkali playa “Raap 100” was also included in the study. Raap 100, vs1, vs2, vs3, and vs4 were not previously identified or numbered by EDAW, but were identified during the kick-off meeting for inclusion.

Focused surveys for listed fairy shrimp species, such as the San Diego fairy shrimp, were conducted by Cheri Kim under RECON’s U.S. Fish and Wildlife Service (USFWS) permit #TE-797665. Survey dates and personnel are shown on Table 1. Surveys were conducted according to USFWS survey guidelines (USFWS 1996) every two weeks, starting January 21, 2005 and ending April 1, 2005. During each survey, the following steps were followed at each pool:

1. Prior to disrupting the water surface of the pool, if the view was relatively clear and unobstructed, the surveyor examined the pool for fairy shrimp to estimate the number of shrimp present.

2. The air temperature, water temperature, and maximum water depth [using staff gauges (see Section 3.4.1)] measurements were recorded.

TABLE 1
SURVEY DATES AND CONDITIONS

Date	Surveyor	Survey	Beginning Conditions	Ending Conditions
1/21/05	Cheri Kim Darin Busby	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
1/28/05	Cheri Kim Diana Saucedo-Ortiz	Hydrology	N/A	N/A
2/04/05	Cheri Kim, Nicole Shorey, Brian Woodward	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
2/11/05	Cheri Kim Nicole Shorey	Hydrology	N/A	N/A
2/17/05	Cheri Kim Darin Busby	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
2/25/05	Cheri Kim Raquel Ordorica	Hydrology	N/A	N/A
3/01/05	Cheri Kim Cheryl Johnson	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
3/11/05	Cheri Kim Diana Saucedo-Ortiz	Hydrology	N/A	N/A
3/16/05	Cheri Kim Mark Dodero	Arroyo toad day survey #1	3:00 P.M.; 67°F; 0–2 mph; 50% cover	5:40 P.M.; 62°F; 0–2 mph; 60% cover
3/16/05	Cheri Kim Mark Dodero	Arroyo toad night survey #1	7:00 P.M.; 55°F; 0–2 mph; 80% cover	9:35 P.M.; 50°F; 0–2 mph; 70% cover
3/17/05	Cheri Kim	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
3/23/05	Cheri Kim Diana Saucedo-Ortiz	Hydrology	N/A	N/A
4/01/05	Cheri Kim Karen Smith	Fairy shrimp, amphibians, hydrology	Refer to Table 4	Refer to Table 4
4/07/05	Diana Saucedo-Ortiz	Hydrology	N/A	N/A

TABLE 1
SURVEY DATES AND CONDITIONS
(continued)

Date	Surveyor	Survey	Beginning Conditions	Ending Conditions
	Vanessa Lee			
4/13/05	Cheri Kim	Hydrology	N/A	N/A
4/14/05	Cheri Kim Brian Woodward	Arroyo toad day survey #2	4:00 P.M.; 71°F; 4–6 mph; 0% cover	7:15 P.M.; 63°F; 4–6 mph; 0% cover
4/14/05	Cheri Kim Brian Woodward	Arroyo toad night survey #2	8:30 P.M.; 58°F; 0–3 mph; 0% cover	11:00 P.M.; 54°F; 0–3 mph; 0% cover
4/19/05	Cheri Kim	Hydrology	N/A	N/A
4/27/05	Cheri Kim Diana Saucedo-Ortiz	Arroyo toad day survey #3	3:30 P.M.; 65°F; 5–9 mph; 65% cover	7:00 P.M.; 65°F; 3–7 mph; 45% cover
4/27/05	Cheri Kim Diana Saucedo-Ortiz	Arroyo toad night survey #3	8:30 P.M.; 54°F; 3–5 mph; 65% cover	10:30 P.M.; 53°F; 1–3 mph; 10% cover
5/09/05	Cheri Kim Brian Woodward	Arroyo toad day survey #4	4:15 P.M.; 67°F; 8–12 mph; 50% cover	7:00 P.M.; 62°F; 5–10 mph; 50% cover
5/09/05	Cheri Kim Brian Woodward	Arroyo toad night survey #4	8:30 P.M.; 58°F; 3–5 mph; 30% cover	11:15 P.M.; 56°F; 2–4 mph; 40% cover
6/03/05	Cheri Kim Diana Saucedo-Ortiz	Arroyo toad day survey #5	4:30 P.M.; 72°F; 4–8 mph; 0% cover	7:00 P.M.; 70°F; 4–8 mph; 0% cover
6/03/05	Cheri Kim Diana Saucedo-Ortiz	Arroyo toad night survey #5	9:00 P.M.; 64°F; 1–3 mph; 0% cover	11:15 P.M.; 62°F; 0–1 mph; 0% cover
6/14/05	Cheri Kim, Nicole Shorey, Matt Guilliams	Arroyo toad day survey #6	5:30 P.M.; 78°F; 2–4 mph; 0% cover	7:30 P.M.; 77°F; 2–4 mph; 0% cover
6/14/05	Cheri Kim, Nicole Shorey, Matt Guilliams	Arroyo toad night survey #6	9:00 P.M.; 65°F; 2–4 mph; 100% fog cover	10:30 P.M.; 65°F; 2–4 mph; 100% fog cover

N/A = ; °F = degrees Fahrenheit; mph = miles per hour; % = percent

3. Using an aquarium fish net attached to an extendable painters pole, the surveyor made a three-foot-long sweep through the water to catch any fairy shrimp or other aquatic species that may have been present. All species caught in the net were examined, identified, and then returned to the pool; except fairy shrimp samples that were collected for accessioning[4].

4. Step 3 was repeated in different locations around the pool approximately 15 to 30 times depending on the size of the pool.

3.2.2 Survey Restrictions/Limitations

Typically, winter rains begin in November or December, and vernal pools begin ponding by late December or early January. With this typical rain schedule, the surveys that began January 21, 2005, would have been timely and in concert with USFWS protocol. Unfortunately, winter rains during the 2004–2005 season began in October 2004, and the vernal pools in the survey area were ponded for weeks prior to the start of the January 21, 2005 fairy shrimp surveys. Based on the survey results (see Section 4.2), it can be inferred that surveys began near the end of the fairy shrimp lifecycle(s)[5], and it is unknown if the fairy shrimp lifecycle(s) was missed entirely in any of the pools, resulting in false-negative data.

3.3 Amphibians

3.3.1 Survey Methodology

Two types of amphibian surveys were conducted on the Preserve. Beginning in January, surveys for vernal pool amphibians were conducted in conjunction with protocol fairy shrimp surveys. Focused surveys for the federally endangered arroyo toad were conducted within Santa Maria Creek beginning in March.

3.3.1.1 Vernal pool amphibians

RECON conducted surveys for amphibians that occur in vernal pools such as Pacific tree frog, western toad, and western spadefoot toad. These surveys were conducted every two weeks, concurrent within the fairy shrimp surveys. At each pool, the presence

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[4] In accordance with the USFWS survey guidelines (USFWS 1996), fairy shrimp samples collected from each pool will be sent to The Natural History Museum of Los Angeles County. In addition, fairy shrimp samples from each pool will be sent to Dr. Andrew Bohonak at San Diego State University in the Evolutionary Biology Department, to aid his ongoing research on San Diego fairy shrimp (*Branchinecta sandiegonensis*) genetics.

[5] More than one generation of fairy shrimp can occur in a pool within one ponding season.

or absence, estimated number (e.g. 10s, 100s, 1000s, etc.), and the lifecycle stage (e.g. egg cluster, tadpole, or toadlet) of each species was noted. Survey dates and personnel are shown on Table 1.

3.3.1.2 Arroyo toad

Portions of Santa Maria Creek containing suitable habitat within the Oak County Estates, Cagney, and Hardy properties were surveyed for arroyo toad in accordance with USFWS Survey Protocol (1999). Per the Protocol, surveys were conducted between March 15 and July 1, with a total of six surveys conducted at least seven days apart. Each survey consisted of a daytime and nighttime component. The daytime component included walking the Santa Maria Creek to note habitat conditions and identify any eggs, larvae, or tadpoles present. The nighttime component included walking along Santa Maria Creek and stopping periodically to listen for arroyo toads calling. Survey dates and personnel are shown on Table 1.

3.3.2 Amphibian Survey Restrictions/Limitations

In accordance with USFWS survey protocol, arroyo toad surveys began on March 16; however, due to the early winter rains, amphibian breeding in Santa Maria Creek began early and the young were already in tadpole stage. The overall presence/absence objective of the survey was met as RECON heard and observed a number of adult arroyo toads in Santa Maria Creek, but the exact breeding location was not confirmed.

The Voorhes Lanes properties that had restricted access were surveyed at night (vocal surveys only) from the Hobbs and Cagney property fences.

3.4 Vernal Pool Hydrology

RECON measured three hydrologic vernal pool characteristics in 2005 including water depth, water temperature, and levels of dissolved oxygen. Measurement methods are described below.

3.4.1 Survey Methodology

3.4.1.1 Staff Gauge Installation

Upon identification of the vernal pools to be studied in 2005, RECON installed a staff gauge in each of the study pools. Each staff gauge was constructed of 24-inch-long sections of 1-inch diameter polyvinyl chloride (PVC) pipe, fitted over 30-inch-long sections of 1/2-inch diameter rebar. The gauge was fitted so the PVC pipe and rebar were flush on one end, and the flush end was capped, indicating the top of the

gauge. From the base of each cap, a permanent black marker was used to place marks at 1-inch increments for a total of 18 inches along the gauge. The remaining 6 inches of PVC pipe/12 inches of rebar (underneath the PVC) was left blank. Self-adhesive numbers indicating the pool's identity were place vertically down the gauge, opposite the side with the inch hash marks.

At each pool, a ruler was used to probe the pool in several locations to determine the deepest point of the pool. The staff gauge was then driven into the ground so that the bottom hash mark, indicating zero inches, was flush with the ground.

3.4.1.2 Pool Depth

The staff gauges for all the vernal pools were monitored weekly from January 21, 2005 to April 19, 2005. The water depth within 0.25 inch was recorded for each pool. If other data was being collected that day, i.e. shrimp/amphibians, the gauges were approached so the surveyor could see the water depth with the naked eye. If no other data was being collected, binoculars were used from the edge of the pools to determine water depth. This was done to minimize disturbance to the vernal pools and their inhabitants.

3.4.1.3 Water Characteristics

Dissolved oxygen levels in each vernal pool were monitored monthly using a Dissolved Oxygen Test Kit (Code 7414/5860) from LaMotte. Dissolved oxygen testing followed instructions and procedures as outlined in the Dissolved Oxygen Test Kit manual.

Water temperatures were recorded in conjunction with fairy shrimp surveys every two weeks (see Section 3.2.1).

3.4.2 Survey Restrictions/Limitations

3.4.2.1 Staff Gauge Installation

Due to the active livestock grazing within the vernal pool habitat, most vernal pools had one- to two-inch-deep hoof imprints throughout the pool bottoms. This artificial micro-topography made it difficult to determine the true bottom depth of many pools. RECON avoided placing the gauges in obvious hoof-print depressions whenever possible, in an attempt to measure the deepest portion of the true pool bottom.

3.4.2.2 Pool Depth

As the vernal pools dried, it was noted that the soil immediately surrounding the staff gauge at vs1 had eroded due to the flow of water through the vernal swale. A small depression measuring 2 inches deep, 2 inches wide and 8 inches long now surrounds

the staff gauge. It is unknown when this depression developed. Due to the small size of the erosional depression, the zero mark on the staff gauged is still representative of the pool at large; however, it may indicate a need to relocate or remove the staff gauge if it is determined the staff gauge is contributing to erosion of the pool bottom.

3.4.2.3 Water Characteristics

Because water levels and characteristics fluctuate so rapidly throughout the rainy season, dissolved oxygen should be measured more frequently; at least every two weeks. More frequent data collection will improve the statistical likelihood of finding correlations between dissolved oxygen and floral/faunal responses in the pools.

4.0 Survey Results

Figures 4-1 through 4-5 (see Attachment 1) show the non-native plant removal and species survey results for tasks RECON completed in 2005 on the Ramona Grasslands/Santa Maria Creek project.

4.1 Invasive Non-native Plant Removal-Year 1

Figures 4-1 through 4-5 show the locations of non-native plant removal that RECON conducted in 2005 on the Ramona Grasslands/Santa Maria Creek project.

Short term results of herbicide use on the artichoke thistle was immediately evident as almost all plants treated died rapidly. The artichoke thistle was treated prior to setting seed, thereby reducing the potential seed source for growth next spring.

Two intermediate wheatgrass patches were treated on the Hardy and Cummings parcels. The annual grasses surrounding the wheatgrass on the Hardy property were trimmed to make the wheatgrass more easily accessible. The wheatgrass was then sprayed. Although the seed source for these species is still present in the vicinity, this treatment reduces the ability for this species to become more established and spread throughout the preserve area. The wheatgrass on the Cummings property was trimmed, but was not sprayed at the owner's request. Trimming this perennial grass reduced the future seed source, but a more aggressive treatment of the wheatgrass on the Cummings parcel will likely be needed to reduce the spread of this species.

A few mature salt cedar trees and giant reed stands were treated (cut and sprayed) in Santa Maria Creek on the Voorhes Lane properties and Cagney Ranch. Small salt cedar seedlings present in Santa Maria Creek, west of Rangeland Road, were also removed. Although the seed source for these species is still present in the Creek, this treatment

reduces the ability for these species to become established and spread throughout Santa Maria Creek.

The milk thistle and Italian thistle on the Voorhes Lane properties had already set seed when treatment occurred. As much seed and plant material as possible was physically removed from the site by hand to reduce the future seed bank; however, the hand removal was likely not as effective long-term as spraying would have been prior to the plants setting seed.

Two clusters of pepperweed were identified on the Ramona Airport and Cummings properties. These clusters were sprayed with AquaMaster™. In order to prevent this highly invasive species from spreading into Santa Maria Creek, an aggressive treatment should continue until this species is eradicated completely from the vicinity.

4.2 Fairy Shrimp

Table 2 lists the vernal pool species observed at each pool during the 2005 protocol surveys, including the dates of observation. Dates that data was not collected due to lack of water in the pools are not shown on the table.

Fairy shrimp were observed in 12 of the 19 vernal pools studies, 11 of which contained the federally endangered San Diego fairy shrimp. On January 21, mature San Diego fairy shrimp were observed in pools e44, e45, e46, e52, e53, e59, e62, e56, e58, and raap 100. On February 4, mature San Diego fairy shrimp were found in e58 and vs1, while juvenile fairy shrimp were found in vs1 and vs2. On February 17, juvenile fairy shrimp were found in e62. Shrimp surveys continued for 6 more weeks (3 surveys), but no more shrimp were observed. Because San Diego fairy shrimp was the only species observed within the survey area, it is assumed that the juveniles observed are San Diego fairy shrimp.

Incidentally, while conducting fairy shrimp surveys on January 21, 2005, a western burrowing owl (*Speotyto cunicularia hypugaea*) observed east of e45 (see Attachment 1: Figure 4-3).

4.3 Amphibians

4.3.1 Vernal Pool Amphibians

Western spadefoot toads were observed in nine vernal pools in 2005. In pools e46 and vs3, tadpoles successfully matured to toadlets before the pools dried. Western spadefoot tadpoles were observed in pools e52, e53, e77, ev1, vs1, vs2 and vs4, but no toadlets were observed. It is possible that the tadpoles in many of these pools did mature to toadlets, and simply dispersed or found cover prior to the next survey.

TABLE 2
VERNAL POOL FAUNA OBSERVED

Pool No.	Date	(Total #'s 1's, 10's, 100's, …/ # swipes/ #'s per swipe) San Diego Fairy Shrimp	Immature Fairy Shrimp	Copepods (Copepoda)	Seed Shrimp (Ostracoda)	Water fleas (Cladocera)	Spadefoot Toad	Other Amphibian Species
r24	01/21/2005	0/ 20+/ 0	0/ 20+/ 0					
	02/17/2005	0/ 10/ 0	0/ 10/ 0	100s	1000s			PTF tad
	03/01/2005	0/ 10/ 0	0/ 10/ 0	100s				
e44	01/21/2005	2/ 20+/ <1	0/ 20+/ 0					
	02/04/2005	0/ 15/ 0	0/ 15/ 0		100s			
	02/17/2005	0/ 15/ 0	0/ 15/ 0	100s	1000s			
	03/01/2005	0/ 15/ 0	0/ 15/ 0		100s			
e45	01/21/2005	1 female/ 20+/ 0	0/ 20+/ 0	1000s	1000s			
	02/17/2005	0/ 15/ 0	0/ 15/ 0	1000s				
	03/01/2005	0/ 15/ 0	0/ 15/ 0		100s			
	04/01/2005	0/ 15/ 0	0/ 15/ 0		1,000,000s			
e46	01/21/2005	10,000s/ 20/ 8-10	0/ 20+/ 0					
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		100s		10s tad	
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0	10,000s			1,000s tad	
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s		100s tad	
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s	100s	1,000s tad	
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s		100s tad	
	04/07/2005	—	—				100s tad	
	04/13/2005	—	—				100s toadlets	
e52	01/21/2005	100s/ 20/ 1	0/ 20+/ 0					
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s		10s tad	
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0	1,000s	10000s			
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		10000s			
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s			
e53	01/21/2005	100,000s/ 20/ 10-20	0/ 20+/ 0					
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s		10s tad	
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0	1,000s	100000s		100s tad	
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		100s	100s	100s tad	

TABLE 2
VERNAL POOL FAUNA OBSERVED
(continued)

Pool No.	Date	(Total #'s 1's, 10's, 100's, …/ # swipes/ #'s per swipe) San Diego Fairy Shrimp	Immature Fairy Shrimp	Copepods (Copepoda)	Seed Shrimp (Ostracoda)	Water fleas (Cladocera)	Spadefoot Toad	Other Amphibian Species
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s		no toadlets observed.	
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0					
e54	01/21/2005	0/ 20+/ 0	0/ 20+/ 0					
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0	100s	1,000s			
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		100s			
e77	02/17/2005	0/ 20+/ 0	0/ 20+/ 0					
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0				100s tad	
	03/11/2005	—	—				100s tad	
	03/17/2005	—	—				No toadlets observed	
ev1	01/21/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s		1000s tad	PTF tads 1,000s
	02/04/2005	—	—		1,000,000s	10000s	1000s tad	PTF tads 1,000s
	02/17/2005	0/ 30+/ 0	0/ 30+/ 0		1,000,000s		1000s tad	PTF tads 10,000s
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		100,000s			PTF and WT tads
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s	100s	10s tad	WT tads
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s			WT tads
	04/07/2005	—	—					WT tads 1,000s
	04/13/2005	—	—					WT tads 1,000s, WT toadlets 100s

TABLE 2
VERNAL POOL FAUNA OBSERVED
(continued)

Pool No.	Date	(Total #'s 1's, 10's, 100's, …/ # swipes/ #'s per swipe) San Diego Fairy Shrimp	Immature Fairy Shrimp	Copepods (Copepoda)	Seed Shrimp (Ostracoda)	Water fleas (Cladocera)	Spadefoot Toad	Other Amphibian Species
ev2	01/21/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tads 1,000s
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		10000s	100s		WT tads 1,000s
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		100s			PTF and WT tads
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1000s	100s		WT tads 1,000s
	03/23/2005	-	-					
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s			WT tads
	04/07/2005	—	—					WT tads 1,000s
	04/13/2005	—	—					WT toadlets 1,000s
e59	01/21/2005	100s/ 40+/ <1	0/ 40+/ 0					dead adult western toad
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tads 100,000s
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tads 100,000s
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s	1000s		WT tads
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000s			WT tads
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0					WT tads
	04/13/2005	—	—					WT toadlets 1,000s
e62	01/21/2005	100s/ 15/ 4	0/ 15/ 0					
	02/17/2005	0/ 15/ 0	10,000s/ 15/ 50					
	03/01/2005	0/ 15/ 0	0/ 15/ 0		1,000,000s	1000s		

TABLE 2
VERNAL POOL FAUNA OBSERVED
(continued)

Pool No.	Date	(Total #'s 1's, 10's, 100's, …/ # swipes/ #'s per swipe) San Diego Fairy Shrimp	Immature Fairy Shrimp	Copepods (Copepoda)	Seed Shrimp (Ostracoda)	Water fleas (Cladocera)	Spadefoot Toad	Other Amphibian Species
e56	01/21/2005	10s/ 30+/ 0-1	0/ 30+/ 0					
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s			
	03/01/2005	0/ 15/ 0	0/ 15/ 0		1,000,000s	1000s		
	03/17/2005	0/ 15/ 0	0/ 15/ 0		1000s			
e58	01/21/2005	100s/ 20+/ 0-2	0/ 20+/ 0		100s			
	02/04/2005	10s/ 15/ 1	0/ 15/ 0		1000s			
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			
	03/01/2005	0/ 15/ 0	0/ 15/ 0		10,000s	1000s		
	03/17/2005	0/ 15/ 0	0/ 15/ 0		1,000s			
raap 100	01/21/2005	100s/ 20+/ 0-1	0/ 20+/ 0					
	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		100s			
	03/11/2005	—	—					WT tad 100s
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0					WT tad 100s
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0			100s		WT tad 100s
	04/13/2005	—	—					WT toadlets 10s
vs1	02/04/2005	100s/ 10/ 8	100s / 10/ 8					
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		1000s	1000s		WT tad 100s
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0			10,000s		
	03/11/2005	—						WT tad 100s
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			WT tad 10s
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		1000s			WT tad 10s
	04/07/2005	—	—				10s	
	04/13/2005	—	—					No toadlets observed
vs2	02/04/2005	0/ 35+/ 0	10s/ 35+/ 0-1		1,000,000s	10,000s		
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s	10,000s		

TABLE 2
VERNAL POOL FAUNA OBSERVED
(continued)

Pool No.	Date	(Total #'s 1's, 10's, 100's, …/ # swipes/ #'s per swipe) San Diego Fairy Shrimp	Immature Fairy Shrimp	Copepods (Copepoda)	Seed Shrimp (Ostracoda)	Water fleas (Cladocera)	Spadefoot Toad	Other Amphibian Species
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tad
	03/11/2005	—	—					WT tad
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s			WT tad 10,000s
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		1000s	100s		WT tad
	04/07/2005	—	—				1000s	
	04/13/2005	—	—					WT toadlets 100s
vs3	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s	10,000s		
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		100,000s	100,000s		
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tad
	03/11/2005	—	—					WT tad
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s			WT tad 10,000s
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		1000s	100s		WT tad
	04/07/2005	—	—				1000s tads	WT tad
	04/13/2005	—	—				100s toadlets	WT toadlets 100s
vs4	02/04/2005	0/ 20+/ 0	0/ 20+/ 0		100s			
	02/17/2005	0/ 20+/ 0	0/ 20+/ 0		10,000s	10,000s		WT tad 100s
	03/01/2005	0/ 20+/ 0	0/ 20+/ 0		1,000,000s			WT tad
	03/11/2005	—	—					WT tad
	03/17/2005	0/ 20+/ 0	0/ 20+/ 0		1,000			WT tad 1000s
	04/01/2005	0/ 20+/ 0	0/ 20+/ 0		100s	100s		WT tad
	04/07/2005	—	—				1000s	WT tad
	04/13/2005	—	—					WT toadlets 100s

PFT = Pacific Tree Frog; Tad = Tadpole; WT = Western Toad
— = Only hydrology surveys performed this day.

Pacific tree frog tadpoles were observed in r24, ev1, and ev2. In r24, the tadpoles were observed only once, and it is unknown if this species matured to toadlets. In ev1, tadpoles of this species were observed on four occasions, increasing the likelihood that this species mature to toadlet stage and remained hidden during subsequent vernal pools surveys.

Western toad tadpoles were observed in ev1, ev2, e59, raap100, vs1, vs2, vs3, and vs4. RECON confirmed that the tadpoles in seven pools, ev1, ev2, e59, raap100, vs2, vs3, and vs4, matured to toadlets. Western toad tadpoles in vs2 likely matured to toadlets as well, but dispersed or found cover prior to the next survey.

Table 2 lists the vernal pool species observed at each pool, including the dates of observation.

