Impact Sciences, Inc., "Assessment and Survey of Mammals within the Newhall Ranch Specific Plan Area, Los Angeles County, California" (May 2005)

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Assessment and Survey of Mammals Within the Newhall Ranch Specific Plan Area

Los Angeles County, California

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EXECUTIVE SUMMARY

Mammal surveys conducted during the year 2004 demonstrated that the most important habitats for maintaining native mammal biological diversity at the Newhall Ranch Specific Plan Area are coastal sage scrub, coast live oak, dry wash, and agricultural habitats. Several common mammal species were observed during survey efforts and several which are considered special-status species by the California Department of Fish and Game and/or the United States Fish and Wildlife Service.

Based on a literature review and the known habitats occurring within the Newhall Ranch, there are several special-status species that have the potential to occur. Potential special-status species include four bat species: California leaf-nosed, spotted, lump-nosed, western mastiff. The San Diego pocket mouse was not observed at the site but has the potential to occur based on its known distribution throughout southern California. Among the larger mammals, examination of the range and habitat preferences indicates the ring-tailed cat is likely to be found at the Newhall Ranch Specific Plan Area. The ring-tailed cat is a fully protected species in California. It prefers rotted trees or boulder patches for nest sites and an abundant supply of rodents.

The special-status mammal species that were recorded from the 2004 surveys include pallid bat, San Diego pocket mouse, desert woodrat, mountain lion, and badger.

1.0 PURPOSE

The overall objectives of the Newhall Ranch mammal assessment and surveys were the following:

- To identify all common and special-status mammal species occurring or potentially occurring within the proposed development areas of the Newhall Ranch Specific Plan area, with particular emphasis on those species considered of special status; and
- To document the relative diversity and extent of mammal species observed during the course of the survey.

Any incidental information regarding use of animal movement pathways would also be noted. The mammal surveys were concentrated on the proposed development areas of the Newhall Ranch Specific Plan (referred to in this text as NRSPA [Newhall Ranch Specific Plan Area]), but also include some sampling within the Magic Mountain Entertainment Center, Castaic Junction, and Stevenson's Ranch Phase V. The intent of the mammal surveys was not to calculate population densities of a specific species; rather, survey results were used to understand the variety of mammal species occurring within the boundaries of the NRSPA, and the overall extent and habitat associations of observed species.

Survey efforts focused on three categories of mammals: small mammals (rodents), large mammals, and bats. The analysis of the data collected also addresses the role these animals play in sustaining the faunal communities of the NRSPA. An extensive review of existing literature has produced a characterization of the expected fauna to which the results of the surveys are compared. The lists and accompanying life history briefs are intended to assist in characterization of the mammal environment, identify potential species of rarity or concern, and assist in future impact analysis for project-level development that will be influenced by such information as presence or absence, home range size, and behavior. For this reason, and because the rodents and bats are poorly known (relative to the larger mammals), the detailed life history lists focus on bats and rodents. The analysis and discussion examines the discrepancy between the expected and observed mammals, and draws conclusions about the reasons for this difference.

1.1 Environmental Setting

The NRSPA descends from high country chaparral and oak woodlands of the Santa Susana Mountains down the north-facing coastal sage scrub-covered slopes, to the riparian scrub and woodlands of the Santa Clara River. A diverse assemblage of habitat types is found on the approximately 12,000-acre property that supports a variety of habitats and associated mammal species. Surveys occurred in the following plant communities throughout the NRSPA (several plant communities discussed and depicted in this report are a mixture of the dominant plant communities shown below):

- Agriculture
- Alluvial/riparian
- Scrub (mixture)
- Chaparral
- Live oak woodland
- Grassland
- Coastal sage scrub
- Southern cottonwood/riparian/willow forest
- Valley oak savannah
- Riparian woodland
- Willow woodland
- Valley oak woodland

Plant communities occurring throughout the NRSPA were previously mapped and provided by Newhall Land and Farming (provided later in this document as **Figure 4, Mammalian Survey Locations With Plant Communities Map**). These vegetation types reflect the soils, slopes, aspects, elevations and other physical features of the area, and are considered synonymously with habitats of the mammals.

2.0 INTRODUCTION

The NRSPA contains an array of habitats for supporting mammalian species. As previously mentioned, this includes small mammal species, large mammals and bats. Small mammals are categorized based upon such criteria as body size and home range size. Included in the small mammal category are species such as rodents (i.e., mice, rats, ground squirrels) and rabbits. Many of these species are difficult to observe in the wild because of their size, their habit of moving only at night, or because they live underground or in other hard to reach areas. Therefore, specific survey techniques were deployed for identifying, capturing and releasing small mammals occurring within the NRSPA. The survey techniques used to identify small mammal species are discussed below in **Section 3.0, Methods and Materials**.

Large mammals such as deer, bobcat, coyote, and mountain lion, perform important ecological functions and are a good indicator of the habitat value within and surrounding the NRSPA. Because large mammals do not typically rely on a specific single habitat, as do many small mammals, specific habitats defined by vegetation cover alone are not necessarily indicators of presence/absence. Similar to surveys for small mammal species, the goal of performing surveys for large mammal species was to gain an understanding of the presence/absence of these mammals within the boundaries of the NRSPA as well as the role they may have in their environment.

Bat surveys were performed in areas (habitats) within the NRSPA where presence of both common and special-status bats were most likely to occur, such as along the Santa Clara River corridor. Both common and special-status bat species are expected to occur, or are known to historically occur, within the NRSPA. Instruments designed for identifying individual bat species were used to detect bat presence without deploying capture and release tactics (see **Section 3.0, Methods and Materials**). Most bat species feed almost exclusively on insects and are thus beneficial in controlling insect populations. Bats are the only major predators of night-flying insects. One bat can eat between 600 and 1,000 mosquitoes and other insect pests in just one hour (Organization for Bat Conservation (OBO, website information, 2005). Similarly, several bat species are pollinators of agricultural and native flowering plants and play a crucial ecological role in the natural environment.

2.1 Project Location

The NRSPA is located in an unincorporated portion of the Santa Clara River Valley in northwestern Los Angeles County. The NRSPA, approximately 12,000 acres in size, is located one-half mile west of the Golden State Freeway (I-5) and largely southwest of the junction of I-5 and State Route 126 (SR-126). Both

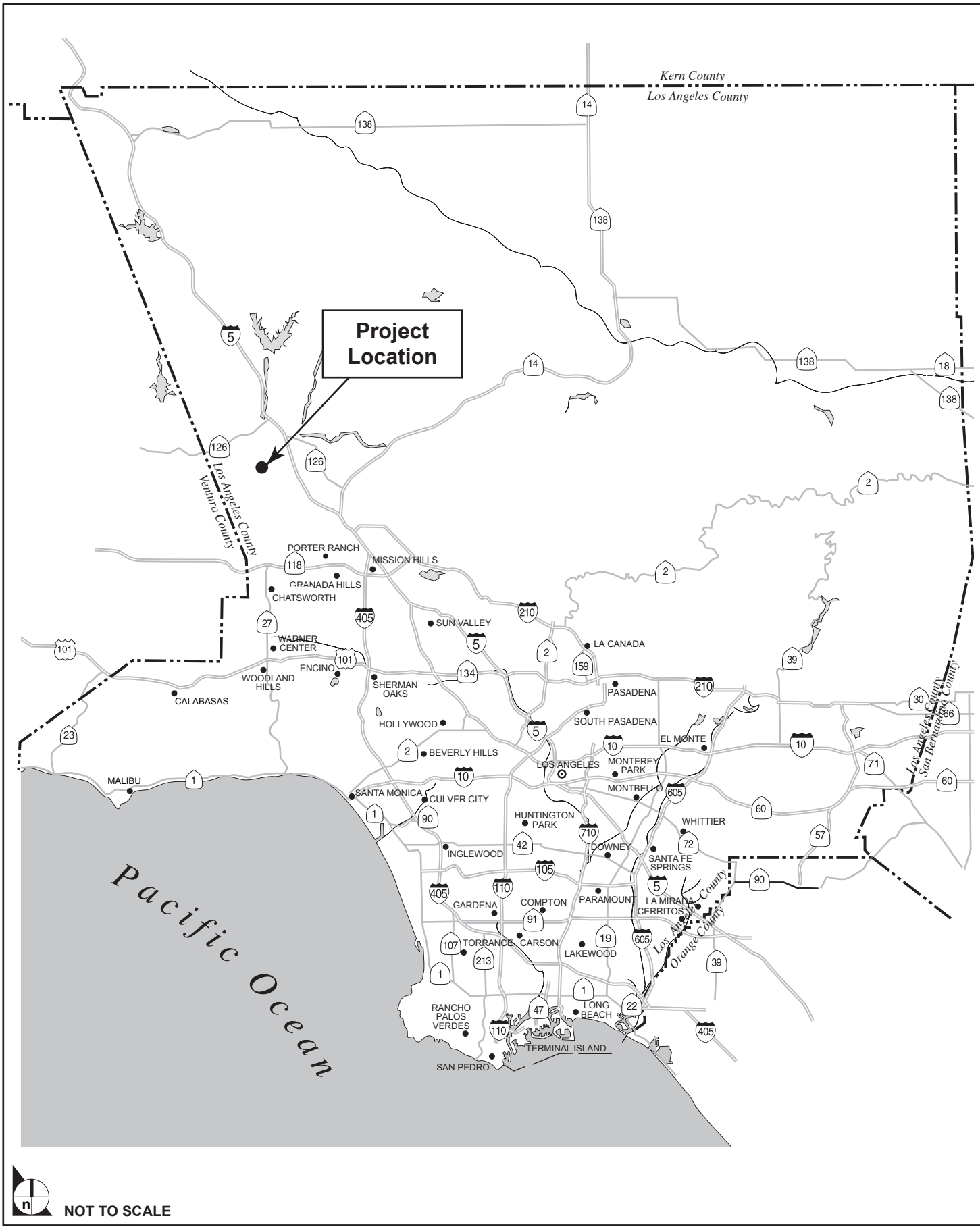
the Santa Clara River and SR-126 transect the northern portion of the NRSPA. The regional location map (**Figure 1, Regional Location**) and the site vicinity map (**Figure 2, Vicinity Map**) illustrate the NRSPA in its regional and local contexts, respectively.

2.1.1 Landscape Linkages

The Santa Clara River is an important riparian corridor that connects the NRSPA area with open space habitats to the east and west (see **Results** section for large mammals recorded in the Santa Clara River). The river and its tributaries serve as travel pathways between the upland habitats to the north and south of the river, as well as upstream and downstream. Large expanses of undeveloped land in the Santa Susana Mountains to the south allow for the movement of wildlife down to the river and back primarily through a series of ridges and canyons. North of the river, wildlife movements from the surrounding hills to the river is somewhat facilitated by the canyons and ridges generally favored as travel pathways, although SR-126 poses a barrier to wildlife movement. Viable upland connections to the east are restricted by the I-5, Stevenson Ranch development project, the Magic Mountain Theme Park, and the continued development of the Santa Clarita Valley.

In addition to the east/west corridor that occurs along the Santa Clara River, other large blocks of open area occur in a north/south orientation west of I-5. This is not an area of large migrations typically found in areas with more seasonal resource availability. The fauna is assumed to be largely resident, although extensive study of the movement of marked large wild mammals has not been conducted. Most large mammals move in patterns throughout large territories in response to feeding and other life history requirements. Mammals with large home range sizes require large contiguous open areas to satisfy their life history requirements.

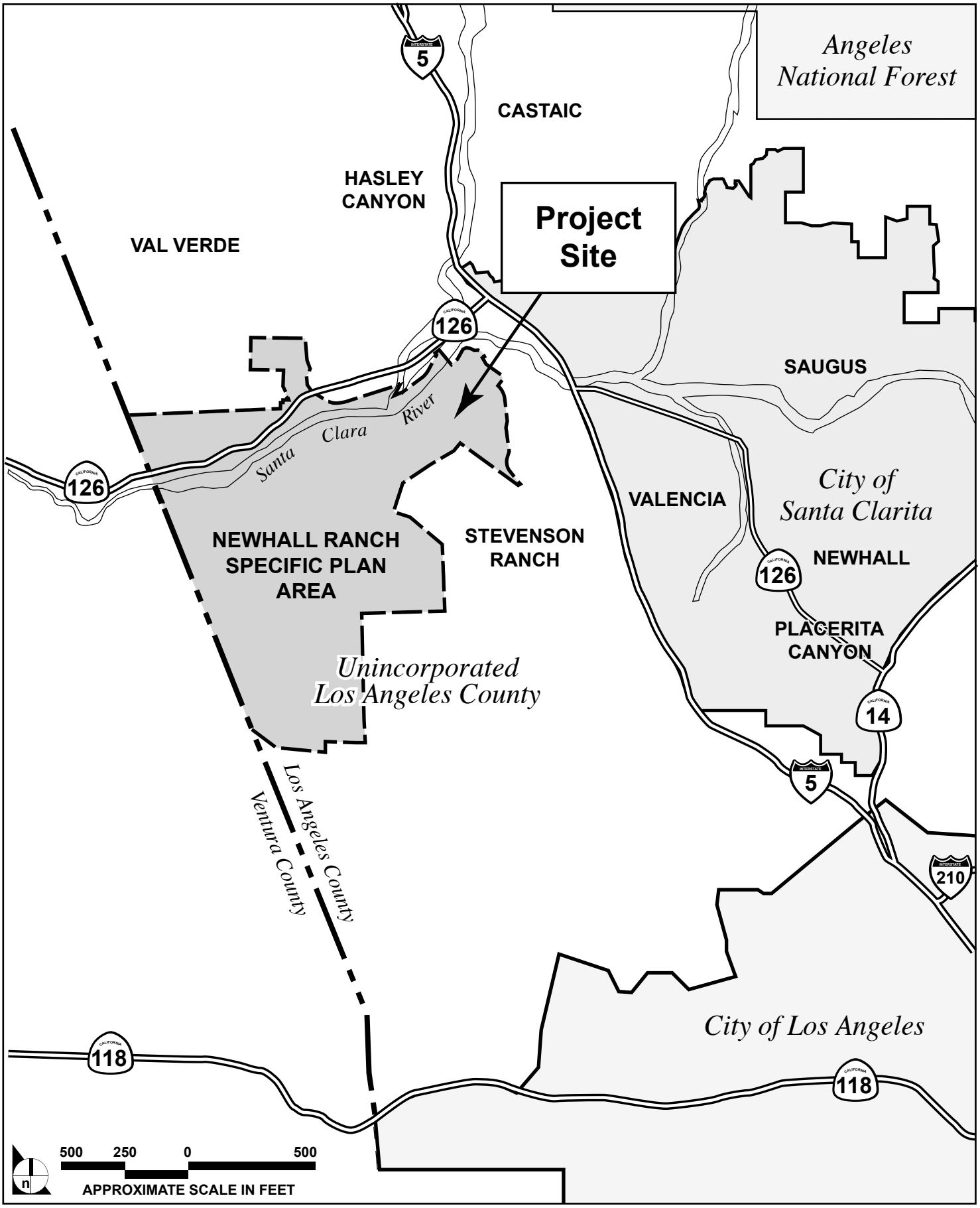
Connections between the Santa Clara River and upland areas serve as more intermittent connections between ecotypes and are more easily characterized as corridors, and as such are not as necessarily broad as geological connections between ecological units (e.g., Los Padres National Forest, Santa Susana Mountains, etc.). To function adequately for animal movement, travel paths must provide the necessary habitat characteristics, and be of adequate dimensions and character (e.g., cover) so as to not inhibit movement.



