Baseline Biodiversity Survey for the Rancho Jamul Ecological Reserve

U.S. Geological Survey Final Report

Prepared for:

California Department of Fish & Game

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

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ABSTRACT

Rancho Jamul Ecological Reserve, a 3,700-acre property previously operated as a cattle ranch, became part of the California Department of Fish and Game reserve system in 1998. Following this acquisition, the U.S. Geological Survey conducted surveys to establish baseline species data and vegetation data layers. Through cooperation with San Diego State University, a vegetation and land cover GIS layer was developed which details the extent and types of vegetation classes found on the reserve. This vegetation mapping established that 15 native and non-native vegetation types, the majority of which had disturbed counterparts, occurred throughout the reserve. Rare plant surveys conducted by McMillan Biological Consulting provided documentation of 131 native and non-native plant species, 18 of which are considered sensitive species. Of these, five plant species detected on the reserve are covered under the Multiple Species Conservation Program. Aquatic surveys reported four native and two non-native amphibian species and six non-native fish species. Herpetofauna pitfall arrays detected four native amphibian species, ten lizard species, and twelve snake species. Twenty-one ant species were recorded using ant pitfall traps co-located at the herpetofauna pitfall arrays. Bird point counts and incidental bird sightings recorded 94 bird species present on or near the study site. Twelve bat species were detected using mist netting, acoustic surveys, and roost site visits. Sherman live traps, combined with herpetofauna pitfall arrays small mammals captures, documented 14 small mammal species present on the reserve. Remotely triggered cameras and track stations were used to document the presence of 11 medium and large bodied mammal species. A total of 150 native vertebrate species and nine non-native vertebrate species were recorded during these surveys. Two herpetofauna species, eight bird species, and two mammal species detected on the reserve are covered under the Multiple Species Conservation Program. Incidental records of the Quino checkerspot butterfly were made onsite during the rare plant surveys, adding this reserve to its known distribution. Summary statistics, discussion, and management recommendations on the flora and fauna of the Rancho Jamul Ecological Reserve are provided in this report.

1. Introduction

The Daley cattle ranch was owned and operated from approximately 1930- 1998 until the death of the senior Daley family member. In 1998, the 3,700-acre (1,492 ha) property was acquired by the California Department of Fish and Game (CDFG) and became the Rancho Jamul Ecological Reserve (RJER), part of a statewide ecological reserve system. The U.S. Geological Survey (USGS) began work in the artificial ponds of the ranch during 1998. This work was done with funding from USGS to determine aquatic species inventories and develop a series of management recommendations for restoration of these sites if necessary. In 2001, the USGS began baseline biodiversity surveys for the CDFG. This project was multifaceted and included vegetation mapping, rare plant surveys, ant surveys, and vertebrate surveys designed to detect reptiles, amphibians, large, medium, and small mammals, birds, bats, and fishes. A variety of techniques was utilized to detect presence and, when possible, relative abundance, for these taxonomic groups. These data will serve as a basis for the development of long-term management and monitoring plans for these natural

lands that have transitioned from agricultural uses to reserve lands. This report summarizes our findings and will include the raw data in a Microsoft Access database.

2. Study Area

RJER is located slightly southeast of Jamul, California, approximately 26 miles (42 km) east-southeast of downtown San Diego (Figure 1). Two major drainage systems cross RJER from the north to the south. Jamul Creek drains the western portions and runs along the base of the Jamul Mountains, while Dulzura Creek drains the eastern portions of RJER and flows along the edge of Otay Lakes Road. Both of these creeks are part of the Otay River watershed, and join to the west where they drain into the eastern corner of the Lower Otay Reservoir.

The habitats within RJER are part of the California Floristic Province, which includes the cismontane areas from southern Oregon to coastal northwest Baja California. This floristic region is characterized by a Mediterranean climate, which has shaped the evolution and biogeography of its species and habitats (Beauchamp 1986; Hickman 1993; Holland 1986; Munz 1974; Oberbauer 1992; Raven & Axelrod 1978; Wiggins 1980).

RJER supports numerous native vegetation communities, including coastal sage scrub, chaparral, riparian woodlands, oak woodlands, vernal pools, native grasslands and other clay soil plant associations. Much of the central plateau/mesa portion of the RJER, between Jamul Creek and Dulzura Creek, is dominated by heavy clay soils. Most of these clay soils are Olivenhain with small patches of Linne and Huerhuero clay mixed in (USDA 1973).

3. Methods

We sampled vegetation, rare plants, aquatics, herpetofauna, ants, avifauna, bats, small mammals, and medium and large mammals on RJER. All sampling occurred from November 2000 through January 2002, with the exception of aquatic surveys which began in early 1998. Sampling was conducted according to the taxonomic group and survey technique. Specialists in the different survey techniques and project tasks were used and the leads for each project are listed below:

Project	Study Lead	Organization
Project management	Hathaway*	USGS
Vegetation mapping	O'Leary*	San Diego State University
Rare plant surveys	McMillan*	McMillan Consultants
Aquatic surveys	Ervin, Warburton, Fisher	USGS
Herpetofauna	Rochester*, Fisher*	USGS
Ants	Pease	USGS
Avifauna	Mendelsohn	USGS
Bats	Stokes	USGS

Small mammals	Brehme, Rochester	USGS
Large mammals	Haas*	USGS
Geospatial data and maps	Hathaway	USGS
Data development	Rochester, Hathaway, Brown	USGS
Report editing	Haas, Brehme, Madden-Smith	USGS

The various sections of the report are authored by the leads on the various projects. General supplemental sections such as abstract, introduction, conclusion, and management recommendations were completed by those names above with an "*".

3.1 Vegetation

3.1.1 Imagery Selection and Acquisition

An integrated approach of procedural steps (described below) was used to produce the vegetation and land cover maps, and summary statistics were derived for the RJER (Figure 2). An aerial photo mosaic produced by Landiscor Aerial Information Inc. was used as a base map for field mapping of vegetation and land cover types on the reserve and for their subsequent geocoding in the San Diego State University (SDSU) Center for Earth Systems Analysis Research (CESAR) laboratory. Aerial photos from which the imagery product (mosaic) was produced were flown at a scale of 1:42,000 on January 4, 2001. Image processing was completed by Landiscor Inc. with a resultant pixel resolution of 1 m (scan ppi: 1067 ppi) using the California State Plane, Zone 3401 as a projection and USGS DOQQs (X,Y) and USGS DEM (Z) as controls.

A grid system having individual cells of approximately 1 km on a side was created and superimposed on the reserve's overall imagery. Gridded subareas of the entire mosaic were plotted individually at a scale of approximately 1:2,100 for use in field mapping. These subareas, referred to as "subimages" for the remainder of this report, are consistent in scale throughout the field mapping effort.

3.1.2 Field Mapping of Vegetation and Land Cover Types

The decision rules system developed and used for the mapping of vegetation and land cover types at Marine Corps Air Station Miramar (O'Leary & Stow 2001) was used. The mapping strategy used the Holland Classification System (Holland 1986) for vegetation types. However, the Holland System is entirely descriptive in nature and suffers from lack of a decision-rules system necessary for discriminating vegetation types in a hierarchical fashion. Such a system is necessary to ensure consistent categorization of vegetation types throughout an entire mapping effort (Mueller-Dombois & Ellenberg 1974; Kuchler 1988a). To remedy this shortcoming, a quantitatively based system of decision rules was employed.

Decision mapping rules were based on the following: 1) the number following the name of each vegetation and land cover type refers to the identifying label of each polygon in the GIS database, 2) following each decision mapping rule are proximate corresponding vegetation types according to four other classification systems, 3) the five digit number that

follows "Holland" refers to the specific vegetation code in the Holland (1986) system, and 4) Corresponding vegetation types from other classifications (Paysen et al. 1980; Ogden Environmental and Energy Services, Inc., 1992; Sawyer & Keeler-Wolf 1995) follow thereafter. The vegetation classifications under these four systems are more general or coarse than the one adopted for this mapping effort, the disparity depending upon the vegetation type in question. For this reason, their vegetation types should not be considered "equivalent" with those classified here, but are simply provided for cross-reference with other mapping efforts.

Numerical cutoffs, usually expressed as a percentage of ground cover by dominant species and growth forms, were created based upon: 1) qualitative descriptions of vegetation types contained within the Holland Classification, 2) guidance provided by the Vegetation/Habitat Mapping Subcommittee of the San Diego Association of Governments (SANDAG), and 3) mapping rules for some vegetation types developed as part of the mapping effort for the Multiple Species Conservation Program (MSCP), City of San Diego. Categories for land cover and vegetation types not found in the Holland Classification were patterned after those used in the MSCP effort. Use of some MSCP categories provides a useful measure of compatibility with the MSCP planning area within which Rancho Jamul Ecological Reserve is embedded. In accordance with the project Scope of Work, a minimum mapping unit (MMU) of 0.1 acres was used for all wetland and riparian vegetation classes. All other vegetation and land cover types were mapped at a MMU of 1.0 acre. The size of the MMU's were chosen to be consistent with the ability of field mappers to discriminate and delineate features on individual images. In addition, high concentrations of noxious, non-native plant species were delineated and identified by species on individual subimages.

Individual units (stands) of vegetation and land cover types were identified in the field by means of the decision-rules system and delineated on the individual subimages. An acetate template imprinted with various geometric forms (squares, circles, and rectangles) for both MMUs was used to help determine whether a specific vegetation or land cover unit met the MMU criteria when mapping in the field. Use of imagery in field mapping also facilitated accurate delineation and encoding of polygons with the 'on-screen' digitizing process (described below) subsequently performed in the CESAR lab. Care was taken to map the outer 0.5-0.75" of individual image plots that overlapped in order to facilitate 'edgematching' when adjacent image's plots were on-screen digitized.

3.1.3 Field Mapping of Non-Native Species Concentration

In addition, locations of concentrations of non-native plant species deemed noxious or undesirable (e.g., *Arundo donax, Ricinus communis, Tamarix ramosissima, Foeniculum vulgare,* etc) were field mapped onto the individual subimages. While no specific MMU was designated for individual species, attempts were made to map any concentrations larger than approximately 10-12 m^2.

3.1.4 CESAR Laboratory Procedures

Encoding of vegetation and land cover polygons into a GIS coverage (ARC/INFO) was performed using an "on-screen digitizing" or "heads-up digitizing" approach and was based on the digital imagery coverage of Rancho Jamul Ecological Reserve. This was achieved using ERDAS IMAGINE software to generate a vector GIS layer in ARC/INFO format. Individual polygons from each mapped subimage were visually delineated and encoded on the appropriate subarea of the overall image. As mentioned earlier, use of the subimagery in field mapping facilitated accurate delineation and encoding of polygons during the digitizing process. Prior to encoding, each subimage was inspected to ensure that each field-mapped polygon was labeled and closed. After being digitized, each polygon was subsequently checked to ensure that it was closed. Color contrast, edge, and texture enhancement routines in IMAGINE facilitated polygon boundary delineation. Polygons were digitized in the graphic overlay plane of a color monitor by using a conventional mouse for location control. Each digitized polygon was checked to ensure that it was closed. After all vegetation and land cover polygons were digitized and entered into the GIS vegetation-land cover layer polygons were labeled. Codes for the vegetation and land cover types were entered manually for each polygon. Each digitized polygon was triple checked by different reviewers against its field-mapped counterpart to ensure labeling accuracy.

3.1.5 Production of Colored Maps and Summary Statistics

A preliminary color scheme for the vegetation and land cover types and map symbols was selected following the label and MMU proofing phase. Colors were carefully selected to enhance recognition of each vegetation and land cover type – particularly those having greatest aerial extent and nearest proximity. Useful summary statistics of the vegetation and land cover types were produced from the GIS coverage.

3.2 Rare Plants

3.2.1 Literature Review and Background Research

California's Natural Diversity Data Base (NDDB), soils maps, topographic maps, recent environmental reports, and professional experience with the plants and habitats of the area were reviewed for existing information on rare plant populations, or the potential for their occurrence on RJER.

The only known botanical surveys conducted on RJER were done as part of the biological impact assessment for the widening of Highway CA 94 by the California Department of Transportation (Caltrans) District 11 (Caltrans, 1997). This work was concentrated along the edges of Highway CA 94 and did not include the remainder of the ranch.

3.2.2 Field Surveys

During the 2001 season, rare plant surveys were conducted on RJER between the months of March through September. Although some of the rare plant surveys were conducted from a vehicle, most of the survey work was done on foot. Biologists Scott McMillan, Bruce April, and Brenda McMillan conducted all surveys. Most of the rare plant populations found on RJER in 2001 were mapped using a hand held GPS unit, but a few of the populations were mapped on the USGS Quadrangle and were later placed in the GIS database by hand (Figures 3-5; Appendix 1). In addition to mapping, field data were collected for each rare plant population, including population size, slope, slope aspect, as well as the disturbance factors affecting each population.

3.3 Aquatics

During 1998 – 2001 ponds within RJER were surveyed for aquatic species (Figure 6; Appendix 2). A variety of species with very divergent life histories were targeted; therefore a variety of different survey techniques was employed. These methods included: hand capture, seining, dip netting, minnow traps, and pitfall traps. These methods are discussed below and examples of species they target are listed.

3.3.1 Hand Capture

At aquatic sites, a minimal number of animals were located and capture was attempted without the use of nets. This technique has proven useful for garter snakes, turtles, and adult treefrogs (pers. obs.).

3.3.2 Seining

Seining was employed in shallow ponds that had little or no habitat complexity. Seining allowed a rapid assessment of the larger aquatic species present in the habitat through exhaustive seining of an entire pond. Seining posed little risk to native species in the area, as they were simply removed from the net and released. Because seining has the disadvantage of being ineffective in deep or heavily vegetated areas and can also be ineffective when the substrate is complex (e.g., thick aquatic vegetation, submerged woody debris, uneven bottom), it was not possible to seine all pools. This technique works very well for most fish, amphibian larvae, large macroinvertebrates, and aquatic frogs (*Xenopus*) (Meador et al. 1993; Warburton & Fisher 2002).

3.3.3 Dip Netting

Dip nets were used to capture individual animals visually detected or to sample areas between and among debris. This technique works well for small fish, all amphibian life stages, large macroinvertebrates, and reptiles (Warburton & Fisher 2002).

3.3.4 Minnow Traps

Minnow traps (Gee© minnow traps) were employed in ponds where seining was ineffective (e.g., Pump Pond) and when ponds were dominated by exotics (all ponds during the sample period). Trapping allowed for sampling multiple sites during a single sample visit. Traps work very well for fish, large macroinvertebrates, aquatic frogs, and garter snakes (Mason and Knight 2001; Warburton & Fisher 2002). Because of the larger mesh size used, they may not capture some tadpoles or small juvenile amphibians. Caution was used to not submerge the traps entirely under the water to prevent accidental drowning of aquatic frogs or garter snakes.

3.3.5 Pitfall Traps

A series of modified pitfall traps were installed at the Corral Pond. These traps were put at the upper and lower ends of the pond and were established to study the behavior of the *Xenopus* while the pond was drained. As the water level was lowered, these frogs dispersed and the traps allowed us to determine the direction and timing of dispersal movement.

3.4 Herpetofauna

Pitfall trap arrays have been widely used to obtain data on a variety of arthropods, amphibians, reptiles, and small mammals throughout southern California (Fisher & Case 2000). Twenty-one herpetofauna arrays were established across the reserve (Figure 7; Appendix 3). Each array consists of seven 5-gallon buckets connected by shade cloth drift-fences. From a center bucket three arms of drift fence extend out 15 m, thus forming a Y (Figure 8). In addition to the center bucket, each arm of the Y has a bucket placed in the middle and at the end. A meter long hardware cloth funnel trap is placed along each of the three arms for capturing large snakes and lizards. Each snake trap has a funnel on each end, allowing animals to enter but not exit, contains PVC pipe to provide shelter for organisms, and is covered with boards to provide shade for captured animals. Sampling was conducted at each array for four consecutive days every 4-5 weeks. The traps were kept closed between the sampling periods.

Captured animals were individually marked either by toe- (lizards and amphibians) or scale-clipping (snakes) and then released. In addition, captured individuals were weighed, measured, sexed, and aged. A sample period is represented by all arrays being open for four consecutive days. A total of 12 four-day sample periods were performed, resulting in 48 survey nights.

Vegetation was recorded in the vicinity of each array following established protocols of the California Native Plant Society (Sawyer & Keeler-Wolf 1995). Various local landscape features were also recorded and entered into a GIS database. The flora and vegetation at each array were measured with two 25-m orthogonal line transects. These transects were north and south of the center bucket of each array, and data were collected at points every 0.5 m for plant species, canopy height, soil type, and litter depth. The proportion of coastal sage scrub, woodland, grassland, and chaparral species were determined

based on the typical plant indicators of these habitat types (Holland 1986). Soil type was characterized into six categories at each array: sandy soil, bare rock, organic soil, moss, leaf litter, and cryptogamic crust.

3.5 Ants

Ants were sampled in association with the 21 herpetofauna and small mammal sampling locations (Figure 7; Appendix 3). Five ant pitfall traps (50mL centrifuge tubes) filled with approximately 25mL of Sierra™ brand antifreeze were installed at each herpetofauna array. This product of antifreeze preserves the specimens while remaining environmentally friendly (Suarez et al. 1998). Holes were made in the soil using a metal stake. A PVC sleeve constructed from a 1" pipe was inserted into each hole and an ant pitfall trap was inserted into the sleeve so that the opening of the centrifuge tube was flush with the ground. The five traps overlaid the existing herpetofauna array in the shape of a "+", with a trap at the center bucket and one located (in each direction) 15 m away from the center bucket (Figure 8). The four corners of the "+" were separated by approximately 20 m.

Each pitfall trap was left open for ten consecutive days. In order to reduce and prevent incidental captures between sampling efforts, the sleeves were closed using empty 50 ml centrifuge tubes with the lids remaining on. The ants were identified and counted after the samples were sorted to remove ants from non-ants and debris. When necessary, representative specimens of unknown species were sent to Dr. Andrew Suarez at UC Berkeley and Dr. Phil Ward of UC Davis to be identified. The five tubes from each array were pooled for analysis to determine the number and relative abundance of ant species at each array. Winged queens and males were noted but not used in analysis since they may have originated from outside the site.

3.6 Avifauna

Avian species were observed and recorded through morning (diurnal) point counts, night driving surveys, and incidental observations from other U.S.G.S research efforts on the reserve.

3.6.1 Diurnal Point Count Surveys

Field methods and data forms used for avifauna surveys were similar to Ralph et al. (1993). Point counts were conducted between roughly 0530 and 1130, recording all birds observed visually and/or audibly. All methods were chosen to maximize species detectability, which ultimately depends on the observer's skill, a bird's distance from the observer, and species' behavior (Nichols et al. 2000). Only mornings with favorable weather conditions (i.e., lacking rain, wind, fog, or abnormally cold temperatures that could hamper bird activity and/or detections) were used for surveys. All birds recorded included those observed visually and/or audibly. Notes regarding habitat associations of birds and signs of any breeding activity were also recorded. The counts were broken down into 0-5 minute and 5-8 minute time frames so that the results could be compared to censuses done with only 5-minute intervals. Additionally, the radius of detection was divided into 0-50 m

and 51-100 m, and observations for each were recorded in distinct columns. Fly-over observations were also recorded in separate columns. Temperature, percent cloud cover, and wind speed were noted at the beginning and end of each day.

Computer-generated point count locations were determined by overlaying a 0.25 km^2 grid on a GIS map of the study area and then placing a point in the middle of each grid cell, so that 0.5 km separated the two closest points. The actual point counts were conducted as close as possible to these computer-generated locations. The total number of points was determined by including as many points as possible that fit within the study area's boundaries. These points were then examined with an existing vegetation map (SANDAG) in an attempt to stratify across the general vegetation types present. The goal was to create a proportional allocation of points across habitat areas. Additional points were hand selected to increase the number of points in areas of specific interest, such as those in rare habitat types that were missed by the computer-generated points, or those added to target species of concern (such as points placed along Dulzura Creek to target Least Bell's Vireos and Yellow-breasted Chats). Accessibility to the computer-generated points determined the exact location in which the point count was conducted. Terrain, vegetation and hydrological features, and land ownership usually determined accessibility. The total number of census points was 68 (Figure 9; Appendix 4). Because of the relatively small size of the study area, it was decided to repeat visits to each point once, for a total of two complete cycles through the 68 points.

Flagging and GPS waypoints (Garmin 12XL) were used to mark all point count stations and to navigate to the points with relative ease. Vegetation data (measured within a 100 m radius of each point count station), substrate, hydrology, aspect, slope, and road presence data were recorded for each point. For each bird identified, the general habitat type (Chaparral, Grassland, Oak Woodland, Riparian, Coastal Sage Scrub, and Human) in which it was found was recorded. Birds using urban habitat or any non-natural structures on the study area (e.g., cisterns, telephone/electricity poles, towers and wires, fences, and corral) were lumped into the category "human" (H). If an individual bird was observed using the interface between two adjacent, or mixed, habitat types, both habitat types were recorded. For example, "C, S," implies that the bird was detected in the combined habitat type of Chaparral (C) and Coastal Sage Scrub (S).

We created files with; (1) notes on the best access, via driving and/or walking to each point, (2) a complete list of species observed, (3) notes on the habitat(s) in which each species was observed, and (4) a digital photograph of each point count station.

In conducting the point counts, especially during the first cycle, considerable time was spent following unknown birds and listening to CD's (Cornell Laboratory of Ornithology 1992) with bird vocalizations for positive identification.

3.6.2 Nocturnal Driving Surveys

In order to target nocturnal species, such as owls and Caprimulgids, two night-driving surveys (during new and full moon phases) were performed in April of 2002. Nocturnal

surveys were conducted from one to two hours before sunset until three to four hours after. During each of the two surveys, the vehicle was stopped at ten locations on roads throughout the study area for 30 minutes. At each location, vocalizations of all potential owl and Caprimulgid species were played from CD's to elicit behavioral responses from such birds for detection, both by visual (aided by the use of a spotlight) and audible (callbacks) means. Data from the night surveys were recorded onto "area search forms" available on Point Reyes Bird Observatory's website: http://www.prbo.org/tools/ index.html (Point Reyes Bird Observatory 2002).

3.7 Bats

Three types of survey methods, acoustic (O'Farrell et al. 1999), mist-nets and roost surveys (Kunz et al. 1996), were employed between November 2000 and September 2001, to conduct inventories for bats at 12 locations across the Reserve (Figure 10; Appendix 5). These techniques were used to examine bat presence and distribution, reproductive status, and foraging and roosting habitats.

3.7.1 Acoustic Surveys

An Anabat II bat detector (Titley Electronics, Balina, New South Wales, Australia) was utilized to detect and record bat echolocation signals when surveyed for foraging bats or bat activity at roost sites. Calls were analyzed and identified to the species level. The unaided ear was also used to detect audible bat echolocation and social calls, which were (in most cases) also identifiable to the species level.

3.7.2 Mist Nets

One to five mist-nets were deployed at foraging sites to capture bats. Captured bats were processed and then released immediately. Species, age, tooth wear (estimate of age), sex, reproductive status, parasite load, general measurements, and any other noteworthy information was recorded. In most cases, a digital camera was used to document the captured bat. Acoustic techniques and mist-netting were conducted simultaneously whenever possible. These complimentary techniques, when used together, provide for an effective means of surveying for foraging bats (O'Farrell & Gannon 1999).

3.7.3 Roost Surveys

Methods used to conduct roost searches include visual and acoustic surveys and, when suitable, mist-netting and hand-netting bats. Some bat species are more easily detected at roost sites (e.g., Townsend's Big-eared bat: *Corynorhinus townsendii*) than foraging sites and so this technique was used to compliment the other two survey methods for conducting a thorough bat inventory. Roost surveys were conducted cautiously knowing that many bat species are sensitive to disturbance at roost sites (Pierson 1998).

3.8 Small Mammals

Two methods were used to capture small mammal species (Jones et al. 1996): Sherman live traps (H. B. Sherman traps, Inc., Tallahassee, FLA) and the pitfall traps associated with the herpetofauna arrays.

3.8.1 Sherman Live Traps

Small mammals were sampled in association with the herpetofauna arrays (Figure 7; Appendix 3). Two sizes of Sherman live traps (large 4 x 4 1/2 x 15" and small 3 x 3 1/2 x 12") were used to capture small mammals. A total of 18 traps (nine small and nine large) were placed around each herpetofauna trapping array (Figure 11). Traps were set in the late morning or afternoon of the first day and then checked each following day starting at sunrise. Traps were baited with a mixture of wild birdseed and rolled oats. Each setting and sampling period typically took five to six hours. Animals captured were weighed, measured (head & body, tail, tuft, hind foot, and ear lengths), assessed for reproductive condition (Kunz et al. 1996), and marked. Marking of rats was done using ear tags, whereas mice were toe clipped. All animals had at least one toe clipped for tissue collection. All mammals were treated in accordance with the American Society of Mammalogists' most recent animal use protocol statement (http://www.mammalsociety.org/committees/index.asp) and approved USGS/WERC ACUC study plan.

Data were analyzed for each array and over the entire reserve. The total number of species captured was used as an index of species richness. Capture rate was used as an index of relative abundance and was calculated using the following equation:

$$CR = \{c_j / t_j n_j\}$$

where, CR = Capture Rate
c_j = number of individuals captured by species (does not include recaptures)
t_j = number of traps set
n_j = number of nights traps were opened

3.8.2 Herpetofauna Array Pitfall Buckets

Small mammals were also captured in the buckets comprising each of the 21 herpetofauna arrays (see Section 3.1.4 for a more detailed explanation of trap configuration and sampling methods). Small mammal species captured in pitfall traps were identified, when possible, and recorded. However, they were not weighed, measured, or marked as was done with the Sherman live trap portion of the study. Data were analyzed as the number of confirmed captures per array site. Capture rates were not calculated, since not all small mammal species captured by the herpetofauna field crews were identified to the species level or individually marked.

3.9 Medium and Large Mammals

Two sampling techniques were used to document the distribution and relative abundance of medium and large bodied mammals across the site: track surveys and remotely triggered camera surveys.

3.9.1 Track Surveys

Scent stations have been widely used as a means to monitor trends in carnivore populations. Following methods developed by Linhart and Knowlton (1975), track surveys have been shown to be effective measures of distribution and relative abundance of mammalian species (Conner et al. 1983; Sargeant et al. 1998).

Five track transects were established along dirt roads throughout the property. Each 1000 m transect consisted of five scent stations at approximately 250 m intervals (transect 1: stations RJ 1 – RJ 5; transect 2: stations RJ 6 – RJ 10; transect 3: stations RJ 11 – RJ 15; transect 4: stations RJ 16 – RJ 20; transect 5: stations RJ 21 – RJ 25) (Figure 12; Appendix 6). To further assess the movement of large and medium bodied mammals, track transects were also established along major roadways bordering the property (Figure 12; Appendix 6). Scent stations along these transects (five scent stations along Highway CA 94: stations 94-1 through 94-5; six scent stations along Otay Lakes Road: stations OL 1 – OL 6) were established at varying intervals to 1) detect potential crossing locations by mammals and 2) to compare relative abundance of mammal species along certain portions of these roadways. Furthermore, six underpasses (four along Highway CA 94; two along Otay Lakes Road) were monitored to document mammal activity through these crossing structures (Figure 12; Appendix 6). Each scent station consisted of a 1 m^2 plot of finely sifted gypsum powder and a rock, placed in the middle of the station, baited with two artificial scent lures every other day (Russ Carman's Pro Choice and Canine Call). Stations were checked for visitation for five consecutive mornings. If an animal visited a station, tracks were identified to species and the station was cleared and resifted. Scent stations were surveyed quarterly: spring, summer, and fall 2001 and winter 2002.

To obtain an index of relative abundance, the number of visits by each species was divided by the total sampling effort. This index was calculated using the following equation:

$$I = \{v_j/(s_j n_j)\}$$

where, I = index of carnivore activity at transect j
v_j = number of stations visited by species at transect j
s_j = number of stations in transect j
n_j = number of nights that stations were active in transect j

Any scent station in which tracks were too difficult to read was omitted from the sampling night. Thus, the true sampling effort was:

$$\{s_j n_j\} - o_j$$

where, o_j = number of omits in transect j

This index does not provide data on the absolute number of individuals. Instead, the index is used to compare relative abundance of species across space and time (Conner et al. 1983; Sargeant 1998). Track indices were pooled across seasons to derive a single track index per transect for each individual species.

3.9.2 Camera Surveys

Remotely triggered cameras have increasingly become a useful tool in recording activity of various wildlife species (Griffiths & Van Schaik 1993; Jacobson et al. 1997; Karanth & Nichols 1998). Cameras provide a relatively low-maintenance means of surveying wildlife populations because visitations to the units are only made to change film and batteries.

Five Camtrak cameras (Camtrak South Inc, 1050 Industrial Drive, Watkinsville, GA 30677) were placed along wildlife trails and dirt roads throughout the property (Figure 12; Appendix 6). Each pass of an animal by the infra-red sensor triggered the camera. Date and time of pass were recorded on each print. Cameras were operated between May 2001 and March 2002.

To obtain an index of relative abundance, the number of visits by each species was divided by the total sampling effort. This index was calculated using the following equation:

$$I = \{v_j/n_j\}$$

where, I = index of activity at camera j
v_j = number of passes by species at camera j
n_j = number of nights that camera j was active

Camera indices were compared among camera locations to detect relative activity levels of species across the property.

4. Results and Discussion

4.1 Vegetation

4.1.1 Vegetation and Land Cover Maps

A draft map was produced, inspected, and edited for layout and color scheme appearance. Several iterations of the above step occurred until a satisfactory final product was produced. In addition, a 1:8,000-scale map was created that delineates high concentrations of noxious, non-native plant species on the reserve. Smaller concentrations (< 0.1 acre) of non-native species are indicated by symbols rather than polygons on this map. Useful summary statistics of the vegetation and land cover types were produced from the GIS

coverage. In addition, a map showing concentrations of non-native plant species was produced.

A 1:8,000-scale vegetation and land cover map of Rancho Jamul Ecological Reserve was produced using the procedural steps described in Section 3.1 (Figure 13). Because polygons were field mapped and subsequently encoded at a relatively large scale (approximately 1:2,000), additional maps of subset areas were accurately produced at scales as large as 1:2,000. Smaller-scaled versions of the entire map (i.e., <1:8,000) may be produced down to a recommended lower limit of approximately 1:35,000 scale, below which the smallest MMU on the map (0.1 acres) would become difficult or impossible to discern (Kuchler 1988a). However, because wetland and riparian vegetation types were mapped down to 0.1 acre MMU, maps of the entire reserve printed containing discernable polygons of these vegetation types should not be printed at a scale less than 1:24,000.

4.1.2 Vegetation and Land Cover Statistics

Preliminary summary statistics of vegetation and land cover types were produced from the GIS layer and inspected for irregularities. About 12% of the polygons were below the MMU specified for various vegetation and land cover types. Occurrence of these polygons that were below a specified MMU was due to: 1) slight overestimation of their minimal size by field mappers, and/or 2) truncation of larger polygons that extend beyond the reserve's boundaries. Undersized polygons resulting from the first reason were individually inspected and eliminated by incorporating them into adjacent polygons based upon: 1) greatest length of common boundary, and/or 2) greatest floristic similarity.

Twenty-eight vegetation/ land cover types were classified during the 2001 mapping effort of RJER. Two types of non-vegetated land cover were mapped, open water and developed. The open water category constituted less than 0.01% of the reserve's total area, and the developed area (1.2%) occurred largely in and around the former Daley Ranch compound. Summary statistics of vegetation and land cover types found on Rancho Jamul Ecological Reserve based on the 2002 mapping effort are presented in Table 1.

Fifteen native and non-native vegetation types were mapped, eight of which had disturbed versions present on the reserve. All but two of the 15 vegetation types are recognized by Holland (1986), one of which (non-native grassland) is dominated by non-native species. The second vegetation type, mixed grassland, was deemed ecologically important (O'Leary & Stow 2001) and was included with the list of Holland recognized vegetation types. Mixed grassland contains roughly equal proportions of native and non-native grassland species. This category was added in an effort to recognize potentially important grassland areas that contain substantial though non-dominant percentages of *Nassella* spp.

A 16th vegetation type, disturbed habitat, was also recognized by the MSCP mapping effort and covered 4.9% of the reserve. Polygons classified as disturbed habitat formerly contained native vegetation that has been largely or entirely removed by brushing, tilling, or some other form of past mechanical disturbance. No other vegetation type exhibited as much

compositional variation. Ground cover was typically dominated by non-native ruderal species, especially forbs such as *Erodium cicutarium.* However, native shrubs such as *Lotus scoparius, Eriogonum fasciculatum,* and non-native grasses were commonly found admixed.

Coastal sage scrub (29.3%) and its disturbed counterpart (19.2%) constitute the greatest total cover (48.5%) of any native vegetation type found at the reserve. Grassland vegetation types comprise 41.4% of the reserve's overall cover. Of these, 84.8% are non-native grassland. The largest concentrations of non-native grasslands are former agricultural fields that occur immediately south of Highway CA 94 in the reserve's northern portion. It is likely that most non-native grassland vegetation on the reserve represents a "type conversion" from coastal sage scrub as a result of agricultural displacement by various crops or heavy grazing pressure by cattle (Keeley 2000). Grassland types containing substantial amounts of native grasses (*Nassella* spp.) in the upland, south-central portion of the reserve occur largely on clay-rich soils and may represent degraded forms of native grassland that existed prior to cattle ranching. Wetland vegetation types comprise 2.77% of the reserve's entire area and are typified by relatively smaller-sized polygons. Southern arroyo-willow riparian forest had the greatest relative coverage (1.06%) and is concentrated along Dulzura and Hollenbeck Creeks. The quality of riparian vegetation along these streams is likely a result of year-round stream flow resulting from water released upstream from Barrett Lake. With the exception of coastal and valley freshwater marsh and mulefat scrub, the various wetland vegetation types were relatively undisturbed. Chaparral vegetation and oak woodland are relatively scarce and constitute 0.58% and 0.55% of the reserve's total area.

4.1.3 Map of Concentrations of Non-Native Plant Species

Locations of noxious and undesirable non-native species were mapped in two formats, greater or less than 0.1 acres (Figure 14). Areas larger then 0.1 acres are displayed as polygons and those less are symbols.