4.3.2 Arroyo Toads

Arroyo toads were observed and detected in Santa Maria Creek, west of Rangeland Road, on the Oak Country Estates property. As seen on Table 3, at the beginning of protocol surveys, arroyo toads were observed calling within 500 feet of Rangeland Road. As the season progressed, the toad observations/vocalizations retreated to the west. During the last two surveys, the only arroyo toads detected were at the west end of Oak Country Estates, in a pond where a two-track dirt road intersects the creek (see Attachment 1: Figure 4-1), and in the creek at the western boundary of the property.

While conducting arroyo toad surveys, RECON noted the presence of adult and juvenile bullfrogs in four locations along Santa Maria Creek. The bullfrogs were eradicated whenever possible, using a pump-action pellet gun. This method was relatively successful for the juvenile bullfrogs; but was largely unsuccessful for the adult bullfrogs, as the pellets appeared to have little adverse effect on them.

TABLE 3
ARROYO TOAD OBSERVATIONS/DETECTIONS

Location	Date	Number of Adults	Detection Type
Location 1: 500 feet west of Rangeland road	3/16/05	3	Observation
Location 2: 1,300 feet west of Rangeland Road*	3/16/05	2	Vocalization
	4/14/05	2	Vocalization
Location 3: 2,300 feet west of Rangeland Road*	4/14/05	2	Vocalization
	4/27/05	2	Vocalization
Location 4: 3,200 feet west of Rangeland Road (Pond)	3/16/05	2	Observation
	4/14/05	3	Observation
	5/9/05	2	Observation
	6/3/05	3	Observation
Location 5: 3,800 feet west of Rangeland Road*	5/9/05	2	Vocalization
	6/3/05	2	Vocalization
	6/14/05	2	Vocalization

*Locations based on vocalizations with no direct observations are approximate.

4.4 Vernal Pool Hydrology

San Diego County received record-breaking rainfall during the 2004–2005 rain season. From October 2004 through May 2005, the Ramona Fire Station recorded 27.24 inches of rain, a significantly greater amount than the average 16.67 inches per year Ramona typically receives (Western Regional Climate Center 2005). The vernal pools likely filled in October and remained full through most, if not all, of November, December, and January prior to the start of surveys.

The vernal pools (r24, e44, e45, e46, e52, e53, e54, e56, e58, e62, and e77) and the alkali playa (raap100) all responded similarly to rain events this spring. Most pools held water during the survey on January 21, and were dried by the next survey on February 4. A series of rainfall events filled the pools again, and most pools held water from February 17 until mid-March, or shortly thereafter. The final significant rain event occurred prior to the March 23 survey, and all pools were dry for the season by April 19, when hydrology studies concluded. Of the 13 weeks hydrology measurements were taken, e77 was dry during eight of those weeks, the driest of the pools; e59 retained water the longest and was the last pool to dry.

The vernal swale measurement locations, ev1, ev2, vs1, vs2, vs3, and vs4, showed water level responses to rainfall similar to the vernal pools, but that did not dry completely until the conclusion of the hydrology studies. In fact, ev1, a man-made stock pond within a vernal swale, held 25 inches of water in one corner of the pond when surveys concluded.

Dissolved oxygen levels and water temperature provided no apparent correlation with observed fairy shrimp or amphibian records. A structured experimental design and statistical analysis would be required to glean this information.

The water depth, temperature, and dissolved oxygen levels of the study pools are shown on Table 4. Photographs of each pool, taken on February 4, 2005, are shown in Attachment 2.

TABLE 4
VERNAL POOL HYDROLOGY DATA

Pool No.	Date	Water Temperature (Fahrenheit)	Air Temperature (Fahrenheit)	Max Pool depth (inches)	Dissolved Oxygen (parts per meter)
r24	01/21/2005	59	67	2.5	–
	02/04/2005	Dry	64	Dry	–
	02/11/2005	–	–	0.25	–
	02/17/2005	56	66	5.5	–
	02/25/2005	–	–	6.3	–
	03/01/2005	60	63	5	10.0
	03/11/2005	–	–	3.5	–
	03/17/2005	Dry	67	Dry	–
	03/23/2005	–	–	3	–
	04/01/2005	Dry	71	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e44	01/21/2005	74	74	2	–
	02/04/2005	57	63	2	11.2
	02/11/2005	–	–	2	–
	02/17/2005	59	66	4.15	–
	02/25/2005	–	–	5.6	–
	03/01/2005	74	66	3.75	14.6
	03/11/2005	–	–	2	–
	03/17/2005	Dry	67	Dry	–
	03/23/2005	–	–	4.25	–
	04/01/2005	Dry	71	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e45	01/21/2005	61	67	2.5	–
	02/04/2005	Dry	64	Dry	–
	02/11/2005	–	–	2.5	–
	02/17/2005	57	66	3	–
	02/25/2005	–	–	3	–
	03/01/2005	63	63	3	8.8
	03/11/2005	–	–	2.5	–
	03/17/2005	Dry	67	Dry	–
	03/23/2005	–	–	3	–
	04/01/2005	65	71	2	2.4
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e46	01/21/2005	63	67	7	–
	02/04/2005	55	64	4.2	9.5
	02/11/2005	–	–	4	–
	02/17/2005	58	66	7	–
	02/25/2005	–	–	7.25	–
	03/01/2005	64	63	6.5	10
	03/11/2005	–	–	6	–
	03/17/2005	59	67	4.5	–
	03/23/2005	–	–	5	–
	04/01/2005	64	71	2.5	13.3

TABLE 4
VERNAL POOL HYDROLOGY DATA
(continued)

Pool No.	Date	Water Temperature (Fahrenheit)	Air Temperature (Fahrenheit)	Max Pool depth (inches)	Dissolved Oxygen (parts per meter)
	04/07/2005	–	–	0.5	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e52	01/21/2005	63	67	6	–
	02/04/2005	56	64	5.1	12.5
	02/11/2005	–	–	4.5	–
	02/17/2005	58	66	7	–
	02/25/2005	–	–	7.25	–
	03/01/2005	63	63	7	11.2
	03/11/2005	–	–	6	–
	03/17/2005	64	67	4	–
	03/23/2005	–	–	5.5	–
	04/01/2005	Dry	71	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e53	01/21/2005	67	67	6	–
	02/04/2005	58	63	4.5	8.7
	02/11/2005	–	–	3.75	–
	02/17/2005	59	66	7.25	–
	02/25/2005	–	–	8	–
	03/01/2005	71	66	7	13.6
	03/11/2005	–	–	6.5	–
	03/17/2005	59	67	4.75	–
	03/23/2005	–	–	5.2	–
	04/01/2005	72	71	2	14.1
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e54	01/21/2005	71	67	2	–
	02/04/2005	Dry	63	Dry	–
	02/11/2005	–	–	1	–
	02/17/2005	60	66	2	–
	02/25/2005	–	–	2	–
	03/01/2005	73	66	2	7.0
	03/11/2005	–	–	1.75	–
	03/17/2005	Dry	67	Dry	–
	03/23/2005	–	–	2	–
	04/01/2005	Dry	71	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e77	01/21/2005	Dry	74	Dry	–
	02/04/2005	Dry	63	Dry	–
	02/11/2005	–	–	Dry	–
	02/17/2005	60	66	3.5	–
	02/25/2005	–	–	5.5	–
	03/01/2005	76	66	3	9.0
	03/11/2005	–	–	0.75	–

TABLE 4
VERNAL POOL HYDROLOGY DATA
(continued)

Pool No.	Date	Water Temperature (Fahrenheit)	Air Temperature (Fahrenheit)	Max Pool depth (inches)	Dissolved Oxygen (parts per meter)
	03/17/2005	Dry	67	Dry	–
	03/23/2005	–	–	0.6	–
	04/01/2005	Dry	71	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
ev1	01/21/2005	65	75	35	–
	02/04/2005	57	63	32.5	9.0
	02/11/2005	–	–	30.5	–
	02/17/2005	57	67	34.5	–
	02/25/2005	–	–	36.25	–
	03/01/2005	69	66	35.75	14.0
	03/11/2005	–	–	33.25	–
	03/17/2005	74	73	32.25	–
	03/23/2005	–	–	31	–
	04/01/2005	70	76	30.5	10.6
	04/07/2005	–	–	29	–
	04/13/2005	–	–	27.25	–
	04/19/2005	–	–	25	–
ev2	01/21/2005	73	74	6.5	–
	02/04/2005	61	66	8.5	12.0
	02/11/2005	–	–	8	–
	02/17/2005	57	67	11.25	–
	02/25/2005	–	–	13	–
	03/01/2005	68	66	13	14.4
	03/11/2005	–	–	12.5	–
	03/17/2005	72	73	10.5	–
	03/23/2005	–	–	11	–
	04/01/2005	75	76	9	11.9
	04/07/2005	–	–	7.5	–
	04/13/2005	–	–	5	–
	04/19/2005	–	–	Dry	–
e59	01/21/2005	72	74	6.5	–
	02/04/2005	71	66	6	11.5
	02/11/2005	–	–	5	–
	02/17/2005	59	66	7	–
	02/25/2005	–	–	7	–
	03/01/2005	71	64	7	11.8
	03/11/2005	–	–	7	–
	03/17/2005	72	73	6	–
	03/23/2005	–	–	8.1	–
	04/01/2005	62	76	5.5	10.3
	04/07/2005	–	–	4	–
	04/13/2005	–	–	1	–
	04/19/2005	–	–	Dry	–
e62	01/21/2005	73	72	2	–
	02/04/2005	Dry	66	Dry	–
	02/11/2005	–	–	0.5	–
	02/17/2005	58	66	6.5	–

TABLE 4
VERNAL POOL HYDROLOGY DATA
(continued)

Pool No.	Date	Water Temperature (Fahrenheit)	Air Temperature (Fahrenheit)	Max Pool depth (inches)	Dissolved Oxygen (parts per meter)
	02/25/2005	–	–	8	–
	03/01/2005	69	64	6	9.0
	03/11/2005	–	–	4.5	–
	03/17/2005	Dry	73	Dry	–
	03/23/2005	–	–	Dry	–
	04/01/2005	Dry	76	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e56	01/21/2005	71	74	4.5	–
	02/04/2005	68	66	2	10.0
	02/11/2005	–	–	2	–
	02/17/2005	64	66	30	–
	02/25/2005	–	–	4	–
	03/01/2005	66	64	3.5	10.0
	03/11/2005	–	–	3.3	–
	03/17/2005	74	73	2	–
	03/23/2005	–	–	Dry	–
	04/01/2005	Dry	76	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
e58	01/21/2005	71	73	4	–
	02/04/2005	68	66	5	10.0
	02/11/2005	–	–	4.5	–
	02/17/2005	62	66	7	–
	02/25/2005	–	–	8.5	–
	03/01/2005	68	64	7	9.8
	03/11/2005	–	–	6.25	–
	03/17/2005	67	73	4	–
	03/23/2005	–	–	2	–
	04/01/2005	Dry	76	Dry	–
	04/07/2005	–	–	Dry	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
raap 100	01/21/2005	69	73	5	–
	02/04/2005	68	66	5.5	7.0
	02/11/2005	–	–	5.75	–
	02/17/2005	62	66	8	–
	02/25/2005	–	–	9.5	–
	03/01/2005	69	64	8.5	7.1
	03/11/2005	–	–	8	–
	03/17/2005	79	75	6.5	–
	03/23/2005	–	–	9	–
	04/01/2005	78	76	5.3	8.6
	04/07/2005	–	–	0.75	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–

TABLE 4
VERNAL POOL HYDROLOGY DATA
(continued)

Pool No.	Date	Water Temperature (Fahrenheit)	Air Temperature (Fahrenheit)	Max Pool depth (inches)	Dissolved Oxygen (parts per meter)
vs1	02/04/2005	64	66	7.5	10.8
	02/11/2005	–	–	6	–
	02/17/2005	58	66	10	–
	02/25/2005	–	–	11.6	–
	03/01/2005	67	64	10	9.8
	03/11/2005	–	–	9.5	–
	03/17/2005	70	75	7.5	–
	03/23/2005	–	–	10.5	–
	04/01/2005	73	76	40.25	10.6
	04/07/2005	–	–	–1*	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
vs2	02/04/2005	69	64	14	12.6
	02/11/2005	–	–	17	–
	02/17/2005	60	66	16.5	–
	02/25/2005	–	–	20	–
	03/01/2005	66	64	18.5	13.0
	03/11/2005	–	–	18	–
	03/17/2005	72	75	16.5	–
	03/23/2005	–	–	19	–
	04/01/2005	74	76	14	18.1
	04/07/2005	–	–	10	–
	04/13/2005	–	–	6.5	–
	04/19/2005	–	–	Dry	–
vs3	02/04/2005	63	64	12	13.8
	02/11/2005	–	–	16	–
	02/17/2005	61	66	15	–
	02/25/2005	–	–	19	–
	03/01/2005	66	64	17.75	13.4
	03/11/2005	–	–	17	–
	03/17/2005	70	75	14	–
	03/23/2005	–	–	18	–
	04/01/2005	77	76	12	11.7
	04/07/2005	–	–	6	–
	04/13/2005	–	–	Dry	–
	04/19/2005	–	–	Dry	–
vs4	02/04/2005	67	64	6	13.25
	02/11/2005	–	–	10	–
	02/17/2005	60	66	8	–
	02/25/2005	–	–	14	–
	03/01/2005	66	64	12	13.0
	03/11/2005	–	–	6	–
	03/17/2005	71	75	6	–
	03/23/2005	–	–	11.5	–
	04/01/2005	79	76	3.5	12.4
	04/07/2005	–	–	3	–
	04/13/2005	–	–	1	–
	04/19/2005	–	–	Dry	–

*Water has eroded around the base of the staff gauge about 2 inches below 0 mark.

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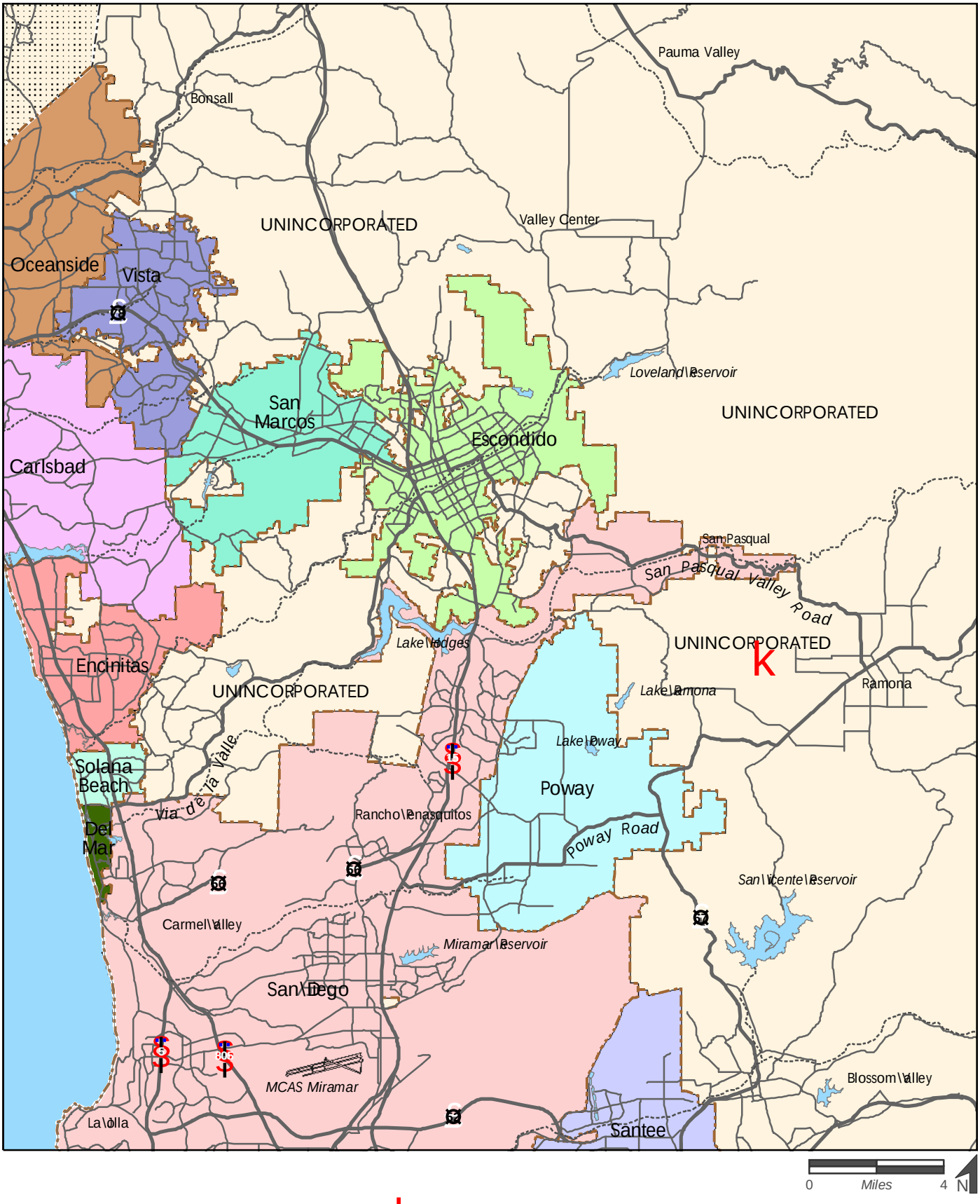
ATTACHMENTS

ATTACHMENT 1



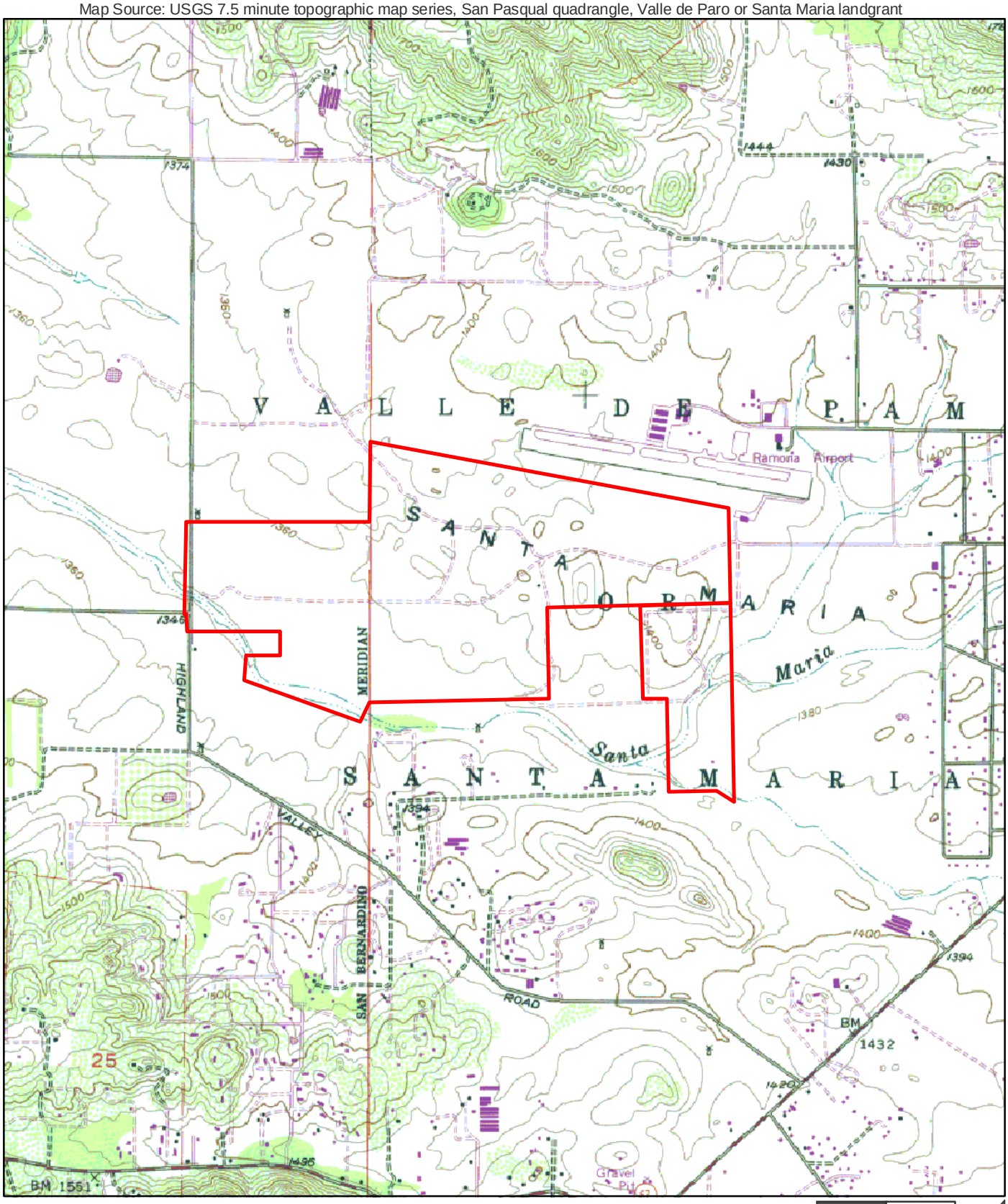
k Project location

RECON

M:\jobs2\4095\common_gis\fig1.mxd 09/14/05

FIGURE 1
Regional Location

Map Source: USGS 7.5 minute topographic map series, San Pasqual quadrangle, Valle de Paro or Santa Maria landgrant



RECON

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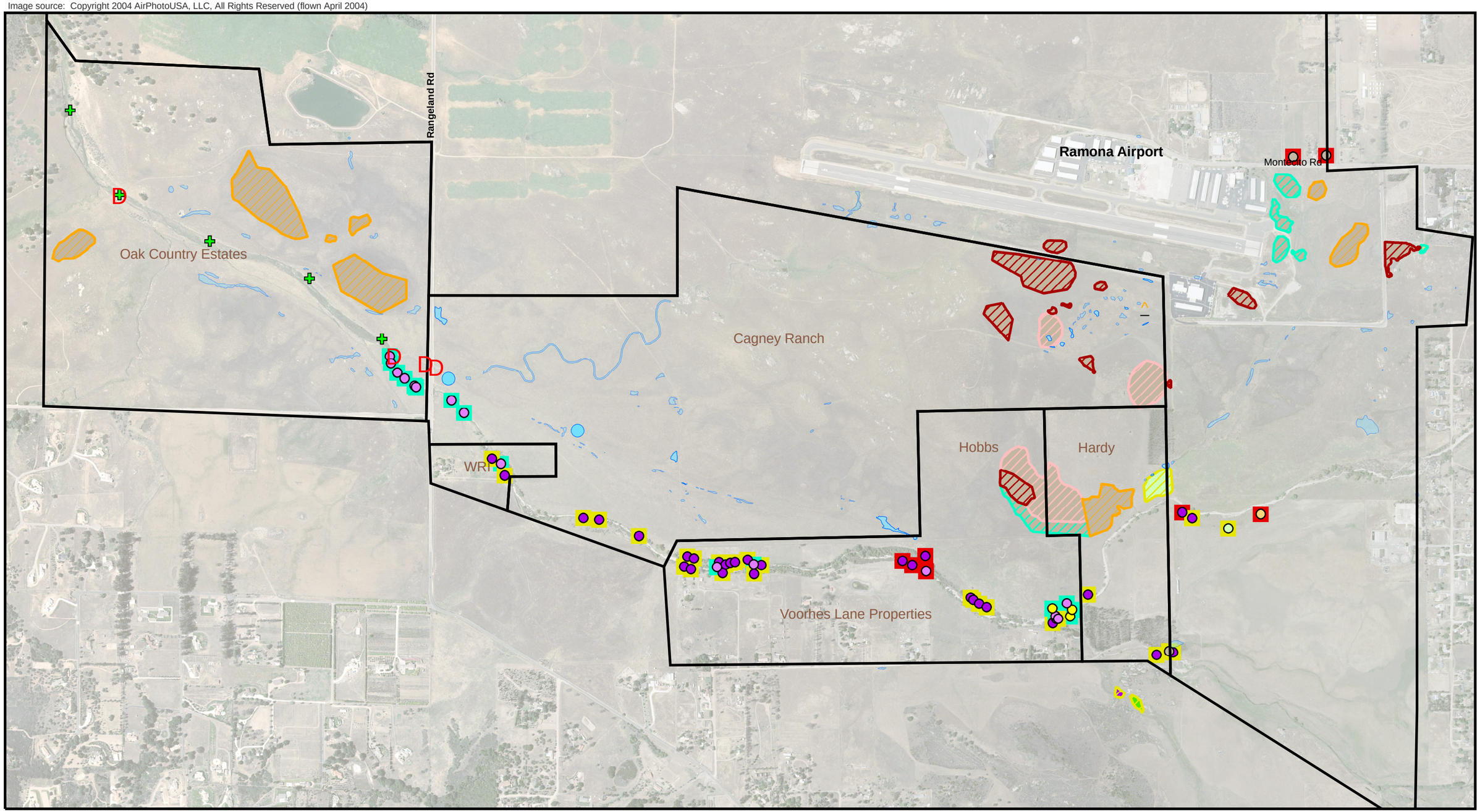
FIGURE 2
Project Location on USGS Map