SOURCE: Impact Sciences, Inc. – May 2005

FIGURE **1**

Regional Location



SOURCE: Impact Sciences, Inc. – May 2005

FIGURE **2**

Project Vicinity

3.0 METHODS AND MATERIALS

3.1 Literature/Database Review

An extensive review of the literature and available databases on mammals of the region produced a list of all common and special-status mammal species historically known to occur, or with some potential to occur, within the NRSPA. The results of this review are presented in the **Results** section below. The search included reviews of home range sizes, habitat preferences, and other life history information. The review of range maps of the mammalian taxa that could potentially be found during the surveys were used in determining potential presence at the NRSPA.

3.2 Field Surveys

Field surveys were chosen to sample mammal species in dominant plant communities throughout the NRSPA during 2004. Survey locations were in dominant plant communities within the NRSPA. Five different survey methods were utilized: small mammal trapping, scent/track stations, spotlighting, cameras, and Anabat recording. Survey locations for each survey method utilized are depicted on **Figure 3, Mammalian Survey Locations Map**, and **Figure 4, Mammalian Survey Locations With Plant Communities Map**.

3.2.1 Camera Stations

As of August 2004, 10 remote motion-activated cameras have been in operation on the Newhall property located near Highway 126 and Castaic Creek (**Figure 3**). The cameras are located at various canyons that converge into the Santa Clara River. These locations were chosen based on the assumption that a number of mammal species were expected to use these areas as travel pathways**.**

Once the cameras were in place, they were checked every other week during the months of April to November, and once every three weeks between November and March. Immediately following each site visit, the film was developed and pertinent data, such as species, number of animals, date, and camera location was recorded on a data spreadsheet. Any photos of animals observed were organized according to month and species.

Figure 3: Mammalian Survey Locations Map

Legend

- Terrestrial Mammal Camera Locations
- 2003 Mammal Tracking Stations (A-AI)
- 2004 Mammal Tracking Stations (1-104)
- Anabat Survey Locations (1-29)
- Small Mammal Trapping Grids (1-34)
- Newhall Ranch Specific Plan Boundary

0.5 0.25 0 0.5 Miles

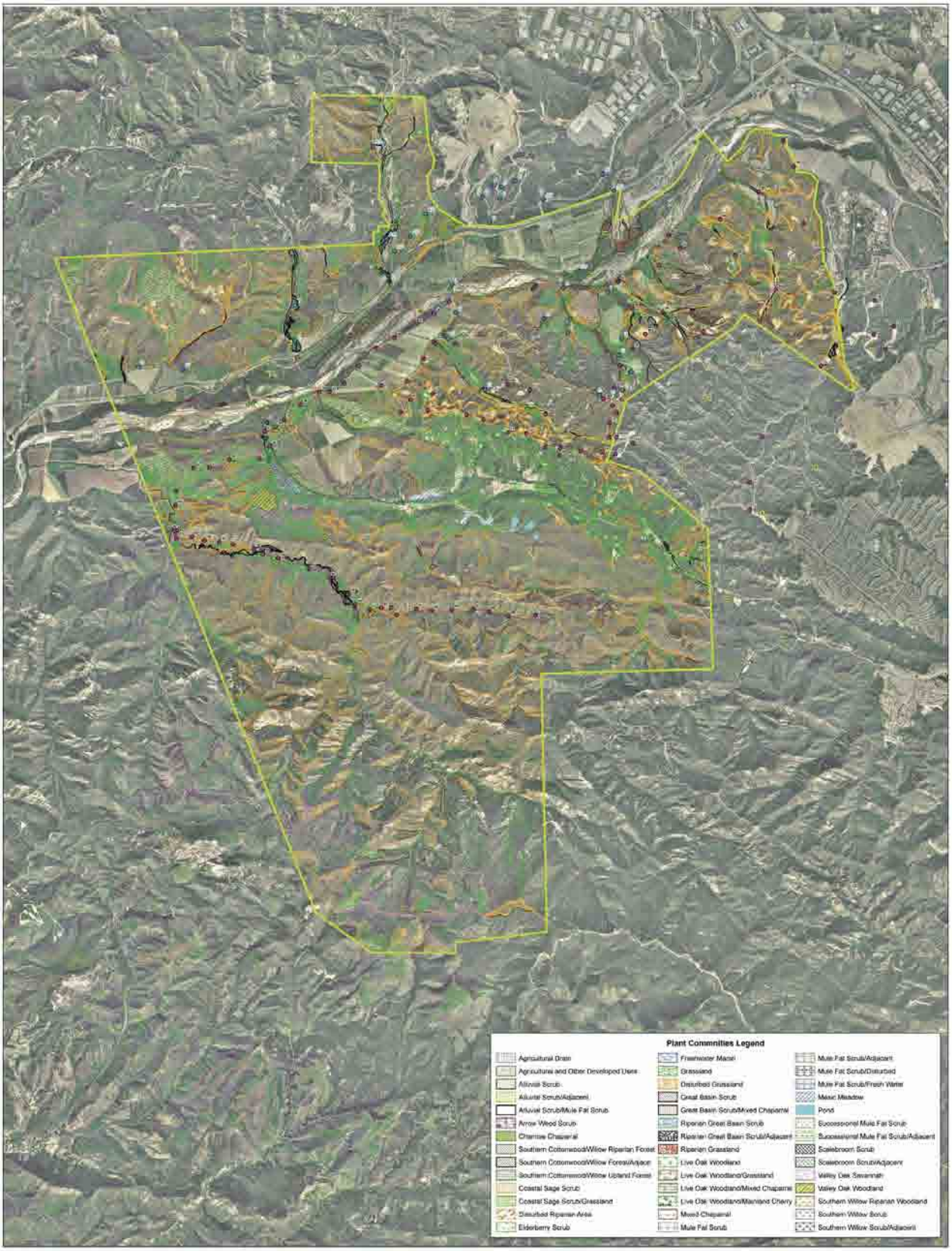


Figure 4: Mammalian Survey Locations with Plant Communities Map

3.2.2 Scent/Track Stations

A total of 104-scent/track stations were strategically distributed throughout the NRSPA to capture mammal distribution data in varying elevations and within most habitats. Scent/track stations consisted of a thin layer of flour, baited with a food attractant (usually a can of tuna cat food). Approximately 4 square feet of flour was spread on the ground (which had been previously smoothed over) for track detection. The food attractant was then placed in the center of the scent/track station to bait animals. Tracks left by mammals visiting the stations allowed identification of the species where track prints were discernable.

Scent/track stations were set up at dusk evening and checked at dawn the next morning for five consecutive days between 1 March and 30 September 2004. Animal tracks were identified and recorded on field data sheets.

3.2.3 Small Mammal Live Trapping

Small mammal populations generally fluctuate annually with low populations occurring late in winter and high populations occurring after the breeding season (spring to summer). For presence/absence surveys (especially for the one special-status rodent species, Los Angeles pocket mouse, with some potential to occur within the NRSPA), Impact Sciences performed sampling during and immediately after the breeding season (summer to early fall) when populations are generally at their annual maximum. Consequently, this likely resulted in the greatest probability of capturing most species likely to occur.

Sherman Live Traps were used to capture and release small mammal species. These traps are made of aluminum with collapsible sides and are 13 x 13 x 38 cm in size. A total of 34 live trapping areas (grids) were placed strategically throughout the NRSPA to ensure all habitat types were covered. Each grid consisted of four trap lines and each trap line consisted of 20 Sherman traps, spaced at approximately 20 feet apart, in a relatively straight line (80 traps per grid). The location of all 34 grids can be viewed on the Newhall Specific Plan Area Survey Map (**Figure 4**).

Trapping data was collected between July 28 and September 30, 2004. Due to the high temperatures in the area during the summer months, traps were set at dusk and checked at dawn to avoid mortality of small mammals captured inside the traps. Grids were checked each morning for five consecutive days. On average, two to three grids were set a week.

3.2.4 Spotlight Surveys

Spotlight surveys are typically used for assessing the relative abundance of nocturnal large mammal species. This survey method was conducted primarily to confirm expected large mammal species occurring within the NRSPA, while noting any large mammal species observed that were not expected. Spotlight surveys involved two observers scanning the road and sides using spotlights (each observer armed with a spotlight) while driving slowly along roadways. When an animal is detected, usually by eye shine, the driver stops and the observers identify the animal (using binoculars or a spotting scope). The time of detection is recorded for each sighting. Spotlight transects need to be fairly lengthy, and because vegetative cover and topography influences visibility, these variables were considered in the spotlight survey design. Spotlight surveys were conducted five days a week throughout the duration of the small mammal live trapping surveys (summer and fall). Several nights (repeated counts) of spotlighting surveys needed to be performed to obtain a measure of sampling error.

3.2.5 Anabat Surveys

Because many North American bat species tend to congregate at preferred roosting sites or at isolated water sources, several field methods are available to identify species and broad habitat associations (Cooperrider, et al. 1986). To avoid harming or harassing bats, capture and release methods were not used. Rather, the AnaBat II Bat Detector was utilized, which is designed to record the echolocation signals for computer analysis, either in the field or later in the laboratory. Its function is to convert the ultrasonic echolocation signals of bats into audible electronic signals, which can be recorded and processed to assist in identification of the species. Flying bats produce high frequency sounds for communication, orientation, and prey capture (Cooperrider, et al. 1986). Ultrasonic, echolocation calls are often recognizable as species-specific (Fenton 1982), with standard reference sonograms available for each species.

3.3 Analytic Methodology

Once the data were collected, the information was evaluated and analyzed with respect to both habitat associations within the NRSPA and mammalian diversity within each habitat type. Histograms were developed t to graphically display these various relationships. **Figure 5, Displaying Presence, Absence, and Habitat Importance for Each Mammalian Species**, will be a raw presentation of the common and special-status mammal species that were observed and the habitats in which they were found. The approach is to list all species every time for each habitat and leave empty spaces for species not found in

various habitats so that not only the habitats where animals live is displayed, but where they don't live is evident as well.

Using the fundamental data from the above histogram, overall mammalian diversity associated with the sampled areas within the NRSPA, as well as relative abundance of mammals in each habitat (based on field sampling conducted), can be analyzed. Histograms displaying the relative abundance of species for each habitat and mammalian species diversity were also developed and are presented in **Figure 6, Displaying Relative Abundance of Species in Each Habitat**, and **Figure 7, Displaying Mammalian Species Diversity of Newhall Ranch**, respectively.

Figure 5
Displaying Presence, Absence, and Habitat Importance for Each Mammalian Species

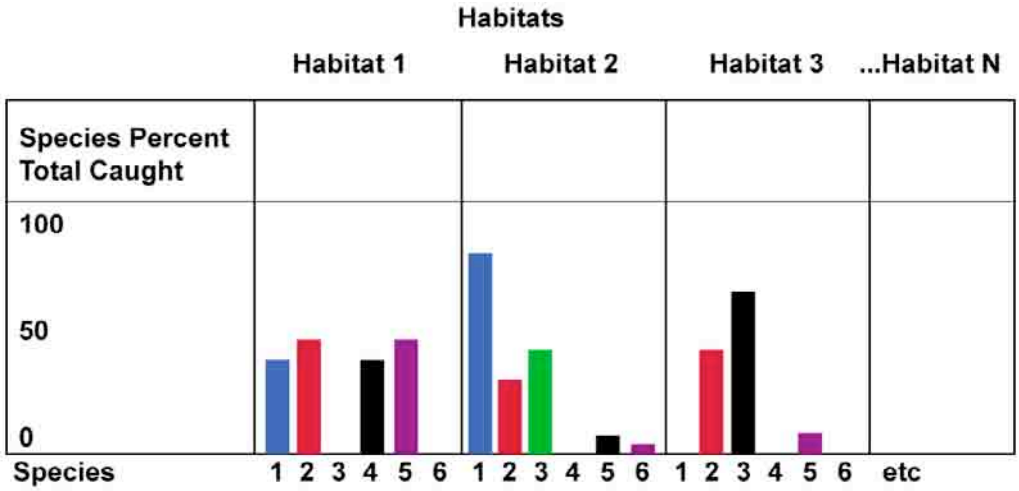


Figure 6
Displaying Relative Abundance of Species in Each Habitat

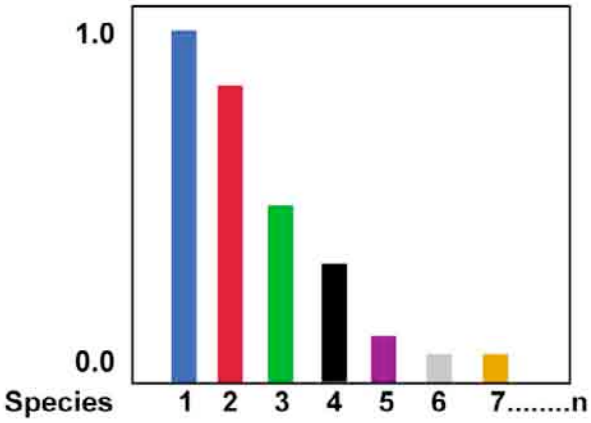


Figure 7
Displaying Mammalian Species Diversity of Newhall Ranch

To calculate an index of diversity, this analysis used the Simpson (1949, in Krebs 1999) index of diversity which measures the probability of randomly finding two individuals of the same species in a trapping sample. If there are many species, the probability is low and diversity would be high. For example, a community of 50 individuals of one species and of 50 individuals of another species would have a diversity index of 0.5. A community of 99 of one species and one of the other would have an index of 0.02 for the same number of species, but lower equitability, hence lower diversity. Of particular interest is the slope and pattern of the line. As with the line of a survivorship curve, it would have biological meaning. For example, Habitat 1 may be less stable than the more diverse and buffered Habitat 2, and the stair-step species distribution of Habitat 3 may point to just a few limiting resources that could be managed, moving it to greater diversity and stability.

