Framework Management and Monitoring Plan

Ramona Grasslands Open Space Preserve
San Diego County, California

Photo by Richard Herrmann\The Nature Conservancy of San Diego

August 2004

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Framework Management and Monitoring Plan

for

Ramona Grasslands Open Space Preserve
San Diego County

Prepared by

CONSERVATION
BIOLOGY
INSTITUTE

Prepared for

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EXECUTIVE SUMMARY

This framework management and monitoring plan provides guidance to maintain and enhance the conservation values of the Ramona Grasslands Open Space Preserve. The Preserve supports many unique biological resources, provides a suite of important environmental services for the region, and preserves a rich cultural and historic heritage.

Ecological Significance

The Ramona Grasslands host a unique assemblage of resources:

- The southernmost population of the endangered Stephens' kangaroo rat;
- Unique vernal wetlands that support endangered San Diego fairy shrimp and several rare plant species;
- Santa Maria Creek and associated habitats are important for neotropical migrant songbirds and the endangered arroyo toad; and
- A diverse raptor community, including the largest population of wintering ferruginous hawks in San Diego.

Oak savannah, riparian woodlands, alkali playas, native perennial grasslands, and rock outcrops contribute to the diversity and ecosystem functions within the grasslands. These resources are imminently threatened by the indirect impacts of urbanization and thus require science-informed monitoring and management to ensure their persistence.

The Ramona Grasslands comprise a significant portion of the Santa Maria Creek subbasin of the San Dieguito River watershed. The Santa Maria Creek, which drains the urbanizing community of Ramona, flows westward through the grasslands, then through Bandy Canyon to its confluence with Santa Ysabel Creek. Below the confluence, the San Dieguito River flows through San Pasqual Valley into Lake Hodges, a City of San Diego drinking water reservoir. The creek corridor serves as both a hydrological and habitat linkage for numerous species. It also provides essential ecosystem processes, such as natural filtration of anthropogenic contaminants that may impair downstream water quality.

The Ramona Grasslands Preserve functions as a core habitat area within a regional network of existing and anticipated conservation lands. The coastal sage scrub, chaparral, and oak woodlands of the surrounding landscape, together with the grasslands, riparian habitat, and vernal wetlands of the core area, constitute an exceptional concentration of regionally and globally significant resources. That significance is reflected by the near complete overlap of the Preserve area by federal Critical Habitat designations (San Diego fairy shrimp, arroyo toad, and California gnatcatcher).

Conservation Targets and Goals

The overarching management goals for the Ramona Grasslands ecosystem are:

- Maintain healthy biotic communities and constituent species populations.
- Maintain functional landscape connections between the grasslands and adjacent undeveloped habitats.
- Improve water quality in Santa Maria Creek and ephemeral aquatic and wetland habitats (i.e., vernal pools, swales, and alkali playas).

The management approach focuses on conservation targets, i.e., communities, species or species assemblages, and processes of conservation concern. The grasslands are subdivided into the following ecological communities, using soil characteristics and hydrological features, which affect their ecological condition and dictate their responses to various management interventions:

- Loamy grasslands/forblands and clayey grasslands/forblands
- Vernal pools and swales
- Alkali playas
- Stream and riparian community

Collectively, target-specific management prescriptions are intended to create a habitat mosaic that sustains the full complement of species native to this area. We apply The Nature Conservancy's Ecological Integrity Assessment approach to guide the management and monitoring planning for each of these unique, but interdependent, communities. This approach involves assessing *ecological integrity* for various *conservation targets* (e.g., water quality or an endangered species) by identifying *key ecological factors* (conditions or processes) that sustain the targets. Identifying the key ecological factors requires understanding how various physical or ecological conditions and processes affect the conservation targets. The relationships between the ecological factors and the conservation targets are expressed as hypotheses within a conceptual model. This information is used to inform and integrate management actions for the grasslands as a whole.

Management Program

The plan reviews a variety of vegetation management tools, including prescribed fire, habitat restoration, and exotic weed control by mechanical means and herbicides. Accumulating science demonstrates that properly managed livestock grazing can be highly beneficial, even essential, to maintaining biological values in a variety of habitats, especially grasslands and vernal wetlands, by controlling the density and reproduction of exotic weeds, reducing buildup of detrimental thatch, and increasing water availability to target resources. This plan concludes that managed grazing is the most cost-effective strategy to achieve the myriad conservation goals for the Preserve.

Unique management prescriptions will be required for each focal community, because the responses to livestock grazing vary dramatically among the different ecological communities and conservation targets. Strategically-placed fencing will delimit management units to control the timing and intensity of cattle use in an adaptive management framework.

> *Riparian Community*—Grazing should initially be removed from the riparian community to allow natural recovery of riparian vegetation. This is expected to improve water quality by encouraging the natural filtering effects of wetland vegetation and by reducing nutrient inputs to waterways from livestock urine and feces. After a period of riparian vegetation recovery, some short-duration, intensive grazing may also be used along portions of Santa Maria Creek to help control invasive exotic plant species or to create openings as breeding habitat for arroyo toads. Managed grazing will likely not be possible in private properties along Voorhes Lane.

> *Loamy Grasslands*—Most of the loamy grasslands area should continue to be moderately to heavily grazed by cattle to maintain habitat conditions favorable to the endangered Stephens' kangaroo rat, ferruginous hawk, burrowing owl, and other wildlife species that thrive in open, forb-dominated habitats.

> *Clayey Grasslands*—Clayey soils support a different composition of grasses and forbs than the loamier soils in which Stephens' kangaroo rat habitat quality will be a priority management objective. These areas may be managed with a more moderate to light grazing regime, so as to enhance the native grasses and forbs. Grazing may be restricted in the easternmost clayey grasslands that support native grasses and vernal pools, with short periods of intensive grazing to control nonnative species and thatch buildup.

> *Vernal Wetlands and Alkali Playas*—Grazing will be retained, with some seasonal restrictions or differences in intensity, within the ephemeral aquatic habitats. Inundation period is an important ecological factor for vernal pool biota, and that period may be reduced by nonnative grasses within the watershed. Management prescriptions therefore call for grazing in vernal wetland and alkali playa watersheds and basins early in the growing season, to reduce dominance by nonnative grasses, followed by removal of cattle once native forbs begin to emerge.

Localized infestations of aggressive nonnative plant species occur throughout the Ramona Grasslands. These infestations—in particular, the rapidly increasing invasion of artichoke thistle—should be managed.

The plan assumes that an experienced rangeland manager will develop grazing prescriptions based on the biological goals presented herein. The grazing prescriptions should be detailed once a firm understanding of the baseline biological conditions and thresholds of ecological integrity have been hypothesized. Grazing prescriptions will regulate the number of animals, seasonal timing, and duration of grazing within different biological communities and will be dependent on annual rainfall, which is highly variable in this semi-arid region. Although the current practice on the property of continuous year-round grazing appears to be creating good habitat condition for these species, management-intensive grazing —a high-density, short-duration grazing rotation system—may increase plant diversity and better control invasive exotics. This management approach is hypothesized to mimic more closely grazing patterns of native grazers than standard, continuous grazing over large areas. The relationship between the spatial and temporal distribution of cattle, rainfall, and the attainment of conservation goals is not currently known. Initial grazing prescriptions therefore will generally call for *status quo*, but with an effort to quantify cattle distribution on a monthly basis so that effects can be assessed. Grazing regimes may then be modified as indicated by the monitoring results within an adaptive management paradigm.

Monitoring Program

Monitoring the responses of the natural resources to the management actions will inform management decisions on modifying the prescriptions, recognizing that the desired biological responses to management actions may require many years to achieve. Thus, a long-term monitoring program is required to elucidate the appropriate degree to which nonnative grass biomass is reduced within these communities, document the ranges of natural variation within the different grasslands communities and the ecosystem as a whole, as well as the differential responses to human-controlled management prescriptions.

The long-term monitoring program will also:

- Measure the success of the non-native plant species removal and restoration program.
- Measure changes in physical condition and hydrology of the creek and ephemeral aquatic habitats (vernal pools, vernal swale, and alkali playas).
- Track the distribution and abundance of conservation targets.
- Track the distribution and abundance of non-native animal species.

Near-term Management and Monitoring Priorities

Management activities of the public and conservation lands within the Grasslands should be integrated, so as to increase coordination and efficiency of management activities and maximize the adaptive learning potential. The plan outlines the following near-term management and monitoring priorities:

1. Collect biological baseline data to develop initial adaptive management prescriptions, refine biological monitoring protocols, and establish monitoring locations, and begin implementing management and Year 0 monitoring in 2005.

2. Initiate eradication program by December 2004.

3. Conduct ongoing litter control, enforcement, and maintenance, starting in Spring 2005.

4. Establish hydrologic and hydraulic baseline of Santa Maria Creek during 2005.

5. Document existing grazing regime by December 2005. Using this information and results of Year 0 monitoring, develop initial grazing prescriptions to be described in Area-Specific Management Directives for the Ramona Grasslands, and begin implementing in 2006.

6. Construct fencing by December 2005. Manage livestock according to the management plan and grazing plan in 2006.

7. Develop a strategy to coordinate involvement of experts and selected stakeholders, e.g., County staff, Ramona community groups, local ranchers, and biologists, by December 2005.

8. Once the distribution of sensitive biological resources is fully understood, and the management required for the long-term protection of those resources is understood and implemented, identify public access opportunities that would be compatible with the persistence of those resources and the management they require. Determine trail and staging area alignments by December 2005.

9. Establish research programs with area universities and monitoring collaboratives with community groups and nonprofit organizations.

10. Explore regional strategies for integrating rangeland management and conservation, such as rotational grassland management experimentation, grass-banking, and grass-fed beef niche markets.

1. INTRODUCTION

The Ramona Grasslands are located in the Santa Maria Valley, situated between the coastal mesas and the mountains of the Peninsular Ranges in west-central San Diego County. The Conceptual Area Protection Plan (CAPP) boundary for the Ramona Grasslands is displayed in Figure 1. About two-thirds of what was once an extensive grassland ecosystem has been lost to development. The valley's remaining grasslands are largely intact, though fragmented by roads and degraded by adjacent development. In recognition of its unique natural resource values, The Nature Conservancy (TNC) and California Department of Fish and Game (CDFG) included most of this remaining habitat, along with the surrounding foothills to the north and south, in the roughly 8,000-acre Ramona Grasslands Wildlife Area CAPP (CDFG 2002). The CAPP was the inception of the County of San Diego's Ramona Grasslands Open Space Preserve (Ramona Grasslands Preserve).

This framework management and monitoring plan provides guidance to maintain, enhance, and monitor the conservation values of biological resources within the Ramona Grasslands CAPP Area (Figure 2), with a focus on the core grasslands area of the Ramona Grasslands Preserve. In 2003 the State Water Resources Control Board awarded a Proposition 13 grant to the County of San Diego for the protection and restoration of a portion of Santa Maria Creek and adjacent ephemeral aquatic habitats in the Ramona Grasslands. The project area for this grant consists of the core grasslands area of the Ramona Grasslands Preserve, which is comprised properties that have already been conserved (e.g., former Cagney Ranch), properties with conservation agreements pending (e.g. Hardy property, Oak Country Estates), properties targeted for conservation, and other properties for which rights-of-entry have or will be obtained to conduct work associated with this grant (e.g., WRI and some Voorhes Lane properties) (Figure 2). This core grasslands area supports many of the unique biological resource values represented in the greater Ramona Grasslands Preserve, provides a suite of important environmental services for the region, and embodies a rich cultural and historic heritage.

The Ramona Grasslands host a unique assemblage of resources:

- The southernmost population of the endangered Stephens' kangaroo rat (*Dipodomys stephensi*);
- Unique vernal wetlands that support endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*) and several rare plant species;
- Santa Maria Creek and associated habitats are important for neotropical migrant songbirds and the endangered arroyo toad (*Bufo californicus*); and
- A diverse raptor community, including the largest population of wintering ferruginous hawks (*Buteo regalis*) in San Diego.

Oak savannah, riparian woodlands, alkali playas, native perennial grasslands, and rock outcrops contribute to the diversity and ecosystem functions within the Grasslands. These resources are imminently threatened by the indirect impacts of urbanization and thus require science-informed stewardship to ensure their persistence.

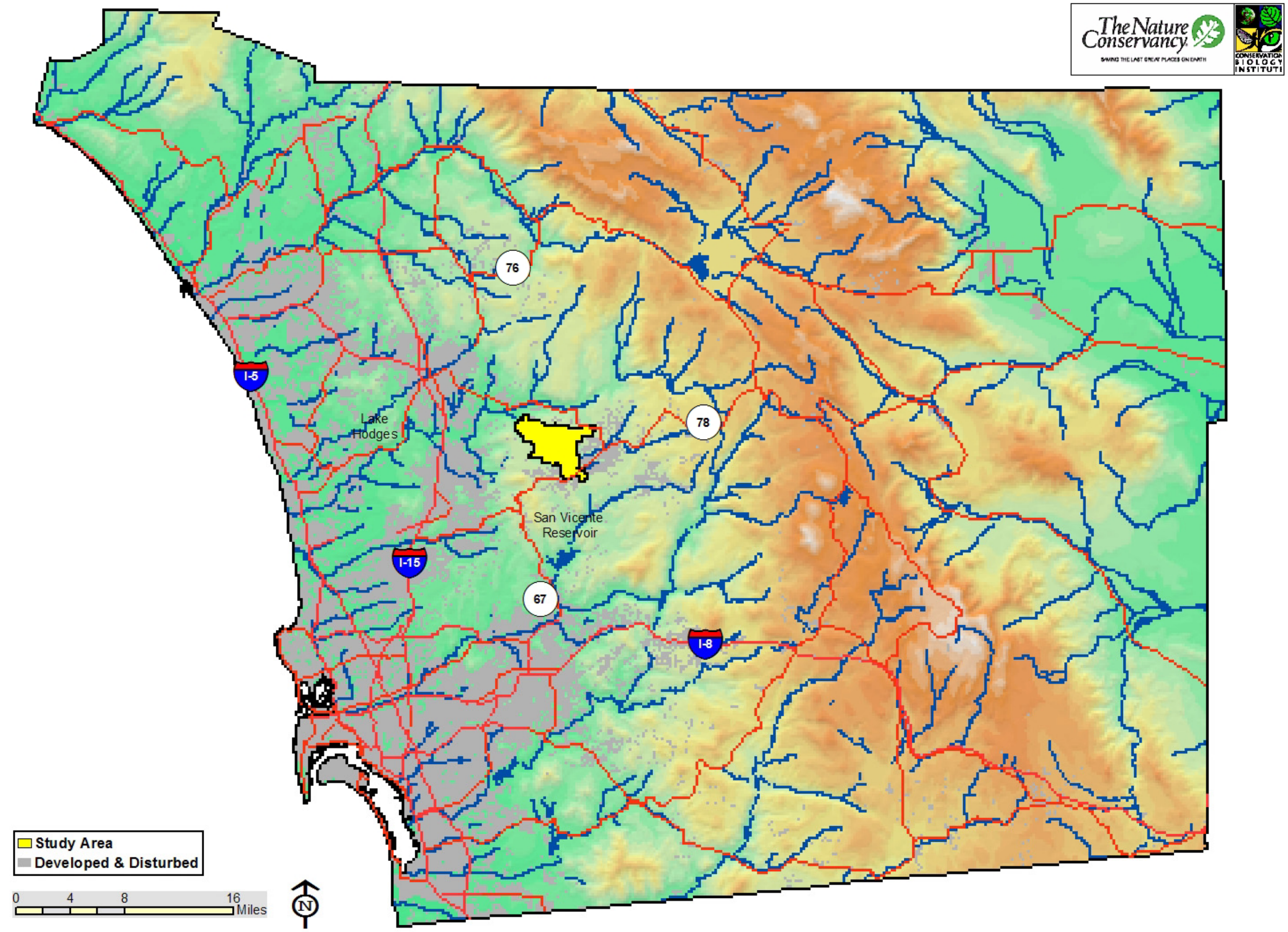

Figure 1. Location of Ramona Grasslands CAPP Area within San Diego County.

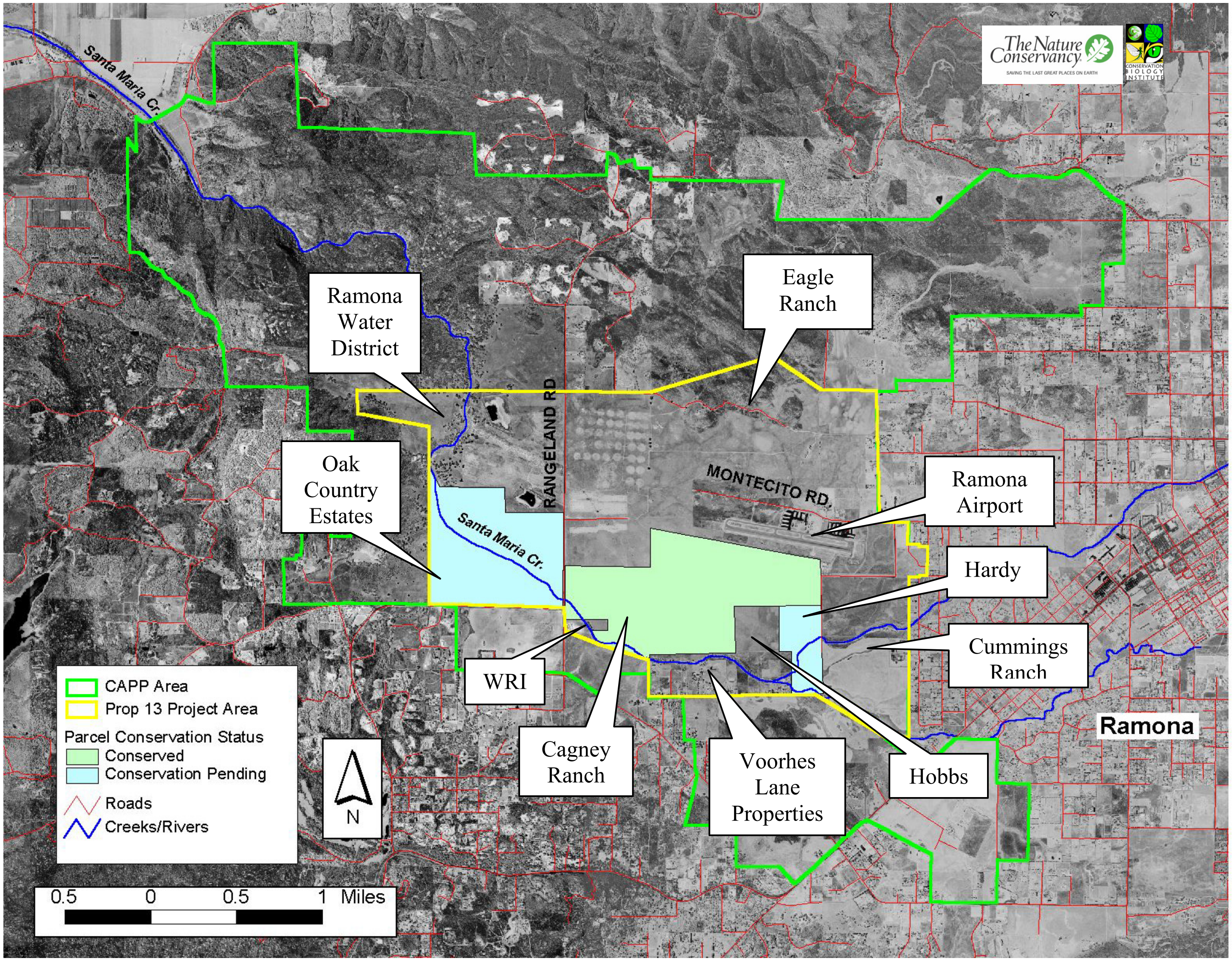

Figure 2. Ramona Grasslands CAPP Area showing the Proposition 13 Santa Maria Creek Project Area and conservation status of properties in the Project Area.

Ecological Significance

The conservation significance of the Ramona Grasslands has been recognized by many governmental and nongovernmental organizations, including the County of San Diego, State Water Resources Control Board, San Diego Regional Water Quality Control Board, CDFG, U.S. Fish and Wildlife Service, TNC, San Dieguito River Valley Conservancy, and the Wildlife Research Institute (WRI), which has its headquarters in the Ramona Grasslands. The Grasslands will play a prominent role in the proposed North County Multiple Species Conservation Program (MSCP), which aims to prioritize conservation for rare and endangered species and the habitats that support them. Lands prioritized for protection in the western subregion MSCP are designated as the Multiple Habitat Planning Area (MHPA), and those within the North County MSCP are designated as the Pre-Approved Mitigation Area (PAMA). Areas that are already conserved or have agreements for conservation are considered *hardline* preserve areas within the MHPA and PAMA (Figure 3).

The Ramona Grasslands function as a core habitat area within a regional network of existing and anticipated conservation lands, including lands in the San Dieguito River Valley to the north and San Vicente Highlands Open Space Preserve to the south (Figure 4). The coastal sage scrub, chaparral, and oak woodlands of the surrounding landscape, together with the grasslands, riparian habitat, and vernal wetlands of the core area, constitute an exceptional concentration of regionally and globally significant resources. That significance is reflected by the near complete overlap of the Ramona Grasslands Preserve by federal Critical Habitat designations for three threatened and endangered species—San Diego fairy shrimp (designated October 2000), arroyo toad (March 2001), and California gnatcatcher (*Polioptila californica*, October 2000) (Figure 5).

Conservation Goals and Targets

The overarching management goals for the Ramona Grasslands ecosystem are:

- Maintain healthy biotic communities and constituent species populations.
- Maintain functional landscape connections between the grasslands and adjacent undeveloped habitats.
- Improve water quality in *waters of the state*, including Santa Maria Creek and ephemeral aquatic and wetland habitats (i.e., vernal pools, swales, and alkali playas).

The management approach focuses on conservation targets, i.e., communities, species or species assemblages, physical or chemical properties, or processes of conservation concern. Table 1 summarizes the resources targeted for management in the core grasslands, northern buffer, and southern linkage areas. This framework plan focuses on the core grasslands area, which includes the following ecological communities:

- Loamy grasslands/forblands and clayey grasslands/forblands
- Vernal pools and swales
- Alkali playas
- Stream and riparian community

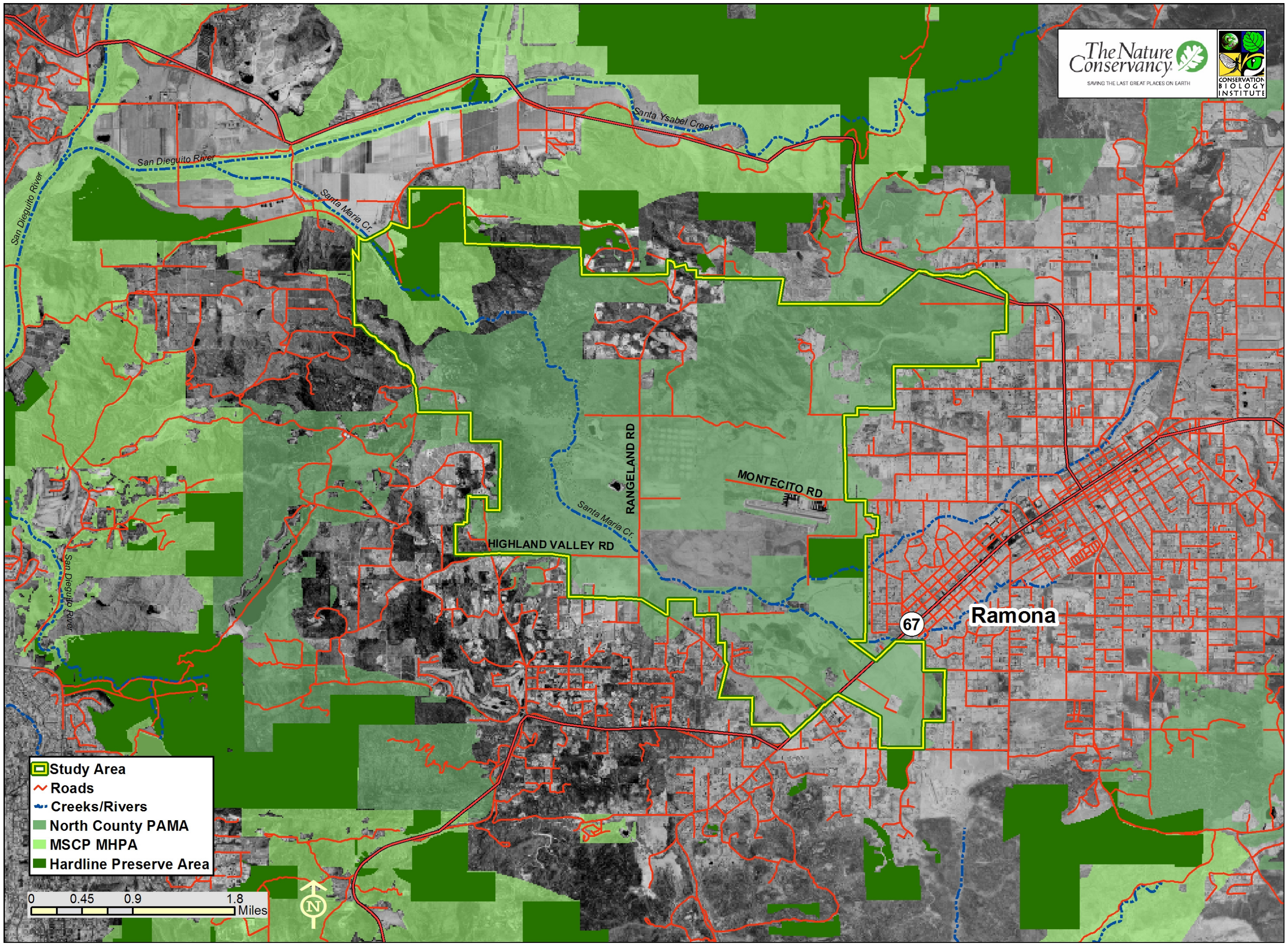

Figure 3. MSCP planning designations for the vicinity of the Ramona Grasslands CAPP Area. (Note: North County PAMA boundary as of April 2004).

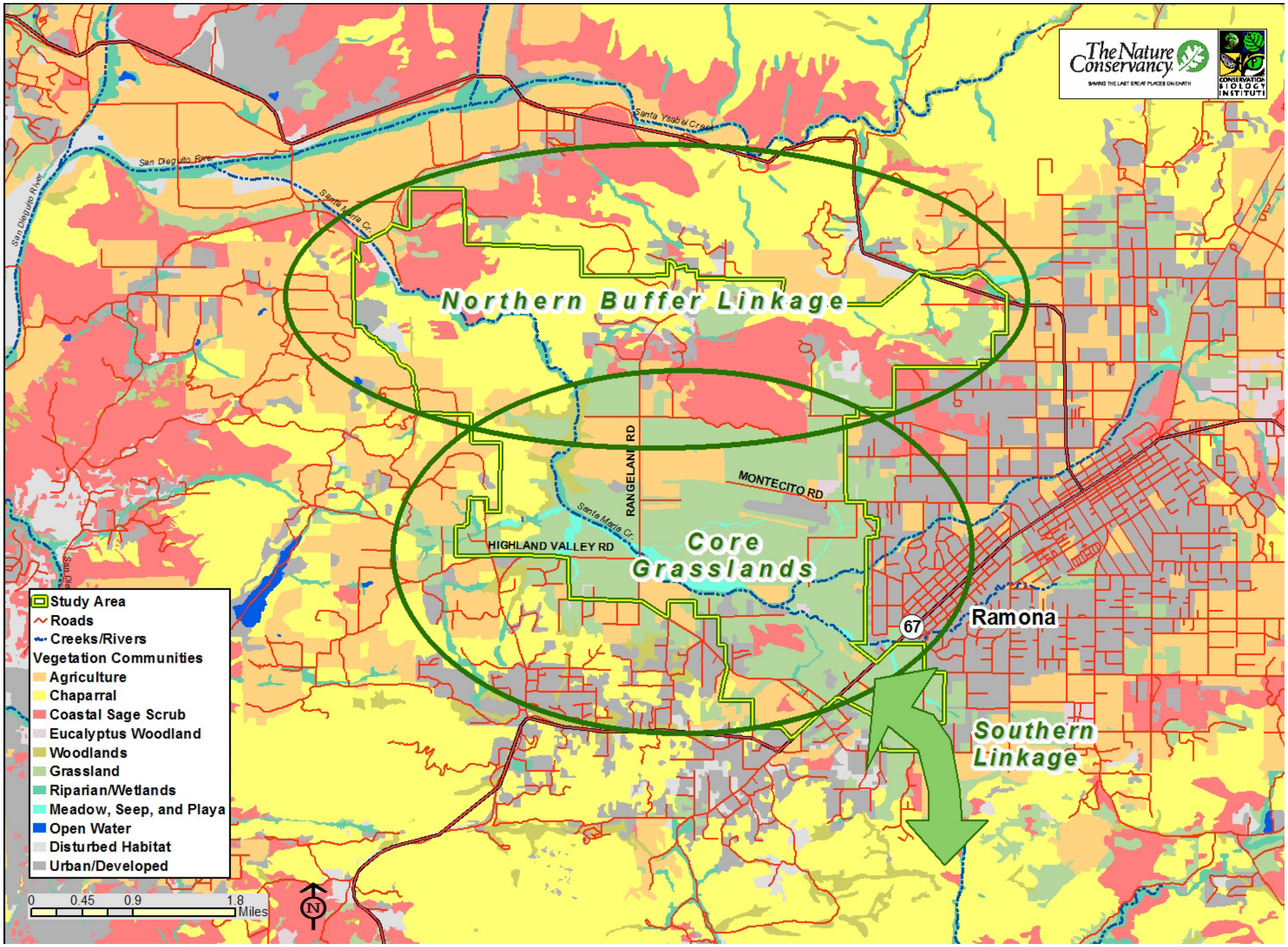

Figure 4. Core, buffer, and linkage areas of the Ramona Grasslands CAPP Area, with vegetation communities.