Image source: Copyright 2004 AirPhotoUSA, LLC, All Rights Reserved (flown April 2004)



Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action

0 Feet 1,000 N

RECON

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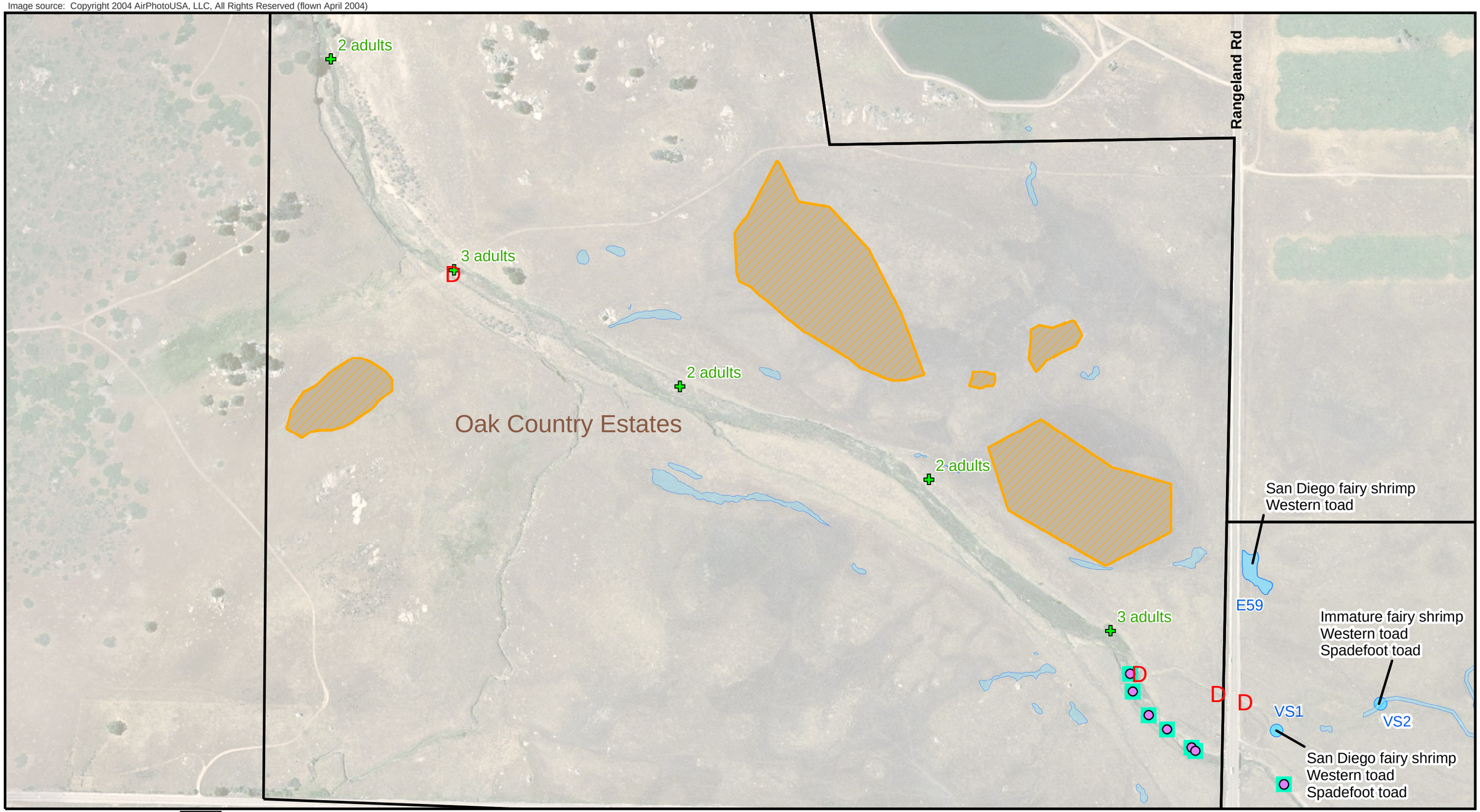
FIGURE 3
Overview: Ramona Grasslands 2005 Survey Results and Exotic Species Removal



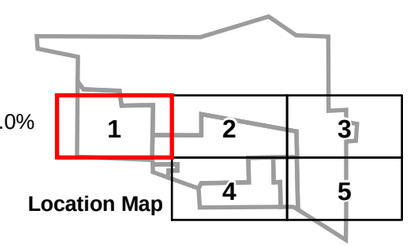
Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action



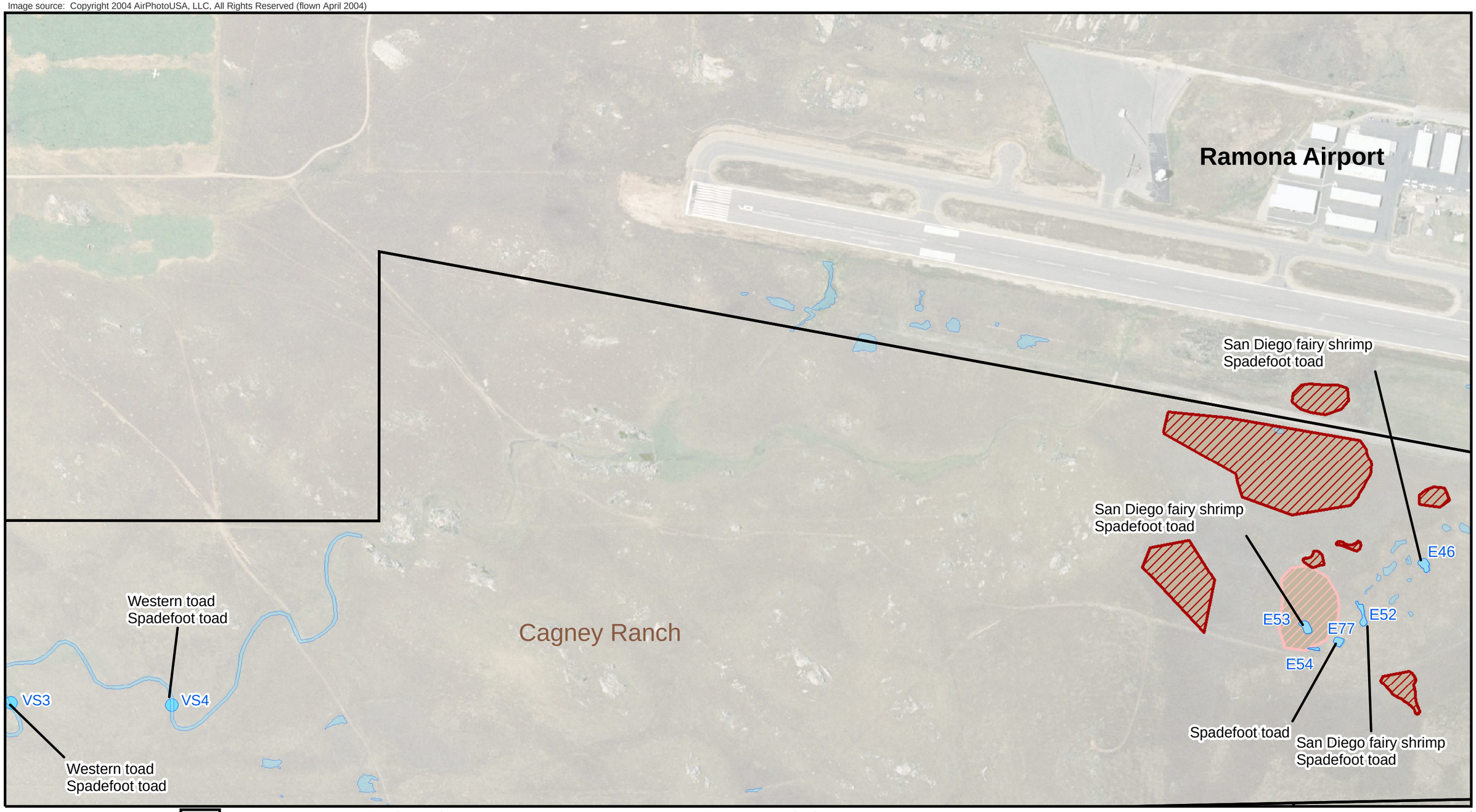
0 Feet 400 N

RECON

M:\jobs2\4095\common_gis\fig4.mxd 09/29/05

FIGURE 4-1
Ramona Grasslands
2005 Survey Results and
Exotic Species Removal

Image source: Copyright 2004 AirPhotoUSA, LLC, All Rights Reserved (flown April 2004)



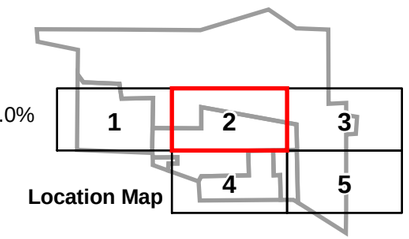
Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action



Location Map

0 Feet 400 N

RECON

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FIGURE 4-2
Ramona Grasslands
2005 Survey Results and
Exotic Species Removal

Montecito Rd

Ramona Airport

Pacific tree frog

R24

San Diego fairy shrimp

E45

E44

San Diego fairy shrimp

Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action

Location Map: 1, 2, 3, 4, 5

0 Feet 400 N

RECON

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FIGURE 4-3
Ramona Grasslands
2005 Survey Results and
Exotic Species Removal

San Diego fairy shrimp
Western toad
RAAP100
San Diego fairy shrimp
E56
San Diego fairy shrimp
E58
San Diego fairy shrimp
E62
Hobbs
Hardy
Voorhes Lane Properties
Lachine/ Barris
Dorrah
Berthiaume
Crook
Wallace
Osbourne
Leggitt

Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action

Location Map: 1, 2, 3, 4, 5

0 Feet 400 N

RECON

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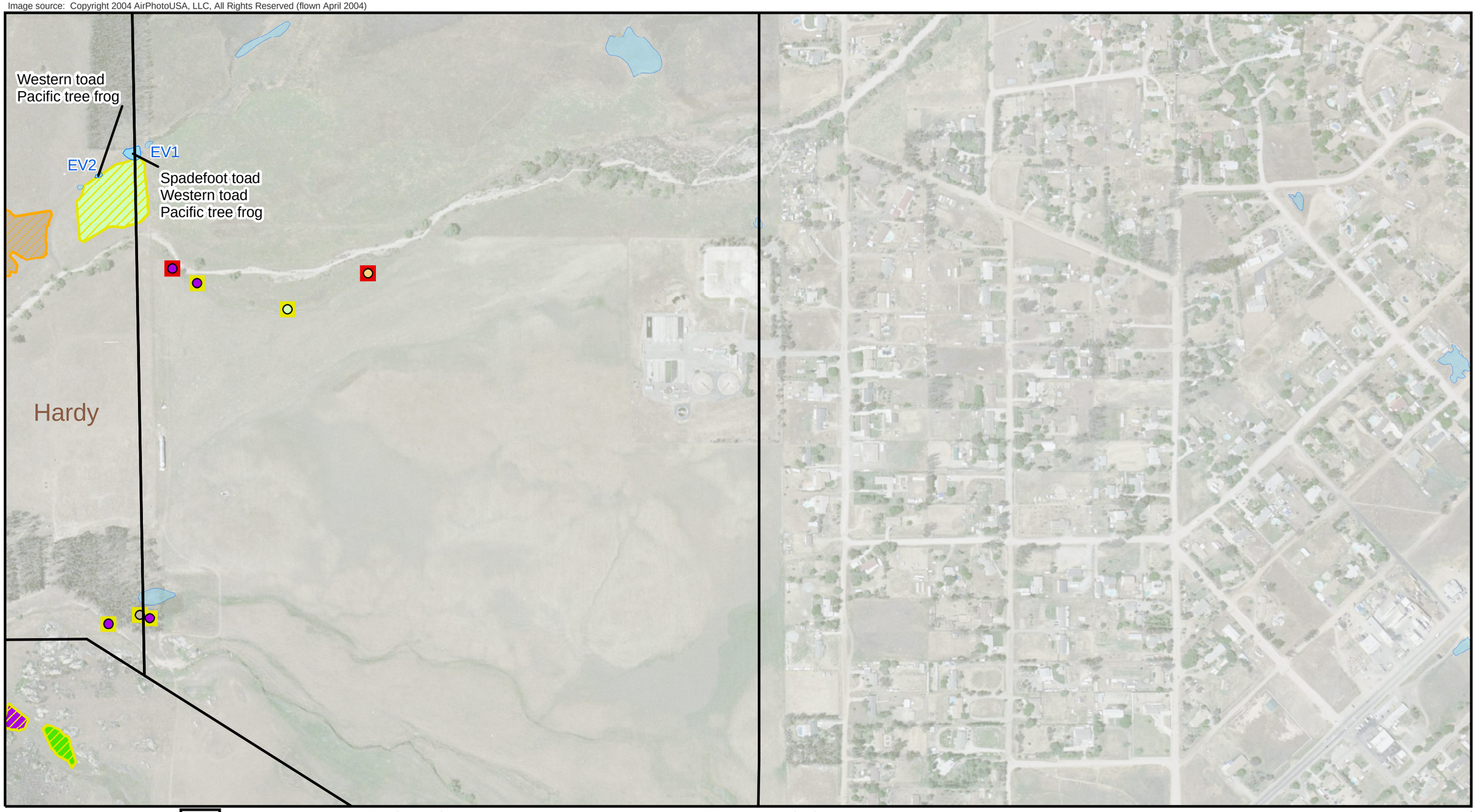
FIGURE 4-4
Ramona Grasslands
2005 Survey Results and Exotic Species Removal



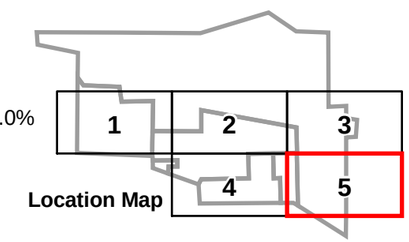
Property boundaries
Vernal Pools
Burrowing owl
Arroyo toad
Bullfrog

Exotic species

- Artichoke thistle *(Cynara cardunculus)*
- Intermediate wheatgrass *(Elytrigia intermedia)*
- Italian thislte *(Carduus pycnocephalus)*
- Milk thistle *(Silybum marianum)*
- Giant cane *(Arundo donax)*
- Lepidium *(Lepidium latifolium)*
- Tamarisk *(Tamarix sp.)*

Treatment method

- Aqua Master 2.0%
- Hand removed
- Transline 0.25% & Aqua Master 2.0%
- Transline 0.25%
- Transline 0.5%
- No action



0 Feet 400 N

RECON

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FIGURE 4-5
Ramona Grasslands
2005 Survey Results and
Exotic Species Removal

ATTACHMENT 2

PHOTOGRAPH 1
Vernal Pool r24, Looking East

PHOTOGRAPH 2
Vernal Pool e44, Looking East

PHOTOGRAPH 3
Vernal Pool e45, Looking East

PHOTOGRAPH 4
Vernal Pool e46, Looking West

PHOTOGRAPH 5
Vernal Pool e52, Looking West

PHOTOGRAPH 6
Vernal Pool e53, Looking North

PHOTOGRAPH 7
Vernal Pool e54, Looking South

PHOTOGRAPH 8
Vernal Pool e56, Looking West

PHOTOGRAPH 9
Vernal Pool e58

PHOTOGRAPH 10
Vernal Pool e59, Looking North

PHOTOGRAPH 11
Vernal Pool e62, Looking Northwest

PHOTOGRAPH 12
Vernal Pool e77, Facing South

PHOTOGRAPH 13
Vernal Swale ev1, Facing North

PHOTOGRAPH 14
Vernal Swale ev2, Facing West

PHOTOGRAPH 15
Alkali Playa raap 100. Facing North

PHOTOGRAPH 16
Vernal Swale vs1, Installing Staff Gauge

PHOTOGRAPH 17
Vernal Swale vs2, Facing Northwest

PHOTOGRAPH 18
Vernal Swale vs4, Facing Northwest

APPENDIX D

Biological Survey Report for the Santa Maria Creek Restoration Project: riparian birds (Lovio 2007)

Biological Survey Report for the Santa Maria Creek Restoration Project:

Riparian Birds

Prepared for:
County of San Diego
Department of Parks and Recreation
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San Diego, CA 92123
Contact: Jennifer Haines

Prepared by:
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Wildlife Biologist-Ecologist
4502 Maryland Street
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On behalf of:
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Contact: Christina Schaefer

January, 2007

Table of Contents

List of Figures

List of Tables

Introduction

Santa Maria Creek traverses the Ramona Grasslands Project (RGP) in an east to west direction for a length of approximately 4.5 miles (7.25 km). A riparian bird census was conducted in the spring and summer months of 2005 for a selected area along the length of Santa Maria Creek within the Ramona Grasslands/Santa Maria Restoration Project study area and riparian habitats associated with the creek. This bird study provides a baseline dataset for future monitoring of the RGP.

Project Location

Surveys were conducted within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California (Figure 1). The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Hobbs, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities.

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

Project Description

The County of San Diego Department of Parks and Recreation was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project. The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area, (hereinafter referred to as "Ramona Grasslands"), to improve water quality and habitat conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition, increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters.

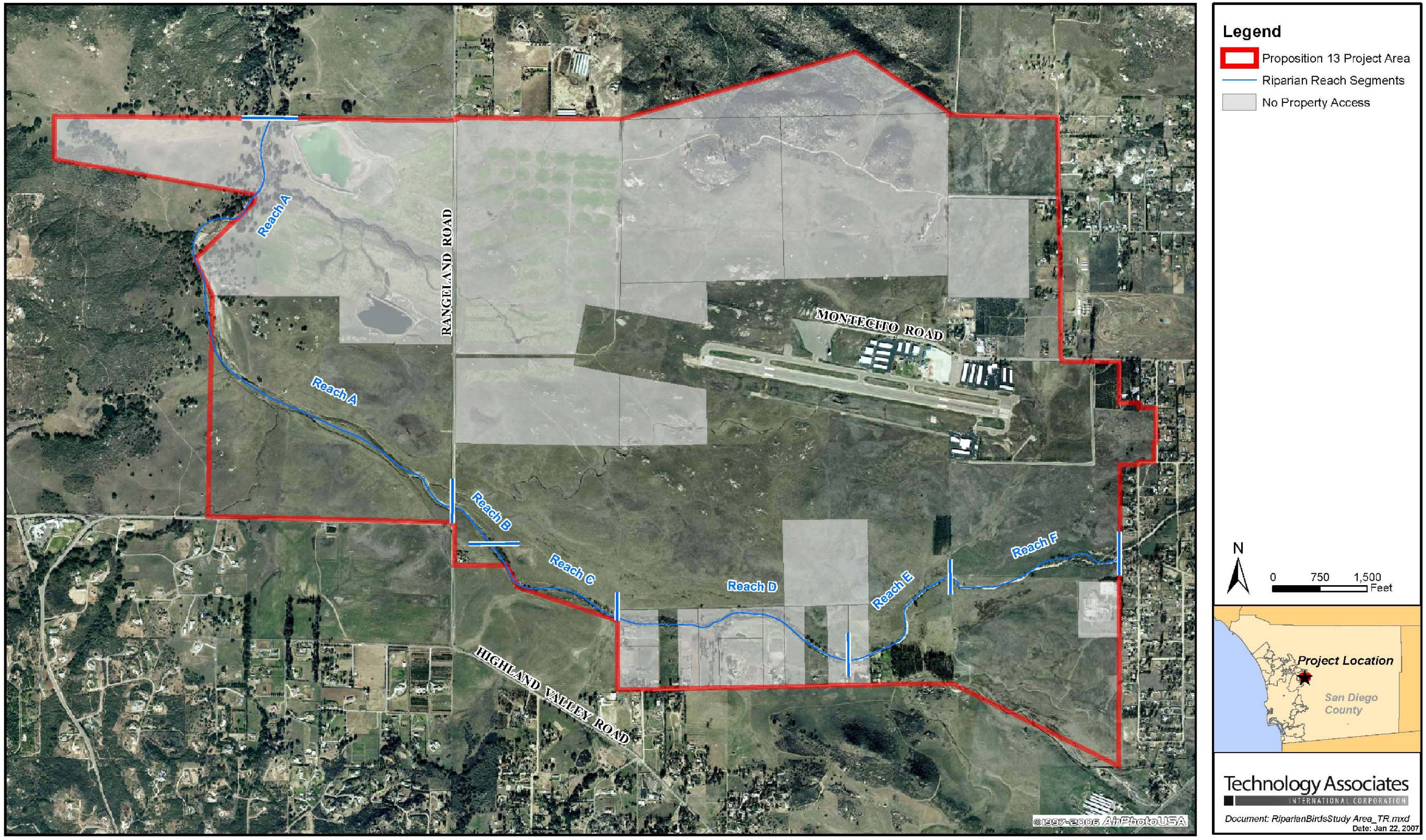

Figure 1: Santa Maria Creek Riparian Birds Study Area

The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system.

A second component of the project consists of collecting baseline biological data, which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek, ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas) and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the "typical" and historic conditions of the Grasslands are unknown.

The conservation target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were also examined for invertebrates, reptiles and amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed. Monitoring the distribution, relative abundance, and species richness of the plant and animal communities, including reptiles, amphibians, birds and raptors, over time will provide insight about the ecological integrity of the riparian and grassland communities. Observations of non-native species, such as the brown-headed cowbird (*Molothrus ater*) which is a brood parasite for many native bird species, will also serve as an important indicator of ecological health.

The following sections describe the methods and results of the baseline riparian bird surveys that were conducted by ornithologist John Lovio in the spring and early summer of 2005 on behalf of TAIC. The significance of these results and recommendations for future monitoring will be discussed as well.

Methods

A breeding-bird census (Van Velzen 1972) was conducted on 3.4 miles (5.4 km) of Santa Maria Creek, from the western edge of residential development in Ramona (just west of Sawday Street) westward to the property line approximately 0.9 creek miles (1.4 km) west of Rangeland Road. Parcels for which no survey access was provided were assessed from neighboring parcels that were access authorized (Figure 1).

The breeding-bird census, which utilizes the technique commonly known as "spot-mapping" (Bibby et al. 1992, Ralph et al. 1993), is intended to not be a form of sampling, but rather a complete census of all birds breeding in a specific area. Under the assumption that pairs of breeding birds occupy regular areas that are at least partially exclusive of other pairs of the same species during the breeding season and that territorial birds advertise their presence by visual and auditory clues, census areas are completely and systematically surveyed on each of multiple visits during a single breeding season. During each census visit, the locations and behaviors of all individuals of all species detected are recorded on a map of the census area. Map registrations from each visit for a given species are transferred to a summary map that displays the cumulative point locations and associated data. Over repeated visits, the cumulative map registrations for each species tend to form distinct clusters that represent different pairs (or other breeding units, as discussed below) of a given species. Summary maps are interpreted by the observer as the different pairs of a species by means of spatial clustering of map registrations, aided by associated field data on demographics, simultaneous observations of adjacent advertising males, nest locations, and knowledge of the ecology of each species. Clusters representing distinct pairs are typically enclosed in hand-drawn polygons, which generally reflect breeding territory cores rather than comprehensive maps of breeding territories or home ranges. The spot-mapping method provides the advantages of a direct measure of abundance and density for each species and, when superimposed on an aerial photograph or vegetation map, a direct measure of distribution of each species with respect to areas of different habitats.