4.1.4 Map Limitations

Mapping accuracy is a combination of good base images (scale here), software accuracy (Erdas, Arc Info) and ground truthing. Some inaccuracies of a categorical and spatial nature likely exist in the maps. Broadly, categorical or misclassification errors could result from misjudgment of the floristic composition or degree of disturbance of a particular polygon. Errors of this type would be most probable where floristic composition or degree of disturbance are in transitional situations with respect to cut-off points in the decision-rules system. This problem was most apparent in the effort to differentiate various grassland types, especially native and mixed types. Difficulty was due largely to high spatial variability or patchiness in the composition of native versus non-native species within many of the larger Non-Native Grassland polygons

Positional or boundary mapping errors may occur. The overall image contains positional errors that normally range between 5-13 meters. Consequently, individual vegetation and land cover polygons field mapped onto individual sub-images may contain slight distortion. Boundary mapping "errors" may result from difficulty in determining an

exact boundary between two vegetation types. While transitions or ecotones between some vegetation types are fairly abrupt, others are more gradual, making boundary placement between them somewhat more subjective (Kuchler 1988b). Digitizing error represents our final type of error that occurs. The digital vector layer representing vegetation and land cover polygons was created by manually copying the hand-drawn polygons from printed subimages to the overall image using a mouse pointer in IMAGINE. As a result, there are minor errors in the shapes of final map polygons with respect to the field-mapped polygons.

4.2 Rare Plants

A total of 131 native and non-native plant species were documented during the 2001 spring and summer season (Figures 3-5; Appendices 7-9). Eighteen of these plant species are considered sensitive (Table 2; Appendix 9). Of these, 13 species are listed as sensitive by government agencies or other native plant authorities (Table 2). Four of these species are covered by the San Diego MSCP: San Diego thorn-mint (*Acanthomintha ilicifoia*), San Diego barrel cactus (*Ferocactus viridescens*), Otay tarplant (*Hemizonia conjugens*) and San Diego goldenstar (*Muilla clevelandii*). Two of these species, Otay tarplant and San Diego thorn-mint, are listed as federally threatened and state endangered. The Otay tarplant was only detected at 2 locations (Figure 4) and San Diego thorn-mint was only detected as an incidental observation during the vegetation mapping field work. Five additional plant species have been included in the sensitive plant species list for reasons that are discussed within the sensitive plant species accounts in Appendix 9.

4.3 Aquatic Species

There are seven major ponds on the reserve that were wetted when ranching was halted in 1998. These ponds were assigned the following names: Canyon Pond, the Cistern, Corral Pond, Kiln Pond, Pump Pond, Rancho Pond, and Willow Pond (Figure 6; Appendix 2). The seven ponds were visited to determine the extent of surface water, whether the pond contained water or if was dry (Table 3), and to determine species presence (Table 4). Over the course of the four-year survey period from 1998 to 2001, all ponds were observed, with the exception of the Cistern and Pump Pond, dry up and become wetted again by yearly rainfall patterns. The Willow Pond is proximate to the Cistern and apparently can be filled by water being piped into it. Willow Pond was observed full on two occasions that were not associated with natural rainfall events. Two ponds were experimentally drained in 1999 to determine if this management action augmented native species diversity. Sparse rainfall during 2000 and 2001 has resulted in many of these ponds remaining dry without augmentation from the canal system.

Established populations of introduced species occurred in all seven of the ponds. Two of the ponds, Corral Pond and Rancho Pond (Figure 6), were pumped dry in 1999. Across all seven of the ponds, four native species were captured, including western spadefoot toad (*Spea hammondii*), western toad (*Bufo boreas*), Pacific treefrog (*Hyla regilla*), and two-striped garter snake (*Thamnophis hammondii*). Non-native species captured included the red swamp crayfish (*Procambarus clarkii*), African-clawed frog (*Xenopus laevis*), bullfrog (*Rana catesbeiana*), mosquito fish (*Gambusia affinis*), green sunfish (*Lepomis cyanellus*),

bluegill sunfish (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and black bullhead (*Ameiurus melas*). All non-native species captured were collected for additional research objectives (i.e., examinations for parasites, collection of vouchers for regional museums) or were euthanized on-site.

As various ponds dried, either through evaporation or through pumping efforts, several non-native fish species disappeared from the ponds. After the different drying episodes, green sunfish (*Lepomis cyanellus*) were no longer found in Canyon Pond, Rancho Pond, or Willow Pond, bluegill sunfish (*Lepomis macrochirus*) were no longer found in Kiln Pond or Willow Pond. In addition, Willow Pond lost largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and mosquito fish (*Gambusia affinis*) after going dry. Toward the end of the study, no non-native fish were detected at the five ponds that went dry, although some native species were detected after drying. Pump Pond and Cistern Pond, which retained water throughout the duration of this study, maintained their populations of non-native fishes.

4.4 Herpetofauna

Twenty-one pitfall trap arrays were surveyed for a total of 48 days across 12 sample periods from March 2001 through April 2002 (Table 5 & 6; Figure 7; Appendix 3). A total of 633 individual captures were recorded representing 26 species, of which 25 are native and one is introduced (Stebbins 1985; Fisher & Case 1997). These species include four amphibians, 10 lizards, and 12 snakes (Table 5; Appendix 10). The exotic species was a Bullfrog (*Rana catesbeiana*) heard calling near array 12. Only one herpetofauna species known to occur on site was not detected in the pitfall trap arrays, the Pacific treefrog (*Hyla regilla*). However, this species was detected during aquatic species surveys (Table 4). Included in these 26 species are three of CDFG's species of special concern (*Spea hammondii*, *Cnemidophorus hyperythrus*, and *Phrynosoma coronatum*) and two MSCP covered species (*Cnemidophorus hyperythrus* and *Phrynosoma coronatum*). Arrays 2 and 10 yielded the most captures (79 and 65), whereas arrays 13 and 15 yielded the fewest captures (six and seven respectively). Species diversity was highest at arrays 9 and 19 (12 species at each array). Species diversity was lowest at arrays 13 and 17 (two species at each array). Table 6 details pitfall trap array captures of herpetofauna species for each month. Pitfall trap arrays were not sampled during the months of January and November. Highest species diversity was observed during the month of May (19 species). Lowest species diversity was observed during the month of December (six species). Capture rate trends followed species diversity trends, peaking in May (17.6 individuals/day) and bottoming out in December (1.6 individuals/day).

RJER is within the range maps of several other herpetofauna species (Stebbins 1985) which were not detected during the course of this study. Species that may be present but were not detected are the rosy boa (*Charina trivirgata*), glossy snake (*Arizona elegans*), night snake (*Hypsiglena torquata*), California lyre snake (*Trimorphodon biscutatus*), speckled rattlesnake (*Crotalus mitchellii*), arroyo southwestern toad (*Bufo californicus*), California treefrog (*Hyla cadaverina*), pond turtle (*Clemmys marmorata*), California legless lizard (*Anniella pulchra*), and the coastal banded gecko (*Coleonyx variegatus*) (Appendix

11). Of these, only the arroyo southwestern toad and the pond turtle are listed as species covered by the MSCP. A rosy boa was found as a road kill on Otay Lakes Road adjacent to west end of the property during the spring of 2000. The majority of the expected species are secretive, cryptic, habitat specialists, and have been hard to detect at other study sites as well. Further trapping and survey efforts, designed to target a specific species, would be needed to confirm the presence or absence of these species. The banded gecko (*Coleonyx variegatus*) has both been shown to be indicator species, whose presence reflects a rich herpetofauna community (Case & Fisher 2001). The absence of detection of the above species should not be taken as an absence of presence. The data presented here only covers one year's worth of pitfall surveys and 48 survey nights. Other herpetofauna pitfall study sites around San Diego County have continued to document new species into the fifth survey year.

The vegetation and habitat data for these pitfall locations are presented in Appendix 12, 13 and 14.

4.5 Ants

At total of 5,160 individuals, representing four subfamilies and 21 species were captured during ant sampling (Table 7; Figure 7) across three sampling periods: winter 2001 (March), summer 2001 (August), and winter 2002 (January). All ants found are native to the area. The most abundant species, determined by total number of individuals captured, were *Forelius foetidus* (2195), *Dorymyrmex bicolor* (1637) and *Pogonomyrmex rugosus* (686) (Table 7). However, the numbers of individuals for both *Forelius foetidus* and *Dorymyrmex bicolor* were biased by one unusually large sample of each species. The most widespread species, determined by the highest percent array occurrence, were *Crematogaster californica* (81%), *Solenopsis xyloni* (71%), *Forelius foetidus* (62%), and *Pheidole vistana* (52%) (Table 7).

With a few exceptions, most ant species do not function well below 20°C, and cease to function below 10°C (Hölldobler & Wilson 1990). Consequently, nine species were detected in each winter sample effort, and 21 species were found in the summer sample. The total number of species from both winter sampling efforts was 12. After removing the two unusually large samples of *Dorymyrmex bicolor* and *Forelius foetidus*, the total number of individuals sampled in winter 2001 was 66, in summer 2001 was 1,376, and in winter 2002 was 133. The data support a clear relationship between outside temperature (and probably other related environmental factors) and the number of foraging workers.

Because the pitfall trap design is geared toward the collection of epigeic (aboveground foraging) ants, this technique may potentially under-sample hypogeic (belowground foraging) and arboreal ants. However, evaluation of pitfall traps as a sampling method for ground-dwelling ants found that most epigeic ants are well represented, especially in open habitats (Bestelmeyer et al. 2000). Also, Suarez et al. (1998) found reasonable epigeic diversity estimates using the proposed sampling technique in coastal sage scrub habitat.

4.6 Avifauna

During our point count surveys, 66 species, representing 1,842 individual birds, were detected (Table 8; Figure 9). The points with the greatest number of detected species were station 55 (23 species), station 54 (19 species), and station 51 (18 species); the points with the fewest number of species detected were station 2 (two species) and stations 4, 6, and 7 (three species). Included in the table is "unidentified hummingbird" detected at several point count stations. In most instances, these were likely female and/or juvenile Black-chinned, Anna's, or Costa's Hummingbirds, based on size, and bill and plumage characteristics. The habitats and dominant plant species for each point are presented in Appendix 15. Incidental observations performed while traveling about the reserve (e.g., while installing herpetofaunal pitfall trap arrays, performing vegetation transects, and traveling between point count locations) resulted in an additional 20 species not observed during point count surveys and the night surveys, coupled with reported sightings from colleagues, produced an additional five species not observed during daylight (Table 9). Therefore, a total of 91 avifauna species were detected across the reserve (Table 9; Appendix 10). Finally, two species (Prairie Falcon and Black-chinned Hummingbird) were not confirmed, but remain as "probable" sightings.

The percentage of each habitat type covered by the point count stations was coastal sage scrub (54%), grassland (34.2%), riparian (4.9%), chaparral (4.7%), oak woodland (2.0%) and human (0.3%) (Figure 15). The greatest number of species (65%) was recorded in coastal sage scrub, which is considered to be inherently rich in biodiversity (Atwood 1993). Although they combined to cover less than 7% of the habitat sampled, chaparral and oak woodland habitats both revealed relatively large proportions of the complete suite of species observed on the study area. Chaparral contributed 22% and oak woodland contributed 21% of all species detected. Consistent with the literature (Knopf et al. 1988), riparian habitats were especially diverse, contributing 12.4% of the total individuals observed and 49% of the species observed during point counts, despite comprising only 4.9% of the area sampled during the point count surveys. Grasslands have been described as habitats of "simple" structure (Cody 1985), and this could likely explain the relatively low proportions, mainly in individual abundance, contributed by this extensively sampled habitat type.

The greatest number of detections was recorded in coastal sage scrub (876 individuals; 43 species), fly-overs (409 individuals; 32 species) and in riparian areas (228 individuals; 33 species) (Table 10). Although fly-overs were recorded as non-habitat-specific, biologically speaking many species do have preferences of vegetation associations over which they tend to fly (M. Mendelsohn, pers. obs.). While habitat generalists such as the European Starling may be seen aerially over any number of habitats, habitat specialists are usually seen aerially over a specific habitat (i.e., California Gnatcatcher's over CSS; Yellow Warbler over riparian areas). Thus, many fly-over observations could likely be, at least for the habitat specialists, considered supplementary to each of the habitat-specific columns.

Thirteen species or subspecies listed as rare, threatened, endangered, of special concern, or fully protected by state and/or federal wildlife agencies were recorded on the study area (Table 11; Appendix 10). Eight of these are covered under the MSCP, Northern

Harrier (*Circus cyaneus*), Peregrine Falcon (*Falco peregrinus*), Burrowing Owl (*Athene cunicularia*), Bell's Vireo (*Vireo bellii*), California Gnatcatcher (*Polioptila californica*), Western Bluebird (*Sialia mexicana*), Rufous-crowned Sparrow (*Aimophila ruficeps canescens*), and Savannah Sparrow (*Passerculus sandwichensis*). A probable fourteenth, the Prairie Falcon, is a Species of Special Concern in the state of California. The paucity of observations, as displayed in the low number or lack of observations during point counts, of such listed species may be a function of their actual low abundance on the study area as well as the limitations of point count surveys. More intensive and species-specific survey protocols should be used for these birds, especially when trying to accurately assess true populations of rare, threatened, or endangered birds.

RJER is within the range maps of several other bird species (Sibley 2000). Species covered under the MSCP that may be present but were not detected are the Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Ferruginous Hawk (*Buteo regalis*), Golden Eagle (*Aquila chrysaetos*), Southwestern Willow Flycatcher (*Empidonax traillii extimus*), and the Coastal Cactus Wren (*Campylorhynchus brunneicapillus couesi*) (Appendix 11). Further surveys would be needed to confirm the presence or absence of these species.

4.7 Bats

4.7.1 Bat Detections

Bat surveys were conducted on 14 different nights at 12 sites on the reserve between November 2000 and November 2001 (Table 12; Figure 10). Twelve bat species were detected among all survey types (Table 13). The most commonly detected species was the Yuma myotis (*Myotis yumanensis*), which was detected at 11 of the 12 survey sites. The least commonly detected bat species were the Townsend's big-eared bat (*Corynorhinus townsendii*), the hoary bat (*Lasiurus cinereus*), and the big free-tailed bat (*Nyctinomops macrotis*). Each was detected once over the course of the study; the hoary bat and big free-tailed bat were detected with low confidence. However, a recent road-cruising survey conducted this past spring (2002) resulted in the finding of a dead hoary bat on Otay Lakes Road in the vicinity of the Rancho Jamul Ecological Reserve. This find confirms the presence of this species in the area. The record for the Townsend's big-eared bat was based on a visual observation of a single individual of this species while it night roosted at the bridge on Highway CA 94 over Dulzura Creek near Otay Lakes Road on November 21, 2001 (culvert 4; Figure 12). Another bat species that was detected infrequently on site is the pallid bat (*Antrozous pallidus*). This species was recorded along Dulzura Creek on May 3, 2001. A small group of these bats (approximately six) were also observed night roosting at the Highway CA 94 bridge site on June 5, 2001 (Table 14). One individual was captured with a hand-net but it escaped out of the net before it could be processed (sexed, measured, photographed, etc). Observations of the pallid bat and Townsend's big-eared bat are significant in that both species appear to be rare in the western lowlands of San Diego County. Western mastiff bats (*Eumops perotis*) were heard (audible bat species) at six of the 12 sites surveyed. Multiple individuals were heard early in the night on several occasions indicating that there is a colony located in the vicinity of, although not within, the RJER.

4.7.2 Breeding Bats

Females in breeding condition of two bat species, the Yuma myotis and big brown bat (*Eptesicus fuscus*), were captured on the Rancho Jamul property confirming that at least these two species are breeding on site. Pallid bats are also likely to be breeding on site based on the observation of the cluster of six or so bats night-roosting at the bridge on Highway CA 94.

4.7.3 Bat Foraging Habitats

Bat foraging habitats surveyed that would be considered significant include Dulzura Creek, Jamul Creek, the Pump Pond, and the Kiln Pond. All but one bat species (Townsend's big-eared bat) detected on site were detected along Dulzura Creek, indicating the importance of this creek to bats in the area. This creek, along with Jamul Creek, has riparian vegetation types (primarily sycamores and oaks) associated with it that are supportive of both foraging and roosting bats. Dulzura Creek typically has year round water flow, which would benefit bats by providing a constant source of drinking water and increased aquatic-emergent insect availability. However, this creek has dried up since the local water authority shut off the water release from Barrett Lake to Otay Lakes in late summer 2001. This drying of Dulzura Creek has likely negatively affected bats in the area. The Pump Pond is an important resource to bats and other wildlife at the Rancho Jamul Ecological Reserve because it has water present year round. However, the steepness of the slopes surrounding this pond, combined with the riparian vegetation that grows around its edge, may prevent many bat species from being able to drink from it, though they can still feed on the insects that are associated with it. The Kiln Pond typically holds water late into the summer, except during unusually dry years, such as this year (2002). It lacks steep surrounding walls and is not blocked by vegetation and thus is accessible to bats for drinking purposes. This is one of very few accessible sources of drinking water to bats on the reserve that holds water into late summer. The Kiln Pond's importance to bats was confirmed by the capture of lactating female big brown bats in late June 2001. Several other animals were observed visiting the Kiln Pond during the bat survey including deer, coyotes, several black-crowned night herons, and many other smaller bird species, indicating the importance of this water source to wildlife on the Rancho Jamul Ecological Reserve. Preservation of open water habitats on the reserve will benefit bats and other wildlife on the property.

4.7.4 Bat Roosting Habitats

Several habitats on the reserve are or may be important to roosting bats. Roosting habitats surveyed include the bridge on Highway CA 94 over Dulzura Creek near Otay Lakes Road, the historic brick kiln, and the horse stables near the main house. Several bat species, including Yuma myotis, California myotis, Townsend's big-eared bat, and pallid bats, were documented night roosting in the Highway CA 94 bridge over Dulzura Creek during the June 5 and November 21, 2001 surveys (Table 14). The structural design (girder construction) and location (over Dulzura Creek) of this bridge make it an ideal night roost for bats in the area. The historic brick kiln was surveyed for day roosting bats on a single date (June 5, 2001). A single western pipistrelle was observed emerging from the kiln at sunset. Several

Yuma myotis were observed visiting the kiln after dark, most likely to use it as a night roost. A pair of barn owls with their young were observed nesting at the kiln on this date as well. The presence of these owls may deter bats from using the kiln as a day roost. It is possible the kiln is used at some other time during the season as a bat day roost, but more surveys would be needed to document this. The horse stables located near the main house were also inspected for roosting bats. A single visit to this site revealed the presence of small amounts of bat guano in one of the corners of the structure. However, no bats were found during the day. This structure is likely used by bats as a night roost only. There is currently a colony of bees occupying this structure, which has deterred any further investigations for roosting bats. In addition to the roosting habitats surveyed on site there are likely several habitats suitable for roosting bats that were not surveyed due to time constraints. There have been, on several occasions, a moderate number (15-20) of big brown bats observed flying early in the evening along Jamul Creek originating from somewhere upstream from the Pump Pond. These bats undoubtedly exist as part of a colony that roosts somewhere in the vicinity of upper Jamul Creek. This colony may exist on the Rancho Jamul Ecological Reserve property itself or somewhere adjacent to it. It is suspected that the big brown bat colony exists in a cavity of one of the large trees, most likely a sycamore, located along Jamul Creek between Highway CA 94 and the Pump Pond. Preservation of large trees (alive and dead) on the reserve would help preserve any bat colonies that may exist in one or more of the trees and also help in maintaining bat foraging habitat. Preservation of structures such as the bridge on Highway CA 94 at Dulzura Creek and the historic brick kiln will also benefit bats on the Rancho Jamul Ecological Reserve.

There are two additional bat species that would be expected to occur on the reserve but were not documented during the course of this study, the Red bat (*Lasiurus blossevillii*) and the Long-eared myotis (*Myotis evotis*). However, in August 2002, after the completion of this study, one Long-eared myotis was found night roosting under the bridge on Highway CA 94 over Dulzura Creek.

4.8 Small Mammals

4.8.1 Focused Survey of Small Mammals Using Sherman Live Traps

Small mammals were surveyed for a total of four nights at each of the 21 arrays. Sherman trap sampling was performed for two consecutive nights each during the weeks of July 9 and August 20, 2001. A total of 1,512 Sherman live trap nights resulted in 153 captures representing 122 individuals of six species (Table 15; Figure 7). The most abundant and widespread species captured was *Chaetodipus fallax* (80 individuals at 18 arrays), followed by *Peromyscus eremicus* (29 individuals at eight arrays). Both these species are common residents of coastal sage scrub communities (REF). For other species (*Peromyscus maniculatus*, *Mus musculus*, *Dipodomys simulans*, and *Neotoma lepida*), between two and four individuals were captured at either one or two array sites. Species capture rates are also presented in Table 15.

4.8.2 Small Mammals Captured During Herpetofauna Pitfall Trap Sampling

Extensive pitfall sampling (7056 trap nights) resulted in 245 captures representing 11 species (Table 16; Figure 7). Pitfall trap methods confirmed the widespread presence of *Chaetodipus fallax* at all arrays. Results also documented the widespread presence of the *Reithrodontomys megalotis* (captured at 20 arrays) and *Peromyscus maniculatus* (captured at 14 arrays). Other species captured that were not documented in the focused Sherman live trap surveys included *Notiosorex crawfordi* (captured at nine arrays), *Microtus californicus* (captured at eight arrays), *Thomomys bottae* (captured at eight arrays), *Sorex ornatus* (captured at five arrays), and *Peromyscus californicus* (captured at two arrays). The only species captured in Sherman live traps that was not captured in the pitfall traps was *Mus musculus*.

4.8.3 Combined Results of Surveys

When combining both survey methods, a total of 14 small mammal species were detected (Table 17). One of these species, *Chaetodipus fallax fallax*, is a state species of special concern. Only one of the 14 species, *Mus musculus*, was non-native. Arrays with the greatest number of species captured were array 10 (nine species), array 19 (eight species), and array 18 (seven species) (Table 17). Arrays with the fewest number of species captured were arrays 13 and 15 (two species) and array 14 (three species) (Table 17).

It is advantageous to perform both pitfall and Sherman trap sampling for a complete small mammal survey (Szaro et al. 1988). Species such as *N. crawfordi, S. ornatus, T. bottae*, and *R. megalotis* are preferentially captured in pitfall traps because of their small size, fossorial nature, and/or their preference for alternate foods (McComb et al. 1991). The larger small mammals, such as *P. californicus*, *Neotoma* and *Dipodomys* species are preferentially captured in Sherman traps because of their decreased likelihood of falling into pitfall traps and their subsequent ease of escape. Medium-sized species of the genus *Peromyscus, Chaetodipus,* and *Mus* are effectively captured using either method (Brehme pers. obs.). This study documented the presence of a wide variety of species. The greater number of species documented using pitfall sampling was in part a result of a significantly greater trapping effort (over 7,000 trap nights of pitfall trap surveys; 1,512 trap nights of Sherman trap surveys) and greater coverage of temporal changes in species occurrence and abundance (all seasons for pitfall trap surveys; summer only for Sherman trap surveys).

RJER is within the range maps of several other rodent species (Jameson & Peeters 1988). Species that may be present but were not detected are the Dusky-footed woodrat (*Neotoma fuscipes*), California pocket mouse (*Chaetodipus californicus*), Brush mouse *(Peromyscus boylii),* Broad footed mole *(Scapanus latimanus),* Southern grasshopper mouse (*Onychomys torridus*), and Brush rabbit *(Sylvilagus bachmani).* Further trapping and survey effort would be needed to confirm the presence or absence of these species.

4.9 Medium and Large Mammals

Eleven mammal species were detected across the reserve. Track surveys detected seven species within the reserve (Table 18), five species along the two roadways (Table 19 & 20), and eight species through the underpasses (Table 21). Camera surveys detected six species (Table 22).

4.9.1 Track Surveys

Seven medium to large mammal species were detected within the reserve, including six native species (mule deer, coyote, bobcat, gray fox, raccoon, and striped skunk,) and one non-native species (domestic dog) (Table 19; Appendix 10). Track stations also documented the presence of several smaller mammal species, including squirrels, rabbits, kangaroo rats, and mice. Transect 3 was visited by seven species, transects 1, 4, and 5 were visited by five species, and transect 2 was visited by four species. Mule deer, coyotes, and domestic dogs were detected on all five transects, bobcats were detected on four transects, and raccoons and striped skunks were detected on three transects. Coyote activity was highest along transect 2, bobcat activity was highest along transect 4, and mule deer activity was highest along transect 3.

Five species were detected at track stations along Highway CA 94 and Otay Lakes Road; two species along Highway CA 94 (Table 19) and five species along Otay Lakes Road (Table 20). Coyotes and domestic dogs visited all of the track stations along Highway CA 94. Station 6 along Otay Lakes Road was visited by four species: coyote, gray fox, raccoon, and domestic dog (Table 20). Stations 1-3 were visited by three species and stations 4 and 5 were visited by two species.

Eight species were detected using underpasses along Highway CA 94 and Otay Lakes Road; eight species through the four underpasses along Highway CA 94 and two species through the two underpasses along Otay Lakes Road (Table 21). Culvert 3 had five species utilize it, including coyote, bobcat, raccoon, striped skunk, and spotted skunk. Spotted skunks were also detected at culvert 1; coyotes were also detected at culvert 2. Raccoons visited five of the six culverts. Domestic dogs and domestic cats were recorded at culvert 2; domestic dogs and opossums were detected at culvert 4.

4.9.2 Camera Surveys

Six medium to large mammal species were detected at camera stations (Table 22). Five species were detected at camera 3, four species were detected at camera 4, and three species were detected at cameras 2, 5, and 6. Coyotes, bobcats, and mule deer were detected at all five camera stations; a single mountain lion was recorded at camera 4. Coyote activity was highest at camera 2, bobcat activity was highest at camera 3, and mule deer activity was highest at camera 4. Several non-target species were also detected at the camera stations, including Black-tailed jackrabbit (*Lepus californicus*) (camera 2), the desert cottontail or brush rabbit (*Sylvilagus* spp.) (cameras 2 and 5), Greater roadrunner (*Geococcyx californianus*) (camera 2), and Lazuli bunting (*Passerina amoena*) (camera 6). One of these

species, San Diego Black-tailed jackrabbit, is a state species of special concern. Appendix 16 contains representative photos of species detected at camera stations.

4.9.3 Combined Results of Surveys

Data collected from both track and camera surveys suggest that Dulzura Creek is an important corridor for carnivore movement within and beyond the reserve. The only mountain lion recorded on the reserve was at camera 4, situated along a side drainage to Dulzura Creek. Mountain lions possess large body sizes, home ranges, and habitat requirements and hence are the most sensitive predator species to fragmentation effects (Beier 1993; Crooks 2002). Specifically, the Rancho Jamul Ecological Reserve alone is too small to permanently support resident lion populations with long-term viability, and thus this reserve likely serves as a critical component of one or several mountain lion home ranges that extend much further than the boundaries of the reserve. In fact, mountain lion home ranges in this region range from approximately 65 km^2 (females) to 500 km^2 (males) (K. Logan, pers. comm.). Elsewhere in southern California, mountain lion home ranges range from 218 km^2 (average female home range) to 767 km^2 (average male home range) (Beier & Barrett 1993). Monitoring for mountain lions throughout the reserve can be best achieved by maintaining long-term camera stations. Although track transects are a cheaper means to document activity, they are only operated quarterly. Thus for large-ranging animals, such as mountain lions, the frequency of track transects reduces the potential for these species to be detected, particularly where there are a wide variety of travel routes (i.e., no choke points). However, camera stations can be operated over much larger time frames, thus increasing the likelihood of detecting the presence of a mountain lion on the reserve. In this study, a mountain lion was not detected at a camera until the 154^{th} day of that camera (Camera 4) being active.

The highest bobcat activity within the reserve was also recorded within the Dulzura Creek drainage: along the same side drainage where the mountain lion was detected (transect 4), along the riparian area south of Highway CA 94 (transect 3), and at the camera positioned in the riparian area (camera 3). Furthermore, the only bobcat activity recorded through underpasses was at culvert 3 under Highway CA 94, which spans a large tributary of Dulzura Creek (Hollenbeck Canyon). Bobcats are intermediate in their sensitivity to habitat fragmentation (Haas 2000; Crooks 2002); they can still exist in fragmented and disturbed habitats, but only those with adequate movement corridors. Bobcats are therefore less sensitive to disturbance than are mountain lions, which seldom use fragmented areas, yet are more sensitive than coyotes, which can persist in all but the most disturbed habitat isolates.

Coyote activity was highest in the northwest corner of the reserve, along transects 1 and 2 and at camera 2. This portion of the reserve is the closest to developed / residential lands. Indeed, coyotes are widespread and relatively abundant throughout the region, however coyote populations can experience local extinction in habitat fragments, especially those that are too small, disturbed, or isolated (Crooks & Soulé 2000).

Spotted skunks were detected using two of the underpasses along Highway CA 94. However, they were not detected at track or camera stations. Unlike the larger and more

conspicuous striped skunks, spotted skunks are a relatively secretive species with restricted habitat requirements and low population densities (Crooks 2002). As such, spotted skunks are difficult to monitor which limit their utility as target species for management and conservation plans. Nevertheless, the status of the spotted skunk in California is currently unclear, and there is growing concern that the species is becoming rare.

Mule deer not only represent a critical component to a functioning ecosystem (in that they are top herbivores), they also comprise the majority of mountain lion diet (Beier 1995). Although mule deer were detected at every track transect and camera station, indicating a wide distribution across the entire reserve, the key to maintaining their populations is to provide adequate crossing structures in order for them to successfully pass under roadways (Reed et al. 1975; Foster & Humphrey 1995; Haas 2000). Currently, only one such structure exists along Highway CA 94 (culvert 2). Although traffic densities remain relatively low – moderate, future increases in road width and traffic volume should necessitate the need for adequate crossing structures for mule deer. Furthermore, in the event that traffic volumes increase, considerations should be given to providing adequate wildlife fencing (to reduce vehicle-related mortality), enhancing existing crossing structures, and providing additional crossing structures. Such considerations are important in maintaining carnivore connectivity (Haas 2000; Lyren 2001).

RJER is within the range of several other mammal species that went undetected by these survey methods: American badger (*Taxidea taxus*), long-tailed weasel** (*Mustela frenata*)(** note- this species was previously detected on site by Jay Diffendorfer, pers. comm.), and ringtail (*Bassariscus astutus*) (Ingles 1965). More intensive, species specific efforts may be necessary to determine whether or not these species may be present on the reserve.

5.0 Conclusions and Management Recommendations

The survey efforts at Rancho Jamul Ecological Reserve have generated a data set which will aide in further development of the management plan for the reserve, preserving the biological diversity of the native wildlands of San Diego County. By the various survey methods, species lists for five vertebrate taxonomic groups were produced: mammals, birds, reptiles, amphibians, and fishes. A species list for one invertebrate group (ants) was also generated. Extensive GIS layers describing the physical habitats present at RJER were generated and ground-truthed, showing the extent and distribution of these habitats. Rare and sensitive plants were located and identified from across the reserve. However, it must be noted that the time period in which these surveys took place, spring 2001 through spring 2002, was the driest year on record and thus not the most optimal for species detection.

5.1 Vegetation

GIS surveys identified 15 habitat types and their disturbed variations located within the boundaries of Rancho Jamul Ecological Reserve. Additionally, populations of non-native plants were located and included in the GIS data set. The long period of agricultural

practices at RJER has impacted the vegetation and habitat. Over half of the total area of the reserve is either non-native grassland or a disturbed variation of a native habitat type. The removal of the grazing herds and subsequent habitat restoration efforts will help the land and habitats recover to a more natural state. Eradication and control efforts should be coordinated for the non-native plant species before they become more widely established throughout the reserve. These areas may be monitored through time to detect compositional shifts in native versus non-native cover.

5.2 Rare Plants

5.2.1 Future Surveys

During the 2001 season, most of RJER was surveyed by either foot or vehicle. However, no area of the reserve was surveyed adequately enough to be considered complete. For rare plant surveys to be considered adequate, all portions of the property should be covered on foot, and any habitats with the potential for rare species should be visited at different, suitable times throughout the growing season. Many rare plant species are annual or herbaceous perennials. Therefore, because of this seasonal variation among the different species, multiple visits during different times of the season are necessary. It is much easier and more accurate to locate these herbaceous species during the narrow spring window for flowering, which is specific to each species. This is especially true with vernal pool, grassland, and clay lens habitats, which are usually dominated by herbaceous species.

Future surveys are recommended for the entire reserve, including areas where rare plant populations were mapped in 2001. All areas with native grasslands and clay lens habitats should be visited at least three times during the season so that the seasonal variation among the different species is accounted for. The grassland and clay lens habitat areas are likely to support additional populations of variegated Dudleya, mesa Brodiaea, Otay tarplant, San Diego goldenstar, and San Diego thornmint.

None of the riparian areas of RJER were surveyed adequately during the 2001 season. Therefore, these areas will need additional surveys to better determine the sensitive species distributions in these habitats. Most riparian areas can be adequately surveyed in two visits during the season. The riparian habitat areas are likely to support additional populations of San Diego marsh-elder and southwestern spiny rush.

Surveys in the fallow agricultural fields and other ruderal areas was very limited in 2001. Although these areas are dominated by non-native plant species, there is still potential for native species that are more tolerant of disturbance. These species include Otay tarplant, small-flowered morning glory, and south coast saltscale.

5.2.2 Future Monitoring

A monitoring objective for rare plants, particularly annual herbaceous species, is to assess changes in the density of individuals in the population. Density provides a useful parameter for management purposes, in that it can be directly related to changes in non-

native plant cover. Total population size can be projected from density estimates, if the area occupied by the population is known. In addition, sampling efforts can be allocated to obtain reasonable confidence intervals about density estimates that will allow temporal changes or spatial differences to be compared statistically.

The recommended protocol for monitoring annual herbaceous species uses the relevé quadrat survey method (Braun-Blanquet 1932) and is a variation of the methods described in the MSCP Biological Monitoring Plan (Ogden 1996). The method was used for the 2001 rare plant monitoring on the City of San Diego's MSCP lands (McMillan & Conservation Biology Institute 2002).

5.2.3 Future Monitoring Locations

Baseline surveys for rare plants in 2001 were not adequate enough to be considered complete. Until this baseline population data (distribution and density) is more complete, it is premature to pick rare plant populations for monitoring. If it becomes necessary to initiate monitoring before baseline surveys are complete, then monitoring sites should be considered temporary.

Rare plant locations should be prioritized for quantitative monitoring using input from qualified botanist and CDFG staff. The following criteria should be used to prioritize the quantitative monitoring:

1. General Geographic Location. By sampling across the full geographic range of the species within the reserve, hopefully the full range of genetic diversity is sampled. The reserve should be divided into southwest, southeast, middle and north areas. This method is only useful for species that occur throughout multiple portions of the reserve.