4.0 RESULTS

4.1 Literature/Database Review

Based on the literature/database review that was conducted, the following represents a discussion of all of the common and special-status mammal species known to historically occur, or with some potential to occur, within the NRSPA. The list was derived from a review of historical observation/trapping records, life history and home range information, and known habitat preferences with respect to the known vegetation and habitat conditions within the NRSPA. These species ultimately served as the "target" of each of the field data collection methodologies employed. A discussion of these species is offered below as it helps to characterize the mammalian fauna within the NRSPA, their role in the ecosystem, and life history. The descriptions below are derived from several sources, primarily Ingles (1965), and Jameson and Peeters (2004). Because the life history and biology of most bats and small mammals (rodents and hares) are not as well known as the larger mammal species, the discussion below focuses on these taxa.

4.1.1 Bats (*Chiroptera*)

Taxonomy

As a group, bats are sensitive to human disturbance. As a result, over half of the more than 900 species are endangered to a degree. There are 44 species in the United States. All North American bats are in the suborder Microchiroptera, largely insectivorous. Seventy percent of all bats are insect eaters, as distinguished from the old world Megachiroptera of larger, mostly fruit-eating bats. There are three families in the Pacific states with a total of about 25 species (all of which occur in California): Phyllostomatidae with a nose leaf, Vespertilionidae (19 species called "evening bats" in the Pacific states) with simple lips and a tail completely enclosed by the flying membrane, and the free-tailed bats, Molossidae. With the exception of neotropical vampires, and two species of nectar and fruit eating bats, Phyllostomatidae are rare in Southern California. All other bats are insectivorous. The most common bat is the Brazilian free-tailed (*Tadarida brasiliensis*), with a U.S. population of over 100 million, the same number as is annually produced in Carlsbad Caverns when females return from central Mexico in the fall migration. Bats constitute about 25 percent of all animals in the Santa Monica Mountains National Recreation Area, an area that includes the Santa Susana Mountains and the NRSPA as well.

Movements

Bats are mostly nocturnal, having well developed ears with a fleshy tragus at the opening to direct sound. Because insect prey are active in the early evening and are nearly absent in winter, bats have adapted accordingly, including a repertoire of tactics such as hibernation and migration in winter. The pallid bat (below) has both a day roost and a night roost, the latter for resting while it feeds on large insects like the Jerusalem cricket. These bats leave the roosts when the temperature dips below 50°F in November, and won't return from migration until about the beginning of April. Tree dwelling bats (e.g., *Lasionycteris, Lasiurus*) migrate south to avoid cold weather. Of those species that do not hibernate, some can migrate over 1000 miles, sometimes at altitudes of over 10,000 feet. Those that hibernate lose up to one-third of their weight during hibernation, their daytime temperature rising to ambient temperature to conserve energy.

Foraging

The projection of high frequency sound at 20,000 to 130,000 cycles/sec. (humans can't detect above 20,000) permits bats to detect objects over 0.18 mm diameter by echolocation. Bats utter 30–50 squeaks/second, each lasting only 1/500 second as it approaches an insect prey item. The noctuid moths

that are heavily preyed upon by bats have developed mechanisms to hear the high frequency echolocation emissions of predatory bats. The bats have, in turn, developed a response by varying their sound. A bat consumes more than half its weight (e.g., 3000 mosquitoes) in insects each night.

Reproduction

Mating occurs during fall within winter roosts. Gestation varies from 56–100 days, depending on the temperature. Usually a single young is born, although some (e.g., Hoary bat, *Lasiurus*) have more. The low reproductive potential is countered by high colony numbers and longevity of over 30 years (10 is 20 is common for most bats). Such a life history (low productivity over a long life [i.e., "K" selected]) can render bats vulnerable when, for example, an important hibernaculum or roost is disturbed by development, or pesticides accumulate in their prey. When parents feed, young are left in a nursery, although they are precocial and when developed enough, cling to the mother in flight. Most bat species have large foraging ranges; a single leaf-nosed bat (*Macrotus californicus)* needs up to 300 acres in which to forage. Young bats fly at three weeks of age. Young are weaned in two to three weeks and are fed on regurgitated food until they hunt on their own at about the fourth week.

Shelter and Roosting

The presence and size of a bat colony or individuals is largely determined by the availability of suitable roost sites near a sufficient food supply. The roosts are typically found in mine shafts, trees (under bark and in holes), old buildings, and caves and can house enormous assemblages of bats. Some bats are solitary or occur in pairs under bark or roof shingles. They are very loyal to the cave or roost where they were born. Bats are very clean, spending considerable time grooming. However, insect parasites seem specific to the kind of bat. Bats can transmit rabies, and transmission to humans can occur, for example, in aerosols.

Limiting Factors

Bats have natural enemies such as owls, hawks, peregrine falcons, raccoons, and snakes. Some are even lost to predatory fish as they skim the surface of water while drinking. They are sensitive to habitat changes, roost disturbance, and pesticides which accumulate in their prey. The most significant agent of mortality is human activity associated with destruction of roost and maternity sites. Forty percent of the bats in North America are endangered or candidates for listing. For example, if they are disturbed during hibernation, their temperature rises in preparation for escape at a cost of 10 to 30 days of stored fat reserve. The Santa Monica Mountains to the south are experiencing a significant pulse of wildlife

mortality due to pesticides that have been documented to accumulate in large carnivores of the Santa Monica and Santa Susana Mountains (Riley et al. 2003, and Riley pers. Comm. 2005). This is the proximate agent in their (large carnivores) mortality since 2002. Such effects are possible with insectivores as well, but have not been investigated.

Expected Bat Species within the NRSPA

About 15 species of bats may or are expected to occur within the NRSPA.[1] These include the following:

California leaf-nosed bat* (*Macrotus californicus*), fringed myotis (*Myotis thysanoides*), small-footed myotis (*M. cilliolabrum (subulatus)*), hairy-winged myotis (*M. volans*), long-eared myotis (*M. evotis*), Yuma myotis (*M. yumanensis*), hoary bat (*Lasiurus cinereus*), red bat (*L. blossevelli (borealis)*), big brown bat (*Epitesicus fuscus*), western pipistrelle (*Pipistrellus hesperus*), spotted bat* (*Euderma maculata*), pallid bat* (*Antrozous pallida*), lump-nosed bat* (*Plecotus townsendii*), Brazilian/Mexican bat (*Tadarida brasiliensis*), and western mastiff bat* (*Eumops perotis*). Species indicated with an asterisk (five) are considered of special-status by state and/or federal resource agencies.

A sixteenth species, the occult little brown bat* (*M. lucifigus occultus*), historically occurred within the Santa Clara River region, including the NRSPA. However, more recent observations and field data place it outside of the northwestern portion of its original range. The California leaf-nosed bat (included in the list above) appears to have been extirpated in the northern and coastal areas of its range, which is roughly south of a line between Santa Barbara and Las Vegas, Nevada. Therefore, the California leaf-nosed bat has the least likelihood of all 15 bat species expected to occur within the NRSPA.

4.1.2 Rodents (*Rodentia*)

The order Rodentia contributes more than half of all mammalian species found in the Pacific states (Ingles 1965) with more individuals than belong to all the other orders combined. About 91 species of rodents are found in California. The ability of some species to go into torpor during the hottest or coldest times results in an ability to occupy most habitats when food is scarce. Their ubiquitous distribution and high numbers result in their fundamental importance as a base in food chains and as a modifier of their environment, leading to rodent-mediated distribution of plants and aeration of soils. Some, particularly the Sciurids (squirrels), but also wood rats, deer mice and voles, can be vectors of diseases affecting humans, including sylvatic plague, tularemia, erlichiosis, and more recently, Lyme disease.

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1 * denotes a California Species of Special Concern.

The review of the literature identified the following nineteen rodent species as potential residents in the various habitats present within the NRSPA. These 19 species are represented by three families: *Sciuridae* – squirrels and chipmunks; *Geomyidae* – Pocket mice, gophers, kangaroo rats, and mice; and *Muridae* – rats, mice, and voles. Each of these families/species are briefly discussed below.

Family Sciuridae

Sciurid rodents consume seed, nuts and fruits and often cache them on the surface as opposed to consuming vegetative parts. They therefore thrive around annual plants with large seed sets. They are diurnal and can do significant agricultural damage where predators such as raptors, coyotes, foxes, bobcats, and badgers, have been reduced. Sciurid rodents generally breed after emerging from hibernation in early spring. The following species likely to be found within the NRSPA include the following:

Beechey (California) ground squirrel (*Spermophilus beecheyi*) is found in all life zones. This species does not hibernate. They are found in open areas such as grasslands, fields, and oak woodland. They consume a wide variety of foods such as seed, leaves, tubers, and carrion. It has a single litter of three to 10 young per year. Males hibernate in late summer, females later, both emerging in late winter.

Merriam's chipmunk (*Neotamias (Eutamias) merriami*) has the lowest elevational distribution of the 11 species of chipmunks in California, often beginning just above the distribution of chaparral. Like many other ground squirrels, they are diurnal, hibernate, and have cheek pouches to carry food. They don't store up fat like ground squirrels, but have large underground food caches of seeds, nut, and fruits. They have a single litter of seven in mid-summer.

Western grey squirrel (*Sciurus griseus*) are found in the Upper Sonoran – Transition. It is found in oak and walnut woodlands. They do not hibernate, are arboreal and diurnal. They primarily consume acorns of different species of oaks, often burying them three to four inches in the soil. They enlarge old woodpecker holes for nests and produce a single litter of three to five young in spring. They are hunted by wild and feral canids, felids, owls, and diurnal raptors.

Botta pocket gopher (*Thomomys bottae*) inhabits the lower Sonoran to Hudsonian life zones with lighter soils (i.e., not clays) and is a solitary fossorial rodent with cheek pouches. These gophers eat bulbs and roots and new plant growth. They have a territorial burrow system of up to 2000 feet^2 in length. Many other animal species use these burrows, and some arthropods only exist in these systems. The gopher typically plugs all entrances, helping to keep temperature and humidity constant. The gopher doesn't hibernate and constructs large food caches. Although they live only about three years, they are prolific and can have three litters of 5 to 10 per year. While predator

control has led to large increases in gopher populations (e.g., 30 per acre in the San Joaquin Valley), overgrazing has been found to increase populations of some gopher species by over 1500 percent (Stoddart, Smith, and Box 1975). Among the other ecological services they perform, a single gopher can bring tons of soil to the surface each year. A population of 100,000 kangaroo rats was found to introduce about 400,000 pounds of plant materials to the subsoil each year (Taylor 1935), and the houses of wood rats produce 10 to 20 sacks of very rich fertilizer when each dwelling decomposes (Greene and Reynard 1932).

Family Geomyidae

These small, solitary mammals are characterized by long tails, the ability to make metabolic water and not require free water, cheek pouches, and their nocturnal nature and seasonal dormancy. They burrow two to three feet below the surface under shrubs, and construct a nest chamber and storage chambers for seeds of mustards, nettles, sunflowers and other plants characteristic of arid – semi-arid environments. Almost all kangaroo rats have less than one year life expectancy. Badgers, snakes, and owls are the most common known nocturnal predators.

***Little pocket mouse** (*Perognathus longimembrus*) live in firm gravelly to fine soils in the more arid regions of the Lower and Upper Sonoran zone. This species consumes grass seed and soil-dwelling arthropods. The subspecies *brevinasus*, the Los Angeles little pocket mouse, is a California Species of Special Concern while another subspecies, the Pacific pocket mouse (*P. l. pacificus*), federally listed as Endangered.

***San Diego pocket mouse** (*Chaetodipus* (*Perognathus) fallax*) lives in sandy to compact soils in open, weedy areas of low desert and foothills in the Lower and Upper Sonoran of southwestern California. It eats the seeds of local plants such as yucca, sage, and ryegrass. It is a California Species of Special Concern.

California pocket mouse (*Chaetodipus (Perognathus) californicus*) lives on chaparral slopes, scrub oak, and sage of the Lower Sonoran to the Transition life zones. It eats the seeds of grasses and shrubs. The Dulzura subspecies (*C. californicus femoralis*) is a California Species of Special Concern.

Pacific kangaroo rat (*Dipodomys agilis*) is found in sandy soils of sage scrub and chaparral. It eats the seeds of forbs and grasses, chamise and laurel sumac. It is the most common kangaroo rat in the coastal southern California region. They are prey for a wide variety of nocturnal predators.

Merriam's kangaroo rat (*Dipodomys merriami*) inhabits light sandy soils of the Lower Sonoran south coast and San Joaquin Valley and east through the Mohave Desert, Colorado River to Texas. It feeds

on seed of bromes and other grasses as well as forbs. It is solitary and territorial, with a home range of < 1/2 acre. They live for up to five years and have two to three litters per year of two young. They metabolize water from the seed diet and consume nearly 1/5 of their body weight a day.