The Santa Maria Creek bird census area consisted of all riparian habitat on the creek between the endpoints described above. This represents about 52 acres of habitat, ranging from narrow sections (30 ft. / 10m) of unvegetated sandy channel to broad sections (220 ft. / 67 m) of mature willow-cottonwood forest. The census reach comprised three basic types of bird habitat: 1) riparian forest ranging from low and open to tall and dense, with or without undergrowth, and dominated by willows (*Salix* spp.) and cottonwoods (*Populus fremontii*); 2) riparian scrub dominated by mulefat (*Baccharis salicifolia*) and/or small willows; and 3) open channel/floodplain with either bare sand or low herbaceous growth (Figure 1). Locations of each of these types is a result of historic land uses and hydrology. Although the distribution of the basic habitat types is complex on a small scale, approximately the western third of the reach is dominated by riparian scrub, the middle third by riparian forest, and the eastern third by a mixture of open channel and disturbed forest.

The bird census was conducted uniformly along the entire study reach, irrespective of habitat types and political boundaries. However, in the locational data analysis, map registrations and breeding territory cores (clusters) were recorded as occurring within any of six land use – habitat segments that correspond to property boundaries (Figure 1 and Table 1). Habitat within each of these segments is fairly uniform as a result of natural and anthropogenic factors and, with the exception of one, the lengths of the segments are roughly comparable (Table 1). The delineation of these segments and the categorization of bird data within them will provide for simultaneous avifaunal comparisons among the habitat types.

Table 1. Characteristics of six land use – habitat segments along Santa Maria Creek (see Figure 1).

Segment	Length (mi)	Area (acres)	Predominant Habitat	Proportion Vegetated
A			Riparian scrub, wet herbaceous	
B			Riparian scrub, wet herbaceous	
C			Open / disturbed willow woodland	
D			Mature willow-cottonwood forest	
E			Open channel with scattered willows	
F			Disturbed willow-cottonwood forest, open channel	

The 2005 Santa Maria Creek breeding-bird census was conducted on seven dates over a period of 37 days between mid-May and mid-June. Table 2 provides a summary of daily field effort and conditions during the census period.

Table 2. Santa Maria Creek 2005 Breeding-Bird Census Effort and Conditions.

Date	Start Time	End Time	Census Duration (hours)	Weather
5-12	07:00	17:00	8.8*	45° to 80° F, clear, wind 0 to 5-10 mph, W
5-20	06:40	14:10	7.5	53° to 90° F, clear, wind 0 to 5-8 mph, W
5-27	06:40	14:50	7.5*	53° to 79° F, low fog to clear, wind 0 to 5-8 mph, SW
6-2	06:10	15:40	8.8*	57° to 65° F, overcast, wind variable, 0 to 3 mph, W
6-6	06:30	15:30	7.8*	57° to 74° F, variable clouds (80-10%), wind 5-15 mph, W
6-10	06:10	14:20	8.2	60° to 70° F, overcast to 10% clouds, wind 0-8 mph, W
6-17	06:30	14:10	7.7	54° to 76° F, variable clouds (80-10%), wind 2-10 mph, W

* Discrepancies between duration and range of hours is attributable to non-census transit time within the census.

Daily census visits were begun shortly after dawn to maximize the use of higher morning bird activity. Starting points on the creek and directions of movement were varied among the census visits, such that each section of the creek was covered at various times of day throughout the census period in an effort to minimize bias from differences in bird activity attributable to time of day. Bird locations for all species were marked on a separate high-resolution aerial photograph for each visit and associated demographic and

behavioral data were recorded on a standard data form (Appendix A). Such information associated with map points serves to facilitate the subsequent interpretation of the cumulative clusters or scatters of map registrations for each species. Conditions or behaviors that convey important information in terms of distinguishing adjacent breeding units of a given species include song or other territorial displays of males (or females of some species), male-female pairs, simultaneous observations of different displaying birds or pairs, relatively large movements of individual birds, nesting behavior such as carrying of material or food or presence of actual nests, and the presence of juvenile birds.

Interpretation of summary maps for the various species involved two somewhat overlapping steps: 1) Initial recognition of map clusters that likely represent separate breeding pairs or other units of the species. This step employed several basic criteria for qualifying any group of map registrations as a potential breeding unit of a species: a) Some level of obvious clustering of registrations relative to the overall dispersion of registrations for the species throughout the study area; criteria for clustering accounted for the scale of movement (generally the reciprocal of density) of the particular species; b) inclusion of registrations from a minimum of three dates spanning at least two weeks (approximately half of the 37-day span of the census period); c) presence of a nest or other definitive evidence of nesting if criteria a or b were lacking or insufficient. 2) Separation of clusters from adjacent clusters of the same species. Clues involved in this process included: a) gaps between clusters in otherwise continuous habitat; b) simultaneous or nearly simultaneous territorial displays by adjacent pairs; c) counterpart territorial registrations close in time in each cluster on one or more dates (greater confidence of distinctness of clusters with more dates).

The details of species summary map interpretation are discussed in Bibby et al. (1992).

Results and Discussion

The Santa Maria Creek Breeding Avifauna

Fifty-five bird species were recorded within the riparian census zone (Figure 2), as defined above. The list of species, their local status, daily total individual counts, and associated statistics are presented in Table 3. The daily counts provide a measure of the frequency of occurrence (or detection) of a given species on the creek and an index of the total breeding density, as discussed below.

Thirty-one of these species were documented or assumed breeding species within the riparian habitat and/or its immediate vicinity. Twenty species are regarded as “visitors”, which are defined as species nesting in adjacent areas of similar or dissimilar habitat that make occasional use of the study area, but exhibit no consistent presence (Van Velzen 1972). Four species were transient neotropical migrants moving from southern wintering grounds to northern breeding grounds.

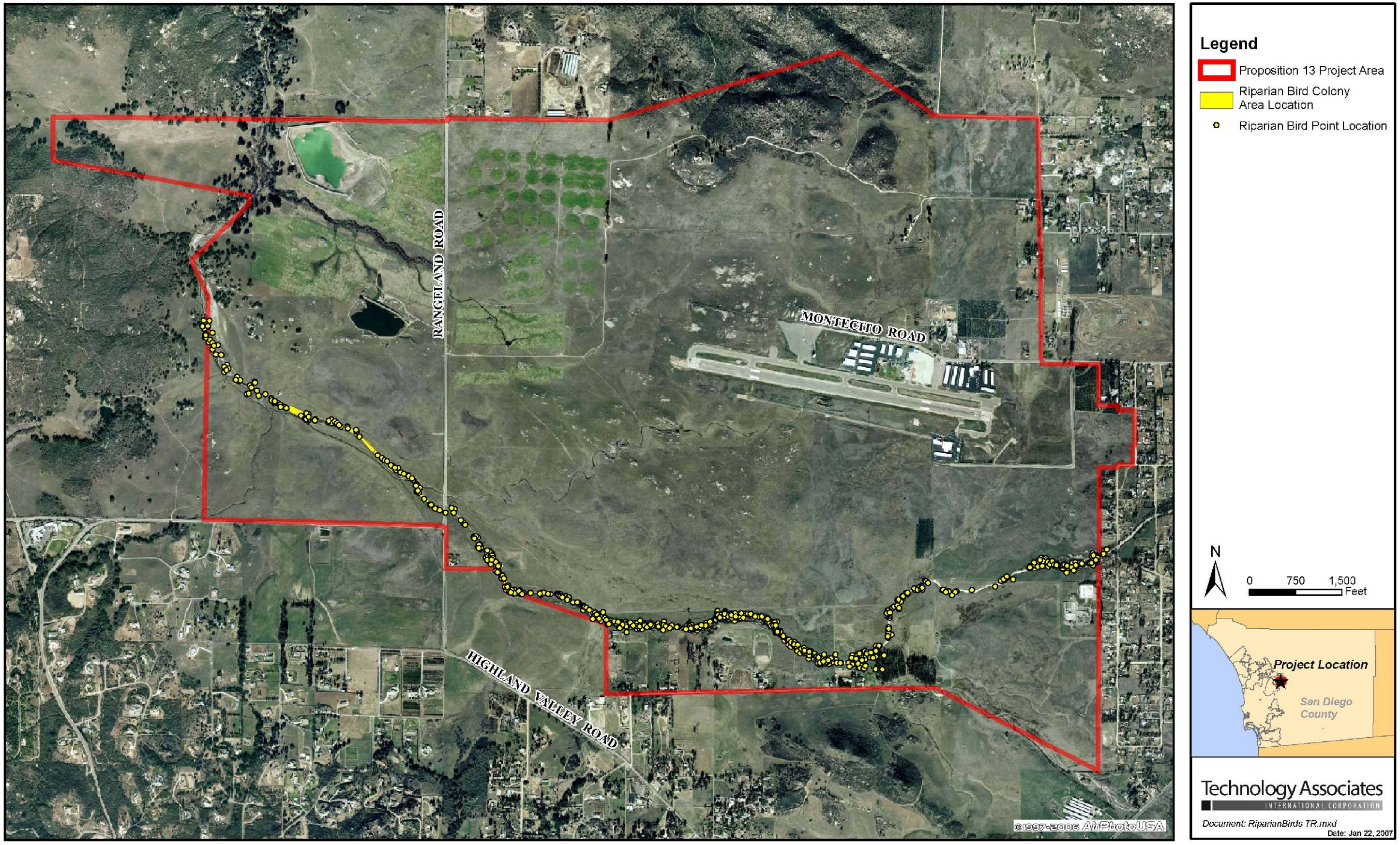

Figure 2: Locations of the Total Number of Breeding Birds Observed in the Study Area

Table 3. Santa Maria Creek 2005 breeding-bird census: species list and daily individual count summary.

Species				Date (Map Code)									
Common	Scientific	Data Code	Status[1]	5/12 (A)	5/20 (B)	5/27 (C)	6/2 (D)	6/6 (E)	6/10 (F)	6/17 (G)	Frequency	Raw Mean[2]	Adjusted Mean[3]
Great Egret	*Casmerodius albus*	GREG	V		1	1					2	0.3	1.0
Snowy Egret	*Egretta thula*	SNEG	V							1	1	0.1	1.0
Mallard	*Anas platyrhynchos*	MALL	B	18	4	2			7		4	4.4	7.8
Cinnamon Teal	*Anas cyanoptera*	CITE	V	2	5						2	1.0	3.5
White-tailed Kite	*Elanus leucurus*	WTKI	V						3		1	0.4	3.0
Cooper's Hawk	*Accipiter cooperii*	COHA	V		1						1	0.1	1.0
Red-shouldered Hawk	*Buteo lineatus*	RSHA	B	1	1				1		3	0.4	1.0
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	B	3	3	2	2	1		1	6	1.7	2.0
American Kestrel	*Falco sparverius*	AMKE	B	1	2		1			2	4	0.9	1.5
Virginia Rail	*Rallus limicola*	VIRA	T	1							1	0.1	1.0
Sora	*Porzana carolina*	SORA	B	1			2				2	0.4	1.5
Killdeer	*Charadrius vociferus*	KILL	V		1	2		1			3	0.6	1.3
Mourning Dove	*Zenaida macroura*	MODO	B	18	10	12	15	10	9	10	7	12.0	12.0
Anna's Hummingbird	*Calypte anna*	ANHU	B	6	6	5	2	3	2	2	7	3.7	3.7
Acorn Woodpecker	*Melanerpes formicivorus*	ACWO	V							2	1	0.3	2.0
Nuttall's Woodpecker	*Picoides nuttallii*	NUWO	B	4	4	2	4	4	5	4	7	3.9	3.9
Northern Flicker	*Colaptes cafer*	NOFL	B	1		1	1	1	3		5	1.0	1.4
Western Wood-pewee	*Contopus sordidulus*	WEWP	T	1							1	0.1	1.0
Willow Flycatcher	*Empidonax traillii*	WIFL	T				1				1	0.1	1.0
Black Phoebe	*Sayornis nigricans*	BLPH	B	9	6	7	7	14	17	6	7	9.4	9.4
Say's Phoebe	*Sayornis saya*	SAPH	V	1					2		2	0.4	1.5
Ash-throated Flycatcher	*Myiarchus cinerascens*	ATFL	B	4	1	4	9	2	2	6	7	4.0	4.0
Cassin's Kingbird	*Tyrannus vociferans*	CAKI	B	5		3	8	7	2	2	6	3.9	4.5
Western Kingbird	*Tyrannus verticalis*	WEKI	B	3	4	1	8	2	1	1	7	2.9	2.9

Table 3, continued			Status[1]	5/12 (A)	5/20 (B)	5/27 (C)	6/2 (D)	6/6 (E)	6/10 (F)	6/17 (G)	Frequency	Raw Mean[2]	Adjusted Mean[3]
Loggerhead Shrike	*Lanius ludovicianus*	LOSH	V						1		1	0.1	1.0
Warbling Vireo	*Vireo gilvus*	WAVI	T	2							1	0.3	2.0
Western Scrub-jay	*Aphelocoma californica*	WESJ	B	1	2	4	6	4	6	2	7	3.6	3.6
American Crow	*Corvus brachyrhynchos*	AMCR	B	3	2	4	4	4	8	3	7	4.0	4.0
Common Raven	*Corvus corax*	CORA	V				2				1	0.3	2.0
N. Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	V	2	1						2	0.4	1.5
Oak Titmouse	*Baeolophus inornatus*	OATI	V							1	1	0.1	1.0
Bushtit	*Psaltriparus minimus*	BUSH	B	13	24	5	9	1	9	29	7	12.9	12.9
Bewick's Wren	*Thryomanes bewickii*	BEWR	V				2	1		1	3	0.6	1.3
House Wren	*Troglodytes aedon*	HOWR	B	2	6	5	13	5	6	9	7	6.6	6.6
Western Bluebird	*Sialia mexicana*	WEBL	V						4		1	0.6	4.0
Northern Mockingbird	*Mimus polyglottos*	NOMO	B	3	8	6	4	4	6	4	7	5.0	5.0
European Starling	*Sturnus vulgaris*	EUST	B	7	6	3	9	4	7	2	7	5.4	5.4
Yellow Warbler	*Dendroica petechia*	YWAR	B	7	1	1	1	2	2	2	7	2.3	2.3
Common Yellowthroat	*Geothlypis trichas*	COYE	B	3		3	8	7	3	7	6	4.4	5.2
Spotted Towhee	*Pipilo maculatus*	SPTO	B	2	2	4	8	9	12	3	7	5.7	5.7
California Towhee	*Pipilo crissalis*	CALT	B	9	4	2	9	9	14	12	7	8.4	8.4
Lark Sparrow	*Chondestes grammacus*	LASP	B	9	8	3	3	7	7	3	7	5.7	5.7
Grasshopper Sparrow	*Ammodramus savannarum*	GRSP	V					2	1		2	0.4	1.5
Song Sparrow	*Melospiza melodia*	SOSP	B	18	8	17	23	19	17	18	7	17.1	17.1
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR	V				1				1	0.1	1.0
Blue Grosbeak	*Guiraca caerulea*	BLGR	B	4	7	6	14	8	11	8	7	8.3	8.3
Red-winged Blackbird	*Agelaius phoenicius*	RWBL	B	57	60	65	209	293	124	4	7	116.0	116.0
Western Meadowlark	*Sturnella neglecta*	WEME	V	2	3	3	2	2	1		6	1.9	2.2

Table 3, continued			Status[1]	5/12 (A)	5/20 (B)	5/27 (C)	6/2 (D)	6/6 (E)	6/10 (F)	6/17 (G)	Frequency	Raw Mean[2]	Adjusted Mean[3]
Brown-headed Cowbird	*Molothrus ater*	BHCO	B	4	1	12	5	8	3	2	7	5.0	5.0
Table 3, continued			**Status[1]**	**5/12 (A)**	**5/20 (B)**	**5/27 (C)**	**6/2 (D)**	**6/6 (E)**	**6/10 (F)**	**6/17 (G)**	**Frequency**	**Raw Mean[2]**	**Adjusted Mean[3]**
Hooded Oriole	*Icterus cucullatus*	HOOR	V		1						1	0.1	1.0
Bullock's Oriole	*Icterus galbula*	BUOR	B	3	8	3	4	4	5	3	7	4.3	4.3
House Finch	*Carpodacus mexicanus*	HOFI	B	29	24	26	37	21	30	39	7	29.4	29.4
Lesser Goldfinch	*Carduelis psaltria*	LEGO	V	3	1			1	2		4	1.0	1.8
American Goldfinch	*Carduelis tristis*	AMGO	V	1			2	1			3	0.6	1.3
House Sparrow	*Passer domesticus*	HOSP	B	3	1	1	1	2			5	1.1	1.6

[1] B = breeding species; V = visitor (see text); T = transient migrant
[2] Total / number of visits
[3] Total / frequency

Four-letter bird species codes used on the standard data form (Appendix A) are given in Table 3, as are the census date codes (A through G) that appear on the species summary maps.

The species summary map interpretation and analysis process was complicated by the high proportion of habitat edge on the study reach and by the varied breeding ecologies of the constituent bird species. Breeding-bird censuses conducted in most terrestrial habitats are optimally conducted on study plots with minimal edge (i.e., close to a perfect square configuration) and surrounded by expanses of similar habitat, so as to minimize the number of peripheral territories and to isolate habitat-specific avifauna from influences of other habitats (Bibby et al. 1992, Ralph et al. 1993). However, characteristically narrow, linear habitats such as riparian zones are inherently "edgy", which provides ample opportunity for use of the riparian zone by species from surrounding habitats and movement of riparian species into surrounding habitats. Nevertheless, edges of this kind are natural and some bird species are attracted to this condition.

The 3.4-mile Santa Maria Creek study reach occurs within a matrix of structurally dissimilar habitats, consisting primarily of grassland, but which includes rural human development and a small amount of coast live oak savannah. This results in the availability of approximately six miles of edge condition.

The complement of bird species breeding on the study reach ranges from species which only infrequently leave the confines of the riparian vegetation (e.g., song sparrow) to

those wide-ranging species of openly vegetated terrain that require only one or a few trees or comparable structures for nesting and perching (e.g., western kingbird). The breeding species on Santa Maria Creek actually form a continuum of affinity to riparian vegetation ranging from obligate to the "visitor" species from other habitats, as defined above. Considering this continuum, the distinction between peripheral breeders and visitors is somewhat arbitrary, although visitors in this study were distinguished as being clearly associated with non-riparian habitats and/or of low frequency and exhibiting poor spatial clustering within the riparian habitat. "Breeding" relative to riparian habitat in this study is defined as regular, spatially discrete use for one or more critical breeding-season functions (e.g., cover, nest placement, foraging). This determination for all species was made by considering frequency of occurrence (Table 3), clustering on summary maps, and behavioral clues. A potentially confounding factor is the range of mobility and scale of spatial use of the various species. Generally, smaller species (e.g., sparrows, warblers) utilize smaller areas, whereas large species (e.g., raptors, woodpeckers) are more wide-ranging, although exceptions occur.

As a result of the variability in the extent and nature of riparian habitat use by the range of 31 breeding species, one or both of two measures of breeding density were made for each species. Table 4 presents the species that exhibited consistent presence, spatial clustering, and which likely nested within or immediately adjacent to the riparian vegetation. Due to the inability of this study to truly delineate the breeding home ranges of most or all of the component breeding bird species and the likelihood that territories or home ranges are actually more extensive (i.e., occurring beyond the riparian habitat) than depicted on the summary maps, the numbers in Table 4 refer to "breeding territory cores". These are defined as the integral number of territories of a species that at least partially include riparian habitat on the study reach. Breeding territory cores were recorded arbitrarily as half (0.5) within a particular creek segment in cases where approximately equal proportions of a cluster occurred within two adjoining segments or in cases where evidence suggested that cores at either the west or east ends of the study reach were partially beyond the study boundaries.

Table 5 presents cumulative individual counts by creek segment as an alternative measure for those species whose distributions on the creek are typically non-clustered and do not appear to directly reflect breeding density. This group includes those that readily use riparian habitat, but require nesting substrate generally not available in that habitat, as well as species with certain mating systems, as discussed below. Due to the wide range of habitat structure on the study reach, some species fit into both categories, exhibiting clustered, breeding activity in some sections and scattered, sporadic occurrences in others. These species are evaluated in both tables.

Tables 4 and 5 also categorize the component species by the units that provide primary breeding clues to the observer. Although all bird reproduction implies male-female pairing, the species vary in their mating systems and in the degree of involvement that the sexes have in actual nesting.

Table 4. 2005 Santa Maria Creek breeding-bird census: species with densities based on mapped breeding territory cores.

Species	Breeding Map Unit	Land-Use Segments						Total Territ.[1]	Std. Density[2]
		A	B	C	D	E	F		
Mallard	young	0	0	0	0	1	0	1	2
Red-shouldered Hawk	pair/nest	0	0	0	0.5	0.5	0	1	2
Red-tailed Hawk	pair/nest	0	0	1	2	0	1	4	8
American Kestrel	pair	0	0.5	0.5	0	0	0.5	1.5	3
Sora	young	1	0	0	0	0	0	1	2
Mourning Dove	pair	0	0.5	2.5	1	0	0	4	8
Anna's Hummingbird	territ. male	0	0	1	0	3	0	4	8
Nuttall's Woodpecker	pair	0	0	0	3	0	1	4	8
Northern Flicker	pair	0	0	0	1	0	0	1	2
Ash-throated Flycatcher	pair	0.5	0	1	2	0	1	4.5	9
Cassin's Kingbird	pair	0	0	0	0.5	0.5	1	2	4
Western Kingbird	pair	0	0	0	0	0	1	1	2
Western Scrub-jay	pair	0	0	0	2	0	1	3	6
American Crow	pair	0	0	0	1	0	1	2	4
Bushtit	pair	0	0	1	1	0	1	3	6
House Wren	pair	0.5	0	0	4	0	1	5.5	11
Northern Mockingbird	pair	0	0	3	0	0	0	3	6
European Starling	pair	0	0	1	1	0	1	3	6
Yellow Warbler	pair	0	0	0	0	1	0	1	2
Common Yellowthroat	pair	4	0	0	0	1	0	5	10
Spotted Towhee	pair	0	0	0	4	0	0.5	4.5	9
California Towhee	pair	0	0	1.5	2.5	0	0	4	8
Lark Sparrow	pair	0	0	1	1	1	1	4	8
Song Sparrow	pair	0	1	1.5	8.5	3	2.5	16.5	33
Blue Grosbeak	pair	1	0.5	1.5	2	0	1	6	12
Bullock's Oriole	pair	0	0	1	1	1	1	4	8
House Finch	pair	0	0.5	2.5	4	2	1	10	20
House Sparrow	pair	0	0	0	0	0	1	1	2
TOTALS		7	3	20	42	14	18.5	104.5	209

[1] Territory cores = number of territories that include riparian habitat (see text).
[2] Standard density: number of breeding units per 100 acres of habitat.

Tables 4 and 5 indicate that most of the species are mapped and evaluated on the basis of observations of or relating to the monogamous male-female pair. Exceptions include: 1) Hummingbirds, whose sexes often occupy different breeding home ranges, often in different habitats, with the females performing all of the nesting tasks. The mapping of Anna's hummingbirds was based mostly on the presence of adult males, whose locations and numbers may not correlate directly with the locations and numbers of females (and therefore nests). 2) Birds of prey, which are monogamous and rely on both sexes for nesting, but are wide-ranging, often utilizing several different habitats. The interpretation of breeding presence of these species in an area is greatly enhanced by the location of the generally conspicuous nests and often by the presence of young. 3) Water birds, which often use watercourses solely for foraging, while nesting elsewhere. Location of nests or

subsequent presence of flightless young contributes strongly to conclusions of local nesting. 4) Colonial nesters, such as the red-winged blackbird, are often polygamous, so the best indicator of breeding density is the number of females, which is assumed to correlate directly with the number of nests. 5) Brood parasites, such as the brown-headed cowbird, are non-territorial with weak pair bonds since the females deposit eggs in the nests of host bird species. The number of females, each of which deposits eggs in one or more host nests, is the most direct indicator of reproduction.

Table 5. 2005 Santa Maria Creek breeding-bird census: species with densities based on cumulative individual map registrations.