2. Types and Level of Disturbance Factors. During baseline surveys, each population should be evaluated qualitatively for the types and level of disturbances potentially affecting it. These disturbance factors should include trash dumping, increased fire frequency, grazing, off-road activity (and other types of mechanical disturbances), illegal trails and foot traffic, and weed invasion. In general, priority should be given to populations that are more disturbed, as monitoring allows for better evaluation of the habitat conditions and provides information for management decisions. An attempt should also be made to monitor at least one of the less disturbed populations of each species for comparison of species-specific impacts of disturbances.

3. Small Population vs. Large Population. An effort should be made to monitor populations of various sizes (distribution and density). The effects of certain disturbance factors may be greater on populations that are small in size and number, or the disturbance factors may have more impact on the larger populations. This can only be determined by evaluating populations of varying sizes when possible.

Rare plant populations should be monitored annually for at least five years in order to establish trends in the density from each monitored population and estimates of sampling variability. Monitoring results and trends can be evaluated following this 5-year period and refinements to monitoring protocols can be considered at that time.

Regardless of which populations are quantitatively monitored in the future, all populations should be evaluated annually, as part of preserve management efforts, to ensure that the populations and habitats are stable. This evaluation does not need to be quantitative to be effective for management purposes, but should include a qualitative evaluation of the same factors monitored in the quantitative monitoring (estimates of distribution, density, and disturbance problems).

5.3 Aquatic Species

Historically, the water levels in the cattle ponds within the RJER were augmented with on-site pumping of ground water, as well as a system of excavated canals designed to capture additional surface runoff during season rainfall events. Lack of maintenance of the canal system resulted in several breaches and sediment fills that have reduced the amount of runoff captured by the system. Where possible, most of the water impoundments on Rancho Jamul Ecological Reserve should be allowed to develop into a natural pattern of drying and refilling. The previous maintenance of the water levels in these ponds has allowed for non-native species to become established. With the drying documented under this study, many of the non-natives seem to have been removed from the system, especially among the fish species. It may take a series of more intensive draining efforts to have any impact on the African clawed-frog, bullfrog, and crayfish populations, all of which can disperse from aquatic refugia into newly wetted habitats. Management recommendations for the enhancement of ponds for native species include draining in fall (to kill bullfrog tadpoles and fishes and to preclude successful recruitment of African clawed-frogs) and trapping for non-natives when pools are holding water (to remove crayfish and African clawed-frogs).

The exceptions to maintaining normal drying patterns would be Cistern Pond, Pump Pond, and Willow Pond. The Cistern Pond may always need to be wetted because of the mechanics of water delivery on the property. Specific recommendations for this pond include (1) adding short impermeable fencing to the existing chain-link fence so that both large and smaller animals do not fall in as it has steep cement sides and can be dangerous and (2) temporarily draining the pond so that non-native fish and bullfrogs can be removed from it; however, this open water source should be maintained for bat foraging. The Pump Pond is always going to be wetted due to its location in the creek. This pond supports an abundance of both moderately and highly invasive non-native species that will be difficult to remove from the system. It could serve as a reintroduction site for Pacific pond turtles (*Clemmys marmorata*). Therefore, chemical treatment to the pond and permanent reaches of Jamul Creek should be done simultaneously to allow removal of the non-native species from the system while not resulting in a permanently inhospitable environment. The Willow Pond has been identified as a site of interest for the development of recreational fishing onsite. This

pond can be filled and drained easily and is far enough from the creek that invasion could be controlled. All other ponds onsite should be managed for native amphibians.

5.4 Herpetofauna

Herpetofauna pitfall arrays detected four amphibian species, ten lizard species, and twelve snake species. While this may not represent the full extent of all species present at Rancho Jamul Ecological Reserve, it most likely includes the majority. The remainder of undetected species would require a more long-term sampling effort or the establishment of alternate survey techniques. Such survey efforts should be considered as supplemental to the pitfall sampling technique employed by this survey and might include visual encounter surveys, transect sampling, and breeding site surveys (Heyer et al. 1994). One of the most important aspects of this data is that it serves as a baseline for future comparisons of species' presence/absence and capture rates at established sampling locations. To be of any comparable measure, future surveys should be carried out as close as possible to the protocols established under this effort. As San Diego continues to become developed, areas like RJER will become increasingly isolated and impacted. Future surveys will be able to compare the data generated at that time to the data collected here, in an attempt to detect population trends and the extirpation of species from the reserve.

5.5 Ants

Thus far, no exotic ant species have been detected from the ant pitfall traps. The most important exotic species to monitor for is the Argentine ant (*Linepithema humile*). The negative effects of Argentine ants on native ants, other arthropods, reptiles, and small mammals has occurred in other portions of San Diego County (Suarez et al. 1998, Laakkonen et al. 2001, Fisher et al. 2002). Likely sources for Argentine ant invasions would be on vehicles or infested plants or building materials that may be brought into the area. In the future it will be important to monitor near paved roads and any buildings within Rancho Jamul Ecological Reserve, where humans may accidentally introduce Argentine or red imported fire ants. Specifically new and existing water sources, and habitat disturbance particularly by new trails, roads, or other infrastructure should be targeted for monitoring.

5.6 Avifauna

A quick mention should be afforded to the issue of how to interpret the lists of bird species and numbers. As previously mentioned, the intent of the study was to develop an avian species inventory, following structured, popular protocols. This resulted in a list of species with habitat associations and relative levels of abundance. Due to temporal, financial, spatial, and personnel limits, it was impossible to create an exhaustive species list for the reserve. In addition, although limited notes on breeding were taken and are available, this study was not intended to assess the breeding status of species on the reserve. Nor should any large or small numbers found herein be extrapolated into breeding success or failure, since abundance levels cannot be reliably converted into fitness measurements of populations (Savard & Hooper 1995).

A vast majority of the species on site will benefit from the habitat recovery that is expected to occur as a result of removing grazing from the reserve and active restoration as outlined in Section 5.2. As disturbed habitats recover, bird species that are habitat specialists will have new ranges in which to disperse (e.g., scrub species moving into former grasslands). Also, understanding the within site distributional changes of native and exotic urbanophilic birds over time will be important as indicators of overall site quality change. These changes result from changing land use patterns from adjacent properties, especially as the rural setting of the region changes to suburban.

5.7 Bats

Multiple complimentary techniques were utilized to document 12 bat species on and adjacent to Rancho Jamul Ecological Reserve. Two species were identified as breeding on the reserve, while others used the reserve as foraging and roosting habitats. Locating, characterizing, and monitoring roosts are all extremely important to bat conservation and management efforts. Several man-made structures were determined to be of significance to bat activity within the reserve. In addition to the man-made structures identified earlier, bats at this study site undoubtedly take advantage of the large trees throughout the reserve. Preservation of these large trees (alive and dead) on the reserve would help preserve any bat colonies that may exist in one or more of the trees and would also help in maintaining bat foraging habitat. Preservation of structures such as the bridge on Highway CA 94 at Dulzura Creek and the historic brick kiln will also benefit bats on the Rancho Jamul Ecological Reserve. It is hoped that as the riparian restoration site along Highway CA 94 and Dulzura Creek matures and develops, additional bat species will be attracted to the area, drawn by the riparian habitat, aquatic-emergent insect populations, and, hopefully, a year-round water source. As noted earlier, much of this creek has dried out. More than just the bat species would benefit from restoring some flow of water to this creek. Also the management of ponds and pools around the property as seasonal aquatic habitats will also benefit the bats.

5.8 Small Mammals

Future survey efforts for small mammals should include multiple techniques. The use of trapping stations containing pitfall traps and small and large size box traps is recommended. As shown here, the various small mammal species present within the reserve, from robust woodrats to minute shrews, are differentially detected when using only a single survey method. Species associated with chaparral and riparian habitats were either captured in low numbers (*P. californicus*) or not at all (*N. fuscipes, P. boylii, C. californicus*). Focused efforts in these areas of the reserve should confirm the presence of these species. The Dulzura kangaroo rat, *D. simulans*, was only captured at two of the survey sites. They primarily occupy open coastal sage scrub habitats (Price & Kramer 1984) and the low number of captures may indicate that the bulk of the scrub on the reserve is currently too dense for their habitat needs. A natural fire or controlled burn within coastal sage scrub habitats on the reserve would be expected to increase population numbers of this species (Price & Waser 1984). The only non-native species documented on the preserve was the house mouse (*Mus musculus*). This is not unexpected, as their presence has been well documented in agricultural fields and grazed grasslands (Ingles 1964). Discontinuation of

grazing practices in RJER and the concomitant return of native vegetation may result in significantly decreased numbers of this species. Species invasion and the recovery of diversity in the restored habitats should be tracked and monitored over time.

5.9 Medium and Large Mammals

Large mammals represent an excellent group of species for conservation, in that they are wide-ranging, exhibit low population densities, and are large patch or interior dwelling species (Meffe et al. 1997). Further, the disappearance of top predators from fragmented systems may have community-wide implications (Robinson 1953 & 1961; Linhart & Robinson 1972; Sargeant et al. 1983; Voight & Earle 1983; Schmidt 1986; Johnson et al. 1989; Sovada et al. 1995; Ralls & White 1995). As a group, carnivores (Order Carnivora) are collectively listed as state mammal species of special concern. Furthermore, the mountain lion (*Puma concolor*) and mule deer (*Odocoileus hemionus*) are listed as covered species as part of the San Diego MSCP. Finally, the area surrounding the reserve has been identified as a critical connectivity zone between Otay Mesa and the southern Laguna Mountains (Cleveland National Forest) (Penrod 2000). Large mammals have been identified as one of the key groups of species indicative of the connection.

Track and camera stations detected eight targeted mammal species within RJER. An additional three targeted species were detected along roadways bordering the reserve. Of the eleven species detected, three were non-native: domestic cat, domestic dog, and Virginia opossum. Dogs were detected at all five track transects within the reserve and have the potential to negatively impact the activity patterns for a variety of native species. Thus, management decisions should consider limiting domestic dog access and removing any stray dog populations. For the purposes of large mammal conservation within the RJER, maintaining connections across Highway CA 94 and Otay Lakes Road will be essential, particularly if traffic volumes along these roadways increase in the future. Future considerations to reduce wildlife mortality along Highway CA 94 and Otay Lakes Road include the construction of larger underpasses (to meet minimum mule deer requirements), wildlife fencing, and vegetative cover leading to existing underpasses (Haas 2000; Lyren 2001). Future surveys should utilize existing sampling locations (which now serve as baseline monitoring locations) and consider alternative sampling methodologies to detect both common and rare species (i.e., hair snares for mountain lion and bobcat; spotlight surveys for mule deer and American badger; hair tubes for long-tailed weasel). Furthermore, given the potential for increased levels of habitat fragmentation surrounding the reserve in the future, obtaining information on the specific movements and activity patterns of fragmentation-sensitive species through radio or GPS telemetry will provide valuable information on these populations that can otherwise not be obtained through track and camera surveys alone.

The discovery of large numbers of Black-tailed jackrabbits at some camera stations is very significant as this species has declined in many areas regionally. Other focal techniques may be investigated for their usefulness for monitoring this species abundance over time.

5.10 Additional Management Recommendations

RJER supports numerous native habitats, many of which are unique to the southern California and Baja California region. These habitats support populations of sensitive plant species, as well as multiple vertebrate species of concern that are dependent on the stability and health of the general habitat. Although small portions of RJER appear stable and healthy in habitat quality, much of the reserve has one or more management issues. In some of the areas, these issues are having adverse impacts on the populations and the habitat quality in general. Without active management of these populations and habitats, many may decline in the future. The baseline data collected in this report is a starting point for building a program that will not only monitor but also manage these populations and habitats. This program of monitoring and management will ensure that these vertebrate species and habitats continue to persist into the future.

Most of RJER is faced with the same management issues that are common throughout all of the open space areas in San Diego County. These problems include invasion by non-native weed species, illegal off-road activity, unauthorized grazing, unauthorized trail development, and a lack of patrols by staff and/or law enforcement. In order to ensure that the habitats are protected and managed correctly, the management plan currently being written for RJER should address the problems discussed below.

5.10.1 Invasion by Non-native Weed Species

This is a common problem throughout all of open space in San Diego County and is often the most serious current threat to the biodiversity levels in the region (within natural areas). On RJER, perennial weed species are a problem in some areas (especially riparian habitats), but it is the annual weed species that present the greatest threat to the long-term stability and health of the rare plant populations. Some of the common annual and perennial weed species associated with the habitats on RJER include:

Species	**Common Name**
Atriplex semibaccata	Australian saltbush
Avena spp.	Wild oats
Brassica spp.	Mustard
Bromus spp.	Brome grass
Centaurea melitensis	Tocalote, star-thistle
Erodium spp.	Filaree, storksbill
Foeniculum vulgare	Fennel
Hedypnois cretica	Crete Hedypnois
Hypochaeris glabra	Smooth cat's-ear
Lolium spp.	Rye-grass
Rumex spp.	Dock
Salsola tragus	Russian thistle, tumbleweed

Some of the rare plant populations on RJER, including San Diego thorn-mint, variegated Dudleya, Otay tarplant, and San Diego goldenstar, are close to disappearing

because of the invasive weed species. Other populations and species will soon be added to this list if the weed invasion is allowed to continue.

While funding for weed control throughout all of the habitats on RJER may not be available, funding should be prioritized for weed control in and around the rare plant populations. Control of weeds on a local basis is effective for maintaining rare plant populations, as long as buffers are established and weed control is maintained for five or more years. Weed control can be achieved through a variety of management methods, including herbicides, mechanical controls, and hand weeding.

Once the weeds have been removed, it is important to establish populations of native plants in the available habitat. This can be done with a combination of seed collection and dispersal, as well as container planting of propagated plants.

5.10.2 Illegal Off-Road Activity

Although this is not a serious problem throughout RJER, in some areas of the reserve this continues to be a very serious threat. Off-road activity can cause physical impacts to the landscape and vegetation, increases the rate of weed invasion in and around the impacts, and can cause mortality in reptiles, and mammals of all sizes.

Options for controlling this problem include improved fencing and signs, increased patrols by staff, and public education of the impacts of such actions. Some areas are currently fenced, but fence destruction or removal allows access to the open space. In many cases, this destruction or removal of fencing has not been addressed for many years, allowing for long-term access for illegal off-road activities. Many areas would benefit from improved signs and other methods of public education.

5.10.3 Unauthorized Grazing

Cattle from adjacent properties surrounding RJER continue to use the reserve for grazing. Private property owners on the south and west sides of RJER maintain cattle grazing on their lands, and the cattle sometimes gain access to the reserve along sections of the reserve boundary. The solution to this problem is to improve fencing by either CDFG or the surrounding property owners. Such fencing may need to be more substantial than barbed wire fencing in these areas.

5.10.4 Unauthorized Trail Access and Development

Public access and use is an important issue for management of RJER. The public should be allowed to enjoy the open space areas of the reserve, but not at the expense of the other natural resources. Most of the existing trails on RJER are not impacting rare plant populations and provide for public access without habitat destruction. Unfortunately, unauthorized access trails have been established within the reserve, and many of these are having serious impacts on the rare habitats and plant populations. As the San Diego continues to grow in population size, public use of the reserve will continue to grow. This

increase in public usage is very likely to be accompanied by an increase in unauthorized trail access and development for horses, mountain bikes, and hikers. As with the off-road activity, the solutions to this problem include better fencing, improved signs and public education, and increased patrol.

5.10.5 Collection

As with unauthorized trail access and development and illegal off-road activity, the collection of the natural resources of RJER will likely increase as nearby populations rise. Both plants and animals can be affected by the seemingly innocent collection of a sample of these wildlife species. As is posted at many of the parks and reserves throughout the county, the public should be notified of the nature of the reserve and encouraged to enjoy the wildlife experience, but to leave what they encounter in place.

At greatest risk to collection would be flowering plants, reptiles, and amphibians. As noted earlier, certain plant species may already be in decline on the reserve. Attractive flowers or the desire for native plants for a garden, may result in sensitive plant species leaving the population on the reserve. Of the vertebrate species on RJER, reptiles and amphibians would be the most likely to be collected as visitors move across the landscape. These animals are small enough to be carried off the reserve and are popular as pets, since they can be kept relatively easily.

5.10.6 Limited Patrol by CDFG Staff

Although RJER is patrolled by CDFG staff, the level of patrol activity may need to be increased. Even with the patrols, some areas continue to have problems with illegal encroachment, off-road use, trash dumping, and other destructive activities. Without an increase in patrols and other forms of oversight, management plans will not be effective.

5.10.7 Additional Surveys

There are a number of sensitive or rare species that may be present but were not detected during these surveys (Appendix 11). Surveys like those carried out in this study should be continued for a longer duration in order to detect most of these species. In addition, there are some species that could be best detected using targeted survey techniques. These include the Quino checkerspot butterfly (*Euphydryas editha quino*), Pacific pond turtle (*Clemmys marmorata*), and arroyo toad (*Bufo californicus*). Surveys for the latter two species are currently being conducted onsite by USGS as a separate effort.

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Table 1. Summary statistics of vegetation and land cover types.

Vegetation Type	*N*[a]	*Mean Area*[b]	*Med*[c]	*Std Dev*[d]	*Min Area*[e]	*Max Area*[f]	*Total Area*[g]	*% of Total*[h]
Diegan Coastal Sage Scrub	35	30.79	7.54	84.45	1.55	502.32	1077.66	29.34
Disturbed Diegan Coastal Sage Scrub	86	8.19	3.56	15.92	1.02	118.97	704.68	19.19
Chamise Chaparral	3	4.56	4.55	3.40	1.16	7.96	13.67	0.37
Disturbed Ceanothus Chaparral	1	2.21	2.21	0.00	2.21	2.21	2.21	0.06
Scrub Oak Chaparral	1	4.43	4.43	0.00	4.43	4.43	4.43	0.12
Disturbed Scrub Oak Chaparral	1	1.47	1.47	0.00	1.47	1.47	1.47	0.04
Non-native Grassland	45	28.68	5.75	72.79	1.06	371.50	1290.38	35.13
Disturbed Non-native Grassland	6	4.07	3.35	2.40	1.51	8.41	24.41	0.66
Disturbed Native Grassland	2	2.72	2.72	2.81	0.73	4.71	5.44	0.15
Non-native/Native Grassland	9	11.65	4.34	16.17	1.04	48.87	104.83	2.85
Disturbed Non-native/Native Grassland	8	12.04	9.98	11.46	1.07	30.67	96.34	2.62
Cismontane Alkali Marsh	1	2.69	2.69	0.00	2.69	2.69	2.69	0.07
Coastal and Valley Freshwater Marsh	9	0.70	0.25	1.02	0.12	3.21	6.33	0.17
Disturbed Coastal and Valley Freshwater Marsh	4	0.58	0.62	0.27	0.27	0.82	2.32	0.06
Southern Coast Live Oak Riparian Forest	2	1.03	1.03	0.74	0.51	1.55	2.07	0.06
Southern Arroyo-Willow Riparian Forest	19	2.06	0.93	2.15	0.26	7.24	39.11	1.06
Disturbed Southern Arroyo-Willow Riparian Forest	1	0.95	0.95	0.00	0.95	0.95	0.95	0.03
Riparian Woodland (Sycamore Woodland)	15	0.75	0.51	0.53	0.23	1.69	11.32	0.31
Disturbed Riparian Woodland (Dist. Sycamore Woodland)	6	1.47	1.26	0.68	0.82	2.49	8.84	0.24
Southern Willow Scrub	26	0.56	0.39	0.38	0.15	1.61	14.53	0.40
Disturbed Southern Willow Scrub	5	1.29	0.65	1.56	0.23	4.00	6.46	0.18
Mulefat Scrub	1	0.53	0.53	0.00	0.53	0.53	0.53	0.01
Disturbed Mulefat Scrub	9	0.73	0.53	0.53	0.18	1.79	6.61	0.18
Coast Live Oak Woodland	8	1.60	1.28	1.19	0.31	3.08	12.84	0.35
Disturbed Coast Live Oak Woodland	3	2.43	2.14	2.38	0.21	4.95	7.29	0.20
Open Water	3	0.79	0.37	0.77	0.32	1.68	2.37	0.06
Disturbed Habitat	26	6.90	2.57	11.36	1.03	44.95	179.33	4.88
Developed	5	8.74	5.82	8.50	1.69	23.30	43.68	1.19
Total	340						3672.81	100%

[a] *total number of polygons for vegetation and landcover type within Rancho Jamul Ecological Reserve*

[b] *average area of vegetation and landcover type (in acres)*

[c] *median area of vegetation and landcover type (in acres)*

[d] *standard deviation of vegetation and landcover type (in acres)*

[e] *minimum area of vegetation and landcover type polygon (in acres)*

[f] *maximum area of vegetation and landcover type polygon (in acres)*

[g] *total area that vegetation and landcover type covers on Rancho Jamul Ecological Reserve (in acres)*

[h] *percent area that vegetation and landcover type covers on Rancho Jamul Ecological Reserve*

Table 2. Sensitive plant species detected during 2001 surveys.

Species		State/Federal Status [a]	CNPS List [b] /Code [c]
Acanthomintha ilicifolia [d]	San Diego thornmint	CE/FT	1B/2-3-2
Atriplex pacifica	South Coast saltscale	--/--	1B/3-2-2
Brodiaea jolonensis [e]	Mesa Brodiaea	--/--	--/--
Convolvulus simulans	Small-flowered morning-glory	--/--	4/1-2-2
Deschampsia danthonioides [e]	Annual hairgrass	--/--	--/--
Dichondra occidentalis	Western Dichondra	--/--	4/1-2-1
Dudleya variegata	Variegated Dudleya	--/--	1B/2-2-2
Ferocactus viridescens [d]	San Diego barrel cactus	--/--	2/1-3-1
Fritilaria biflora [e]	Chocolate lily	--/--	--/--
Harpagonella palmeri	Palmer's grapplinghook	--/--	2/1-2-1
Hemizonia conjugens [d]	Otay tarplant	CE/FT	1B/3-3-2
Iva hayesiana	San Diego marsh-elder	--/--	2/2-2-1
Juncus acutus ssp. *leopoldii*	Southwestern spiny rush	--/--	4/1-2-1
Muilla clevelandii [d]	San Diego goldenstar	--/--	1B/2-3-2
Plantago erecta [e]	Dot-seed plantain	--/--	--/--
Romneya coulteri	Coulter's matilija poppy	--/--	4/1-2-3
Selaginella cinerascens [e]	Ashy spike-moss	--/--	--/--
Viguiera laciniata	San Diego sunflower	--/--	4/1-2-1

[a] *FT = Federallythreatened; CE = State Endangered*

[b] *California Native Plant Society List: 1A = Species presumed extinct; 1B = Species rare, threatened, or endangered in California and elsewhere; 2 = Species rare, threatened, or endangered in California but which are more commonelsewhere and are eligible for state listing; 3 = Species for which more information on distribution, endangerment, and/or taxonomic information is needed; 4 = A watch list of species of limited distribution, which need to*

[c] *Rarity-Endangerment-Distribution (R-E-D) Codes:*

Rarity : 1 = Rare, but found in sufficient numbers and distribution widely enough that the potential for extinction is low at this time; 2 = Occurrence confined to several populations or to one extended population; 3 = Occurrence limited to one or a few highly restricted populations, or present in such small numbers that it is seldom reported.

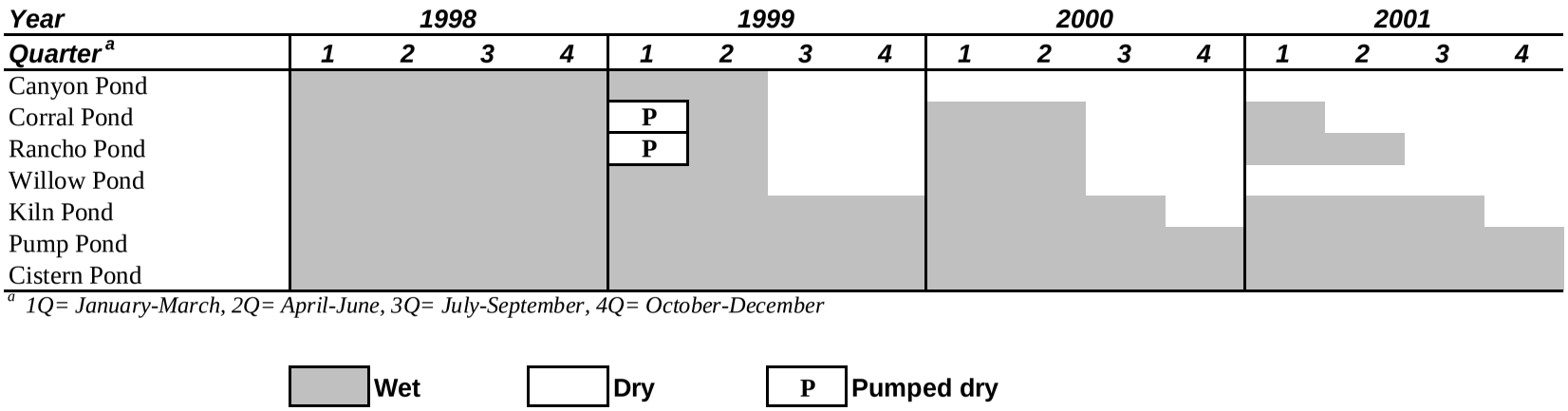
Endangerment : 1 = Not Endangered; 2 = Endangered in a portion of its range; and 3 = Endangered throughout its

Distribution : 1 = More or less widespread outside California; 2 = Rare outside California; and 3 = Endemic to

[d] *MSCP covered species*

[e] *Species considered rare, but currently not listed or on any official watch list.*

Table 3. Wet/dry patterns of ponds at Rancho Jamul Ecological Reserve 1998-2001.



[a] *1Q= January-March, 2Q= April-June, 3Q= July-September, 4Q= October-December*

Wet Dry P Pumped dry

Table 4. Occurrence of aquatic species at Rancho Jamul Ecological Reserve 1998-2001.

	Ephemeral Ponds					Perennial Ponds		Total # of Ponds Species Occur
	Canyon Pond	Corral Pond	Rancho Pond	Willow Pond	Kiln Pond	Pump Pond	Cistern Pond	
Native Species								
Bufo boreas			P		P			2
Hyla regilla		P	P					2
Spea hammondii			P					1
Thamnophis hammondii	P		P			P	P	4
Exotic Species								
Ameiurus melas						P		1
Micropterus salmoides				X				1
Pomoxis nigromaculatus				X				1
Gambusia affinis				X		P		2
Procambarus clarkii			P			P		2
Lepomis cyanellus	X		X	X		P		4
Lepomis macrochirus				X	X	P	P	4
Xenopus laevis	P	P	P	P	P	P		6
Rana catesbeiana	P	P	P	P	P	P	P	7
Total No. of Native Species	1	1	4	0	1	1	1	
Total No. of Exotic Species	3	2	4	7	3	7	2	

P = Extant populations

X = Populations extirpated after pond drying episodes

Table 5. Number of herpetofauna individuals and species captured at pitfall arrays by array.

	Array Number																				Total #
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**Individuals**
Amphibians																						
Batrachoseps major						1			1	8										1		11
Bufo boreas	1	3		1		1			3													9
Rana catesbeiana												1										1
Spea hammondii [a]				4		1	1	2	1		1								1			11
Lizards																						
Xantusia henshawi										1												1
Elgaria multicarinatus	3							1				3		1	1		1	3	1	1	2	17
Eumeces gilberti																			1			1
Eumeces skiltonianus [a]							5		1		1	4	1	3	3	5		5	2	1	1	32
Cnemidophorus hyperythrus [ab]		22	1				1	1	19	30									15	8		97
Cnemidophorus tigris		10	1			3	6	1		1	2	1						1	1	2	1	30
Sceloporus occidentalis	52	20	23	8	11	16	16	11	12	7	13	14	5	14	2	10	16	8	11	6	14	289
Sceloporus orcutti										4												4
Uta stansburiana		21	1	9	2	7	4	1	1	10	1	1						4	2	1	2	67
Phrynosoma coronatum [ab]						1	2	1							1				2	1	2	10
Snakes																						
Leptotyphlops humilis						1			1			3							3			8
Diadophis punctatus												2							1			3
Lampropeltis getulus		2							1					1		2				1		7
Masticophis flagellum																		1				1
Masticophis lateralis							2	1			1					1						5
Pituophis melanoleucas					1		2		1	1								1				6
Rhinocheilus lecontei										1												1
Salvadora hexalepis [a]																				1		1
Tantilla planiceps		1				3	1		1		1								1		1	9
Thamnophis hammondii [a]																		1				1
Crotalus ruber [a]										1		1								1	1	4
Crotalus viridis								2	2	1	1							1				7
Total Individuals	56	79	26	22	14	34	40	21	44	65	21	30	6	19	7	18	17	25	41	24	24	633
Total Species	3	7	4	4	3	9	10	9	12	11	8	9	2	4	4	4	2	9	12	11	8	26

[a] *CDFG species of special concern*

[b] *MSCP covered species*

Table 6. Number of herpetofauna individuals and species captured at all pitfall arrays by month.

	Month											
Species	**Jan[c]**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov[c]**	**Dec**
Amphibians												
Batrachoseps major		1	5	2	1							2
Hyla regilla		2	2									
Bufo boreas			4	2						2		1
Rana catesbeiana						1						
Spea hammondii[a]			2	8	1							
Lizards												
Xantusia henshawi								1				
Elgaria multicarinatus		1	5	4	2	2	2		1			
Eumeces gilberti			1									
Eumeces skiltonianus[a]		6	10		3	2	6	2	3			
Cnemidophorus hyperythrus[ab]			7	5	26	19	8	12	8	11		
Cnemidophorus tigris				5	5	4	1	4	9	2		
Sceloporus occidentalis		22	58	53	21	6	32	29	31	34		1
Sceloporus orcutti		1	1			1				1		
Uta stansburiana		10	16	5	6	3	7	9	4	5		2
Phrynosoma coronatum[ab]		2	2	1	2		1	1		1		
Snakes												
Leptotyphlops humilis					1	1	6					
Diadophis punctatus		1			1		1					
Lampropeltis getulus		1			5			1				
Masticophis flagellum						1						
Masticophis lateralis					2		1		2			
Pituophis melanoleucas			1	2	2					1		
Rhinocheilus lecontei							1					
Salvadora hexalepis[a]					1							
Tantilla planiceps					3	1	2	1	1			
Thamnophis hammondii[a]					1							
Crotalus ruber[a]				2	1				1			
Crotalus viridis				1	4		2					
Total Individuals	-	47	114	90	88	41	70	60	60	57	-	6
Total Species	-	10	13	12	19	11	13	9	9	8	-	4
Number of Sampling Days/Month	-	4	8	8	4	4	4	4	4	4	-	4
Capture Rate (individuals/day)	-	11.75	14.25	11.25	22	10.25	17.5	15	15	14.25	-	1.5

[a] *CDFG species of special concern* [b] *MSCP covered species* [c] *no sample periods fell within these months*

Table 7. Number of individuals, species, and ant subfamilies captured at ant pitfall trap arrays.

Species		*Array number* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	*Total # Individuals*	*% Array Occurrence*
Subfamily Dolichoderinae																								
Dorymyrmex bicolor	Pyramid Ant												1637										1637	5
Dorymyrmex insanus	Pyramid Ant			2																		1	3	10
Forelius foetidus		19		31	49		1	12	60			8	2	2				18	1957		19	17	2195	62
Forelius pruinosus															1								1	5
Tapinoma sessile	Maloderous House Ant	3		3									1					61					68	19
Subfamily Ecitoninae																								
Neivamyrmex nigrescens	Army Ant						1															1	2	10
Neivamyrmex opacithorax	Army Ant															3							3	5
Subfamily Formicinae																								
Liometopum occidentale		57																					57	5
Myrmecocystus mimicus	Honey Pot Ant							4															4	5
Subfamily Myrmecinae																								
Crematogaster californica	Acrobat Ant		1	1	8	4	21	12	12	11	11	12		3		33	2		6	1	1	13	152	81
Crematogaster hespera	Acrobat Ant				4																		4	5
Leptothorax andrei									1			1			1	2	1			6	3		15	33
Messor andrei	Harvester Ant																9		1				10	10
Pheidole sp.																				2			2	5
Pheidole cerebrosior										3													3	5
Pheidole clementensis			16			1	6			2	1			1		9							36	33
Pheidole vistana								18	30	1			1		7	13	8		13	1	3	10	105	52
Pogonomyrmex rugosus	Harvester Ant		102							142	228									204	9	1	686	29
Solenopsis molesta	Thief Ant	18	1	8	2									2		1						1	33	33
Solenopsis xyloni	Native Southern Fire Ant	5	1		1	4	6	7	58				4	6		1	2	2		1	14	5	117	71
Tetramorium spinosum						3	11					2		1		1			1	3	5		27	38
Total Individuals		102	121	45	64	12	46	53	161	159	240	23	1645	15	9	63	22	81	1978	218	54	49	5160	
Total Species		5	5	5	5	4	6	5	5	5	3	4	5	6	3	8	5	3	5	7	7	8	21	
Total Subfamilies		3	1	2	2	1	3	3	2	1	1	2	2	2	2	2	1	2	2	1	2	3	4	

Table 8. Avifauna species and number detected at point count stations, sorted from most common species to least common species.