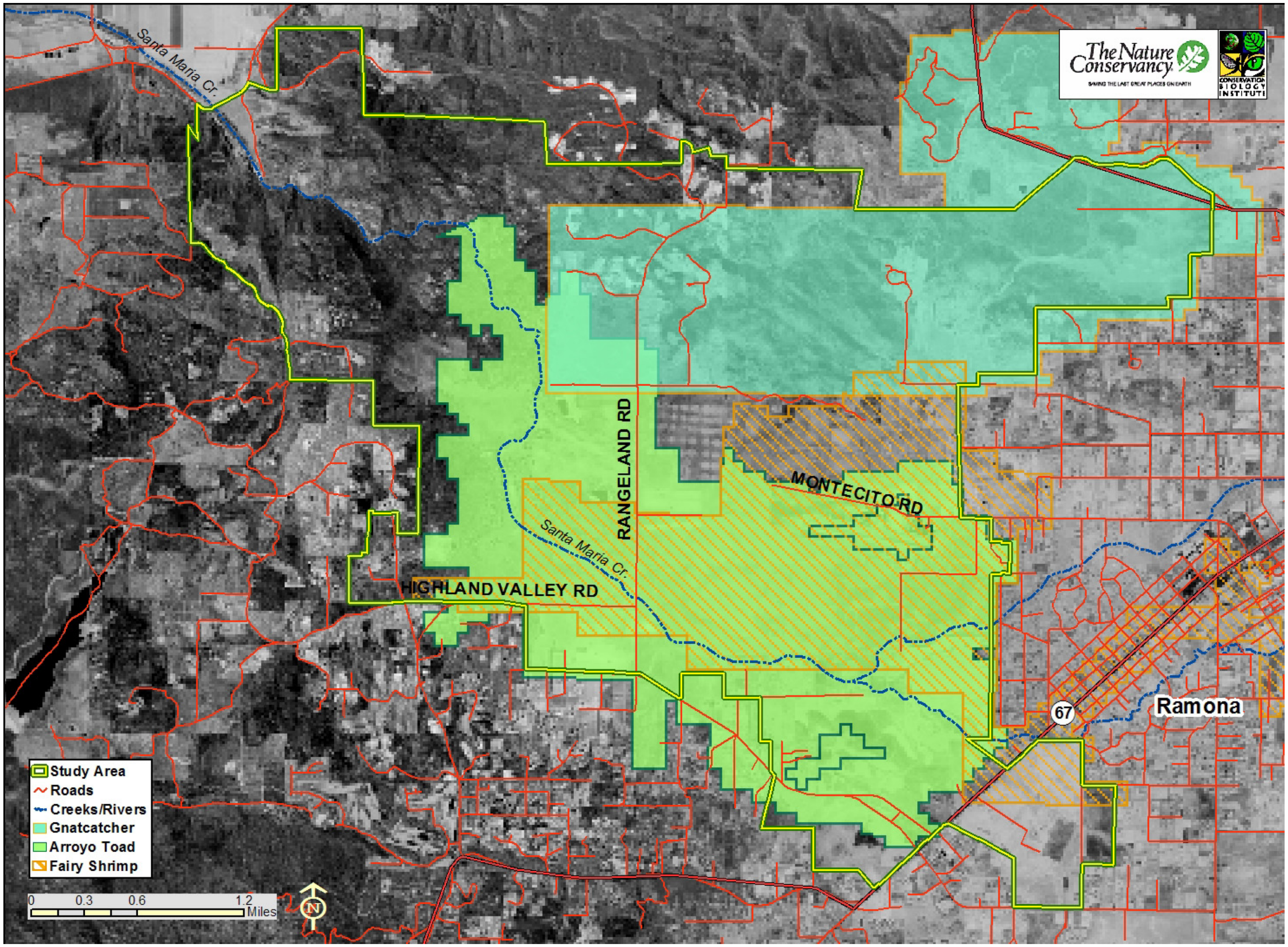

Figure 5. Critical Habitat designations in the Ramona Grasslands CAPP Area.

Table 1. Conservation targets, by community, Ramona Grasslands CAPP Area.

CORE GRASSLANDS

Stream and riparian corridor
- Water quality
- Arroyo toad
- Riparian songbirds

Loamy grasslands
- Stephens' kangaroo rat
- Ferruginous hawk
- Burrowing owl

Clayey grasslands
- Purple needlegrass
- Small-leaved morning-glory
- Graceful tarplant

Vernal pools and swales
- Spadefoot toad
- San Diego fairy shrimp
- Southern tarplant
- Spreading navarretia
- Toothed downingia
- Little mousetail

Alkali playas
- Parish's brittlescale
- Saltgrass
- Alkali barley

BUFFERS / LINKAGES

Coastal sage scrub
- California gnatcatcher
- Sage sparrow

Oak woodlands
- Western bluebird

RAMONA GRASSLANDS MOSAIC

Wide-ranging Animals
- Golden eagle
- Raptors
- Badger
- Bobcat
- Mountain lion

Conservation and management of the core grasslands area, including restoration of riparian habitat along Santa Maria Creek, will improve downstream water quality within the San Dieguito River and contribute to the recovery of the Stephens' kangaroo rat and vernal pool species. While not the focus of this plan, species that use the buffer and linkage areas, and the entire Ramona Grasslands habitat mosaic, will benefit from appropriate management of the core grasslands. For example, golden eagles (*Aquila chrysaetos*) nest on the rocky cliffs above Bandy Canyon and use the core grasslands for foraging. Other wide-ranging species, such as the badger (*Taxidea taxus*), bobcat (*Felis rufus*), and mountain lion (*Felis concolor*), also use the entire landscape mosaic. California gnatcatchers and other coastal sage scrub species potentially use the core grasslands area for dispersal between the San Dieguito River Valley and San Vicente Highlands Open Space Preserve.

2. DESCRIPTION OF STUDY AREA

Geography and Climate

The Santa Maria Valley is a broad basin (elevation 1,350-1,450 ft), surrounded by gentle hills and rocky rises vegetated with coastal sage scrub, chaparral, and oak woodlands. It lies within the Southern California Mountains and Valleys ecological section of the South Coast Ecoregion (Bailey et al. 1994, Goudey and Smith 1994, McNab and Avers 1994; Miles and Goudey 1998). The climate is generally hot and subhumid, with moderate oceanic influence. Temperature extremes at Ramona range from about 17^{o}F to 112^{o}F, with minimum mean temperatures in December-January of 37-38^{o}F, and maximum mean temperatures during July-August of about 91^{o}F (as recorded at the Ramona Airport). Rainfall is largely restricted to the period November through March, with seasonal totals ranging from about 7 to 20 in. (mean = 14 in.) (Anonymous 1977). Heavy nighttime and morning fogs are common, especially during fall through spring (Spencer personal observation).

The Ramona Grasslands comprise a significant portion of the Santa Maria Creek subbasin of the San Dieguito River watershed (Figure 6). Santa Maria Creek and its tributaries drain about 57 mi^2 from the mountains east of Ramona, across the grasslands, and through the steep and narrow walls of Bandy Canyon to its confluence with Santa Ysabel Creek. Below the confluence, the San Dieguito River flows through San Pasqual Valley into Lake Hodges, a City of San Diego drinking water reservoir which is listed as an impaired water body (Clean Water Act 303(d) listed) due to excessive runoff of non-point source pollutants within the watershed.

Soils

The Santa Maria Valley basin is predominantly filled with soils of the Fallbrook and Bonsall series (Figure 7, Table 2), which are well-drained to moderately well-drained sandy loams with a subsoil of clay loam or sandy clay loam over decomposed granodiorite, on gentle (2-9%) slopes (USDA 1973). On a more local scale, however, there is significant variation in soil characteristics depending on topographic location, depth of clay subsoils, and effects of erosion and deposition. Granodiorite outcrops dot the grasslands, predominantly on hilltops, with

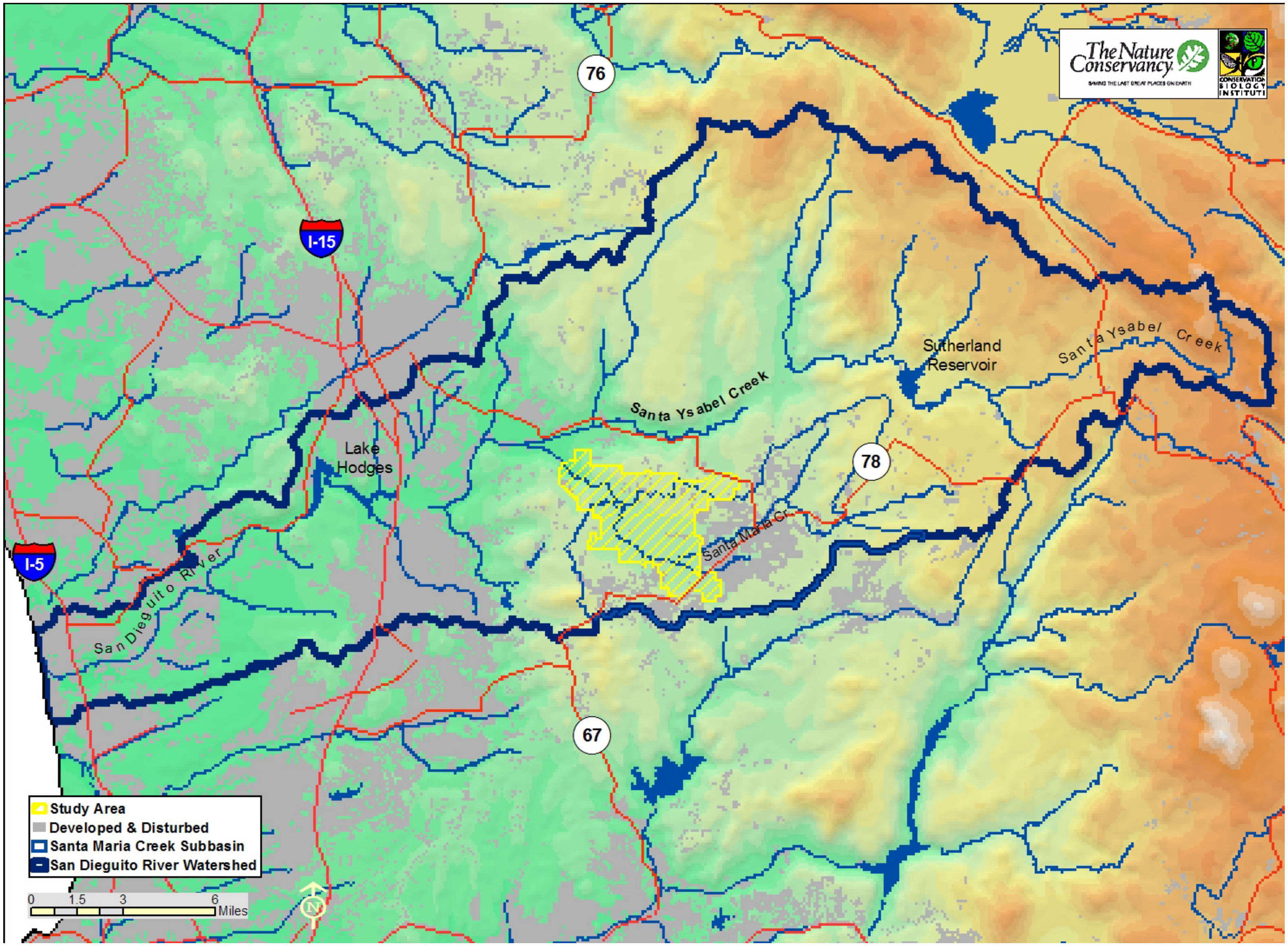

Figure 6. Location of Ramona Grasslands CAPP Area relative to watersheds of Santa Maria Creek and San Dieguito River.

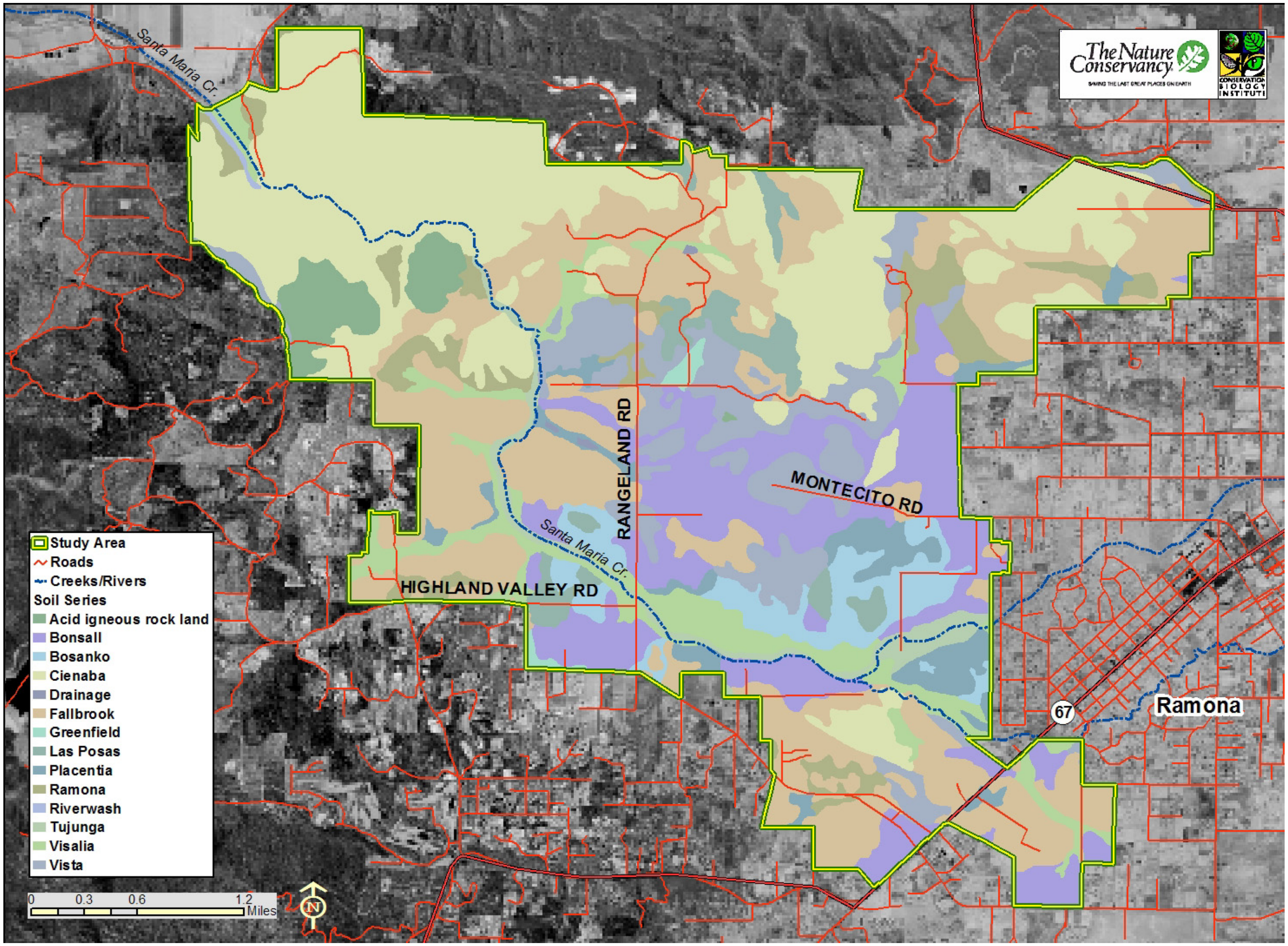

Figure 7. Soil series within the Ramona Grasslands CAPP Area.

Table 2. Pertinent characteristics of soils in the core grasslands area.

Soil Series*	Characteristics	Distribution	Biological Relevance
Bonsall Sandy Loams	Moderately well-drained, shallow to moderately deep sandy loams with heavy clay subsoil on gentle, generally concave slopes.	Scattered, mostly in western portion of grasslands.	Low potential to support vernal pools. Generally suitable for SKR, depending on depth to clay subsoil.
Bonsall-Fallbrook Sandy Loams	A complex intermixing of Bonsall sandy loams (in swales) and Fallbrook sandy loam (on rises).	Widespread on undulating uplands, including much of the central portion of grasslands.	Bonsall portions in swales support vernal pool and swale species; Fallbrook portions on rises are among most important SKR-supporting soils.
Bosanko Clay	Moderately deep clays on undulating hills; slightly alkaline.	Large area extending from east end of airport to and along Santa Maria Creek; scattered areas on either side of creek (e.g., west of Rangeland Road).	Heavy clays supporting vernal pools, swales, and alkali playas. Appears to be avoided by cattle. Supports some dense stands of artichoke thistle. Low potential for SKR
Fallbrook Sandy Loams	Well-drained, moderately deep to deep sandy loams weathered in place from granodiorite on gentle to steep upland slopes.	Widespread on hills throughout grasslands, especially on hills with granodiorite outcrops.	Among the best soils supporting SKR; associated with oak woodlands on hills around grasslands.
Las Posas Fine Sandy Loams	Well-drained, moderately deep stony fine sandy loams with a clay subsoil on upland slopes.	Scattered small rises in grasslands, generally adjacent to lower-lying Bosanko Clays, and larger chaparral and oak-covered hills north of the grasslands.	Rated as low potential to support vernal pools. Marginal to unsuitable for SKR. Supports patches of native bunchgrasses (including purple needlegrass), and may be highly suitable for native grassland restoration.
Placentia Sandy Loams	Moderately well-drained sandy loams over a sandy clay subsoil, formed in granitic alluvium; moderately alkaline, with calcareous underlayer. On flat to gentle slopes, sometimes with mima mound topography.	Scattered small areas within grasslands; large expanses lost to development by the town of Ramona.	Supports the greatest density of vernal pools in Ramona area, often with classic mima mound topography. Also strongly associated with vernal swales and alkali playas supporting unique species.

Table 2. Pertinent characteristics of soils in the core grasslands area.

Soil Series*	Characteristics	Distribution	Biological Relevance
Tujunga Sands	Very deep, excessively well-drained sands derived from granitic alluvium, on alluvial fans and floodplains.	Comprises the length of the Santa Maria Creek channel.	Too sandy and subject to flooding to reliably support SKR. Primarily suited to restoring riparian vegetation.
Visalia Sandy Loams	Moderately well-drained, very deep sandy loams derived from granitic alluvium on alluvial fans and floodplains.	Predominant soil comprising the floodplain of Santa Maria Creek and Etcheverry Creek.	Perhaps too sandy and subject to flooding to reliably support SKR. Very few burrows, mostly associated with berms. Alkali playas cut through this area.
Vista Rocky Coarse Sandy Loam	Well-drained, deep, coarse sandy loams on slopes over weathered rock, with abundant boulders and rock outcrops.	Scattered large rocky hills throughout grasslands.	Highly suitable for SKR, especially in midslopes. Complex rocky outcrops provide den sites for coyotes, raptor roost sites, and homes for ground squirrels and other rodents. Cattle appear to congregate on these soils, especially along drainage swales between rocky hills and outcrops.

*Source: USDA 1973.

SKR = Stephens' kangaroo rat

relatively deep, well-drained soils of decomposed granodiorites sloping away from them. Lower-lying areas tend to heavier, clay soils, with shallow or even surface expression of clay hardpans. These soils sometimes develop characteristic vernal pool mima mound topography, which is best expressed on Placentia soils in the Ramona area. Gabbro outcrops in the western portion of the grasslands likely influence plant associations (Sproul personal communication). Soils within the floodplain of Santa Maria Creek include deep, well-drained to excessively drained, sandy alluvium in the Visalia series (USDA 1973).

Soils have a strong influence on the distribution of target resources and assignment of management priorities (Table 2). Placentia soils have the greatest concentration of vernal pools, swales, and alkali playas. Bosanko clays dominate the low-lying eastern portion of the core grasslands and may be suitable for native grassland restoration. Several sandy loams (e.g., Fallbrook and Vista) in the northern and western portion of the grasslands provide optimal habitat conditions for the Stephens' kangaroo rat. Soils along Santa Maria Creek are mostly sandy alluvial deposits—Tujunga sands along the stream channel and Visalia sandy loams in the adjacent floodplain. A series of alkali playas lies within areas mapped as Visalia sandy loams (USDA 1973), but these areas more likely have clay soil inclusions or eroded areas too small to have been mapped at the USDA mapping resolution.

Fire History

San Diego County has perhaps the most severe fire weather in the nation, with huge shrubland wildfires sometimes driven by hot, dry Santa Ana winds during autumn (Keeley and Fotheringham 2001). Fire plays a strong role in shaping local vegetation communities. Repeated short-interval fires in chaparral and sage scrub habitats tend to type-convert them to annual grasslands having few trees or shrubs (Minnich and Dezzani 1998, Keeley 2001). Hills surrounding the Ramona Grasslands have burned repeatedly (every decade in the past 50 years), and increasing fire ignitions correlated with human population growth (Keeley and Fotheringham 2001) may conceivably increase the extent of the grasslands over time via type-conversion of shrub habitats. However, there are no recent records of fires on large portions of the grasslands, perhaps in part due to heavy grazing pressure that reduces fuel loads. Recent small, prescribed fires were conducted on the Ramona Airport property (2001 and 2004) to improve habitat for the Stephens' kangaroo rat.

Prehistoric and Historic Land Uses (*Prepared by Dr. Susan Hector*)

During the prehistoric period (the era before the founding of the San Diego Mission in 1769), Native Americans occupied the Santa Maria Valley for many thousands of years. The people living in the area at the time of Spanish contact are known as the Kumeyaay people.

The Santa Maria Valley was home to a large, complex civilization for many hundreds of years: the Kumeyaay Indian villages collectively called Pamo. The Pamo villages were seamlessly integrated into one of the last remnants of extensive grassland habitat in coastal Southern California. Surrounding and embedded within these grasslands are a variety of rare habitat types, including vernal pools, Diegan coastal sage scrub, oak woodland and riparian forests, all which would have served to support village residents. The rich environment within the Ramona Grasslands provided abundant resources for the Pamo villagers. Of particular and unique importance was the native grassland. The plants and animals distinctive to this habitat contributed toward the large number of people who lived in the Pamo village complex.

The cultural resources within the Santa Maria Creek and Ramona Grasslands are particularly important to preserve because the sites exist at a landscape scale and the area contains a wide variety of residential, activity-based, and ceremonial archaeological locations. It is extremely rare in California to find an entire settlement complex of villages that can be preserved undisturbed in an intact natural landscape which also supports rare and endangered species.

The Pamo villages consisted of a complex settlement system perfectly adapted to the grasslands environment of the Santa Maria Valley. The Pamo settlement system contained a network of villages, special activity sites for the production of stone tools, seasonal sites for gathering and processing acorns and other seeds, and religious and sacred locations. Over a period of thousands of years, several large villages and outlying activity areas were established and occupied. Dozens of these undisturbed archaeological sites still exist within the Ramona Grasslands.

Research on the archaeology of the Santa Maria Valley was conducted at San Diego State University's South Coastal Information Center (SCIC) and at the San Diego Historical Society by Dr. Susan M. Hector, principal investigator. Detailed results of the research are provided in Appendix C. The research consisted of a record search at SCIC to identify recorded archaeological sites and determine which areas had been systematically surveyed for cultural resources; and an archival, photograph, and map search at the San Diego Historical Society. The original plat maps for the Santa Maria Grant were examined to identify any possible historic structures or features; none were observed. Aerial photographs were also examined to identify prehistoric and historic features. Dr. Hector also obtained and evaluated archaeological and cultural resource studies in the Santa Maria Valley as part of the background research for the restoration project.

The Cagney, Voorhes Lane, and Hardy properties have not been systematically surveyed for cultural resources, so there were no previously recorded sites identified in those areas as a result of the record and archival searches. Informal site visits by Dr. Hector in April and July 2002 resulted in the discovery of four sites on the former Cagney property. Three of the sites are prehistoric camp sites, and the fourth is a historic bombing target (see description below). The three prehistoric sites have been recorded at the SCIC as SDI-17144, SDI-17143, and SDI-17142. A systematic survey of the unsurveyed properties would most likely result in the discovery of additional cultural resources.

In addition to a diverse complex of prehistoric resources, the Ramona Grasslands area has important historical sites as well. The area near the Airport was used during World War II as a bombing target. The Ramona Bombing Target and Emergency Landing Field included 405 acres near the town of Ramona. Eventually, the Navy acquired enough property for a landing field, which was transferred to the County of San Diego in 1956; the County had leased the airfield since 1947. The Ramona Bombing Target was used to practice dive-bombing an aircraft carrier, and is located on the former Cagney property. It has been recorded at the SCIC as P-037-024571. The Target consisted of a series of concentric rock rings to simulate the size and shape of an aircraft carrier. Some remains from the practice bombs still remain in remote locations within the Ramona Grasslands area. Conservation of this important World War II site is important, as development continues to obscure the recent history of our nation.

The County's MSCP requires inventory and management of cultural resources included within the habitat preserve system. The specific language added to the County of San Diego's Framework Management Plan for all MSCP preserves in its jurisdiction is simple, yet requires action (see Appendix C for the complete requirements).

Recent and Current Land Uses

The majority of the core grasslands area continues to be used primarily for cattle grazing and equestrian facilities, with limited improvements such as perimeter fencing, wells, and corrals. The grasslands have been grazed by cattle for many years. Part of the Ramona Grasslands Preserve is under lease to the Tellam family for cattle ranching. The operation consists of year-round cattle grazing, without rotation or rest periods. Stocking rates are established on an annual basis, primarily based on weather and resultant forage condition (Tellam personal communication). No quantitative measures are made of forage production or residual dry matter. Bulls are added to the range around the first week of December to begin siring calves, with calving starting in mid-September. Calves are removed the following summer when the forage begins losing nutritional value. Supplemental feed is provided during summer (molasses supplement for increased protein and improved digestion of the dry forage), when the pregnant cows are on the range, which is otherwise low in nutrition once the vegetation dries out.

The cattle tend to congregate heavily in some portions of the property and avoid others. In particular, cattle grazing seems most intense near rocky swales, where more mesic conditions make for better forage, and in the northwestern grasslands, close to the effluent spray fields of the Ramona Water District. The spray fields are supported by a subsurface pipe network and sprinkler irrigation system. The much richer forage associated with this irrigation and associated nutrient enrichment is highly attractive to cattle. According to the local grazing leaseholder (Tellam personal communication), economically viable cattle ranching in the grasslands is largely dependent on the increased productivity provided by these spray fields.

Grazing is least intense in the low-lying clay soils to the east and south, which appear to support mostly unpalatable plants, such as graceful tarplant (*Holocarpha virgata* ssp. *elongata*). Cattle also seem not to graze very intensively on the well-drained sandy areas near Santa Maria Creek, although cows congregate near cover provided by riparian trees, especially for calving (Tellam personal communication). Water sources and salt licks also influence cattle distribution, with heavily trampled areas around well sites near Santa Maria Creek, where salt and water are currently located.

The California Department of Forestry and Fire Protection has maintained the Ramona Air Attack Base at the airport since 1958. In 2002 the County extended the 4,000-ft runway an additional 1,000 ft to the west (not shown on figures in this plan) to accommodate larger fire-fighting aircraft. This extension, along with associated airport upgrades (e.g., sewer lines, taxiway, control tower), removed habitat occupied by the Stephens' kangaroo rat and impacted vernal pools. As mitigation for these impacts, 62.5 acres of airport property were conserved (west and north of the extended runway in the western half of the airport property), and 20.2

acres supporting vernal pools were conserved as part of the Ramona Grasslands Preserve (Figure 2). Habitat management plans for the Stephens' kangaroo rat (FAA 2002) and vernal pools (FAA 2003) were prepared to govern long-term management and monitoring of these target resources on the mitigation sites.

Some areas around the periphery of the Santa Maria Valley are used for dry farming. Rural residential development and estate homes are scattered on hills around the perimeter of the grasslands, and houses line the south side of a portion of Santa Maria Creek, along Voorhes Lane). Otherwise, the core of the grasslands area remains relatively unfragmented, except by a few paved roads (e.g., Rangeland Road) and unpaved ranching roads.

3. ECOLOGICAL COMMUNITIES AND MANAGEMENT IMPLICATIONS

The Ramona Grasslands ecosystem is an interconnected and interdependent set of ecological communities, encompassing oak woodlands, chaparral, and coastal sage scrub in the surrounding hills, and the riparian corridor, vernal wetlands, and native and annual grasslands within the core grasslands area. Because of the effects of prehistoric and historic land uses, the current composition of vegetation communities in the Grasslands (i.e., predominance of grasslands) may not reflect the composition prior to human settlement of the area. Oberbauer (1978) suggests that grassland habitat is successional in coastal and foothills areas of San Diego County and in many areas may be replaced by shrubs in the absence of disturbance. It is likely that the Ramona Grasslands exhibited a greater mosaic of vegetation types prior to human settlement, and the probable changes in fire and grazing regimes associated with humans, with a greater proportion of coastal sage scrub species and oaks historically, particularly on the rocky knolls and loamy soils. The resources currently present in the Grasslands are valuable management targets because of the limited regional distribution of large grassland areas and vernal pool habitats in San Diego County, particularly those that support endangered species such as the Stephens' kangaroo rat and San Diego fairy shrimp. Although the Ramona Grassland system could potentially be managed to shift community composition to something that we hypothesize might be closer to historic conditions (e.g., greater abundance of shrub species), management actions must reflect the needs of current priority resources and altered conditions (e.g., prevalence of nonnative grasses).

For the purpose of this framework management plan, the core grasslands area is subdivided into communities using soil characteristics and hydrological features, which affect their species composition and influence their responses to various management interventions (Figure 8):

<u>Grasslands</u>—

> *Loamy grasslands* dominate in the center of the core grasslands area. This community is comprised of annual, mostly nonnative, grasses and forbs that are generally associated with well-drained, loamy soils on hills and slopes, as well as sandy alluvial soils along the floodplain.