Species	Breeding Map Unit	Land-Use Segments						Total Regis.
		A	B	C	D	E	F	
Mallard	young	10	4	2	0	15	0	31
Red-shouldered Hawk	pair/nest	0	0	0	3	1	0	4
Mourning Dove	pair	16	2	26	12	7	13	76
Anna's Hummingbird	territ. male	1	1	5	3	13	1	24
Black Phoebe	pair	6	2	5	12	21	10	56
Cassin's Kingbird	pair	1	0	1	6	4	11	23
Western Kingbird	pair	0	0	7	6	1	4	18
Western Scrub-jay	pair	0	0	2	19	0	4	25
Bushtit	pair	40	3	15	14	11	5	88
Red-winged Blackbird	female	40	0	0	0	0	0	40
Brown-headed Cowbird	female	1	0	0	7	1	4	13
TOTALS		115	12	63	82	74	52	398

The total density of all breeding birds on the study reach of Santa Maria Creek is approximately 158 units per 50 acres, as determined by composite count from Tables 4 and 5. This figure excludes only the Black Phoebe, which likely nests in non-riparian habitat and which could not be measured in terms of density due to its dispersion along the study reach. Therefore, the total breeding density is probably between 160 and 170 units per 50 acres.

The number of breeding territory cores for each species in Table 4 is transformed to the number per 100 acres of habitat, which is a standard for comparison among bird assemblages and over time within assemblages (Van Velzen 1972). In the case of the census reach of Santa Maria Creek, this transformation is tantamount to doubling the actual count, given the habitat area of approximately 50 acres. This standard transformation is typically done on the basis of the area of habitat, but due to the typically linear configuration of riparian habitat, the length of the reach may be a better unit of habitat measurement.

An internal validation of the numbers of breeding units for each species in Table 4 is provided by comparison with the adjusted mean total individual counts for those species in Table 3. These two numbers are roughly comparable for most species, suggesting that

on an average census day on which the species was detected, representatives of most or all of the breeding territories on the creek were encountered and recorded.

Qualitative Analysis and Discussion of the Santa Maria Creek Breeding Avifauna

It will be interesting to observe habitat affinity changes of riparian birds along Santa Maria Creek during future monitoring studies as the riparian corridor matures and improves as a result of grazing reduction and habitat recovery. Figure 3 shows the number of birds by habitat affinity occupying each creek segment (analyzed for each 1,000 feet per creek segment). With the exception of the marshy wetlands west of Rangeland Road that is dominated by marsh birds, all other habitats are dominated by generalists. Only the forested riparian segment within private property shows a relatively higher number of marsh and forest-associated birds than the overgrazed segments of the study area.

The simplest measure of avian diversity is species richness or the number of species occupying a defined area. The 2005 census of the 3.4-mile reach of Santa Maria Creek revealed 31 breeding species and is compared with other California breeding riparian bird censuses from the Journal of Field Ornithology and other sources in Table 6. Comparison with the other studies indicates that the present study falls within the range of species richness and standard breeding density.

Table 6. Comparison of the 2005 Santa Maria Creek Breeding-Bird Census with other comparable California studies. Studies are arranged from north to south.

Location	Year	Habitat	Plot Size (acres)	Number of Breeding Species	Standard Breeding Density[1]	Source
Cordelia, Solano County	1988	Alder-Maple forest with Bay and Oak	33.8	36	426	Lovio 1989
Fremont, Alameda County	1995	Willow riparian	20.0	22	290	Riensche et al. 1996
Livermore, Alameda County	1990	Sycamore woodland with Oaks	60.0	27	216	Cogswell 1991
Clovis, Fresno County	1949	Willow-Cottonwood woodland with Oaks	33.0	20	197	Ingles 1950
Fallbrook, San Diego County	1991	Willow riparian	28.9	31	626	Weaver 1992
Ramona, San Diego County	2005	Willow-Cottonwood forest with rip. scrub	52	31	317	Present study (unpublished)

[1] Standard density: number of breeding units per 100 acres of habitat.

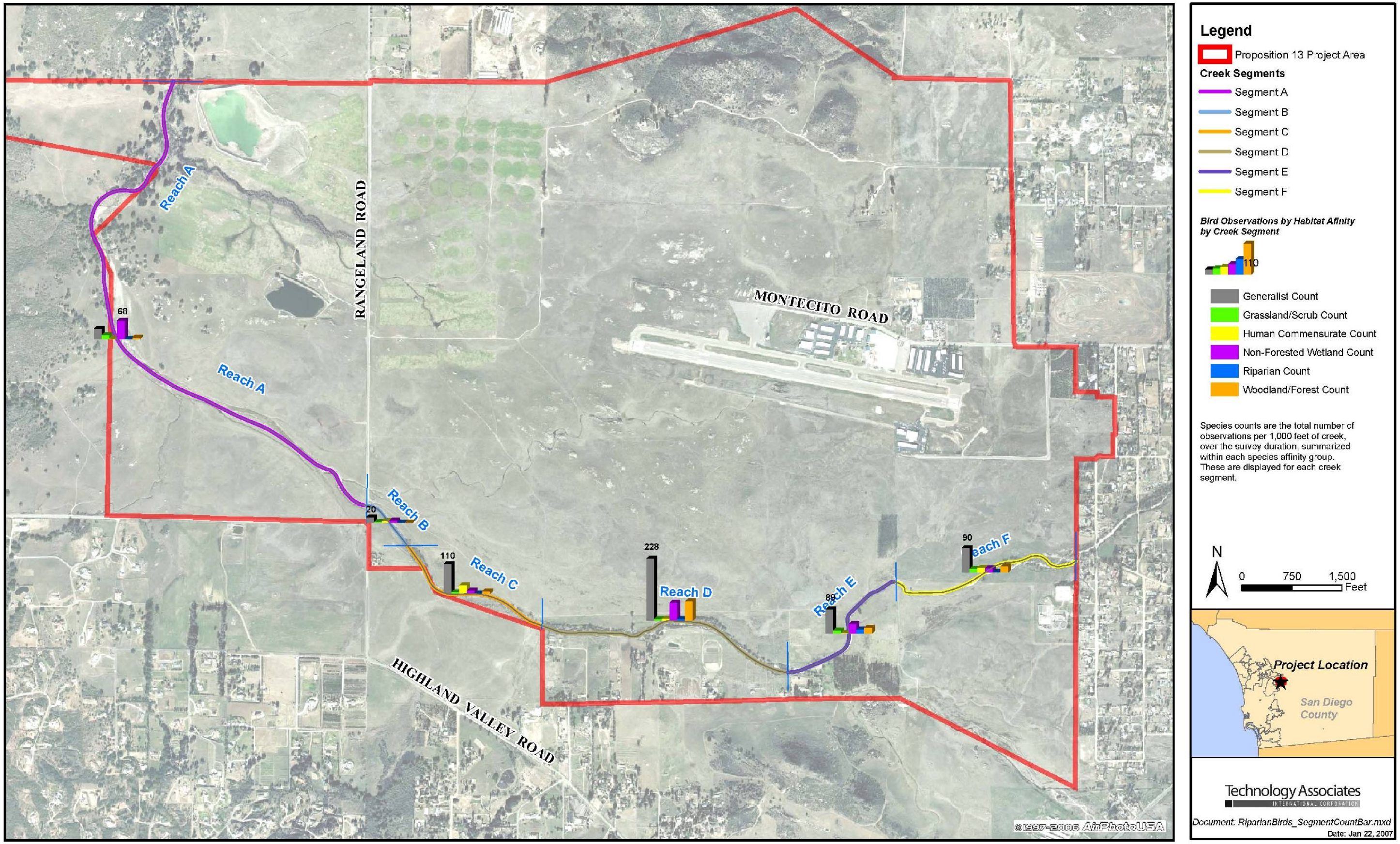

Figure 3: Summary of the Number of Bird Observations by Affinity Group in the Study Area

Beyond the simple measure of species richness, an evaluation of the integrity and completeness of an avian species assemblage requires an examination of the identities of the component species. One important measure is the proportion of the species that are obligates or specialists for the particular habitat type, relative to the proportion of habitat generalist species. Figure 4 shows relative species richness by habitat affinity calculated for 1,000 feet of area within each creek segment.

Table 7 indicates the ranges of affinities of the 31 breeding-bird species in this study to the various structural habitat types within the Santa Maria Valley. This categorization includes the spectrum of habitat types or features utilized to greater or lesser extents for various functions (nesting, foraging, perching, etc.) throughout the nesting cycle.
Using species characterizations from Table 7, Table 8 categorizes the 31 breeding species by habitat breadth and general habitat types.

Table 8 indicates that the breeding avifauna of Santa Maria Creek is composed mostly (16 species or 52%) of habitat generalists, including red-tailed hawk, American kestrel, mourning Dove, Anna's hummingbird, black phoebe, ash-throated flycatcher, Cassin's and western kingbirds, western scrub-jay, American crow, bushtit, spotted and California towhees, brown-headed cowbird, blue grosbeak, and house finch. Some of these habitat generalists use human-associated features as readily as native features and whose presence provides no indication of riparian habitat quality. Another three species (10%), northern mockingbird, European starling, and house sparrow (the latter two of which are non-native), are primarily associated with human habitations. Furthermore, the starling and sparrow are cavity nesters that compete with native species for nest sites. One species (3%), the lark sparrow, is typical of grassland or open scrub, but seeks edges of taller vegetation structure. Stated alternatively, approximately 65% of the breeding avifauna would probably occur in the Santa Maria Valley in the absence of riparian vegetation.

Five species (16%), red-shouldered hawk, Nuttall's woodpecker, northern flicker, house wren, and Bullock's oriole, are generally associated with woodland or forest, including non-native tree groves, and are not restricted to riparian forest.

Five species (16%), mallard, sora, common yellowthroat, song sparrow, and red-winged blackbird, are associated with non-forested wetlands, but only two of these (common yellowthroat and song sparrow) also typically occur within riparian forest canopy.

Only one (3%) of the component species, the yellow warbler, may be regarded as a riparian obligate species. This species does show limited affinity to non-native forests when adjacent to riparian systems and the single pair recorded in this study was partially associated with a large grove of eucalyptus trees immediately adjacent to creek segment E (Table 1).

Table 7. Affinities of Santa Maria Creek breeding bird species to basic habitat structural types in the Santa Maria Valley environs. X = major affinity; x = secondary affinity.

Species	General Habitat Structural Types							
	Grassland	Scrub	Marsh/Wetland	Undergrowth[1]	Forest/Woodland[2]	Riparian Forest	Human Structure	Human Vegetation
Mallard			X					
Red-shouldered Hawk					X	X		X
Red-tailed Hawk	X	X			X	X		X
American Kestrel	X	X			X	X	X	X
Sora			X					
Mourning Dove		X			X	X	x	X
Anna's Hummingbird		X			X	X		X
Nuttall's Woodpecker					X	X		x
Northern Flicker					X	X		X
Black Phoebe	x	x	X		x	X	X	X
Ash-throated Flycatcher	x	X			X	X	x	x
Cassin's Kingbird	X	X			X	x	x	X
Western Kingbird	X	X			x	X	x	X
Western Scrub-jay		X			X	x	X	X
American Crow					X	x	X	X
Bushtit		X			X	X		X
House Wren		x			X	X	X	x
Northern Mockingbird		x			x	x	X	X
European Starling	X	x			X	X	X	X
Yellow Warbler					x	X		x
Common Yellowthroat	x	x	X	X	x	X		
Spotted Towhee		X		X	X	X		
California Towhee		X		X	X	x	x	X
Lark Sparrow	X	x			x	x		
Song Sparrow	x	x	X	X	x	X		x
Red-winged Blackbird	x		X	X				
Brown-headed Cowbird	X	x			X	X		X
Blue Grosbeak	X	x	x			X		
Bullock's Oriole					X	X		X
House Finch	X	X			X	x	X	X
House Sparrow	x	x					X	X

[1] General low, dense vegetation within a forest or woodland canopy.
[2] General forest/woodland structure.

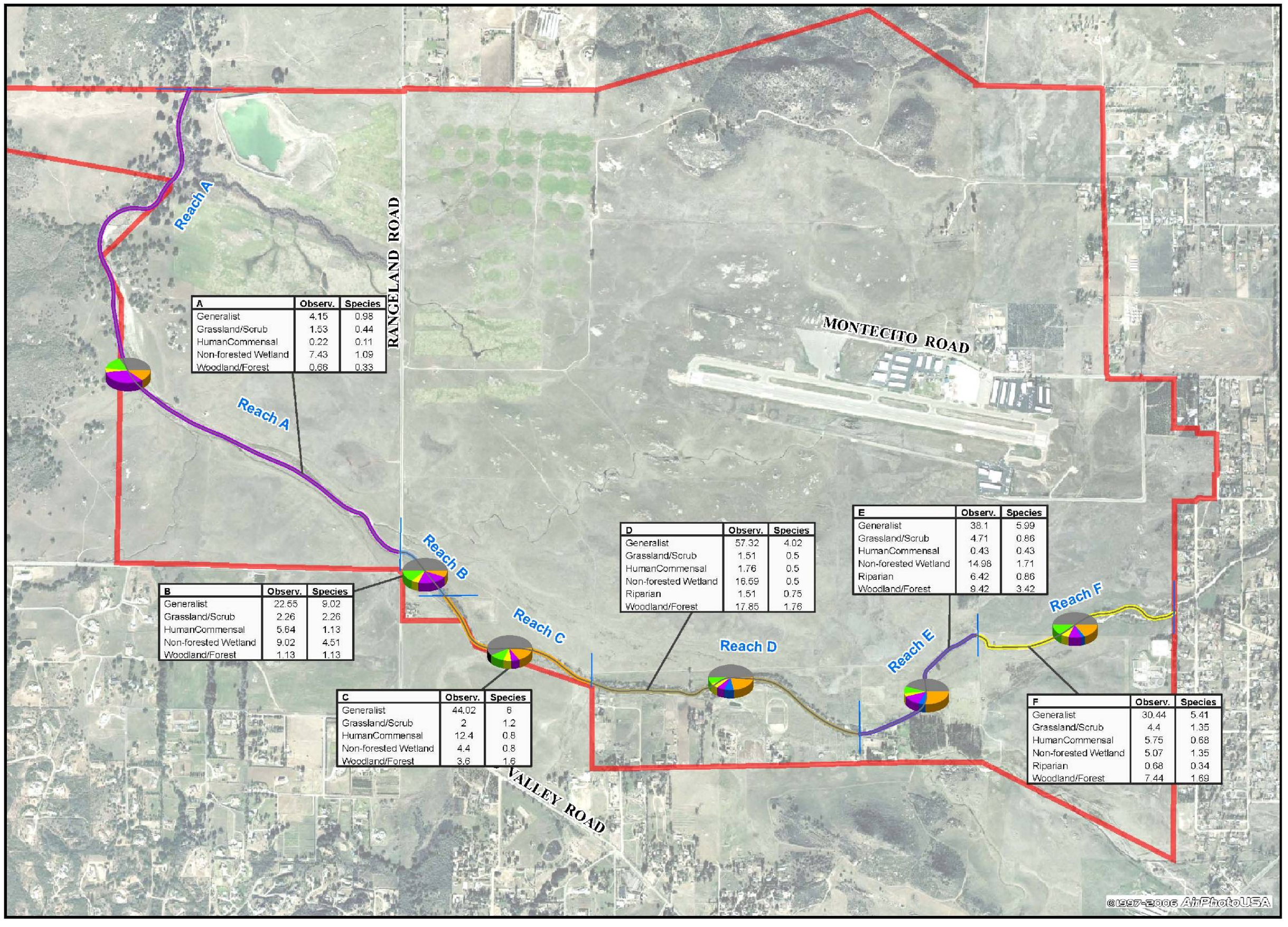

Figure 4: Summary of the Number of Riparian Bird Species by Affinity Group in the Study Area

Table 8. Categorization of the Santa Maria Creek breeding avifauna by degree and type of habitat specializations.

Habitat Affinity	Number of Species	Percentage
Human Commensal	3	10
Habitat Generalist	16	52
Non-Forested Wetland	5	16
Grassland / Scrub	1	3
General Woodland/Forest	5	16
Riparian Woodland/Forest	1	3

A number of riparian-associated or riparian obligate species would be expected, to varying degrees, to occur on at least some sections of Santa Maria Creek, considering its length, vegetation, elevation, and geographic location.
These species include:

- Green Heron (R)
- Cooper's Hawk (F)
- Black-chinned Hummingbird (R)
- Downy Woodpecker (R)
- Western Wood-pewee (F)
- Willow Flycatcher (R)
- Pacific Slope Flycatcher (F)
- Bell's Vireo (R)
- Hutton's Vireo (F)
- Tree Swallow (R)
- Bewick's Wren (G)
- Swainson's Thrush (R)
- American Robin (F)
- Orange-crowned Warbler (F)
- Yellow-breasted Chat (R)
- Black-headed Grosbeak (F)
- Lazuli Bunting (G)
- Hooded Oriole (F)
- Lesser Goldfinch (F)
- American Goldfinch (R)

As annotated, this list includes several riparian obligate (R) species, as well as general forest / woodland (F) species, and a few habitat generalists (G) that are of potential occurrence on the census reach, but were not found to be breeding in 2005. Some of these species did occur as visitors during the 2005 breeding-bird census (Table 3), but for unknown reasons were not persistent, despite the presence of suitable habitat.

Not all of the above species have equal probability of occurring on Santa Maria Creek, but should be watched for through monitoring associated with the restoration and recovery phase of the preserve. With habitat management, the distribution of bird species by habitat affinity may change; for example, with the discontinuation of grazing, riparian vegetation may establish, thereby providing more habitat for forest/woodland species and riparian obligates.

A number of sensitive or listed riparian bird species were marginally associated with the Santa Maria Creek study reach.

The Cooper's hawk was represented by an observation of one bird on 20 May (Table3). This forest-nesting species is considered sensitive in San Diego County and likely nested in riparian or non-native forest in the vicinity of the study reach in 2005. Future nesting occurrence of this species in mature forest, such as that in creek segment D, is probable.

One singing willow flycatcher was found in dense forest in creek segment D on 2 June, but this species was not detected on subsequent visits. The riparian vegetation on this segment appears to be suitable for this federally endangered species in terms of structure and extent. However, the bird detected may have been of one of the sub-species that only migrates through San Diego County. The endangered subspecies (*E. t. extimus*) is of possible occurrence along Santa Maria Creek.

The western bluebird, a Covered Species under the City of San Diego's Multiple Species Conservation Planning program, was represented by one record of four birds, including young, on 10 June, 2005. This cavity-nesting species may find suitable habitat in the forested sections of Santa Maria Creek, but is more likely to occur in the oak savannah west of the study reach.

One pair of yellow warbler occurred on the study reach and is discussed above. A higher density of this species, particularly in creek segment D, would be expected.

Conclusions

The section of Santa Maria Creek through Santa Maria Valley, by virtue of its size, natural setting, and natural hydrology provides great potential for supporting significant population segments of several riparian bird species that can serve to bolster regional populations. The largely undeveloped landscape of the Santa Maria Valley comprises several important natural communities, which, in juxtaposition form a rich preserve as a consequence of the high beta-diversity among its component elements. Such complexity of habitat types preserves not only species richness, but a richness of ecotones.

Despite the potential of the area, the current breeding riparian avifauna appears to be depauperate in terms of obligate species. Habitat generalists dominate the avifauna, suggesting an historic degradation of riparian values from anthropogenic activities. The absence of certain species is puzzling, as sections of apparently suitable habitat are

available. The paucity of riparian obligate species in the presence of habitat suggests a fairly recent and only partial recovery of conditions, coupled with lag effects associated with avian colonization from distant source populations. The enhancement of the area for riparian obligate species will likely not result in the loss of habitat generalists, but rather in an increase in diversity. Continued monitoring will reveal whether any habitat changes are accompanied by increases in bird diversity.

Future Monitoring and Management Recommendations

As highly mobile organisms, birds shift spatially among years on generally larger scales than encompassed by individual studies. These shifts may be attributable to local population factors such as survivorship and recruitment or to larger-scale (regional or continental) factors and may not be reflective of local habitat conditions. Because of this natural year-to-year variability in the composition of avifauna and in the relative abundances of component species within bounded areas, several, preferably consecutive years of study are required to allow the differentiation of short-term fluctuations from actual population trends. This position forms the basis for the following monitoring and management recommendations.

Monitoring

- An initial monitoring scheme of three to five consecutive years is recommended during the period of relatively static habitat conditions (prior to significant natural recovery and/or active restoration). As the range of variability is revealed, longer intervals (two to five years) may be implemented.
- The spot-mapping method described herein would be preferable for determining an accurate baseline due to its direct census and direct spatial correlations with habitat features.
    - Due to length of the study reach (3.4 miles) and amount of time required for a complete census pass (eight to ten hours), it is recommended that future efforts divide the reach into halves to be covered either simultaneously by two observers or on consecutive days by one observer. The approximate time for survey of one half of the reach would be six hours, which would allow the collection of more detailed data.
    - Future census efforts should begin earlier in the season than mid-May, as this date is relatively late in the nesting phase for most species. An initiation date in early April is recommended.
    - Future census efforts should provide for eight to ten census visits extending into early June to include the fledging period of most species and to provide comparability with the 2005 data.
- Conduct at least two night survey visits to determine the nocturnal avifauna.
- An alternative survey method to spot-mapping would be fixed point-count surveys, which require significantly less effort, but provide only an index of abundance, sample rather than completely census the study area, and do not

provide unambiguous information on habitat relationships in areas of high habitat edge.
    - Point-count schemes must address the issue of independence of sampling stations and adequate sample size.
    - Although not directly comparable with spot-mapping data (maps), fixed or variable radius point-count sampling schemes may be superimposed on baseline maps of species' distributions for comparison.
    - Under budget constraints, a more frequent point-counting sampling design may be alternated at longer intervals with spot-mapping for verification and comparability with the baseline.
- Regardless of survey method, bird monitoring should at least be qualitatively comprehensive (i.e., should record all species in the area) so as to detect even the sporadic occurrences of species on the above "watch list" that may other wise escape detection by the sampling scheme.
- Continue regular monitoring of habitat elements of importance to birds (e.g., vegetation density, canopy closure, undergrowth) in conjunction with bird surveys, particularly during periods of rapid natural recovery, perturbation (e.g. flood scouring), or active restoration.
- Provide a detailed aerial photograph-based map of vegetation composition and structure, as well as other habitat features, upon which to superimpose bird data. Update this map at intervals of two to five years, depending on the rate of habitat change.
- Formulate a survey and monitoring scheme for grassland birds since the Santa Maria Valley appears to support significant population segments of several restricted species in San Diego County.

Management

- Maintain suitable hydrology in future years to sustain riparian vegetation.
- Remove, reduce, or restrict cattle grazing from sections of the creek (e.g., segments C, E, and F) to allow regeneration and maturation of forest and development of understory.
- Augment the area of mature riparian forest on segment D through active or passive restoration on adjoining segments.
- Ensure the development and persistence of native overstory and understory vegetation elements through a combination of planting and weed control, especially in recovering areas.
- Maintain or enhance the large-scale biodiversity of Santa Maria Creek by maintaining some degree of open marshy vegetation on the section west of Rangeland Road to benefit red-winged blackbird colonies and arroyo toad.
- Maintain existing and establish new snags to ensure the availability of nesting substrate for cavity-nesting birds.

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APPENDIX E

Biological Survey/Monitoring Report for the Santa Maria Creek Restoration Project: arroyo toads (Hollingsworth et al. 2006)

Biological Survey/Monitoring Report for the Santa Maria Creek Restoration Project:

Arroyo Toads

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Table of Contents

List of Figures

List of Tables

Introduction

The presence of the federally endangered arroyo toad (*Bufo californicus*) within the Ramona Grasslands Preserve (RGP) has been documented in the past and is known to occur in a limited stretch of Santa Maria Creek (Varanus Biological Services, Inc. 2004; Gergus 1994). The Santa Maria Creek traverses the RGP in an east to west direction for a length of approximately 4.5 miles (7.25 km). Arroyo toads occupy the western, downstream section of the creek in a narrow, flat-bottomed, low gradient stretch of the streambed for a distance of about 1.0 mile (1.6 km).

Directed sight surveys were conducted in May and June of 2006 to confirm the presence of toads in known areas, evaluate the 2006 breeding season, document disturbance, and explore the length of the Santa Maria Creek within the preserve to determine the presence or absence of toads in unreported areas.

