National Park Service
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Natural Resource Program Center

Mammal Inventories for Eight National Parks in the Southern Colorado Plateau Network

Aztec Ruins National Monument
Bandelier National Monument
Chaco Culture National Historical Park
El Malpaís National Monument
El Morro National Monument
Petroglyph National Monument
Salinas Pueblo Missions National Monument
Yucca House National Monument

Natural Resource Technical Report NPS/SCPN/NRTR-2007/054

ON THE COVER
Western pipistrelle (*Pipistrellus hersperus*), U.S. Geological Survey/Tony R. Mollhagen.

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Introduction

Historically, the Colorado Plateau has been the subject of many geological and biological explorations. J. W. Powell explored and mapped the canyon country of the Colorado River in 1869 (Powell 1961). C. H. Merriam, V. Bailey, M. Cary, and other employees of the Bureau of Biological Survey conducted biological explorations of the area in the late 1800s. In recent times, researchers such as S. D. Durrant (1952), Durrant and Robinson (1962), D. M. Armstrong (1972), J. S. Findley et al. (1975), D. F. Hoffmeister (1986), and J. Fitzgerald et al. (1994) have made considerable contributions to our understanding of the fauna of the Colorado Plateau. Despite earlier efforts, biological details on many regions of the plateau have remained insufficiently explored.

In an effort to gather valuable biological information, the National Park Service (NPS) initiated a nationwide program to inventory vascular plants and vertebrates on NPS lands (Stuart 2000). The U.S. Geological Survey, Fort Collins Science Center, Arid Lands Field Station became a cooperator on this effort in 2001, when we began mammalian inventories on five parks within the NPS Southern Colorado Plateau Network (SCPN): Aztec Ruins National Monument (AZRU), El Morro National Monument (ELMO), Petroglyph National Monument (PETR), Salinas Pueblo Missions National Monument (SAPU), and Yucca House National Monument (YUHO). Existing baseline data on mammalian occurrences in these parks varied from very sparse to moderate, with little information available for most parks. In most cases, information was insufficient to assess the status of species of local concern. A final report on inventory efforts on these five parks was submitted in February 2004 (Bogan et al. 2004).

In 2003, biologists from the Arid Lands Field Station began work on three additional parks in the SCPN: Bandelier National Monument (BAND), Chaco Culture National Historical Park (CHCU), and El Malpaís National Monument (ELMA). The primary emphasis at these three parks was on non-volant mammals, as personnel from the Field Station had worked earlier on bats at all three parks (Bogan et al. 1998, Valdez et al. 2002a, 2002b). A final report on inventories at these three parks was submitted in April 2005.

This publication details fieldwork conducted in all eight parks from 2001–2004. The information that appears here was originally contained in two separate reports that have been combined in order to make it easier for readers to find information on SCPN mammal inventories. To remain faithful to the original reports, and because of slightly differing objectives, personnel, and emphases at the two sets of parks, we have generally presented the methods, results, and recommendations separately for the 5-park and 3-park inventories.

Objectives

The primary objective of these inventories was to attempt to document the occurrence of at least 90% of the mammalian species expected to occur at each park via a two-year field inventory and examination of existing pertinent records. Secondary objectives included describing the distribution and abundance of species of special concern (e.g., threatened and endangered species, exotics, and other species of special management interest), providing baseline information necessary for the development of a monitoring strategy, and assisting in the development of a coordinated network data management effort resulting in biological resource information being accessible to resource managers, scientists, and the public. Data from this project will directly contribute to the development of a long-term monitoring curriculum for each park.

Study Area

The Colorado Plateau is a geologically and topographically distinct region with numerous plateaus and highlands that, strictly speaking, are drained by the Colorado River and its numerous tributaries. It is situated between the arid Great Basin to the west and the montane forests of the Rocky Mountains to the east and covers approximately 337,000 km^2 (130,000 mi^2). Areas of relevance to the National Park Service extend from southwestern Wyoming through much of eastern Utah, and into parts of western Colorado,

northern Arizona, and northwestern New Mexico (Stuart 2000).

The NPS units included in the Southern Colorado Plateau Network are in Arizona, Colorado, New Mexico, and Utah. They range in size from 404,700 ha (more than a million acres) (Grand Canyon National Park [GRCA] and Glen Canyon National Recreation Area) to 14.8 ha (34 acres) (YUHO), and encompass a diverse array of landforms, elevation ranges, geologic substrates, vegetation types, and wildlife habitats. Most are within the Colorado Plateau region, and are dominated by Colorado Plateau shrubland, grassland, and piñon-juniper woodland. However, peripheral parks and elevation extremes are allied with the Mogollon Highlands, Great Plains, Sonoran Desert, Chihuahuan Desert, Middle Rio Grande Basin, and Southern Rocky Mountain regions.