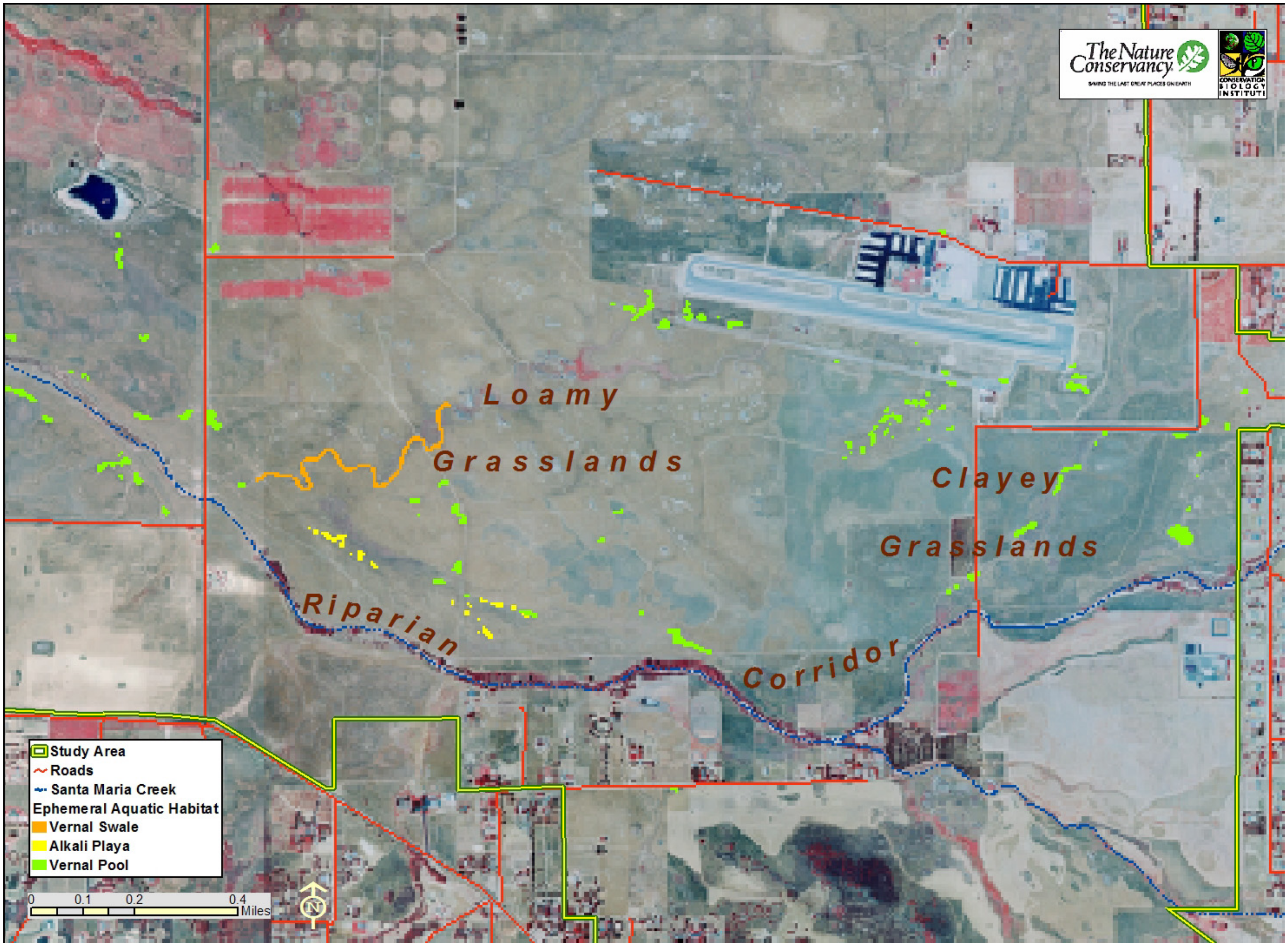

Figure 8. Ecological communities, core grasslands area.

Clayey grasslands occur in heavier clay soils that line the lower-lying portions of the grasslands, especially in the easternmost area, but also immediately west of Rangeland Road. Native grasses and forbs, such as purple needlegrass (*Nassella pulchra*), are more common on these soils than on better-drained soils, but must still compete with nonnative grasses.

<u>Vernal pools/swale</u>—

Vernal pools and one vernal swale occur as small and scattered wetlands within the grassland matrix, especially in areas of clay soils. The densest area of vernal pools is in the eastern portion of the core grasslands area within the clayey grasslands, but vernal pools also occur on clay soils within the loamy grasslands community. They depend on the surrounding grassland matrix in their watersheds for much of their hydrologic functions.

<u>Alkali playas</u>—

Alkali playas lie within the Santa Maria Creek floodplain, north of the creek, and pond surface water for a short duration during winter rainfalls. They may be associated with a historic channel paralleling the creek. The playas represent a unique wetland habitat type for San Diego County and support several rare plant species.

<u>Riparian corridor</u>—

This includes the Santa Maria Creek channel and adjacent wetland vegetation and floodplain habitat.

Collectively, target-specific management prescriptions are intended to create a habitat mosaic that sustains the full complement of species native to this area. We apply The Nature Conservancy's Ecological Integrity Assessment approach (TNC 2002) to guide the management and monitoring planning for each of these unique, but interdependent, communities. This approach involves assessing *ecological integrity* for various *conservation targets* (e.g., water quality or an endangered species) by identifying *key ecological factors* (conditions or processes) that sustain the targets. Identifying the key ecological factors requires understanding how various physical or ecological conditions and processes affect the conservation targets. The relationships between the ecological factors and the conservation targets are expressed as hypotheses within a conceptual model. This information is used to inform and integrate management actions for the grasslands as a whole.

Table 3 serves as a conceptual model for how various conservation targets, key ecological factors, and indicators can inform management actions for the Ramona Grasslands. Management approaches vary among the ecological communities because of hypothesized differences in how specific management actions differentially affect conservation targets via key ecological factors. For example, livestock grazing (herbivory) benefits a number of target resources by opening up habitat, controlling weedy exotic species, reducing detrimental thatch buildup, and increasing water availability in vernal wetlands, although resources may respond differentially to the timing and intensity of livestock grazing. However, grazing may adversely affect other target resources (e.g., riparian vegetation and water quality) due to herbivory, trampling, and nutrient input from urine and feces. Such differences in the anticipated response of target resources to ecological factors and management tools are used to define management approaches for each ecological

Table 3. Conceptual model for managing conservation targets, Ramona Grasslands Preserve.

Conservation Target	Key Ecological Factors	Factors	Indicators	Desired Condition	Management Implications
Stephens' kangaroo rat (SKR)	vegetation structure and composition	grazing (herbivory), fire	forb/grass ratio	abundance of annual forbs to produce preferred foods and facilitate movements	Moderate to heavy grazing is beneficial on loamy soils.
			% bare ground	abundant bare ground patches for foraging, dust bathing, etc.	
			residual thatch	very sparse thatch remaining during summer-fall to facilitate foraging, movement, and forb regeneration	
	soil condition/burrow availability	soil type	soil texture and depth	deep loams	Management unlikely to improve SKR conditons on heavier clay soils; management ineffective on wetland soils. Avoid heavy trampling on moist soils.
		compaction (e.g., trampling)	soil bulk density	low bulk density; well-drained soils	
		pocket gopher abundance	gopher burrows	abundant pocket gophers to aerate soils and provide "starter" burrows for kangaroo rats	
Ferruginous hawk	prey base (esp. pocket gophers)	soil type, vegetation diversity	similar to SKR	abundant pocket gophers and other rodent prey	Same as SKR: Graze loamy soils to maintain open, forb-dominated foraging areas with abundant gophers.
	vegetation structure and composition	same as SKR	similar to SKR	open, sparse vegetation to facilitate successful foraging behavior	
Burrowing owl	vegetation structure	grazing	same as SKR	same as SKR	Same as SKR
	burrow availability	ground squirrel abundance	ground squirrel burrow counts	abundant burrows to facilitate nesting	Prohibit poisoning of squirrels or other rodents in areas occupied by burrowning owls; add artificial burrows as necessary.

Table 3. Conceptual model for managing conservation targets, Ramona Grasslands Preserve.

Conservation Target	Key Ecological Factors	Factors	Indicators	Desired Condition	Management Implications
Native grassland community	competition with annual plants	grazing (competitive advantage to annuals when grazed)	native to nonnative abundance/biomass ratio	light herbivory to favor perennial growth and reproduction	Perennial grassland management areas should have little to no grazing.
		soil type (competitive advantage to annuals on loamy soils)	soil texture	clay soils to favor perennials in competition with annuals	Native grassland restoration unlikely to succeed except on clay soils due to competitive advantages of annuals on better-drained soils.
Arroyo toad	habitat quality	grazing intensity, hydrologic characteristics	groundwater elevation	high local groundwater table	Restore riparian vegetation on channel banks to slow flow and increase bank storage and groundwater recharge.
			persistence of surface water	surface water in Santa Maria Creek through June	
			channel characteristics	open channel bottom with sand and gravel bars	Maintain open channel bottom via natural scour patterns or with periodic grazing.
		vegetation structure	canopy structure	occasional openings (no trees or shrubs) on sand bars in creek	Consider occasional use of cattle to open canopy in specific sites to improve breeding habitat.
Least Bell's vireo and other neotropical migrant bird species	riparian vegetation structure and composition	livestock grazing	vertical structure, density and species composition of riparian vegetation	dense shrubby understory with closed overstory, dominated by willows, cottonwoods, and mulefat	Restrict cattle from stream corridor to allow passive restoration of riparian/wetland vegetation; intervene with active restoration as indicated by monitoring; use cattle as management tool to alter structure of vegetation as indicated by monitoring.

Table 3. Conceptual model for managing conservation targets, Ramona Grasslands Preserve.

Conservation Target	Key Ecological Factors	Factors	Indicators	Desired Condition	Management Implications
Surface water quality	non-point source pollutant inputs to creek	livestock bank trampling; input of urine/feces	concentrations of nitrogen (N), phosphorus (P), suspended solids	Basin Plan standards; little/no livestock urine or feces in creek; no disturbance of channel banks; little/no runoff of excess N and P from uplands into wetlands	Restrict cattle from riparian zone and upland buffer; maintain water and shade sources well away from floodplain to spread urine/feces away from waterways; allow riparian vegetation to recover from grazing; intervene with exotic removal and/or active restoration as indicated by monitoring. No new development in Preserve. There will be minimal park development such as trails and trail heads and possibly a staging area.
		urban runoff	loads of N, P, automotive hydrocarbons, pesticides, herbicides, metals	reduced pollutant loads from Ramona to areas downstream of Cagney property	
	riparian vegetation structure (stabilizes soils and filters out pollutants)	grazing (herbivory)	density and cover of vegetation along and within stream channel	natural density and diversity of riparian vegetation to stabilize stream banks and filter out pollutants; greatly reduced inputs of N, P, and TDS into waters of the state.	Restrict cattle from stream corridor to allow passive restoration of riparian/wetland vegetation; intervene with active restoration as indicated by monitoring.

Table 3. Conceptual model for managing conservation targets, Ramona Grasslands Preserve.

Conservation Target	Key Ecological Factors	Factors	Indicators	Desired Condition	Management Implications
San Diego fairy shrimp	depth and duration of innundation (hydroperiod)	watershed size and vegetation density in pool and watershed	exotic plant density; residual thatch	innundation through March/April in average rain years; hydroperiod for no less than 2 weeks at a time	Grazing during wet season may maintain hydroperiod by reducing vegetation density and thatch.
	metapopulation dynamics and local extinctions	proximity of pools; wildlife or cattle use of pools (disperse cysts); absence of toxics (incl. pesticides) and sediments in watershed	fairy shrimp presence and abundance (adults, cysts) by pool; recurring maturation on	pools managed as complexes with conserved watersheds; natural dissemination of cysts among pools (by birds, other wildlife); appropriate water quality	Some cattle use may disseminate cysts between pools. Restrictions of pesticide use and sediment discharge in watershed.
Vernal pool/swale plant communities	competition from exotic species	grazing (herbivory); fire	native/exotic ratio; populations of native vernal pool indicator species; thatch density	high native/exotic ratio; stable/increasing populations of native vernal pool plants; low residual thatch during summer/fall	Use managed livestock grazing (or fire) during the aquatic phase of vernal wetlands, when exotic weed growth is most active (November-April depending on rainfall), to control weedy exotics and reduce thatch; remove grazing at the beginning of the drawdown period during period of native forb growth (May-October); control invasive exotics as necessary by other means based on monitoring; physically remove feces from watersheds as necessary.
	depth and duration of innundation (hydroperiod)	watershed size and integrity (contiguity); vegetation density in pool and watershed	exotic density; residual thatch	inundation through March/April in average rain years; hydroperiod for no less than two weeks at a time	
	integrity of pool bottom	trampling in wet season	hoof prints, fractures in pool hardpan, stirring of vernal pool soils and decreasing water holding capacity	intact clay hardpan pool bottom	
	nutrient loads	urine/feces in pools and watersheds	P, N, feces	low levels of P, N, feces in pools.	

Table 3. Conceptual model for managing conservation targets, Ramona Grasslands Preserve.

Conservation Target	Key Ecological Factors	Factors	Indicators	Desired Condition	Management Implications
Alkali playa plant communities	competition from exotic species	grazing (herbivory); fire	native/exotic ratio; populations of endemic plant species associated with saline/alkaline conditions; thatch density	high native/exotic ratio; stable/increasing populations of endemic plants associated with saline/alkaline playa habitats; low residual thatch during summer/fall	Use managed livestock grazing (or fire) during the aquatic phase of vernal wetlands, when exotic weed growth is most active (November-April depending on rainfall), to control weedy exotics and reduce thatch; remove grazing at the beginning of the drawdown period during period of native forb growth (May-October); control invasive exotics as necessary by other means based on monitoring; physically remove feces from watershed as necessary.
	location in floodplain, seasonal inundation and presence of saline and alkaline soils	floodplain size and integrity (contiguity); infrequent indundation and intervals of drying between flooding; vegetation density in playa and watershed	exotic density; residual thatch	infrequent inundation with intervals of drying; appropriate salinity or alkalinity levels (pH above 8.5)	
	integrity of depression bottom	trampling in wet season	hoof prints, stirring of playa soils and decreasing hydrological gradient	intact clay playa bottom/appropriate pH in soil	
	nutrient loads	urine/feces in playas and floodplain	P, N, feces	low levels of P, N, feces in pools.	

community. Defining management approaches requires considering our scientific understanding of the ecology of each community, the responses of each community to major stressors, and the existing and desired conditions for each conservation target. In addition, resources in the Ramona Grasslands must be managed adaptively to account for existing uncertainties in our understanding of this complex system and unexpected management responses.

The scientific foundations, existing and desired conditions, and management recommendations for each of the major ecological communities are discussed in Sections 4 though 7. Section 9 synthesizes the proposed management regimes for the core grasslands area

4. GRASSLANDS

Scientific Background

Grassland ecology

Although California's grasslands have been greatly reduced in extent and altered in composition since Spanish colonization, they remain important natural, or naturalized, communities that support high levels of biological diversity (Carlsen et al. 2000). Large areas of California's grasslands have been converted to agriculture and development, because they typically occurred on relatively flat terrain. The cumulative effects of livestock grazing, mechanical disturbance, introduction of nonnative plant species, and alteration of natural fire regimes have resulted in most remaining grasslands being dominated by nonnative herbaceous species, especially grasses of Mediterranean origin (Keeley 2001, Huenneke 1989, Mack 1989, Stromberg and Griffin 1996, Heady 1977).

California grasslands are often classified as native or nonnative, based on the relative proportion of native perennial grasses and forbs versus exotic annual grasses and forbs. This division is overly simplified, because all California grasslands contain both native and nonnative species, and even those classified as nonnative or annual grasslands may contain a large number of native annual forbs and grasses. Also, the proportion of native versus nonnative components in a location can shift over time, with variations in rainfall, fire, grazing, or other disturbance factors. Nevertheless, an estimated 99% of California's remaining grasslands are dominated by nonnative, annual grass species, and most lack any presence of native bunchgrass (Huenneke 1989). Even the best remaining examples of native perennial bunchgrass in California are apparently very different in structure and composition than in pre-colonial times, because nonnative annual grasses now tend to fully occupy spaces between widespread bunchgrasses, which formerly would have been filled with native forbs (Reiner 1999, Heady 1977, Keeley 1989, Stromberg and Griffin 1996).

In San Diego County, annual grassland is generally described as a mixture of annual grasses and broad-leaved, herbaceous species. Annual species generally comprise from 50% to more than 90% of the vegetative cover, and most annuals are nonnative species. Nonnative grasses typically comprise at least 30% of the vegetation, although this number can be much higher in some years and lower in others, depending on land use and climatic conditions. Usually, the annual grasses are less than 3 ft in height and form a continuous or open cover. Emergent shrubs and trees may be present, but do not comprise more than 15% of the total vegetative cover. Characteristic annual grassland species include foxtail chess (*Bromus madritensis* ssp. *rubens*), rip-gut grass (*Bromus diandrus*), wild oats (*Avena* spp.), fescues (*Vulpia* spp.), red-stem filaree (*Erodium cicutarium*), mustards (*Brassica* spp.), lupines (*Lupinus* spp.), and goldfields (*Lasthenia* spp.), among others.

Grassland communities with 10% or more cover of native bunchgrasses are considered native grasslands by the California Natural Diversity Database (CNDDB). Native perennial grasslands are very rare in San Diego County. Oberbauer and Vanderwier (1991) estimated that almost 95% of the original acreage of native grasslands in the county had been lost by 1988, and that less than 7,250 acres of native grasslands remained.

California's native grassland species evolved in generally nutrient-poor soils and semi-arid climates. They tend to be slow-growing and unable to take advantage of elevated nutrient levels. In contrast, introduced weedy species tend to be nitrophilic, with the ability to greatly increase growth and reproductive output in response to elevated nutrient levels (Bobbink et al. 1998, Claassen and Marler 1998, Reever Morgan and Seastedt 1999). Nitrogen deposition in soil from air pollution (especially automobile exhaust) and perhaps from agricultural uses (fertilizers, manure) increases the performance of these weedy species, enabling them to outcompete the slower-growing annuals. This trend is exacerbated by the ability of these faster-growing exotic species to rapidly take up available water and to build up a thick thatch layer. This thatch layer impedes germination by native seeds and, during dry seasons, is highly flammable, increasing fire frequencies to the further detriment of some native species. In general, native perennial bunchgrasses are better able to sustain populations on soils heavier in clays, which tend to be more nutrient-poor and to hold water longer. In other words, the aggressive, annual Mediterranean species are less able to outcompete native perennial species on clay, rocky areas, or other nutrient-poor soils (such as gabbro and serpentine soils) than on loamier, richer, or better-drained soils (Keeley 2001, Harrison et al. 2002). Thus, soils that might be considered poor for agricultural production are important refugia for native species.

Most grasslands evolved with grazing by a variety of native grazers. Following the extinction of Pleistocene megafauna, native grazers in the Ramona Grasslands likely consisted of large ungulates such as pronghorn antelope, smaller mammals such as rabbits and ground squirrels, and insects such as grasshoppers. However, California's native perennial bunchgrasses are sensitive to continuous grazing pressure, because they have an elevated apical meristem (primary growing point) that is susceptible to removal by grazers (Heady 1977). Continued heavy grazing can remove any new tillers that are produced from axillary meristems (secondary growing points) and can also reduce foliar and root growth. This limits the ability of perennial grasses to rebound from grazing pressure relative to annual grasses, which grow more rapidly from the base of the plant.

However, under natural conditions, grazing tends to be patchy over time, with short periods of intense grazing followed by periods of rest as grazers move on. Thus, natural grasslands would have a shifting mosaic of periodic grazing disturbance, which allowed for a diversity of species with differing requirements, and which allowed perennial bunchgrasses to persist. Mimicking such natural grazing regimes increases biodiversity relative to either ungrazed or overgrazed (continuously grazed) conditions (Wild Farm Alliance 2003, Reiner 1999, Macon 1999).

Harrison et al. 2002 found grazing to increase species diversity on nutrient-poor serpentine soils more than non-serpentine soils, which may also apply to other nutrient-poor soils, such as clay or gabbro-derived soils.

Fire is a natural process that is largely responsible for maintaining grasslands against succession to shrublands or forests in many regions. Fire temporarily releases individual plants or seeds from competition for nutrients, light, and water, thus leading to rapid growth and reproduction. Fire also removes thatch, thus stimulating germination and growth of diverse species that may be suppressed during inter-fire periods.

Stressors

After outright conversion of grasslands by urban or agricultural development, the primary threat to ecological integrity in grassland communities is the accumulation of dense annual grasses, weeds, and associated thatch. This applies to grasslands on loamy as well as clay soils, as well as to the various micro-communities embedded within the grassland matrix, such as vernal pools and playas. Dense annual plant cover and thatch choke out native plant species, create impenetrable barriers to species like the Stephens' kangaroo rat or foraging raptors, and greatly reduce water depth and duration in vernal wetlands, all to the detriment of target resources. Aggressive weedy invaders, such as star thistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*) pose a significant threat to biological diversity and ecosystem health. In addition, perennial species such as artichoke thistle (*Cynara cardunculus*) quickly form a monoculture to the exclusion of native species and transform the structure of grassland systems, thereby reducing their value for conservation. These weedy invaders threaten to eliminate remaining native species over large areas of California (Reiner 1999).

Livestock grazing can be either a stress or a benefit to the health of grassland ecosystems, depending on its intensity, duration, and seasonality, and depending on which target resources are of greatest interest. In addition to eating vegetation, which can dramatically affect vegetation composition and structure, cattle also trample and compact soils, transport weed seeds, collapse burrows of subterranean wildlife, and redistribute nutrients on the landscape via their urine and feces. The effects of these processes on ecological integrity depend on the resource targets of interest, as well as characteristics of the soils (texture, depth, bulk density, moisture content), vegetation (e.g., annual versus perennial grassland), and other factors (Harrison et al. 2002, Krueger et al. 2002).

Despite the ecological stresses created by poorly managed grazing, livestock grazing remains one of the most effective management tools for controlling invasive plants and reducing detrimental thatch (Reiner 1999, Macon 1999). *Natural* grazing regimes (hypothesized to be a rotation of short-term intense grazing followed by periods of rest) actually increase biodiversity by creating a diverse mosaic of conditions and by stimulating growth and germination in some species. However, continuous grazing can greatly decrease plant diversity, favoring species best able to compete under those conditions. For example, native perennial bunchgrasses do not persist well with continuous grazing due to their growth and reproductive form. In contrast, some target species in the Ramona Grasslands, such as the Stephens' kangaroo rat and ferruginous hawk, seem to benefit from a continuous, year-round grazing regime. However, plant diversity is very low in such areas, and wildlife diversity is undoubtedly diminished in these continuously grazed areas relative to a mosaic of differing grazing regimes and grassland types.

Similarly, fire can be both a stressor and benefactor of grassland health, depending on timing and specific conditions. Too frequent fire reduces diversity and favors weedy annual species over native species with lower reproductive and growth rates. Nonnative grasses have characteristics that alter the fire regime in ways that favor their persistence over the indigenous vegetation, an ecological process termed *niche construction* (Odling-Smee et al. 1996, D'Antonio and Vitousek 1992, Keeley 2001). Niche construction occurs when organisms modify their environment in ways that ultimately enhance their own fitness relative to competitors. Mediterranean grasses are so successful in California, in large part, because of their propensity to shift the fire regime to more frequent, cooler fires, which favors their own germination and growth over that of native competitors. This becomes a positive feedback loop, in which an increase in annual grasses increases fire frequency, which further favors increases in annual grasses (D'Antonio and Vitousek 1992). Dry season fires, after weedy annual species have set seed, further benefit the Mediterranean annuals relative to native perennial species. Early spring fires may shift the balance more in favor of native species by destroying the annual seed crop (Keeley 2001), because many native perennial species have the ability to resprout after fire.

Management approaches

The biggest challenge to managing the Ramona Grasslands ecosystem is controlling the threats posed by overly dense, weedy annual species and associated thatch buildup at a landscape scale, given that the various target resources will respond differently to different management regimes. A mosaic of areas having different timing and intensity of grazing pressure, accompanied by restricted use of prescribed fire or other management intervention, likely would maximize biological diversity over the broader grasslands area.

Although poorly managed livestock grazing can have detrimental effects on some conservation targets, accumulating science shows that properly managed livestock grazing can be highly beneficial, even essential, to maintaining biological values in grassland ecosystems (e.g., Reiner 1999, Barry 1998, O'Farrell and Uptain 1987, Harrison et al. 2002, Macon 1999, Menke 1992, Hart 2001). Proponents of grazing as a vegetation management tool recognize grazing as a natural and integral process in most grassland ecosystems (Reiner 1999, Macon 1999, Krueger et al. 2002). There are numerous examples of grassland degradation or losses of native species caused by the removal of cattle (e.g., Hart 2001, Barry 1998, Reiner 1999, Kan 1998, O'Farrell 1992, 1997; Rice personal communication). However, nearly all grassland ecologists and range managers agree that continuous heavy grazing is unnatural, unsustainable, and deleterious to natural resources—leading to losses in biological diversity, soil compaction, erosion, reduced watershed quality, and reduced return on grazing investments (Krueger et al. 2002). A strategy of *management-intensive grazing*—which involves pulsed, intensive grazing on small pastures for a matter of days, followed by rest to allow vegetation to recover—mimics the activity of migratory grazers that evolved in grasslands and prairies. This strategy has been demonstrated to control exotic species, increase plant diversity, and reduce negative impacts to soils (Krueger et al. 2002, Macon 1999, Wild Farm Alliance 2003).

Pollak and Kan (1996) studied use of spring prescribed fire to control invasive exotic weeds in a mima mound vernal pool system at Jepson Prairie Preserve in Solano County, California. They found that late spring burns (near the end of the growing season, but before seed set in weed species) greatly reduced the cover of thatch and nonnative annual grasses, such as medusahead, while increasing the dominance of native species and the cover of native grasses and forbs. Similar studies have been performed elsewhere in California with similar results, and late-spring burning is increasingly recommended as a management tool for exotic species control and biodiversity maintenance in California grasslands (Menke 1992, Wills 2000, Pollak and Kan 1996, Keeley 2001, O'Farrell 2003, Spencer 2002) and can be considered a potential tool in the Ramona Grasslands.

Mowing, disking, raking, and superficial scraping have limited use for landscape-level vegetation management. Mowing alone creates thatch, which is a primary threat to native species conservation in California grasslands. Mowing followed by raking may alleviate the thatch problem, but it may promote *lawn-like* conditions, encouraging dense, low growth that may be impenetrable to target species (e.g., Stephens' kangaroo rat) or inhibit native species germination. However, studies in western Riverside County suggest that mowing, followed by raking, may benefit Stephens' kangaroo rat habitat as much as grazing, fire, or other management methods (Kelt personal communication). Raking may help reduce the unnatural level of nitrogen in surface soils as the thatch is removed from the site, thus decreasing the competitive advantage to weedy, nitrophilous exotics over time. However, costs and thatch disposal requirements make this method less practical than grazing or fire for large areas.

Disking and scraping are extremely labor-intensive, and the results suggest that any benefits to Stephens' kangaroo rat habitat are short-lived (O'Farrell 1992, 1997; Appendix A). At the Ramona Airport, hand-scraping and raking of surface duff to expose and level mineral soils following a controlled burn had clear, short-term, positive benefits to the rats (which were clearly attracted to raked grids for travel and foraging; Spencer 2003), but no discernable benefit remains 2 years after the treatments (Spencer personal observations 2004; see case study, Appendix A). Also on the airport property, Spencer and others have frequently noted Stephens' kangaroo rats invading areas disturbed by mechanical means (raking, construction traffic, etc.), but then disappearing as vegetation recovers over time from the disturbance. Finally, mechanical methods also have potential for direct killing of wildlife or disruption of natural soil crusts and structure.

As nonnative grasses can outcompete native grasses in high nitrogen environments (Bobbink et al. 1998, Claassen and Marler 1998, Reever Morgan and Seastedt 1999), techniques that decrease nitrogen availability show promise in native grassland restoration (Alpert and Maron 2000). These techniques include (1) adding carbon to the soil (e.g., in the form of sawdust or rice straw) to increase microbial growth and thus competition for soil nitrogen, which favors perennial species over annuals (McLendon and Redente 1992, Alpert and Maron 2000); (2) harvesting above-ground plant material and removing it from the site so it cannot decompose and return nutrients to the soil (Smith personal communication); and (3) densely seeding native grassland species (e.g., *Hemizonia*) (Smith personal communication).

<u>Case studies in grasslands management methods for Stephens' kangaroo rat</u>. The Stephens' kangaroo rat serves as a good indicator for other conservation targets in the loamy grassland community. Its habitat requirements are similar to those of other targets [burrowing owl (*Speotyto cunicularia*) and ferruginous hawk), and the effects of various management treatments

are relatively well-studied. Appendix A reviews some case studies that are directly relevant to designing vegetation management approaches for the Ramona Grasslands Preserve.

O'Farrell (1997) concluded that, provided grazing was not a management option, rotational use of prescribed fire was preferred to a disk-and-drag treatment or a combined burn/disk-and-drag treatment, but that burning would need to be repeated frequently, depending on precipitation patterns. For example, if there were 2 consecutive years of above-average rainfall after a burn, another burn would be required to restore suitable habitat conditions.

Spencer and others have studied the population of Stephens' kangaroo rats on the Ramona Airport property since its discovery in late 1997 and have looked at the effects of cattle grazing, horse grazing, prescribed fire, and some mechanical disturbance methods to create or maintain suitable habitat condition. Observations reinforce many of O'Farrell's conclusions about optimal habitat characteristics and vegetation management methods and suggest that cattle grazing is the most effective method for long-term habitat maintenance.

Existing Conditions

The following discussions are based on field reconnaissance of the former Cagney Ranch, Hardy property, Hobbs property, and WRI property by the Conservation Biology Institute (in fall 2003 and spring 2004). Detailed botanical surveys were conducted by Fred Sproul of WRI on the former Cagney Ranch, Hardy property and Hobbs property during the period April-July 2004 (Sproul unpublished data). In addition, CBI and Sproul mapped nonnative plants in areas of Oak Country Estates visible from Rangeland Road and on the portions of the Ramona Airport and Cummings Ranch visible from Montecito Road. Additional information was obtained from Ecological Ventures California, Inc. (2003), EDAW (2002, 2003a,b), EDAW and TAIC (2004), LaCoste (personal communication), PSBS (1989), and Westec Services (1980), which cover various portions of the Ramona Grasslands Preserve.

Vegetation communities and stressors

The Ramona Grasslands is a complex mosaic of habitat conditions that vary directly with soil characteristics, land uses, and grazing. Vegetation on clayey soils is very different from that on loamy soils, largely because of the physical differences in how soil structure affects water availability to plants and soil penetration by roots and burrowing animals. Moreover, roads, the airport and associated infrastructure, and the effluent spray fields have altered natural hydrological functions in the grasslands area (EDAW 2003a), which undoubtedly affects distributions of target resources.

Existing fences, rock outcrops, water sources, and topography tend to concentrate cattle activity more in some areas than others, resulting in a mosaic of grazing intensities and habitat disturbance. Most of the grazed area is in the loamy grasslands, dominated by nonnative annual grasses and forbs, including filaree (*Erodium* spp.), wild oat, rip-gut brome (*Bromus diandrus*), vinegar weed (*Trichostemma lanceolatum*), Bermuda grass (*Cynodon dactylon*), and ragweed (*Ambrosia* sp.). Some areas far from water sources, and especially those on clay soils, are lightly to very lightly grazed, resulting in dense cover of nonnative annuals and accumulated thatch.