Family Muridae

These species differ from the old world rodents (Murinae) in their dentition and tails with hair among other characteristics. The Cricitines (deer mice, wood rats, harvest mice) differ anatomically from the Microtines (voles, lemmings, jumping and tree mice, and muskrat). The NRSPA may well house five of the seven species of *Peromyscus,* a group that can reach high density with overlapping home ranges of up to 10 acres. They are prey for a wide variety of predators. While much is known about some of the species in this family, little is known about several of the species.

Western harvest mouse (*Reithrodontomys magalotis*) is found in all life zones in California. They are nocturnal seed and fruit eaters that build nests in thick grass. They share runways with meadow mice and construct ball shaped grass nests. They have the capacity to drink very salty water, an adaptation to arid habitats. Harvest mice are preyed upon by owls, snakes, and predatory mammals.

Brush mouse (*Peromyscus boylei*) is found in rocky areas of the Upper Sonoran chaparral. It eats forb and shrub seed, although insects are a major dietary item. Brush mice are generally nocturnal and are preyed upon by owls, snakes, and predatory mammals.

Parasitic (California) mouse (*P. californicus*) is found in the chaparral and foothill woodland of the Upper Sonoran. It consumes seeds of the California bay laurel. It often occupies wood rat nests upon which it apparently depends for shelter, often declining when wood rats decline.

Cactus mouse (*P. eremicus*) inhabits sandy, shrubby areas in the arid portions of the Lower Sonoran and valley lowlands. It eats seeds, leaves, and insects. This mouse estivates in summer.

Pinyon mouse (*P. truei*) are found in pinyon-juniper, brush and foothill woodlands. It eats seeds, insects, and berries, including juniper berries. It will also use wood rat nests like the parasitic mouse (above).

Deer mouse (*P. maniculatus*) is one of the widest spread of the native rodents and is found in all life zones. It eats seeds, leaves, insects, and hypogenous fungi. It has controlled some insect outbreaks by predation of larvae (e.g., the gypsy moth). The deer mouse nests in burrows, rocks, and logs and stashes seeds in such places as well.

Southern grasshopper mouse (*Onochomys torridus*) inhabits valley grassland of the Lower Sonoran. Its primary prey is nocturnal arthropods, and it consumes very little plant material. It nests in burrows of other animals and is hunted by snakes, owls, and weasels.

Woodrats (*Neotoma fuscipes*) are found in the Lower Sonoran, Upper Sonoran, into the Transition zone. They build large nests, often in dry riparian areas and poison oak thickets. It dominates the nocturnal rodent community and will defend a food patch like prickly pear cactus. It is also known as a "pack rat" and will construct nests up to six feet high of sticks, manure, and man-made implements (e.g., trash) that will sometimes house other animals. Some such nests persist for thousands of years. Woodrats are preyed upon by owls, foxes, coyotes, and snakes.

Desert woodrats (*N. lepida*) are found in sage scrub and chaparral of the Lower and Upper Sonoran, often in rocky areas. Dusky-footed woodrats (*Neotoma fuscipes*) are found in the Lower Sonoran to Transition zones. The subspecies *intermedia* (San Diego desert woodrat) is a California Species of Special Concern. Previous trapping records indicate its presence in the Santa Barbara – Newhall Ranch – Tejon area (Univ. California, Museum of Vertebrate Zoology 2005) although other subspecies have been found in the same geographic area. In the absence of definitive anatomical evidence to the contrary, the assumption is that the specimens recovered in surveys are subspecies *intermedia.*

With the exception of the **California meadow vole** (*Microtus californicus*), the sixteen species of Microtine rodents primarily inhabit montane meadows and deep forest environments. The California meadow vole can occur at NRSPA. Its populations typically boom and decline dramatically on a three to four year cycle. This is partly because of exceptional fecundity – three to four litters per year of up to 9 per litter. They construct distinctive runways through the grass on home ranges of less than1/4 acre.

Subfamily Murinae

Although considered alien exotics, these two rat species and one mouse species are now significant elements in many local ecosystems and currently occur in developed areas of the region. All three species, the Norway rat (*Rattus norvegicus*), the black rat (*R. rattus*), and the house mouse (*Mus musculus*), favor the built environment of humans. The black rat and house mouse will disperse and colonize adjacent fields, streamsides, and the edges of wooded areas, and are omnivorous. They are vulnerable to predators and usually cannot compete with native fauna in such areas. The Norway rat is nearly twice the size of the black rat, and can harbor tularemia and the fleas transmitting the bubonic plague.

Several members of the family Insectivora (shrews and moles) could also potentially occur within the NRSPA. These include desert shrew (*Notiosorex crawfordi*), ornate shrew (*Sorex ornatus*), and broad-footed mole (*Scapanus latimanus*).

4.1.3 Medium/Large Mammals

A total of 16 medium to large sized mammals also are known to occur or potentially occur within the NRSPA. These include the following: virginia opossum (*Didelphis virginiana*), porcupine (*Erethizon dorsatum*), ringtail (*Bassariscus astutatus*), raccoon (*Procyon lotor*), long-tailed weasel (*Mustela frenata),* striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), black-tailed jackrabbit (*Lepus californicus bennettii*), desert cottontail (*Sylvilagus audubonii*), brush rabbit (*Sylvilagus bachmani),* badger *(Taxidea taxus),* coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), and mule (blacktailed) deer (*Odocoileus hemionus*).

4.2 Field Surveys

The results of the data collected from the various field surveys are presented below.

4.2.1 Camera Stations

The initial evaluation of the camera data did not yield a substantial amount of data – far too few photographs of animals were taken to be of any interpretive value. Mammal species caught on photograph include those that were expected such as mule deer, coyote, raccoon, and opossum. It was decided to continue to monitor the cameras to capture any seasonal pulse in large mammal movement, or to document the presence of any uncommon animals such as ring-tailed cat and mountain lion. These data are currently still being collected.

4.2.2 Scent/Track Stations

Tracks of 23 mammal species were identified at the various track stations. Review of the station data (**Table 1, Scent/Track Station Results**) reinforces the evident contribution that coastal sage scrub and agricultural habitats make to biodiversity at the site. In this case, it reflects the diversity of larger native mammals. These animals not only use preferred habitats within their home ranges, but move within home ranges in movement corridors, as well as during dispersal of young males, most of which occurs at one or two years of age (Bunnell and Harstead 1983). Movement behavior of larger ungulates and their

predators generally reflects preference for specific topographic and microclimatic elements, particularly for drainages and ridgelines.

Table 1
Scent/Track Station Results[1]

Species	Coastal Sage Scrub	Agriculture	Mixed Chaparral	Coast Live Oak Woodland	Dry Wash	Riparian Willow	Scrub	Mulefat Scrub	Grassland	Valley Oak
Coyote	37	25	1	2		4	6	2	18	
Grey fox	20	32				12		1	9	4
Cottontail *spp.*	26	2							2	
Bobcat	5	1		1				1	1	
Mtn. lion						4				
Woodrat	10	2					1			
Kangaroo rat	12	8				4	4	1	6	2
Mice *spp.*	16	6	3							
Skunk *spp.*	16	6	1			4		1	9	
Badger		1								
Deer	10	16	1			2		1		
Raccoon	6	3		1			1	1	1	
Feral cat		2							1	
Weasel	4						1			
Gopher	2									

[1] *The scent station data do not break some taxa into species. The "cottontail" could be one of two subspecies as could the "skunk," and the rodents were not identified to species.*

4.2.3 Small Mammal Live Trapping

A total of 10 rodent species were trapped during the trapping effort. Results of 13,500 trap nights on grids in the seven administrative sections of the NRSPA used for this report (Portero, Mission, Landmark, Homestead, Legacy, Magic Mountain, and Outside of the Specific Plan) are lumped by habitat types and displayed below in **Table 2, Results of Small Mammal Trapping**. The sampling regime and habitats are shown in **Figure 8, Distribution of Small Mammal Species by Plant Communities**. A graphic depiction of these data from the small mammal trapping is displayed in **Figure 9, Small Mammal Diversity in Coastal Sage Scrub**. In addition to the small mammal trapping, scent stations for tracks (**Table 1**), and Anabat recordings (**Table 3**) are combined to give a picture of mammal diversity and habitat selection at the property (**Table 4**). The discrepancy between mammals expected and mammals encountered are evaluated in **Tables 5** and **6**.

Table 2
Results of Small Mammal Trapping[1]

Species	Coastal sage scrub	Agriculture	Mixed chaparral	Coast Live Oak Woodland	Dry Wash	Riparian Willow	Scrub	Mulefat Scrub	Grassland	VOS
Deer mouse	298	43	12	95	108	93	51	138	54	37
CA pocket mouse	330	59	9	78	17	55	34	70	188	25
Brush mouse	18	6			6	1			3	
Cactus mouse	11	1		1					7	1
Dusky- footed wood rat	32	16		21	44	7				
Desert wood rat	21	4		5	5	5		4		
Pacific kangaroo rat	66	52	14	16	34		27			2
CA vole	14	1		5	6	5	2			
CA mouse	3	1								
Western harvest mouse	26	7		31	11		10	2	39	

[1] *Note: for all tables in this report, elderberry shrub, cottonwood/riparian, willow and arundo/willow from data sheets have been combined as riparian willow; agricultural drain has been combined with agriculture and labeled "agriculture," and grassland/structures is combined with grassland.*

In six of the 10 habitats, the deer mouse and California pocket mouse are numerically dominant. These habitats tend to be the most open, or offer significant edge, for these species. The coastal sage and grassland types have two to three times the number of individuals of these species than the other habitats, and because the grid occupied about the same area in all cases, the densities are assumed to also be greater in these more open habitats. Coastal sage and agriculture appear to hold the most species – the highest diversity. **Table 2** and the histograms both illustrate the ubiquitous distribution of the deer mouse, California pocket mouse, Pacific kangaroo rat, and Western harvest mouse. These represent separate genera while the congeneric cactus, brush, California mice, and vole are not found in some habitats such as mixed chaparral, oak, and scrub habitats. Although the wood rats are not as abundant as the smaller rodents, they are found in most habitats except the most open.

However, the results clearly indicate the relative abundance of the deer mouse and California pocket mouse, and the importance of the coastal sage scrub, coast live oak, dry wash, and agricultural habitats as sites of high biodiversity in the rodent fauna of the area surveyed.

Figure 10, Small Mammal Diversity in Agriculture, depicts the distribution and numbers of small mammal species by habitat type.