The climate of the Colorado Plateau is characterized by periods of drought and irregular precipitation, relatively warm-to-hot growing seasons, and long winters with sustained periods of freezing temperatures. Winters are dominated by Pacific-region storm patterns. Summers in the southern portions of the plateau are dominated by monsoonal moisture from the Gulf of Mexico. Orographic effects control local climates on the central portions of the Colorado Plateau. Evapotranspiration rates are extremely high for a temperate region, resulting from hot summers and extremely low precipitation (100–250 mm/yr or 4–10 in/yr in most locations; Stuart 2000).

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Upland, Aztec Ruins National Monument.

Vegetation on much of the plateau is characterized by low, open woodlands of drought-adapted conifers at intermediate elevations, and extensive areas of drought-tolerant shrubs and grasses at lower elevations. At the highest elevations, significant communities of ponderosa pine, mixed conifer, and subalpine forests occur, especially at GRCA and BAND. Due to freezing temperatures in the winter, large succulents that characterize subtropical and warm-temperate regions are lacking.

Although the Colorado Plateau has been a distinct geological region for much of the Mesozoic and Cenozoic, vertebrate biota is in many ways impoverished compared to surrounding areas. This may result both from history, because of the relatively rapid rise of the region combined with increased erosion and cooling temperatures since the Miocene, and from harsh climate. Among the mammals, Stephen's woodrat arguably may be a mammalian endemic to the Colorado Plateau (Hoffmeister 1986).

Serious gaps exist in our understanding of some taxonomic groups on the Colorado Plateau. In particular, relatively little is known about the status and distribution of bats, small mammals, reptiles (especially snakes), amphibians, indigenous annual plants, and exotic plants. Even available data on the better-known large mammals, birds, and perennial plants is uneven in quality. Good biological inventory data and reliable species lists are critical to understanding the natural resources in each of the network park units, and will provide useful information for a wide range of resource management issues.

Aztec Ruins National Monument

Aztec Ruins NM preserves an archeological site with a reconstructed example of a great kiva, a type of ceremonial structure found in the Four Corners area at sites of the Chaco period (900–1150 A.D.) AZRU is located north of Aztec, San Juan County, New Mexico, on the west bank of the Animas River. The site includes riparian, lowland, and

upland areas. The natural resources of this site, including water, croplands, and riparian vegetation, were important to the prehistoric inhabitants. Today, these same resources are an important aspect of the monument and provide a context for understanding the development of the Chacoan culture.

AZRU includes more than 128 ha (317 acres) of Upper Sonoran desert scrub. Dominant vegetation includes fourwing saltbush (*Atriplex canescens*), rabbitbrush (*Chrysothamnus* sp.), black greasewood (*Sarcobatus vermiculatus*), and sagebrush (*Artemisia* sp.), with piñon (*Pinus edulis*) and juniper (*Juniperus* sp.) woodlands on the uplands. Willows (*Salix* sp.) and cottonwoods (*Populus* sp.) border the riverbanks and ditches, with cattails (*Typha* sp.) growing in the marshy areas. The monument also includes some cultivated areas and Ancestral Pueblo ruins. Elevation ranges from 1716–1774 m (5630–5820 ft). We worked throughout the monument.

Prior to these inventories, estimated completeness of biological inventories for mammals at AZRU was unknown; number of species estimated by the SCPN was 26. Baseline inventories were recommended (SCPN Biological Inventory Proposal, November 2000).

Bandelier National Monument

Bandelier National Monument is located in the Jemez Mountains of north-central New Mexico. The presidential proclamation that created Bandelier in 1916 (No. 1322; stat. 1764:1916) stated that "... certain prehistoric aboriginal ruins ... are of unusual ethnologic, scientific, and educational interest, and it appears that the public interests would be promoted by preserving these relics of a vanished people, with as much land as may be necessary for the proper protection thereof."

The significance of Bandelier lies in its superb combination of cultural, natural, and wilderness values. To recognize the wilderness values, President Ford signed legislation in October 1976, creating a 9,423-ha (23,267 acres) Bandelier Wilderness (Public Law 94-567). Ninety percent of the park is managed as wilderness, and more than half of its trails (Frijoles Cañon and Bandelier Backcountry) are part of the National Trails System. Bandelier's ecosystems and their biogeophysical elements are highly altered, poorly understood, and possibly unstable (Stuart 2000). Loss of naturally functioning ecosystems as a result of historic grazing and fire suppression is causing accelerated loss of soils, cultural resource values, and material remains; catastrophic fires; and unnatural changes in plant and animal abundance and distribution.