Shrubs and trees grow only where cattle are excluded by large rock outcrops, property fences, or other barriers.

In addition to nonnative species, the clayey grasslands also support a greater concentration of native grasses and forbs, including purple needlegrass, creeping wild rye (*Leymus triticoides)*, saltgrass (*Distichlis spicata)*, small-leaved morning-glory (*Convolvulus simulans*), tarweed (*Deinandra fasciculata),* and graceful tarplant.. Especially dense concentrations of native purple needlegrass and small-leaved morning-glory are mapped in Figure 9. Fred Sproul surveyed for graceful tarplant in June 2004, but found only dried specimens from the previous year. In years of better rainfall, this species occupies the Bosanko clay soils in the eastern part of the grasslands (Sproul personal communication). Invasive exotic plant species, especially artichoke thistle (Figure 9), have increased dramatically in recent years, greatly reducing habitat value for native wildlife and reducing forage quality for cattle.

Current grazing levels in much of the Preserve are beneficial to the Stephens' kangaroo rat, which thrives on sparse, forb-dominated vegetation communities with little thatch and abundant bare ground. Grazing also benefits some target raptor species, such as ferruginous hawks and burrowing owls. However, heavy grazing may also reduce the diversity and abundance of some prey species (e.g., rodents, lagomorphs, songbirds, insects, etc.) that help support a more diverse community of raptors and other predatory species. Continuous heavy grazing also reduces native plant diversity, which is very low in the areas supporting the most Stephens' kangaroo rats (O'Farrell 2003, Spencer 2002). There fore, grazing intensity in the Ramona Grasslands must be managed to optimize habitat conditions for a variety of target resources.

Conservation targets

In loamy grassland areas, conservation targets include the Stephens' kangaroo rat, ferruginous hawk, and burrowing owl (Appendix B). These species require similar habitat conditions that benefit from moderate grazing regimes. Soils likely to support Stephens' kangaroo rats occur over much of the core grasslands area (Figure 10). This species is widely but patchily distributed in loamy grassland areas, especially on the western half of the airport property, large areas east of Rangeland Road, and scattered locations north of the airport and west of Rangeland Road.

About 12-15 ferruginous hawks winter in the Ramona Grasslands each year (Bittner personal communication). This is the largest wintering concentration of these rare hawks in San Diego County (Bittner personal communication). The birds forage primarily in open, loamy grassland areas that support large populations of pocket gophers (Bittner personal communication). Abundant pocket gophers also benefit Stephens' kangaroo rats, which improve pocket gopher burrow systems for their own use.

Burrowing owls have been observed throughout the Ramona Grasslands, but they do not currently nest there (Lincer personal communication). They benefit from ground squirrels (a burrow source) and perches (rocks, fence posts) in the grasslands. The Wildlife Research Institute is working toward establishing a breeding population in the Preserve, aided by captive breeding and artificial burrows.

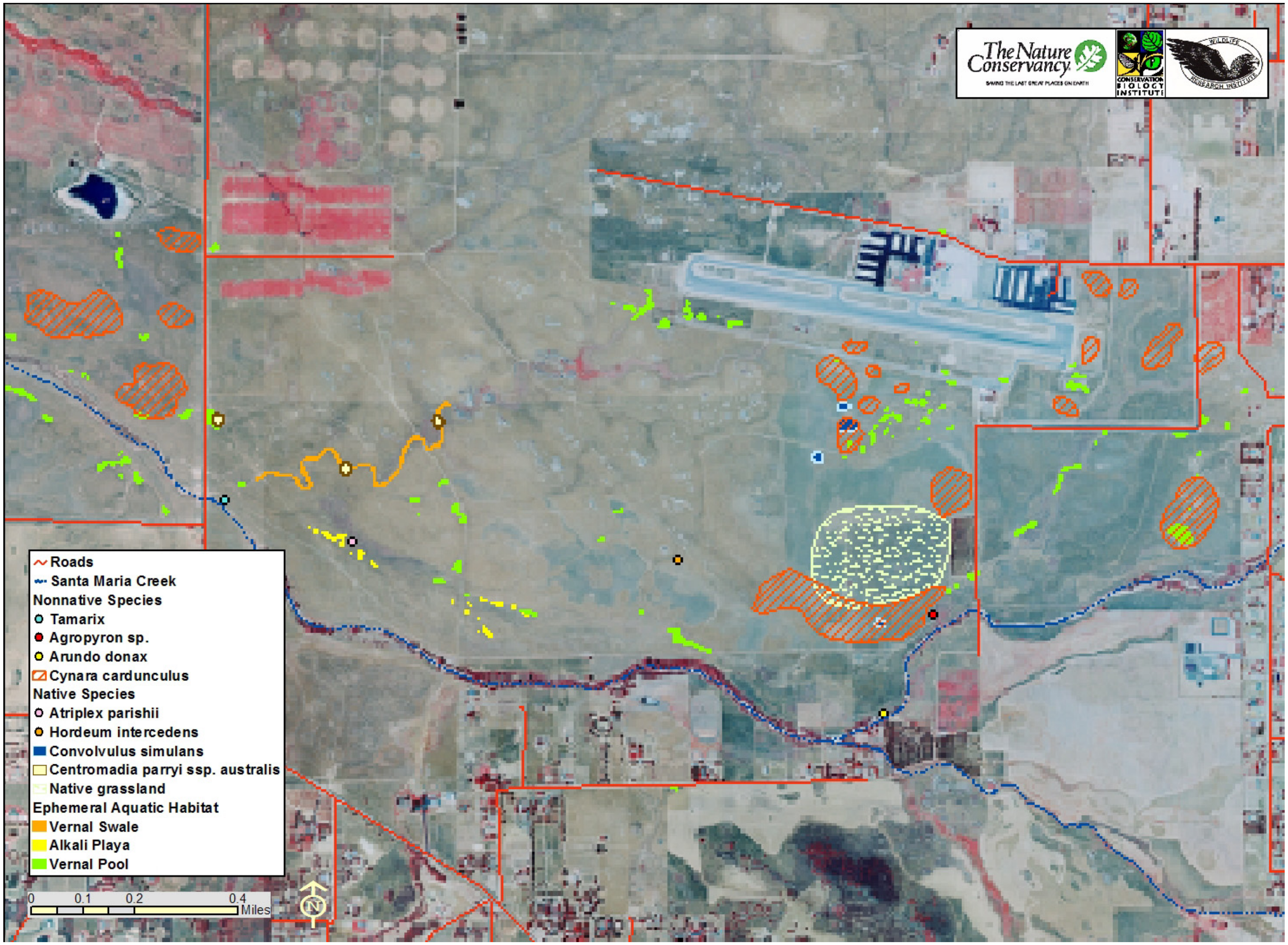

Figure 9. Locations of selected native plant species and nonnative species, core grasslands area.

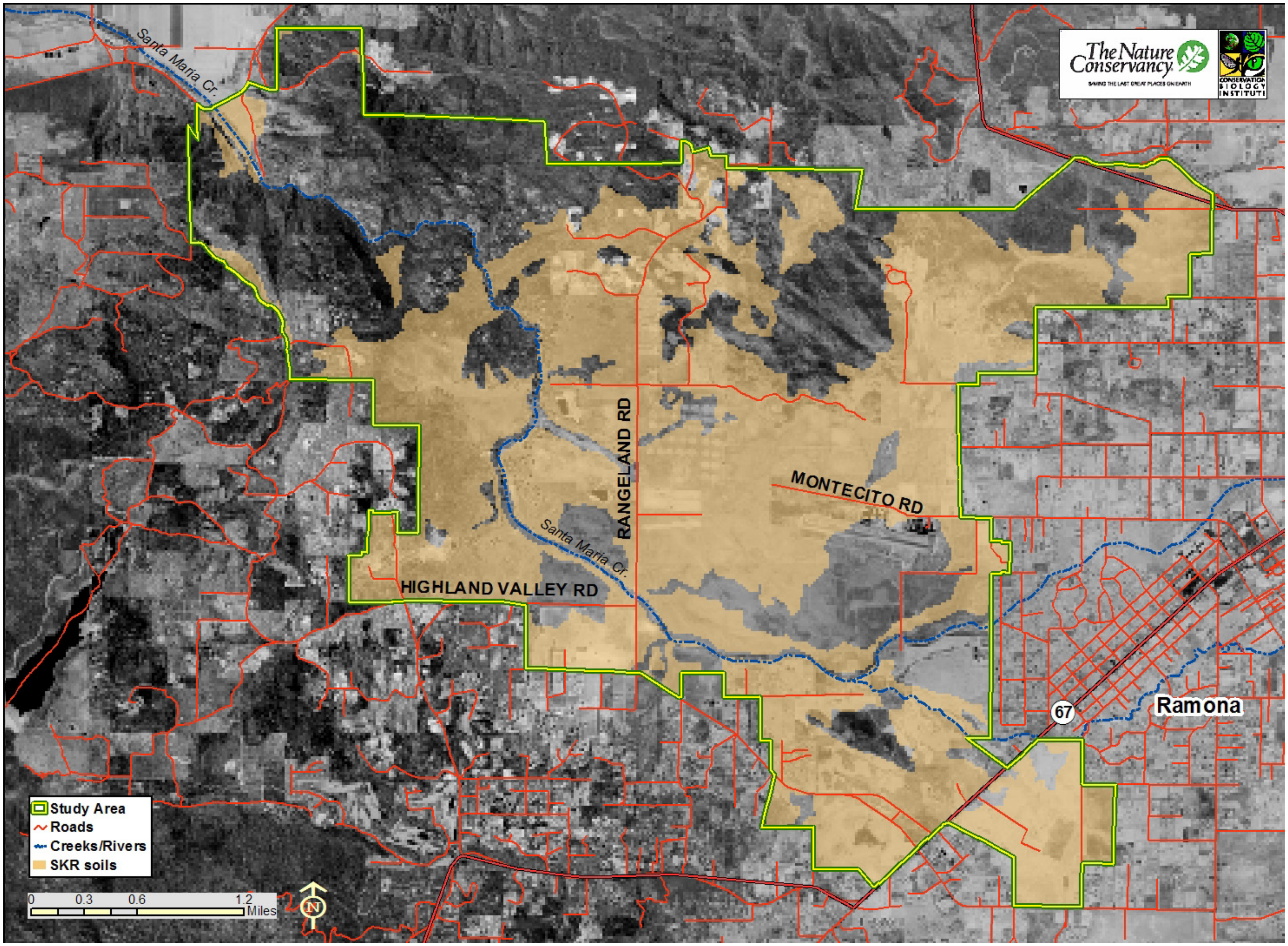

Figure 10. Soils likely to support Stephens' kangaroo rats in the Ramona Grasslands CAPP Area.

Native grasses and forbs are conservation targets for the clayey grasslands, including purple needlegrass, saltgrass, small-leaved morning-glory, and graceful tarplant (Appendix B). Use of seasonal grazing to control weeds would likely benefit these species.

Wide-ranging conservation target species, which use the entire Ramona Grasslands landscape mosaic, include raptors (as a species guild), the golden eagle, badger, and bobcat. Golden eagles nest on rock cliffs above Bandy Canyon and forage for prey in the open grasslands. Bobcats undoubtedly use surrounding vegetation communities and probably forage in the open grasslands. The Ramona Grasslands are probably too small and isolated to reliably support a population of badgers, which seem particularly susceptible to habitat fragmentation and road impacts. However, badgers still occupy grasslands in less developed areas of the county (e.g., Warner Basin and Santa Ysabel grasslands) and may use the Ramona Grasslands if they are sufficiently protected and managed as part of a larger landscape that links other San Diego County grasslands. Wayne Spencer recently noted badger sign for the first time on the Ramona Airport property in 2004, and Scott Tellam (personal communication) reported that badgers are seen occasionally by local residents.

Restoration and Management

Desired conditions

Management should strive to produce a mix of grassland conditions to support diverse ecological values, from sparse, forb-dominated grasslands for Stephens' kangaroo rats to denser, more botanically diverse perennial grasslands. Resource targets may vary by soil types in the Grasslands. Management should control unnatural build up of thatch and remove or control invasive exotics that degrade habitat value or natural ecosystem function. Some naturalized exotic species cannot or should not be fully controlled, such as *Erodium* spp., which is an important food source for Stephens' kangaroo rats.

Of the conservation targets identified for loamy grassland habitats, desired conditions are probably best studied for the Stephens' kangaroo rat. For this species, the desired condition is high forb/grass ratio, high proportion bare ground, and very low thatch by mid-summer (after the vegetation dries; Spencer 2002, O'Farrell and Uptain 1987, O'Farrell 1992, 1997; Appendix A). In a dry or average rainfall year, the desired condition is probably 20%-50% bare ground by late summer, with very little thatch, and a forb/grass ratio greater than 2. In a wet year, these measures, especially forb/grass ratio, may not be as meaningful. The same conditions that benefit Stephens' kangaroo rats favor ferruginous hawks and burrowing owls (Bittner and Lincer personal communications).

The management goal for the clayey grasslands community is to reduce the abundance of nonnative invasive plant species, which could be achieved with light to moderate, wet-season grazing that reduces competition and thatch.

Restoration and management actions

Given the management options available for maintaining target resources in the grasslands community, it appears that managed grazing is the most effective tool for managing vegetation composition and structure in the core grasslands area. The objective of managed grazing should be to promote a mosaic of different grazing regimes and grassland conditions, each supporting different sets of target resources. Management units should be designated based on the varying requirements of the ecological communities and logistics of grazing access, control, and intensity. Prescribed fire should supplement grazing when necessary to help control exotics and thatch, especially where unpalatable species make grazing less effective (e.g., in clayey grasslands). Some mechanical control and use of herbicides will also be necessary to treat aggressive invasive species that are not palatable to livestock or easily controlled by fire, such as artichoke thistle.

Most loamy grassland areas should continue to be moderately grazed by cattle to maintain open, forb-dominated habitats. Heavier clay soils and associated vernal wetlands should be grazed in late winter-early spring to reduce density of nonnative annual grasses and prevent thatch buildup. Ideally, this grazing should be timed to coincide with the period of rapid growth and greatest forage nutrition, but before weedy species set seed, the timing of which may be affect by rainfall patterns. This will vary year-to-year depending on rainfall patterns, but generally during late February to early June. Fencing will be necessary to confine cattle in predominantly clay soils areas for periods, as they prefer the loamy soils when given a choice. Salt licks and water sources should be distributed to encourage cattle use of areas requiring increased grazing pressure and to minimize disturbance to wetland habitats.

Monitoring targets

The following conservation targets should be monitored (Section 9):

- Vegetation (distribution, abundance, composition, and structure)
    - Purple needlegrass
    - Small-leaved morning-glory
    - Graceful tarplant
    - Nonnative thatch
- Stephens' kangaroo rat
    - Habitat quality (using proportion of bare ground and forb/grass ratio as indicators)
    - Population distribution (using burrow density as an indicator, calibrated using periodic live trapping and burrow-count transects on sample grids)
- Raptors (distribution and relative abundance)
    - Wintering ferruginous hawks
    - Breeding burrowing owls

5. VERNAL POOLS AND SWALES

Scientific Background

Ecology of vernal wetlands

Vernal pools and vernal swales are unique seasonal wetlands that persist on impermeable soils and are subject to extreme climatic variations. As a result, they form ephemeral plant communities that support an unusual flora and fauna, often rich in endemic species specifically adapted to alternating periods of inundation and drought (Zedler 1987). Vernal wetlands typically occur as a series of micro-depressions (vernal pools) or are manifested as a drainage pattern that flows during high rainfall and forms distinct ponded areas during the drying phase (vernal swales). The subsoil is hardpan or claypan, which prevents downward percolation of water. The depressions collect water from precipitation and runoff from the surrounding undulating landscape—mounds (called mima mounds from the Mima Prairie in Washington, where this unique topographic condition was first described)—or upstream watershed (Cox 1984, Zedler 1987). The inundation period coincides with the rainy season in Southern California's Mediterranean climate (November through March). Pools may remain inundated intermittently for 3-5 months or may not fill at all, depending on the volume of precipitation in a given year (USFWS 1998b) and on the size and topography of the watershed (Black and Zedler 1993). Several smaller pools may be part of a single watershed.

When pools are dry during the summer months, fairy shrimp and other aquatic invertebrates persist as cysts and eggs in the soil, where they can be dormant for many years until opportune hatching conditions return. Water chemistry and water temperature are the limiting factor for fairy shrimp presence (Eriksen and Belk 1999, Branchiopod Research Group 1996). Vernal pools also support amphibians, although in Southern California only the spadefoot toad (*Scaphiopus hammondii*) is considered an obligate vernal pool species (USFWS 1998b). The Pacific tree frog (*Pseudacris regilla*) and western toad (*Bufo boreas halophilus*) spend the majority of their life cycles in upland areas, but need inundated areas for breeding and will utilize vernal pools when available (Simovich et al. 1996).

Individual species are distributed along a moisture gradient based on their response to inundation and moisture regime. Some plants bridge the gap between aquatic and terrestrial habitats by being heterophyllous, or producing both submerged and exposed leaf forms (Keeley 1990). As pools dry out, rings of different plant species flourish at the fringes of the vernal pool basins. Because of these unique conditions of periodic wet and dry conditions, endemism is common within this ephemeral plant community.

In San Diego County, vernal pool identification is commonly based on the presence of indicator species (Bauder 1993, City of San Diego 1993, USACOE 1997) and hydrologic and soils indicators (City of San Diego 1993). The County of San Diego (1991) and the CDFG (Holland 1986) consider vernal pools sensitive because the species they support are found nowhere else, and their biodiversity is a compelling reason for conservation (Simovich 1998).

Stressors

Vernal pools are among the most threatened resources in California (Jones and Stokes 1987), as a result of loss and degradation through direct and indirect impacts of human activities. In the Central Valley and the adjacent Sierra Foothill Ecoregion, 87% of vernal pools have been lost to agriculture and draining (Bainbridge 2002). In San Diego County, urbanization is the greatest threat and has resulted in loss of 96% of vernal pools (Bauder 1987, Oberbauer 1990). Trash dumping, trampling (including heavy cattle grazing), off-road vehicle activities, fuel spills, polluted run-off, fill discharge, and invasion with nonnative species [e.g., rye grass (*Lolium perenne* and *L. multiflorum*), Bermuda grass, and bullfrogs (*Rana catesbeiana*)] can reduce vernal pool functions and lead to local extirpation of vernal pool species (USFWS 1998b). Additionally, some native plants may outcompete vernal pool flora by increasing biomass and water absorption rates.

Landscape fragmentation disrupts connectivity of vernal pool complexes and watershed integrity, limits access by pollinators and predators, and reduces flooding between basins, ultimately leading to reduced gene flow and possible extirpation (USFWS 1998b). For example, chain-link fencing, by excluding predators from vernal pool habitat, allows an increase in rodent populations. Increased burrowing activity in the vernal pool watershed can alter the hydrologic regime. Thorp and Leong (1995) demonstrate that some pollinators cannot travel more than 1 mi. between vernal pools or vernal pool complexes, and they are also affected by ornamental landscaping in urban settings (USFWS 1998b). As vernal pools become more restricted in distribution, they become more vulnerable to catastrophic loss. For example, San Diego button celery (*Eryngium aristulatum* var. *parishii*) and spreading navarretia (*Navarretia fossalis*) remain in only two locations within the entire Ramona vernal pool ecosystem.

Management approaches

Vernal pools benefit most from landscape-scale management strategies that consider the integrity and hydrological regime of the vernal pool watershed and potential indirect impacts of surrounding land uses, specifically invasion by nonnative plants and pollutant runoff. Although fairy shrimp may be sensitive to herbicides (Branchiopod Research Group 1996), there is no conclusive evidence of negative effects of *Rodeo* on these invertebrates (Simovich 2003, unpublished data). In the Central Valley, artificial watering of vernal pools was successful in drowning out nonnative rye grass, while vernal pool plants thrived in this environment (Marty personal communication.). However, this method has not been applied in Southern California vernal pool systems and has not been supported by the USFWS (Wynn personal communication) or San Diego vernal pool experts (Bauder personal communication). The artificially altered hydroperiod may have an unknown, and perceived negative, effect on fairy shrimp populations and the overall function of the vernal pool ecosystem.

Controlled burns (Cox and Austin 1990; Bauder 1996; Pollak and Kan 1996; Simovich et al. 1996) and controlled grazing (USFWS 2004, Marty 2004) may be useful in removing excessive thatch and nonnative species. Southern California vernal pool ecosystems evolved with fire and ungulate grazing, e.g., pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*). Managed cattle grazing seems to benefit the overall function of Central Valley vernal pools (Marty 2004), where species diversity and native plant cover increased with cattle grazing, while exotic species cover decreased. Cattle grazing also resulted in increased inundation duration (hydroperiod).

Restoration of vernal pool ecosystems is difficult, if not impossible, in the drier regions of Southern California. The USFWS accepts vernal pool restoration only where appropriate soils and sufficient watershed area remain intact, in areas where pools occurred historically (USFWS 1998b). Restoration of weed-infested pools involves salvaging vernal pool indicator species, solarizing the pools, and subsequently re-seeding with the salvaged material.

Existing Conditions

The following discussions are based on field reconnaissance of the former Cagney Ranch, Hardy property, Hobbs property, and WRI property by the Conservation Biology Institute (in fall 2003 and spring 2004). Detailed botanical surveys were conducted by Fred Sproul of WRI on the former Cagney Ranch, Hardy property and Hobbs property during the period April-July 2004 (Sproul unpublished data). In addition, CBI and Sproul mapped nonnative plants in areas of Oak Country Estates visible from Rangeland Road and on the portions of the Ramona Airport and Cummings Ranch visible from Montecito Road. Additional information was obtained from Ecological Ventures California, Inc. (2003), EDAW (2002, 2003a,b), EDAW and TAIC (2004), LaCoste (personal communication), PSBS (1989), and Westec Services (1980), which cover various portions of the Ramona Grasslands Preserve.

Hydrology, vegetation community, and stressors

The Ramona vernal pools are part of the Inland Valley Management Area of the Southern California recovery plan (USFWS 1998b). The majority of pools in this area are isolated from extreme maritime influences by topography and distance from the coast. Indicator species within this management area include federally and state listed species—spreading navarretia, San Diego button-celery, and San Diego fairy shrimp—as well as other sensitive plant species, including woolly marbles (*Psilocarphus brevissimus*), water starwort (*Callitriche marginita*), pygmy crassula (*Crassula aquatica*), quillwort (*Isoetes* sp.), toothed downingia (*Downingia cuspidata*), and little mousetail *(Myosurus minimus* ssp. *apus).*

The Ramona vernal pools were originally described by Beauchamp and Cass (1979), Balko (1979), and Bauder (1986). At that time, the Ramona pools were labeled as pool group T1-5, which described only the vernal pool complex southeast of the Ramona Airport. Additional vernal pools along Main Street, at the Ramona High School, and throughout the Santa Maria Valley were identified subsequently (PSBS 1989). A vernal swale that exhibits seasonal ponding and supports vernal pool species is also included as part of the Ramona complex (EDAW and TAIC 2004). This swale may facilitate migration by amphibians and other species.

Impermeable soil types associated with vernal pools in the Ramona area include Placentia, Bonsall, Fallbrook, and Bosanko (Figure 11). Bonsall-Fallbrook sandy loams to the west and east of the Ramona Airport runway exhibit a thin, sandy topsoil layer over heavier clay subsoils. The majority of the Ramona vernal pools, as well as the vernal swale connected to Santa Maria Creek, are associated with Placentia sandy loams. Saltgrass, alkali barley (*Hordeum depressum),*

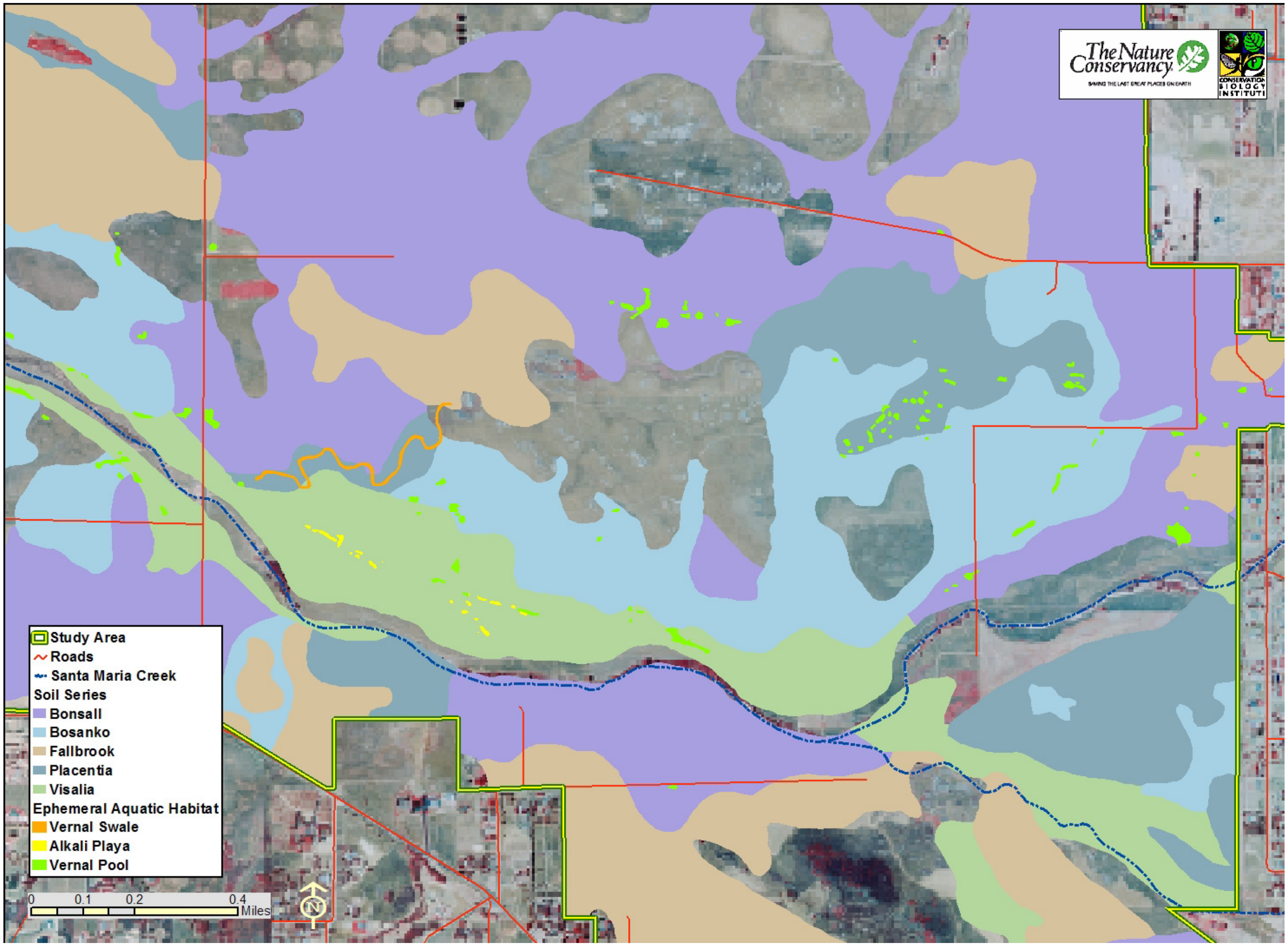

Figure 11. Soils associated with vernal wetlands and alkali playas, core grasslands area.

and southern tarplant (*Centromadia parryi* ssp. *australis)* occur in the vernal swale and alkali playas along Santa Maria Creek. Bermuda grass has invaded portions of this area.

The vernal pool watersheds in the core grasslands are undeveloped pastures supporting cattle and dominated by nonnative grasses and forbs. The general topography consists of low rises (10-20 ft) around scattered outcrops of granitic boulders, separated by swales and flats. The pools in the northeastern portion of the core grasslands display a distinct, although shallow, mima mound topography. Cattle grazing has helped to maintain adequate watershed function by decreasing thatch buildup. Anecdotal evidence suggests that increased biomass and residual thatch in areas where cattle grazing has been discontinued (e.g., Ramona Airport) result in higher water absorption rates and, thus, less surface water runoff filling the vernal pools (Ecological Ventures California 2003). However, surveys in the northeastern pool complex suggest that water quality may be compromised by cattle ranching (EDAW 2003b), although the effect on vernal pool species is unclear.

Artichoke thistle occurs in scattered patches throughout the eastern grasslands and west of Rangeland Road (Figure 9) and does well in soils with a heavy clay content (Thomsen et al. 1986).

Conservation targets

Woolly marbles, water starwort, pygmy crassula, quillwort, toothed downingia, and little mousetail have been documented within the Ramona Grasslands vernal pools (Appendix B). Although some of these have not been observed in recent years (EDAW and TAIC 2004, EDAW 2003a, Recon 1995), they are likely to persist in the seed bank.

While San Diego button-celery is absent from vernal pools in the Ramona Grasslands, two small populations exist in protected locations in downtown Ramona. It is not known whether this species ever existed in the core grasslands area. Spreading navarretia has been reported from the grasslands; however, it is believed to be extant only in the largest, fenced pool on the eastern edge of the grasslands (pool E5). The plant was historically reported from pool C2e at the Ramona Airport east of Ramona Airport Road (Recon 1995), but has not been relocated during multiple subsequent surveys (EDAW 2003a).

The San Diego fairy shrimp occurs in the vernal swale and many, if not all, vernal pools in the grasslands, as well as in portions of Santa Maria Creek (EDAW 2003b). Some vernal wetlands have not held water long enough for fairy shrimp to reach maturity and be positively identified as *B. sandiegonensis* (EDAW 2002, 2003b, LaCoste personal communication, Ecological Ventures California 2003). According to Simovich (2003), pools must be inundated for at least 2 weeks to complete a full life cycle within one season. The drought and an increase in biomass as a result of reduced or eliminated cattle grazing have reduced surface water runoff to the pools (Ecological Ventures California 2003). Intensive cattle grazing in vernal pool basins during the wet season and subsequent churning of vernal pool subsoils have also been blamed for decreased water-holding capacity and premature drying of pools (EDAW 2003b), although there is no scientific literature supporting this assumption.