Figure 8
Distribution of Small Mammal Species by Plant Communities

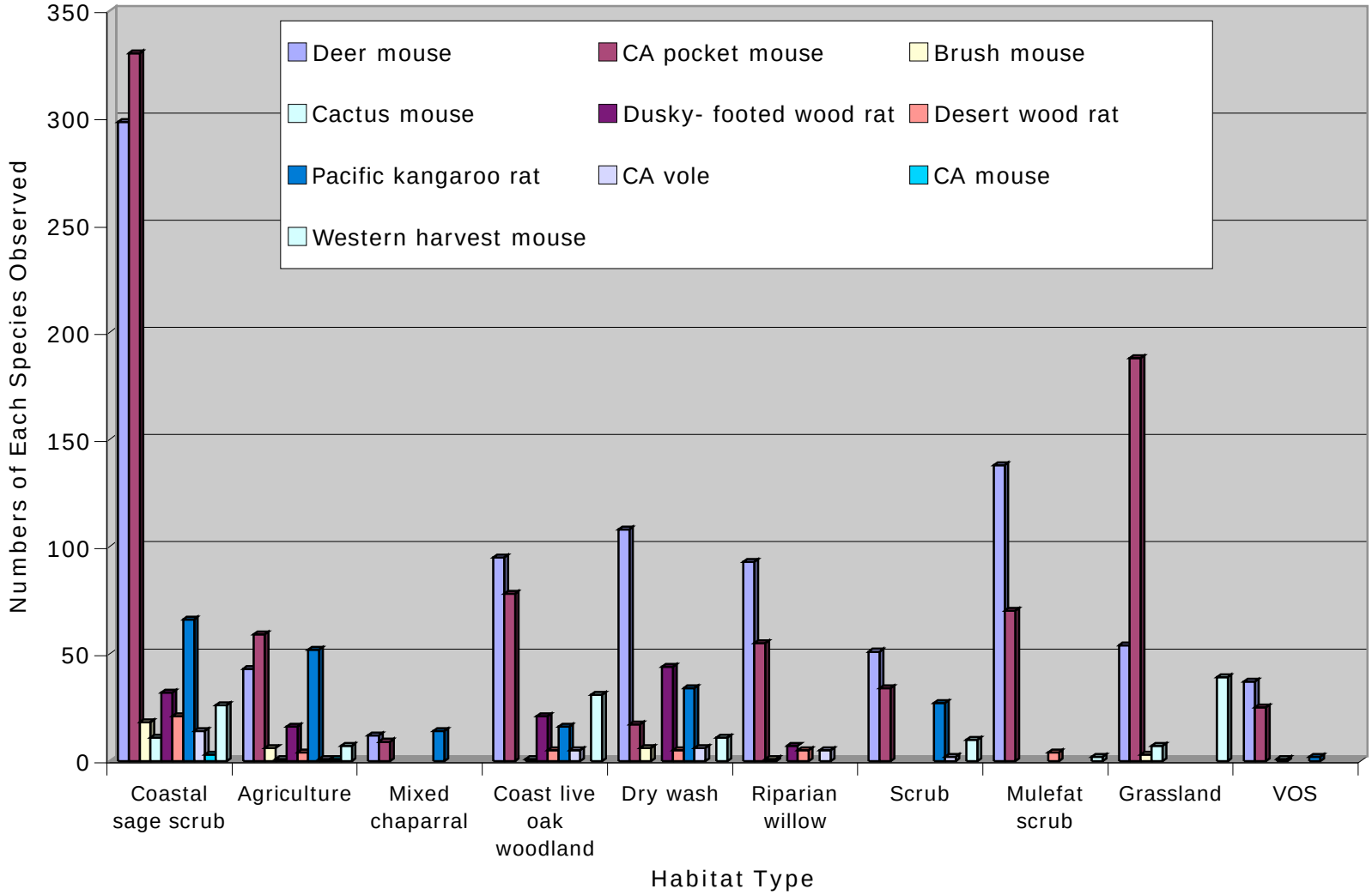


Figure 9
Small Mammal Diversity in Coastal Sage Scrub

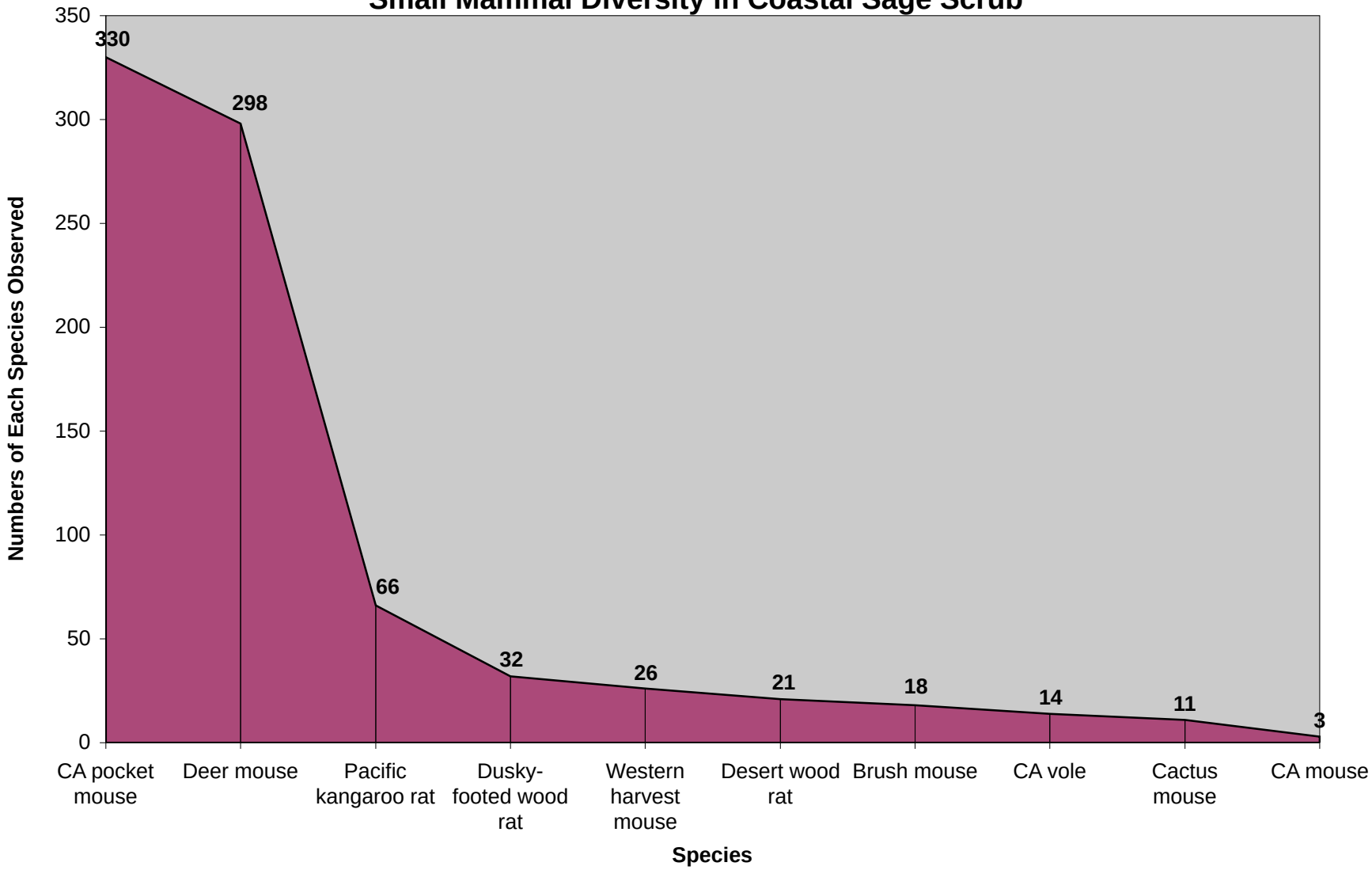
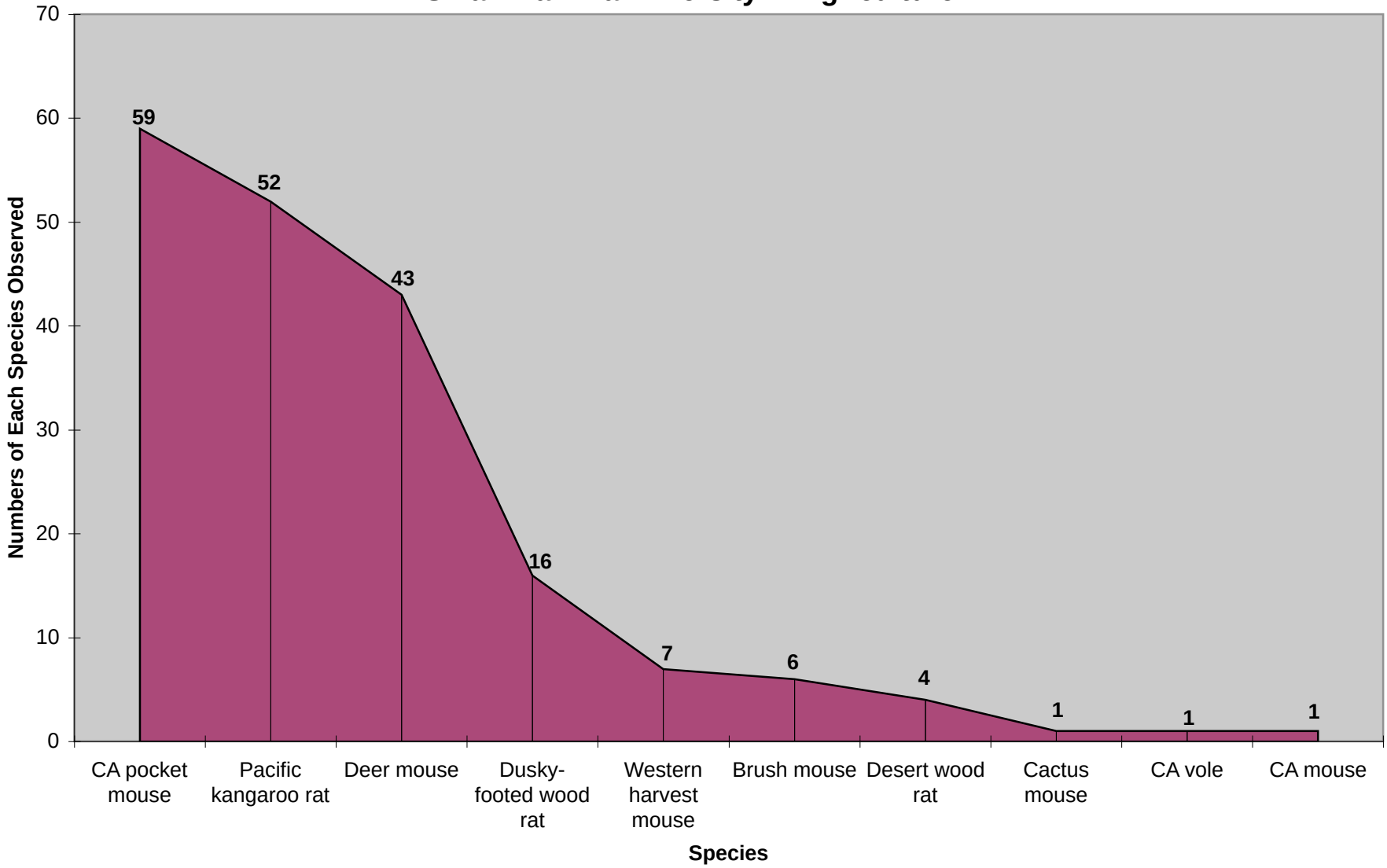


Figure 10
Small Mammal Diversity in Agriculture



4.2.4 Spotlight Surveys

The results of the spotlight surveys differed among the canids (coyote and gray fox), which were observed sporadically during the surveys (24 and 9 percent, respectively, of all large mammal sightings), but were completely absent at the scent/track stations. Skunks were much more evident at the scent stations than in spotlight surveys (7 as opposed to 37 percent). Deer, bobcat and raccoon had about the same representation in both types of surveys. Deer were the most abundant of the large mammals observed during the spotight surveys (41 percent of all mammals observed). We presume that the spotlight surveys disclose animals more in proportion to their representation in the area, and the scent stations reveal presence and absence by attracting animals to the bait. Nevertheless, the spotlight surveys demonstrated the presence of coyotes, and foxes and the scent/track stations demonstrated the presence of mountain lions. The numbers of deer also provided evidence of their importance in the trophic structure of the area as they are a significant prey item for mountain lions.

4.2.5 Anabat Surveys

Results of the Anabat sampling (**Table 3**, **Results of Anabat Identification for Bats at the NRSPA**) show a complete absence of bats from the most extensive habitat type on the property, coastal sage scrub. Five habitats were used: the live oak woodland, riparian, agriculture, mulefat scrub, and grassland. The mulefat is a basically riparian type and can be lumped with riparian for this evaluation for a total of 36 percent of all records. This survey suggests that the bats largely forage in the more open habitat types.

Of the bats listed as California Species of Special Concern, the pallid bat was the only one recorded by the Anabat surveys at Newhall Ranch. The pallid bat is a member of the suborder Microchiroptera. This bat is known to feed on flightless arthropods like Jerusalem crickets, scorpions, and beetles, often foraging on the ground (Heermanson and O'Shea 1983). It is found from central Mexico to British Columbia and throughout California except in the Trinity/Siskyou and Sierra Mountains, and can be particularly abundant in the Sonoran Zone of the southwestern portion of the state and Great Basin communities to the east and north. Mating begins in October, the sperm stored until ovulation. Birth of two young occurs in June. The bat roosts under bridges, in cliff fissures, and abandoned buildings. It makes seasonal movements, but no long migrations.

Table 3
Results of Anabat Identification for Bats at the NRSPA (%)

Species	Coastal Sage Scrub	Agriculture	Mixed Chaparral	Coast Live Oak	Dry Wash	Riparian Willow	Scrub	Grassland	Mulefat Scrub	Valley Oak	Total
Pipistrellus hesperus						7		2	9		18
Epitesicus fuscus				3		7			6		16
Myotis cilliolabrum		2		6		6		1	1		16
Myotis californicus		5		48		7		2			62
Myotis thysanoides				1							1
Tadarida brasiliensis		9		5		1			1		15
Lasiurus blossevilli						2					2
Antrozous pallidus				2		1					3
Total		**16 (12)**		**65 (48)**		**31 (23)**		**5 (4)**	**18 (13)**		**135**

4.3 Vegetation Associations and Species Diversity

Table 4, Number Of Species of Mammals Observed Within the Habitats of NRSPA, compares the three classes of mammals studied with the vegetation in which they were observed or trapped.

Table 4
Number Of Species of Mammals Observed Within the Habitats of NRSPA

Category of Animal	Coastal sage scrub	Agriculture	Mixed chaparral	Coast Live Oak	Dry Wash	Riparian Willow	Scrub	Grassland	Mulefat Scrub	Valley Oak
Small rodent	10	10	3	8	8	6	5	5	4	4
Bats		3		6		7		3	4	
Larger mammals	8	9	3	3		5	3	7	5	1
Total	**18**	**22**	**6**	**17**	**8**	**18**	**8**	**15**	**3**	**5**

Inspection of **Table 4** shows that the different surveys described herein successfully sampled a wide variety of the mammalian fauna occupying a diverse set of habitats. In all cases some selectivity is apparent: for all taxa it can be concluded that mixed chaparral is not a favored habitat; for all taxa, the coast live oak and riparian are favored habitats (particularly if riparian is lumped with the riparian mulefat scrub type); coastal sage is important to small and large wild mammals, although bats appear to avoid it. The implications of these distributions for biological diversity, stability, and resilience is discussed below in **Section 5.0**, **Conclusions**.

Although remarkably little is known about the wild ungulates of the Santa Monica, Simi, and Santa Susana mountains (Riley, pers. Comm. 2005), expected patterns of use are reflected in the use of the riparian willow habitat as documented in **Table 1** and spotlight surveys. Uses of such habitats and corridors as well as home range size is modified by grazing of domestic stock. Livestock use generally increases the home range size and movements of deer. One clear distinction between the small rodents and larger wildlife is the use of grassland by the latter. As **Figure 8** illustrates, the grasslands at Newhall tend to follow the ridges and their greater use could also reflect their use as movement pathways. Harris (1983) and Gillen et al. (1984) found that both wild and domestic ungulates use different areas of their range to move, forage, escape, and shelter. Deer select slopes of less than 40 percent, elk less than 30 percent, and cattle less than 10 percent (Julander and Jeffery 1964, Ganskopp and Vavra 1986). The use of the upper and lower portions of the third dimension of the larger animals home range is a feature of areas of high relief such as is found at Newhall.

Table 5, Mammal Species Expected and Found at Newhall Ranch, lists all the target species identified as a result of the literature and database review and indicates which species from this list were observed during the course of the field survey effort. About half (52 percent) of the 56 mammalian species reasonably expected at NRSPA were observed. Possible reasons for not observing the remaining species are also given.

Table 5
Mammal Species Expected and Found at Newhall Ranch

Species Expected	Species Observed	Possible Reason for Absence
Marsupialia		
Virginia opossum (*Didelphis virginiana*)	X	
Insectivora		
Desert (Gray) shrew (*Notiosorex crawfordi*)		This animal requires a more arid environment; low potential of occurrence.
Ornate shrew (*Sorex ornatus*)		The shrew needs significant riparian woodland; low potential of occurrence.
Broad-footed mole (*Scapanus latimanus*)		The mole needs significant riparian woodland and agriculture and more mesic soils; low potential of occurrence.