	Point Count Station																							
Species	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***21***	***22***	***23***	***24***
Cliff Swallow			2			1	1		1	1		20			1	5					1			
California Towhee	1											6					2	1	5	3		3	5	2
Wrentit	5																2	3	4	8		3	1	6
Spotted Towhee	4							1										4	2	2		1	3	3
Lazuli Bunting	2								1			2						4	3	3			2	2
California Quail	2												1				1		1	2		2		1
Grasshopper Sparrow		1	2	7		5	6	1	3	4	2		3	1	4		2							1
Mourning Dove	3							1				6	1		3	4	1		1	2	1	1		4
Western Meadowlark	1		4					4		1	2	2	2		1				1					
Common Raven	5				1		3	4	3			2	2			1	2			1			2	
Bushtit	3								2						1					2			3	
White-crowned Sparrow	1				1			4				4						1					1	
Red-winged Blackbird					7	1							2								16	1		
Lesser Goldfinch					3			1											2	3				
Horned Lark			13																					
European Starling													1		1						1	2		
Song Sparrow	2								6				1	1			1				4			
Common Yellowthroat					3				4	2			2	2			1							
Bullock's Oriole					2				4						1	3	1	1			4			2
Anna's Hummingbird											4	1						1	4	1			1	1
House Finch	1				2									9										
Unidentified Hummingbird	2		1						1					1									3	
Western Kingbird				2							3				1	5	1				2			
Rufous-crowned Sparrow															2					1				
Blue Grosbeak								2	1	1			1											2
Red-tailed Hawk	1				1						1				2	1	1		1				1	
California Thrasher																			2	1				
Brewer's Blackbird					5																4			
Mallard																								
American Goldfinch														1										1
Lark Sparrow												3			1		2							
Western Scrub-Jay	1																							
Violet-green Swallow																								
Yellow Warbler									2								2				1			
Northern Rough-winged Swallow												2									6			
Phainopepla																1								
Savannah Sparrow		3		1									6	1										
Bewick's Wren																							2	
Sage Sparrow																								
American Crow	4																							
Killdeer																								
Yellow-breasted Chat									1				2				1							
Black Phoebe													1											
Costa's Hummingbird																			3					
Ash-throated Flycatcher																								
Loggerhead Shrike																								
Northern Mockingbird																								
Nuttall's Woodpecker	1																							
American Kestrel																						1		
California Gnatcatcher																						2		
Lawrence's Goldfinch														4										
Allen's Hummingbird																				1				
Red-shouldered Hawk														1	2									
Acorn Woodpecker																								
Least Bell's Vireo																	1							
Greater Roadrunner																								
Merlin										1								1						
Nashville Warbler									2															
Orange-crowned Warbler													1				1							
Green Heron																								
Oak Titmouse																								
Peregrine Falcon																								
Townsend's Warbler																								
Warbling Vireo																								
Western Tanager								1																
White-tailed Kite																							1	
Yellow-rumped Warbler																								
Total Individuals	39	4	22	10	25	7	10	19	31	10	12	48	26	21	20	20	20	16	29	30	40	16	25	25
Total Species	17	2	5	3	9	3	3	9	13	6	5	10	14	9	12	7	15	8	12	13	10	9	11	11
Indiv. detected/8-min count	19.5	2.0	11.0	5.0	12.5	3.5	5.0	9.5	15.5	5.0	6.0	24.0	13.0	10.5	10.0	10.0	10.0	8.0	14.5	15.0	20.0	8.0	12.5	12.5

Table 8 (continued).

	Point Count Station																					
Species	***25***	***26***	***27***	***28***	***29***	***30***	***31***	***32***	***33***	***34***	***35***	***36***	***37***	***38***	***39***	***40***	***41***	***42***	***43***	***44***	***45***	***46***	***47***	***48***
Cliff Swallow	1		1						2	16						8			1					
California Towhee	3	5	3	1	2	3	4	3	2	2	3		4			2	1	4	5	2	2	10	4	5
Wrentit	4	1	6	3	5	2	3	4	5	3	4		5	1	2	1	3	3	2	1	3	3	1	5
Spotted Towhee	4	2	2	5	4	1	2	6	7	3	5		5			1	2	1	2	3	4	1	2	2
Lazuli Bunting	3	1	2	2	3	4	4	2		1			2		2	2	2	1	2		4			6
California Quail	6	1	4		2	1	2		8		1		3	3	2			1	5			2	7	1
Grasshopper Sparrow						3						3		5	3	2							1	1
Mourning Dove		2	1		3	3	1		1			1	2			1	1	2	2	2				
Western Meadowlark	4					2	2	2	1					4	4	3	1						4	1
Common Raven		1	1					1	1					1				4			3		1	
Bushtit		5			1		6			1					3			5		2	1			
White-crowned Sparrow	2				1		3		2	17					1				5			2		5
Red-winged Blackbird	1			2																				
Lesser Goldfinch	1	1			1	1										1		6	1				1	
Horned Lark			1							11					1		2	2						
European Starling							2		1			1				15								
Song Sparrow		1			1	2						1		2						1	1	1	1	
Common Yellowthroat					1	5								2							1			
Bullock's Oriole				2	3										1								2	
Anna's Hummingbird	2						1			1	3								2					
House Finch	4				4																		4	
Unidentified Hummingbird				1	1	2					3			1					2		2			
Western Kingbird	3				1	1								1					2				2	
Rufous-crowned Sparrow	2						3		1	2								3						
Blue Grosbeak	1					1								1	1		1						1	
Red-tailed Hawk						1				1														
California Thrasher		1	1				2							1			2							
Brewer's Blackbird				1								7												
Mallard																			5				3	
American Goldfinch					3	5							1											
Lark Sparrow																1						2		2
Western Scrub-Jay										2	3							1		1		1		
Violet-green Swallow														1										
Yellow Warbler																								
Northern Rough-winged Swallow																			4					
Phainopepla			1	1	2								3										1	
Savannah Sparrow												1												
Bewick's Wren		1						2									1			2				
Sage Sparrow			1							8														
American Crow																								
Killdeer																								
Yellow-breasted Chat																							1	
Black Phoebe																			1	1				
Costa's Hummingbird													1	1										
Ash-throated Flycatcher														1										
Loggerhead Shrike																								
Northern Mockingbird											1													
Nuttall's Woodpecker				1										1										
American Kestrel																								
California Gnatcatcher										1							1							
Lawrence's Goldfinch																								
Allen's Hummingbird																				1				
Red-shouldered Hawk																								
Acorn Woodpecker																								
Least Bell's Vireo																								
Greater Roadrunner			1																					
Merlin																								
Nashville Warbler																								
Orange-crowned Warbler																								
Green Heron																								
Oak Titmouse																								
Peregrine Falcon																								
Townsend's Warbler																				1				
Warbling Vireo																				1				
Western Tanager																								
White-tailed Kite																								
Yellow-rumped Warbler																								
Total Individuals	41	22	25	19	38	37	35	20	31	69	23	14	26	26	20	37	17	33	41	18	21	22	36	28
Total Species	15	12	13	10	17	16	13	7	11	14	7	6	9	14	10	11	11	12	14	12	9	8	16	9
Indiv. detected/8-min count	20.5	11.0	12.5	9.5	19.0	18.5	17.5	10.0	15.5	34.5	11.5	7.0	13.0	13.0	10.0	18.5	8.5	16.5	20.5	9.0	10.5	11.0	18.0	14.0

Table 8 (continued).

Species	Point Count Station																				Grand Total
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	
Cliff Swallow	1		5	2	6				6	8	30		7				2	20			149
California Towhee	1	3	3	3		7			2			3		5	4	6	4	2	1	5	145
Wrentit	3		3			2			1		1	2		2	5	7	2	1		3	134
Spotted Towhee	3		2	1		3	1		2		2	1		1	2	4	1	3	1	5	116
Lazuli Bunting	1		2			2	1		2	1	2			4	4			4	5	4	94
California Quail		10	2	1		1	1		1		1				3	1					80
Grasshopper Sparrow					2	1	1			2			4	2					1		73
Mourning Dove	2		3		2	1	1	1	1								1				62
Western Meadowlark	1	4								5		1						1	3		61
Common Raven		5				2						3	4			1			1	5	60
Bushtit			3											2		10		6	2	1	59
White-crowned Sparrow			2	3																4	59
Red-winged Blackbird				8	7		5	2													52
Lesser Goldfinch	2		10			2	4		2		2			1	1	1				1	48
Horned Lark					3					3		2							7		45
European Starling	4		7				1	1			1			1	2						41
Song Sparrow				2			2	5									2			1	38
Common Yellowthroat				4			5	2	1												35
Bullock's Oriole				2		2	1	2													33
Anna's Hummingbird			1								1	1		1	1	1				3	31
House Finch			1		2	1								3							31
Unidentified Hummingbird						1								2	3				1		27
Western Kingbird								3													27
Rufous-crowned Sparrow		1								2								3	1	2	23
Blue Grosbeak				4		1	1		1		1			1							22
Red-tailed Hawk		1	1			2						1	3				1			1	21
California Thrasher			1								1				2	3		1		2	20
Brewer's Blackbird																					17
Mallard				3	2			3													16
American Goldfinch							1		1										2		15
Lark Sparrow					2								1						1		15
Western Scrub-Jay							1	1								2	1			1	15
Violet-green Swallow			2							5	3		3								14
Yellow Warbler				1			3	4													13
Northern Rough-winged Swallow																					12
Phainopepla				1			1												1		12
Savannah Sparrow																					12
Bewick's Wren						1														2	11
Sage Sparrow																					9
American Crow											2	1					1				8
Killdeer					1		7														8
Yellow-breasted Chat				1			1	1													8
Black Phoebe						1	1	2													7
Costa's Hummingbird						1															6
Ash-throated Flycatcher						2		1											1		5
Loggerhead Shrike	2	2				1															5
Northern Mockingbird			2				1							1							5
Nuttall's Woodpecker								2													5
American Kestrel		1										2									4
California Gnatcatcher																					4
Lawrence's Goldfinch																					4
Allen's Hummingbird												1									3
Red-shouldered Hawk																					3
Acorn Woodpecker				1			1														2
Least Bell's Vireo							1														2
Greater Roadrunner																1					2
Merlin																					2
Nashville Warbler																					2
Orange-crowned Warbler																					2
Green Heron							1														1
Oak Titmouse														1							1
Peregrine Falcon								1													1
Townsend's Warbler																					1
Warbling Vireo																					1
Western Tanager																					1
White-tailed Kite																					1
Yellow-rumped Warbler			1																		1
Total Individuals	20	27	51	37	27	34	43	31	20	26	47	18	22	27	27	37	15	41	28	40	1842
Total Species	10	8	18	15	9	18	23	15	11	7	12	11	6	13	9	11	9	9	14	16	67
Indiv. detected/8-min count	10.0	13.5	25.5	18.5	13.5	17.0	21.5	15.5	10.0	13.0	23.5	9.0	11.0	13.5	13.5	18.5	7.5	21	14	20	

Table 9. Avifauna species detected within Rancho Jamul Ecological Reserve. Includes species detected during diurnal point counts, nocturnal driving surveys, and incidental observations.

Species	*Scientific Name*	*Habitat(s)*	*Abundance* [a]
Acorn Woodpecker	*Melanerpes formicivorus*	Riparian	R
Allen's Hummingbird	*Selasphorus sasin*	Oak woodland	R
American Crow	*Corvus brachyrhynchos*	Aerial, oaks, "urban"	U
American Goldfinch	*Carduelis tristis*	Riparian	U
American Kestrel	*Falco sparverius*	Frequently on telephone wires	C
Anna's Hummingbird	*Calypte anna*	CSS, willows	C
Ash-throated Flycatcher	*Myiarchus cinerascens*	Willows, CSS	U
Barn Owl[b]	*Tyto alba*	Fence posts, riparian, kiln area	C
(Least) Bell's Vireo	*Vireo bellii (pusillus)*	Willows	R
Belted Kingfisher[b]	*Ceryle alcyon*	Willows	S
Bewick's Wren	*Thryomanes bewickii*	CSS	U
Black Phoebe	*Sayornis nigricans*	Fence post, riparian	C
Black-chinned Hummingbird[c]	*Archilochus alexandri*	CSS	R-U, if present
Black-crowned Night-Heron[b]	*Nycticorax nycticorax*	Riparian / pond	R
Black-headed Grosbeak[b]	*Pheucticus melanocephalus*	Roadside, oaks	R
Blue Grosbeak	*Guiraca caerulea*	Roadside, CSS, willows	U
Brewer's Blackbird	*Euphagus cyanocephalus*	CSS, agriculture, ruderal	R
Bufflehead[b]	*Bucephala albeola*	Human-made pond (cistern)	S
Bullock's Oriole	*Icterus bullockii*	Riparian, CSS	C
Burrowing Owl[bd]	*Athene cunicularia*	Grassland / open-CSS interface	R
Bushtit	*Psaltriparus minimus*	CSS, riparian	A
California Gnatcatcher	*Polioptila californica*	CSS	S
California Quail	*Callipepla californica*	CSS	A
California Thrasher	*Toxostoma redivivum*	CSS / *Malosma*	U
California Towhee	*Pipilo crissalis*	CSS	A
Chipping Sparrow[b]	*Spizella passerina*	Roadside, CSS	S
Cliff Swallow	*Petrochelidon pyrrhonota*	Aerial, cistern	A
Common Poorwill[b]	*Phalaenoptilus nuttallii*	CSS, riparian	S
Common Raven	*Corvus corax*	Aerial, large trees, boulders	C
Common Yellowthroat	*Geothlypis trichas*	Riparian	C
Costa's Hummingbird	*Calypte costae*	Willows, scrub	U

Table 9 (continued).

Species	*Scientific Name*	*Habitat(s)*	*Abundance* [a]
Dark-eyed Junco[b]	*Junco hyemalis*	CSS	R
Eared Grebe[b]	*Podiceps nigricollis*	Pond	S
European Starling[e]	*Sturnus vulgaris*	Roadside / farmland, elect. wires	U
Grasshopper Sparrow	*Ammodramus savannarum*	Grassland	C
Great Horned Owl[b]	*Bubo virginianus*	Sycamores, rock outcropping	U
Greater Roadrunner	*Geococcyx californianus*	Roadside, CSS	R
Greater Yellowlegs[b]	*Tringa melanoleuca*	Pond	S
Green Heron	*Butorides virescens*	Riparian, pond	S
Horned Lark	*Eremophila alpestris*	Grassland, open/gravelly CSS	C
House Finch	*Carpodacus mexicanus*	Roadside, willows, sycamores, CSS	C
House Wren[b]	*Troglodytes aedon*	Riparian	R
Killdeer	*Charadrius vociferus*	Roadside, near pond / creek	U
Lark Sparrow	*Chondestes grammacus*	CSS, grassland, fence	U
Lawrence's Goldfinch	*Carduelis lawrencei*	Roadside riparian and scrub	U
Lazuli Bunting	*Passerina amoena*	CSS	C
Lesser Goldfinch	*Carduelis psaltria*	Fence wires along road, CSS, willows	C
Loggerhead Shrike	*Lanius ludovicianus*	Grassland / scrub	R
Long-eared Owl[bd]	*Asio otus*	Mesa grassland / CSS interface	S
Magpie Jay (Black-throated form)[e]	*Calocitta colliei*	Willows	S
Mallard	*Anas platyrhynchos*	Pond	U
Merlin	*Falco columbarius*	Grassland/aerial	R
Mountain Bluebird[b]	*Sialia currucoides*	Grassland/CSS	U
Mourning Dove	*Zenaida macroura*	All habitats	A
Nashville Warbler	*Vermivora ruficapilla*	Willows	R
Northern Flicker[b]	*Colaptes auratus*	CSS	R
Northern Harrier[b]	*Circus cyaneus*	Grassland/CSS, aerial	U
Northern Mockingbird	*Mimus polyglottos*	Roadside CSS	U
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Cistern, aerial	U
Nuttall's Woodpecker	*Picoides nuttallii*	Riparian	U
Oak Titmouse	*Baeolophus inornatus*	Oak Woodland / CSS	S
Orange-crowned Warbler	*Vermivora celata*	Riparian	S
Pacific-slope Flycatcher[b]	*Empidonax difficilis*	Willows	R
Peregrine Falcon	*Falco peregrinus*	Aerial, riparian	S
Phainopepla	*Phainopepla nitens*	Roadside fence, riparian, CSS	U

Table 9 (continued).

Species	*Scientific Name*	*Habitat(s)*	*Abundance* [a]
Prairie Falcon[bc]	*Falco mexicanus*	Aerial	S, if at all present
Red-shouldered Hawk	*Buteo lineatus*	Eucalyptus, sycamores / willows, aerial	C
Red-tailed Hawk	*Buteo jamaicensis*	Nesting in sycamores; telephone poles	C
Red-winged Blackbird	*Agelaius phoeniceus*	Riparian	C
Ring-necked Duck[b]	*Aythya collaris*	Human-made pond (cistern)	S
Ring-necked Pheasant[be]	*Phasianus colchicus*	Roadside	R
Rufous-crowned Sparrow	*Aimophila ruficeps*	CSS	U
Sage Sparrow	*Amphispiza belli*	CSS	U
Savannah Sparrow	*Passerculus sandwichensis*	Grassland	U
Say's Phoebe[b]	*Sayornis saya*	Roadside	S
Snowy Egret[b]	*Egretta thula*	Pond	R
Song Sparrow	*Melospiza melodia*	Grassland, CSS, riparian	A
Spotted Towhee	*Pipilo maculatus*	CSS, riparian	A
Townsend's Warbler	*Dendroica townsendi*	Oak woodland	S
Turkey Vulture[b]	*Cathartes aura*	Aerial	U
Violet-green Swallow	*Tachycineta thalassina*	Aerial/grassland/CSS	U
Warbling Vireo	*Vireo gilvus*	Oak woodland	S
Western Bluebird[b]	*Sialia mexicana*	Roadside fence	U
Western Kingbird	*Tyrannus verticalis*	Roadside fence, riparian, CSS	C
Western Meadowlark	*Sturnella neglecta*	Grassland, CSS	C
Western Scrub-Jay	*Aphelocoma californica*	CSS, oaks	C
Western Tanager	*Piranga ludoviciana*	Riparian / scrub	S
White-crowned Sparrow	*Zonotrichia leucophrys*	Grassland, roadside, CSS	U
White-tailed Kite	*Elanus leucurus*	Tel. poles / grassland, aerial	U
Wrentit	*Chamaea fasciata*	CSS	A
Yellow Warbler	*Dendroica petechia*	Willows	C
Yellow-breasted Chat	*Icteria virens*	Willows	U
Yellow-rumped Warbler	*Dendroica coronata*	CSS / *Malosma*	R

[a] *abundance estimate: A = abundant; C = common; U = uncommon; R = rare; S = scarce (usually 3 or fewer observations)*

[b] *species that were not observed during point counts*

[c] *sightings were not confirmed but are considered probable*

[d] *species that were observed by colleagues only*

[e] *non-native species*

Table 10. Habitat associations of avifauna species detected at point count stations, sorted as in Table 8.

	Habitat Type[a]														
Species	**C**	**C,G**	**C,S**	**G**	**G,R**	**G,S**	**H**	**O**	**O,R**	**O,S**	**R**	**R,S**	**S**	**Fly-over**	**Species Total**
Cliff Swallow														149	149
California Towhee	14						2	1		2		4	122		145
Wrentit	15												119		134
Spotted Towhee	8		4					3			1		100		116
Lazuli Bunting	11									3	6		74		94
California Quail	3						1					5	71		80
Grasshopper Sparrow				60		2							11		73
Mourning Dove				2			4				5	4	27	20	62
Western Meadowlark				13	3	5					7		31	2	61
Common Raven						1	5	2		1	8		3	40	60
Bushtit	3							2			5		49		59
White-crowned Sparrow	5					2					6		46		59
Red-winged Blackbird				5	6						32		2	7	52
Lesser Goldfinch	5			1							8		21	13	48
Horned Lark				9		1							28	7	45
European Starling							6				1			34	41
Song Sparrow				1	2			1			30		4		38
Common Yellowthroat				4							29		2		35
Bullock's Oriole											19	4	8	2	33
Anna's Hummingbird	6												18	7	31
House Finch				9						3	4		11	4	31
Unidentified Hummingbird[c]	3			1									10	13	27
Western Kingbird				3							8		2	14	27
Rufous-crowned Sparrow	3												20		23
Blue Grosbeak				1				1			9	2	9		22
Red-tailed Hawk							1				1		1	18	21
California Thrasher	4												16		20
Brewer's Blackbird													1	16	17
Mallard											3			13	16
American Goldfinch											1		10	4	15
Lark Sparrow		2		4			3						6		15
Western Scrub-Jay	1		3					2	1	1	2		5		15
Violet-green Swallow														14	14
Yellow Warbler											12			1	13
Northern Rough-winged Swallow							2							10	12
Phainopepla											1		7	4	12
Savannah Sparrow				12											12
Bewick's Wren	4							2					5		11
Sage Sparrow													9		9
American Crow							5	1					1	1	8
Killdeer				1							7				8
Yellow-breasted Chat											8				8
Black Phoebe								1			4		2		7
Costa's Hummingbird	3												2	1	6

Table 10 (continued).

	Habitat Type[a]														
Species	***C***	***C,G***	***C,S***	***G***	***G,R***	***G,S***	***H***	***O***	***O,R***	***O,S***	***R***	***R,S***	***S***	***Fly-over***	***Species Total***
Ash-throated Flycatcher											1		4		5
Loggerhead Shrike													5		5
Northern Mockingbird				1									4		5
Nuttall's Woodpecker								1			1		2	1	5
American Kestrel														4	4
California Gnatcatcher													4		4
Lawrence's Goldfinch				4											4
Allen's Hummingbird								1						2	3
Red-shouldered Hawk														3	3
Acorn Woodpecker											1			1	2
Least Bell's Vireo											2				2
Greater Roadrunner													2		2
Merlin													1	1	2
Nashville Warbler											2				2
Orange-crowned Warbler											2				2
Green Heron														1	1
Oak Titmouse													1		1
Peregrine Falcon											1				1
Townsend's Warbler								1							1
Warbling Vireo								1							1
Western Tanager											1				1
White-tailed Kite														1	1
Yellow-rumped Warbler														1	1
Total Individuals	88	2	7	131	11	11	29	20	1	10	228	19	876	409	1842
% Total Individuals/Habitat	4.8	0.1	0.4	7.1	0.6	0.6	1.6	1.1	0.1	0.5	12	1	48	22.2	100
Total Species	14	1	2	17	3	5	9	14	1	5	33	5	42	31	67[b]
% Total Species/Habitat	21	1.5	3	25	4.5	7.5	13	21	1.5	7.5	49	7.5	63	46.3	

[a] *habitat that species was detected in during point count; combined habitat codes indicate species was utilizing the interface of those habitat types; habitat codes: C = chaparral; G = grassland; H = human; O = oak woodland; R = riparian; S = coastal sage scrub.*

[b] *summing across this row does not add up to 67, since the same species was quite often observed in multiple habitat types.*

[c] *this is only added into diversity calculations when no other hummingbird species is recorded at a point.*

Table 11. Sensitive avifauna species detected.

Species	*Listing* [a]
American Peregrine Falcon	SE, FP, MSCP
Bell's Sage Sparrow	SSC
Burrowing Owl	SSC, MSCP
California Horned Lark	SSC
Coastal California Gnatcatcher	FT, SSC, MSCP
Least Bell's Vireo	SE, FE, MSCP
Loggerhead Shrike	SSC
Merlin	SSC
Northern Harrier	SSC, MSCP
Savannah Sparrow	MSCP
Southern California Rufous-crowned Sparrow	SSC, MSCP
Western Bluebird	MSCP
White-tailed Kite	FP
Yellow Warbler	SSC
Yellow-breasted Chat	SSC

[a] *protection code: FE = federal endangered; FT = federal threatened; FP = state fully protected; SE = state endangered; SSC = species of special concern in California; MSCP covered species*

Table 12. Bat survey locations, survey dates, and methodologies.

Site Number	*Location*	*Survey Dates*	*Survey Methodology*
1	Pump Pond	Nov 27 2000	Acoustic
2	Horse Stables (street lamp)	Nov 29 2000	Acoustic
3	Jamul Creek (at herp array 1)	Mar 15 2001	Acoustic
4	Dulzura Creek (restoration area)	Apr 19 2001	Mist-net, Acoustic
4	Dulzura Creek (restoration area)	May 3 2001	Mist-net, Acoustic
5	Corral Pond	May 22 2001	Mist-net, Acoustic
6	Old Historic Brick Kiln	June 5 2001	Acoustic
7	Bridge on Hwy 94 at Dulzura Creek	June 5 2001	Hand-net, Visual
7	Bridge on Hwy 94 at Dulzura Creek	Nov 21 2001	Visual
8	Kiln Pond	June 27 2001	Mist-net, Acoustic
9	Pump Pond	June 28 2001	Acoustic
10	Dulzura Creek (restoration area)	July 7 2001	Mist-net, Acoustic
11	Dulzura Creek (restoration area)	Sep 12 2001	Mist-net, Acoustic
12	Willow Pond	Sep 26 2001	Acoustic

Table 13. Bat species detection methods and occurrence by sites.

Species		*Detection Method*	*Detection Sites*
Myotis yumanensis [ab]	Yuma myotis	Mist-net Capture, Hand-net Capture, Acoustic, Visual	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Myotis californicus	California myotis	Mist-net Capture, Hand-net Capture, Acoustic, Visual	4, 7, 9, 10, 11, 12
Myotis ciliolabrum [b]	Small-footed myotis	Acoustic	4, 10, 11
Pipistrelleus hesperus	Western pipistrelle	Acoustic	4, 6, 8, 9, 10, 11, 12
Eptesicus fuscus	Big Brown bat	Capture, Acoustic	4, 8, 9, 10
Lasiurus cinereus	Hoary bat	Acoustic	4
Corynorhinus townsendii [abc]	Townsend's Big-eared bat	Visual	7
Antrozous pallidus [abc]	Pallid bat	Hand-net Capture, Acoustic, Visual	4, 7
Tadarida brasiliensis	Mexican Free-tailed bat	Acoustic	1, 2, 3, 4, 5, 10, 11, 12
Nyctinomops femorosaccus [a]	Pocketed Free-tailed bat	Acoustic	1, 2, 3, 4, 5, 8, 9, 10, 12
Nyctinomops macrotis [a]	Big Free-tailed bat	Acoustic	4
Eumops perotis [ab]	Western mastiff bat	Acoustic	5, 8, 9, 10, 11, 12

[a] *CA species of special concern*

[b] *Bureau of Land Management sensitive species*

[c] *Forest Service sensitive species*

Table 14. Summary of bat species detected during each survey. Includes bat species detected during surveys of foraging areas, day and night roosts. Methods of detection include hand-net capture, mist-net capture, acoustic, and visual.

Site No.	Date	Scientific Name	Detection Method	Survey Type
1	November 27, 2000	*Tadarida brasiliensis*	acoustic	Foraging bats
		Pipistrellus hesperus	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
2	November 29, 2000	*Tadarida brasiliensis*	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
3	March 15, 2001	*Tadarida brasiliensis*	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
4	April 19, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Eptesicus fuscus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Antrozous pallidus	acoustic	Foraging bats
		Tadarida brasiliensis	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
	May 3, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Eptesicus fuscus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Myotis ciliolabrum	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Tadarida brasiliensis	acoustic	Foraging bats
		Antrozous pallidus	acoustic	Foraging bats
		Lasiurus cinereus	acoustic	Foraging bats
		Nyctinomops macrotis	acoustic	Foraging bats
5	May 22, 2001	*Tadarida brasiliensis*	acoustic	Foraging bats
		Myotis yumanensis	mist-net capture, acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats
6	June 5, 2001	*Pipistrellus hesperus*	acoustic	Day roosting bats
		Myotis yumanensis	acoustic	Day roosting bats
7	June 5, 2001	*Antrozous pallidus*	hand-net capture	Night roosting bats
		Myotis yumanensis	hand-net capture	Night roosting bats
		Myotis californicus	hand-net capture	Night roosting bats
	November 21, 2001	*Myotis yumanensis*	visual	Night roosting bats
		Corynorhinus townsendii	visual	Night roosting bats

Table 14 (continued).

Site No.	Date	Scientific Name	Detection Method	Survey Type
8	June 27, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Eptesicus fuscus	mist-net capture, acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats
9	June 28, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Eptesicus fuscus	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
10	July 7, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Eptesicus fuscus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Tadarida brasiliensis	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
		Myotis ciliolabrum	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats
11	September 12, 2001	*Myotis ciliolabrum*	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
		Pipistrellus hesperus	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats
		Tadarida brasiliensis	acoustic	Foraging bats
12	September 26, 2001	*Pipistrellus hesperus*	acoustic	Foraging bats
		Tadarida brasiliensis	acoustic	Foraging bats
		Myotis yumanensis	acoustic	Foraging bats
		Nyctinomops femorosaccus	acoustic	Foraging bats
		Myotis californicus	acoustic	Foraging bats
		Eumops perotis	acoustic	Foraging bats

Table 15. Total number and capture rates[a] of small mammals captured during Sherman live trap surveys. Number outside parentheses is total captures at site, number within parentheses is capture rate.

		Array Number										
Species		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Chaetodipus fallax	San Diego pocket mouse	1 (0.014)	2 (0.028)	2 (0.028)			4 (0.056)	4 (0.056)	1 (0.014)	2 (0.028)	4 (0.056)	7 (0.097)
Dipodomys simulans	Pacific Kangaroo rat							1 (0.014)				
Mus musculus	European house mouse											
Neotoma lepida	Desert woodrat										2 (0.028)	
Peromyscus eremicus	Cactus mouse							6 (0.083)	1 (0.014)		4 (0.056)	
Peromyscus maniculatus	Deer mouse									3 (0.042)		
Spermophilus beecheyi [b]	California ground squirrel											
Sylvilagus auduboni [c]	Desert cottontail						1 (0.014)					
Total Number of Captures		1	2	2	0	0	5	11	2	5	10	7
Total Number of Species		1	1	1	0	0	1	3	2	2	3	1
Total Capture Rate/Array		0.014	0.028	0.028	0.000	0.000	0.056	0.153	0.028	0.069	0.139	0.097

[a] *Capture rate calculated by dividing number of captures by number of trap nights*

[b] *this species was observed during the surveys at many sites*

[c] *juveniles of this species were incidentally trapped and therefore were not included in the analyses*

Table 15 (continued).

Species		Array Number 12	13	14	15	16	17	18	19	20	21	Total Captures	Total # Arrays
Chaetodipus fallax	San Diego pocket mouse		6 (0.083)	5 (0.069)	10 (0.139)	10 (0.139)	1 (0.014)	6 (0.083)	3 (0.042)	5 (0.069)	7 (0.097)	80 (0.053)	18
Dipodomys simulans	Pacific Kangaroo rat										1 (0.014)	2 (0.001)	2
Mus musculus	European house mouse	1 (0.014)					2 (0.028)					3 (0.002)	2
Neotoma lepida	Desert woodrat											2 (0.001)	1
Peromyscus eremicus	Cactus mouse			1 (0.014)				3 (0.042)	5 (0.069)	7 (0.097)	2 (0.028)	29 (0.019)	8
Peromyscus maniculatus	Deer mouse					1 (0.014)						4 (0.003)	2
Spermophilus beecheyi [b]	California ground squirrel												
Sylvilagus auduboni [c]	Desert cottontail				1 (0.014)								
Total Number of Captures		1	6	6	11	11	3	9	8	12	10	122	19
Total Number of Species		1	1	2	1	2	2	2	2	2	3	6	
Total Capture Rate/Array		0.014	0.083	0.083	0.139	0.153	0.042	0.125	0.111	0.167	0.139	0.079	

[a] *Capture rate calculated by dividing number of captures by number of trap nights*

[b] *this species was observed during the surveys at many sites*

[c] *juveniles of this species were incidentally trapped and therefore were not included in the analyses*

Table 16. Total number of small mammals[a] captured during pitfall trap surveys.

		Array Number																				Total	Total #
Species		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	Captures	Arrays
Chaetodipus fallax	San Diego pocket mouse				2	2	2		1	1		1	1			1	3		2				16	10
Dipodomys simulans	Pacific kangaroo rat			1															1				2	2
Microtus californicus	California vole	5	12	10	4				3		2		2							1			40	8
Neotoma lepida	Desert woodrat										1												1	1
Notiosorex crawfordi	Desert shrew								2		4	1			4		1		5	5	1	2	25	9
Peromyscus californicus	Parasitic mouse					1				1													2	2
Peromyscus eremicus	Cactus mouse											1			1				1	1		1	5	5
Peromyscus maniculatus	Deer mouse		3			5	1		1	2	1	1	1			3	1	1	1	1	1		23	14
Reithrodontomys megalotis	Western harvest mouse	6	7	9	6	16	13	4	4	3	6	3	4	8	9		2	1	3	2	2	4	112	20
Sorex ornatus	Ornate shrew										3								2	1	1	1	8	5
Thomomys bottae	Botta pocket gopher	1	2	1	1		2				1		2							1			11	8
Total Number of Captures [a]		12	24	21	13	24	18	4	11	7	18	7	10	8	14	4	7	2	15	12	5	8	245	21
Total Number of Species		3	4	4	4	4	4	1	5	4	7	4	5	1	3	2	4	2	7	7	4	4	11	

[a] *Captures where small mammals were identified to the species level*

Table 17. Small mammal species captured at each herpetofauna array. Species presence (X) is determined from the combined results of Sherman live trap and pitfall trap sampling.

		Array Number																			Total # Arrays Species Captured
Species		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
Chaetodipus fallax [a]	San Diego pocket mouse	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	21
Dipodomys simulans	Pacific kangaroo rat			X				X											X			X	4
Microtus californicus	California vole	X	X	X	X				X		X		X							X			8
Mus musculus [b]	European house mouse												X					X					2
Neotoma lepida [a]	Desert woodrat										X												1
Notiosorex crawfordi	Desert shrew								X		X	X			X		X		X	X	X	X	9
Peromyscus californicus	Parasitic mouse					X				X													2
Peromyscus eremicus	Cactus mouse							X	X		X	X			X				X	X	X	X	9
Peromyscus maniculatus	Deer mouse		X			X	X		X	X	X	X	X			X	X	X	X	X	X		14
Reithrodontomys megalotis	Western harvest mouse	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	20
Sorex ornatus	Ornate shrew										X								X	X	X	X	5
Spermophilus beecheyi [c]	California ground squirrel																						
Sylvilagus auduboni [d]	Desert cottontail						X									X							
Thomomys bottae	Botta pocket gopher	X	X	X	X		X				X		X							X			8
Total Number of Species		4	5	5	4	4	4	4	6	4	9	5	6	2	3	2	4	4	7	8	6	4	21

[a] *CA species of special concern*

[b] *non-native species*

[c] *this species was observed during the surveys at many sites*

[d] *juveniles of this species were incidentally trapped and therefore were not included in the analyses*

Table 18. Medium and large mammal species detected at baited tracking stations.