Restoration and Management

Desired conditions

The management objective for the Ramona Grasslands vernal wetlands is to maintain and enhance vernal pool and vernal swale functions through management actions within the watershed as well as within individual basins. Implementing strategies to meet this objective will improve the hydrologic regime through control of invasive species and thatch buildup within the watershed and the basins. Seasonal exclusions of cattle will improve the quality of runoff within the watershed, thus decreasing opportunities for introduction of sediments and nutrients.

Restoration and management actions

Management actions should minimize creation and use of dirt roads and trails, which can disrupt watershed integrity, alter animal movement patterns, and create disturbed areas for the establishment of invasive species. Use of dirt roads and trails by humans and cattle also contributes to invasive species dispersal and sedimentation in vernal wetlands. Specifically, pedestrian, equestrian, and vehicle access to vernal wetlands should be restricted.

Cattle should be restricted from the heavy clay soils in the eastern part of the preserve for much of the year to allow recovery of native grasses and forbs, but grazing should be used seasonally to control invasive nonnative herbaceous species and thatch buildup. The most appropriate period for allowing cattle grazing in ephemeral aquatic habitats appears to be during the aquatic phase of the habitats (i.e., when water is ponded); cattle should be excluded from vernal pools at the beginning of the drawdown period (i.e., when the water begins to evaporate). Reducing thatch through cattle grazing will contribute to pool inundation by improving water flow into basins, maintaining appropriate water levels, and thereby maintaining appropriate temperatures.

Once the pools have been stabilized on an effective grazing regime, consider introduction of spreading navarretia, little mousetail, and toothed downingia into vernal pool basins that support appropriate soil conditions for these introductions, specifically the northeastern vernal pool system and the vernal swale, on Placentia soils, and vernal pools on Bonsall and Bosanko clay soils elsewhere in the grasslands. Further refined studies will be required to determine which receiver pools have suitable conditions for the introduction of these species.

Monitoring targets

The monitoring program should focus on the following targets (Section 9):

- Water temperature and dissolved oxygen
- Vernal wetlands and watershed hydrology
- Indicator plant species (distribution, abundance)
- Indicator animal species (distribution, abundance)
    - San Diego fairy shrimp
    - Spadefoot toad
- Nonnative and invasive species (vernal wetlands and watersheds)

6. ALKALI PLAYAS

Scientific Background

Alkali playa ecology

The alkali playas in the Ramona Grasslands are different in origin and species composition than most alkali playas, sinks, or meadows described in the literature. Typically, alkali sinks are shallow drainage basins, associated with alkaline or saline soils high in soluble salts, which form during periods of high precipitation (Twisselmann 1967, Tiner et al. 2002). These basins are dominated by halophytic, or salt-tolerant, plant communities, often associated with desert scrub shrublands. Larger desert playas are relatively common in the Great Basin of Nevada and Utah, the Pacific Northwest (Crawford and Kagan 2002), the Southwest and Texas panhandle (Tiner et al. 2002), and in New Mexico (Wood and Muldavin 2000). Smaller alkaline depressions occur in the San Joaquin Valley (Bainbridge 2002) and Riverside County (County of Riverside 2002).

Alkali playas and vernal pools are often indistinguishable and difficult to differentiate (White 1994), although vernal pools receive water on a seasonal and more predictable interval than alkali playas. Alkali playas often undergo periods of less inundation, frequent and rapid evaporation, and subsequent excretion and accumulation of salts and minerals in the underlying soil strata. The soils (vertisols) in alkali playas tend to be poorly drained, irregularly inundated, and saline or alkaline, with relatively high electrical conductivity values and pH values ranging between 7.5 and 10. Multiple wet-dry cycles during one growing season are common (Tiner et al. 2002). Vegetation patterns in alkali playas are similar to those described for vernal pools. A unique flora develops in association with the moisture gradient, when water moves toward the center of the depression due to evaporation. Generally, saline playas are overwhelmingly dominated by saltgrass and *Atriplex* species.

Stressors

Alkali playa habitats are declining throughout their range due to habitat destruction and fragmentation from urban and agricultural development, pipeline construction, alteration of hydrology and floodplain dynamics, off-road vehicle activity, trampling by cattle and sheep, weed abatement, fire suppression practices (including disking and plowing), and competition from invasive plant species (Bramlet 1993, Roberts and McMillan 1997, USFWS 1998b). The effects of intensive grazing on alkali playas are not known. A variety of different *Atriplex* species have been used as cattle feed and are nutritionally valuable as browse for mule deer and pronghorn. Bermuda grass is capable of invading and outcompeting native species in alkali playas.

Management approaches

Grazing has been used to manage alkali playa systems associated with some *Atriplex* species, but the grazing response of the two rare *Atriplex* present in the Ramona Grasslands alkali playas is not known.

Existing Conditions

The following discussions are based on field reconnaissance of the former Cagney Ranch, Hardy property, Hobbs property, and WRI property by the Conservation Biology Institute (in fall 2003 and spring 2004). Detailed botanical surveys were conducted by Fred Sproul of WRI on the former Cagney Ranch, Hardy property and Hobbs property during the period April-July 2004 (Sproul unpublished data). In addition, CBI and Sproul mapped nonnative plants in areas of Oak Country Estates visible from Rangeland Road and on the portions of the Ramona Airport and Cummings Ranch visible from Montecito Road. Additional information were obtained from Ecological Ventures California, Inc. (2003), EDAW (2002, 2003a,b), EDAW and TAIC (2004), LaCoste (personal communication), PSBS (1989), and Westec Services (1980), which cover various portions of the Ramona Grasslands Preserve.

Hydrology, vegetation community, and stressors

Alkali playas, or alkali meadows, occur along the north side of Santa Maria Creek (Figure 11). Their origin may be associated with an ancient creek channel. They inundate in the winter months, though less frequently and for a shorter duration than vernal pools. Species composition of these areas includes Parish's brittlescale (*Atriplex parishii*), Coulter's saltbush (*A. coulteri*), dwarf peppergrass (*Lepidium latipes),* and vernal pool plantain *(Plantago bigelovii).* Saltgrass, alkali barley*,* and southern tarplant also occur in and around the depressions.

Bermuda grass has invaded the alkali playa community and is growing within *A. parishii* and *A. coulteri* hummocks, possibly outcompeting these rare (in San Diego County) plants.

Conservation targets

The *Atriplex* species in the Ramona grasslands (*A. parishii* and *A. coulteri*) have been found elsewhere in the Southwest but are rare in San Diego County (Appendix B). Parish's brittlescale was believed to be extinct until 1990 but has since been relocated in Riverside County. Coulter's saltbush is threatened with extinction throughout its range. Southern tarplant is also considered rare (CNPS 2001). Fairy shrimp have not been found during recent surveys of the alkali depressions.

Restoration and Management

Desired conditions

Little is known about the optimal function of the Santa Maria Valley alkali playas or the population dynamics of the *Atriplex* species and southern tarplant. The presence of these plant species despite historic cattle grazing indicates that some level of grazing is tolerated. Elimination of Bermuda grass should benefit these species. The relationship of the playas to adjacent vernal pools, the swale, and Santa Maria Creek is also not clear. Multi-year hydrologic studies of the playas, relative to Santa Maria Creek flows and adjacent vernal wetlands, may help to establish this relationship.

Restoration and management actions

Baseline botanical surveys should be conducted in the alkali playas to determine species composition, frequency, and density. Surveys conducted to date were qualitative and performed in a season with very low rainfall and after many of the herbaceous species were no longer present. Removal and control of Bermuda grass, through grazing, manual, or chemical methods, should benefit native species in the alkali playas. Prescribed fire and solarizing (i.e., killing the entire seed bank in the soil), followed by reseeding, should be considered as possible restoration approaches.

Monitoring targets

The monitoring program should focus on the following targets (Section 9):

- Water temperature and dissolved oxygen
- Water depth and relationships to other hydraulic systems (Santa Maria Creek and vernal pools/swale)
- Floral species (distribution, abundance)
- Indicator animal species (distribution, abundance)
  - San Diego fairy shrimp
  - Spadefoot toad
- Nonnative and invasive species (including watershed areas)

7. STREAM AND RIPARIAN COMMUNITY

Scientific Background

Stream and riparian ecology

Riverine ecosystems generally include both aquatic and riparian communities within a larger landscape matrix of upland communities. The aquatic system is usually flanked by a distinct riparian vegetation community that relies on surface flows or high groundwater along the stream corridor. Riparian communities thus occur along the channels, banks, and floodplains of rivers and streams and represent a transitional zone between aquatic and upland ecosystems (NRC 2002). In arid San Diego County, most riverine aquatic systems are naturally ephemeral, with surface flows restricted to periods of runoff during and following rains along all or portions of their length. Riparian communities are usually the most biologically rich and diverse portions of the landscape, due to the greater water availability and, hence, productivity relative to more extensive upland communities.

Riparian and riverine habitats have been widely eliminated or impaired by human development, agriculture, and water management activities throughout the arid western U.S. (Faber et al. 1989). In California, the State Water Resources Control Board (State Board) has authority over the conservation, control, and use of the state’s water resources and the responsibility for ensuring that these resources are protected for the use and enjoyment of California residents (California Water Code 2000). *Waters of the state* are defined as any surface water or groundwater, including saline water, within the boundary of the state.

The physical and chemical characteristics of watersheds largely determine water quality characteristics of the surface waters in riverine systems, as well as the nature of their aquatic and riparian biological communities. Flow pattern, stream gradient, channel substrate, water temperature, and water quality characteristics influence the species composition of riverine systems (Allan 1995, Ward 1998, Gasith and Resh 1999). Modifications of surface water characteristics are reflected in changes in the composition of riparian and aquatic communities. In fact, stream and wetland assessments routinely use biological metrics, such as benthic macroinvertebrate community composition indices, as water quality indicators (Karr and Chu 1999, Regional Board 2004).

The dynamics of river flow and associated fluvial processes (e.g., flooding, scour, deposition, channel meandering) affect the biological composition and structure of both aquatic and riparian communities. Riparian communities are adapted to the dynamic conditions found in fluvial systems and are thus resilient to disturbance. Flooding, erosion and sedimentation, and channel migration produce disturbances that remove areas of riparian habitat and provide the physical conditions necessary to establish new patches of habitat. For example, many riparian plant species require bare mineral soils, such as those deposited by receding floodwaters, to germinate (Faber et al. 1989, Stromberg 1993). Disturbance and colonization events in riparian habitats are patchy in their distribution, resulting in an ecosystem characterized by spatial mosaics of plant species composition, age, and physical structure. These habitat mosaics increase the overall habitat diversity for wildlife (Gregory et al. 1991, Shafroth et al. 1998). Modifying a stream's natural flow regime can result in changes in the habitats and species supported by the fluvial system (Poff et al. 1997).

Healthy stream corridors (including both aquatic and riparian components) provide numerous environmental services, including hydrological, biogeochemical, and habitat and food web functions (Christensen et al. 1996). The importance of these services, and the loss or degradation of riverine ecosystems, are a common focus of conservation and restoration efforts (Cairns 1995, Paul and Meyer 2001, NRC 2002). Healthy stream corridors provide bank storage of floodwaters and reduce discharge velocity, which reduces the potential for channel erosion and down-cutting. In addition to stabilizing channel banks and eliminating a source of sediment, slower flowing water carries less suspended sediment, and wetland and riparian vegetation traps sediment that falls out of suspension. Slower moving water also has more time to percolate into stream banks and can help to recharge groundwater basins.

Aquatic and wetland habitats are also characterized by complex biogeochemical processes, including extraction of dissolved nutrient compounds (e.g., nitrogen and phosphorus) from the water column and accumulation in plant and animal tissues, thus preventing or slowing their transport downstream. Riparian buffers, constructed wetlands, and biofiltration systems trap and retain sediments and nutrients and thereby can improve water quality of runoff from development projects. These are effective *Best Management Practices* for reducing nutrients in urban and agricultural runoff (Owens et al. 1996, Petry et al. 2002, Brown and Caldwell 2004). Therefore, conservation and restoration of streams, riparian and wetland areas, and streamside buffer zones are means to maintain and enhance water quality (e.g., NRC 2000, Center for Watershed Protection 2001).

The structural diversity of riparian habitats is reflected in the diversity of wildlife species they support. The ground cover, understory, and canopy of riparian habitats provide cover and foraging opportunities for wetland and upland species with differing habitat requirements.

Stressors

In addition to direct removal or alteration of riverine communities by human uses (e.g., development, water diversion, or channelization), water quality and the health of aquatic and riparian communities can be drastically affected by a variety of land uses. For example, excessive livestock grazing can impact stream systems adversely through vegetation removal, soil compaction, destabilizing channel banks, nutrient and bacterial input to watercourses, and transport of exotic plant propagules (seeds or vegetative parts that can establish new plants). Cattle tend to congregate in riparian areas (Belsky et al. 1999), and the effects of excessive cattle grazing on stream systems can dramatically alter stream hydrology, water quality, channel morphology, and wildlife habitat quality (see Belsky et al. 1999 for review).

Urbanization generally increases the area of impervious surfaces (e.g., roads, parking lots, buildings), which reduce rainfall infiltration, thereby increasing runoff rates and stream flows. Increased urbanization generally increases the magnitude of flood flows and, in areas where there is excessive irrigation of urban landscaping, stream base flow (Hirsch et al. 1990, Booth 1991, Paul and Meyer 2001, White and Greer in MS). These hydrologic changes can result in increased channel scour, channel geomorphic changes, and changes in vegetation composition.

Runoff from impervious surfaces and urban landscaping often carries oil and grease, nutrients, dissolved and suspended solids, heavy metals, and pesticides and fertilizers. Thus, water quality typically decreases from increasing levels of constituents associated with urban environments, as erosion and mobilization of sediment from elevated flood peaks increase (Klein 1979, Hirsch et al. 1990, Booth 1991, Center for Watershed Protection 2001, Paul and Meyer 2001). This increases the need for healthy wetland vegetation to help filter out these pollutants.

Management approaches

Riparian and wetland restoration can be implemented in an active or passive manner (NRC 2000). Active restoration involves elements such as bank stabilization, installation of water control structures, planting or seeding native species, and possible irrigation. Active restoration efforts to create wetland habitat in upland areas are often required by regulatory agencies such as the U.S. Army Corps of Engineers and CDFG to offset losses associated with the clearing or filling of wetlands or riparian habitats. Active restoration has the potential to produce quick responses but may not produce self-sustaining, functioning ecosystems, particularly where extensive grade changes or water control structures are required (Williams 1993, Goodwin et al. 1997, Tucker in prep.).

Passive restoration removes sources of stress, which allows the resilient riparian or wetland ecosystem to recover via natural processes (Kauffman et al. 1997). Passive restoration is considered by some to be the logical and necessary first step of any restoration program, and passive restoration of overgrazed stream corridors by excluding or restricting livestock is a common practice (Kauffman et al. 1997, NRC 2000). There are numerous examples of the rapid recovery of riparian habitats following exclusion of livestock from stream corridors (Elmore and Kauffman 1994, Hobbs and Norton 1996). Exclusion of cattle from the stream corridor has also been shown to reduce erosion and soil loss from stream banks (Owens et al. 1996). Restoration of riparian vegetation along a stream corridor improves water quality by slowing flow and retaining sediment and nutrients.

There is evidence that livestock grazing, under some management prescriptions, can have neutral or even positive effects for selected riparian characteristics or species. For example, studies on cattle ranches in New Mexico have documented a greater abundance of willow flycatchers breeding in riparian habitats that are grazed by cattle, under a progressive grazing regime, relative to those not grazed (Stoleson and Finch 2000). With progressive grazing, cattle are frequently rotated and excluded from riparian areas, except for all or portions of the dormant season of vegetation. Elmore and Kauffman (1994) and Hobbs and Norton (1996) suggest that periodic grazing by cattle can maintain riparian vegetation in a shrubby structure preferred by species such as the willow flycatcher. In the absence of grazing, riparian vegetation can mature to a more woodland structure. It is also possible that cattle grazing can maintain the open conditions required by arroyo toads, when dense riparian and wetland growth might restrict suitable habitat.

Managed grazing is also an effective tool for controlling nonnative herbaceous plant species in riparian habitats. Chemical applications are problematic near aquatic habitats. Controlled burns have been used for nonnative annual grass control, but implementing controlled burns is often limited by weather, firefighter resources, and the concerns of adjacent homeowners.

Protection and restoration of natural habitats in the watershed are effective ways to (1) prevent further urbanization, thereby eliminating future sources of water quality degradation; (2) eliminate sources of sediment; and (3) improve the quality of urban runoff, thereby improving downstream water quality.

Existing Conditions

The following discussions are based on field reconnaissance of the former Cagney Ranch, Hardy property, Hobbs property, and WRI property by the Conservation Biology Institute (in fall 2003 and spring 2004). Detailed botanical surveys were conducted by Fred Sproul of WRI on the former Cagney Ranch, Hardy property and Hobbs property during the period April-July 2004 (Sproul unpublished data). In addition, CBI and Sproul mapped nonnative plants in areas of Oak Country Estates visible from Rangeland Road and on the portions of the Ramona Airport and Cummings Ranch visible from Montecito Road. Additional information were obtained from Ecological Ventures California, Inc. (2003), EDAW (2002, 2003a,b), EDAW and TAIC (2004), LaCoste (personal communication), PSBS (1989), and Westec Services (1980), which cover various portions of the Ramona Grasslands Preserve.

Hydrology, vegetation community, and stressors

Santa Maria Creek on the former Cagney Ranch has a well-defined channel, 3-6 ft deep and 10-50 ft wide. Reaches of the stream channel show evidence of trampling by cattle. Santa Maria Creek flows only in response to storm events (ephemeral flow), and its channel geomorphology is generally maintained by bank-full discharges, which occur during floods of 1.5-3 year return intervals (Leopold 1994). Rainfall in San Diego County has high inter-annual variability. Large magnitude floods that occur at high return intervals are unpredictable and can significantly affect channel geomorphology, through heavy scouring and sediment transport that can recontour channel banks. Riparian vegetation along the stream is dominated by arroyo willow (*Salix lasiolepis*), with a few black willows (*Salix goodingii*), yerba mansa (*Anemopsis californica*), and mulefat (*Baccharis salicifolia*). Freshwater marsh species (e.g., *Carex* sp. and *Cyperus* sp.) grow at the western (downstream) end of the stream channel, i.e., west of Rangeland Road, which appears to be wetter than upstream areas. The channel substrate is largely sandy alluvium, except for its western end, which is finer, clayey material.

The Santa Maria Creek watershed management unit faces three principal stressors: (1) increasing urbanization in the watershed, (2) excessive cattle grazing, and (3) invasive nonnative plant species. These stressors can be responsible for reduced water quality and habitat quality within the Santa Maria Creek system.

Urbanization in the watershed. Increasing growth in the town of Ramona threatens to degrade downstream water quality of Santa Maria Creek as well as water quality of ephemeral aquatic habitats. Lake Hodges, which lies below the confluence of Santa Maria Creek and Santa Ysabel Creek, has been proposed by the San Diego Regional Water Quality Control Board (Regional Board) for Clean Water Act section 303(d) listing as an impaired water body, due to excessive color, nitrogen, phosphorus, and total dissolved solids. Much of the pollutant load originates from agricultural uses within the watershed, including extensive livestock use within the Ramona Grasslands, where cattle often graze within the creek bed itself. This affects levels of water pollutants both directly, e.g., from livestock urine and feces concentrated in or near stream channels, and indirectly, by removing wetland vegetation that otherwise serves to stabilize channel banks and filter out pollutants.

Cattle grazing. Grazing in some reaches of Santa Maria Creek has greatly reduced the biomass of riparian vegetation on the banks of the channel relative to upstream areas that are fenced from cattle. The sandy alluvial soils in the creek channel have been disturbed by cows moving to and from the channel, which has resulted in slumping of the channel banks, particularly in the vicinity of Rangeland Road. Cow feces are present in the stream channel and alkali playas adjacent to the stream. The presence of cattle in the channel, grazing on riparian vegetation and disturbing the channel banks, likely results in transport of sediments, nutrients, and fecal bacteria to downstream waterbodies. Vegetation removal and disturbance of the channel banks can reduce habitat quality for riparian and stream-associated wildlife species.

Invasive nonnative plants. Nonnative annual grasses, including filaree, wild oat, rip-gut grass, vinegar weed, Bermuda grass, and ragweed, threaten the integrity of the Santa Maria Creek watershed. In addition, artichoke thistle occurs in scattered patches throughout the Santa Maria Creek watershed (Figure 9). This species spreads rapidly and, if left untreated, could become highly problematic by changing the composition and structure of the grasslands and adversely affecting the conservation value of the grasslands. Scattered individuals of giant cane (*Arundo donax*) and tamarisk (*Tamarix* sp.) occur in the Santa Maria Creek channel. These species could also spread, crowd out native species, and eventually decrease habitat value.

Conservation targets

Improved water quality is a conservation target for the Ramona Grasslands Preserve. Water quality in Lake Hodges downstream of the Preserve is impaired due to excessive nutrients. In the Ramona Grasslands Preserve, nutrient sources include feces and urine of livestock, sediment (primarily phosphorus), and urban runoff. Restoration of Santa Maria Creek is expected to improve the quality of surface water leaving the Preserve.

A breeding population of arroyo toads has been documented in the western reach of Santa Maria Creek (USFWS 2003). Bill Hass has speculated that the hydrology of Santa Maria Creek upstream of Rangeland Road is not suitable for arroyo toads, but there is no evidence to support this contention (USFWS 2003). Because of the topography of the Santa Maria Valley, it is possible that groundwater elevations are higher in the western end of the valley and, therefore, provide more consistently suitable habitat for this species. San Diego County is experiencing a multi-year drought, and hydrology upstream of Rangeland Road may be suitable for arroyo toad breeding only in years of good rainfall. Restoration of riparian habitat in Santa Maria Creek may allow local recharge of the groundwater aquifer, which may improve arroyo toad habitat conditions upstream of Rangeland Road. Monitoring of this species, as well as vegetation composition and hydrology, is necessary to better understand the factors limiting arroyo toad distribution in the Santa Maria Valley.

The least Bell's vireo (*Vireo bellii pusillus*) has not been documented in the Santa Maria Valley, but the area has not been adequately surveyed to confirm absence of this species. A core population of vireos in the San Pasqual Valley to the north may provide a source of immigrants to Santa Maria Creek. Least Bell's vireos, and other neotropical migratory songbirds, are expected to benefit from restoration of riparian habitat in Santa Maria Creek, if canopy cover and dense understory cover develop. However, if riparian and wetland habitat becomes too dense within the stream corridor, there is a potential that arroyo toads could be excluded, even if hydrologic conditions are suitable. Highly controlled livestock grazing or mechanical vegetation management may be necessary to maintain open areas suitable for arroyo toad breeding and development.

Restoration and Management

Desired conditions

The restoration and management goals for the Santa Maria Creek riparian corridor are to (1) restore riparian and wetland vegetation communities within the creek corridor, and (2) manage the watershed of the creek to maintain its structural integrity. The management approach to meet these goals should strive to improve water quality by stabilizing channel banks in areas where elevated erosion is occurring, decreasing the potential for bank erosion, reducing sediment loads to downstream areas, and increasing opportunities for the retention of sediments and nutrients from upstream sources (Gregory et al. 1991, Owens et al. 1996, Petry et al. 2002).

Riparian and wetland restoration should also slow water velocities to allow groundwater recharge and enhance habitat quality for a variety of target resources, such as the arroyo toad, neotropical migratory songbirds, and grassland species that use the riparian area for cover, perching, and foraging (e.g., various raptors and small mammals).

Restoration and management actions

Removing sources of stress in the Santa Maria Creek watershed—future development, cattle grazing, and invasive nonnative plants—will allow restoration of the stream corridor. Protecting land within the Ramona Grasslands Preserve from future development is a critical action that will minimize future fragmentation, pollutant loading, and altered hydrology of the creek and adjacent wetlands. Therefore, the riparian corridor should be fenced to exclude cattle and allow the riparian habitat to recover. Managed grazing may be appropriate in the future, once riparian habitats recover, to maintain a desirable habitat structure and to maintain open areas suitable for arroyo toad breeding and development.

Aggressive nonnative plants, such as giant reed and tamarisk, should be removed immediately. Furthermore, exclusion of cattle from the stream corridor may also allow nonnative herbaceous species to increase in abundance. These species should be monitored and controlled as necessary.

Monitoring targets

Chemical, biological, and physical variables that should be monitored include (Section 9):

- Water quality
  - Suspended solids
  - Nutrients (nitrogen and phosphorus compounds)
  - Biological oxygen demand
  - Metals
  - Bacteria (fecal coliforms, *Enterococcus*)
  - Standard field measurements (temperature, dissolved oxygen, pH, etc.)
- Riparian vegetation
  - Species composition
  - Structure (e.g., cover, height, development of multiple vertical layers)
- Wildlife
  - Least Bell's vireo
  - Arroyo toad
- Physical condition and hydrology
  - Channel cross-sections
  - Stream discharge and velocity

8. PLANNING CONSIDERATIONS FOR PUBLIC ACCESS, TRAILS, AND MAINTENANCE

Public access to the Ramona Grasslands Preserve is appropriate in selected areas to provide opportunities for compatible recreational and educational activities, including hiking, bird-watching, biking, equestrian use, and picnicking. However, access should be restricted to designated trails and staging areas to preclude adverse impacts to sensitive resources via trampling and loss of vegetation, increased erosion from trail scars, and disruption of breeding activities. Off-road vehicle use and hunting are not compatible with maintaining preserve functions or with the residential nature of the surrounding area.

The County of San Diego Trails Program is preparing a Community Trails Master Plan that will describe corridors for an integrated public trails system, including areas within the Ramona Grasslands Preserve. This trails system eventually will be integrated into the Public Facilities Element of the County's General Plan 2020, and site-specific information will be used to established specific alignments.

This framework management plan does not propose specific trail alignments or staging areas within the Ramona Grasslands Preserve, but rather outlines considerations for future trail planning, once management priorities and prescriptions for natural resources have been established:

1. Conduct comprehensive natural and cultural resource surveys, develop adaptive management prescriptions, and install fencing prior to establishing detailed trail alignments or staging area locations. The results of these surveys, conducted as part of adaptive management of the Ramona Grasslands Preserve, will inform planning and placement of trails and staging areas. Public access areas should not interfere with the implementation of adaptive management prescriptions (e.g., herbicide applications, managed grazing, prescribed burning, etc.).

2. Use the results of the baseline surveys identifying sensitive resource areas and considerations from the development of initial adaptive management prescriptions to inform trail and staging area planning and placement. Trails and staging areas should avoid sensitive resource areas and make use of existing roads and disturbed areas at the edge of the Preserve for locating staging areas. Cover staging area surfaces with gravel or mulch to minimize erosion. Provide picnic facilities only at the staging areas and outside the Preserve.

3. Select trail alignments that avoid sensitive resources such as vernal pools, alkali playas, and riparian and stream habitats. Ideally, locate trails a minimum of 25 ft from these wetland habitats to minimize the potential for sedimentation. The Stephens' kangaroo rat is somewhat tolerant of disturbance; therefore, locating a trail within its habitat may be acceptable. Design trails to accommodate all user groups (e.g., hikers, bikers, equestrians) on a single trail.

4. Fence trails on both sides with appropriate materials (e.g., split rail fencing) to establish a clear trail corridor and to prevent users from leaving the established trail and creating *volunteer* trails. Because livestock will be using portions of the Preserve, fencing will also prevent public access to livestock areas. In addition, consider the operational needs of livestock managers when planning trail alignments and fencing (e.g., locations of gates to allow cattle to cross the trail). Inspect and maintain fencing regularly.

5. Cover trails with gravel or mulch to minimize erosion, and maintain them regularly. Prohibit the use of eucalyptus mulch that could suppress native plant growth adjacent to trails, and do not use materials for trail mulch that are a source of seed of invasive plant species.

6. Provide litter control measures, such as closed garbage cans and recycling bins, at access points to the Ramona Grasslands Preserve trail. Collect garbage frequently, and instruct trail users not to feed wildlife.

7. Install signs to educate, provide direction, and promote the sensitive use and enjoyment of the Preserve. Signs that explain public use rules are generally most effective at public entrances to the Preserve.

8. Prohibit lighting in the Preserve except where essential for public safety. Artificial lighting can adversely affect habitat values, particularly for nocturnal species. Along the Preserve edge, limit road lighting to low pressure sodium lights directed away from the Preserve.

9. Regularly monitor public use of the Preserve, and enforce all public use regulations.

9. ADAPTIVE MANAGEMENT AND MONITORING

Meffe et al. (2002) defined a *golden rule* of natural resource management: *Natural resource management should strive to identify and retain critical types and ranges of natural variation in ecosystems, while satisfying the combined needs of the ecological, socioeconomic, and institutional systems*. However, natural resource managers often have an imperfect knowledge of biological systems, their natural ranges of variability, and their anticipated responses to management actions. There are often significant uncertainties associated with formulating and implementing management actions to maintain ecosystem health or integrity, particularly in diverse and human-altered ecosystems such as the Ramona Grasslands. Adaptive management is the concept of treating natural resources management as an experiment, where responses of the system to management actions are observed and recorded, so that the manager can learn from the experience and alter future management actions as appropriate (Holling 1978, Walters 1986, Meffe et al. 2002). Adaptive management explicitly recognizes the gaps in our knowledge and understanding of ecosystems, the inherent uncertainties in land management, and the need for management to be flexible and informed by monitoring. Treating management as an experiment allows ecosystem responses to be evaluated through monitoring; and management actions can be adjusted accordingly, which increases our overall understanding of the natural variation of factors that contribute to ecosystem health or integrity.

Components of experimental design typically include controls and replication, randomization, and interspersion of treatments (Hurlbert 1984). However, in the Ramona Grasslands it will be difficult to design formal experiments for many target resources. For example, due to their distribution, it is not practical to construct enclosures around all vernal pools or vernal pool complexes to replicate even a single treatment/control experiment, let alone evaluate a variety of grazing intensity and timing treatments. However, comparing the responses of target resources to alternative management options, even if conducted outside the framework of a controlled experiment, can increase land managers' understanding of ecosystem variability and response.

Therefore, the objective of this framework plan is to establish biological goals for a workable and cost-effective management program for restoring the Ramona Grasslands ecosystem, with the understanding that an experienced rangeland manager will develop grazing prescriptions based on these goals. Grazing prescriptions will regulate the number of animals, seasonal timing, and duration of grazing within different biological communities. The desired biological responses to management actions may require many years to achieve. Thus, a long-term monitoring program will allow us to document the ranges of natural variation within the different grasslands communities and the ecosystem as a whole, as well as the differential responses to human-controlled management prescriptions.