Species Expected	Species Observed	Possible Reason for Absence
Chiroptera		
California leaf-nosed bat* (*Macrotus californicus*)		This animal requires a more arid environment; low potential of occurrence.
Fringed myotis (*Myotis thysanoides*)	X	
Small-footed myotis (*M. subulatus*)		This animal requires a more arid environment; low potential of occurrence.
Hairy-winged myotis (*M. volans*)		These need the structural and biotic elements of forest environment; low potential of occurrence.
Long-eared myotis (*M. evotis*)		These need the structural and biotic elements of forest environment; low potential of occurrence.
Yuma myotis (*M. yumanensis*)		This animal requires a more arid environment; low potential of occurrence.
Small footed bat (*M. ciliolabrum*)	X	
California bat (*M. californicus*)	X	
Red bat (*L. bossevilli (borealis*))		These are found at higher summer elevations; low potential of occurrence.
Hoary bat (*Lasiurus cinereus*)		These are found at higher summer elevations; low potential of occurrence.
Big brown bat (*Epitesicus fuscus*)	X	
Western pipistrelle (*Pipistrellus hesperus)*	X	
Spotted bat* (*Euderma maculata*)		These are found at higher summer elevations; low potential of occurrence.
Pallid bat* (*Antrozous pallida)*	X	
Lump-nosed bat* (*Plecotus townsendii*)		Occupies caves, mine shafts, and buildings within its range and should be found in the Sonoran Life Zone on the NRSPA; high potential of occurrence.
Brazilian/Mexican (guano) bat (*Tadarida brasiliensis)*	X	
Western mastiff bat* (*Eumops perotis*)		Although not common, should be found within the semi-arid Lower Sonoran with cliffs of the NRSPA; moderate potential of occurrence.
Carnivora		
Coyote (*Canis latrans*)	X	
Gray fox (*Urocyon cinereoargenteus*)	X	
Ringtail (*Bassariscus astutatus*)		This animal is very secretive and prefers dense woodland and riparian areas; moderate potential of occurrence.
Raccoon (*Procyon lotor*)	X	
Long-tailed weasel (*Mustela frenata)*		Open areas with rock or lumber and junk piles, throughout the region from the Lower Sonoran to the Hudsonian; high probability of occurrence.
Striped skunk (*Mephitis mephitis*)	X	
Spotted skunk (*Spilogale putorius*)		In rocky, brushy areas from the Lower Sonoran to the Transition, often adapting ground squirrel burrows; high probability of occurrence.
American badger* *(Taxidea taxus)*	X	
Mountain lion* (*Felis concolor*)	X	
Bobcat (*Lynx rufus*)	X	
Artiodactyla		
Mule (black-tailed) deer (*Odocoileus hemionus*)	X	
Rodentia		
Beechey (California) ground squirrel (*Spermophilus beecheyi*)	X	
Merriam's chipmunk (*Neotamias (Eutamias) merriami*)		These need the structural and biotic elements of forest environment; low potential of occurrence.
Western grey squirrel (*Sciurus griseus*)		The gray squirrel requires less disturbed (xerified, compacted) sites; low potential of occurrence.

Species Expected	Species Observed	Possible Reason for Absence
Botta pocket gopher (*Thomomys bottae*		A fossorial animal, it is difficult to observe; high probability of occurrence.
Little (Los Angeles) pocket mouse* (*Perognathus longimembru brevinasus*)		A very secretive, hibernating species in sandy soils of semi-arid areas, but should have been trapped if was present in large numbers; low potential of occurrence.
San Diego pocket mouse* (*Chaetodipus (Perognathus) fallax*)		Likely to occur further to the south; low potential of occurrence.
California pocket mouse (*Chaetodipus (Perognathus) californicus*)	X	
Pacific kangaroo rat (*Dipodomys agilis*)	X	
Western harvest mouse (*Reithrodontomys magalotis*)	X	
Brush mouse (*Peromyscus boyleii rowleyii*)	X	
Parasitic (California) mouse (*P. californicus*)	X	
Cactus mouse (*P. eremicus*)	X	
Pinyon mouse (*P. truei martirensis*)		Found in open woodlands. Need to specifically target rocky areas in trapping; moderate probability of occurrence.
Deer mouse (*P. maniculatus*)	X	
Southern grasshopper mouse* (*Onochomys torridus ramona*)		Need less disturbed (xerified, compacted, fewer annuals, more perennial grasses) valley grassland soils and later successional plants of Lower Sonoran; moderate potential of occurrence.
Dusky footed woodrat (*Neotoma fuscipes macrotis*)	X	
San Diego Desert woodrat* (*N. lepida intermedia*)	X	
California meadow vole (*Microtus californicus)*	X	
Norway rat (*Rattus norvegicus)*		This species is an associate of humans, their products and infrastructure (more human habitation); moderate potential for occurrence.
Black rat (*R. rattus*)		This species is an associate of humans, their products and infrastructure (more human habitation); moderate potential for occurrence.
House mouse (*Mus musculus*)		This species is an associate of humans, their products and infrastructure (more human habitation); moderate potential for occurrence.
Lagomorpha		
San Diego black-tailed jackrabbit* (*Lepus californicus bennettii*)	X	
Desert cottontail (*Sylvilagus audubonii*)	X	
Brush rabbit (*Sylvilagus bachmani)*		Not as numerous as other lagomorphs and few records in the area; low potential for occurrence.

* *Indicates a species considered of special-status by resource agencies*

Table 6
Allocation of Reasons for Absence

Allocating agent of absence (needs:)	No. (Percent) of missing species
Should have been recorded (more sampling?)	8 (30)
More agriculture	3 (11)
More wooded/forested	7 (26)
More native/perennial grassland, less disturbance history (i.e., heavy grazing)	3 (11)
More human habitation	3 (11)
More arid/desert	2 (1)
More rocks/cliffs/crevices	1 (T)
Total	27 species not found

5.0 CONCLUSIONS

5.1 Biodiversity, Stability, and Resilience in the Community of Mammals and their Habitats Within the NRSPA

As Krebs (2001) notes, biodiversity is an important aspect of conservation biology because an inventory of what needs protection or management is required. For any area under consideration, community ecologists tend to lump species in specific groups to disclose large patterns and to understand what caused them. This is precisely the approach taken in the study of mammals at Newhall Ranch.

The simplest measure of biodiversity is the number of resident species ("richness") although the distribution of the number of each species is a component of diversity as well (heterogeneity or equitable abundance). The number of species represented by a single or few individuals is often high with just a few other species numerically dominant. This generates a hollow curve best described as a logarithmic series and generally arises in communities with one or a very few dominant environmental elements and processes (i.e., a simpler community). These are often fragile communities prone to species loss and require particular management interventions. In other communities groupings of species (in some logical taxonomic order) show a few groups as very rare, many fairly abundant, and the remainder very abundant – a bell shape (or "normal") distribution of abundance with the x-axis depicted logarithmically. It is the common log-normal distribution seen in a number of communities reflecting species abundance patterns with tighter division of a complex of resources and fine niche divisions (i.e., a diverse, stable, and more complex community organization, generally to be managed differently than the first type). There are a high number of species in one habitat (alpha diversity) and there can also be a high number of

habitats with diverse species leading to a high total biological diversity in an area (between habitat, or beta diversity). The question here is, "is the case at the NRSPA"? The importance of competition and predation (among other processes) is greater in these cases (e.g., high diversity, log-normal distribution), and single-species focused conservation efforts can prove expensive and fruitless, often requiring significant maintenance inputs. The lack of understanding of these systems often frustrates or causes the underestimation of the resources, knowledge and effort required for successful reclamation and restoration efforts.

Using a series of histograms (**Figures 8–18**) of the numerical strength of each species in a habitat type, the heterogeneity (species richness and abundance) of each habitat will be assessed as a way of describing the biodiversity value of each habitat. The 10 rodent species are sympatric as described for each species (above) and have distinct niches permitting their co-existence. However, they are displayed together in the Figures as they represent a single taxon (rodents) of comparable life histories (i.e., generally at the same trophic level) and metabolic weights. The data collected at Newhall are examined below in the series of histograms for each major habitat type, to reveal patterns of species richness. The habitats will be arrayed in a gradient of diversity and forms to reveal any patterns in species diversity much as latitudinal, altitudinal or longitudinal gradients exist over large areas (**Figures 8–18**). If, for example, the histograms reveal a lognormal distribution indicative of fine niche divisions, the maintenance of predators could be a key to maintaining the biological diversity of the herbivores such as rodents or deer (in the sense of Paine, 1966 who demonstrated that increased predation can lead to greater prey diversity, and of Lubchenko, 1986 who believed that predation and competition were complementary in communities, with the latter more influential at the parasite and predator trophic levels).

From the data in **Table 2**, the proportions of each species in each habitat were calculated and Simpson's index of diversity was calculated by:

$$D = 1 - \sum (p_i)^2$$

p_i = proportion of individuals of species in the community

Table 7, Ordination of Habitats by Simpson's Index of Diversity, gives the indices for the rodent community in each habitat at NRSPA. The rodent data were used because the sampling intensity was the most intensive and sample design was the most extensive, sampling all of the habitats.