Transect	Dates Surveyed	Track Stations	Sampling Effort [a]	Species Detected [b]	Number of Detections	Track Index
1	May 15 - 19, 2001	1-5	98	*Canis latrans* (Coyote)	44	0.449
	Jul 31 - Aug 4, 2001			*Canis familiaris* (Domestic dog)	21	0.214
	Oct 30 - Nov 3, 2001			*Odocoileus hemionus* (Mule deer)	3	0.031
	Feb 5 - Feb 9, 2002			*Mephitis mephitis* (Striped skunk)	2	0.020
				Procyon lotor (Raccoon)	1	0.010
2	May 15 - 19, 2001	6-10	99	*Canis latrans* (Coyote)	55	0.556
	Jul 31 - Aug 4, 2001			*Canis familiaris* (Domestic dog)	18	0.182
	Oct 30 - Nov 3, 2001			*Felis rufus* (Bobcat)	3	0.030
	Feb 5 - Feb 9, 2002			*Odocoileus hemionus* (Mule deer)	3	0.030
3	May 15 - 19, 2001	11-15	98	*Canis latrans* (Coyote)	42	0.429
	Jul 31 - Aug 4, 2001			*Canis familiaris* (Domestic dog)	22	0.224
	Oct 30 - Nov 3, 2001			*Odocoileus hemionus* (Mule deer)	12	0.122
	Feb 5 - Feb 9, 2002			*Mephitis mephitis* (Striped skunk)	6	0.061
				Felis rufus (Bobcat)	5	0.051
				Procyon lotor (Raccoon)	1	0.010
				Urocyon cinereoargenteus (Gray fox)	1	0.010
4	May 15 - 19, 2001	16-20	97	*Canis latrans* (Coyote)	31	0.320
	Jul 31 - Aug 4, 2001			*Canis familiaris* (Domestic dog)	15	0.155
	Oct 30 - Nov 3, 2001			*Odocoileus hemionus* (Mule deer)	10	0.103
	Feb 5 - Feb 9, 2002			*Felis rufus* (Bobcat)	9	0.093
				Mephitis mephitis (Striped skunk)	3	0.031
5	May 15 - 19, 2001	21-25	100	*Canis latrans* (Coyote)	34	0.340
	Jul 31 - Aug 4, 2001			*Canis familiaris* (Domestic dog)	13	0.130
	Oct 30 - Nov 3, 2001			*Felis rufus* (Bobcat)	3	0.030
	Feb 5 - Feb 9, 2002			*Odocoileus hemionus* (Mule deer)	3	0.030
				Procyon lotor (Raccoon)	2	0.020

[a] *Sampling Effort = $(s_j n_j)$-o_j , see Section 3.9.1.*

where, s_j = number of stations in transect j

n_j = number of nights that station was active in transect j

o_j = number of station nights omitted in transect j due to complicatio

[b] *Summed over 4 sample periods.*

Table 19. Medium and large mammal species detected at baited track stations along Highway CA 94.

Station	*Dates Surveyed*	*Sampling Effort* [a]	*Species Detected*	*Number of Detections*	*Track Index*
CA 94-1	May 15 - 19, 2001	20	*Canis latrans* (Coyote)	4	0.200
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	1	0.050
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
CA 94-2	May 15 - 19, 2001	20	*Canis latrans* (Coyote)	3	0.150
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	2	0.100
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
CA 94-3	May 15 - 19, 2001	19	*Canis familiaris* (Domestic dog)	2	0.105
	Jul 31 - Aug 4, 2001		*Canis latrans* (Coyote)	1	0.053
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
CA 94-4	May 15 - 19, 2001	20	*Canis familiaris* (Domestic dog)	1	0.050
	Jul 31 - Aug 4, 2001		*Canis latrans* (Coyote)	1	0.050
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
CA 94-5	May 15 - 19, 2001	20	*Canis latrans* (Coyote)	2	0.100
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	1	0.050
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				

[a] *Sampling Effort* = $(s_j n_j)$-o_j , *see Section 3.9.1.*

where, s_j = *number of stations in transect j*

n_j = *number of nights that station was active in transect j*

o_j = *number of station nights omitted in transect j due to complications*

Table 20. Medium and large mammal species detected at baited track stations along Otay Lakes Road.

Station	*Dates Surveyed*	*Sampling Effort* [a]	*Species Detected*	*Number of Detections*	*Track Index*
Otay Lakes Road-1	May 15 - 19, 2001	20	*Canis familiaris* (Domestic dog)	3	0.150
	Jul 31 - Aug 4, 2001		*Canis latrans* (Coyote)	2	0.100
	Oct 30 - Nov 3, 2001		*Procyon lotor* (Raccoon)	2	0.100
	Feb 5 - Feb 9, 2002				
Otay Lakes Road-2	May 15 - 19, 2001	20	*Canis familiaris* (Domestic dog)	6	0.300
	Jul 31 - Aug 4, 2001		*Canis latrans* (Coyote)	4	0.200
	Oct 30 - Nov 3, 2001		*Mephitis mephitis* (Striped skunk)	1	0.050
	Feb 5 - Feb 9, 2002				
Otay Lakes Road-3	May 15 - 19, 2001	20	*Canis familiaris* (Domestic dog)	3	0.150
	Jul 31 - Aug 4, 2001		*Canis latrans* (Coyote)	1	0.050
	Oct 30 - Nov 3, 2001		*Procyon lotor* (Raccoon)	1	0.050
	Feb 5 - Feb 9, 2002				
Otay Lakes Road-4	May 15 - 19, 2001	20	*Canis latrans* (Coyote)	8	0.400
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	1	0.050
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
Otay Lakes Road-5	May 15 - 19, 2001	19	*Canis familiaris* (Domestic dog)	2	0.105
	Jul 31 - Aug 4, 2001		*Mephitis mephitis* (Striped skunk)	1	0.053
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
Otay Lakes Road-6	May 15 - 19, 2001	20	*Canis latrans* (Coyote)	3	0.150
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	2	0.100
	Oct 30 - Nov 3, 2001		*Procyon lotor* (Raccoon)	1	0.050
	Feb 5 - Feb 9, 2002		*Urocyon cinereoargenteus* (Gray fox)	1	0.050

[a] *Sampling Effort* = $(s_j n_j)$-o_j , *see Section 3.9.1.*

where, s_j = *number of stations in transect j*

n_j = *number of nights that station was active in transect j*

o_j = *number of station nights omitted in transect j due to complications*

Table 21. Medium and large mammal species detected at underpasses along Highway CA 94 and Otay Lakes Road.

Underpass	*Dates Surveyed*	*Sampling Effort*[a]	*Species Detected*	*Number of Detections*	*Track Index*
Culvert 1	May 15 - 19, 2001	19	*Spilogale gracilis* (Spotted skunk)	4	0.211
	Jul 31 - Aug 4, 2001		*Mephitis mephitis* (Striped skunk)	2	0.105
	Oct 30 - Nov 3, 2001		*Procyon lotor* (Raccoon)	2	0.105
	Feb 5 - Feb 9, 2002				
Culvert 2	May 15 - 19, 2001	19	*Canis familiaris* (Domestic dog)	6	0.316
	Jul 31 - Aug 4, 2001		*Felis catus* (Domestic cat)	3	0.158
	Oct 30 - Nov 3, 2001		*Canis latrans* (Coyote)	2	0.105
	Feb 5 - Feb 9, 2002		*Mephitis mephitis* (Striped skunk)	1	0.053
Culvert 3	May 15 - 19, 2001	20	*Procyon lotor* (Raccoon)	9	0.450
	Jul 31 - Aug 4, 2001		*Felis rufus* (Bobcat)	8	0.400
	Oct 30 - Nov 3, 2001		*Spilogale gracilis* (Spotted skunk)	5	0.250
	Feb 5 - Feb 9, 2002		*Mephitis mephitis* (Striped skunk)	3	0.150
			Canis latrans (Coyote)	1	0.050
Culvert 4	May 15 - 19, 2001	20	*Procyon lotor* (Raccoon)	7	0.350
	Jul 31 - Aug 4, 2001		*Canis familiaris* (Domestic dog)	1	0.050
	Oct 30 - Nov 3, 2001		*Didelphis virginiana* (Virginia opossum)	1	0.050
	Feb 5 - Feb 9, 2002				
Culvert 5	May 15 - 19, 2001	20	*Procyon lotor* (Raccoon)	1	0.050
	Jul 31 - Aug 4, 2001		*Mephitis mephitis* (Striped skunk)	1	0.050
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				
Culvert 6	May 15 - 19, 2001	20	*Procyon lotor* (Raccoon)	5	0.250
	Jul 31 - Aug 4, 2001				
	Oct 30 - Nov 3, 2001				
	Feb 5 - Feb 9, 2002				

[a] *Sampling Effort = $(s_j n_j)$-o_j , see Section 3.9.1.*

where, s_j = number of stations in transect j

n_j = number of nights that station was active in transect j

o_j = number of station nights omitted in transect j due to complications

Table 22. Medium and large mammal species detected at camera stations. Non-targeted species are listed as present.

Camera	*Sampling Days*	*Species Detected*	*Number of Detections*	*Camera Index*
2	133	*Canis latrans* (Coyote)	74	0.556
		Odocoileus hemionus (Mule deer)[a]	4	0.030
		Felis rufus (Bobcat)	1	0.008
		Lepus californicus (Black-tailed jackrabbit)[b]	Present	
		Geococcyx californianus (Greater roadrunner)	Present	
3	198	*Felis rufus* (Bobcat)	34	0.172
		Canis latrans (Coyote)	21	0.106
		Odocoileus hemionus (Mule deer)	21	0.106
		Canis familiaris (Domestic dog)	1	0.005
		Mephitis mephitis (Striped skunk)	1	0.005
		Sylvilagus spp.	Present	
4	164	*Odocoileus hemionus* (Mule deer)	40	0.244
		Canis latrans (Coyote)	13	0.079
		Felis rufus (Bobcat)	1	0.006
		Puma concolor (Mountain lion)[a]	1	0.006
5	45	*Odocoileus hemionus* (Mule deer)	4	0.089
		Canis latrans (Coyote)	2	0.044
		Felis rufus (Bobcat)	2	0.044
		Sylvilagus spp.	Present	
6	141	*Odocoileus hemionus* (Mule deer)	6	0.043
		Canis latrans (Coyote)	2	0.014
		Felis rufus (Bobcat)	2	0.014
		Passerina amoena (Lazuli bunting)	Present	

[a] *MSCP covered species*

[b] *CDFG species of special concern*

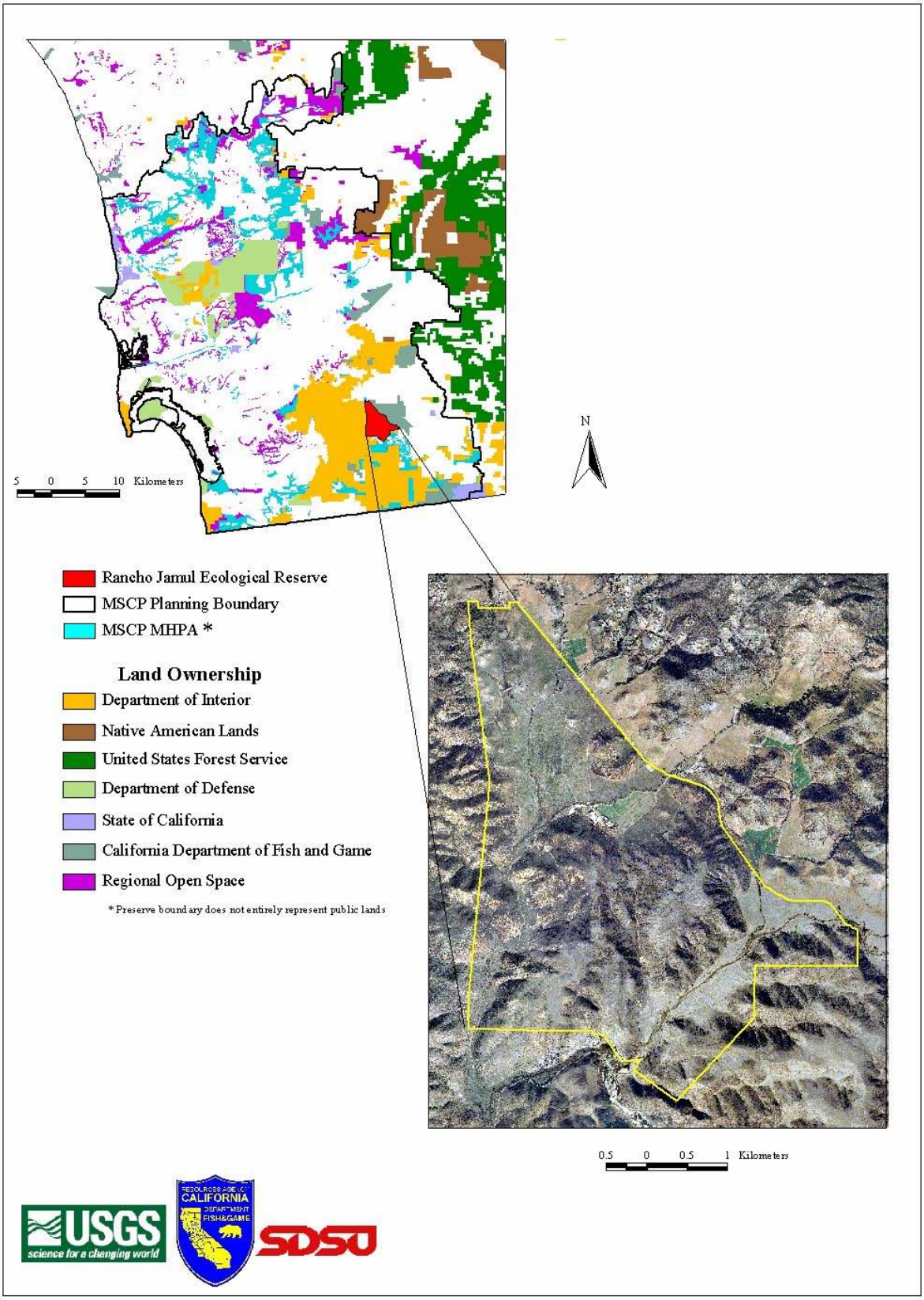


Figure 1. Location of Rancho Jamul Ecological Reserve.

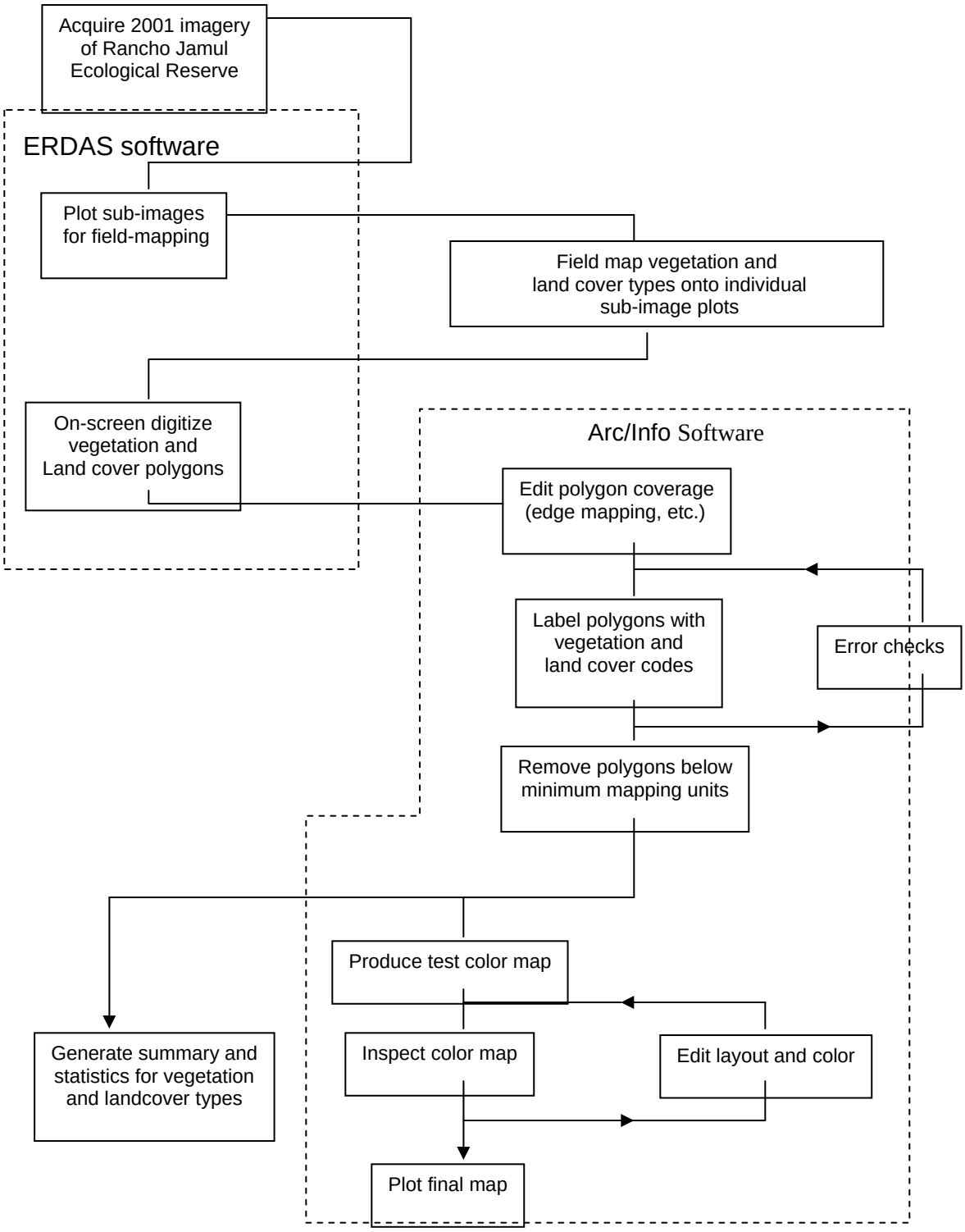


Figure 2. Flow chart depicting procedural steps of the integrated approach used to produce the vegetation and landcover maps and derived summary statistics.

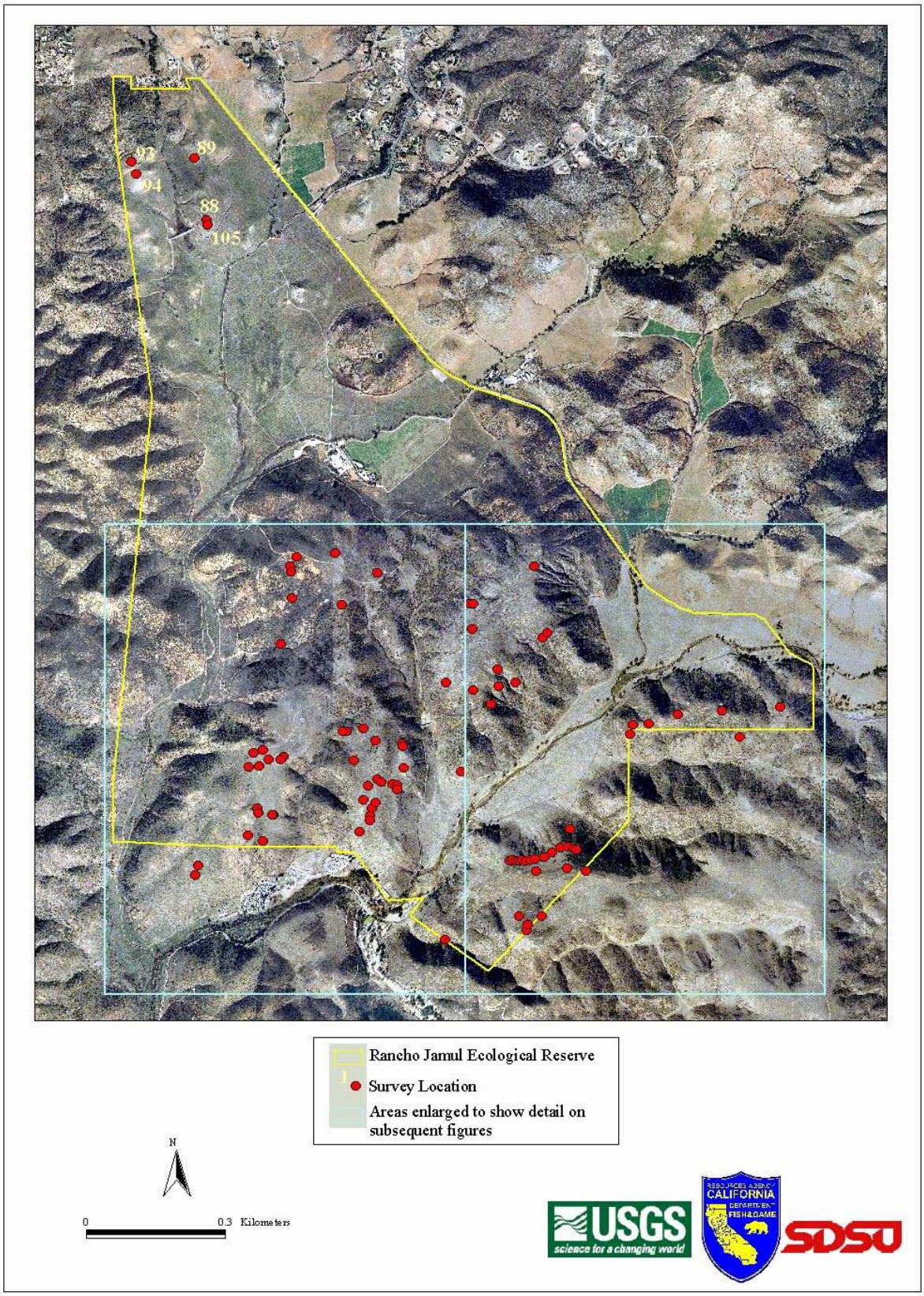


Figure 3. Rare plant locations surveyed at Rancho Jamul Ecological Reserve 2001.

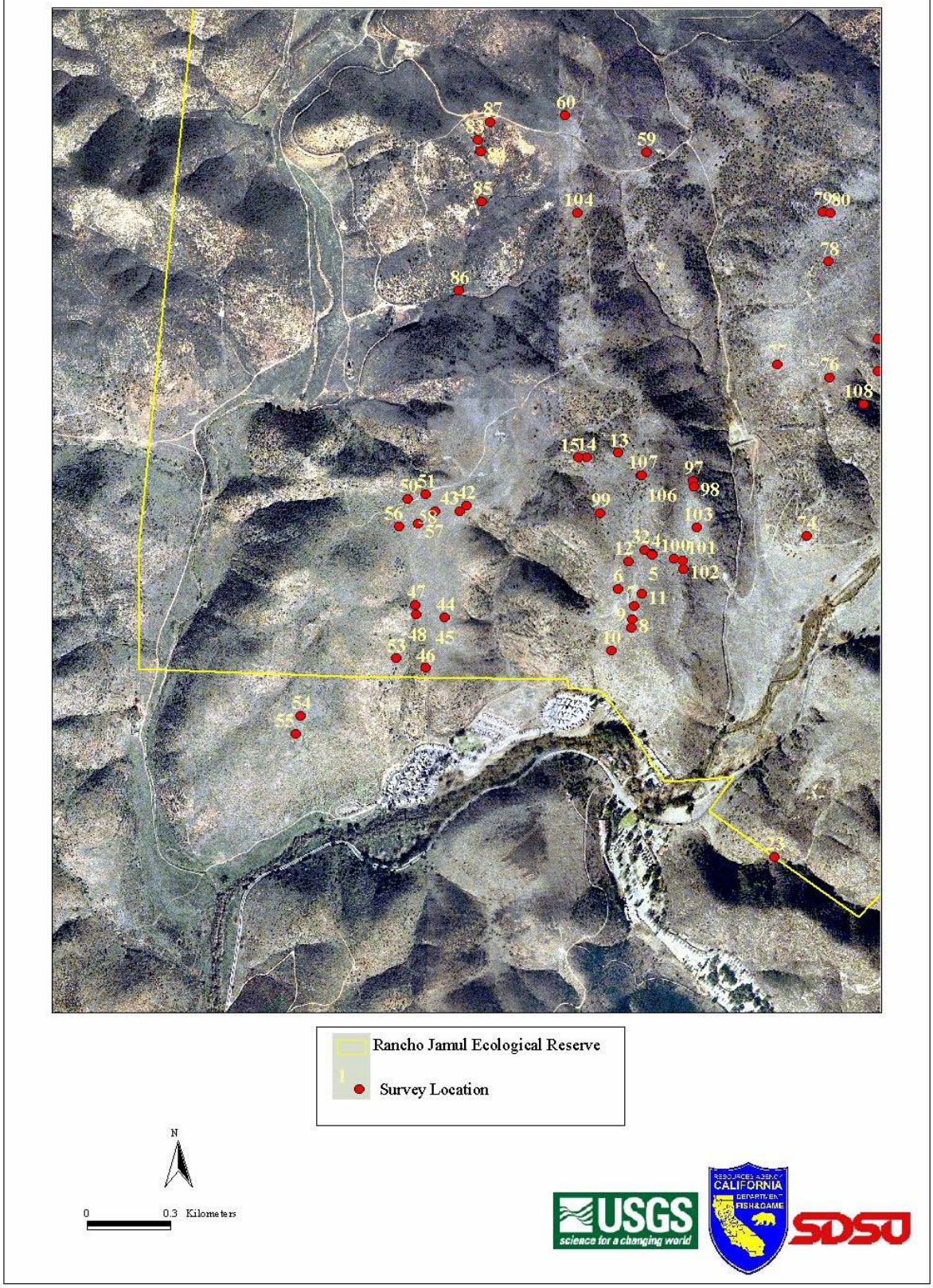


Figure 4. Rare plant locations surveyed at Rancho Jamul Ecological Reserve 2001 (southwest quarter).

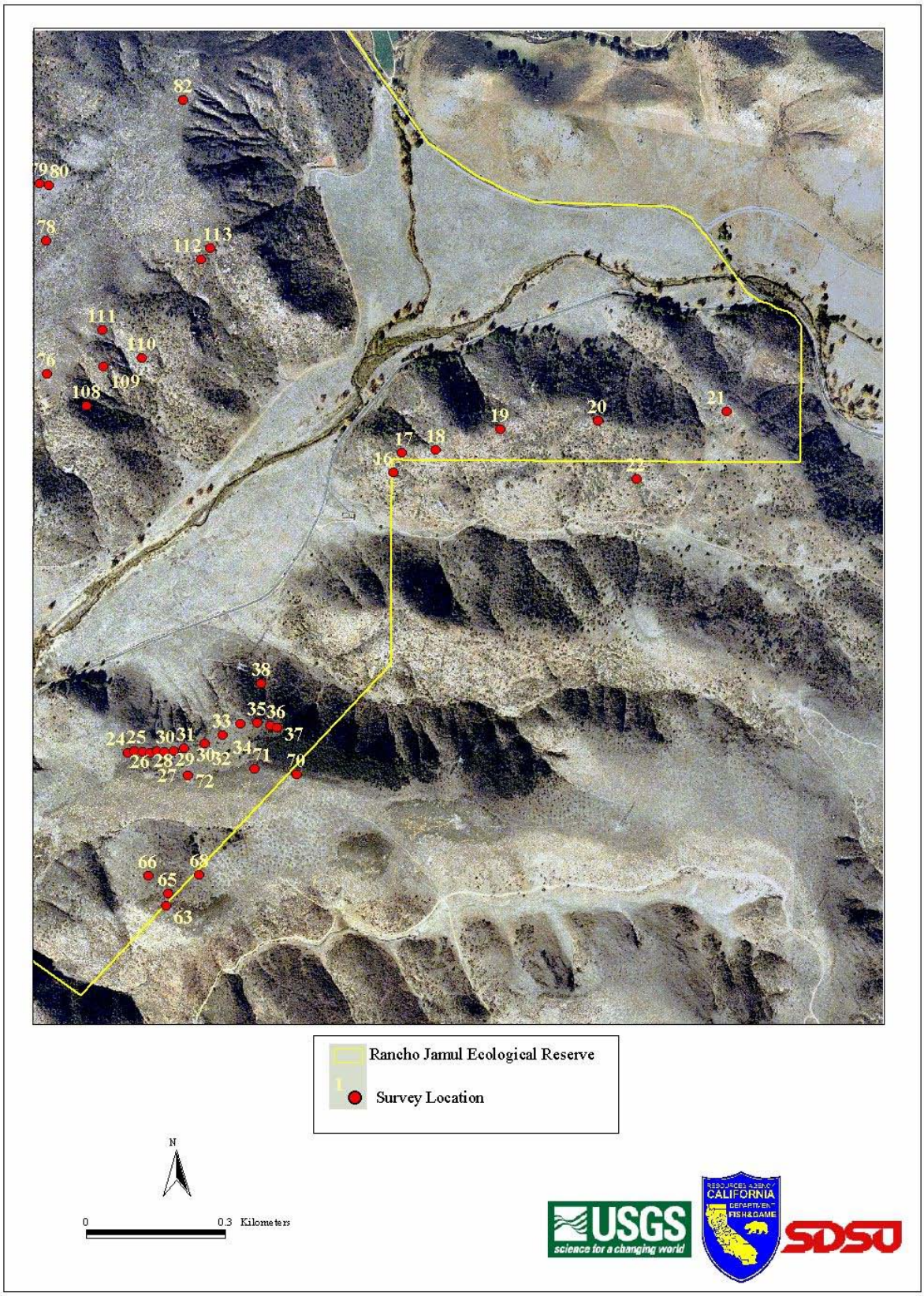


Figure 5. Rare plant locations surveyed at Rancho Jamul Ecological Reserve 2001 (southeast quarter).

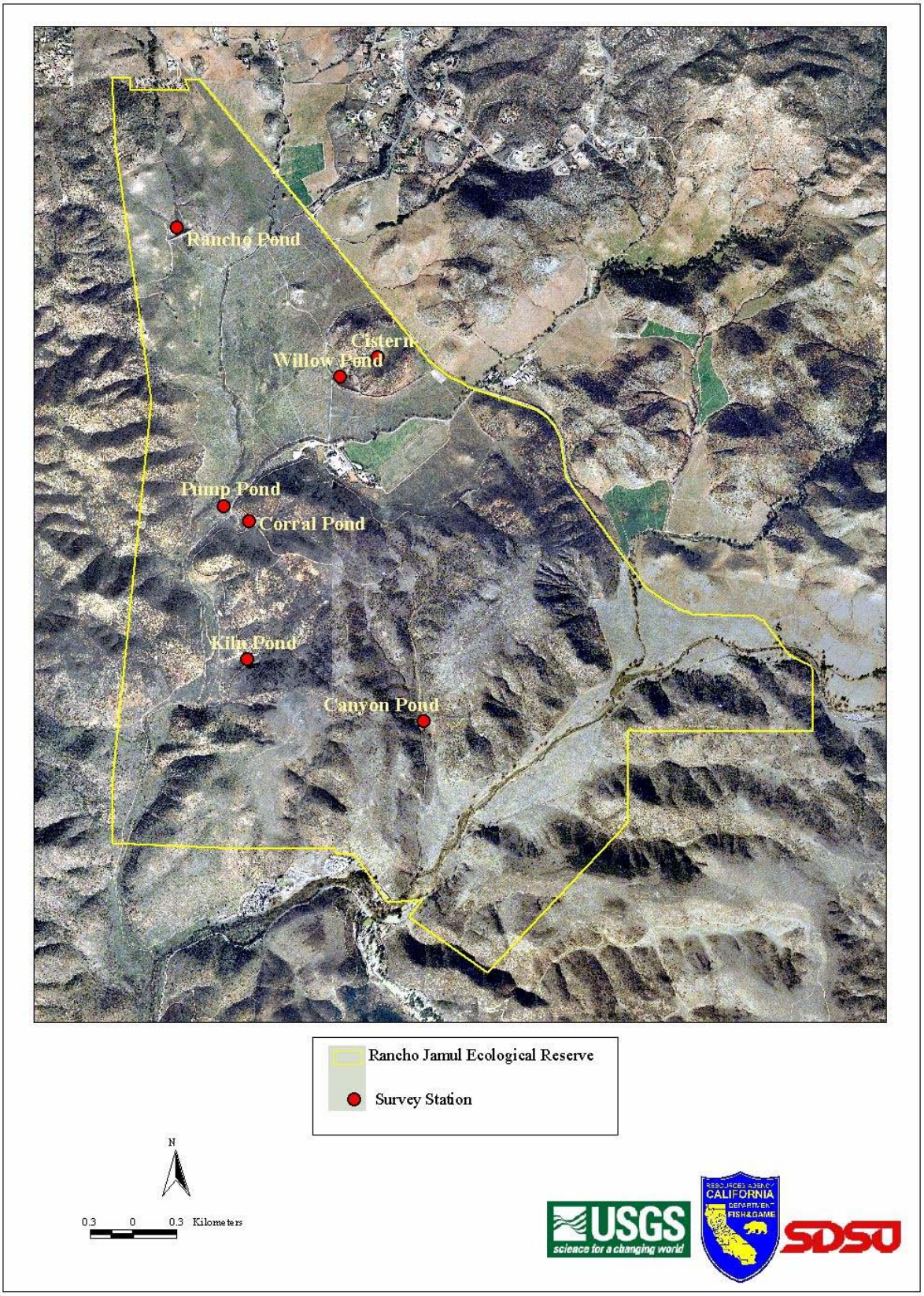


Figure 6. Aquatic locations surveyed at Rancho Jamul Ecological Reserve from 1998 to 2001.