Project Location

Surveys were conducted within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California. The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Hobbs, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities.

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

Project Description

The County of San Diego Department of Parks and Recreation was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project. The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area, (hereinafter referred to as "Ramona Grasslands"), to improve water quality and habitat conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition,

increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters. The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system.

A second component of the project consists of collecting baseline biological data, which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek, ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas) and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the "typical" and historic conditions of the Grasslands are unknown.

The target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were surveyed for fairy shrimp, amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed. The following sections describe the methods and results of the baseline arroyo toad surveys in the spring of 2006 that were conducted by herpetologists Bradford Hollingsworth and Angelo-Soto Centeno from the San Diego Natural History Museum and Mark Roll from TAIC. The significance of these results and recommendations for future monitoring will be discussed as well.

Methods

Day and nighttime directed sight surveys were conducted on 31 May 2006 and 12 June 2006 following the guidelines of the U.S. Fish and Wildlife Service (1999), augmented with recommendations from United States Geological Survey (USGS 2003; additional USGS survey protocols in preparation). Surveys traversed the RGP in nine reaches from downstream to upstream (Table 1, Figs. 1-2). Two to three biologists walked along the edge or within the creek to detect the presence or absence of arroyo toads. Surveys were confined to the erosion contours of the creek bed. Upland habitats beyond the banks of stream channel were not surveyed.

Data were recorded on datasheets (see Appendix I) and in field notebooks to document life stage, time, location, habitat, air and water/substrate temperatures, and signs of disturbance. Photographic vouchers were recorded for all sight records provided the animal's position allowed for photography (Appendix II). Locations were recorded with a handheld Garmin Legend GPS unit using an accuracy reading of six meters or less. A handheld Coleman lantern, a Canon high intensity video light, and headlamps assisted nighttime surveys.

Results

During the two survey dates, arroyo toads were detected in Reaches 1-5 in the Santa Maria Creek (Appendix II, Table 2, Fig. 1). A total of 11 adults were observed and the presence of a number of tadpoles and toadlets provides evidence of successful breeding. Two locations contained toadlets (=neonates) representing five individual observations, and five general locations had tadpoles (=larvae) representing 13 individual observations (Table 2). No toads (adults, toadlets, tadpoles, egg strings, or calls) were detected in Reaches 6-9, which corresponds to the reaches of creek from 0.7 miles NW of the Rangeland Road to the eastern margins of the RGP in Ramona.

Only three areas were identified with both adult toads and either tadpoles or toadlets (or both). The first location is in Reach 1 (11S 504980 3656519), located in a riparian corridor with large coast live oak (*Quercus agrifolia*), cottonwoods (*Populus fremontii*), and sycamores (*Platanus racemosa*). This location is in the most northwestern section of the creek where toads were seen. The creek at this location has the underlying bedrock exposed and large open pools are prevalent. The second location is in Reach 2 (11S 504748 3656374), located in a large sweeping northeastern bend in the creek with a large, exposed, elevated sandy shoulder. Mulefat (*Baccharis salicifolia*) is common here and the creek is a shallow, intermittent stream. The third location is in Reach 5 (11S 504948 3655652), located at the crossing of a dirt service road through the creek. This site consists of a large, still pool with sandy banks and bottom. The upstream portion of the pool is vegetated and approximately 2 ft deep, while the downstream portion becomes open and shallow, from 2-5 inches deep.

Overall, within Reaches 1-5 of the Santa Maria Creek, no flow could be detected within the stream and most surface water was in shallow open pools, vegetated pools, or in marshy, heavily vegetated sections. Open pool depth was between 2-3 feet deep. The total length of stream where arroyo toads were observed measures 0.75 miles (1.2 km).

Adult toads were detected in Reaches 1, 2, and 5, mostly using upland habitat within the erosion banks of the stream channel, from 10-30 meters from the stream water. On 31 May 2006, four adults were observed 10-20 meters from the stream in sandy soils. On 12 June 2006, seven adults were observed; one submerged in the water at the large open pond beginning Reach 5 and the remaining six in Reach 2, usually associated with sandy soils 10-30 meters from the stream. Adult activity was confined to the nighttime hours from 9:00-11:56 pm and air temperatures ranging from 10.4-20.1˚C.

Toadlets (=neonates) were observed in Reaches 2 and 5 associated with wet, sandy soils adjacent to surface water. On 31 May 2006, a single toadlet was observed along the downstream margin of the large pond beginning Reach 5. On 12 June 2006, approximately 10-15 toadlets were observed at the same pond and a single toadlet at a location in Reach 2. Toadlets were observed from 5:38-10:00pm during both day and nighttime surveys, with air temperatures ranging from 17.3-26.1˚C.

Tadpoles (=larvae) were observed in Reaches 1-5 during both day and nighttime surveys. The majority of tadpoles were observed in the large open pond beginning Reach 5. On 31 May 2006, a large number (200-300) of tadpoles were observed along the shallow margins of the pond. On 12 June 2006, a large number of slightly larger tadpoles were again seen at this same location. Only one other location, in Reach 1, contained a large number of tadpoles. On 31 May 2006, approximately 200-300 tadpoles were observed in an open shallow section of stream in Reach 1; however, on 12 June 2006 this section had dried and no tadpoles could be found in the adjacent deeper pools. Tadpole observations in Sections 2-4 were limited to either single individuals or small numbers and often associated with heavily vegetated, shallow sections of stream. Most tadpoles appeared to be early-stage (stage <32; see Fig. 3d), except in two cases. In Reaches 2 and 3, tadpoles (Table 2: 03 and 05) appeared to be late-stage with the formation of hindlimbs and well-differentiated digits (stage 36-40; see Fig. 3c). Tadpoles were found in water temperatures ranging from 18.2-30.0˚C.

A great number of exotic species were observed co-inhabiting the stream with arroyo toads. The most prevalent were bullfrogs (*Rana catesbeiana*), but crayfish (*Procambarus clarkii*), mosquitofish (*Gambusia affinis*), young-of-year largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanellus*) were also seen (Fig. 4). Bullfrogs were seen from Reach 1 to the downstream margin of Reach 6. All life-stages were observed in large numbers, including calling adult males, froglets, metamorphs, and tadpoles. Besides from the presence of exotic species, the second-most noticeable disturbance was trampling by cattle.

Native herpetofauna species seen during the surveys include pacific treefrog (*Pseudacris regilla*), western toad (*Bufo boreas*), two-striped garter snake (*Thamnophis hammondii*), and California kingsnake (*Lampropeltis getula*) (Appendix III).

Discussion

Arroyo toads (*Bufo californicus*) are present and successfully bred in 2006 from a short section of the Santa Maria Creek in the Ramona Grasslands Preserve. Adults, toadlets, and tadpoles were observed during the course of day and nighttime surveys in late May and mid-June. Due to the late dates of these surveys, other signs of reproduction, including calling males, amplexus, and egg deposition, were not detected. However, the presence of tadpoles (both early and late stage) and toadlets provide evidence of a successful 2006 breeding season.

The presence of toads along the downstream, western section of the creek has been documented by previous surveys in 2003 and 2005 (Varanus Biological Services, Inc. 2004; RECON Environmental, Inc. 2005). During the 2005 breeding season, surveys conducted between 16 March 2005 and 14 June 2005 detected toads (observation and/or vocalization) at five locations on the Oak Country Estates Property, west of Rangeland Road. Detections moved further westward toward the western boundary of the Oak Country Estates Property as the breeding season progressed. The westward movement of toads observed during 2005 surveys is consistent with observations from the current surveys. Arroyo toad locations reported in 2003 correspond closely with the observations made during these surveys. During the 2003 breeding season, males called on both 15 March 2003 and 27 March 2003, and amplexus was observed on both dates. Tadpoles were seen on 27 March 2003 and toadlets emerged on 13 June 2003. Adults began using upland habitat, within the stream channel, starting on 18 April 2003. Observations from the current surveys match closely. A single toadlet was first seen on 31 May 2006 and more appeared during the 12 June 2006 survey. Early and late-stage tadpoles persist and nearly all adults were seen in upland habitats, typically 10-30 meters from the stream.

One exception is the presence of adults, toadlets, and tadpoles at the large, still pool with sandy banks at the beginning of Reach 5 (11S 504948 3655652). In 2003, surveys did not find evidence of breeding at this location, but instead, found breeding pools further to the west (Varanus Biological Services, Inc. 2004). As a consequence, the presence of breeding at this location breaks the reported trend of the westward movement of breeding sites, away from Rangeland Road. The pool is located east of the 2003 breeding sites at a crossing of a dirt service road and is excavated by ranchers in order to provide a watering area for cattle (Mike White, pers. comm., 2006).

No records of arroyo toads east of Rangeland Road exist. Surveys in Reaches 7-9 found a progression of a marshy stream filled with rushes (*Juncus* sp.) at the Rangeland Road bridge to a dry, sandy riparian corridor extending past the Voorhes Lane properties to the eastern margin of the RGP. Varanus Biological Services, Inc. (2004) reports that this section of the Santa Maria Creek did not have sufficient surface water to support breeding

from 1998 to 2003. Considering the emergence of toadlets in mid-June in both 2003 and 2006 in the western sections of the creek, the lack of surface water would be a limiting factor to tadpole survival to the time of metamorphosis. Besides from the lack of surface water, the current surveys found the sandy, streambed conditions to be suitable arroyo toad habitat.

Besides from issues of hydrology, additional habitat disturbances within the current arroyo toad population make conditions for breeding and successful recruitment less than ideal. The most pressing threat is the large quantities of introduced bullfrogs (*Rana catesbeiana*) seen throughout the arroyo toad population. No effort was made to scientifically quantify the number of bullfrogs present. However, the number is easily in the thousands within the 0.75 mile (1.2 km) section of creek that contains arroyo toads. Bullfrog adults, froglets, metamorphs, and tadpoles were common throughout Reaches 1-5, and extend into the beginning of Reach 6. Three museum vouchers were collected (SDSNH 72589, 72590, and 72599). Bullfrogs are known to be aggressive predators. Varanus Biological Services, Inc. (2004) reports the palpation of an arroyo toad from the stomach of a bullfrog on 27 March 2003.

Removal of this introduced predator could improve arroyo toad habitat and increase the success of recruitment. Three arroyo toad breeding centers were detected along the 0.75 mile (1.2 km) section of creek during the current surveys. In comparable regions, arroyo toad densities can be ten calling males/100m or 100/km (Sweet and Sullivan 2005). While surveys were not conducted during calling season, the 2003 surveys report nine calling males on 15 March 2003 over a 300 meter section of creek (Varanus Biological Services, Inc. 2004). As a result, the overall breeding success in the Santa Maria Creek is substantially less than ideal.

Eradication of bullfrogs requires the detection of source and satellite populations due to this species ability to travel long distances across dry land. It is unknown if the Santa Maria Creek serves as the source population or if it is a satellite population. If the latter, the detection of the source population would be necessary before bullfrog eradication could commence. Candidate source populations include the two Ramona Municipal Water District treatment ponds located as close as 0.10 miles (0.16 km) to Santa Maria Creek. During the 2006 surveys, neither of these ponds were visited and it is unknown if bullfrogs occur there. Other introduced species detected during the course of the 2006 surveys are crayfish (*Procambarus clarkii*), mosquitofish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanellus*). These should be considered for eradication as well.

Additional disturbances include the trampling of the streambed and upland habitat by cattle. Cattle trampling is visually unpleasant, yet it is unknown if this disturbance has an adverse effect on arroyo toads. Cattle grazing may provide a positive influence on the creek, by keeping vegetation from choking out the streambed (Mike White, pers. comm., 2006).

Future Monitoring Recommendations

We recommend continual monitoring of the arroyo toad population in the Santa Maria Creek and to implement the following actions and management policies:

• Assess breeding density and success. We suggest that annual surveys should start in early March and continue through June, in two week intervals, to detect the full breeding cycle, from the onset of calling to the emergence of toadlets. Pit-tagging adult individuals would allow mark and recapture methods to be used. Special attention should be paid to calling male densities to allow for meaningful comparisons year after year.

• Determine extent of creek use. We suggest that the downstream extent of the population be determined to have a better understanding of the distribution and survival of the species in this region. To date, the upstream extent of the population is well-known and its absence from sections of the Santa Maria Creek east of Rangeland Road investigated. No effort has been made to assess the extent of the population downstream. There is evidence that arroyo toad is present downstream from the study area, which is indicated by the presence of suitable habitat for approximately 1.2 miles beyond the study area boundary and the presence of arroyo toad (toad 10) at the terminus of the downstream study area boundary.

• Assess upland habitat use. We suggest that the extent of upland habitat use be assessed and should start in April and continue through October. Pit-tagging adult individuals would allow mark and recapture methods to be used. Pit-fall trapping with drift-net fences should be placed at incrementally distant locations to assess the extent of upland habitat use.

• Eradicate introduced species. We suggest that an annual eradication program be implemented to reduce the numbers of bullfrogs, crayfish and exotic fish. Aggressive removal of bullfrogs prior to their breeding season should reduce pressures caused by tadpole competition and adult bullfrog predation on toads.

• Determine source population for bullfrogs and control. Survey potential source populations within a 5 km area for bullfrogs and implement an eradication program. If possible, source populations should be fenced with tight-nit mesh to a height of 5 feet.

• Investigate the effects of cattle. Develop an experimental plot to exclude cattle from a subsection of the creek. Plant community composition should be evaluated prior to fencing to determine if cattle grazing has an effect on vegetation and hydrology.

• Excavate new ponds upstream. Create manmade surface water habitats in sandy reaches of the creek to extend the arroyo toad population upstream. Currently, arroyo toads use a manmade pool in Reach 5 of this study and have bred successfully in these habitats. Attempts to duplicate this shallow pool should be made.

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U.S. Fish and Wildlife Service. 1999. Survey Protocol for the Arroyo Toad.

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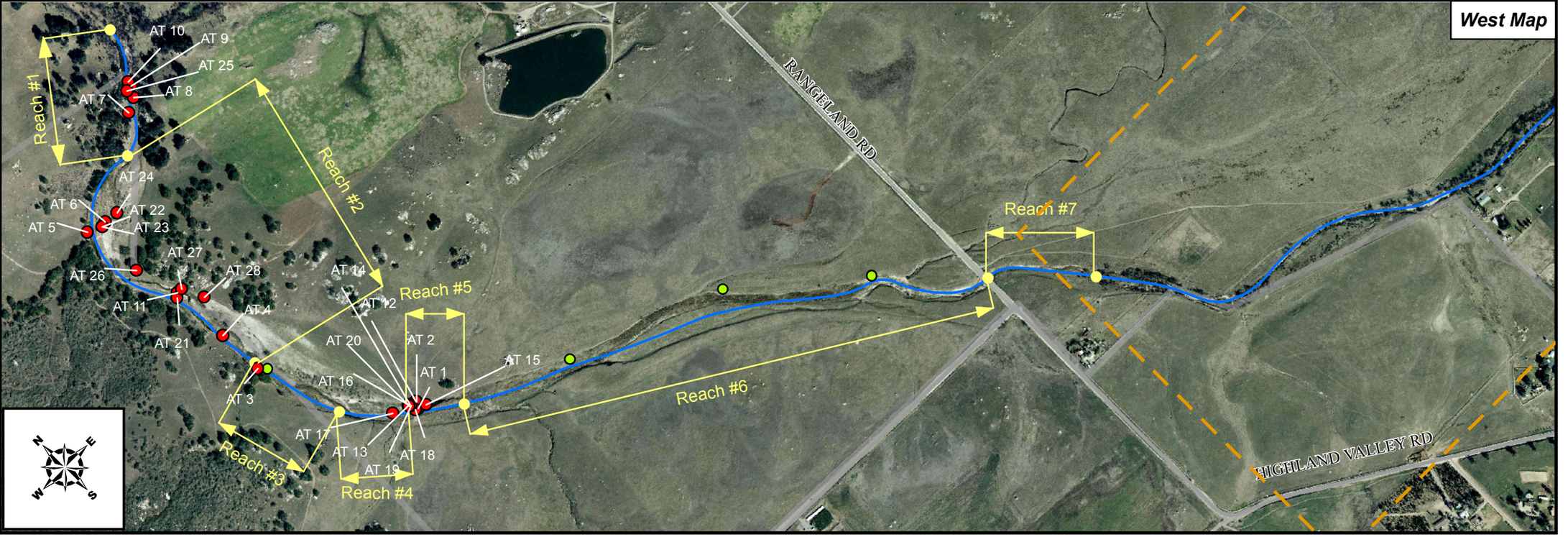
Table 1: Description of Santa Maria Creek transects used during directed sight surveys.

Reach	Length (m)	UTM Region	UTM Easting	UTM Northing	Elevation (m)	Habitat	Stream Condition
Reach 1	280	11S	505058	3656653	379	Riparian corridor with large oak and sycamore	Open still ponds (some 1-2 meters deep)
Reach 2	650	11S	504888	3656439	398	Open riparian with mulefat	Still intermittent stream
Reach 3	210	11S	504768	3655954	399	Open riparian with mulefat	Marshy stream
Reach 4	160	11S	504828	3655763	402	Open riparian with mulefat	Still intermittent stream
Reach 5	100	11S	504939	3655672	406	Open riparian with mulefat	Open still stream with manmade pond
Reach 6	1130	11S	505031	3655607	401	Open riparian with mulefat	Marshy intermittent stream, with small pond
Reach 7	240	11S	505971	3655026	412	Open riparian with willow and rushes (*Juncus* sp.)	Marshy stream
Reach 8	2250	11S	506145	3654879	411	Riparian corridor with large oak and sycamore	Dry
Reach 9	1450	11S	508111	3654359	414	Open riparian corridor with oak and sycamore	Dry
End	n/a	11S	509281	3654864	419	Ends in Ramona neighborhood	Dry

Table 2. Arroyo Toad localities during 2006 surveys along the Santa Maria Creek in the Ramona Grasslands Preserve.

Toad Sighting	UTM Region	UTM Easting	UTM Northing	Elev (m)	Date	Time	Life Stage	Reach
01a*	11S	504948	3655652	404	31-May-2006	5:38pm	Tadpoles (300+)	Reach #5
01b	11S	504948	3655652	404	31-May-2006	5:38pm	Toadlet (1)	Reach #5
02*	11S	504956	3655664	401	31-May-2006	9:13pm	Tadpoles (~10)	Reach #5
03	11S	504771	3655943	404	31-May-2006	9:58pm	Tadpoles (~6)	Reach #3
04*	11S	504767	3656040	402	31-May-2006	10:12pm	Tadpole (1)	Reach #2
05	11S	504718	3656388	389	31-May-2006	10:47pm	Tadpole (1)	Reach #2
06	11S	504759	3656378	388	31-May-2006	10:55pm	Adult (1)	Reach #2
07	11S	504951	3656503	380	31-May-2006	11:12pm	Adult (1)	Reach #1
08	11S	504980	3656519	389	31-May-2006	11:19pm	Tadpoles (300+)	Reach #1
09	11S	504993	3656539	398	31-May-2006	11:26pm	Tadpoles (~10)	Reach #1
10	11S	504996	3656549	395	31-May-2006	11:32pm	Adult (1)	Reach #1
11	11S	504763	3656169	396	31-May-2006	11:56pm	Adult (1)	Reach #2
12*	11S	504954	3655666	406	12-Jun-2006	6:15pm	Tadpoles (50-100)	Reach #5
13	11S	504938	3655670	404	12-Jun-2006	6:20pm	Tadpoles (200-300)	Reach #5
14	11S	504941	3655669	404	12-Jun-2006	6:30pm	Toadlet (1)	Reach #5
15*	11S	504965	3655646	411	12-Jun-2006	7:00pm	Tadpoles (~20)	Reach #5
16	11S	504939	3655671	411	12-Jun-2006	7:15pm	Toadlets (10-15)	Reach #5
17*	11S	504904	3655682	400	12-Jun-2006	8:45pm	Tadpole (1)	Reach $4
18*	11S	504942	3655654	406	12-Jun-2006	8:45pm	Tadpoles (200-300)	Reach #5
19*	11S	504942	3655666	401	12-Jun-2006	9:00pm	Adult (1)	Reach #5
20	11S	504938	3655669	398	12-Jun-2006	9:03pm	Toadlet (3)	Reach #5
21	11S	504754	3656161	413	12-Jun-2006	9:35pm	Adult (1)	Reach #2
22	11S	504748	3656374	400	12-Jun-2006	10:00pm	Adult (1)	Reach #2
23	11S	504748	3656374	400	12-Jun-2006	10:00pm	Toadlet (1)	Reach #2
24	11S	504790	3656374	395	12-Jun-2006	10:10pm	Adult (1)	Reach #2
25	11S	504980	3656537	400	12-Jun-2006	10:30pm	Tadpole (2)	Reach #1
26	11S	504735	3656261	392	12-Jun-2006	10:50pm	Adult (1)	Reach #2
27	11S	504774	3656169	397	12-Jun-2006	11:00pm	Adult (1)	Reach #2
28	11S	504796	3656124	395	12-Jun-2006	11:05pm	Adult (1)	Reach #2

*no photographic voucher taken, see Appendix II for skipped numbers.



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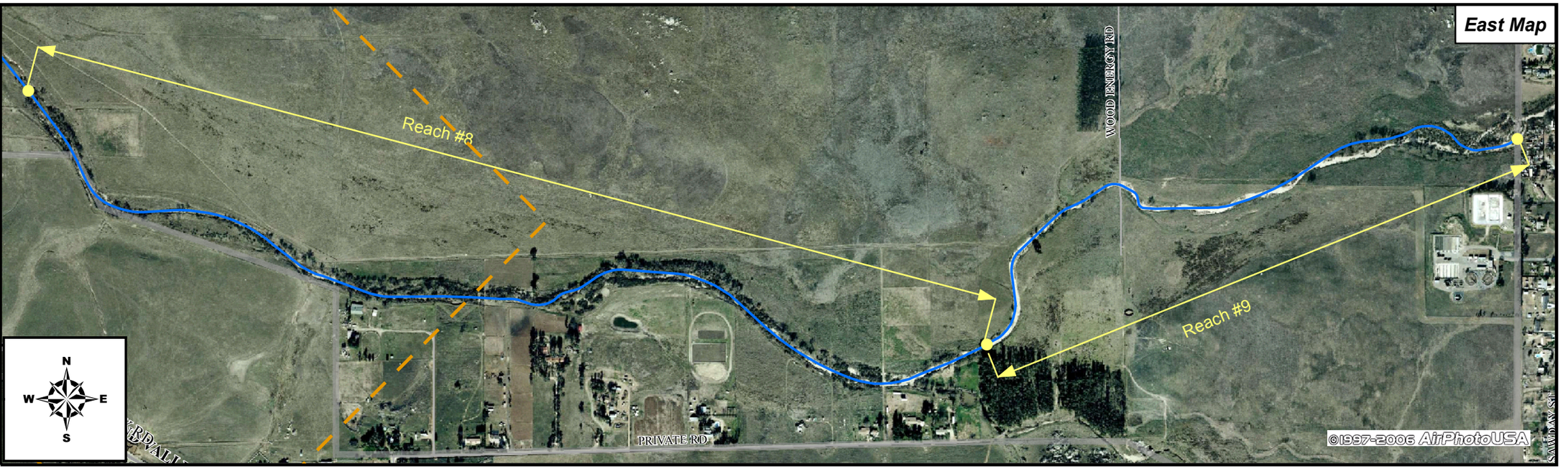


Figure 1: Arroyo toad survey reaches 1-9 and 2005/2006 survey results.