Because of the distribution of resources, logistical constraints, and uncertainties regarding the optimal management approach for some communities (e.g., alkali playas), it is not practical to treat each community type as an individual management unit (i.e., a unit that will receive a specific management regime). For example, we identify similar goals, and thus similar grazing regimes, for vernal pools and clayey grasslands in the eastern portion of the Preserve. The eastern management unit can easily be fenced from the loamy grasslands management unit, thus allowing different grazing regimes in the two management units. However, due to their distribution, vernal pools and the vernal swale within the loamy grassland community will be subject to the same grazing regime as for the loamy grasslands. Therefore, it may be necessary for the rangeland manager to regulate grazing at a smaller scale within the management unit (e.g., use of temporary silt fencing or electric fencing).

The management actions outlined below integrate our current understanding of the biological requirements for target resources and the logistical considerations for establishing workable management units. Management units proposed for the Ramona Grasslands Preserve should be delineated with fences, which will allow livestock grazing regimes to be managed independently within each unit. This will also allow some experimentation of varying grazing pressures within the same biological community. Some management actions (e.g., nonnative plant eradication) will be implemented independent of management unit boundaries.

As more lands are conserved as part of the Ramona Grasslands Preserve, they will be added to the management program. The County Department of Parks and Recreation, which is responsible for management of the Preserve, may adapt specific management actions in response to changing environmental conditions.

Managed Grazing

The plan assumes that an experienced rangeland manager will develop grazing prescriptions based on the biological goals presented herein. Grazing prescriptions will describe the fencing, number of animals, seasonal timing, and duration of grazing within different biological communities and will be dependent on annual rainfall, which is highly variable in this semi-arid region. The relationship between the spatial and temporal distribution of cattle, rainfall, and the attainment of conservation goals is not currently known. Initial grazing prescriptions therefore will make an effort to quantify cattle distribution on a monthly basis so that effects can be assessed. Grazing regimes may then be modified as indicated by the monitoring results within an adaptive management paradigm.

Proposed management units in the Ramona Grasslands Preserve (Figure 12) differ with respect to timing and intensity of grazing. The grazing regimes that are initially proposed for these units are summarized in Table 4. Management units should be delineated with three-strand barbed wire fencing, electric fencing, or other fencing appropriate for retaining cattle.

Table 4. Summary of grazing regimes by management unit.

Management Unit	Grazing Regime
Unit 1 Riparian corridor	Remove grazing to allow restoration of riparian vegetation. Once riparian vegetation recovers, use limited grazing during dormant season to control weedy exotics, control vegetation density and structure, and maintain open areas for arroyo toads.
Unit 2 Loamy grasslands	Moderate to heavy grazing to maintain open, forb-dominated grasslands (20-50% bare ground and a forb/grass ratio ≥ 2).
Unit 3 Clayey grasslands	Wet-season grazing when exotic weed growth is most active (November-April, depending on rainfall and temperature) to reduce vegetation density and thatch and control weedy exotics. Remove grazing at the beginning of the drawdown period of vernal pools during period of native forb growth (May-October).

Management unit 1—riparian corridor

The entire stream and riparian corridor should be fenced to initially exclude grazing from this unit and allow recovery of riparian and wetland habitats (management units 1A-1D). A stratified riparian canopy with a dense, shrubby understory layer within 3-6 ft of the ground will likely require 5+ years to achieve a condition suitable for neotropical migratory bird species (USFWS 1998a) and some raptors. After this time period, limited grazing during the dormant season of riparian vegetation should be allowed to control vegetation density and structure, to control nonnative herbaceous species, and to maintain open areas for arroyo toads. Arroyo toads are rarely found in areas with closed canopies of riparian vegetation (USFWS 1999); they require an open channel in areas of high water tables.

Restoration of the Santa Maria Creek corridor will be accomplished by constructing fencing along both sides of the creek corridor, at the top of the channel bank, at least 20 ft from the edge of the channel.

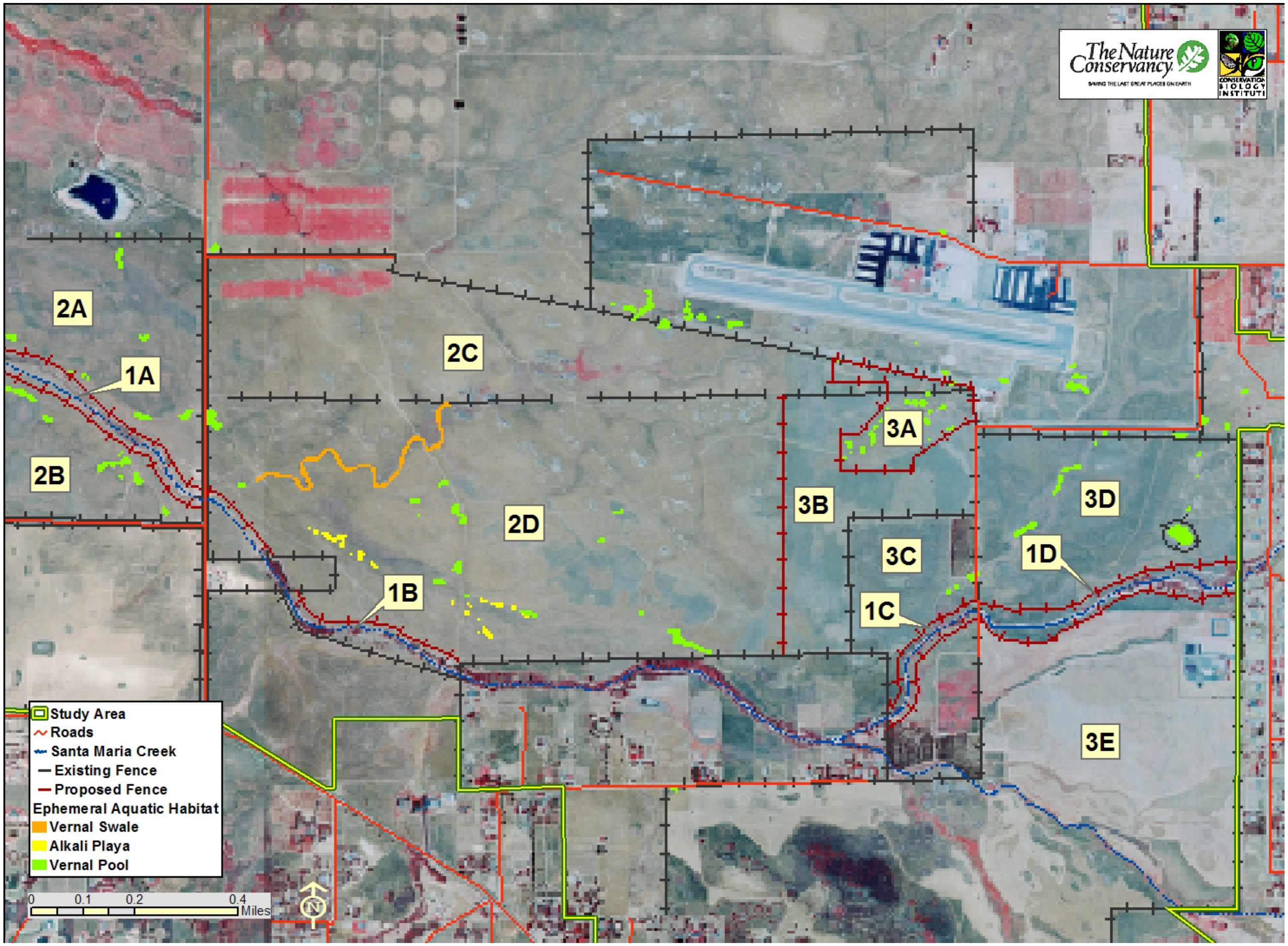

Figure 12. General location of existing and proposed fencing and proposed management units for the core grasslands area.

Four reaches of Santa Maria Creek (generally divided by ownership boundaries) will be fenced (Figure 12).

Reach A (west of Rangeland Road)—This reach is approximately 4,000 ft long. Fencing will be constructed along both sides of the creek corridor for a total of approximately 8,000 ft. of fencing.

Reach B (Rangeland Road, east to Voorhes Lane properties)——The length of this reach is approximately 3,200 ft. Reach B has already been fenced along both sides of the creek corridor. WRI installed the northern fence in the spring of 2004, with assistance from TNC. The portion of Reach B that crosses the Voorhes Lane properties has existing fencing that prevents cattle from accessing these properties.

Reach C (Hardy Ranch)—The length of this reach is approximately 1,600 ft. Fencing will be constructed along both sides of the creek corridor for a total of approximately 3,200 ft. of fencing.

Reach D (Cummings Ranch)—This reach is approximately 2,900 ft. long. Fencing will be constructed along both sides of the creek corridor for a total of approximately 5,800 ft. of fencing.

Management unit 2—loamy grasslands

Management Unit 2 comprises the majority of the loamy grassland community, which supports Stephens' kangaroo rats and foraging habitat for ferruginous hawks. This unit is subdivided into four areas (A-D), delineated by existing fences and proposed fences that define the riparian corridor (unit 1). The existing grazing regime in this management unit appears suitable for maintaining habitat quality for these target species, i.e., 20-50% bare ground and a forb/grass ratio ≥2 (Spencer 2003).

Each of the four subunits also supports vernal pools, the vernal swale, and/or alkali playas. These ephemeral aquatic communities may require community-specific management actions, which could include temporary fencing, and therefore should be closely monitored to ensure protection of target resources. The existing fences will allow rotation of livestock and some experimentation with grazing pressure between and among subunits.

Management unit 3—clayey grasslands

Management unit 3 comprises the majority of the clayey grassland community, which supports vernal pools and remnant native grasses and forbs. This unit is subdivided into five areas (A-E), delineated by existing fences, proposed fences that define the riparian corridor (unit 1), and a proposed fence between units 2 and 3, along the western perimeter of the clay soils (Figure 12). The proposed fence between units 2 and 3 is approximately 2,700 ft. Subunit 3E is currently used for agriculture.

Subunits 3A, 3C, and 3D support vernal pools. Grazing will be allowed annually in these subunits during the early aquatic phase of the vernal pools, when nonnative annual plants are dominant and before they set seed. We anticipate grazing during the period November to April, but the precise timing will depend on rainfall and temperature within a given year. Cattle should be rotated out of vernal pool areas at the beginning of the drawdown period of the pools. The objective of this grazing regime is to minimize the abundance and cover of nonnative annual species, reduce the amount of thatch, and maximize the abundance and cover of native species.

The clayey grasslands in units 3B and 3E may require a longer grazing period to effectively control nonnative plant species. The goal for these subunits is to increase the cover of native grass species. This is likely best accomplished with light to moderate, wet-season grazing that reduces cover of nonnative species and thatch. Controlled burns may also be an effective tool in native grassland restoration. The existing and proposed fences will allow rotation of livestock and some experimentation with grazing pressure and use of prescribed fire between and among subunits.

Eradication of Perennial Nonnative Plants

Locations of giant cane and tamarisk have been mapped for that portion of the Santa Maria Creek corridor currently within the Ramona Grasslands Preserve. Surveys for these and other invasive species should be conducted along the entire length of the creek corridor through the grasslands, and the individual plants should be removed by hand or using chemical treatments (Bossard et al. 2000). The limited number and small size of giant cane and tamarisk currently known within the Ramona Grasslands Preserve could probably be eradicated by hand.

Artichoke thistle is a large threat to the integrity of the Santa Maria Creek watershed. As cows do not eat artichoke thistle, aggressive chemical treatment is appropriate for this species. Eradication should be conducted over a much of the infested area in the Grasslands as possible. Eradication will require as long as 5+ years (Kelly 2000). Recommended herbicides include clopyralid (e.g., Transline®) and glyphosate (e.g., Roundup Pro® or Rodeo®). Chemical treatments using 2% glyphosate (as Roundup®) in a foliar application can be 95-98% effective (Kelly 2000). Clopyralid, a broadleaf-selective herbicide, should be used while artichoke thistle is in the rosette stage and should not be used after May 1. It is recommended that the pre-emergent herbicide sulphuron (e.g., Telar®) be included in the herbicide solution. Only EPA-approved, glyphosate base, systemic herbicides (e.g., Rodeo®) should be used when applying herbicides within 100 ft of a natural watercourse or body of water. Glyphosate is a non-selective herbicide that works against both broadleaf weeds and grasses. Glyphosate application must be implemented during artichoke thistle's bolting stage, without harming non-target, native species. Clopyralid should not be used on sites where movement through soil (e.g., loamy sand or sand) could contaminate ground water. Chemicals should be applied during the period from mid-February to June. Controlled burns may enhance the effectiveness of chemical treatment.

One stand of intermediate wheatgrass (*Elytrigia intermedia)* was mapped within the preserve. While this plant is not on the California Invasive Plant Council list, it is not native and should be removed.

Controlled Burning

Prescribed fire can benefit certain communities by promoting habitat suitability for some native animal species or increasing the competitive advantage of some native plant species (Menke 1992, O'Farrell 1997, Pollak and Kan 1998, Wills 2000, Keeley 2001, Harrison et al. 2002, Spencer 2002, O'Farrell 2003, Reiner personal communication). The timing of burning will depend on the specific management objectives. TNC has had success with native grassland restoration by using spring burns (Reiner personal communication), while Harrison et al. (2002) noted increased abundance of native grasses relative to nonnative grasses on serpentine soils following a fall burn. Controlled burning may be an appropriate element of habitat management within the Ramona Grasslands Preserve, either in conjunction with other actions (e.g., managed grazing) or as an independent action. However, implementing controlled burning in the Ramona Grasslands may be problematic because of visibility concerns at the Ramona Airport and regional air quality issues.

Habitat Restoration

Managing the Ramona Grasslands to reduce stressors will result in restoration of native communities in the Preserve. Native plant species represented on the Preserve or in the seed bank are assumed to provide an adequate source of propagules to recolonize habitats once suitable conditions have been restored through management. However, active restoration may be necessary if, after some period of management, communities do not respond or respond more slowly than desired.

Riparian corridor

Active restoration may be desirable to *jump-start* recovery of the riparian habitat along Santa Maria Creek or to introduce species not adequately represented in the recovering community. Surveys in other non-grazed reaches of the creek should inform decisions on species introductions. Desirable species can be introduced via cuttings, containers, or seeding.

Clayey grasslands

Remnant native grasses occur in clay soils, particularly in management unit 2. Once the nonnative annual species have been controlled via grazing, other management approaches should be considered to maximize native species composition in the clayey grasslands, such as controlled burning or selected plantings of native grasses and forbs.

Vernal wetlands

If the vernal pools and vernal swale do not support target species once stressors have been minimized via grazing management, controlled burning, or other management approaches, introduction of spreading navarretia, little mousetail, and toothed downingia should be considered. Vernal pool basins that support appropriate soil conditions for these introductions are likely candidates for reintroductions, i.e., the northeastern vernal pool system and the vernal swale system on Placentia soils, and vernal pools on Bonsall and Bosanko clay soils elsewhere in the grasslands. Further studies will be required to determine which receiver pools would be appropriate for the introduction of these vernal pool species. For selected vernal pools (e.g., the unvegetated pool and pools that have been subjected to intensive weed abatement in management unit 3D), salvage biota and use for restoration of candidate pools in the Preserve. Ensure purity of salvaged material before inoculation of the receptor/restoration sites.

Long-term Monitoring Program

Monitoring the responses of the natural resources to the management actions will inform management decisions on modifying the prescriptions, recognizing that the desired biological responses to management actions may require many years to achieve. The initial monitoring program will be used to characterize the range of baseline conditions for each conservation target and to differentiate which conditions best characterize the target at its *healthiest* or most *natural* state (TNC 2002). Monitoring *indicators* will be measured to assess the existing state of the target resource and whether and how management is pushing it toward a desired state. As defined by TNC (2002), *integrity thresholds* will be identified as hypotheses, based on the acceptable and optimal ranges of variation in each target's key ecological factors. These will be refined as new information is collected through the monitoring program. This section identifies some indicators and potential integrity thresholds for conservation targets, with the understanding that these will be refined based on expert input and monitoring results.

The objectives of monitoring are to

- Document the ranges of natural variation within the different communities (i.e., baseline conditions),
- Collect and continuously update information that will inform adaptive management and grazing prescriptions (e.g., reduction in nonnative grass biomass),
- Measure the success of the nonnative plant species removal and restoration program.
- Measure changes in physical condition and hydrology of the creek and ephemeral aquatic habitats.
- Track the distribution and abundance of conservation targets.
- Track the distribution and abundance of nonnative animal species.

As part of initiating the monitoring program, it is proposed that a detailed manual be developed to implement the recommendations herein. The manual will be coordinated with specific grazing prescriptions developed for the Grasslands. The protocols recommended in this Framework Plan will require field refinement to determine specific locations for sampling, number of monitoring stations, monitoring schedule, and sample data collection forms. This information, along with the expected range of parameters that may serve as "trigger points" or thresholds for initiating for recommended management actions, will be included in the manual, which will be completed in 2005.

As more lands are conserved and become part of the Ramona Grasslands Preserve, they will be added to the monitoring and management program.

Preserve-wide

1. <u>Vegetation communities</u>. Delineate and characterize vegetation communities across the Ramona Grasslands Preserve, including vegetation structure, species composition, and level of disturbance. Map the distribution and abundance of nonnative plant species that should be removed or controlled. Update the vegetation map every 3-5 years or after

significant events, such as flooding, fire, or altered grazing regime. In addition, establish a series of photo-monitoring points across different vegetation communities in the Preserve to document changes in vegetation cover and structure.

2. Nonnative animal species. Annually survey for bullfrogs, cowbirds, and other nonnative animal species, by walking through suitable habitat and mapping their distribution and relative abundance.

Riparian corridor

1. Water quality. Annually monitor upstream and downstream of the Ramona Grasslands Preserve to determine the retention of water quality constituents. Establish monitoring stations at (a) the upstream end of the Ramona Grasslands near the interface with the urban area of Ramona, and (b) Rangeland Road. Sampling frequency is defined in the Santa Maria Creek Restoration Water Monitoring Quality Assurance Project Plan (City of San Diego Water Department 2004). Analyze samples for suspended solids, nutrients (nitrogen and phosphorus compounds), biological oxygen demand, metals, and bacteria (fecal coliforms, *Enterococcus*). At each monitoring event, collect standard field measurements (temperature, dissolved oxygen, pH, etc.) and benthic macroinvertebrates. Use macroinvertebrate composition indices as indicators of water quality, following the California Stream Bioassessment Procedure (CDFG 2003).

2. Vegetation. Within the stream corridor, establish permanent vegetation transects perpendicular to the river channel. Collect quantitative data on species composition and structure (e.g., cover, height, development of multiple vertical layers) along each transect. Measure foliage volume at 1-m height intervals within 2 x 2-m plots, and identify species contributing to the foliage volume. Quantify recruitment of woody riparian tree and shrub species within each 2 x 2-m plot, and measure heights and girths for the dominant riparian tree and shrub species along each transect. Monitor annually for the first 5 years after excluding cattle; thereafter, reevaluate sampling frequency based on the grazing management regime.

3. Wildlife. Monitor arroyo toads and riparian birds in the stream corridor annually to assess their distribution and relative abundance. Conduct surveys for arroyo toads according to standard USFWS survey protocols. Record locations of adults, egg masses, tadpoles, and juveniles.

   Survey for riparian birds along systematic survey routes, such that all portions of the riparian habitat can be monitored. Identify species using the habitat and their relative abundance, and quantify the number of nesting pairs of any sensitive riparian bird species (e.g., least Bell’s vireo, southwestern willow flycatcher, yellow-breasted chat, Cooper’s hawk) using the habitat for nesting. Conduct surveys at varying times of day between visits. Monitor the stream reach three times during January through mid-March, with at least a 7-day interval between site visits. Begin surveys within 1 hr after sunrise and end by noon. Do not survey under extreme conditions, i.e., during heavy rain or when the temperature is >95°F or <40°F or with winds >10 mph. Use taped vocalizations, as needed. Map the territories (singing males) and nest locations, and record the nest fate, i.e., determine number of eggs laid, nest parasitism rates, eggs or nests lost to nest predators, and number of chicks fledged.

4. Physical condition and hydrology. Measure the physical dimensions of the channel and substrate composition along a series of cross-sections. Establish cross-sections at the same locations used for vegetation transects. Record substrate characteristics (e.g., fines, sand, gravel, etc.) at five points along each transect, at 0%, 25%, 50%, 75%, and 100% of the stream cross-sectional distance. Measure the depth of the channel at 1-m intervals along the transect. Measure channel cross-sections during periods of surface water flow, if possible, so that stream discharge and velocity can be assessed. Measure stream discharge and velocity at a single transect. Coordinate monitoring frequency with vegetation monitoring (#2 above).

Grasslands

1. Vegetation. Collect quantitative data on vegetation species distribution, abundance, composition, and structure (e.g., cover, height, amount of thatch), using randomly allocated 1-m^2 quadrats, randomly distributed throughout the grasslands. Record percent vegetative cover (categorized by native vs. nonnative species cover), species abundance, and amount of thatch for each quadrat. Quadrat size may need to be adjusted based on the results of initial monitoring studies.

2. Stephens' kangaroo rats. During the dry, late-summer season (July–October), conduct annual surveys to map distribution and relative abundance of Stephens' kangaroo rats, based on burrow density (using methods described in Spencer 2002, 2003). Use burrow counts on standardized grids coupled with live-trap population sampling to quantify species abundance (O'Farrell 1992b, 2003; Spencer 2003, Diffendorfer and Deutschman 2002). Quantify documented correlations between Stephens' kangaroo rat abundance and habitat characteristics to refine management actions under the adaptive management program. This approach is described below. In addition, note changes in habitat quality or other notable changes.

   Burrow density plots. Use transect sampling plots established within each sampling area to obtain quantitative estimates of the number of burrows per area and to correlate burrow counts with population densities (O'Farrell 1992). Count all active Stephens' kangaroo rat burrows within a 3-m swath along one side of each transect line (i.e., the total number of burrows within 1,620 m^2 of survey area) and convert to burrow density estimates (number of burrows per hectare). Active burrows are holes free of detritus or spider webs, showing obvious signs of ingress or egress by kangaroo rats, or containing kangaroo scat in or near the entrance. Convert burrow densities to population density estimates using a linear regression analysis of burrow density versus population density estimated from trapping results (O'Farrell 1992).

   Periodic trapping for population estimates. Conduct capture-mark-recapture trapping to estimate Stephens' kangaroo rat numbers and densities on the transect plots. Correlate these estimates with results of the burrow counts, vegetation quadrats, and reconnaissance surveys for extrapolation to other areas and to the Preserve as a whole. Trapping should be of sufficient intensity and duration to reliably estimate resident population sizes using density estimation software (e.g., program CAPTURE), the O'Farrell's (1992) border strip adjustment method, or other suitable method approved by USFWS. Correlate density estimates with burrow counts using linear regression. This will allow long-term monitoring to rely on burrow counts (without trapping) once a statistical correlation is established. This will also allow extrapolation of total population and carrying capacity estimates on the Preserve.

Trapping shall generally follow USFWS protocols for trapping Stephens' kangaroo rat, including the following considerations:

a. Place Sherman live traps (modified to prevent accidental tail amputation) at 15-m intervals along the transects, and bait with mixed birdseed or rolled oats. To optimize trap success, place traps near an active burrow, trail, or dust bath, if such a feature is found within 5 m of the trap station.

b. Set traps (opened) at dusk, and check at least twice nightly (once near midnight and once at dawn). Close traps during daylight. To avoid harm to captured animals, do not set traps during periods of inclement weather (e.g., rain, heavy dew, or heavy fog) or when the ambient temperature may drop below 2^{o}C (36^{o}F).

c. Mark captured animals (i.e., for individual identification) using ear tags, PIT tags, or another method approved by the wildlife agencies. Record standard biological measurements (e.g., sex, age, reproductive condition, and body weight).

d. Continue trapping until an asymptote in newly captured animals is reached, or a majority of marked animals are recaptured at least once. Trapping is expected to be conducted for 5 consecutive nights on a plot, unless results indicate that more or fewer nights are necessary for accurate estimates.

There has been discussion in recent years of standardizing all Stephens' kangaroo rat population and habitat monitoring throughout the species' range, perhaps based on recommendations of Diffendorfer and Deutschman (2002). These recommendations are generally consistent with the standardized grid methods currently in use on the Ramona Airport property and recommended above, but no final design has yet been adopted by the USFWS. The Ramona Grasslands monitoring program should strive to be consistent with regional recommendations, if and when they are finalized.

3. <u>Raptors</u>. Annually monitor raptors to assess their distribution and relative abundance. The Wildlife Research Institute has a long record of monitoring raptor abundance in the grassland areas (with some restrictions due to limited access to private properties). These efforts should be continued systematically each year on conserved lands and along roads.

Vernal pools and swale

1. <u>Water characteristics</u>. Annually monitor changes in water characteristics in response to management actions. Collect data within the swale and a sample of pools from different portions (e.g., different management subunits) of the Ramona Grassland Preserve. Monitor monthly during the aquatic phase of the pools. Analyze samples for water temperature and dissolved oxygen.

2. <u>Hydrology</u>. Monitor water depth weekly within the swale and a sample of pools from different portions of the Ramona Grassland Preserve (e.g., different management subunits)

on an annual basis. Install two staff gages—a *deep* staff at the deepest point in the pool and a *shallow* gage. If the pool is fairly uniform in depth, only one gage is needed. Record water depth to the nearest 0.10 m at each staff gage. These data will allow determination of the following metrics: total number of days inundated, maximum number of days continuously inundated, average depth, variability of depth, and number of times the pools fill and recede each wet season. In general, the range and coefficient of variation of the hydrological parameters are more meaningful as a comparative measure for pools than the mean.

3. Vegetation. Within the swale and a sample of pools from different portions of the Preserve (e.g., different management subunits), collect data annually on vegetation species composition and cover, using permanent transects. Randomly assign the locations of transects each year. Establish two transects within each pool or swale, perpendicular to one another. Transects should extend from the deepest portion of the pool to the edge of the upland habitat. Use 1 dm^2 quadrats to sample vegetation every 1 m along each transect, and record percent vegetative cover (categorized by native vs. nonnative species cover) and species abundance for each quadrat. Quadrat size may need to be adjusted based on the results of initial monitoring.

4. Fauna. Annually monitor the abundance and distribution of San Diego fairy shrimp and amphibians in the swale and all vernal pools. Record the presence of amphibian adults, egg masses, larvae, and subadults throughout the aquatic phase of the pools. Also collect San Diego fairy shrimp at 2-week intervals throughout the aquatic phase of the pools to determine their distribution and whether they are successfully completing their life cycles.

Alkali playas

The ecology of alkali playas in the Ramona Grasslands Preserve is not well understood. Monitoring should initially focus on developing a better understanding of the functions of these systems. The monitoring program for alkali playas should be revisited after initial monitoring efforts. Conduct monitoring annually within a sample of alkali playas from different portions of the preserve (e.g., different management subunits).

1. Water characteristics. Monitor annually in response to management actions by measuring water temperature and dissolved oxygen monthly within all playas, during the aquatic phase.

2. Hydrology. Install two staff gages in each playa—a *deep* staff at the deepest point and a *shallow* gage. If the playa is fairly uniform in depth, only one gage is needed. Record water depth to the nearest 0.10 m at each staff gage, and estimate areas of the pool at each depth. Monitor weekly. These data will allow determination of the following metrics: total number of days inundated, maximum number of days continuously inundated, average depth, variability of depth, and the number of times the alkali playas fill and recede each wet season. In general, the range and coefficient of variation of the hydrological parameters are more meaningful as a comparative measure than the mean.

3. Vegetation. Collect quantitative data on vegetation species composition and structure using permanent transects. Randomly assign the locations of transects each year. In each

playa, establish two vegetation transects, perpendicular to one another, extending from the deepest portion of the pool to the edge of the upland habitat. Use 1 dm^2 quadrats to sample vegetation every 1 m along each transect, and record percent vegetative cover (categorized by native vs. nonnative species cover) and species abundance for each quadrat. Quadrat size may need to be adjusted based on the results of initial monitoring.

4. Fauna. Annually monitor the abundance and distribution of San Diego fairy shrimp and amphibians in the alkali playas. Record the presence of amphibian adults, egg masses, larvae, and subadults throughout the aquatic phase of the playas. Also collect San Diego fairy shrimp at 2-week intervals throughout the aquatic phase of the playas to determine their distribution and whether they are successfully completing their life cycles.

Data Management and Reporting

A data management system should be developed to store, manage, and analyze baseline data collected for the Ramona Grasslands Preserve, including both maps and quantitative monitoring data. The data management system should be compatible with the subregional Natural Community Conservation Planning (NCCP) database structure being developed by the wildlife agencies and should include the baseline Geographic Information System (GIS) map data for annual updating. The base map used for this management plan can serve as the base map for updating spatial biological data. Monitoring data collected to track the responses of resources to initial management and restoration actions should be incorporated into this database every year, so that the success of management and restoration activities can be assessed.

A record of habitat management and monitoring activities should be maintained to assist in evaluating changes in resource status, responses to management actions, and the success of restoration actions. The record will also assist in updating the habitat management and monitoring plan, as needed. Resource status should be reviewed annually to inform the next year’s reserve management activities. Funding for the next year's reserve management activities should be prioritized, and a budget should be prepared for the prioritized list of proposed management and monitoring actions for each year.

The County of San Diego Department of Planning and Land use will include an annual summary of management and monitoring activities at the Ramona Grasslands Preserve in its North County MSCP annual report.

Management, Monitoring, and Maintenance Priorities for 2005-2006

The following tasks should be prioritized for implementation within the next 2 years. Ideally, all County of San Diego managed lands and any privately managed open space in the Ramona Grasslands should be integrated into this adaptive management and monitoring program, so as to increase coordination and efficiency of management activities and maximize the adaptive learning potential.

1. Collect biological baseline data to develop initial adaptive management prescriptions, refine biological monitoring protocols, and establish monitoring locations, and begin implementing management and Year 0 monitoring in 2005.

2. Initiate eradication program by December 2004.

3. Conduct ongoing litter control, enforcement, and maintenance, starting in Spring 2005.

4. Establish hydrologic and hydraulic baseline of Santa Maria Creek during 2005.

5. Document existing grazing regime by December 2005. Using this information and the results of Year 0 monitoring, develop initial grazing prescriptions to be described in the Area Specific Management Directives for the Ramona Grasslands, and begin implementing in 2006.