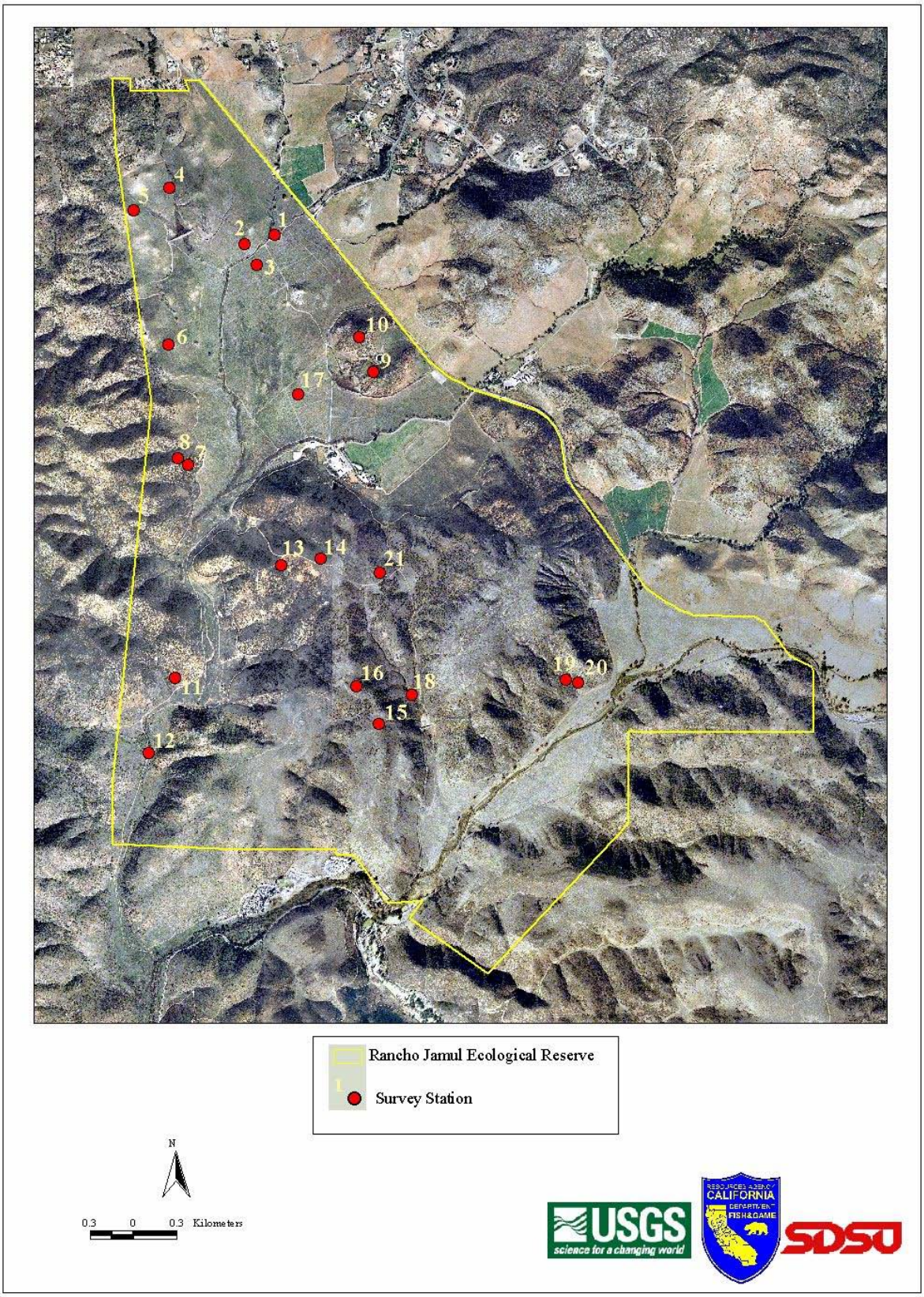


Figure 7. Herpetofauna, ant, and small mammal survey station locations at Rancho Jamul Ecological Reserve in 2001 and 2002.

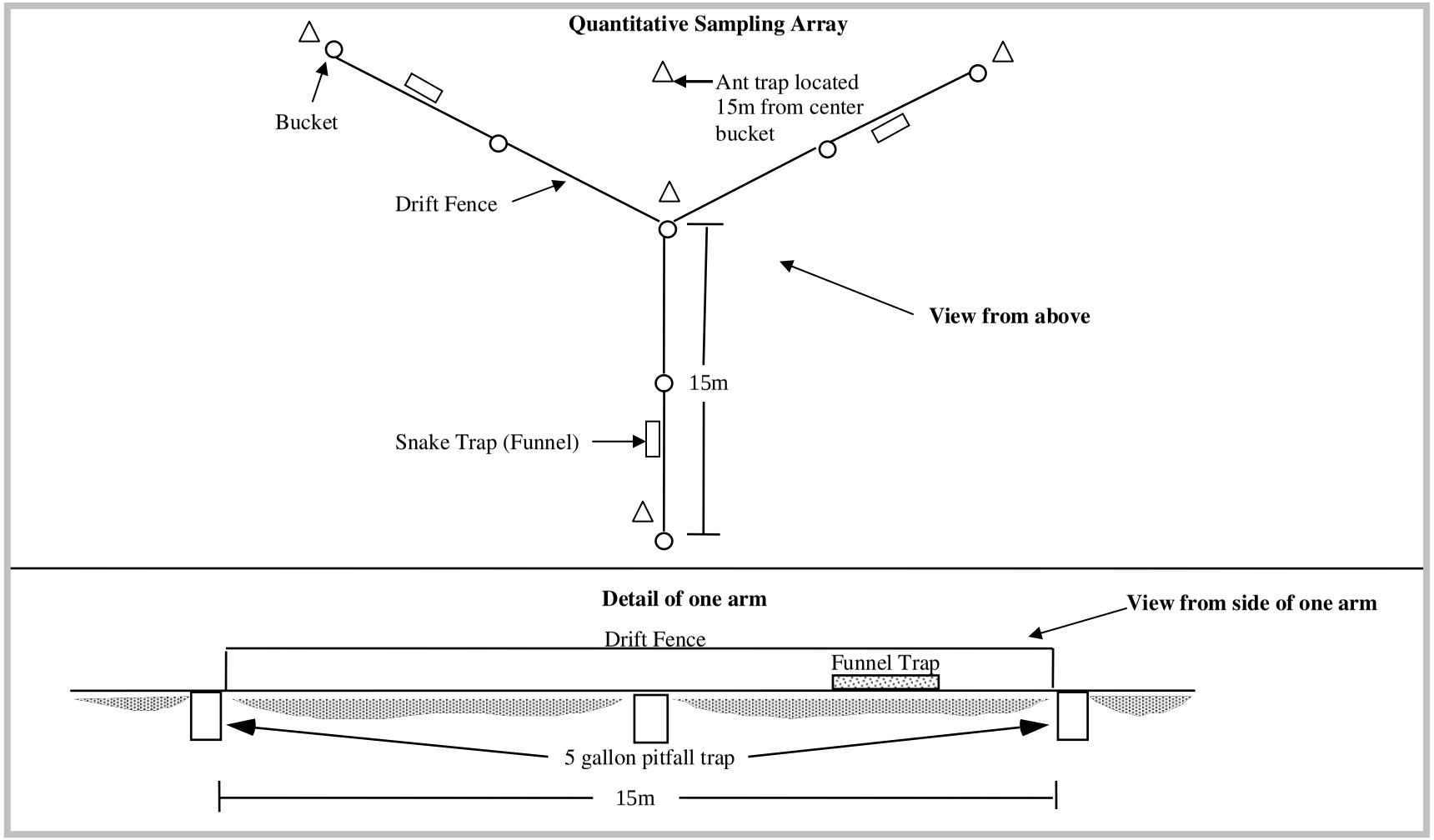


Figure 8. Terrestrial survey design for location of pitfall and funnel traps with drift fences for herpetofauna surveys and pitfall traps for ant surveys. Each herpetofauna pitfall trap is represented by a circle, snake traps by squares, and ant traps by triangles. Figure not drawn to scale.

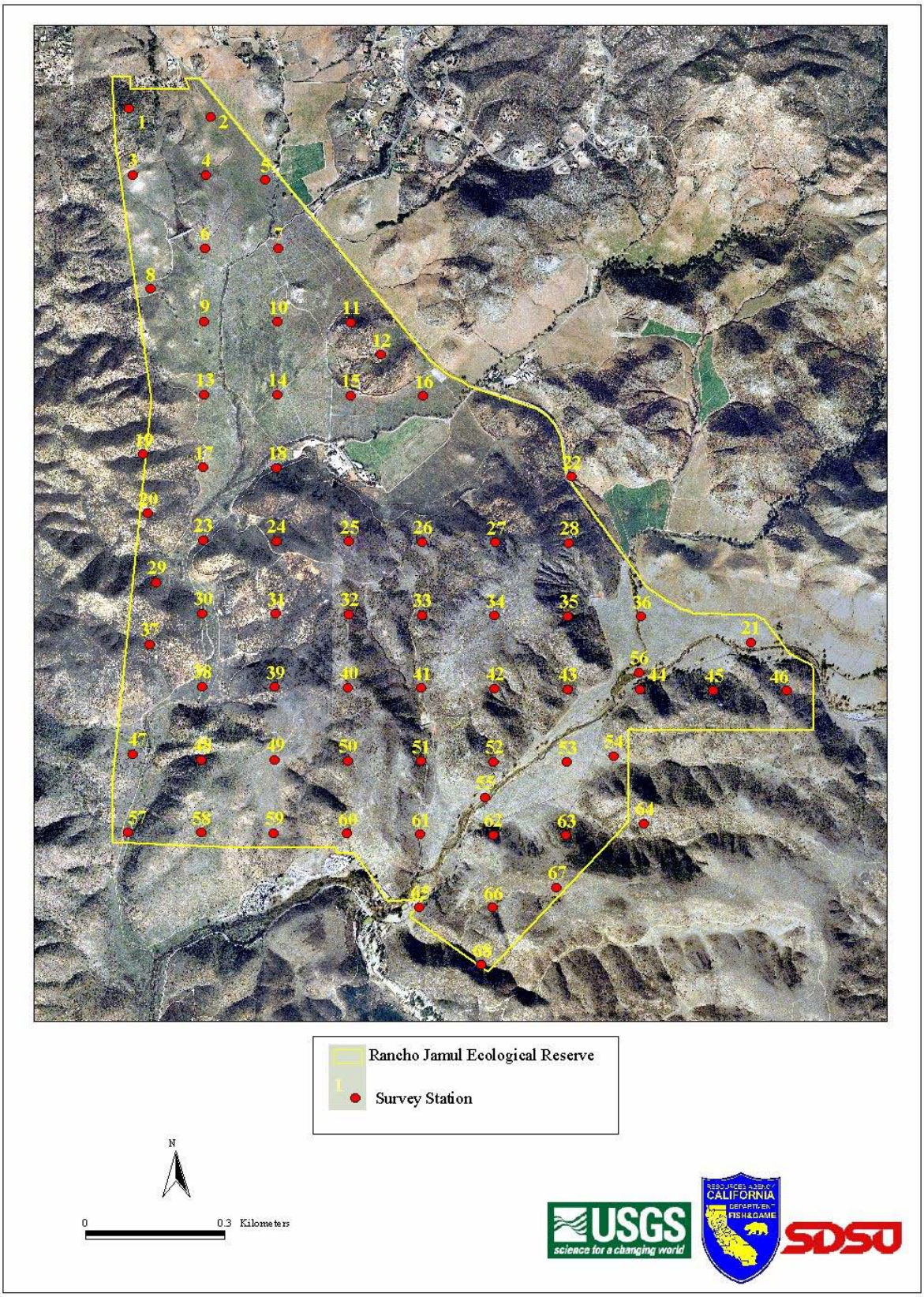


Figure 9. Bird survey locations at Rancho Jamul Ecological Reserve in 2001.

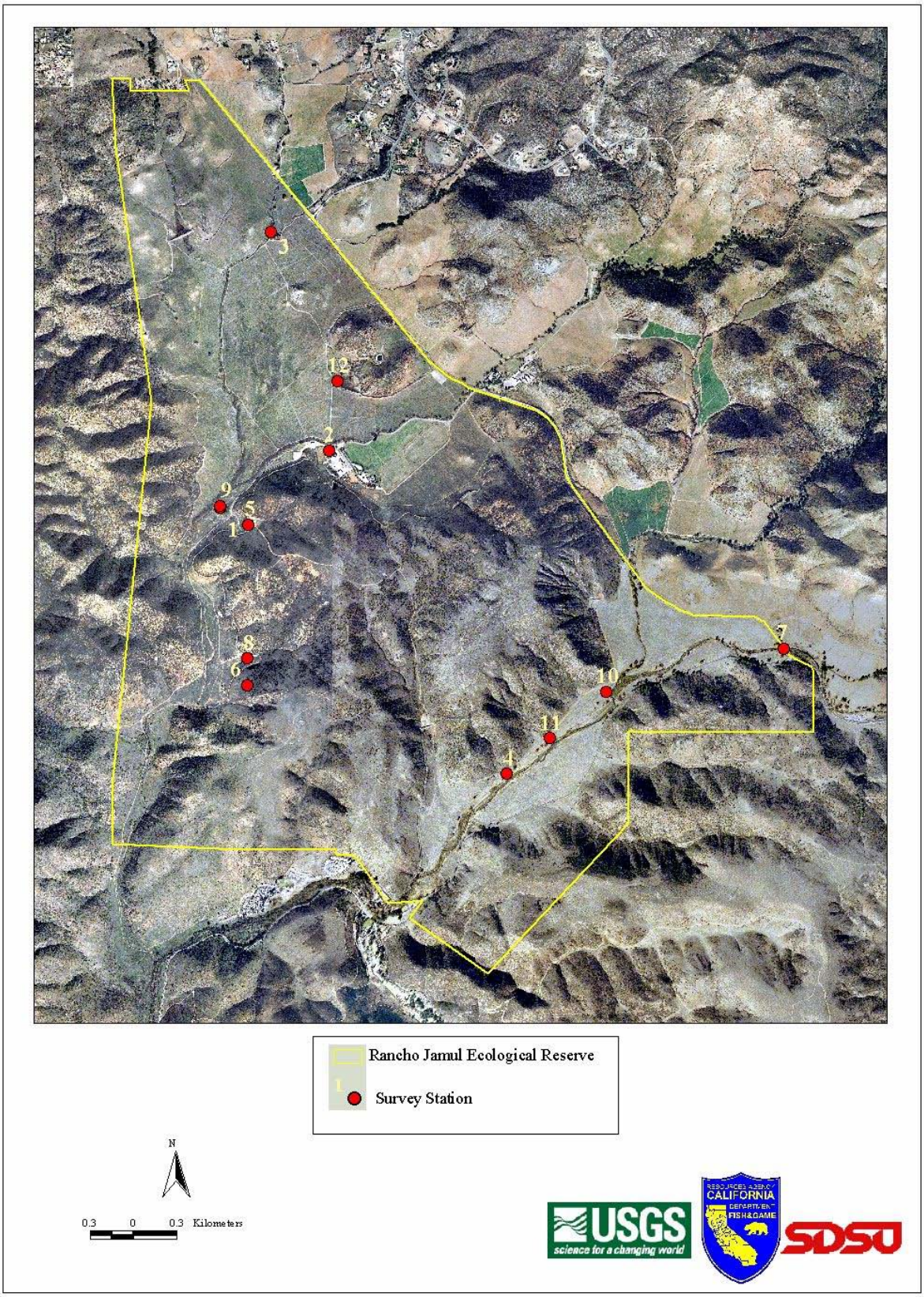


Figure 10. Bat survey locations at Rancho Jamul Ecological Reserve in 2000 and 2001.

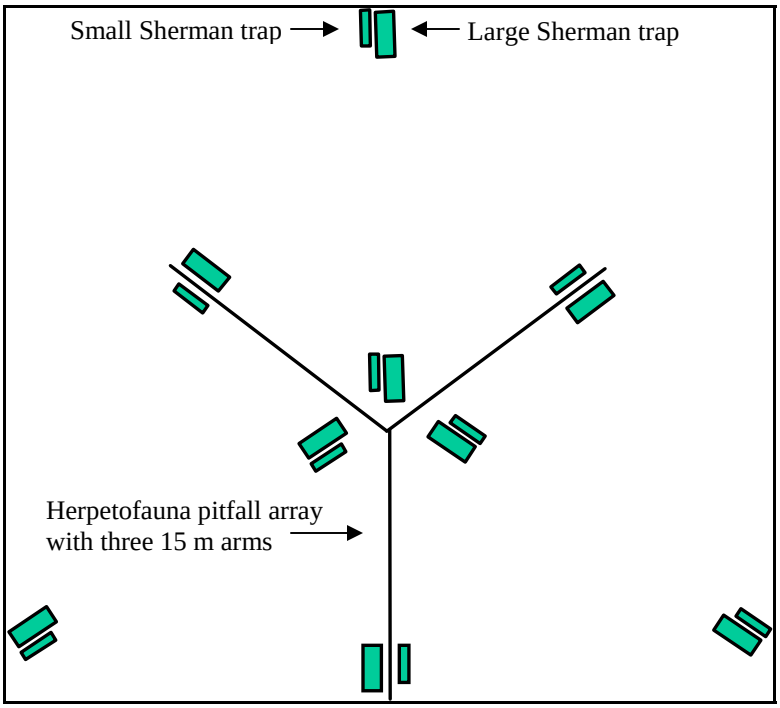


Figure 11. Sherman live trap configuration (9 small and 9 large traps) around a herpetofauna pitfall array. Figure not drawn to scale.

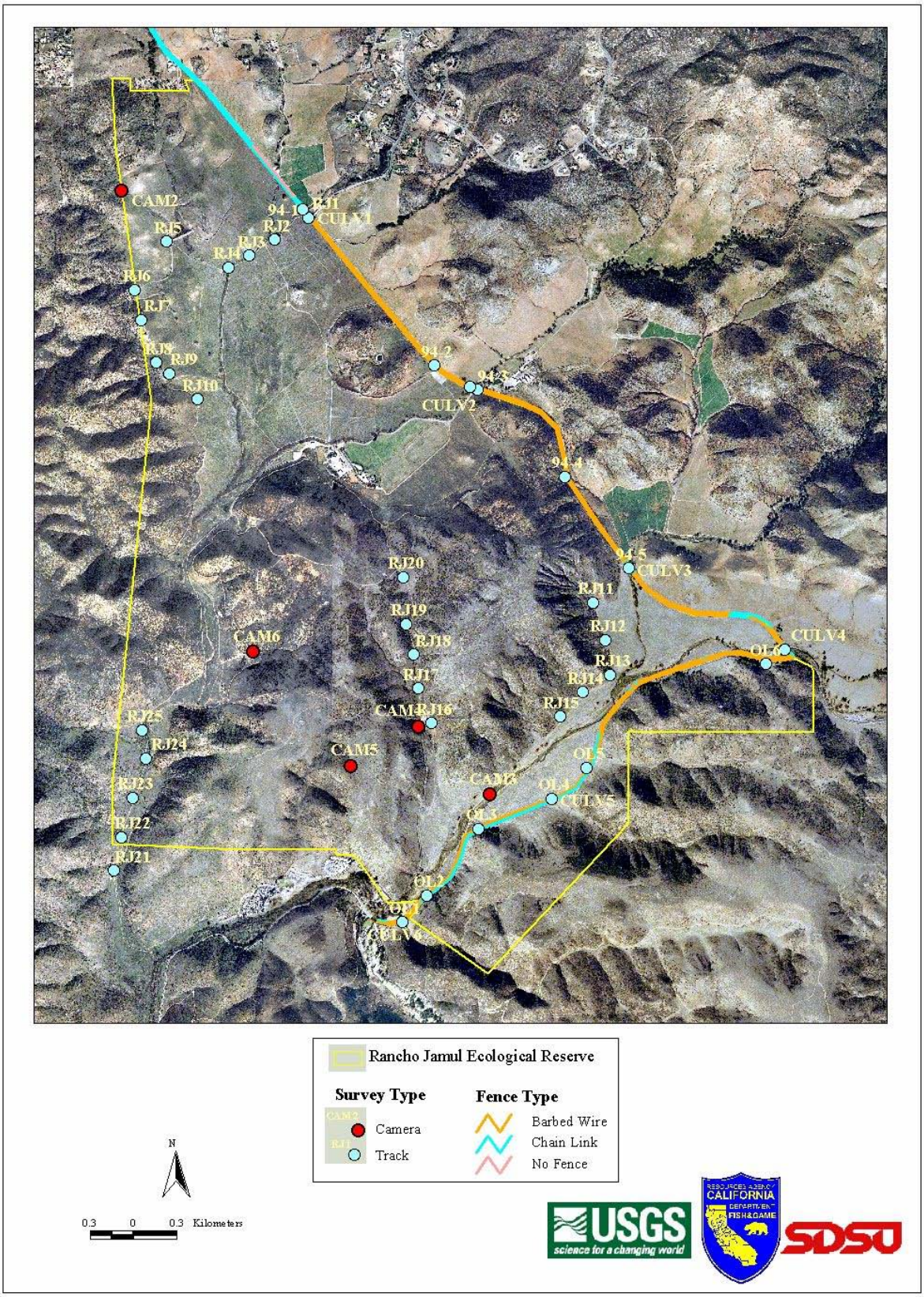


Figure 12. Carnivore survey locations at Rancho Jamul Ecological Reserve in 2001 and 2002.

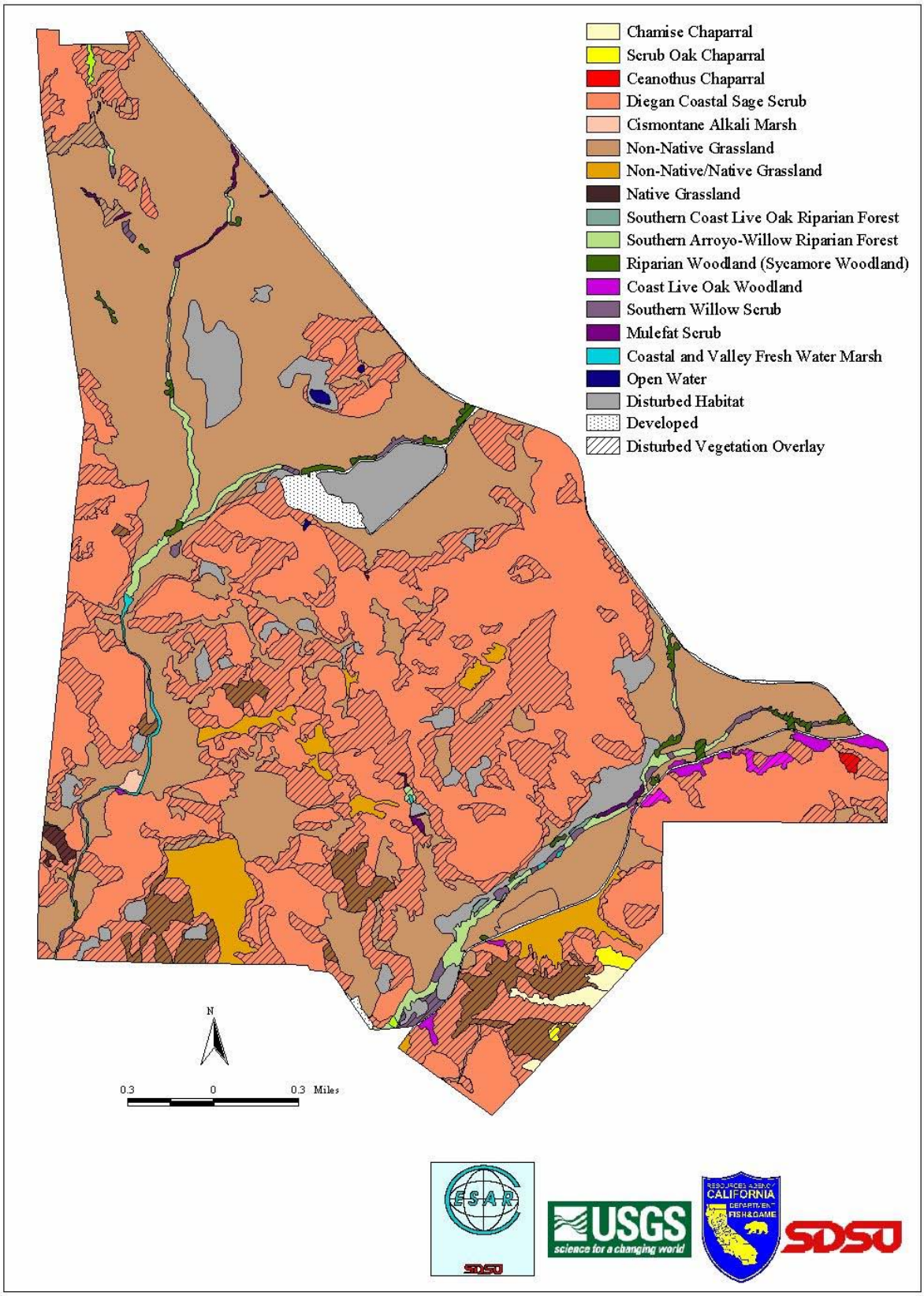


Figure 13. Vegetation and land cover types at Rancho Jamul Ecological Reserve 2002.

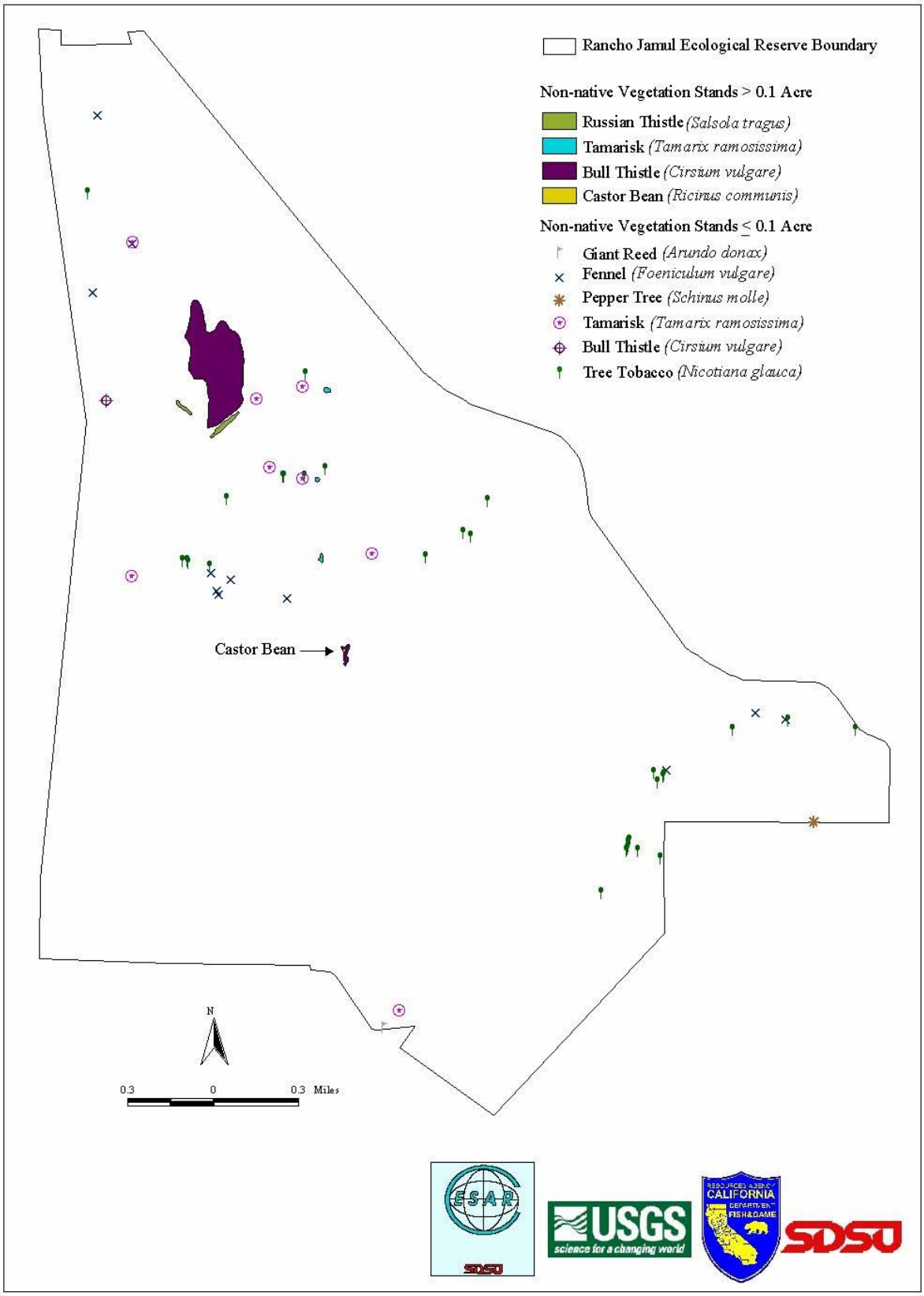


Figure 14. Non-native plant species locations at Rancho Jamul Ecological Reserve 2002.

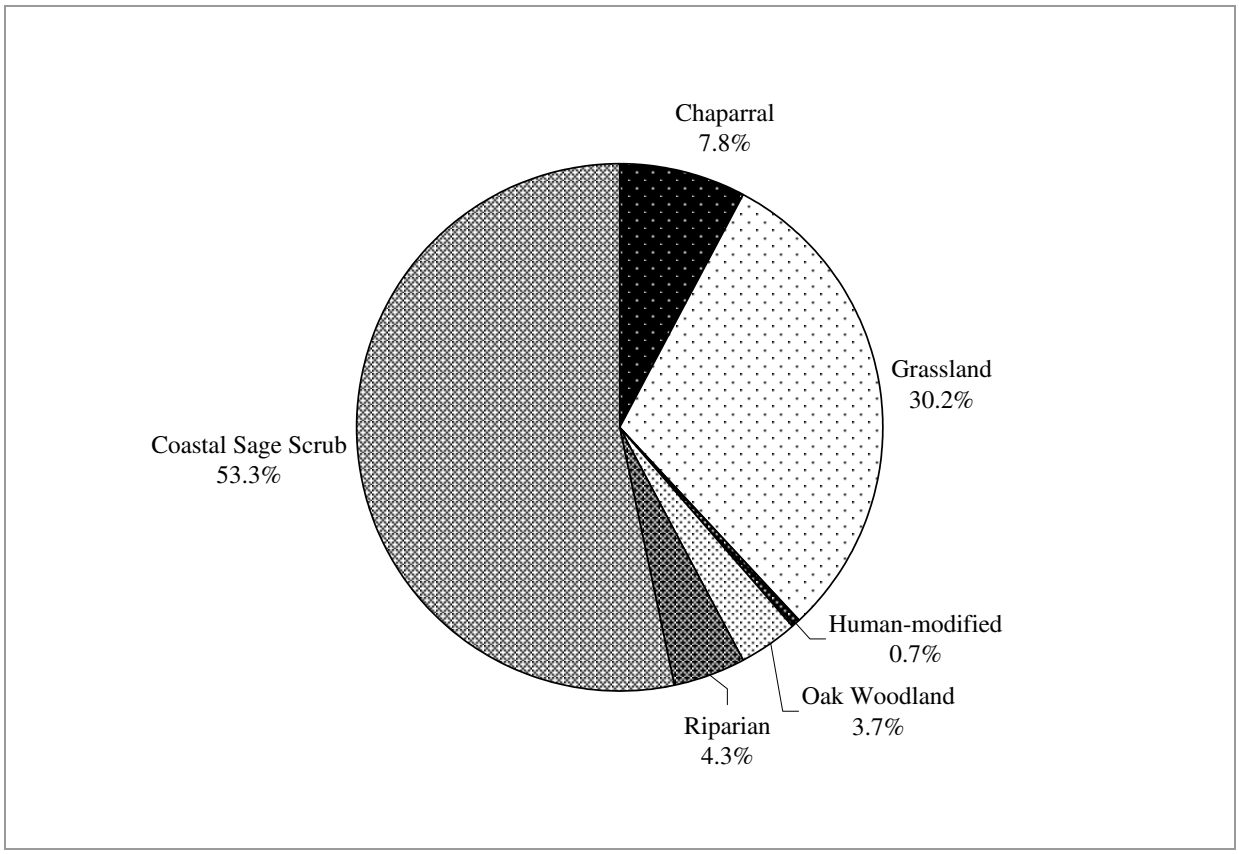


Figure 15. Proportion of habitat type surveyed during avifauna point counts (n = 68) in 2001. Habitat type was measured within a 100m radius of each point.