Legend

- Proposition 13 Project Area
- Arroyo Toad (2006)
- Arroyo Toad (2005)
- Surveyed Reaches
- Reach Division Endpoint
- Adjacent Map Boundary

Technology Associates
INTERNATIONAL CORPORATION

Document: Split_ArroyoToad.mxd

Date: Dec 15, 2006

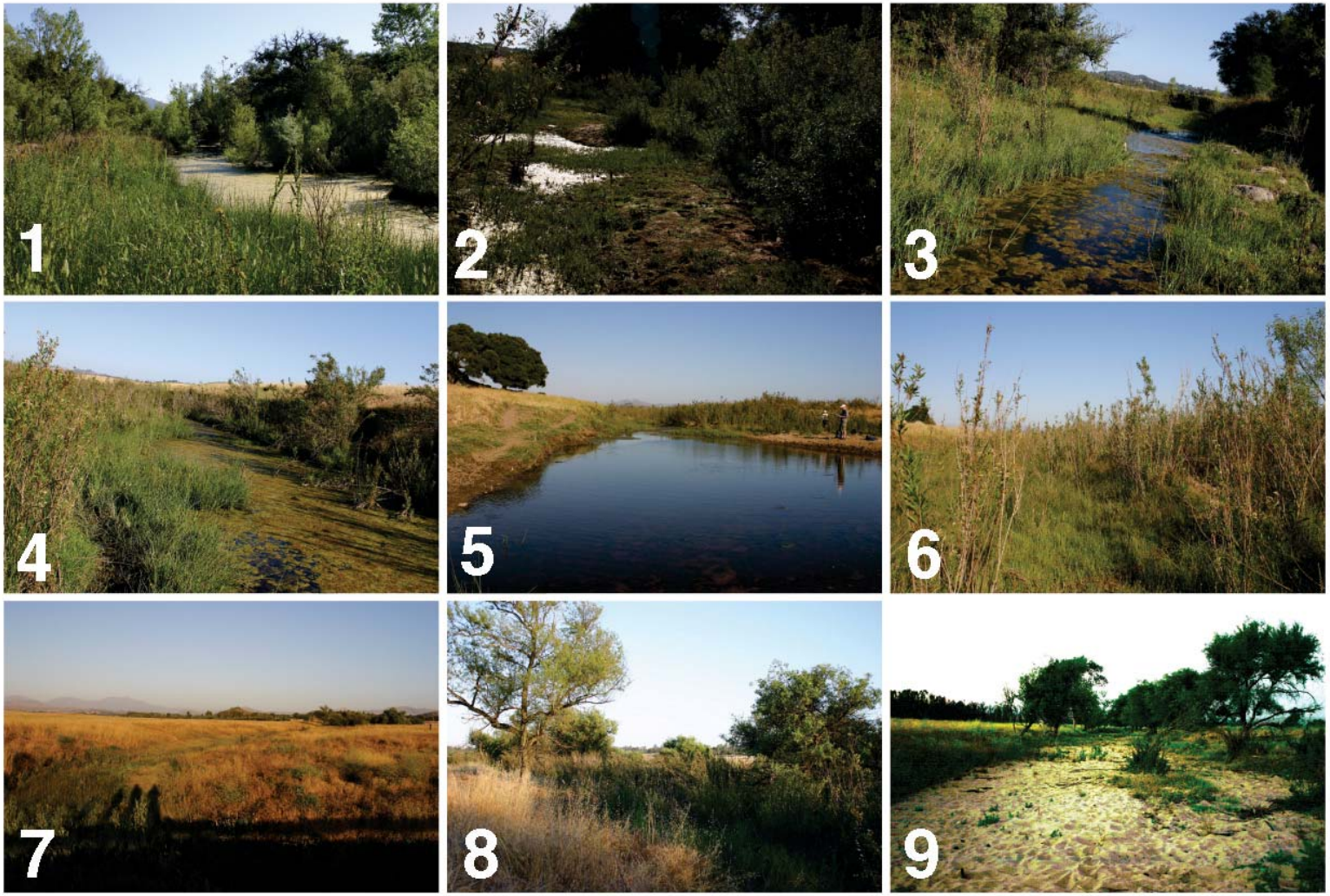


Figure 2. Habitats of survey stretches, Stretches 1-9 (see Table 1), in Santa Maria Creek.

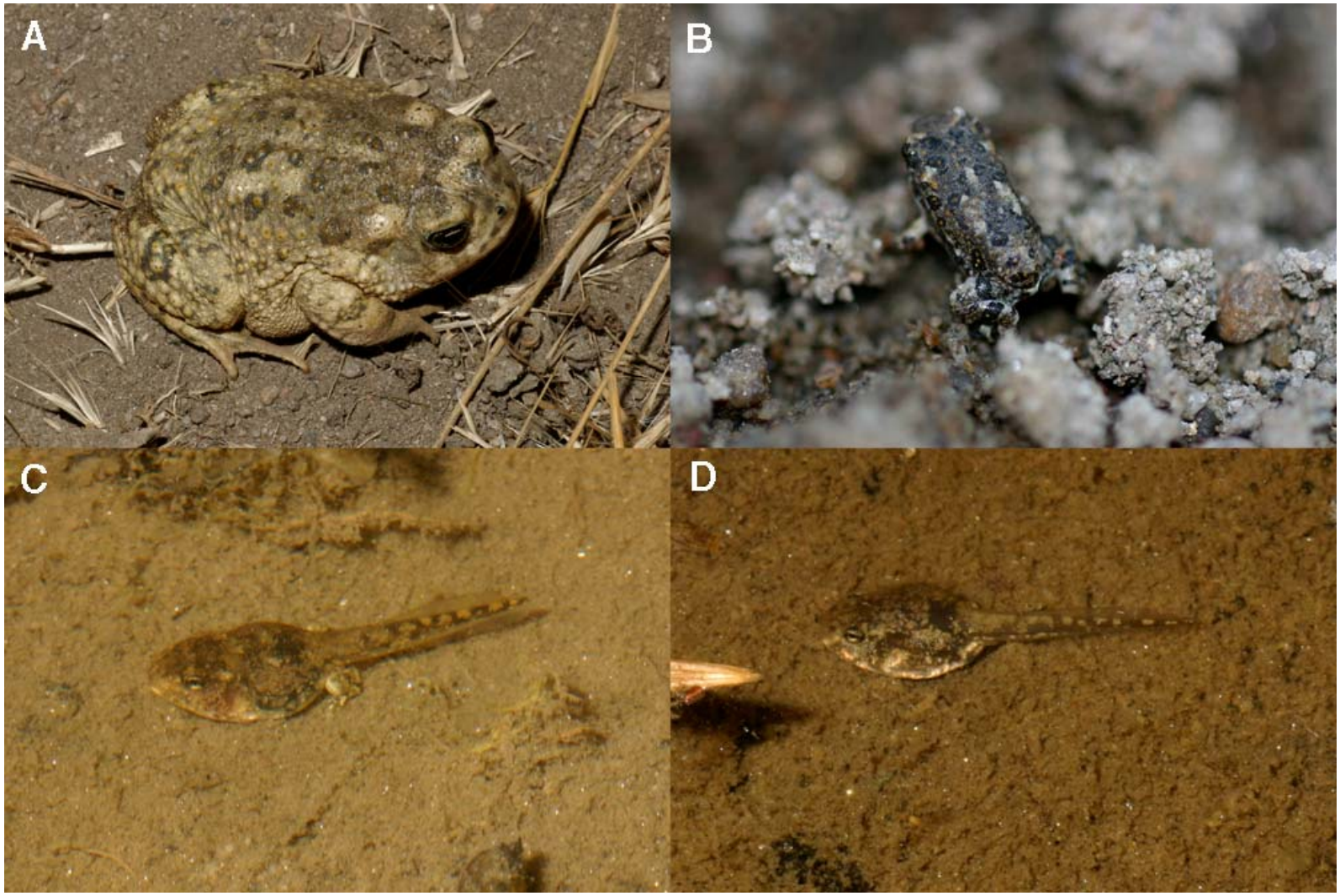


Figure 3. Arroyo Toad life stages observed during 2006 surveys: a) adult in upland habitat; b) toadlet in moist, sandy soil; c) late-stage tadpole; and d) early-stage tadpole.

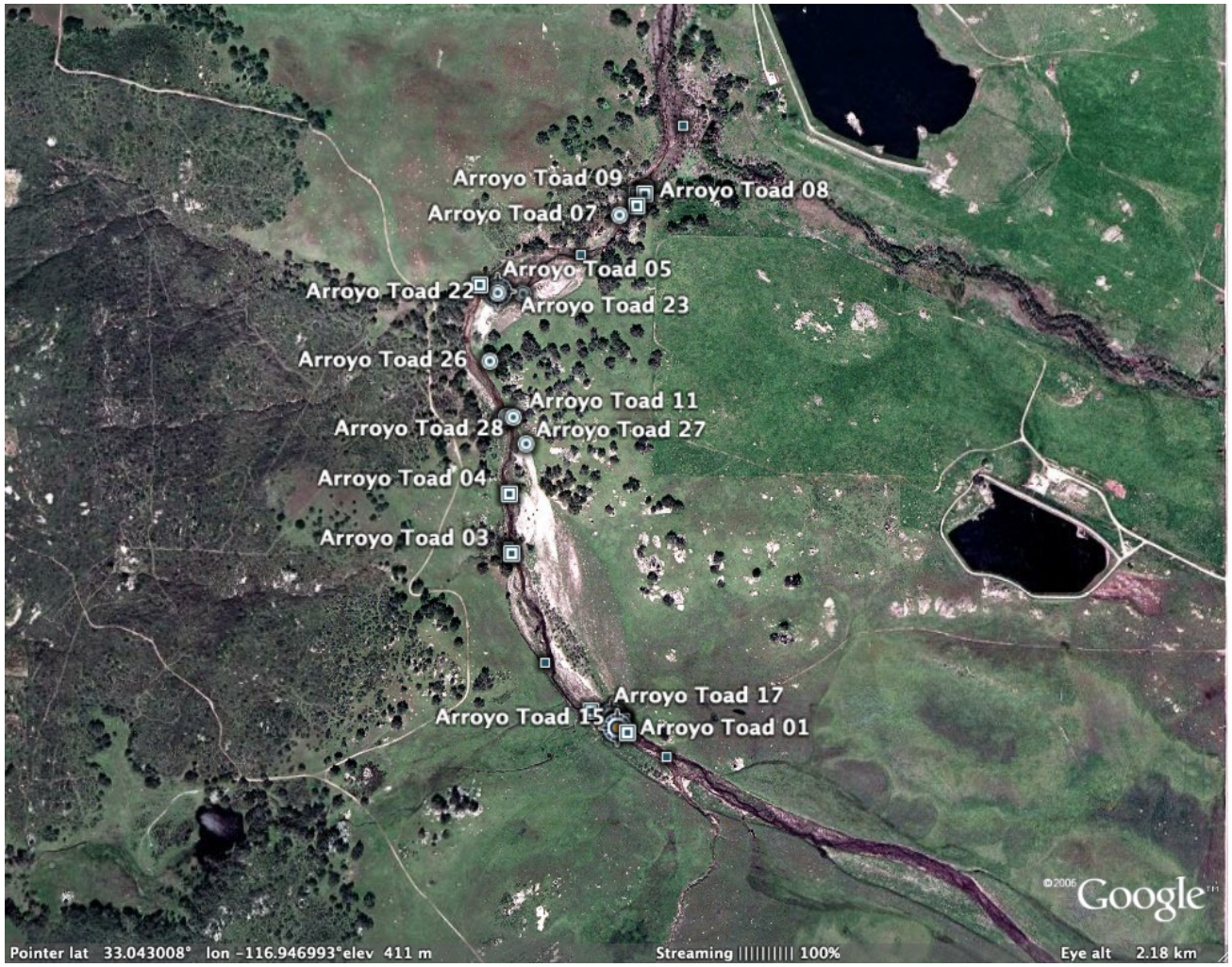


Figure 4. Map of the Preserve with survey stretches 1-5 (see Table 1) along the Santa Maria Creek showing locations of Arroyo Toad sightings.

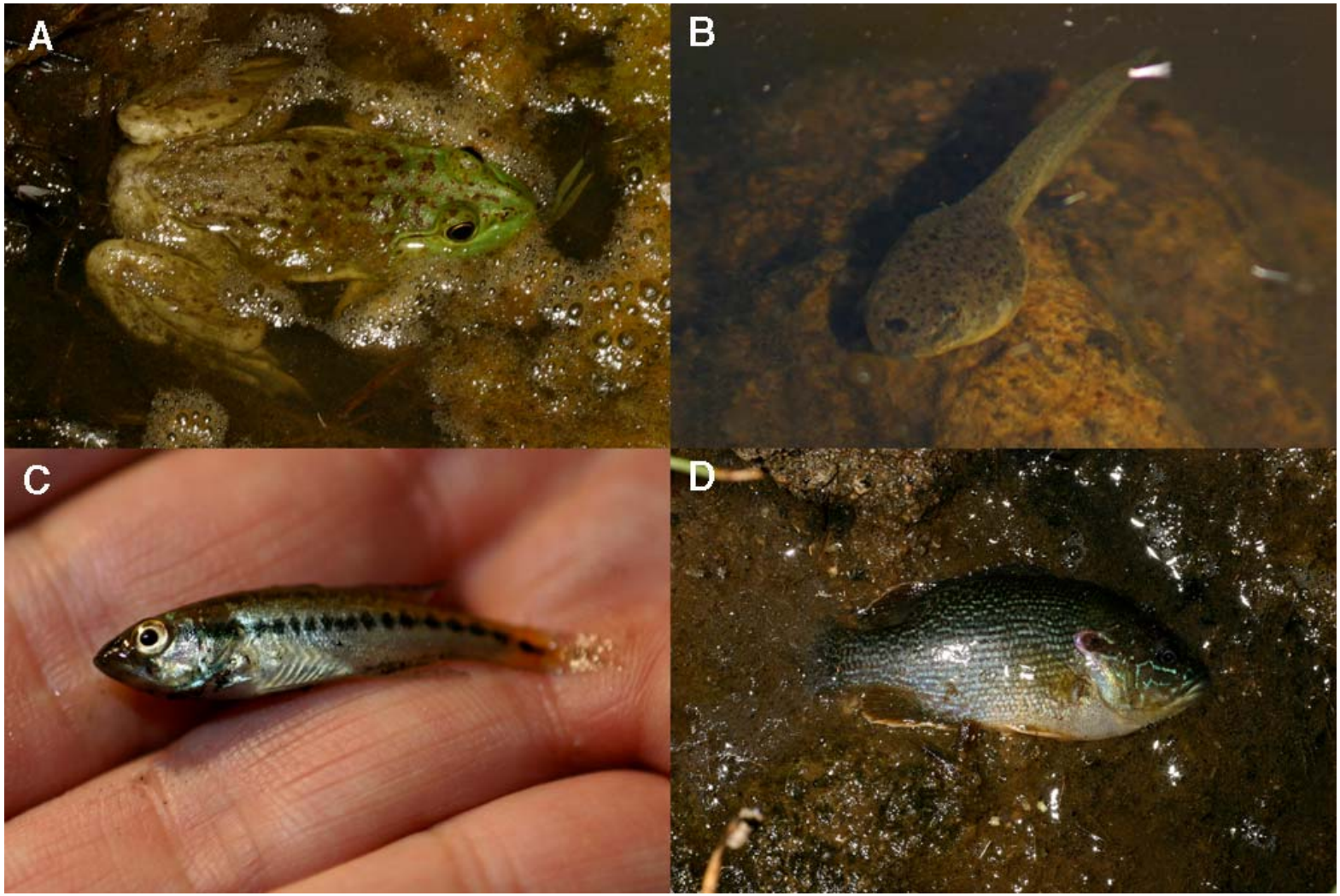


Figure 5. Exotic species observed during 2006 surveys: a) adult male bullfrog; b) bullfrog tadpole; c) largemouth bass; and d) green sunfish.

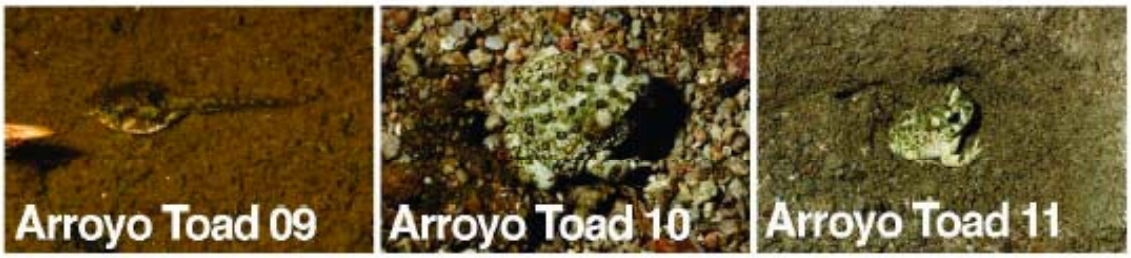
Appendix I

Data Sheet Example

Appendix II

Photographic Vouchers of Arroyo Toad Observations

(see Table 2 for specific data)



31 May 2006 Survey

Appendix II (continued)

Photographic Vouchers of Arroyo Toad Observations

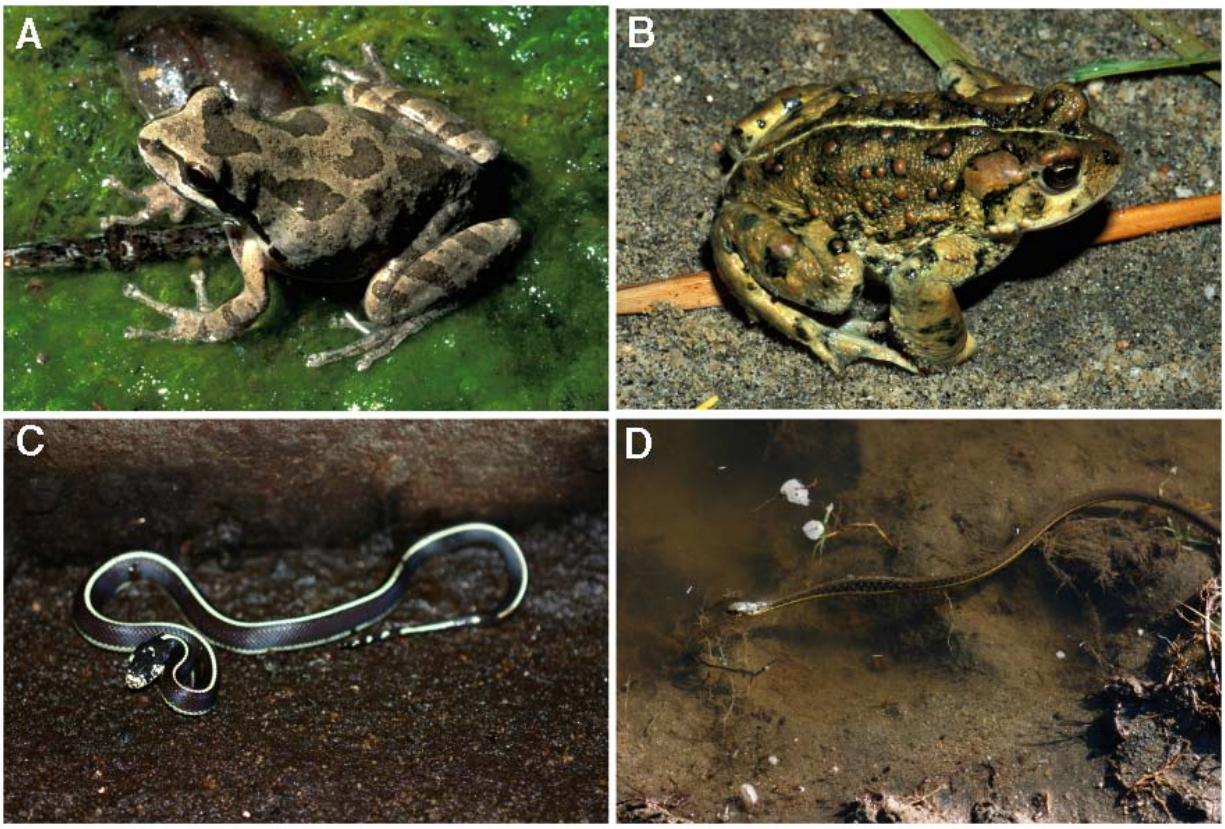
(see Table 2 for specific data)

12 June 2006 Survey

Appendix III

Native Species Seen At the Ramona Grasslands Preserve

A. *Pseudacris regilla*; B. *Bufo boreas*; C. *Lampropeltis getula*; D. *Thamnophis hammondii*



Species	Reach	Datum	UTM Region	UTM Easting	UTM Northing	Elevation (m)	Date
Bufo boreas	Reach #2	WGS84	11S	504770	3656140	395	12-Jun-2006
Lampropeltis getula	Reach #6	WGS84	11S	505971	3655026	412	12-Jun-2006
Pseudacris regilla	Reach #6	WGS84	11S	505971	3655026	412	31-May-2006
Pseudacris regilla	Reach $4	WGS84	11S	504904	3655682	400	12-Jun-2006
Thamnophis hammondii	Reach #6	WGS84	11S	505971	3655026	412	31-May-2006
Thamnophis hammondii	Reach #5	WGS84	11S	504962	3655675	405	12-Jun-2006

APPENDIX F

Invasive Weed Report for the Santa Maria Creek Restoration Project: grassland and riparian invasive weed control efforts and results (Kelly & Associates 2007)

Invasive Weed Report for the Santa Maria Creek Restoration Project:

Grassland and Riparian Invasive Weed Control Efforts and Results

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Table of Contents

Contents Page

List of Tables

Table Page

List of Figures

Figure Page

INTRODUCTION

Project Location

The invasive species control portion of the Santa Maria Creek Restoration project was performed within a core preserve area known as the Ramona Grasslands Preserve (RGP). RGP is located in the vicinity of the Santa Maria Creek and the Ramona Airport in the western portion of the community of Ramona, San Diego County, California (Figure 1). The preserve area includes properties currently owned by The Nature Conservancy, including the former Cagney Ranch, the Hardy property, Oak Country Estates, the Hobbs property, and Eagle Ranch. Adjacent landowners, including Wildlife Research Institute (WRI), selected Voorhes Lane properties, Cumming Ranch, the County's Ramona Airport open space, Martz, and the Ramona Water District were given the opportunity to take part in this project. Only properties with landowner consent were included in project activities.

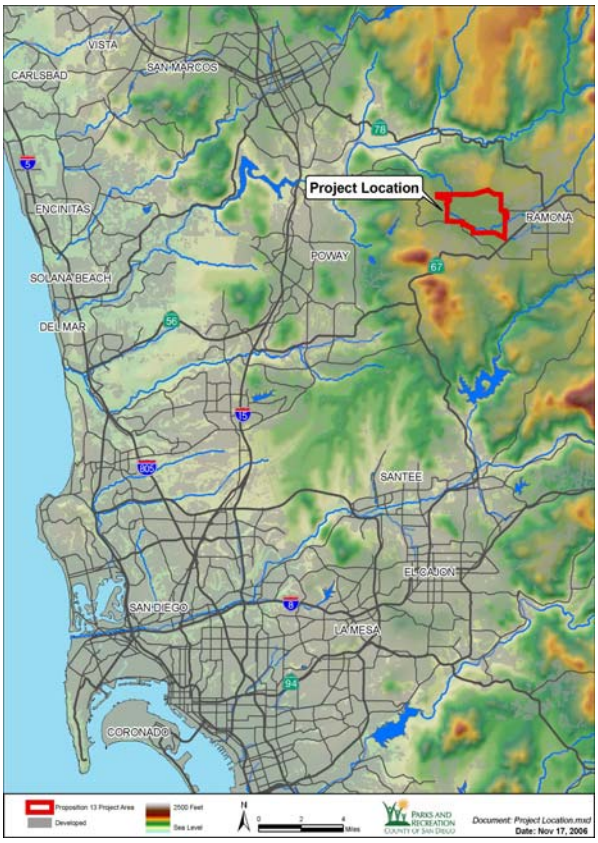


Figure 1. Project Location

Most of the properties have been used as livestock pasturage, but were formerly part of a large expanse of native grassland. These locations have been identified by the proposed North County Multiple Species Conservation Program (MSCP) Subarea Plan as areas of very high quality habitat and, as such, have been included in the planned preserve area.