6. Construct fencing by December 2005. Manage livestock according to the management plan and grazing plan in 2006.

7. Develop a strategy to coordinate involvement of experts and selected stakeholders, e.g., County staff, Ramona community groups, local ranchers, and biologists, by December 2005.

8. Once the distribution of sensitive biological resources is fully understood, and the management required for the long-term protection of those resources is understood and implemented, identify public access opportunities that would be compatible with the persistence of those resources and the management they require. Determine trail and staging area alignments by December 2005.

9. Establish research programs with area universities and monitoring collaboratives with community groups and nonprofit organizations.

10. Explore regional strategies for integrating rangeland management and conservation, such as rotational grassland management experimentation, grass-banking, and grass-fed beef niche markets.

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APPENDIX A

CASE STUDIES IN GRASSLANDS MANAGEMENT FOR STEPHENS' KANGAROO RAT

O'Farrell (1992, 1997) conducted two replicated experiments comparing alternative habitat treatments to benefit Stephens' kangaroo rat populations at the Lake Mathews Ecological Reserve (2-year study) and Shipley/Skinner Reserve (5-year study) in Riverside County. Grazing (the predominant pre-reserve land use) was apparently not a treatment option in either study due to water quality concerns at nearby reservoirs. In both studies O'Farrell performed four replicates each of three treatment types (plus untreated controls): (1) burn, (2) disk-and-drag, and (3) combined burn/disk-and-drag. Disk-and-drag involved dragging an adjustable disk unit behind a tractor, with the disk spacing partly or completely closed to accomplish a surface disturbance (<3 in. deep) without destroying burrows.

In the Lake Matthews study, burn treatments promoted increased annual forb abundance and dramatic increases in Stephens' kangaroo rat populations the year after treatment. The other two treatments actually inhibited Stephens' kangaroo rat population growth relative to control plots, which O'Farrell attributed to the promotion of dense annual grasses (rather than forbs) by the disk-and-drag treatment, and perhaps deleterious subsurface effects to soils or burrows.

This short-term, positive response following fire at Lake Matthews should be tempered by results from the longer-term study at Shipley/Skinner. There, all treatments were initially implemented in September 1991, but the treatment schedule was somewhat thwarted by (1) inability to fully burn two treatment plots due to overly moist fuels, and (2) a wildfire that swept over most of the plots in October 1993, before the monitoring program was completed. The results were nevertheless informative. There was a dramatic increase in Stephens' kangaroo rat densities for all treatments in the initial year following treatment, especially on burn plots. Untreated control plots also experienced lesser increases. However, by the second post-treatment year, densities plummeted to below the baseline level, with decreases more severe for all treatment types than for controls. O'Farrell attributed the decrease to an increase in vegetation density the second year following treatments. The 1993 wildfire again resulted in dramatic increases in Stephens' kangaroo rat populations the following year, but by the second year (1995), densities had once again declined precipitously. These *boom-and-bust* fluctuations were also complicated by inter-annual variations in precipitation.

O'Farrell (1997) concluded that, provided grazing was not a management option on the reserves, rotational use of prescribed fire was the preferred option of those tested, but that burning would need to be repeated frequently, depending on precipitation patterns. For example, if there were 2 consecutive years of above-average rainfall after a burn, another burn would be required to restore suitable habitat conditions.

Wayne Spencer and others have studied the population of Stephens' kangaroo rat on the Ramona Airport property since its discovery in late 1997 and have looked at the effects of cattle grazing, horse grazing, prescribed fire, and some mechanical disturbance methods to create or maintain suitable habitat condition. Observations strongly reinforce many of O'Farrell's conclusions about optimal habitat characteristics and vegetation management methods, and suggest that cattle grazing is the most effective method for long-term habitat maintenance.

Differences in vegetation composition and structure, and in Stephens' kangaroo rat population, are striking along fence lines separating grazed and ungrazed fields at the airport (Photos A-1 and A-2). For example, Stephens' kangaroo rats have been virtually absent from dense vegetation inside the runway safety zone (where grazing is not allowed and vegetation is periodically mowed), although immediately adjacent grazed areas support healthy populations. One previously ungrazed area was burned in November 2001 to improve habitat for Stephens' kangaroo rats prior to release of kangaroo rats removed from a construction zone and held in captivity until the spring of 2002. A grid was also raked and leveled within the burn area to remove unburned duff, expose mineral soils, and level an otherwise rugged surface for easier travel and foraging, as kangaroo rats are not well adapted to navigating rugged terrain. Habitat conditions were excellent on the burned/raked plot by time of the release. Not only did released Stephens' kangaroo rats remain on the improved plot and reproduce, but additional animals moved onto the release site from adjacent habitat areas, resulting in that plot having the highest Stephens' kangaroo rat density ever recorded on the airport property during summer-fall of 2002. Animals were also clearly attracted to the raked and leveled grid paths. However, by summer 2003, O'Farrell retrapped the site and found greatly increased vegetation density and reduced population size on the plot. Although the area was supposed to be grazed by cattle after the Stephens' kangaroo rat burn and Stephens' kangaroo rat release, to maintain habitat condition, stocking rates were lower than recommended, and vegetation greatly increased in density a year later (Selinger personal communication, O'Farrell 2003).

These observations reinforce O'Farrell's findings in Riverside County that prescribed burns have short-term (1-year) positive effects on habitat value and Stephens' kangaroo rat densities, in a *boom-and-bus*t dynamic, and hence need to be conducted frequently to be a successful management technique. Grazing, on the other hand, maintains habitat quality on a more continuous basis. Moreover, at least on the airport property, frequent burning is not a favored option due to smoke and other safety concerns from prescribed fires (Selinger personal communication.).

Desired Conditions

Figures A-1 and A-2 illustrate relationships between proportion of bare ground and the forb/grass ratio during late summer in a dry year (2001) and a relatively wet year (2002) at the Ramona Airport (Spencer 2003). (Note that thatch abundance is highly inversely correlated with percent bare ground and hence may be redundant as a monitoring indicator.) These results support observations by O'Farrell (1992, 1997, 2003) that Stephens' kangaroo rats reach higher densities in areas of high forb/grass ratios and abundant bare ground in summer, but the exact relationship varies with annual rainfall patterns. In a dry or average rainfall year, the desired condition is probably 20-50% bare ground by late summer, with very little thatch, and a forb/grass ratio greater than 2. In a wet year, these measures, especially forb/grass ratio, may not be as meaningful.

Photo A-1. Ungrazed versus grazed grasslands at the boundary between Ramona Airport (left) and former Cagney Ranch (right). Stephens' kangaroo rats are absent from the ungrazed area (Photo taken 8 June 2004 by W. Spencer.)

Photo A-2. Ungrazed (foreground) versus grazed (background) versus recently burned/ungrazed (left) at the Ramona Airport/former Cagney Ranch boundary. Stephens' kangaroo rats were found only in the grazed portion, but will likely colonize burned area in coming weeks. (Photo taken 8 June 2004 by W. Spencer.)

Figure A-1. Stephens' kangaroo rat burrow density versus percent bare ground on 10 monitoring grids at the Ramona Airport, 2001 and 2002.

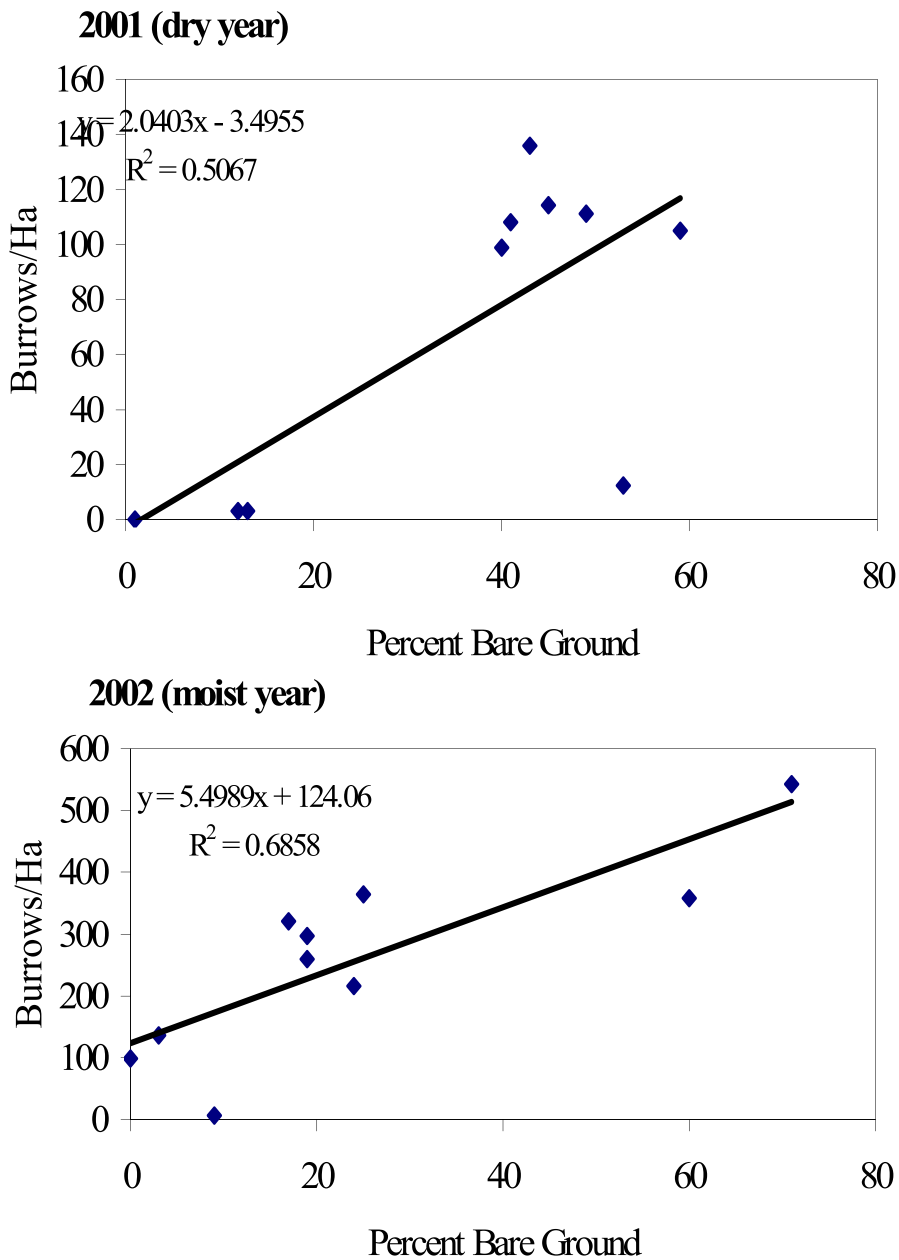
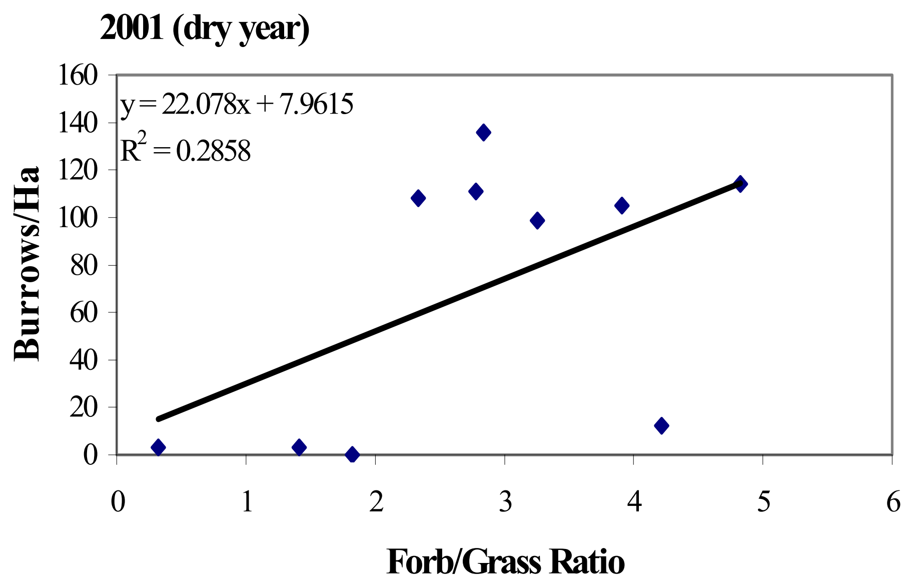
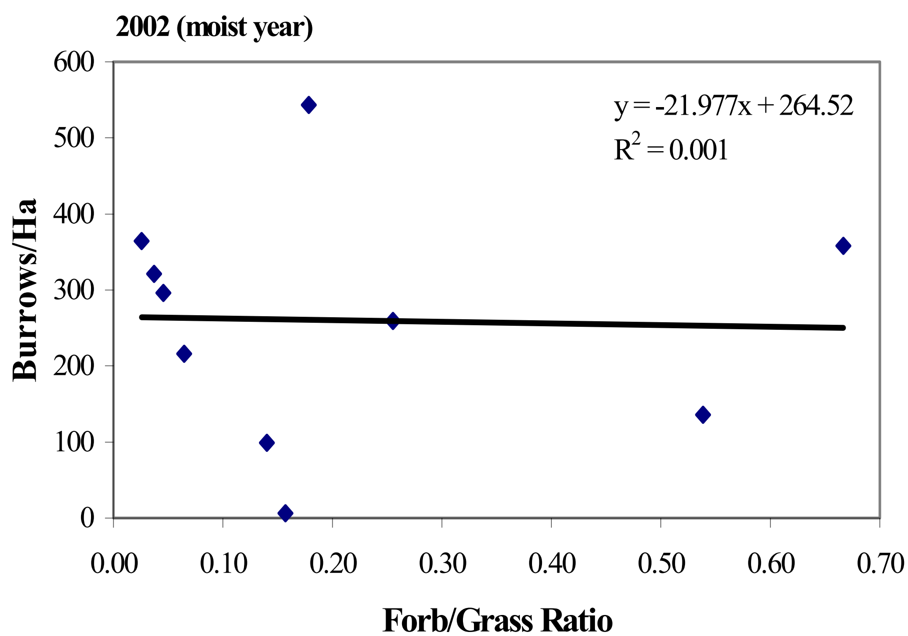


Figure A-2. Stephens' kangaroo rat burrow density versus forb/grass ratio on 10 monitoring grids at the Ramona Airport, 2001 and 2002.





APPENDIX B

TARGET SPECIES ACCOUNTS

FLORA

Coulter's saltbush—*Atriplex coulteri*

CNPS List 1B/RED 2-2-2*

A. coulteri is a perennial herb that occurs in the Southern California counties of San Diego, Orange, Riverside, Los Angeles, Santa Barbara, and San Bernardino, as well as coastal islands. Its distribution stretches to Baja California and San Benito Islands, Mexico (Reiser 1994). This species occurs on coastal bluff scrub, coastal dunes and coastal scrub, and valley and foothill grasslands. It grows on alkaline or clay soils below 460 m (CNPS 2001) and blooms from March through October. *A. coulteri* may be nearing extinction in all areas of its range. It occurs in a subset of the alkali playas north of Santa Maria Creek.

Parish's brittlescale—*Atriplex parishii*

CNPS List 1B/RED 3-3-2*

A. parishii occurs in Riverside County, California and probably Baja California, Mexico, but was thought to be extirpated in Los Angeles, Orange, San Bernardino, and San Diego counties. Nine of the eleven known California occurrences are historic (NatureServe 2004). The preferred habitat of Parish's brittlescale includes chenopod scrub, playas, and vernal pools below 1900 m (CNPS 2004). It blooms from June through October. The greatest threats to this species include habitat destruction and fragmentation due to urban and agricultural development, as well as grazing, off-road vehicle use, exotic plant species, alteration of hydrology and floodplain dynamics, and fire suppression activities. (Bramlet 1993, Roberts and McMillan 1997). One population of *A. parishii* occurs within the alkali playas north of Santa Maria Creek. The population in Ramona is one of possibly only two extant locales for the species.

Southern tarplant—*Centromadia (=Hemizonia) parryi* var. *australis*

CNPS List 1B/RED 3-3-2*

This annual herb occurs in coastal Southern California southward from Santa Barbara County through northern Baja California, Mexico (Hickman 1993, Reiser 1994). In San Diego County it is known from very few locations, including the Ramona Grasslands. The southern tarplant grows in valley and foothill grasslands, alkaline locales, vernal pools, peripheral salt marsh, and freshwater wetlands (CNPS 2001, Lum 1975, Walker 1992). It is as likely to be found in wetlands as in non-wetlands. Tolerance or preference for slightly saline soil may be a factor in the restricted distribution of this species. Southern tarplant occurs in the swale north of Santa Maria Creek and in the southeastern corner of the grasslands. It blooms from May to November.

Small-flowered morning glory—*Convolvulus simulans*

CNPS List 4/RED 1-2-2*

C. simulans is known from San Diego, Orange, Riverside, and Los Angeles counties, coastal islands, inland counties ranging north to Contra Costa County, and Baja California (Reiser 1994). In San Diego County, the species occurs on a small mesa on the north slopes of Otay Valley, east of Rock Mountain, and in several north county areas, including Palomar Airport Road and in Ramona. This plant occurs on friable to heavy clay soils, serpentine seeps, and ridges in areas devoid of shrubs or in clearings within coastal sage scrub, chaparral, and grassland communities. It may also occur in clayey and cobbly soils below 700-1,000 ft elevation, and is often associated with *Acanthomintha ilicifolica*.

This small herbaceous annual blooms from March through June. It is threatened by development and urbanization, specifically as it tends to occur on small clay soil lenses of no more than 1,000 ft^2 in size, which have become rare in Southern California (Reiser 1994). *C. simulans* occurs in the clay soils in the eastern part of the Ramona Grasslands.

Saltgrass—*Distichlis spicata*

Saltgrass is a dioecious perennial grass which is widely distributed across the western United States and Canada from Saskatchewan to eastern Washington, south to California, Texas, and Mexico. It prefers areas of seasonal moisture where the water table is near the surface, such as vernal pools, seasonal ponds, salt flats, grasslands, valley bottoms, and along the edges of streams and lakes. Saltgrass is an effective pioneer species because it spreads rapidly by rhizomes, tolerates inhospitable conditions, and is well-adapted to fire. It is highly resistant to grazing, trampling, and other forms of local disturbance, because it re-grows profusely from rhizomes (McGinnies 1975). Saltgrass occurs in large, and increasing, expanses in the Ramona Grasslands, specifically in and around the alkaline playas associated with Visalia soils and in the eastern part of the grasslands associated with clay soils.

Toothed downingia—*Downingia cuspidata*

Downingia cuspidata is distributed from northern to southwestern California (below 450 m) and extends into northern Baja California. It used to be one of the most common vernal pool plants in the region but has been steadily declining. Downingia is a vernal pool obligate, common in wet to drying vernal pools, lake margins, and meadows along the coasts and foothills. This annual germinates under water and blooms when pools dry, in April and May.

Downingia is pollinated by bees and must cross-pollinate to produce seeds. Downingia thrives in moisture conditions and recedes during drought conditions. It occurs in two vernal pools in the northeastern vernal pool complex in the Ramona Grasslands, the southeastern grassland pools, and historically in the Ramona Airport pools. Some of the historic downingia populations have not been found in subsequent surveys, possibly due to drought conditions.

San Diego button celery—*Eryngium aristulatum* var. *parishii*

USFWS Endangered
CDFG Endangered
CNPS List 1B/RED 2-3-2*

San Diego button-celery is found on the lower coastal slope of Riverside and San Diego counties and in Baja California, Mexico (CNPS 2001). In San Diego County, the species occurs on Camp Pendleton, Carlsbad, San Marcos, Marine Corps Air Station Miramar, Clairemont Mesa, College Park, East San Diego, and Otay Mesa (Beauchamp 1986, USFWS 1993). San Diego button-celery occurs in grassland valleys, coastal sage scrub, and freshwater wetlands. It is restricted to vernal pool habitats under intermittently moist conditions and on clay soils, often growing around the periphery of vernal pool basins (CNPS 2001, Lum 1975, Walker 1992).

San Diego button-celery is a prostrate biennial or perennial species that blooms from March through July. It reproduces by outcrossing and is presumably insect-pollinated. Seeds are self- and, possibly, animal-dispersed (Zedler 1987). Threats include agriculture, urbanization, road maintenance, vehicular traffic, foot traffic, and edge effects. The San Diego button-celery has not been reported from the Ramona Grasslands area. In Ramona, this plant occurs in one location (at Kalbaugh and La Brea Streets) on Bonsall soil, and has been historically reported from a second downtown location (off 16th Street) on Placentia soil.

Graceful tarplant—*Holocarpha virgata elongata*

CNPS List 4/RED 1-2-3*

The graceful tarplant is endemic to San Diego County, Riverside County, and Orange County (Reiser 1994) in mostly inland areas. It occurs in disturbed areas of chaparral, cismontane woodland, coastal sage scrub, and valley and foothill grasslands below 600 m (Hickman 1993, CNPS 2001). The graceful tarplant is an annual herb that blooms from July through November and is self-fertilized (CNPS 2004, Munz 1974). The greatest threat is habitat degradation due to land development. Fred Sproul surveyed for graceful tarplant in June 2004, but found only dried specimens from the previous year. In years of better rainfall, this species occupies the Bosanko clay soils in the eastern part of the grasslands (Sproul personal communication).

Alkali barley—*Hordeum intercedens*

CNPS List 3/RED ?-2-2*

Vernal barley is an annual grass that blooms from March through June. It ranges from San Mateo County in the north to Baja California in the south and also occurs on some of the Channel Islands (Reiser 1994). It occurs in coastal dunes and coastal sage scrub and is typically associated with saline flats and depressions in grasslands and within vernal pool basins below 1000 m. This species is regionally declining and is only known in San Diego County from Otay Mesa and Camp Pendleton. Past botanical surveys may have overlooked this species, as it appears similar to the more abundant *Horduem depressum.* The greatest threat to vernal barley populations is habitat degradation of vernal pools and isolated alkaline wetlands due to land development (Reiser 1994). Fred Sproul found one occurrence of this plant in the grasslands in June 2004, in the clay soils north of Santa Maria Creek.

Little mousetail—*Myosurus minimus* ssp. *apus*

CNPS List 3/RED 2-3-2*

Little mousetail has a relatively widespread distribution, ranging from Oregon to Baja California (CNPS 2001). In San Diego County, the species is declining and restricted to Camp Pendleton (Stuart Mesa, Wire Mountain), Carlsbad, Ramona, the mesas north of San Diego, National City, Proctor Valley, and Otay Mesa. Little mousetail occurs in valley grasslands, coastal sage scrub, alkaline marshes, and freshwater wetlands below 640 m (CNPS 2001). As an obligate vernal pool species, it prefers the deeper portions of pool basins, and sprouts just after the surface water evaporates. It has been observed on clay and loam soils (Reiser 1994).

Little mousetail is a small, tufted annual that blooms March through June. It may experience yearly fluctuations in population size, depending on the level of seasonal moisture. It is presumably insect-pollinated (Grant and Grant 1965), and seeds are self- and, possibly, animal-dispersed. Threats to this species include vehicular traffic, livestock grazing, agriculture, and edge effects. Little mousetail has historically occurred in four vernal pools within the Ramona Grasslands, including the largest, fenced pool in the eastern grasslands, which may be the only extant population. There are also records from downtown Ramona and in two pools west of Rangeland Road (Westec 1980).

Purple needlegrass—*Nassella pulchra*

Purple needlegrass occurs on the west side of the Coast Ranges from northern Baja California north to the Oregon border. The species also occurs in the Central Valley and foothills of the Cascade Range and Sierra Nevada, and on the Channel Islands. It occurs in open chaparral, coastal sage scrub, valley grassland, and woodland foothills below 1,524 m. It is associated with a variety of soil types but is well adapted to those with high clay content (Steinberg 2002).

Purple needlegrass is monoecious and wind pollinated. It begins to flower in early May. Seed matures and is dispersed by late July (Steinberg 2002). This species is well-adapted to light grazing, which can increase purple needlegrass cover and reduce that of nonnative annuals. However, it does poorly in response to intense, continuous grazing, especially under drought conditions (Bartolome 1981). Purple needlegrass is well-adapted to fire, although frequent, high-intensity fires may be detrimental.

Needlegrass grasslands used to dominate the Southern California valley grasslands landscape, but native grasses associated with this landscape, including the purple needlegrass, have been outcompeted by introduced nonnative annual grasses that were imported as animal feed. The greatest threats to this species are continuous, heavy grazing, a high density of exotic annuals, and frequent, high-intensity fires (Dyer and Rice 1996, Steinberg 2002). Purple needlegrass is effective in restoration projects and can be established by transplants or by seed (Tyson and Rackelmann 1982). It occurs throughout the clay soils in the eastern Ramona Grasslands.

Spreading navarretia—*Navarretia fossalis*

USFWS Threatened
CNPS List 1B/RED 2-3-2*

Spreading navarretia occurs in western Riverside and southwestern San Diego counties and northwestern Baja California. Historically, it occurred in relatively few of the San Diego County vernal pools (Camp Pendleton, San Marcos, Mira Mesa, National City, Otay Mesa, and Ramona). It appears to be more abundant in Baja California.

Spreading navarretia blooms in April-June and generally occurs in vernal pools or roadside depressions below 450 m (1,476 ft) elevation. It often prefers clay hardpan or silty alkaline substrates. The primary threats are loss of habitat to agricultural practices, road construction, grazing, urbanization, and associated edge effects. Alterations of the watershed may reduce the source of water and encourage invasion of habitat by upland plant species. Introduction of spreading navarretia into restored vernal pools is crucial for conservation of this species in Ramona (USFWS 1998b).

N. fossalis is known only from the largest, fenced pool in the eastern Ramona Grasslands. This pool did not fill during the wet season of 2004. All historic locations of spreading navarretia in Ramona are associated with the Bonsall-Fallbrook and Placentia soil series. This species was reported by Fred Sproul (1989) and Recon (1995) from vernal pool C2e at the Ramona Airport. However, it has not been found during at least three separate survey efforts since then and is believed to be extirpated from this location.

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*CNPS List and R-E-D Code

List 1B—Plants rare, threatened, or endangered in California and elsewhere.
List 3—Plants about which we need more information—a review list.
List 4—Plants of limited distribution—a watch list.

R—Rarity

1. Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.
2. Distributed in a limited number of occurrences, occasionally more if each occurrence is small.
3. Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported.

E—Endangerment

1. Not endangered.
2. Endangered in a portion of its range.
3. Endangered throughout its range.

D—Distribution

1. More or less widespread outside California.
2. Rare outside California.
3. Endemic to California.

FAUNA

San Diego fairy shrimp—*Branchinecta sandiegonensis*

USFWS Endangered

The San Diego fairy shrimp is currently known to occur only in Orange and San Diego counties and in northern Baja California. It is usually found in vernal pools on mesas and in roadside ditches and shallow tire ruts (<12 in. [30 m] deep). Simovich and Fugate (1992) found that San Diego fairy shrimp hatch in temperatures of 50°-59°F (10°-15°C) early in the season after winter and spring rains (January-March). As they reach maturity, the female develops prominent ovisacs, while the male's second antennae become modified for clasping the female during mating. Females may produce clutches of 100-300 eggs or more. Following fertilization, embryonic development begins within a shell secreted by the female. Embryonic development stops within a day or two, and the embryo goes into diapause. The diapausing embryo is referred to as a *resting egg* or *cyst*. Once released by the female, cysts fall to the bottom of the pool. Cysts may hatch within the same season if conditions remain appropriate, or the cysts will remain in the sediments of vernal pools after they dry. Fairy shrimp cysts are resistant to dessication and high temperatures and can likely remain viable in the soil for many years (Donald 1983, Simovich and Hathaway 1997). Once rehydrated, cysts can hatch within 48 hr and reach maturity in 1-2 weeks, depending on water temperature (Hathaway and Simovich 1996, Simovich and Hathaway 1997). Cysts that do not hatch in a given season may remain in the soil and hatch in a subsequent year. Although little studied, the diet of San Diego fairy shrimp most likely consists of algae, bacteria, protozoa, rotifers, and small pieces of organic debris (Pennak 1989, Eng et al. 1990).

The current distribution of this species has been greatly reduced because of a loss of vernal pool habitat to development and habitat degradation from nonnative plants, dumping, and increased sedimentation from trails and off-road vehicles. No comprehensive population data exist for San Diego fairy shrimp in Ramona, although it is known to occur in the grasslands, and the majority of vernal pools in the Preserve likely have the potential to support this species. The high abundance of nonnative annual plants in some vernal pools in the Ramona Grasslands Preserve has reduced their hydroperiod, thus reducing habitat suitability for San Diego fairy shrimp.

Arroyo toad—*Bufo californicus*

USFWS Endangered
CDFG Special Concern Species

This subspecies of southwestern toad is typically associated with gravelly or sandy washes, stream and river banks, and arroyos. Adult toads spend most of the year in burrows in upland habitat near washes and streams. Adults are known to range up to 3,000 ft from breeding pools (Griffin et al. 1999) and burrow in adjacent upland habitats, including agricultural fields (Griffin and Case 2001). Nonbreeding habitat includes sage scrub, mixed chaparral, Joshua tree woodland, and sagebrush habitats. Breeding activity has been observed February-June depending on temperatures and precipitation (Sullivan 1992, Sweet 1993). Breeding occurs in quiet, clear backwaters of streams as waters recede from the floods of the wet season. Eggs are laid on the bottom of the shallow pools, usually in tangled strings of one to three rows. The eggs are sensitive to siltation and require good water quality. Because the eggs are laid in very shallow water and are not anchored or attached, rapid changes in stream flow can leave the eggs dry or wash them away. The tadpoles reach a maximum length of about 1.5 in. and are solitary and extremely cryptic, typically mottled or spotted with blackish to brown colors. Young toadlets bask during the day on sandy or gravely, saturated substrates in the late summer before beginning the subterranean life of the adults. Heavily shaded, closed canopy stream reaches are generally not suitable for this species (USFWS 1999). The adults spend the majority of the year in burrows, are nocturnal, and can occasionally be found at night foraging on open, sandy areas around the drainage.

Approximately 75% of the historical habitat of the species has been destroyed, and many of the remaining populations are threatened. The primary reasons for the decline of the species include dams and water projects, urban development, agriculture and grazing, and human recreational activities in breeding areas. A breeding population of arroyo toads was found in Santa Maria Creek at the western end of the Ramona Grassland Preserve, east of Rangeland Road in 1992.