Appendix 1. Rare plant survey point locations.[a]

Point #	Degrees N	Degrees W
2	32.66012	116.85390
3	32.66012	116.85391
4	32.65999	116.85363
5	32.65998	116.85361
6	32.65887	116.85492
7	32.65832	116.85430
8	32.65790	116.85438
9	32.65761	116.85441
10	32.65690	116.85516
11	32.65871	116.85402
12	32.65976	116.85453
13	32.66324	116.85495
14	32.66309	116.85614
15	32.66308	116.85645
16	32.66302	116.83548
17	32.66357	116.83523
18	32.66365	116.83409
19	32.66423	116.83196
20	32.66448	116.82875
21	32.66477	116.82449
22	32.66288	116.82747
23	32.65028	116.84891
24	32.65515	116.84420
25	32.65518	116.84400
26	32.65517	116.84372
27	32.65515	116.84348
28	32.65519	116.84326
29	32.65518	116.84300
30	32.65521	116.84268
31	32.65527	116.84235
32	32.65540	116.84166
33	32.65566	116.84109
34	32.65598	116.84050
35	32.65601	116.83995
36	32.65593	116.83950
37	32.65588	116.83929
38	32.65711	116.83981
42	32.66151	116.86071
43	32.66133	116.86093
44	32.65791	116.86149
45	32.65791	116.86151
46	32.65629	116.86222
47	32.65830	116.86261
48	32.65800	116.86258
50	32.66171	116.86291
51	32.66188	116.86224
53	32.65659	116.86334
54	32.65474	116.86693
55	32.65414	116.86714
56	32.66085	116.86324
57	32.66092	116.86251
58	32.66132	116.86187
59	32.67291	116.85394
60	32.67409	116.85703
63	32.65088	116.84290
65	32.65122	116.84285
66	32.65171	116.84350
68	32.65174	116.84182
70	32.65455	116.83863
71	32.65470	116.84002
72	32.65451	116.84223
74	32.66062	116.84777
76	32.66571	116.84694
77	32.66613	116.84893
78	32.66943	116.84699
79	32.67104	116.84723
80	32.67099	116.84693
82	32.67338	116.84249
83	32.67328	116.86034
84	32.67292	116.86024
85	32.67131	116.86019
86	32.66844	116.86102
87	32.67385	116.85988
88	32.69464	116.86662
89	32.69847	116.86752
93	32.69820	116.87212
94	32.69742	116.87176
97	32.66235	116.85208
98	32.66218	116.85204
99	32.66129	116.85561
100	32.65986	116.85278
101	32.65979	116.85247
102	32.65952	116.85244
103	32.66085	116.85194
104	32.67094	116.85654
105	32.69432	116.86653
106	32.66252	116.85406
107	32.66253	116.85404
108	32.66484	116.84564
109	32.66593	116.84509
110	32.66618	116.84382
111	32.66696	116.84512
112	32.66894	116.84188
113	32.66926	116.84157

[a] *locations obtained in WGS84*

Appendix 2. Coordinates of ponds surveyed 1998 - 2001.[a]

Pond Name	*Degrees N*	*Degrees W*
Rancho Pond	32.69428	116.86868
Cistern	32.68632	116.8539
Willow Pond	32.6851	116.85667
Pump Pond	32.67709	116.8651
Corral Pond	32.67616	116.86325
Canyon Pond	32.66386	116.85043
Kiln Pond	32.66762	116.86331

[a] *locations obtained in WGS84 datum*

Appendix 3. Coordinates of herpetofauna, ant, and small mammal survey stations.[a]

Array Number	*Degrees N*	*Degrees W*
1	32.69390	116.86154
2	32.69332	116.86371
3	32.69203	116.86277
4	32.69677	116.86924
5	32.69536	116.87181
6	32.68710	116.86918
7	32.67965	116.86771
8	32.68008	116.86849
9	32.68545	116.85428
10	32.68763	116.85533
11	32.66649	116.86859
12	32.66184	116.87047
13	32.67351	116.86090
14	32.67394	116.85802
15	32.66375	116.85367
16	32.66606	116.85534
17	32.68405	116.85971
18	32.66557	116.85133
19	32.66651	116.84005
20	32.66636	116.83917
21	32.67306	116.85371

[a] *locations obtained in WGS84 datum*

Appendix 4. Coordinates of avifauna point counts.[a]

Point #	Degrees N	Degrees W	Point #	Degrees N	Degrees W
1	32.70149	116.87225	35	32.67031	116.84002
2	32.70100	116.86629	36	32.67031	116.83469
3	32.69741	116.87198	37	32.66842	116.87055
4	32.69741	116.86664	38	32.66583	116.86669
5	32.69712	116.86232	39	32.66583	116.86136
6	32.69290	116.86665	40	32.66582	116.85603
7	32.69289	116.86132	41	32.66582	116.85069
8	32.69037	116.87063	42	32.66581	116.84536
9	32.68838	116.86666	43	32.66580	116.84003
10	32.68838	116.86132	44	32.66580	116.83470
11	32.68837	116.85599	45	32.66579	116.82936
12	32.68639	116.85379	46	32.66578	116.82403
13	32.68387	116.86666	47	32.66163	116.87170
14	32.68387	116.86133	48	32.66132	116.86670
15	32.68386	116.85599	49	32.66132	116.86136
16	32.68386	116.85066	50	32.66131	116.85603
17	32.67937	116.86667	51	32.66131	116.85070
18	32.67936	116.86134	52	32.66130	116.84537
19	32.68016	116.87107	53	32.66129	116.84003
20	32.67651	116.87070	54	32.66168	116.83665
21	32.66875	116.82668	55	32.65910	116.84602
22	32.67891	116.83979	56	32.66685	116.83480
23	32.67486	116.86668	57	32.65682	116.87203
24	32.67485	116.86134	58	32.65681	116.86670
25	32.67484	116.85601	59	32.65680	116.86137
26	32.67483	116.85068	60	32.65680	116.85604
27	32.67483	116.84535	61	32.65679	116.85071
28	32.67482	116.84001	62	32.65679	116.84538
29	32.67224	116.87008	63	32.65678	116.84005
30	32.67034	116.86669	64	32.65754	116.83439
31	32.67034	116.86135	65	32.65228	116.85072
32	32.67033	116.85602	66	32.65228	116.84538
33	32.67033	116.85068	67	32.65355	116.84072
34	32.67032	116.84535	68	32.64874	116.84619

[a] *locations obtained in WGS84 datum*

Appendix 5. Coordinates of bat survey stations.[a]

Site Number	*Location*	*Degrees N*	*Degrees W*
1	Pump Pond	32.67704	116.86539
2	Horse Stables (street lamp)	32.68059	116.85746
3	Jamul Creek (at herp array 1)	32.69410	116.86182
4	Dulzura Creek (restoration area)	32.66069	116.84433
5	Corral Pond	32.67598	116.86331
6	Old Historic Brick Kiln	32.66607	116.86330
7	Hwy 94 Bridge at Dulzura Creek	32.66811	116.82405
8	Kiln Pond	32.66774	116.86330
9	Pump Pond	32.67713	116.86535
10	Dulzura Creek (restoration area)	32.66580	116.83713
11	Dulzura Creek (restoration area)	32.66291	116.84121
12	Willow Pond	32.68489	116.85689

[a] *locations obtained in WGS84 datum*

Appendix 6. Coordinates of large and medium mammal sampling locations, including track stations, camera stations, and underpasses.[a]

Survey Location	*Degrees N*	*Degrees W*
CA 94		
94-1	32.69545	116.85946
94-2	32.68587	116.84980
94-3	32.68440	116.84666
94-4	32.67905	116.84022
94-5	32.67343	116.83555
Otay Lakes Road		
OL 1	32.65150	116.85193
OL 2	32.65316	116.85014
OL 3	32.65731	116.84637
OL 4	32.65917	116.84106
OL 5	32.66111	116.83855
OL 6	32.66758	116.82552
Transect 1		
RJ 1	32.69496	116.85907
RJ 2	32.69360	116.86148
RJ 3	32.69259	116.86335
RJ 4	32.69187	116.86485
RJ 5	32.69345	116.86943

Survey Location	*Degrees N*	*Degrees W*
Transect 2		
RJ 6	32.69043	116.87170
RJ 7	32.68860	116.87124
RJ 8	32.68597	116.87007
RJ 9	32.68529	116.86911
RJ 10	32.68371	116.86710
Transect 3		
RJ 11	32.67132	116.83816
RJ 12	32.66898	116.83722
RJ 13	32.66686	116.83683
RJ 14	32.66577	116.83887
RJ 15	32.66426	116.84044
Transect 4		
RJ 16	32.66379	116.84986
RJ 17	32.66594	116.85083
RJ 18	32.66801	116.85122
RJ 19	32.66990	116.85173
RJ 20	32.67281	116.85196

Survey Location	*Degrees N*	*Degrees W*
Transect 5		
RJ 21	32.65459	116.87299
RJ 22	32.65666	116.87245
RJ 23	32.65910	116.87159
RJ 24	32.66153	116.87070
RJ 25	32.66326	116.87095
Cameras		
CAM 2	32.69655	116.87271
CAM 3	32.65943	116.84560
CAM 4	32.66359	116.85081
CAM 5	32.66114	116.85574
CAM 6	32.66813	116.86294
Underpass		
CULV 1	32.69545	116.85946
CULV 2	32.68456	116.84721
CULV 3	32.67343	116.83555
CULV 4	32.66843	116.82410
CULV 5	32.65917	116.84106
CULV 6	32.65150	116.85193

[a] *locations obtained in WGS 84 datum*

Appendix 7. Plant species detected during 2001 rare plant surveys.

Species	***Habitat*** [a]
Acourtia microcephala	DCSS, DGL
Achillea millefolium	DCSS, DGL
Adenostoma fasciculatum	CHP
Allium haematochiton	DGL
Ambrosia psilostachya	DR
Amsinckia menziesii var. *intermedia*	DCSS, DGL
Anagallis arvensis	DGL
Apiastrum angustifolium	DGL
Artemisia californica	DCSS
Atriplex pacifica [b]	DCSS, DGL, NNG
Asclepias fascicularis	DGL
Astragalus trichopodus	DGL, NNG
Atriplex semibaccata [c]	DCSS, DGL, NNG
Avena sp. [c]	DCSS, DGL, NNG
Baccharis salicifolia	DCSS, DR
Baccharis sarothroides	DCSS, DGL, DR
Bloomeria crocea ssp. *crocea*	DCSS, DGL, NNG
Bothriochloa barbinodis	DCSS, DGL
Brassica nigra [c]	DCSS, DGL, NNG
Brickellia californica	DCSS, DGL
Brodiaea jolonensis [b]	DGL, DVP, NNG,
Bromus carinatus	DGL
Bromus diandrus [c]	DGL, NNG
Bromus hordeaceus [c]	DGL, NNG
Bromus madritensis spp. *rubens* [c]	DGL, NNG
Calochortus splendens	DCSS, DGL, NNG
Calystegia macrostegia	DCSS, DGL
Castilleja exerta	DGL
Cheilanthes clevelandii	DCSS, DGL
Chlorogalum parviflorum	DCSS, DGL
Centaurea melitensis [c]	DCSS, DGL, NNG
Clematis lasiantha	DCSS
Convolvulus simulans [b]	DGL, NNG
Cortaderia jubata [c]	DR
Crassula erecta	DCSS, DGL
Cuscuta sp.	DCSS, DGL, NNG
Cynara cardunculus [c]	DCSS, DGL
Cynodon dactylon [c]	DGL, DR, NNG
Daucus pusillus	DGL
Deschampsia danthonioides [b]	DVP
Dichelostemma capitatum ssp. *capitatum*	DCSS, DGL
Distichlis spicata	DGL, DVP, DR , NNG
Dodecatheon clevelandii	DGL
Dudleya pulverulenta	CHP, DCSS
Dudleya variegata	DCSS, DGL
Eremocarpus setigerus	DGL, NNG
Erigeron foliosus	DCSS, DGL
Eriogonum fasciculatum	DCSS, DGL

Appendix 7 (continued).

Species	***Habitat*** [a]
Eriophyllum confertiflorum	DCSS, DGL
Erodium botrys [c]	DCSS, DGL, NNG
Erodium cicutarium [c]	DCSS, DGL, NNG
Eschschotlzia californica	DCSS, DGL
Eucrypta chrysanthemifolia	DCSS, DR
Ferocactus viridescens	DCSS, DGL
Filago sp.	DCSS, DGL
Foeniculum vulgare [c]	DCSS, DGL, DR, NNG
Fritilaria biflora	DGL
Galium angustifolium ssp. *angustifolium*	DCSS
Gilia angelensis	DGL
Gnaphalium palustre	DR
Grindelia camporum var. *bracteosum*	DGL
Gutierrezia sarothrae	DCSS, DGL
Harpagonella palmeri [b]	DGL
Hazardia squarrosus	DCSS, DGL
Hedypnois cretica [c]	DGL, NNG
Helianthemum scoparium	DCSS, DGL
Heliotropium curvassavicum [c]	DR, NNG
Hemizonia conjugens [b]	DGL, NNG
Hemizonia fasciculata	DCSS, DGL, NNG
Hypochaeris glabra [c]	DCSS, DGL, NNG
Isocoma menziesii var. *menziesii*	DCSS, DGL
Isomeris arborea	DCSS
Iva hayesiana [b]	DR
Jepsonia parryi	DCSS, DGL
Juncus acutus ssp. *leopoldii* [b]	DCSS, DGL, DR
Lasthenia californica	DCSS, DGL
Lathyrus vistitus ssp. *alefeldii*	DCSS
Lessingia filaginifolia var. *filaginifolia*	DCSS, DGL
Lepidium nitidum	DGL, NNG
Linanthus dianthiflorus	DCSS, DGL
Lolium perenne [c]	DGL, NNG
Lotus scoparius	DCSS, DGL
Lupinus spp.	DCSS, DGL
Lythrum hyssopifolium [c]	DVP
Malosma laurina	DCSS
Marah macrocarpus	DCSS
Marrubium vulgare [c]	DCSS, DGL, NNG
Mimulus aurantiacus	DCSS
Mimulus guttatus	DR
Mirabilis californica	DCSS
Muilla clevelandii [b]	CHP, DGL
Nassella pulchra	DCSS, DGL
Navarretia hamata	DCSS, DGL
Nicotiana glauca [c]	DCSS, DGL

Appendix 7 (continued).

Species	***Habitat*** [a]
Opuntia littoralis	DCSS, DGL
Opuntia prolifera	DCSS, DGL
Pellaea mucronata	DCSS, DGL
Pennisetum sp.[c]	DGL, NNG
Pentagramma triangularis	DCSS, DGL
Phacelia cicutaria	DCSS
Phoradendron tomentosum	DCSS, DR
Plantago erecta [b]	DGL, NNG
Platanus racemosa	DCSS, DR
Polypogon monspeliensis [c]	DVP, NNG
Quercus agrifolia	DCSS
Rhamnus crocea	DCSS
Rhus integrifolia	DCSS, DGL
Romneya coulteri [b]	DCSS
Rumex sp.[c]	DGL, DVP, NNG
Salix spp.	DR
Salsola tragus	DCSS, DGL, NNG
Salvia apiana	DCSS, DGL
Salvia mellifera	DCSS
Sanicula sp.	DGL
Schismus barbatus [c]	DCSS, DGL, NNG
Scrophularia californica	DCSS
Selaginella bigelovii	DCSS, DGL
Selaginella cinerascens [b]	DCSS, DGL
Sidalcea malvaeflora ssp. *sparsifolia*	DCSS, DGL
Silene gallica [c]	DGL, NNG
Sisyrinchium bellum	DCSS, DGL
Sporobolus airoides	DCSS, DGL
Uropappus lindleyi	DGL, NNG
Viguiera laciniata	DCSS, DGL
Viola pedunculata	DGL
Vulpia myuros [c]	DCSS, DGL, NNG
Xanthium sp.[c]	DCSS, NNG
Xylococcus bicolor	CHP, DCSS
Yucca schidigera	DCSS, NNG
Yucca whipplei	DCSS, NNG
Zygadenus fremontii	DGL

[a] *habitat codes: CHP = Chaparral; DCSS = Disturbed Coastal Sage Scrub; DGL = Disturbed Native Grassland/Disturbed Clay Lens; DR = Riparian Drainages; DVP = Disturbed Vernal Pool; NNG = Non-Native Annual Grassland*

[b] *sensitive species (see Table 1 for sensitive status and Table 2 for explanation of codes)*

[c] *non-native species*

Appendix 8. Summary of rare plant observations.

Genus	Species	Common Name	Figure Number	Point Id	Date	# of individ.*
Atriplex	*pacifica*	South Coast saltscale	*13*	*59*	26-May-01	3
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*2*	05-May-01	1000
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*4*	05-May-01	1000
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*53*	23-May-01	500
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*54*	23-May-01	100
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*58*	23-May-01	100
Brodiaea	*jolonensis*	Mesa Brodiaea	*13*	*101*	28-Jul-01	200
Convolvulus	*simulans*	Small-flowered Morning Glory	*13*	*59*	26-May-01	1000
Convolvulus	*simulans*	Small-flowered Morning Glory	*13*	*60*	26-May-01	1000
Convolvulus	*simulans*	Small-flowered Morning Glory	*13*	*83*	09-Jun-01	1000
Convolvulus	*simulans*	Small-flowered Morning Glory	*13*	*84*	09-Jun-01	500
Convolvulus	*simulans*	Small-flowered Morning Glory	*13*	*87*	09-Jun-01	1000
Deschampsia	*danthonioides*	Annual Hairgrass	*13*	*99*	13-Jul-01	20
Dichondra	*occidentalis*	Western Dichondra	*14*	*70*	02-Jun-01	100
Dichondra	*occidentalis*	Western Dichondra	*13*	*74*	02-Jun-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*3*	05-May-01	10000
Dudleya	*variegata*	Variegated Dudleya	*13*	*4*	05-May-01	10000
Dudleya	*variegata*	Variegated Dudleya	*13*	*6*	05-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*7*	05-May-01	10000
Dudleya	*variegata*	Variegated Dudleya	*13*	*8*	05-May-01	10000
Dudleya	*variegata*	Variegated Dudleya	*13*	*9*	05-May-01	5000
Dudleya	*variegata*	Variegated Dudleya	*13*	*11*	05-May-01	5000
Dudleya	*variegata*	Variegated Dudleya	*13*	*12*	05-May-01	500
Dudleya	*variegata*	Variegated Dudleya	*13*	*13*	05-May-01	20
Dudleya	*variegata*	Variegated Dudleya	*13*	*42*	19-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*43*	19-May-01	100
Dudleya	*variegata*	Variegated Dudleya	*13*	*44*	19-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*47*	19-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*48*	19-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*50*	19-May-01	10
Dudleya	*variegata*	Variegated Dudleya	*13*	*51*	19-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*54*	23-May-01	500
Dudleya	*variegata*	Variegated Dudleya	*13*	*55*	23-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*56*	23-May-01	500
Dudleya	*variegata*	Variegated Dudleya	*13*	*57*	23-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13*	*58*	23-May-01	1000
Dudleya	*variegata*	Variegated Dudleya	*13, 14*	*76*	03-Jun-01	100
Dudleya	*variegata*	Variegated Dudleya	*14*	*82*	05-Jun-01	200
Dudleya	*variegata*	Variegated Dudleya	*13*	*97*	13-Jul-01	100
Dudleya	*variegata*	Variegated Dudleya	*13*	*98*	13-Jul-01	50
Dudleya	*variegata*	Variegated Dudleya	*13*	*100*	28-Jul-01	50
Dudleya	*variegata*	Variegated Dudleya	*13*	*102*	28-Jul-01	50
Dudleya	*variegata*	Variegated Dudleya	*13*	*103*	28-Jul-01	100
Dudleya	*variegata*	Variegated Dudleya	*13*	*104*	28-Jul-01	500
Dudleya	*variegata*	Variegated Dudleya	*13*	*107*	28-Jul-01	50
Dudleya	*variegata*	Variegated Dudleya	*14*	*111*	26-Nov-01	500
Dudleya	*variegata*	Variegated Dudleya	*14*	*112*	26-Nov-01	1000

Appendix 8 (continued).

Genus	Species	Common Name	Figure Number	Point Id	Date	# of individ.*
Fritilaria	*biflora*	Chocolate Lily	*13, 14*	*78*	05-Jun-01	1
Fritilaria	*biflora*	Chocolate Lily	*13, 14*	*79*	05-Jun-01	30
Harpagonella	*palmeri*	Palmer's Grapplinghook	*13*	*59*	26-May-01	1000
Hemizonia	*conjugens*	Otay Tarplant	*13*	*45*	19-May-01	1000
Hemizonia	*conjugens*	Otay Tarplant	*13*	*58*	19-May-01	500
Juncus	*acutus ssp.leopoldii*	Southwestern spiny rush	*13*	*23*	22-May-01	1
Muilla	*clevelandii*	San Diego Goldenstar	*13*	*7*	02-Jun-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*13*	*9*	02-Jun-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*24*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*25*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*26*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*27*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*28*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*29*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*30*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*31*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*32*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*33*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*34*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*35*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*36*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*37*	18-May-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*65*	02-Jun-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*66*	02-Jun-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*68*	02-Jun-01	10000
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*71*	02-Jun-01	10
Muilla	*clevelandii*	San Diego Goldenstar	*14*	*72*	02-Jun-01	10000
Plantago	*erecta*	Dot-seed Plantain	*13*	*4*	05-May-01	2000
Plantago	*erecta*	Dot-seed Plantain	*13*	*7*	05-May-01	5000
Plantago	*erecta*	Dot-seed Plantain	*13*	*8*	05-May-01	5000
Plantago	*erecta*	Dot-seed Plantain	*13*	*9*	05-May-01	1000
Plantago	*erecta*	Dot-seed Plantain	*14*	*19*	12-May-01	200
Plantago	*erecta*	Dot-seed Plantain	*13*	*42*	19-May-01	10000
Plantago	*erecta*	Dot-seed Plantain	*13*	*43*	19-May-01	10000
Plantago	*erecta*	Dot-seed Plantain	*13*	*50*	19-May-01	10000
Plantago	*erecta*	Dot-seed Plantain	*13*	*51*	19-May-01	10000
Plantago	*erecta*	Dot-seed Plantain	*14*	*63*	02-Jun-01	10000
Plantago	*erecta*	Dot-seed Plantain	*13*	*77*	03-Jun-01	1000
Plantago	*erecta*	Dot-seed Plantain	*13, 14*	*80*	05-Jun-01	1000
Plantago	*erecta*	Dot-seed Plantain	*13*	*85*	09-Jun-01	1000
Plantago	*erecta*	Dot-seed Plantain	*13*	*86*	09-Jun-01	1000
Plantago	*erecta*	Dot-seed Plantain	*12*	*89*	16-Jun-01	100
Plantago	*erecta*	Dot-seed Plantain	*13*	*105*	28-Jul-01	500
Plantago	*erecta*	Dot-seed Plantain	*13*	*106*	28-Jul-01	1000
Plantago	*erecta*	Dot-seed Plantain	*13, 14*	*108*	12-Nov-01	500
Plantago	*erecta*	Dot-seed Plantain	*14*	*109*	12-Nov-01	1000
Plantago	*erecta*	Dot-seed Plantain	*14*	*110*	26-Nov-01	500

Appendix 8 (continued).

Genus	Species	Common Name	Figure Number	Point Id	Date	# of individ.*
Plantago	*erecta*	Dot-seed Plantain	*14*	*113*	26-Nov-01	5000
Romneya	*coulteri*	Coulter's matilija poppy	*13*	*46*	19-May-01	10
Viguiera	*laciniata*	San Diego Sunflower	*13*	*6*	05-May-01	2
Viguiera	*laciniata*	San Diego Sunflower	*13*	*9*	05-May-01	5
Viguiera	*laciniata*	San Diego Sunflower	*13*	*10*	05-May-01	20
Viguiera	*laciniata*	San Diego Sunflower	*13*	*14*	05-May-01	2
Viguiera	*laciniata*	San Diego Sunflower	*13*	*15*	05-May-01	5
Viguiera	*laciniata*	San Diego Sunflower	*14*	*16*	12-May-01	40
Viguiera	*laciniata*	San Diego Sunflower	*14*	*17*	12-May-01	50
Viguiera	*laciniata*	San Diego Sunflower	*14*	*18*	12-May-01	50
Viguiera	*laciniata*	San Diego Sunflower	*14*	*19*	12-May-01	50
Viguiera	*laciniata*	San Diego Sunflower	*14*	*20*	12-May-01	30
Viguiera	*laciniata*	San Diego Sunflower	*14*	*21*	12-May-01	40
Viguiera	*laciniata*	San Diego Sunflower	*14*	*22*	12-May-01	40
Viguiera	*laciniata*	San Diego Sunflower	*12*	*88*	16-Jun-01	200
Viguiera	*laciniata*	San Diego Sunflower	*12*	*93*	16-Jun-01	10
Viguiera	*laciniata*	San Diego Sunflower	*12*	*94*	16-Jun-01	40

* these are population estimates only and are not meant to be used for monitoring purposes

Appendix 9. Sensistive plant species accounts.

Acanthomintha ilicifolia **- San Diego thornmint**
CNPS: 1B, 2-3-2 State: Endangered Federal: Threatened

San Diego thornmint is an annual herb that occurs in heavy clay soils associated with native grasslands, coastal sage scrub, chaparral, and vernal pools. This herb blooms between April and July and is found from northern San Diego County south to northwestern Baja California, Mexico (CNPS 2001). This species is listed as threatened by the United States Fish and Wildlife Service (USFWS) and endangered by the California Department of Fish and Game (CDFG).

San Diego thornmint was not found on the project area during the 2001 season, but was found on the portion of RJER that is on the north side of SR 94. These populations were found during the 2001 season while conducting surveys for the County of San Diego (Sproul 2001).

Although San Diego thornmint was not found in the project area, the appropriate soils and plant associations were found in many parts of the ranch. These areas of heavy clay soils have excellent potential for San Diego thornmint, so this species is a primary candidate for future sensitive species surveys. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

Atriplex pacifica **– South Coast saltscale**
CNPS: 1B, 3-2-2 State: -- Federal: --

South Coast saltscale in an annual (occasionally perennial) that blooms from March to October and grows in the coastal sage scrub, grassland, and vernal pool habitats in southern California. This species is also found in Arizona, as well as Baja California and Sonora, Mexico.

South Coast saltscale was mapped in one locality during the 2001 season (Figure 4; Appendix 8), with a total of 3 individuals. This species has potential to be found in most of the native habitat types on RJER, but it can also be found in the more disturbed areas of the ranch, so the agricultural and ruderal portions of the ranch have potential for this species as well.

Appendix 9 (continued).

***Brodiaea jolonensis* – Mesa Brodiaea**
CNPS: -- **State: --** **Federal: --**

Mesa Brodiaea is bulbous species that flowers in spring and early summer and is found in heavy clay soils of the coastal mesas from Monterey County to northern Baja California, Mexico. This species occurs in heavy clay lenses and is usually associated with vernal pools. In San Diego County and northern Baja California, this species has become rare, with most of the habitat lost to development. Although this species is considered rare, it is currently not listed and is not on any official watch list.

Mesa Brodiaea was mapped at 6 localities during the 2001 season on the central mesa/plateau in the heavy clay soil areas associated with variegated Dudleya and other clay soil species (Figure 4; Appendix 8). In an effort to maximize the survey time spent during the 2001 surveys, this species was not mapped at every locality that it was found, so the distribution and density of the Mesa Brodiaea populations are greater than the data from 2001 would indicate. The estimated total population size of Mesa Brodiaea on RJER is at least 10,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Convolulus simulans* – Small-flowered morning-glory**
CNPS: 4, 1-2-2 **State: --** **Federal: --**

Small-flowered morning-glory is an annual that blooms in the early to late spring and is found from Contra Costa county south into northwestern Baja California, Mexico. This species is found in the open clay soils associated with coastal sage scrub, chaparral, and grassland habitats.

Small-flowered morning-glory was mapped at 5 localities during the 2001 season, on the central mesa/plateau on heavy clay soils. Small-flowered morning-glory can handle disturbance factors better than most of the other clay soil species, therefore, small-flowered morning-glory will persist even when species like San Diego thornmint have been extirpated.

In an effort to maximize the survey time spent during the 2001 surveys, this species was not mapped at every locality where it was found, so the distribution and density of the small-flowered morning-glory populations are greater than the data from 2001 would indicate. The estimated total population size of small-flowered morning-glory on Jamul Ranch is at least 10,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

Appendix 9 (continued).

***Deschampsia danthonioides* – annual hairgrass**
CNPS: -- **State: --** **Federal: --**

Annual hairgrass is a vernal pool indicator species that is found from northern Baja California, Mexico to southern Oregon. This species is also found in the vernal pool type habitats of Arkansas and South America (Chile). In the western United States this species flowers from March to July.

Although this species has a wide global distribution, in southern California this species has become increasingly rare as the vernal pool habitat is destroyed by development and weed invasion. Although this species is becoming increasingly rare, it is currently not listed and is not on any official watch list.

This species was found in one of two vernal pools found on the central mesa/plateau in an area with mima mound formations (Figure 4; Appendix 8). The population size in this pool during the 2001 season was 20 plants. These pools are only a few feet apart and both pools also support vernal pool stonecrop (*Crassula aquatica*) and grass poly *(Lythrum hyssopifolium*). The pools are naturally shallow so they do not support a high diversity of vernal pool species. Both pools are in the direct path of an access road that continues to be used by patrols (CDFG and Border Patrol) and other vehicle traffic. In addition to vehicular traffic, weed invasion is also a problem with these vernal pools and the surrounding habitat.

***Dichondra occidentalis* – Western Dichondra**
CNPS: 4, 1-2-1 **State: --** **Federal: --**

Western Dichondra is a rhizomatous perennial herb that blooms from March to July. This species is found in the chaparral, coastal sage scrub, and native grasslands of southern California and Baja California, Mexico.

Western Dichondra was mapped in two localities during the 2001 season, both on the south side of Otay Lakes Road on a north-facing slope (Figure 4 & 5; Appendix 8). The total estimated population size for these two localities is over 1,000 plants. Although these were the only populations found on the ranch during 2001, this species can be difficult to find because it often occurs under the cover of large shrubs and other perennial plants. An increase in the frequency of fire and the associated weed invasion are the most common disturbance factor currently affection the distribution and density of this species.

Appendix 9 (continued).

Dudleya variegata **- variegated Dudleya**
CNPS: 1B, 2-2-2 State: -- Federal: --

Variegated Dudleya is a cormose perennial that is found in heavy clay soils and rock out-crops from northern San Diego County to northwest Baja California, Mexico. This species flowers from April to June and occurs in native grassland and clay lens habitats associated with vernal pools, chaparral, and coastal sage scrub. This species ranges from the coast to the inland valleys and foothills. Variegated Dudleya was mapped in 36 localities during the 2001 season and all of these localities were found in the central mesa/plateau on the heavy clay soils with rock outcrop areas (Figure 4 & 5; Appendix 8). This species was found in the heavy clay soils associated with mesa Brodiaea and other clay soil species.

In an effort to maximize the survey time spent during the 2001 surveys, this species was not mapped at every locality that it was found, so the distribution and density of the variegated Dudleya populations are greater than the data from 2001 would indicate. The estimated total population size of variegated Dudleya on RJER is over 100,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

Ferocactus viridescens **– San Diego barrel cactus**
CNPS: 2, 1-3-1 State: -- Federal: --

This cactus species is found in the coastal zone of central and southern San Diego County and northwestern Baja California, Mexico. This species flowers in the spring to early summer and occurs in rocky and clays soils associated with the coastal sage scrub and maritime succulent scrub, as well as chaparral and grassland habitats.

San Diego barrel cactus was found scattered in low number along a few of the south-facing slopes on RJER during the 2001 season. None of these populations were mapped in an effort to concentrate the survey time on the other species that are more dependent on the survey timing (e.g., variegated Dudleya). The estimated total population size of San Diego barrel cactus on RJER is over 100 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

Appendix 9 (continued).

***Fritilaria biflora* – Chocolate lily**
CNPS: -- **State: --** **Federal: --**

Chocolate lily is a bulbous perennial species found along the coastal zone of California from Mendocino County to San Diego County and northwestern Baja California, Mexico. Chocolate lily flowers in the spring and is found in grassland areas; especially those associated with heavy clay soils. In San Diego County and northern Baja California, this species has become rare, with most of the habitat lost to development and non-native plant invasion. Although this species is considered rare, it is currently not listed or on any official watch list.

Chocolate lily was mapped in 2 localities during the 2001 season, and both of these populations were found on the heavy clay soils of the central mesa/plateau (Figure 4 & 5; Appendix 8). The estimated total population size of Chocolate lily on RJER is approximately 30 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Harpagonella palmeri* – Palmer's grapplinghook**
CNPS: 2, 1-2-1 **State: --** **Federal: --**

Palmer's grapplinghook is a small-flowered annual with hooked-tipped fruits. This annual flowers in the early to late spring and occurs in San Diego County and northwestern Baja California, Mexico, and this species is associated with the heavy clay soils common to Otay tarplant (*Hemizonia conjugens*) and San Diego Thornmint.

Palmer's grapplinghook was mapped at 1 locality during the 2001 season in the heavy clay soils of the central mesa/plateau (Figure 4; Appendix 8). This species was found with small-flowered morning-glory and other clay soil species. The estimated total population size of Palmer's grappling hook on RJER is about 1,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Hemizonia conjugens* – Otay tarplant**
CNPS: 1B, 3-3-2 **State: Endangered** **Federal: Threatened**

This annual tarplant is restricted to southern San Diego County and a few areas in Baja California, Mexico. This species is associated with certain heavy clay soils common in the South-Bay area. Populations of this species can fluctuate dramatically from year to year, so accurate population counts and localities can be difficult to determine. This species is listed as threatened by the USFWS and endangered by the CDFG.

***Hemizonia conjugens* – Otay tarplant (continued)**

Otay tarplant was found at 2 localities during the 2001 season (Figure 4; Appendix 8). Both of these localities occur on the heavy clay soils of the central mesa/plateau. Similar to small-flowered morning-glory, Otay tarplant can handle disturbance factors better than most of the other clay soil species, therefore, Otay tarplant will persist even when species like San Diego thornmint have been excluded. The estimated total population size of Otay tarplant on RJER is about 2,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Iva hayesiana* – San Diego marsh-elder**
CNPS: 2, 2-2-1 State: -- Federal: --

San Diego marsh-elder is found in San Diego County and northern Baja California, Mexico. This subshrub species occurs in variety of riparian habitats and flowers in the spring and summer.

San Diego marsh-elder was scattered throughout some of the riparian areas of Jamul Ranch during the 2001 season. In an effort to maximize the survey time spent during the 2001 surveys, this species was not mapped. The estimated population size of San Diego marsh-elder on RJER is over 500 plants. The most common disturbance factors currently affecting the distribution and density of this species is weed invasion (perennial riparian weeds) and increased erosion of the drainages on the ranch due to grazing and agricultural practices (see below).

***Juncus acutus* ssp. *leopoldii* – Southwestern spiny rush**
CNPS: 4, 1-2-1 State: -- Federal: --

This species occurs in southern California and northwestern Baja in mesic meadows, seeps, alkaline flats, and coastal salt marsh habitats. Southwestern spiny rush is a rhizomatous perennial that flowers in the spring and early summer.

Southwestern spiny rush was mapped in 1 locality during the 2001 season. This species was found in a small seasonal drainage with mule fat (*Baccharis salicifolia*) and willow species (*Salix* spp.). This species was also found in a few other seasonal drainages on the ranch, but was not mapped.

***Juncus acutus* ssp. *leopoldii* – Southwestern spiny rush (continued)**

The estimated total population size of southwestern spiny rush on RJER is over 50 plants. The most common disturbance factors currently affecting the distribution and density of this species is weed invasion (annual and perennial riparian weeds) and increased erosion of the drainages on the ranch due to grazing and agricultural practices (see below).

***Muilla clevelandii* - San Diego goldenstar**
CNPS: 1B, 2-2-2 State: -- Federal: --

San Diego goldenstar is a perennial bulb that occurs in grassland and clay lens habitats associated with coastal sage scrub, chaparral, and vernal pool areas in San Diego County and northwest Baja California, Mexico (CNPS 2001). This species flowers between the months of April and June and is usually associated with clay soils on the coastal mesas and foothill slopes.

San Diego goldenstar was mapped at 24 localities during the 2001 season (Figure 4 & 5; Appendix 8). These localities were concentrated in two main areas on the south side of Otay Lakes Road in the native grassland and coastal sage scrub habitats.

The estimated total population size of San Diego goldenstar on RJER is over 100,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Plantago erecta* – Dot-seed plantain**
CNPS: -- State: -- Federal: --

Dot-seed plantain is an annual that occurs in grassland and clay lens habitats associated sage scrub, chaparral, and vernal pool areas in California and Baja California, Mexico with coastal (CNPS 2001). This species flowers between the months of April and June and is usually associated with clay soils on the coastal mesas and foothill slopes.

Dot-seed plantain is usually most abundant is areas which have natural cryptogamic soil crusts. Cryptogamic crusts form on soils in arid environments and are composed of blue-green algae (cyanobacteria), lichens, mosses, fungi, and bacteria. Although the species was once very common in southern California, it's distribution and density has been reduced due to development, weed invasion, and poor land management activities (Mattoni et al. 1997).

***Plantago erecta* – Dot-seed plantain (continued)**

Although this species is not rare in southern California, it is listed here because it is the host plant for the Quino checkerspot butterfly (*Euphydryas editha quino*). The Quino checkerspot butterfly is federally listed as endangered because it has seen substantial loss of habitat resulting in reduced distribution and population density throughout its range. This species occurs from Riverside County south into northwestern Baja California. Within San Diego, this species has been nearly extirpated due to development of the coastal mesas, inland valleys and foothills. In addition to the losses suffered due to development, this species has suffered in the remaining open space areas as well. The cryptogamic soil crusts which are very important to the butterfly and its host plant have suffered extensive disturbance from off-road activities, grazing, and weed invasion in the areas that remain as habitat.