Figure 11
Small Mammal Diversity in Mixed Chaparral

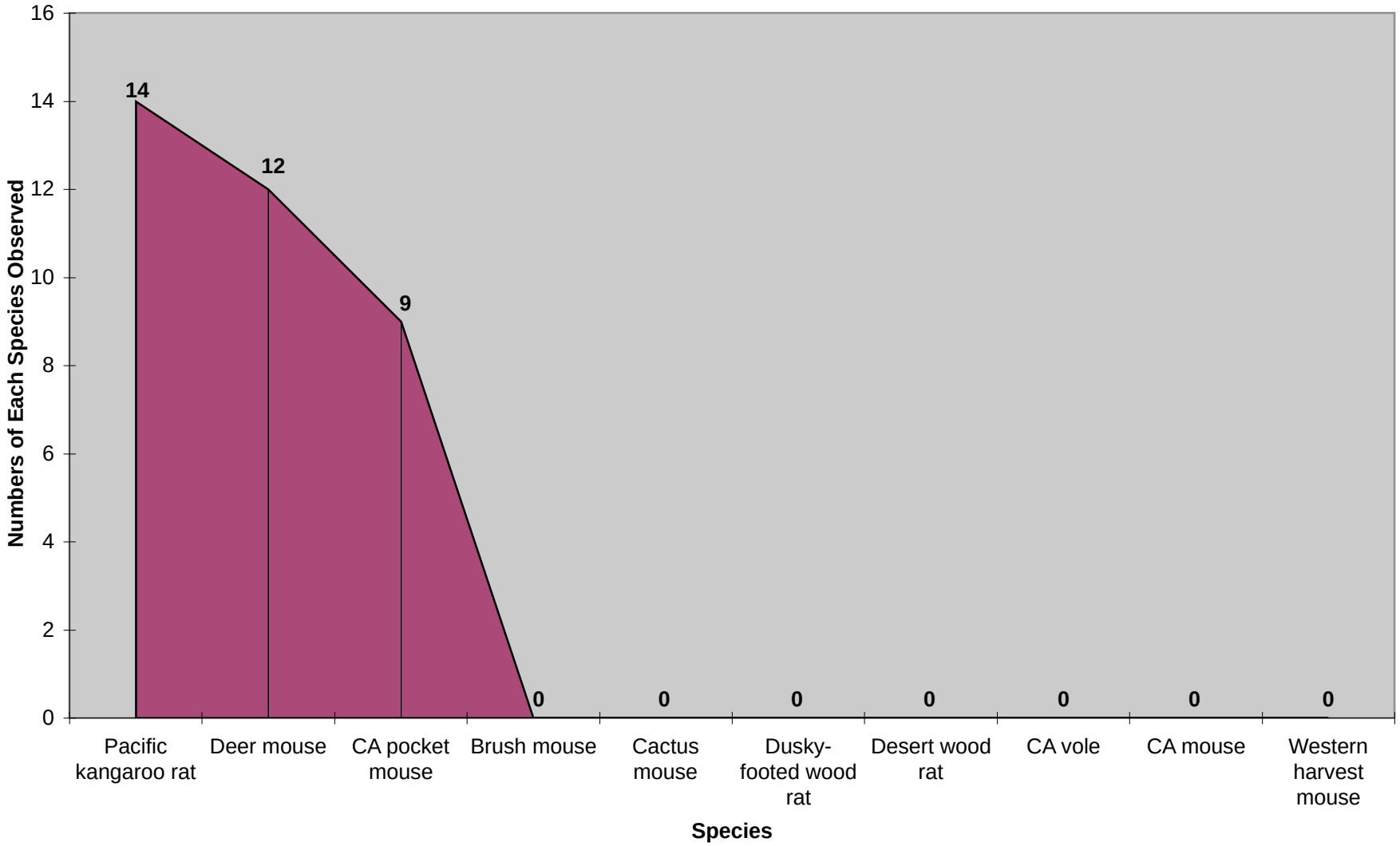


Figure 12
Small Mammal Diversity in Coast Live Oak Woodland

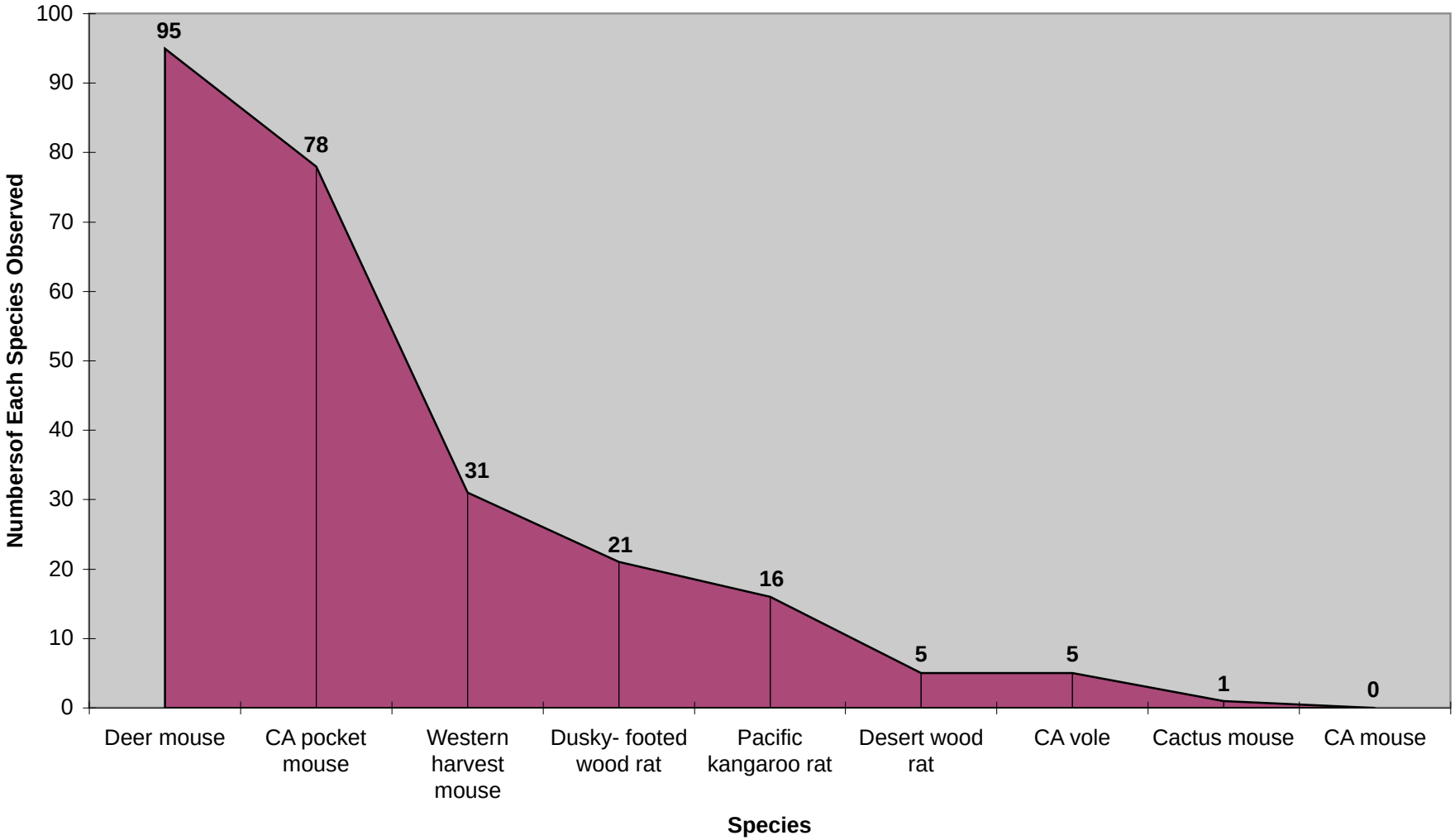


Figure 13
Small Mammal Diversity in Dry Wash

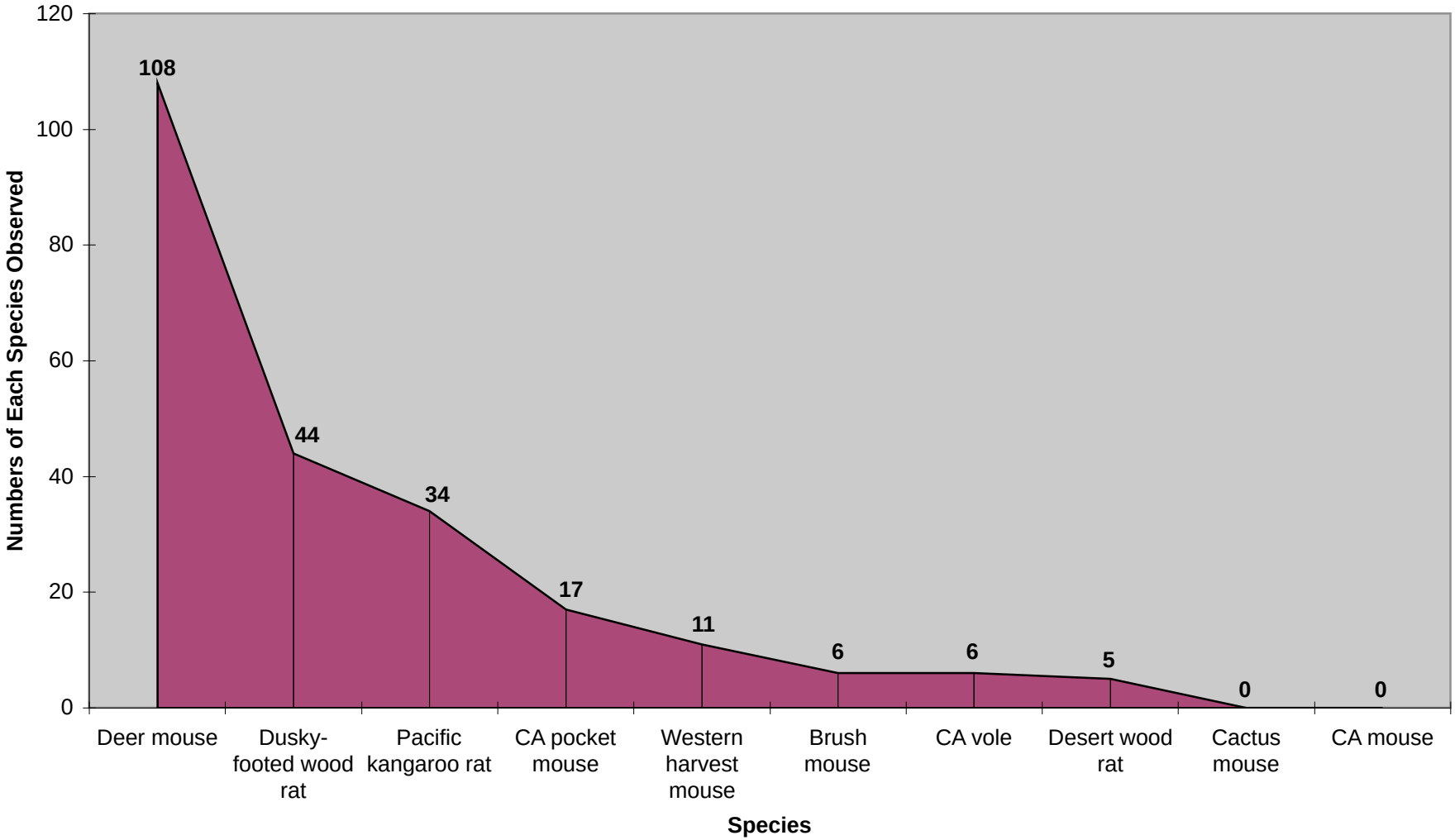


Figure 14
Small Mammal Diversity in Riparian Willow

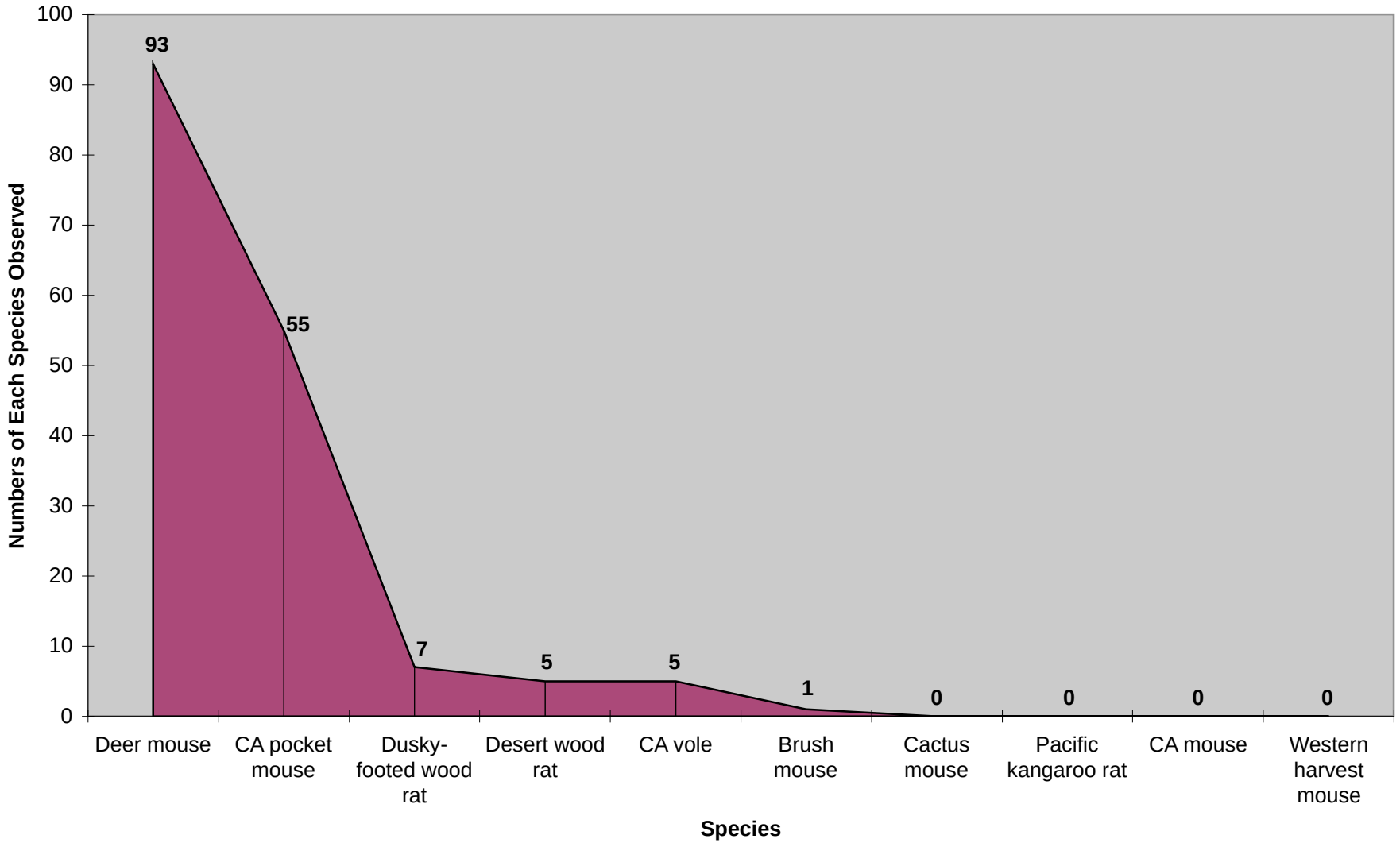


Figure 15
Small Mammal Diversity in Scrub

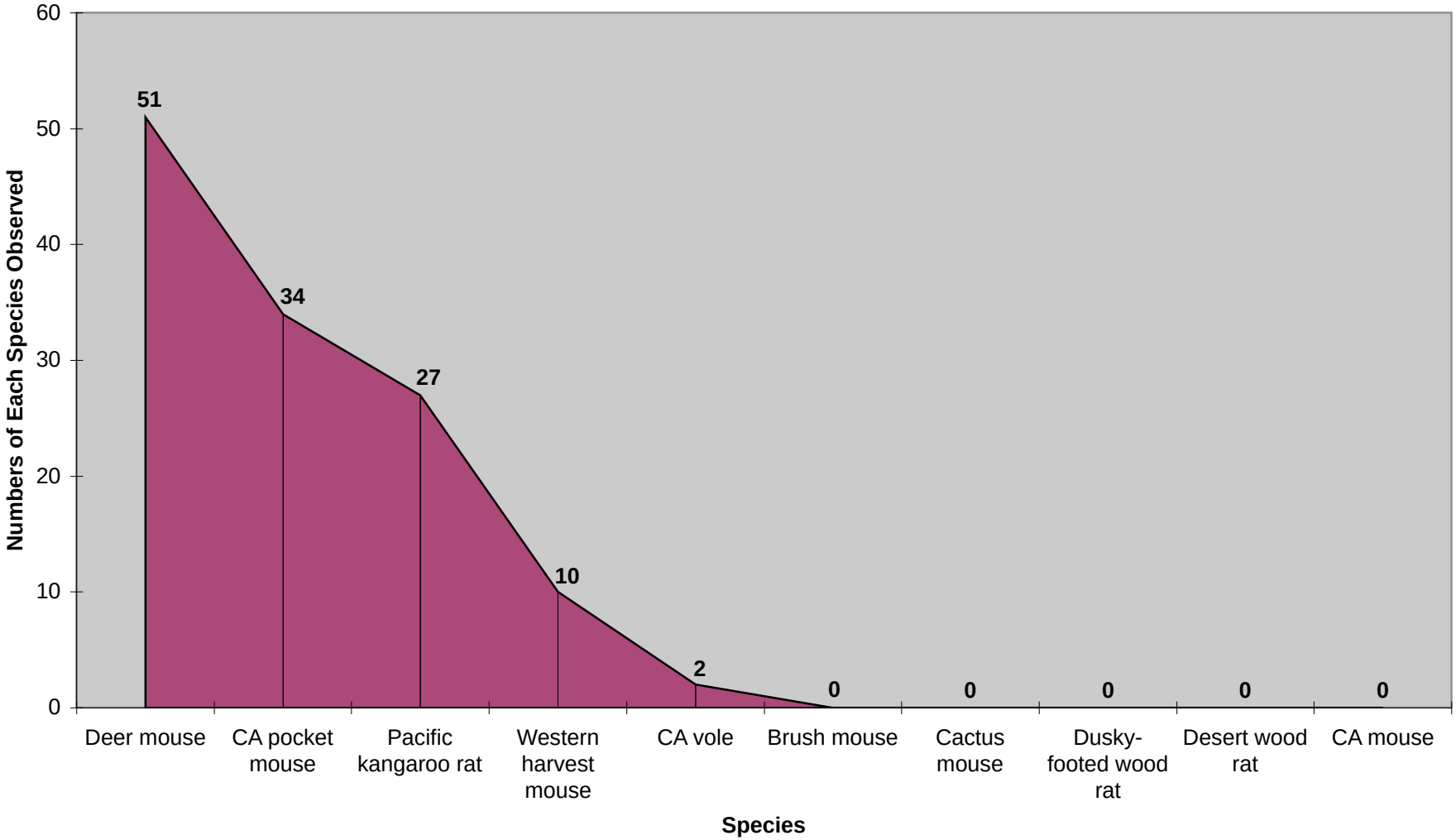


Figure 16
Small Mammal Diversity in Mulefat Scrub

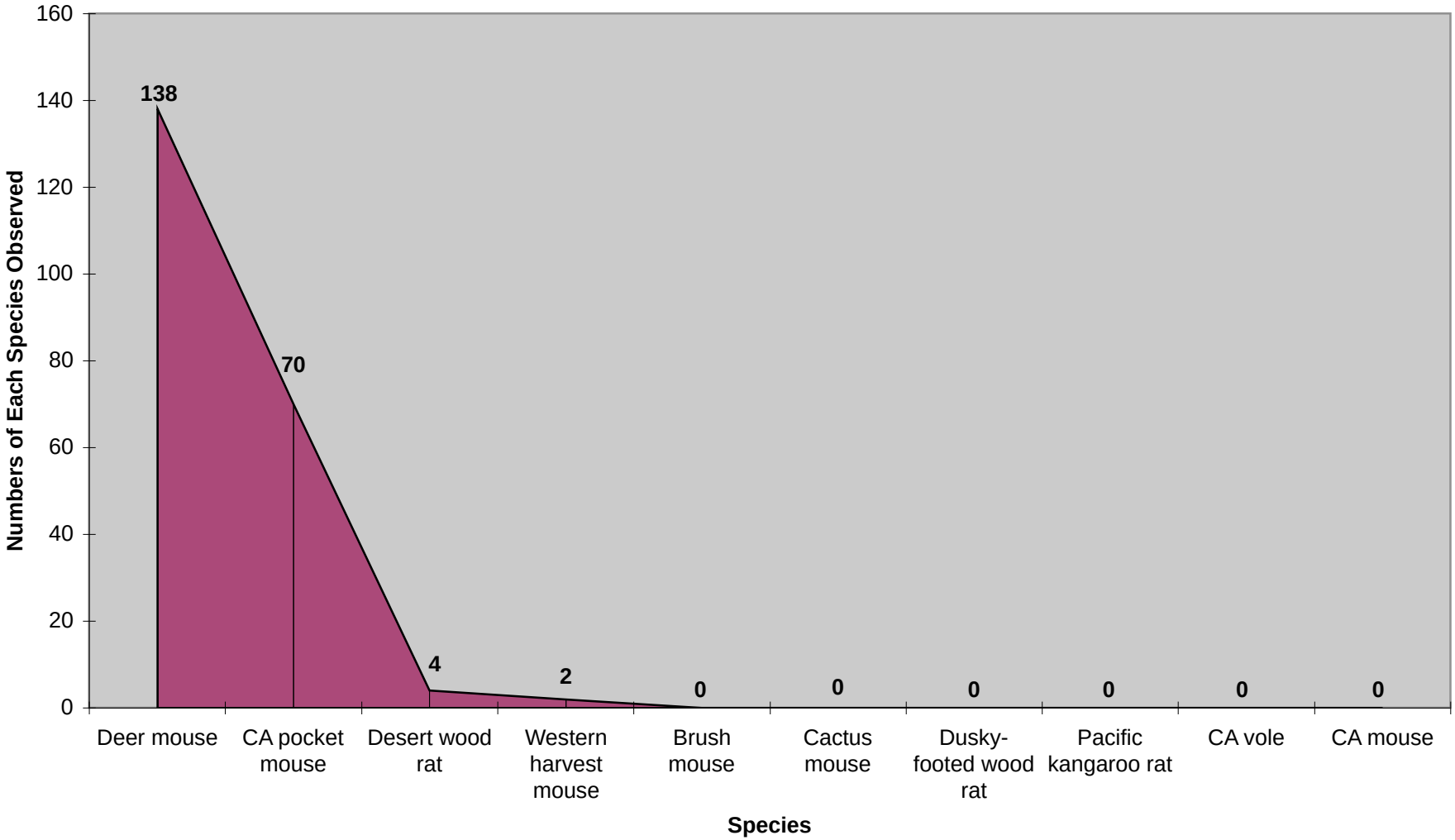


Figure 17
Small Mammal Diversity in Grassland

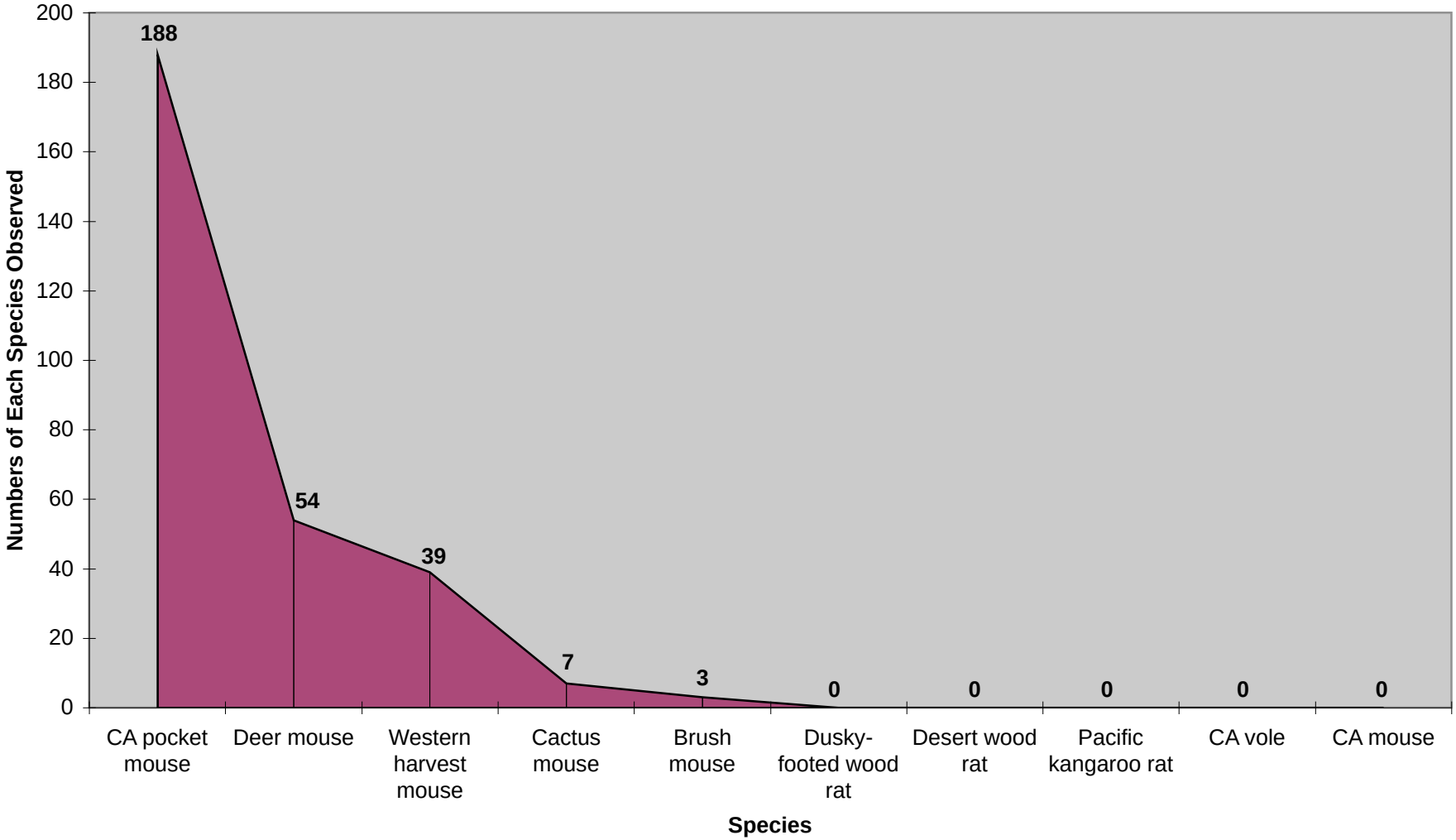


Figure 18
Small Mammal Diversity in Valley Oak Savannah

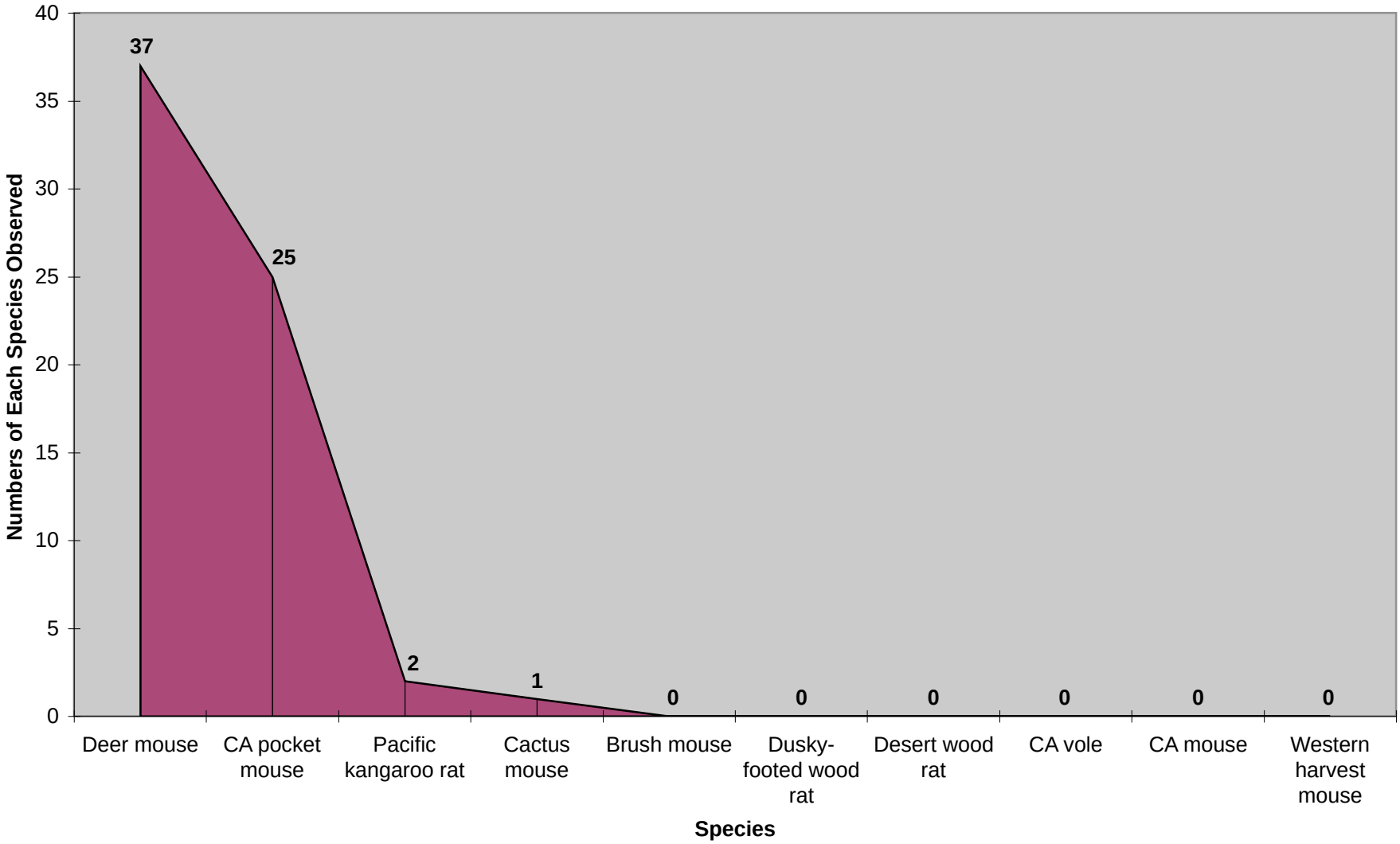


Table 7
Ordination of Habitats by Simpson's Index of Diversity

Agriculture	Coastal Live Oak Woodland	Dry Sash	Scrub	Coastal Sage Scrub	Mixed Chaparral	Riparian willow	Grassland	Valley Oak Savanna	Mulefat Scrub
0.767	0.735	0.714	0.702	0.694	0.656	0.573	0.529	0.527	0.477

These indices generally reflect the subjective evaluation (above) of the data in **Table 2** and the histograms. Of "…coastal sage scrub, coast live oak, dry wash, and agricultural habitats as sites of high biodiversity…," only the coastal sage scrub is undervalued by the Simpson index. A look at the curves in **Figures 8** to **18** may explain the apparent discrepancy. Although coastal sage scrub has all 10 of the species trapped (only matched by agriculture), only two species account for 77 percent of the animals trapped in coastal sage scrub, whereas the other three habitat types exhibit much more equitability between species. It takes three species to reach 77 percent of the numeric trap returns in agriculture, scrub, dry wash, and coast live oak woodland habitats.

In conclusion, the habitats within the NRSPA in which the highest mammal biological diversity was found included coastal sage scrub, coast live oak, dry wash, and agricultural habitats.

5.2 Special-Status Species

The following conclusions are derived from the 2004 field survey effort:

- Of the five species of bats of special concern (California leaf-nosed, spotted, pallid, lump-nosed, western mastiff), one (the pallid bat) was found in the survey, and two others are likely to be found with additional sampling – the western mastiff, and lump-nosed bats. The pallid bat requires open grassland while the western mastiff uses open areas with cliffs and crevices, and the lump-nose prefers arid scrub up to the pinyon-juniper. Suitable open, rocky areas exist at Newhall Ranch;

- Of the four rodents species of concern, one—the San Diego desert woodrat—regularly visited the traps; the other three species have low potentials to occur within the NRSPA;

- Among the larger mammals, San Diego black-tailed jackrabbit, badger and mountain lion were observed. Examination of the range and habitat preferences indicate the ring-tailed cat could also be found.

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