Project Description

The County of San Diego Department of Parks and Recreation was awarded a Proposition 13 Grant by the California Water Resources Control Board for the Santa Maria Creek Protection and Restoration Project. The purpose of the grant is to protect and restore Santa Maria Creek and its adjacent watershed areas within the Ramona Grasslands Preserve, the project area, (hereinafter referred to as "Ramona Grasslands"), to improve water quality and habitat

conditions in the creek corridor. Santa Maria Creek has been subjected to unmanaged cattle grazing, which has resulted in elevated suspended sediment concentrations, bacteria, and nutrients in the stream. In addition, increasing urbanization in the town of Ramona, upstream of the project area, has contributed urban, non-point source runoff to the stream. Land uses upstream of the Ramona Grasslands are largely rural residential, but development densities are projected to increase in the future according to General Plan 2020 of the County of San Diego. The Santa Maria Creek Protection and Restoration Project will prevent residential development in the Ramona Grasslands, thus eliminating a future source of urban runoff to Santa Maria Creek and downstream receiving waters. The project will also manage cattle grazing by limiting access of livestock to the creek corridor with fencing, thus eliminating a source of agricultural pollutants and allowing stabilization of the channel and restoration of riparian and wetland vegetation to enhance riverine functions in the creek system. A second component of the project consists of collecting baseline biological data according to the Ramona Grasslands Framework Management Plan (CBI 2004), which will facilitate preserve management decision-making and track responses to management actions to refine recommended monitoring protocols. Baseline data will enable preserve managers to:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in the physical condition and hydrology of the creek and ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas), and their watersheds.
- Track changes in the current distribution and abundance of management target species.
- Understand the distribution of non-native animal species.
- Provide a benchmark to which all subsequent monitoring data can be compared, realizing that the “typical” and historic conditions of the Grasslands are unknown.

The target species selected for the baseline surveys are the arroyo toad (*Bufo californicus*), riparian bird species, raptors, and Stephens' kangaroo rat (*Dipodomys stephensi*). In addition, vernal pools were surveyed for fairy shrimp, amphibians, and plant species. Grassland floral surveys and vegetation transects across Santa Maria Creek were also performed.

The proposed project includes a restoration plan that will help restore the integrity of the native grassland and riparian habitats within the preserve. This will be accomplished through a multi-year comprehensive removal and control of invasive non-native plant species, which have been shown to rapidly outcompete native plant species, alter natural hydrologic patterns, and provide poor foraging and nesting habitat for native wildlife. Specifically, artichoke thistle (*Cynara cardunculus*) has been rapidly spreading in the grasslands and is the major removal target for exotic species control. Two other invasive weeds are of concern in the grasslands, milk thistle

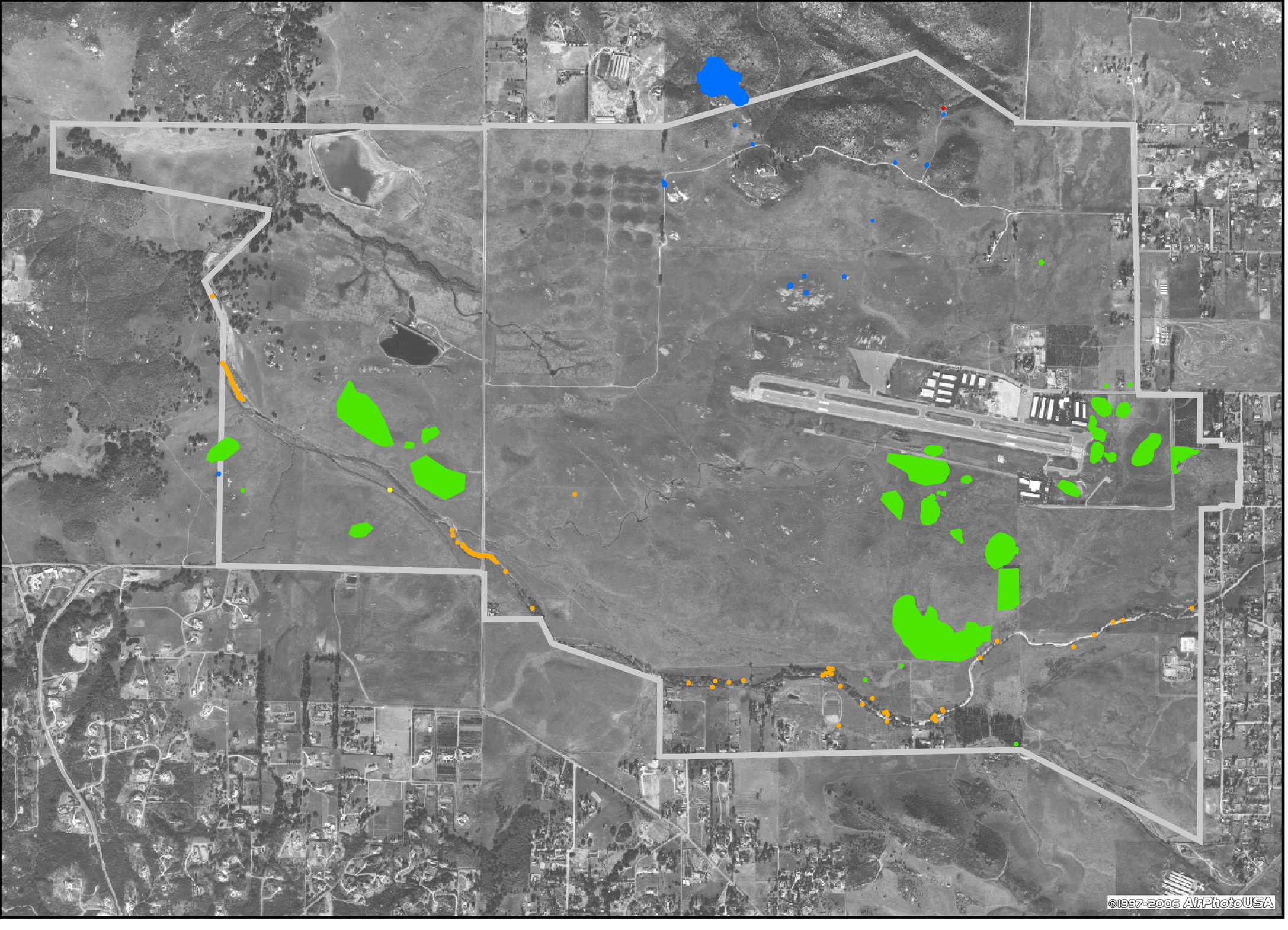
(*Silybum marianum*) and intermediate wheatgrass (*Elytrigia intermedia*). It should be noted that these species are not eaten by the cattle present on the range, while the cattle do eat the other grassland species. The cattle can also spread the seed of these species by carrying them on their hooves (pers. obs.) Riparian invasive weeds include salt cedar (*Tamarix ramosissima*), giant reed (*Arundo donax*), and milk thistle. The following sections describe the methods and results of the invasive weed control work that was conducted by Kelly & Associates from November 2005 through August 2006. The significance of these results and recommendations for future monitoring and control efforts will be discussed as well.

SURVEYS

Field work was conducted throughout the Year 2 exotic species treatment season between winter 2005 and summer 2006 by Kelly & Associates, in coordination with TAIC. Year 1 exotic species control was performed by Recon (Recon 2005) under contract with the County of San Diego Department of Public Works. Maps, provided by TAIC, of the invasive weed populations of the project area were ground-truthed in the field. These maps were based on data from a previous contractor that worked the grasslands in 2005 (Recon 2005) and were found to be largely accurate. However, two exceptions were found:

1. Salt cedar in the western reach of the creek on the Oak Country Estates parcel had not been mapped. The plants appeared to be 2-3 years old and can be difficult to see, especially with the recent thick growth of mule fat in several reaches of the creek.
2. A population of artichoke thistle was found on the southwestern portion of the Oak Country Estates parcel. The plants were mature and had seed heads from previous years and had not been treated in 2005. Access to this population was difficult, with no road or trail crossing this portion of the property, and the population was difficult to see from a distance until mature plants bolted later in the year. This population is mapped as Patch 11. A total of 362 plants, mature multi-year and seedlings alike, were controlled.
3. Artichoke thistle within the new acquisition parcel on Eagle Ranch were treated by The Nature Conservancy.

Invasive weed distribution within the Ramona Grasslands is illustrated in Figures 2, 3, and 4. Surveys revealed that the year 2005 control effort had not prevented flowering and seed production. Control efforts were conducted late in the season (Bruce Hanson, pers. comm.). It was estimated that more than 75% of the mature plants had gone to seed. This seed has been observed to have an average longevity of five years (Kelly 2000). Mapping of herbicide treatment methods in the previous year indicated that the main herbicide, Transline, had been applied too late in the season to be effective. This possibly accounts for the high rate of plants observed resprouting from previous year's plant biomass.



Legend

- Prop 13 Project Area
- Unknown Exotic Bunchgrass
- Palo Verde
- Horehound
- Artichoke Thistle
- Tamarisk

N

0 750 1,500 Feet

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Figure 2. Location of Invasive Weeds within the Ramona Grasslands 1, including artichoke thistle.

Legend

- Prop 13 Project Area
- Lepidium
- Pepper Tree
- Milk Thistle
- Russian Thistle
- Olive Tree

N

0 750 1,500 Feet

Technology Associates
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Figure 3. Location of Invasive Weeds within the Ramona Grasslands 2, including milk thistle and Lepidium.

Legend

- Prop 13 Project Area
- Giant Cane
- Natal Grass
- Eucalyptus
- Intermediate Wheatgrass
- Italian Thistle

N

0 750 1,500 Feet

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Figure 4. Location of Invasive Weeds within the Ramona Grasslands 3, including eucalyptus groves.

Goals

There were several major goals at the beginning of the 2005/2006 weed season:

1. Sweep the creek on the publicly owned and privately permitted parcels and kill the major invasives (saltcedar, arundo, milk thistle).
2. Kill all mature, reproductive artichoke thistle before it had a chance to flower and set seed. Mature, reproductive plants have a deep tap root with large underground storage tubers.
3. Begin the process of exhausting the seed bank of artichoke thistle. This plant is a deep and relatively long-lived seed (Kelly 2000).
4. Stop the relatively new infestations of milk thistle and intermediate wheatgrass before they had a chance to spread beyond their introduction foci.
5. Map new populations of these invasive weeds.

Methods

Two methods were used to control the weeds. The most frequently used method was to spray herbicides where and when most appropriate. A 50-gallon truck sprayer was used when dense concentrations of plants occurred, while backpack sprayers were used in less dense situations. No matter which tool was used, for the most part the applications were a spot spray, not a broadcast spray application. A second method was to use a "cut stump" technique on arundo and saltcedar. The saltcedar or arundo is cut with loppers, chainsaw, or handsaw, then a concentrated herbicide is applied to the cut stump within one minute of cutting.

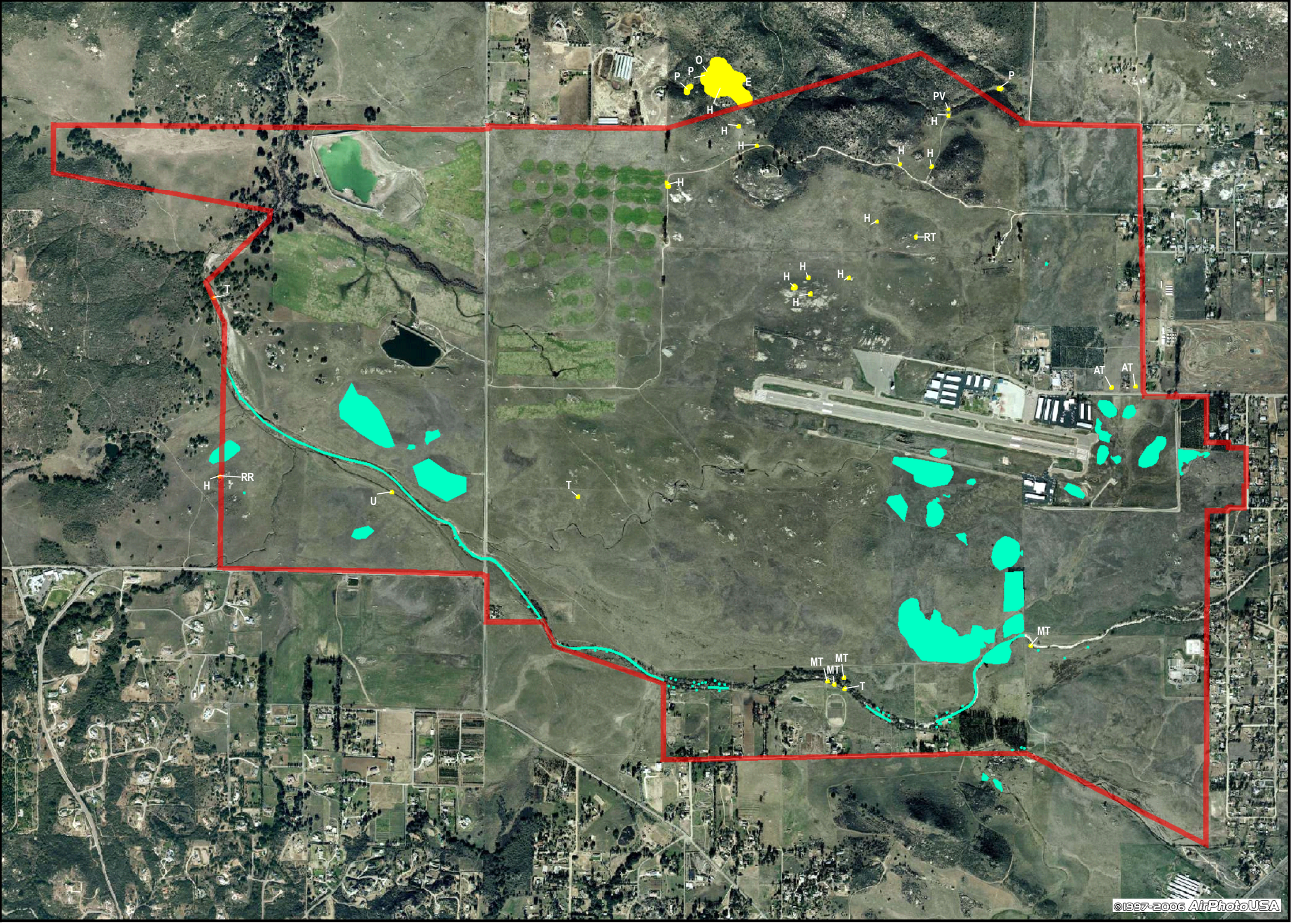
The herbicides used were Transline, Garlon 4a, Pathfinder (a pre-mix of Garlon 4a in a seed oil base) Glypro Pro (a Glyphosate herbicide, a generic Roundup), and Fusilade II; application quantities varied (Table 1). Transline and Garlon 4a are broadleaf specific herbicides. Transline, approved for Rangeland use with cattle present, is most effective when used at the basal stage of artichoke thistle. It begins to lose effectiveness when artichoke bolts, when it erupts from its basal stage and grows upwards, including sending up the flowering stalk. At that point, Garlon 4a and Glyphosate Pro (generic Roundup), become more effective. Glypro Pro is a non-specific herbicide, controlling both dicots and monocots. Once the plants were bolting in the field, Kelly & Associates shifted to a cocktail of Transline and either Garlon 4a or GlyPro II. Keeping Transline in the cocktail of herbicides was important because the herbicide has a pre-emergent effect on the next year's growth, killing emerging seedlings.

Table 1. Herbicides and adjuvants

Herbicide	**Quantity**
Glyphosate	95 ounces
Garlon 4a (or Pathfinder)	233 ounces
Transline	174 ounces
Surfactant	195 ounces
Fusilade	5 ounces
Blazon dye	395 ounces
Total of Transline & water mix sprayed	696 gallons
Total of other herbicide & water mix sprayed	5 gallons

All references to Transline assume the rate of herbicide used was the same, i.e., 0.25 oz of Transline per gallon of water with both surfactant and dye added. This was consistent throughout the season. Garlon 4a was used at 1% (1.33 oz per gallon of water) and mixed with Transline. Glypro Pro was used at 1% and mixed with Transline. Fusilade II is a grass specific herbicide. Fusilade II was used at the rate of 1 oz per gallon of water. Pathfinder is strictly used in cut stump applications at full strength. The numbers of weeds controlled are based on counting the first backpacks or truck spraying counts per gallon, then extrapolating times the total number of gallons of spray mix used in that patch that day. An error rate of +/- 5% would be reasonable. If anything, given the volume of small seedlings in the count, the total is probably on the low side.

All the major patches of artichokes were visited and sprayed an average of 5 times (see Appendix A for a chronological application schedule). A final sweep of the riparian was conducted in two visits in July and August.



Legend

- Proposition 13 Project Area
- Untreated Exotic Plants
- Treatment Areas

AT = Artichoke Thistle
E = Eucalyptus
H = Horehound
L = Lepidium
MT = Milk Thistle
O = Olive Tree
PV = Palo Verde
P = Pepper Tree
RR = Rhynchelytrum repens
RT = Russian Thistle
T = Tamarisk
U = Unknown exotic bunchgrass

N

0 750 1,500 Feet

Technology Associates
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Figure 5. Invasive Weeds treated in 2005 and 2006.

RESULTS

After termination of the Year 2 invasive species treatment season, no invasive species remained in the Ramona Grasslands and associated Santa Maria Creek riparian habitat with the exception of those outside of this scope (e.g., some invasives were treated by The Nature Conservancy outside this scope, and detailed information is not available). The eradicated species and associated herbicide quantities are stated in Table 2 below and shown on Figure 5 (see previous page).

Table 2. Controlled invasive species and associated herbicide quantities.

Invasive Weed Species	**Quantity (*individuals)** *unless stated otherwise
Artichoke Thistle	193,541
Milk Thistle	2,236
Intermediate Wheatgrass	675 bunches
Lepidium, a net	0.008 acre
Tamarix	419
Arundo	3 clumps
Pampas grass	8
Polypogon grass	2 bunches

Artichoke Thistle Control

All of the patches previously mapped developed in several waves of dense plants. Early in the season, the patches tended to be composed of as many re-sprouts rather than seedlings. Starting from the underground perennial tuber, these plants emerge and grow faster than seedlings. Most resprouting tubers emerge earlier in the season than seedlings. After the first artichoke control sweep of the grasslands, the re-growing plants tended to be seedlings and therefore smaller. Despite the below average season total of rainfall, the timing of the rainfalls and the amount of rain with each storm served to bring up several robust waves of artichoke seedlings, thus beginning the process of depleting the seed bank.

A final examination of the artichoke fields in August 2006, after the germination and flowering season for artichoke, found no plants that survived to flower or set seed, achieving the major goal of this contract. Year 3 treatments, however, will be conducted as necessary and feasible in the winter of 2006/2007.

Riparian Exotics Control

Invasive control in the riparian habitat was less difficult than control in the grasslands, for two reasons. First, Year 1 treatment was successful on arundo and tamarisk. Since milk thistle treatment was not part of the original Year 1 treatment scope, this plant was not treated prior to Year 2. By the time the artichokes had been controlled it was too late for milk thistle control, the latter having gone to seed (Bruce Hanson, pers. comm.). Second, there is no seed bank for tamarisk and arundo. Tamarix seed lasts 1-2 days, is wind-borne, and must fall on wet, open soil or sand. Arundo is not known to produce viable seed. Hence, once mature invasive species such as these are controlled in a riparian system, follow-up maintenance, while needed, tends to be light and focused on new seedlings (there's always tamarisk seed in the air!).

At the final sweep in the riparian corridor all known tamarisk, arundo and milk thistle were eliminated. A lack of additional rain and hot weather should prevent further seed germination for this season.

RECOMMENDATIONS

Future Invasive Week Control Efforts

Artichoke control should be continued for a total of five years to guarantee eradication. Future contracts for invasive weed control should require that invasives be controlled prior to seed set. This will prevent the augmentation of the seed bank, which in the case of artichoke thistle is about five years. Riparian invasives is likely to remain light until new property owners give permission to enter their parcels for the first time. Several of the non-accessible parcels have significant patches of arundo and large tamarisk.

Old locations of artichoke should show a significant drop-off in the number of artichokes resprouting or germinating in 2007. After the 2007 season of control, future years (2008 onward) should show an exponential drop-off in artichokes. By 2009 the artichoke problem should be a relatively light maintenance item. By 2011, this weed, if no plants have been allowed to flower and set seed in previous seasons, should be eradicated except the occasional plant from a deep seed. Kelly & Associates have eliminated this weed completely from a number of locations, with many years of no artichokes showing, from sites as bad as the Ramona grasslands.

In the future, with the resprouting artichokes no longer expected to be a factor, the number of sweeps can be reduced to 2 to 3 depending on the amount and pattern of rainfall.

Non-Native Grass Control Through Grazing

Kelly & Associates would recommend mapping and monitoring the location and quantity of ungrazed grassland. It was our impression that several sizeable areas were not grazed much, leaving a large fuel load for possible fire and a large non-native grass biomass and seed source. We don't know if this was deliberate this year because of the riparian fencing project getting underway, or due to cattle indifference to the type of grass present, or too little grazing "pressure" in general. This mapping and monitoring could be important to document if there are major weed grasses that cattle are not controlling.

REFERENCES

Kelly, Mike. 2000. *Cynara cardunculus* in Bossard, C., J. Randall, and M. Hoshovsky**.** Invasive Plants of California's Wildlands. Univ. of California Press, Berkeley. 2000.

Conservation Biology Institute (CBI). 2004 Framework Management and Monitoring Plan for Ramona Grasslands Open Space Preserve, San Diego County, California. Prepared for the Nature Conservancy, October 2004.

APPENDIX A

Date	Location (Patch)	Treatment	Species Treated
11/30/2005	Patch 9	Transline	artichoke thistle
	along creek	Transline	milk thistle, tamarisk, arundo
12/27/2005	Patch 1	Transline	artichoke thistle
	Patch 2	Transline	artichoke thistle
	Patch 3	Transline	artichoke thistle
	Patch 4	Transline	artichoke thistle
12/28/2005	Patch 4	Transline	artichoke thistle
	Patch 5	Transline	artichoke thistle
	Patch 6	Transline	artichoke thistle
12/29/2005	Patch 6	Transline	artichoke thistle
1/4/2006	Patch 6	Transline	artichoke thistle
	Patch 8	Transline	artichoke thistle
1/5/2006	Patch 9	Transline	artichoke thistle
1/6/2006	Patch 6	Transline	artichoke thistle
	Patch 7	Transline	artichoke thistle
2/24/2006	Patch 1	Transline	artichoke thistle
	Patch 2	Transline	artichoke thistle
	Patch 3	Transline	artichoke thistle
	Patch 4	Transline	artichoke thistle

3/1/2006	Patch 2	Transline	artichoke thistle
	Patch 3	Transline	artichoke thistle
	Patch 5	Transline	artichoke thistle
	Patch 6	Transline	artichoke thistle
	Patch 8	Transline	artichoke thistle
3/2/2006	Patch 5	Transline	artichoke thistle
	Patch 6	Transline	artichoke thistle
	Patch 8	Transline	artichoke thistle
3/27/2006	Patch 9	Transline	artichoke thistle
4/18/2006	Patch 9	Transline, glyphosate and Fusilade II	artichoke thistle, pampas grass
	Patch 6	Transline	artichoke thistle
5/17/2006	Patch 6	Transline	artichoke thistle
5/23/2006	Patch 1	Transline / Garlon 4 cocktail	artichoke thistle
	Patch 4	Transline / Garlon 4 cocktail	artichoke thistle
	Patch 2	Transline / Garlon 4 cocktail	artichoke thistle
	Patch 3	Transline / Garlon 4 cocktail	artichoke thistle
5/24/2006	Patch 1	Not specified	artichoke thistle
	Patch 4	Not specified	artichoke thistle
	Patch 5	Not specified	artichoke thistle
	Patch 6	Not specified	artichoke thistle
	Patch 7	Not specified	artichoke thistle
	N 33.03625 W -116.94764	Not specified	artichoke thistle

6/19/2006	Patch 11	Transline & Glyphosate Pro	artichoke thistle
	Patch 1	Transline	artichoke thistle
	Patch 2	Transline	artichoke thistle
	Patch 3	Transline	artichoke thistle
	Patch 4	Transline	artichoke thistle
	Eucalyptus Plantation	Transline	artichoke thistle
	Patch 9	Transline	artichoke thistle
	Patch 6	Transline	artichoke thistle
	Patch 7	Transline	milk thistle
	Nursery fence line	5% Glyphosate mix	Lepidium
7/6/2006	Patch 6	Transline	artichoke
	east of Rangeland in Creek	Glyphosate	tamarisk
8/10/2006	in Creek, ranging from bridge at Rangeland to parcel boundary in northeast	pure glyphosate	tamarisk, tree tobacco