There are numerous large populations of dot-seed plantain scattered throughout Jamul Ranch. This is especially true of the heavy clay soils on the central mesa/plateau. Large and dense populations of dot-seed plantain were found associated with the variegated *Dudleya* , mesa *Brodiaea* , and other clay soil species. During the spring of 2001, a total of 17 localities were mapped for this species. In an effort to maximize the survey time spent during the 2001 surveys, this species was not mapped at every locality that it was found, so the distribution and density of the dot-seed plantain populations are greater than the data from 2001 would indicate. The estimated total population size of dot-seed plantain on RJER is at least 100,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

While conducting the 2001 rare plant surveys on RJER, Quino checkerspot butterflies were found at two localities on RJER. Both of these localities represent single individuals, but neither site was surveyed using USFWS protocols.

***Romneya coulteri* – Coulter's matillija poppy**
CNPS: 4, 1-2-3 State: -- Federal: --

Coulter's matillija poppy is a perennial herb that is restricted to southern California. This species occurs in the chaparral and coastal sage scrub, and blooms from March to August.

Coulter's matillija poppy was mapped at 1 locality during the 2001 season (Figure 4; Appendix 8). This species was found in patches on the central mesa/plateau and also on the west-facing slopes above Jamul Creek. Only one population was mapped, and it was on the central mesa/plateau. None of the populations along Jamul Creek were mapped.

The estimated total population size of Coulter's matillija poppy on RJER is over 100 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Selaginella cinerascens* – Ashy spike-moss**
CNPS: -- **State: --** **Federal: --**

Ashy spike-moss is a non-flowering plant that occurs on dry exposed soils within the coastal sage scrub, chaparral and grassland habitats in Orange County, San Diego County and northwestern Baja California, Mexico.

This species is no longer considered sensitive by regulatory agencies (USFWS and CDFG), but it is rapidly disappearing from southern California due to development, grazing, off-road activities and weed invasion.

Ashy spike-moss occurs in scattered localities on the central mesa/plateau and in small patches along the ridges, on the south side of Otay Lakes Rd.

This species can be very patchy and time consuming to map, so it was not mapped during the 2001 season. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

***Viguiera laciniata* – San Diego sunflower**
CNPS: 4, 1-2-1 **State: --** **Federal: --**

This flowering shrub occurs in the coastal sage scrub and chaparral in San Diego County and northern Baja California, Mexico. San Diego sunflower blooms in the spring and summer and is found on south facing slopes throughout San Diego County.

The species is common on the south facing slopes throughout RJER in the coastal sage scrub and grassland areas. As with other species, an effort was made to maximize the survey time spent during the 2001 surveys, so this species was not mapped. The estimated total population size of San Diego sunflower on RJER is at least 5,000 plants. Weed invasion is the most common disturbance factor currently affecting the distribution and density of this species.

Appendix 10. Complete list of vertebrate species detected at Rancho Jamul during USGS - BRD Wildlife Surveys 2000-2002. Includes species detected during aquatic surveys 1998 - 2001.

Common Name	Scientific Name	Detection Method*
CLASS: AMPHIBIA (Amphibians)		
CAUDATA (Salamanders)		
PLETHODONTIDAE (Lungless Salamanders)		
Garden Slender Salamander	*Batrachoseps major*	PF
ANURA SALIENTIA (Frogs and Toads)		
PELOBATIDAE (Spadefoot Toads)		
Western Spadefoot	*Spea (Scaphiopus) hammondii*	AS, PF
BUFONIDAE (True Toads)		
Western Toad	*Bufo boreas*	AS, PF
HYLIDAE (Treefrogs and relatives)		
Pacific Tree Frog	*Hyla regilla*	AS
RANIDAE (True Frogs)		
Bullfrog	*Rana catesbeiana* [1]	AS, PF
PIPIDAE (Pipid Frogs)		
African Clawed Frog	*Xenopus laevis* [1]	AS
CLASS: REPTILIA (Reptiles)		
SQUAMATA (Lizards and Snakes)		
PHRYNOSOMATIDAE		
Granite Spiny Lizard	*Sceloporus orcutti*	PF
Western Fence Lizard	*Sceloporus occidentalis*	PF
Side-blotched Lizard	*Uta stansburiana*	PF
Coast Horned Lizard	*Phrynosoma coronatum* [2]	PF
XANTUSIIDAE (Night Lizards)		
Granite Night Lizard	*Xantusia henshawi*	PF
SCINCIDAE (Skinks)		
Western Skink	*Eumeces skiltonianus*	PF
Gilbert's Skink	*Eumeces gilberti*	PF
TEIIDAE (Whiptails and relatives)		
Orange-throated Whiptail	*Cnemidophorus hyperythrus* [2]	PF
Western Whiptail	*Cnemidophorus tigris*	PF
ANGUIDAE (Alligator Lizards and relatives)		
Southern Alligator Lizard	*Elgaria multicarinata*	PF
LEPTOTYPHLOPIDAE (Slender Blind Snakes)		
Western Blind Snake	*Leptotyphlops humilis*	PF
COLUBRIDAE (Colubrids)		
Ringneck Snake	*Diadophis punctatus*	PF
Baja California Coachwhip	*Masticophis flagellum*	PF
Striped Racer (California Whipsnake)	*Masticophis lateralis*	PF
Western Patch-nosed Snake	*Salvadora hexalepis*	PF
Gopher Snake	*Pituophis melanoleucus*	PF
Common Kingsnake	*Lampropeltis getula*	PF
Long-nosed Snake	*Rhinocheilus lecontei*	PF
Two-striped Garter Snake	*Thamnophis hammondii*	AS, PF
California Black-headed Snake	*Tantilla planiceps*	PF

Appendix 10 (continued).

Common Name	Scientific Name	Detection Method*
VIPERIDAE (Vipers)		
Red Diamond Rattlesnake	*Crotalus ruber ruber*	PF
Western Rattlesnake	*Crotalus viridis*	PF
CLASS: AVES (Birds)		
PODICIPEDIFORMES (Grebes)		
PODICIPEDIDAE (Grebes)		
Eared Grebe	*Podiceps nigricollis*	IN
CICONIIFORMES (Herons, Storks, Ibises, and relatives)		
ARDEIDAE (Herons and Bitterns)		
Snowy Egret	*Egretta thula*	IN
Green Heron	*Butorides virescens*	BP
Black-crowned Night-Heron	*Nycticorax nycticorax*	IN
CATHARTIDAE (New World Vultures)		
Turkey Vulture	*Cathartes aura*	IN
ANSERIFORMES (Screamers, Ducks, and relatives)		
ANATIDAE (Swans, Geese, and Ducks)		
Mallard	*Anas platyrhynchos*	BP
Ring-necked Duck	*Aythya collaris*	IN
Bufflehead	*Bucephala albeola*	IN
FALCONIFORMES (Vultures, Hawks, and Falcons)		
ACCIPITRIDAE (Hawks, Old World Vultures, and Harriers)		
White-tailed Kite	*Elanus leucurus*	BP
Northern Harrier	*Circus cyaneus* [2]	IN
Red-shouldered Hawk	*Buteo lineatus*	BP
Red-tailed Hawk	*Buteo jamaicensis*	BP
FALCONIDAE (Caracaras and Falcons)		
American Kestrel	*Falco sparverius*	BP
Merlin	*Falco columbarius*	BP
Peregrine Falcon	*Falco peregrinus* [2]	BP
Prairie Falcon	*Falco mexicanus*	IN
GALLIFORMES (Megapodes, Curassows, Pheasants, and relatives)		
PHASIANIDAE (Quails, Pheasants, and relatives)		
Ring-necked Pheasant	*Phasianus colchicus* [1]	IN
ODONTOPHORIDAE (New World Quail)		
California Quail	*Callipepla californica*	BP
CHARADRIIFORMES (Shorebirds, Gulls, and relatives)		
CHARADRIIDAE (Plovers and relatives)		
Killdeer	*Charadrius vociferus*	BP
SCOLOPACIDAE (Sandpipers and relatives)		
Greater Yellowlegs	*Tringa melanoleuca*	IN
COLUMBIFORMES (Pigeons and Doves)		
COLUMBIDAE (Pigeons and Doves)		
Mourning Dove	*Zenaida macroura*	BP
CUCULIFORMES (Cuckoos and relatives)		
CUCULIDAE (Typical Cuckoos)		
Greater Roadrunner	*Geococcyx californianus*	BP, RC

Appendix 10 (continued).

Common Name	Scientific Name	Detection Method*
STRIGIFORMES (Owls)		
TYTONIDAE (Barn Owls)		
Common Barn Owl	*Tyto alba*	NT
STRIGIDAE (Typical Owls)		
Great Horned Owl	*Bubo virginianus*	NT
Burrowing Owl	*Athene cunicularia hypugea* [2]	NT
Long-eared Owl	*Asio otus*	NT
CAPRIMULGIFORMES (Goatsuckers and relatives)		
CAPRIMULGIDAE (Goatsuckers)		
Common Poorwill	*Phalaenoptilus nuttallii*	NT
APODIFORMES (Swifts and Hummingbirds)		
TROCHILIDAE (Hummingbirds)		
Black-chinned Hummingbird	*Archilochus alexandri*	IN
Anna's Hummingbird	*Calypte anna*	BP
Costa's Hummingbird	*Calypte costae*	BP
Allen's Hummingbird	*Selasphorus sasin*	BP
CORACIIFORMES (Kingfishers and relatives)		
ALCEDINIDAE (Kingfishers)		
Belted Kingfisher	*Ceryle alcyon*	IN
PICIFORMES (Woodpeckers and relatives)		
PICIDAE (Woodpeckers and Wrynecks)		
Acorn Woodpecker	*Melanerpes formicivorus*	BP
Nuttall's Woodpecker	*Picoides nuttallii*	BP
Northern Flicker	*Colaptes auratus*	IN
PASSERIFORMES (Perching Birds)		
TYRANNIDAE (Tyrant Flycatchers)		
Pacific-Slope Flycatcher	*Empidonax difficilis*	IN
Black Phoebe	*Sayornis nigricans*	BP
Say's Phoebe	*Sayornis saya*	IN
Ash-throated Flycatcher	*Myiarchus cinerascens*	BP
Western Kingbird	*Tyrannus verticalis*	BP
LANIIDAE (Shrikes)		
Loggerhead Shrike	*Lanius ludovicianus*	BP
VIREONIDAE (Typical Vireos)		
Bell's Vireo	*Vireo bellii* [2]	BP
Warbling Vireo	*Vireo gilvus*	BP
CORVIDAE (Jays, Magpies, and Crows)		
Magpie Jay (Black-throated form)	*Calocitta colliei* [1]	IN
Western Scrub-Jay	*Aphelocoma californica*	BP
American Crow	*Corvus brachyrhynchos*	BP
Common Raven	*Corvus corax*	BP
ALAUDIDAE (Larks)		
Horned Lark	*Eremophila alpestris*	BP
HIRUNDINIDAE (Swallows)		
Violet-green Swallow	*Tachycineta thalassina*	BP
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	BP

Appendix 10 (continued).

Common Name	Scientific Name	Detection Method*
Cliff Swallow	*Petrochelidon pyrrhonota*	BP
PARIDAE (Titmice and relatives)		
Plain Oak Titmouse	*Baeolophus inornatus*	BP
AEGITHALIDAE (Bushtit)		
Bushtit	*Psaltriparus minimus*	BP
TROGLODYTIDAE (Wrens)		
Bewick's Wren	*Thryomanes bewickii*	BP
House Wren	*Troglodytes aedon*	IN
SYLVIIDAE		
California Gnatcatcher	*Polioptila californica* [2]	BP
TURDIDAE		
Western Bluebird	*Sialia mexicana2*	IN
Mountain Bluebird	*Sialia currucoides*	IN
TIMALIIDAE (Babblers)		
Wrentit	*Chamaea fasciata*	BP
MIMIDAE (Mockingbirds and Thrashers)		
Northern Mockingbird	*Mimus polyglottos*	BP
California Thrasher	*Toxostoma redivivum*	BP
STURNIDAE (Starlings & Allies)		
European Starling	*Sturnus vulgaris* [1]	BP
PTILOGONATIDAE (Silky Flycatchers)		
Phainopepla	*Phainopepla nitens*	BP
PARULIDAE (Wood Warblers and relatives)		
Orange-crowned Warbler	*Vermivora celata*	BP
Nashville Warbler	*Vermivora ruficapilla*	BP
Yellow Warbler	*Dendroica petechia*	BP
Yellow-rumped Warbler	*Dendroica coronata*	BP
Townsend's Warbler	*Dendroica townsendi*	BP
Common Yellowthroat	*Geothlypis trichas*	BP
Yellow-breasted Chat	*Icteria virens*	BP
THRAUPIDAE (Tanagers)		
Western Tanager	*Piranga ludoviciana*	BP
EMBERIZIDAE (Emberizines)		
Spotted Towhee	*Pipilo maculatus*	BP
California Towhee	*Pipilo crissalis*	BP
Rufous-crowned Sparrow	*Aimophila ruficeps* [2]	BP
Chipping Sparrow	*Spizella passerina*	IN
Lark Sparrow	*Chondestes grammacus*	BP
Sage Sparrow	*Amphispiza belli*	BP
Savannah Sparrow	*Passerculus sandwichensis* [2]	BP
Grasshopper Sparrow	*Ammodramus savannarum*	BP
Song Sparrow	*Melospiza melodia*	BP
White-crowned Sparrow	*Zonotrichia leucophrys*	BP
Dark-eyed Junco	*Junco hyemalis*	IN
CARDINALIDAE (Cardinals, Grosbeaks & Allies)		
Black-headed Grosbeak	*Pheucticus melanocephalus*	IN

Appendix 10 (continued).

Common Name	Scientific Name	Detection Method*
Blue Grosbeak	*Guiraca caerulea*	BP
Lazuli Bunting	*Passerina amoena*	BP, RC
ICTERIDAE (Blackbirds, Orioles & Allies)		
Red-winged Blackbird	*Agelaius phoeniceus*	BP
Western Meadowlark	*Sturnella neglecta*	BP
Brewer's Blackbird	*Euphagus cyanocephalus*	BP
Bullocks Oriole	*Icterus bullockii*	BP
FRINGILLIDAE (Finches)		
House Finch	*Carpodacus mexicanus*	BP
Lesser Goldfinch	*Carduelis psaltria*	BP
Lawrence's Goldfinch	*Carduelis lawrencei*	BP
American Goldfinch	*Carduelis tristis*	BP
CLASS: MAMMALIA (Mammals)		
DIDELPHIMORPHIA (Marsupials)		
DIDELPHIDAE (Opossums)		
Virginia Opossum	*Didelphis virginiana* [1]	TS
INSECTIVORA (Insectivores)		
SORICIDAE (Shrews)		
Ornate Shrew	*Sorex ornatus*	PF
Desert Shrew	*Notiosorex crawfordi*	PF
CHIROPTERA (Bats)		
VESPERTILIONIDAE (Evening Bats)		
Yuma Myotis	*Myotis yumanensis*	BS
California Myotis	*Myotis californicus*	BS
Western Small-footed Myotis	*Myotis ciliolabrum*	BS
Western Pipistrelle	*Pipistrellus hesperus*	BS
Big Brown Bat	*Eptesicus fuscus*	BS
Hoary Bat	*Lasiurus cinereus*	BS
Townsend's Big-eared Bat	*Corynorhinus (Plecotus) townsendii*	BS
Pallid Bat	*Antrozous pallidus*	BS
MOLOSSIDAE (Free-tailed Bats)		
Brazilian Free-tailed Bat	*Tadarida brasiliensis*	BS
Pocketed Free-tailed Bat	*Nyctinomops femorosacca*	BS
Big Free-tailed Bat	*Nyctinomops macrotis*	BS
Western Mastiff Bat	*Eumops perotis*	BS
LAGOMORPHA (Rabbits, Hares, and Pikas)		
LEPORIDAE (Rabbits and Hares)		
Audubon's (Desert) Cottontail	*Sylvilagus audubonii*	RC, TS
Black-tailed (Hare) Jackrabbit	*Lepus californicus*	RC
RODENTIA (Squirrels, Rats, Mice, and relatives)		
SCIURIDAE (Squirrels, Chipmunks, and Marmots)		
California Ground Squirrel	*Spermophilus beecheyi*	TS
GEOMYIDAE (Pocket Gophers)		
Botta's Pocket Gopher	*Thomomys bottae*	PF
HETEROMYIDAE (Pocket Mice and Kangaroo Rats)		
San Diego Pocket Mouse	*Chaetodipus fallax*	PF, ST

Appendix 10 (continued).

Common Name	Scientific Name	Detection Method*
San Diego Kangaroo Rat	*Dipodomys simulans*	PF, ST
MURIDAE		
Western Harvest Mouse	*Reithrodontomys megalotis*	PF
Cactus Mouse	*Peromyscus eremicus*	PF, ST
California Mouse	*Peromyscus californicus*	PF
Deer Mouse	*Peromyscus maniculatus*	PF, ST
Desert Woodrat	*Neotoma lepida*	PF, ST
House Mouse	*Mus musculus* [1]	ST
California Vole	*Microtus californicus*	PF
CARNIVORA (Carnivores)[2]		
CANIDAE (Foxes, Wolves, and relatives)		
Domestic Dog	*Canis familiaris* [1]	RC, TS
Coyote	*Canis latrans*	RC, TS
Gray Fox	*Urocyon cinereoargenteus*	TS
PROCYONIDAE (Raccoons and relatives)		
Raccoon	*Procyon lotor*	TS
MEPHITIDAE (Skunks)		
Western Spotted Skunk	*Spilogale gracilis*	TS
Striped Skunk	*Mephitis mephitis*	RC, TS
FELIDAE (Cats)		
Feral Cat	*Felis cattus* [1]	TS
Mountain Lion	*Puma concolor* [2]	RC
Bobcat	*Lynx rufus*	RC, TS
ARTIODACTYLA (Even-toed Ungulates)		
CERVIDAE (Deer, Elk, and relatives)		
Mule Deer	*Odocoileus hemionus* [2]	RC, TS
CLASS: OSTEICHTHYES (Bony Fish)		
ATHERINIFORMES		
POECILIDAE (Livebearers)		
Mosquito fish	*Gambusia affinis* [1]	AS
PERCIFORMES		
CENTRARCHIDAE (Sunfishes)		
Green sunfish	*Lepomis cyanellus* [1]	AS
Bluegill sunfish	*Lepomis macrochirus* [1]	AS
Largemouth bass	*Micropterus salmoides* [1]	AS
Black crappie	*Pomoxis nigromaculatus* [1]	AS
SILURIFORMES		
ICTALURIDAE (Bullhead and Catfishes)		
Black bullhead	*Ameiurus melas* [1]	AS

** Detection Method Codes: AS - Aquatic Survey, BP - Bird Point Count Survey, BS - Bat Survey, IN - Incidental, NT - Night Time Bird Point Count Survey, PF - Pitfall Survey, RC - Remote Camera, ST - Sherman Trap, TS- Track Station*

[1] *introduced species*

[2] *MSCP covered species*

Appendix 11. Rare or sensitive vertebrate species that potentially occur at Rancho Jamul Ecological Reserve that were not detected in 2000-2002 surveys.

Common Name	Scientific Name
CLASS: AMPHIBIA (Amphibians)	
ANURA SALIENTIA (Frogs and Toads)	
BUFONIDAE (True Toads)	
Arroyo Southwestern Toad	*Bufo microscaphus* [1]
CLASS: REPTILIA (Reptiles)	
TESTUDINES (Turtles)	
EMYDIDAE (Box and Water Turtles)	
Western Pond Turtle	*Clemmys marmorata* [1]
SQUAMATA (Lizards and Snakes)	
EUBLEPHARIDAE (Eyelid Geckos)	
Western Banded Gecko	*Coleonyx variegatus* [2]
BOIDAE (Boas)	
Rosy Boa	*Charina (Lichanura) trivirgata* [2]
COLUBRIDAE (Colubrids)	
Glossy Snake	*Arizona elegans* [2]
CLASS: AVES (Birds)	
FALCONIFORMES (Vultures, Hawks, and Falcons)	
ACCIPITRIDAE (Hawks, Old World Vultures, and Harriers)	
Cooper's Hawk	*Accipiter cooperi* [1]
Swainson's Hawk	*Buteo swainsoni* [1]
Ferruginous Hawk	*Buteo regalis* [1]
Golden Eagle	*Aquila chrysaetos* [1]
PASSERIFORMES (Perching Birds)	
TYRANNIDAE (Tyrant Flycatchers)	
Southwestern Willow Flycatcher	*Empidonax traillii extimus* [1]
TROGLODYTIDAE (Wrens)	
Coastal Cactus Wren	*Campylorhynchus brunneicapillus couesi* [1]
CLASS: MAMMALIA (Mammals)	
CHIROPTERA (Bats)	
VESPERTILIONIDAE (Evening Bats)	
Long-eared Myotis	*Myotis evotis* [2]
Western Red Bat	*Lasiurus blossevillii* [2]
RODENTIA (Squirrels, Rats, Mice, and relatives)	
MURIDAE	
Southern Grasshopper Mouse	*Onychomys torridus* [2]
CLASS: MAMMALIA (Mammals)	
CARNIVORA (Carnivores)	
PROCYONIDAE (Raccoons and relatives)	
Ringtail	*Bassariscus astutus* [2]
MUSTELIDAE (Weasels and relatives)	
American Badger[1]	*Taxidea taxus* [1]

[1] *MSCP covered species*

[2] *USGS recommended species for which additional surveys may be required.*

Appendix 12. Habitat type at each pitfall array site at Rancho Jamul Ecological Reserve and the top three plant species recorded during vegetation transects.

	Habitat Type					*Dominant Plant Species**		
Array Number	***Riparian Woodland***	***Non-Native Grassland***	***Coastal Sage Scrub***	***Disturbed Coastal Sage Scrub***	***Non-Native/ Native Grassland***	***1***	***2***	***3***
1	X					PLRA	BRSP	RASA
2		X				BRSP	AVSP	BRNI
3		X				BRSP	BRNI	LASE
4		X				ERSP	AVSP	BRSP
5		X				ERSP	AVSP	BRSP
6		X				AVSP	BRSP	ERSP
7			X			ERFA	CUCA	VUMY
8				X		ERFA	ERSP	ARCA
9				X		BRSP	ERFA	BRNI
10				X		VILA	BRSP	PHSP
11				X		ERFA	BRSP	ARCA
12	X					BRSP	PLRA	BRNI
13		X				BRSP	CESO	AVSP
14		X				BRSP	AVSP	CESO
15					X	BRSP	CESO	NAPU
16					X	BRSP	NAPU	ERSP
17		X				BRSP	CAMA	LASE
18			X			NAPU	ARCA	SAAP
19				X		BRSP	ARCA	MALA
20				X		BRSP	MALA	ARCA
21				X		ERFA	ARCA	BRSP
# Arrays per Habitat Type	2	8	2	7	2			

** Plant Species Codes can be found in Appendix 13*

Appendix 13. Plant species codes used in the description of plant communities associated with pitfall arrays and bird point count stations.

Code	Species	Common Name	Family
ADFA	*Adenostoma fasciculatum*	Chamise	Rosaceae
AMSP	*Amsinckia sp.*	Fiddleneck sp.	Boraginaceae
ARCA	*Artemisia californica*	California Sagebrush	Asteraceae
AVSP	*Avena sp.*	Wild Oats	Poaceae
BASA	*Baccharis salicifolia*	Mulefat	Asteraceae
BASR	*Baccharis sarothroides*	Broom Baccharis	Asteraceae
BRNI	*Brassica nigra*	Black Mustard	Brassicaceae
BRSP	*Bromus sp.*	Brome Grass	Poaceae
CAMA	*Calystegia macrostegia*	Wild Morning-glory	Convolvulaceae
CESO	*Centaurea solstitialis*	Yellow Star-thistle	Asteraceae
CUCA	*Cuscuta californica*	Dodder	Convolvulaceae
ERCO	*Eriophyllum confertiflorum*	Golden-yarrow	Asteraceae
ERFA	*Eriogonum fasciculatum*	California Buckwheat	Polygonaceae
ERSP	*Erodium sp.*	unk. Filaree	Geraniaceae
GUSP	*Gutierrezia sp.*	Snakeweed	Asteraceae
HEAR	*Heteromeles arbutifolia*	Toyon, Christmas Berry	Rosaceae
HOMU	*Hordeum murinum*	Foxtail (Glaucous) Barley	Poaceae
ISME	*Isocoma menziesii*	Goldenbush	Asteraceae
KEAN	*Keckiella antirrhinoides*	Keckiella	Scrophulariaceae
LASE	*Lactuca serriola*	Prickly-lettuce	Asteraceae
LOMU	*Lolium multiflorum*	Italian Ryegrass	Poaceae
LOSC	*Lotus scoparius*	Deerweed	Fabaceae
MALA	*Malosma laurina*	Laurel Sumac	Anacardiaceae
MAMA	*Marah macrocarpus*	CA Man-root, Wild Cucumber	Cucurbitaceae
MIAU	*Mimulus aurantiacus*	Coast Monkey Flower	Scrophulariaceae
NAPU	*Nassella pulchra*	Purple Needlegrass	Poaceae
PHSP	*Phacelia sp.*	unk. Phacelia	Hydrophyllaceae
PLRA	*Platanus racemosa*	Sycamore	Platanaceae
QUAG	*Quercus agrifolia*	Coast Live Oak	Fagaceae
QUBE	*Quercus berberidifolia*	Scrub Oak	Fagaceae
RASA	*Raphanus sativus*	Radish	Brassicaceae
RHCR	*Rhamnus crocea*	Redberry	Rhamnaceae
SAAP	*Salvia apiana*	White Sage	Lamiaceae
SALA	*Salix lasiolepis*	Arroyo Willow	Salicaceae
VILA	*Vigueiera laciniata*	San Diego Sunflower	Asteraceae
VUMY	*Vulpia myuros*	Fescue	Poaceae

Appendix 14. Vegetation transect summary data for pitfall array sites at Rancho Jamul Ecological Reserve.

		Array Number																				
		1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***21***
Canopy Height, cm	***Average***	30.0	34.5	52.1	35.1	19.8	40.4	51.8	41.7	69.0	49.1	51.3	533.9	68.7	52.7	72.6	68.8	43.4	80.4	82.1	200.0	56.3
	Median	26.0	26.0	49.0	30.0	17.0	35.0	49.5	28.0	77.0	52.5	54.0	97.0	63.0	49.0	62.5	68.0	42.5	78.0	75.0	147.0	54.5
	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	153	141	136	280	59	140	165	132	162	125	140	2200	198	167	275	260	87	198	267	600	125
	StDev	24.5	31.0	25.6	30.3	12.9	32.8	38.0	39.2	37.7	31.9	35.0	797.7	41.6	27.6	53.2	47.4	19.4	43.4	60.3	155.2	37.3
Leaf Litter, cm	***Average***	6.6	1.7	2.5	3.1	1.3	1.5	0.6	1.0	2.2	0.8	0.6	6.1	5.9	3.0	1.9	1.4	7.0	0.7	1.1	1.6	1.2
	Median	6.0	1.0	2.0	2.0	1.0	0.5	0.5	0.5	1.5	0.5	0.5	4.5	5.0	2.0	1.0	1.0	5.5	0.5	0.5	1.0	0.5
	Minimum	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
	Maximum	18.0	14.0	12.0	14.0	4.0	9.0	3.0	9.0	16.0	8.0	4.0	20.0	20.0	17.0	10.0	6.0	30.0	10.0	7.0	6.0	14.0
	StDev	3.8	2.3	2.0	2.7	0.9	2.1	0.6	1.1	2.6	1.1	0.7	5.1	4.6	2.9	2.1	1.4	5.3	1.2	1.2	1.4	2.2
Substrate Type	***Sandy Soil***		12	2	6	5	34	29	13	3	21	30	1	2	4	3	7		33	19	5	19
	Leaf Litter	100	76	98	94	93	60	69	87	94	64	69	98	98	96	97	91	100	67	78	89	73
	Organic Soil																				5	
	Cryptogamic Crust		1							3							1			1		
	Bare Rock		11			2	6	2			15	1	1				1			2	1	8
Number of Points Along Transect, n		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Vegetation Layer Structure	***% Trees***												18.0%								15.9%	
	% Shrubs	10.1%	27.9%	34.9%	11.4%	0.5%	24.3%	42.9%	36.4%	45.8%	49.2%	46.9%	42.4%	46.2%	29.4%	39.3%	40.2%	24.6%	64.5%	66.0%	59.7%	50.0%
	% Herbs	89.9%	72.1%	65.1%	88.6%	99.5%	75.7%	57.1%	63.6%	54.2%	50.8%	53.1%	39.6%	53.8%	70.6%	60.7%	59.8%	75.4%	35.5%	34.0%	24.4%	50.0%
	Total Hits	109	104	152	166	185	148	133	129	166	124	147	139	197	211	234	219	142	172	159	176	132
Habitat Type [1]	***Coastal Sage Scrub***			4.6%				58.6%	48.1%	34.9%	55.6%	53.7%	12.2%		2.8%	9.0%	13.7%	10.6%	50.6%	56.0%	57.4%	63.6%
	Non-Native Grassland	95.4%	83.7%	85.5%	96.4%	83.2%	98.0%	10.5%	22.5%	60.8%	26.6%	33.3%	59.7%	76.6%	85.8%	48.3%	50.2%	73.9%	1.7%	32.1%	28.4%	13.6%
	Native Grassland		3.8%						1.6%							19.7%	26.0%		30.2%			
	Riparian / Woodland	*											19.4%									

[1] *Habitat types with the relative percentage for select dominant species at each pitfall array. The dominant species used for each Habitat Type are as follows:*
Coastal Sage Scrub: ARCA, ERFA, MALA, SAAP, VILA
Non-Native Grass: AVSP, BRNI, BRSP, ERSP, LAMU, RASA, VUMY
Native Grass: NAPU
Riparian: PLRA

** although the linear vegetation transect at this array did not score any PLRA, it is still classified as Riparian / Woodland due to the proximity to a large PLRA whose canopy did occur over a portion of the array.*

Appendix 15. The habitat type within a 100 meter radius of each bird point count station on Rancho Jamul Ecological Reserve and the top three plant species recorded at each point.

	Habitat Type[a]						Dominant Plant Species*		
Point	Chap	Grass	Human	Oak	Rip	CSS	1	2	3
1					5	95	MALA	ARCA	ERFA
2		100					BRSP	BRNI	RASA
3		99				1	AVSP	ERSP	BRNI
4		100					AVSP	BRNI	BRSP
5		85			15		BRSP	RASA	BRNI
6		100					BRSP	BRNI	RASA
7		100					BRSP	RASA	BASR
8		70			20	10	BRSP	AVSP	ERSP
9		50			50		SALA	BASA	PLRA
10		100					BRSP	BRNI	AVSP
11						100	ERFA	ARCA	ISME
12		25				75	ERFA	ISME	ARCA
13		80			20		BRSP	AMSP	RASA
14		100					ISME	BRSP	AMSP
15		70				30	BRSP	RASA	AMSP
16		100					BRSP	AVSP	
17		100					HOMU	AVSP	BRSP
18						100	RHCR	ERFA	ARCA
19	75					25	MALA	ARCA	MIAU
20	50					50	MALA	ARCA	SAAP
21		70			30		BRSP	LOMU	HOMU
22						100	ERFA	ARCA	VILA
23	75					25	RHCR	SAAP	ARCA
24						100	ARCA	ERFA	RHCR
25						100	ARCA	ERFA	SAAP
26						100	MALA	ARCA	SAAP
27						100	ARCA	ERFA	SAAP
28						100	ARCA	KEAN	MALA
29					10	90	ERFA	ARCA	MALA
30		60			10	30	AVSP	HOMU	BRSP
31						100	ARCA	ERFA	MALA
32						100	MALA	ARCA	ERFA
33						100	MALA	ERFA	ARCA
34						100	ERFA	ARCA	MALA
35	60					40	MALA	KEAN	ARCA

Appendix 15 (continued).

	Habitat Type[a]						Dominant Plant Species*		
Point	Chap	Grass	Human	Oak	Rip	CSS	1	2	3
36		100					AVSP	BRSP	AMSP
37						100	MALA	ARCA	ERFA
38		90			10		AVSP	BRSP	HOMU
39		70				30	NAPU	BRSP	BRNI
40						100	MALA	ERFA	ARCA
41						100	ERFA	ARCA	MALA
42						100	ERFA	ARCA	VILA
43		30	20			50	MALA	ARCA	VILA
44				90		10	QUAG	RHCR	MAMA
45						100	QUAG	MALA	ARCA
46						100	ARCA	ERFA	MALA
47		30			20	50	ARCA	ERFA	ISME
48						100	ARCA	SAAP	MALA
49		65				35	AVSP	BRSP	ERCO
50						100	MALA	ARCA	LOSC
51		50				50	ARCA	ISME	MALA
52					40	60	ERFA	ARCA	MALA
53		100					AVSP	RASA	BRNI
54		50				50	MALA	ARCA	ERFA
55		60			40		RASA	BRSP	AVSP
56		45		15	40		BRSP	AVSP	SALA
57					20	80	ARCA	ERFA	MALA
58						100	ERFA	ARCA	AVSP
59		50				50	MALA	ARCA	ERFA
60						100	ARCA	ERFA	MALA
61		100					AVSP	BRSP	LOMU
62		10		10		80	ARCA	ERFA	MALA
63						100	MALA	ERFA	ARCA
64						100	ERFA	MALA	ARCA
65				10		90	ARCA	SAAP	MALA
66		60				40	NAPU	BRSP	ERSP
67	10			10		80	ARCA	ERFA	ISME
68	48	5				47	RHCR	QUBE	ERFA

* Plant Species Codes can be found in Appendix 13.

[a] percent coverage of habitat(s) within 100 m radius of point count: habitat codes: Chap = chaparral; Grass = grassland: Human = human; Oak = oak woodland; Rip = riparian; CSS = coastal sage scrub.

Appendix 16. Carnivore photos from camera stations

Species detected at camera station 2:

Bobcat

Black-tailed Jackrabbit

Coyote

Appendix 16 (continued).

Coyote

Coyote

Mule deer

Appendix 16 (continued).

Roadrunner

Species detected at camera station 3:

Bobcat with bird in mouth

Appendix 16 (continued).

Bobcat

Coyote

Mule deer

Appendix 16 (continued).

Striped skunk

Species detected at camera station 4:

Coyote

Appendix 16 (continued).

Mule deer

Mountain lion

Appendix 16 (continued).

Species detected at camera station 5:

Bobcat

Mule deer

Appendix 16 (continued).

Species detected at camera station 6:

Bobcat

Lazuli Bunting

Appendix 16 (continued).

Lazuli Bunting

Mule deer