Western spadefoot toad—*Scaphiopus hammondii*

USFWS Endangered
CDFG Special Concern Species

This spadefoot is almost endemic to California, ranging from the Central Valley and southward on the coastal slope from Point Conception to northern Baja California (CDFG 1988, Jennings and Hayes 1994). It generally occurs below 914 m (3,000 ft), but can be found as high as 1,372 m (4,500 ft). The range has become fragmented by human expansion, and 80% of the original occupied habitat has been lost in Southern California (Jennings and Hayes 1994). Grassland, scrub, and chaparral are the preferred habitats of the western spadefoot toad. Occasionally, they occur in oak woodlands as well. During the breeding season (January-May), vernal pools or slow-flowing creeks must be available for egg laying and larval development. Water temperature must be between 48°F and 86°F for successful breeding to occur. Larval development must be completed before the pools dry up. It may take up to 2 yr to sexually mature. The remainder of the year is spent torpid in burrows in upland habitats such as grassland and coastal sage scrub. Spadefoot toads feed on insects, worms, and other invertebrates.

The greatest threats to this species are loss and fragmentation of habitat due to urban and agricultural development, nonnative predators, heavy grazing, off-road vehicles, and contaminant runoff. In addition, many populations of spadefoot toads are small and isolated, which makes them more vulnerable to catastrophic events. EDAW (2002) reported western spadefoot toads (tadpoles, metamophs and adults) from the vernal pools in the northeastern portion of the Ramona Grasslands Preserve, though comprehensive surveys of the Ramona Grasslands have not been conducted.

Least Bell's vireo—*Vireo bellii pusillus*

USFWS Endangered
CDFG Endangered

The least Bell's vireo is a neotropical migratory songbird that is restricted to breeding in willow- and mulefat-dominated riparian woodlands in Southern California. The majority of breeding pairs occur in San Diego, Santa Barbara, and Riverside counties. In San Diego County, major vireo populations are currently located on six river systems: Tijuana, Sweetwater, San Diego, Santa Ysabel Creek/San Dieguito River, San Luis Rey River/Pilgrim Creek, and Santa Margarita (USFWS 1998a). Least Bell's vireos prefer semi-open riparian woodlands with a dense shrub understory. This species is vulnerable to brown-headed cowbird parasitism (Kus 1991a, 1991b, 1992a, 1992b), and reduction or elimination of cowbirds in least Bell's vireo nesting habitat can benefit this species substantially. The Least Bell's vireo is not known to occur in Santa Maria Creek; however, it has not been adequately surveyed for this species. There is a core breeding population of least Bell's vireos in the adjacent San Pasqual Valley, estimated to range between 75 and 125 pairs (MEC 1998). The habitat in the eastern end of the Ramona Grasslands Preserve has not been adequately assessed to determine its suitability for breeding by vireos, and the habitat where cows have not been excluded is not currently suitable for this species.

Stephens' kangaroo rat—*Dipodomys stephensi*

USFWS Endangered
CDFG Threatened

The largest portion of this species' highly restricted geographic range comprises the inland valleys of western Riverside County. However, Stephens' kangaroo rats are known to occupy a few scattered grassland areas in northern San Diego County, particularly on and near Marine Corps Base Camp Pendleton, Fallbrook Naval Weapons Station, and near Lake Henshaw, Rancho Guejito, and Ramona (San Diego County Mammal Atlas Database 2004). They may occupy other open habitat areas in the county that have not been sufficiently surveyed. Stephens' kangaroo rats are habitat specialists that occupy open grassland or sparse coastal sage scrub with a preponderance of annual forbs, few if any shrubs (less than 30% shrub cover), and abundant areas of bare ground. Typical habitat consists of native and nonnative forbs such as filaree (*Erodium* sp.), dove weed (*Eremocarpus setigerus*), tarplant (*Hemizonia* sp.), and goldfields (*Lasthenia* sp.). Dense grass or shrub cover can exclude this species from otherwise suitable habitat, presumably by interfering with the species' natural bounding movements and its ability to forage efficiently.

Stephens' kangaroo rats are primarily found on friable, loamy soils that facilitate burrowing. They are rarely found on soils high in clay or rock content, which make burrowing difficult, or on very sandy soils, in which burrows tend to collapse. They sometimes use clayey soils near more suitable habitat areas if there are sufficient burrows created by other rodents (especially ground squirrels or pocket gophers) for them to use. Stephens' kangaroo rats tend to avoid steep slopes (>39%) and seem most abundant on gentle slopes (about 7-11%).

Kangaroo rats are saltatorial (jumping), nocturnal, burrow-dwelling rodents that subsist primarily on seeds, along with some vegetable matter and occasional insects. They are highly evolved morphologically, physiologically, and behaviorally to survive arid conditions. They have large hind limbs for jumping and reduced fore limbs; long, tufted tails for balance; large eyes adapted to nocturnal vision; and greatly enlarged tympanic bullae (ear capsules) for sensitive hearing. Kangaroo rats can survive long periods, or indefinitely, without drinking water, and have fur-lined, external cheek pouches to transport seeds to cache locations. Because of their adaptations, kangaroo rats generally require sandy loam soils conducive to burrowing and foraging for seeds. Ground cover must be sparse, with bare patches of earth interspersed with seed-producing annual plants. The distribution of Stephens' kangaroo rats in suitable habitat is usually highly patchy, with clusters of burrows occupied by kangaroo rats separated by unoccupied areas. They are good dispersers, sometimes showing up in habitat patches hundreds of meters from other occupied habitats, so long as there is sufficiently open and gentle terrain to facilitate travel. They are known to disperse along linear habitat features, such as dirt roads or road shoulders.

Much historically suitable habitat has been removed and fragmented by urban and agricultural development. This has accentuated the disjunct nature of the species' distribution by eliminating corridors through which the kangaroo rats disperse from one tract of suitable habitat to another. The Ramona population has very low if any genetic variability, probably due to thousands of years of isolation from other populations.

Stephens' kangaroo rats are broadly but patchily distributed on loamy grasslands across much of the core grasslands area. The largest concentrations of the species appear to occur near the center of the grasslands, roughly centered around the western half of the airport property, and northern and western portions east of Rangeland Road. Populations also occur on appropriate soils west of Rangeland Road and north of the airport, extending to the northeastern corner of the grasslands, but survey coverage is not complete, especially north of the airport.

Ferruginous hawk—*Buteo regalis*

CDFG Species of Special Concern
Partners in Flight Priority Bird Species

The ferruginous is a migratory hawk that breeds from British Columbia eastward to southwestern Manitoba and southward to Nevada and Texas. It winters from central and southern parts of the breeding range southward to Baja California and northern mainland Mexico (AOU 1998). It does not breed in Southern California, but is a fairly common winter resident of grasslands and agricultural areas in southwestern California (Garrett and Dunn 1981). It generally arrives in Southern California in September and departs by mid-April.

The ferruginous hawk requires large, open tracts of grasslands, sparse shrub, or desert habitats with elevated structures for nesting. Its wintering habitat is also mostly open grasslands, but it may also occur in areas of mixed grassy glades and pineries (Brown and Amadon 1968). Within Southern California, ferruginous hawks typically winter in open fields, grasslands, and agricultural areas. There are no breeding records from California. The diet includes lagomorphs, ground squirrels, mice, and pocket gophers, as well as some birds, reptiles, and amphibians. Pocket gophers are probably a primary prey species in the Ramona Grasslands, where Bittner (personal communication) has observed ferruginous hawks piercing shallow gopher burrows with their talons to grab gophers through the soil cover when they observe motion. Ferruginous hawks search for prey from low flights over open, treeless areas, and glide to intercept prey on the ground. They also hover or hunt from perches, including dirt mounds or rocks. Cooperative hunting and ground pursuit of prey have been observed. When prey are abundant, hunting occurs from daybreak to mid-morning, then again from late afternoon and evening. In winter, these hawks spend most of the day perched, usually in a lone tree or on a utility pole (Bechard and Schmutz 1995, Plumpton and Andersen 1997, Zeiner et al. 1990). Several ferruginous hawks may perch within 50 m of each other (Bechard and Schmutz 1995).

Continuing threats to the species include habitat destruction and fragmentation, poor grazing management, poisoning or other rodent control measures, mining, and fire (Bechard and Schmutz 1995). The species is sensitive to human disturbance around nests, and a minimum buffer zone of 0.25 km around nests has been recommended as sufficient to prevent nest desertion during brief or intermittent human disturbances (White and Thurow 1985). In winter, the species seems behaviorally flexible and somewhat tolerant of human disturbance, provided an adequate prey base is available (Plumpton and Anderson 1997). The species may persist in urban open space grasslands, as long as these are large and support sufficient prey populations (Berry et al. 1998). Approximately 12-15 ferruginous hawks winter every year in the Ramona Grasslands (Bittner personal communication).

Burrowing owl—*Speotyto (Athene) cunicularia hypugaea*

USFWS Species of Management Concern
CDFG Species of Special Concern
Partners in Flight Priority Bird Species

The burrowing owl breeds from southern Canada, south into Baja California and Central Mexico, from the Pacific coast on the west to the Great Plains states on the east. The winter range is similar, except owls vacate the northernmost areas during winter (Haug et al. 1993) and may winter south into Central America. The burrowing owl is a year-long resident throughout most of California except the coastal northwest forests and higher mountains. It is a year-round resident in open lowlands of Southern California (Garrett and Dunn 1981), although there is some movement of more northerly birds into the southern and coastal parts of the region (Garrett and Dunn 1981).

Burrowing owls require large open expanses of sparsely vegetated habitat on gently rolling or level terrain with an abundance of active mammal burrows. They occur in shortgrass prairies, grasslands, lowland scrub, agricultural lands (particularly rangelands), coastal dunes, and desert floors (Haug et al. 1993). They may also opportunistically use golf courses, cemeteries, airports, vacant lots, irrigation ditches, or other human-created habitats (Haug et al. 1993). The burrowing owl seems to prefer moderately to heavily grazed grasslands for nesting and roosting and avoids cultivated fields (Clayton and Schmutz 1999). Burrowing owls require mammal burrows for roosting and nesting cover, although they may occasionally dig their own burrow in soft, friable soil. They will also use pipes, culverts, and nest boxes where natural burrows are scarce (Robertson 1929). One burrow is typically selected for use as the nest, with a number of satellite burrows scattered within the defended territory. Burrow sites having good horizontal visibility and little grass coverage are preferred. Elevated perches are used where vegetation does not allow for ground-level line of sight (Green and Anthony 1989). MacCracken et al. (1985) found that nest burrows were in sandier soils than non-nest burrows. All nest burrows found to be reused in a study in Oregon were in silty loam (Green 1983).

The burrowing owl is diurnal but forages primarily at dawn and dusk (Thomsen 1971). Although they eat mostly insects and small mammals, they are opportunistic and may also take reptiles, birds, and carrion. They hunt by using short flights, running along the ground, hovering, or by using an elevated perch from which to spot prey. The species is semi-colonial and considered the most gregarious owl in North America. The home range varies from about 0.1 to 4 acres (mean = 2 acres) (Thomsen 1971, Martin 1973). Territory size is flexible depending on available habitat and burrows (Haug et al. 1993). Burrowing owls usually nest in abandoned mammal burrows, including those of ground squirrels and badgers, which they improve for their own use. The nest chamber is often lined with grass, feathers, or other debris. Breeding occurs from March through August, with a peak in April and May. The clutch size is 6-11. Young emerge from the burrow at about 2 weeks, and they fly by about 4 weeks (Zarn 1974).

Threats include habitat loss and conversion, predation (including by other raptors, Bittner and Lincer personal communications), collisions with vehicles, reduced burrow availability due to rodent control, and pesticides (James and Espie 1997, Grinnell and Miller 1944, Zarn 1974, Remsen 1978). Collisions with autos may be a significant cause of mortality, especially where owls are forced by land uses to concentrate their burrows along roadsides and canals (Remsen 1978). Population numbers have markedly declined throughout the species' range in recent decades (James and Ethier 1989, Zeiner et al. 1990). The species appears to be seriously threatened with extirpation from central western and Southern California because of habitat loss, with population declines estimated during the 1980s at >70% (DeSante and Ruhlen 1995). The use of insecticides may reduce the availability of their primary prey or result in secondary poisoning. Owl survival can be adversely affected by disturbance and foraging habitat loss even when impacts to individual birds and burrows are avoided (CDFG 1995). The following have been suggested as management and mitigation strategies (Green 1983, Trulio 1995): protection of burrowing mammal populations; wood or plastic nest boxes and tunnels; artificial perches which provide hunting and predator observation sites; vegetation management through fire or grazing; provision of 6.5 acres of foraging habitat per pair, provision of two burrows for each burrow impacted, relocation of owls, and avoidance of disturbance during the nesting season.

Burrowing owls are occasionally seen in various portions of the Ramona Grasslands, but are not currently known to breed there. The Wildlife Research Institute (WRI) has begun a captive breeding program at its facility within the core grasslands area, with hopes of establishing breeding populations here and elsewhere in San Diego County. WRI has also established a number of artificial burrows for burrowing owls along their property boundary in the grasslands to accommodate natural colonists or released birds.

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APPENDIX C

CULTURAL RESOURCES OVERVIEW OF THE RAMONA GRASSLANDS PRESERVE AND SANTA MARIA CREEK HABITAT RESTORATION PROJECT AREA

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Introduction

This appendix provides general information about the cultural resources of the Ramona Grasslands area, and more specific information about properties that will be acquired or managed by the County of San Diego for proposed habitat restoration. General recommendations are also provided for management of cultural resources as properties are acquired, although specific recommendations cannot be made until field surveys and site inspections are completed.

During the prehistoric period (the era before the founding of the San Diego Mission in 1769), Native Americans occupied the Santa Maria Valley for many thousands of years. The people living in the area at the time of Spanish contact are known as the Kumeyaay people.

The Kumeyaay Indians of southern California have been referred to as Tipai (southern area), Ipai (northern area), and as Diegueño by the Spanish because they were removed to the San Diego Mission. Different than other California Indians, the Kumeyaay speak a Yuman language, and are associated with groups east of the coast into Arizona (Luomala 1978). The extensive production and use of fired pottery by the Kumeyaay is also unique among California Indians. The Kumeyaay pottery tradition includes highly decorated vessels in a wide variety of functional shapes. Figures made of fired clay have been found in the Santa Maria Valley.

For thousands of years, Native American groups were organized into groups of villages called by one general name. One village may actually consist of several occupied areas, as well as special use areas such as hunting camps, resource procurement and processing areas, and seasonal gathering locations. Each collective village group had a unique social organization, and the people who lived in the affiliated villages under one locational name considered themselves distinct from other groups of villages. This cultural pattern resulted in a high level of cultural diversity among the Kumeyaay.

The Santa Maria Valley was home to a large, complex civilization for many hundreds of years: the Kumeyaay Indian villages collectively called Pamo. The Pamo villages were seamlessly integrated into one of the last remnants of extensive grassland habitat in coastal Southern California. Surrounding and embedded within these grasslands are a variety of rare habitat types, including vernal pools, Diegan coastal sage scrub, oak woodland and riparian forests, all which would have served to support village residents. The rich environment within the Ramona grasslands provided abundant resources for the Pamo villagers. Of particular and unique importance was the native grassland. The plants and animals distinctive to this habitat contributed toward the large number of people who lived in the Pamo village complex.

The Pamo villages consisted of a complex settlement system perfectly adapted to the grasslands environment of the Santa Maria Valley. The Pamo settlement system contained a network of villages, special activity sites for the production of stone tools, seasonal sites for gathering and processing acorns and other seeds, and religious and sacred locations. Over a period of thousands of years, several large villages and outlying activity areas were established and occupied. Dozens of these undisturbed archaeological sites still exist within the Ramona Grasslands area.

The Kumeyaay Indians had a different attitude toward the Spanish missionaries than other California Indians. While many groups were friendly or passive toward these new immigrants, the Kumeyaay aggressively resisted attempts to control them, rebelling vigorously and frequently. They are described as "passionately devoted to the customs of their fathers" (Kroeber 1970: 711). The Diegueño continued to resist attempts to alter their culture. Ten years after the mission at San Diego was established, the Spanish sent an expedition to Pamo to take action against the group (Kroeber 1970: 712). However, eventually 92 Pamo villagers were taken to the San Diego Mission (Merriam 1968:170).

The cultural resources within the Santa Maria Creek and Ramona Grasslands areas are particularly important to preserve because the sites exist at a landscape scale and the area contains a wide variety of residential, activity-based, and ceremonial archaeological locations. It is extremely rare in California to find an entire settlement complex of villages that can be preserved undisturbed in an intact natural landscape also supporting rare and endangered species.

Research Results

Research on the archaeology of the Santa Maria Valley was conducted at San Diego State University's South Coastal Information Center (SCIC) and at the San Diego Historical Society by Dr. Susan M. Hector, principal investigator. The research consisted of a record search at SCIC to identify recorded archaeological sites and determine which areas had been systematically surveyed for cultural resources; and an archival, photograph, and map search at the San Diego Historical Society. The original plat maps for the Santa Maria Grant were examined to identify any possible historic structures or features; none were observed. Aerial photographs were also examined to identify prehistoric and historic features. Dr. Hector also obtained and evaluated archaeological and cultural resource studies in the Santa Maria Valley as part of the background research for the restoration project.

Although only half of the Ramona Grassland project area has been surveyed for archaeological sites, over 140 sites have been recorded (Table C-1); it is likely that many more prehistoric sites are located in the valley.

The Cagney, Voorhes Lane, and Hardy properties have not been systematically surveyed for cultural resources, so there were no previously recorded sites identified in those areas as a result of the record and archival searches. Informal site visits by Dr. Hector in April and July, 2002, resulted in the discovery of four sites on the Cagney property. Three of the sites are prehistoric camp sites, and the fourth is a historic bombing target (see description below). The three prehistoric sites have been recorded at the South Coast Information Center as SDI-17144, SDI-17143, and SDI-17142. A systematic survey of the unsurveyed properties would most likely result in the discovery of additional cultural resources.

The vast majority of known archaeological sites along Santa Maria Creek have milling features or components. The types of milling features include mortars, basins, slicks, and cupules. The valley also has quarry sites, stone tool production areas, temporary or seasonal camps, and major village sites. The 9 major village locations known to have existed in the valley are distributed along major resource zones within the valley. Several contain stacked rock architecture, consisting of stone walls and rooms. Prehistoric Kumeyaay architecture consisted of domed, semi-subterranean shelters, ramadas, ceremonial houses, and other enclosures. The Santa Maria Creek area contains the remains of several structures built by the Kumeyaay, including rock structures and a unique ceremonial structure. The Pamo village complex included several large, permanent towns, as well as numerous specialized sites including quarries, temporary camps, and resource procurement locations.

Analyzing the information from the record searches, archives, and related archaeology reports, all of the sites in the area date to the Late Prehistoric period (1500 years before the present to 1769); this cultural period in San Diego County was a time of cultural and social complexity, permanent villages, and broad trade networks. The rich natural resources of the valley supported a large prehistoric population.

One particular archaeological site is an excellent example of a large village site located in the Ramona Grasslands area, within the Oak Country Estates project area. The Oak Country Estates property was surveyed for cultural resources by Mooney and Associates, and several of the sites were tested for significance (Carrico and Cooley 2002). One of the sites was home for 75-100 people during the Late Prehistoric period (approximately 1500-500 years ago). Although this site has only been investigated at a minimal level, it contains a rich archaeological deposit representing the large Pamo villages. Six rock enclosures were found at the site. Several rock enclosures are built into natural bedrock outcrops. Most of the rooms are adjacent to one another, and represent defensive lookouts, residential rooms, and storage rooms. The site also contains bedrock milling features, and a wide variety of pottery, stone tools and projectile points, and midden deposits.

A unique ceremonial structure was found in the Ramona Grasslands area, also within the Oak Country Estates project area. The structure consists of three parallel stone alignments, which are directed toward a monolithic split boulder, and allow a sighting to a distinct mountain pass in the distance. This feature was discovered in April, 2002, and preliminary research indicates that no other ceremonial or astronomical feature like it has ever been seen in the Kumeyaay culture area. The stone alignments are 30-50 meters in length. This structure may have statewide or national significance.

In addition to a diverse complex of prehistoric resources, the Ramona Grasslands area has important historical sites as well. The area near the Airport was used during World War II as a bombing target. The Ramona Bombing Target and Emergency Landing Field included 405 acres near the town of Ramona. Eventually, the Navy acquired enough property for a landing field, which was transferred to the County of San Diego in 1956; the County had leased the airfield since 1947. The Ramona Bombing Target was used to practice dive bombing an aircraft carrier, and is located on the Cagney property. It has been recorded at the South Coastal Information Center as P-037-024571. The Target consisted of a series of concentric rock rings to simulate the size and shape of an aircraft carrier. Some remains from the practice bombs still remain in remote locations within the Ramona Grasslands area. Conservation of this important World War II site is important as development continues to obscure the recent history of our nation.

Recommendations

The County's MSCP requires inventory and management of cultural resources included within the habitat preservation system. The specific language added to the County of San Diego's Framework Management Plan for all MSCP preserves in its jurisdiction is simple, yet requires action. The following text is from the County's Framework Management Plan, which is the general guidance to be followed for the entire Preserve system.

General Management Directives: Cultural Resources

All Preserve lands will be inventoried for cultural resources. Cultural resources include historic structures, features, and landscaping as well as historic and prehistoric archaeological sites, features, and artifacts. Protection and preservation of cultural resources will comply with County of San Diego ordinances (Title 4; Public Property, Division 1: Parks and Beaches, Article 2, Section 41.113), as well as applicable state and Federal laws.

A. Inventories shall include a record search at the South Coastal Information Center, and an on-foot field survey, as well as pertinent archival and historical research.

B. Specific management plans and directives will be prepared for each Preserve to preserve and interpret cultural resources.

C. All management activities within the Preserve, including but not limited to trail construction, placement of fencing and gates, and restoration of habitat will take into consideration potential impacts to cultural resources.

D. No removal or modification of cultural resources shall occur without written approval from the Director of Parks and Recreation, County of San Diego.

E. Removal or disturbance of cultural resources shall not occur prior to completion of an approved mitigation program, such as data recovery or recordation. Preservation in place is the preferred mitigation measure.

F. Condition and status of cultural resources shall be noted as part of routine monitoring activities and remedial measures shall be taken if damage is noted.

G. Site location information will be confidential, and will be available only to qualified cultural resource staff and land managers. Site locations will not be shown on maps or divulged to the public.

H. Interpretive programs for Native American heritage, local and regional history, and prehistory will be developed for the Preserve. These may include lectures, walks, kiosks, signs, brochures, and displays, but will not include excavations, collecting of artifacts, or disclosure of confidential site locations unless an interpretive plan is developed and approved by the Director of Parks and Recreation, County of San Diego. The plan will include direct supervision by a qualified archaeologist approved by the Director of Parks and Recreation, County of San Diego.

I. Any cultural materials collected from the Preserve will be curated at a qualified curation facility.

Properties within the Ramona Grasslands and Santa Maria Creek project areas fall into two categories: Properties that have been inventoried for cultural resources, and properties where no inventory has been done, and little or no cultural resource information is available. As properties are added to the preserve, conduct a record search at the South Coastal Information Center to determine whether inventories have been accomplished. These recommendations should be included in the Area-Specific Management Directives in preparation of the project area.

Properties inventoried for Cultural Resources

Oak Country Estates and the County's Ramona Airport have been surveyed for cultural resources, and site location information is available for those areas. Technical reports have also been completed for these properties.

1. For each known culture resource, develop a management strategy that will consider the potential proximity of public access; measures needed to stabilize the resource from erosion or other adverse impacts; and the need for restricting public access. This strategy shall be based on field inspections to collect baseline information about the condition of the site.
2. Conduct a bimonthly monitoring program for cultural resources identified within the Ramona Grasslands preserve area as properties are added. Use the SDCAS monitoring protocols (Attachment A) to record baseline conditions and note changes. Any adverse changes to the condition of the site shall be immediately remedied in consultation with an archaeologist.
3. Certain archaeological sites, such as those present on Oak Country Estates, contain above ground features such as rock rooms and alignments. These sites are highly sensitive and easily vandalized. Public access to these areas should be prohibited, and a 100' buffer should be provided between the sites and any public use.
4. The use of bulldozers and other equipment that disturbs the surface of the ground should not be permitted for fire suppression activities.
5. A prescribed cattle grazing program, limiting the number and location of cattle on the properties, could be an appropriate way to control vegetation while benefiting sensitive species. Uncontrolled cattle grazing will damage archaeological sites and should not be allowed.
6. Interpretive information about the cultural resources located within the preserve should be provided to the public, without disclosing specific information about site locations. The interpretive component may consist of signage away from the sites, informative brochures, and lectures or talks. Specific programs disclosing site locations or providing direct public access to sensitive cultural resources shall be prohibited.

Properties that have not been inventoried for Cultural Resources

The properties proposed for immediate addition to the preserve (Voorhes Lane easements, Hardy, and Cagney) have not been surveyed for cultural resources.

1. Restrict public use of those properties where no information is available until a complete cultural resource survey can be conducted.

2. No trails, staging areas, or any other improvements should be constructed until the cultural resource surveys are complete.
3. As soon as possible, conduct a complete cultural resources survey on unsurveyed properties acquired for the preserve: Hardy, Cagney, and Voorhes Lane. As future acquisitions are made, conduct cultural resource surveys.
4. All cultural resources identified shall be recorded at the South Coastal Information Center (SCIC). The site location information will be used for planning future improvements and will allow appropriate management of cultural resources.
5. For each site identified during the inventory, develop a management strategy that will consider the potential proximity of public access; measures needed to stabilize the resource from erosion or other adverse impacts; and the need for restricting public access.
6. Conduct a bimonthly monitoring program for cultural resources identified within the Ramona Grasslands preserve area as properties are added. Use the SDCAS monitoring protocols (Attachment A) to record baseline conditions and note changes. Any adverse changes to the condition of the site shall be immediately remedied in consultation with an archaeologist.
7. Certain archaeological sites contain above ground features such as rock rooms and alignments. These sites are highly sensitive and easily vandalized. Public access to these areas should be prohibited, and a 100’ buffer should be provided between the sites and any public use.
8. The use of bulldozers and other equipment that disturbs the surface of the ground should not be permitted for fire suppression activities.
9. A prescribed cattle grazing program, limiting the number and location of cattle on the properties, could be an appropriate way to control vegetation while benefiting sensitive species. Uncontrolled cattle grazing will damage archaeological sites and should not be allowed.
10. Interpretive information about the cultural resources located within the preserve should be provided to the public, without disclosing specific information about site locations. The interpretive component may consist of signage away from the sites, informative brochures, and lectures or talks. Specific programs disclosing site locations or providing direct public access to sensitive cultural resources shall be prohibited.

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Table C-1. Recorded cultural and historic sites in Ramona Grasslands Preserve.

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
5796		X	X						
5797		X							
5798			X						
5946			X						
5947		X	X						
6058			X						
6059		X	X						Testing done; projectile point found--quartz
6060						X			
6061			X						
6063			X						
6064			X						
6065						X			
6066			X			X			
7322	X		X						Chalcedony projectile point, cupule features
7323			X						
7751			X						
7752			X						
7754			X			X			
7757	X		X						Rock rooms
7760		X	X						Stone alignment
7761						X			
7768			X						
7769			X						
7770	X		X						Biface
8248			X			X			Hearth
8249							X		Stone wall and cellar
8866									
9709						X			

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
9727			X			X			
9901		X	X						
10257			X						
10258			X			X			
10259		X	X				X		Stacked rock features and walls
10260			X						
10261			X						
10262			X			X			Serrated chalcedony biface
10263			X						
10264			X						
10265			X						
10267			X						
10268			X						
10270			X						
10271			X						
10272			X						Cupule features
10273			X						
10274			X						
10275			X						
10276			X						
10277			X						
10279			X						
10280			X				X		Purpled glass
10281			X						
11083			X						
11084			X						
11085			X						
11086			X			X			
11087			X						Cottonwood Triangular projectile point
11088			X						
11105			X						

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
11106			X						
11108			X						
11109			X						
11112			X						
11113			X						
11114			X						
11115			X						
11116			X						
11117			X						
11118			X						
11119			X						
11120			X						
11121			X						
11122		X	X						Obsidian flakes
11123			X						
11124			X						
11125			X						Heavily used
11126			X						
11127			X						
11128			X						
11129			X						
11130			X						Two areas of milling
11131			X						
11132			X						
11133			X						
11471			X						
11472			X						
11925		X							
11926			X						
11927			X						Rock shelter
11928					X			Rock art	Needs additional investigation

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
12022	X		X						Many milling features, chert and obsidian flakes
12041			X						
12125			X						
12144							X		Fenton Ranch house remnants
12158			X						
12159			X						
12473	X		X						Complex village site with activity areas; pre-1900 school site
12474			X						
12476	X		X				X		In addition to prehistoric village, 1850s adobe house on site--Montecito ranch house
12477						X			
12478			X						
12480		X	X				X		Historic dump in area
12481		X	X						
12482			X	X					
12483		X							Chert projectile point
12484			X						
12485						X			
12486		X							Two projectile points: one is serrated side-notched
12487		X	X						
12488				X					Quartz quarry; worked flakes and tools at site
12489	X		X						Cottonwood Triangular projectile point
12490		X							
12491						X			
12492						X			
12493				X					Quartz quarry with worked flakes
12494		X	X						
12495			X			X			
12496		X							Rock shelter north of site not investigated
12497	X								This site was being pot-hunted in 1991

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
12498			X						
12499			X						
12501			X						
12503						X	X		Concrete pad
12504						X			
12505		X							
12693			X						
12742	X		X						Four Cottonwood projectile points (2 quartz, one obsidian, one chert), obsidian flakes
12743							X		Possibly old Bandy homestead; no structure remains
14095			X						
14096			X						
14101			X			X			
14161			X			X			
14341			X						
15780			X						
16095			X						
16096							X		Historic earthen dam
16097			X						
16173			X						
16174			X						
16175	X		X						Residents have used metates from the site to make a monument; it is called "Metate Park"
Temp 40102-1			X			X			Cagney property
Temp 40102-2		X	X						Cagney property
Temp 40102-3		X		X					Cagney property
P-037-024554					X				Two rock alignments directed at a monolithic split rock; may be a third alignment

Site No. (SDI-)	Village	Seasonal Camp	Milling Site	Quarry	Ceremonial	Lithic Scatter	Historic	Other	Comments
P-037-024571							X		Cagney property
Total: 145 recorded sites									