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Ponderosa pine woodland, Frijoles Canyon, Bandelier National Monument.

There has not been a broad, systematic survey of the mammal fauna of BAND. Guthrie and Large (1980) summarized data on distribution and frequency of mammals within BAND, drawing primarily on sightings by park personnel and visitors prior to September 1979. Individual research studies include an extensive survey of bats that provided data on the occurrence and biology of 15 bat species in the Bandelier area (Bogan et al. 1998). Stuart (2000) estimated the documentation level of mammals at BAND to be 80% and the number of species to be 44.

Chaco Culture National Historical Park

Chaco Culture National Historical Park is located in northwestern New Mexico. The park and a system of Chaco Culture Archaeological Protection Sites (Chaco Protection Sites) were established for purposes of recognizing and preserving unique archeological resources within Chaco Canyon, the San Juan Basin, and the surrounding area. The park is listed on the National Register of

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Grassland, Chaco Culture National Historical Park.

Historic Places, and was designated a UNESCO World Heritage Site in 1987.

The role of the park in conserving regional biodiversity will become more important as park vegetation continues to recover from earlier grazing activities and as land-use pressure mounts on the surrounding region. Land within the original national monument was fenced between 1935 and 1948. Today, the park likely represents the largest ungrazed grassland resource in northwestern New Mexico. Non-native tamarisk (*Tamarix* spp.) is common throughout Chaco Wash.

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Kipuka (an "island" of land completely surrounded by one or more younger lava flows), El Malpaís National Monument.

Cheatgrass (*Bromus tectorum*) has invaded several thousand hectares within the park. Past research at Chaco Canyon included studies of plant remains from archeological sites and early Holocene packrat middens, as well as some work on birds and reptiles, and limited work on mammals.

Individual research projects pertaining to mammals at CHCU include Cully (1981), which analyzed distribution and abundance of small mammals from trapping data in four habitats; Jones (1972), which discussed small mammal trapping data; and Valdez et al. (2002a), which conducted an intensive survey of bats. Stuart (2000) estimated completeness of biological inventories for mammals at CHCU to be 80%, with an estimated 44 species thought to occur.

El Malpaís National Monument

El Malpaís National Monument, located in west-central New Mexico, was established to preserve the nationally significant Grants Lava Flow, the Las Ventanas Chacoan Archeological Site, and other significant natural and cultural resources. ELMA preserves and protects natural and cultural resources of the unique lava fields and associated features. It also perpetuates this ecosystem for the benefit of present and future generations, for traditional cultural uses, and for long-term scientific inquiry.

Inventories of plant and animal species on the monument will provide information for management decisions on resource issues, including the occurrence of rare, unknown, and endemic species associated with the lava flows. Useful information on the natural history of the park is included in Mabery (1997). Of the three parks, ELMA is probably the least studied for mammals, although Hooper (1941) provided important information on mammals of the lava fields and some mammal work was done in connection with surveys conducted by Lightfoot et al. (1994). Valdez et al. (2002b) documented the occurrence of bats at ELMA and provided data on relative abundance, reproduction, seasonal activity, diet, and ectoparasites. Bats were captured with mistnets, and occurrence and activity were monitored with ultrasonic detectors (ANABAT). Stuart (2000) estimated completeness of biological inventories

for mammals at ELMA to be 80%, with an estimated 48 species thought to occur on the park.

El Morro National Monument

El Morro National Monument, located in western New Mexico, features a sandstone monolith rising 61 m (200 ft) above the valley floor. This monolith, known as Inscription Rock, bears hundreds of inscriptions of Spanish explorers and early American immigrants and settlers. The monument also includes pre-Columbian petroglyphs and Pueblo Indian ruins. Proclaimed on December 8, 1906, and including boundary changes on June 18, 1917, and June 14, 1950, the monument now consists of 518 ha (1,280 acres) of federal and nonfederal lands.

ELMO is at an elevation range of about 2,165–2,256 m (7,100–7,400 ft). Several floristic provinces contribute to the vegetation at ELMO, including the Colorado Plateau, Great Basin, and Chihuahuan provinces (Brown 1982, McLaughlin 1989, 1992). Grasslands, dominated by blue grama grass (*Bouteloua gracilis*) and horsebrush (*Tetradymia canescens*), with sparse, one-seed juniper (*Juniperus monosperma*), grade into more dense stands of juniper and piñon, with an understory of blue grama, horsebrush, snakeweed (*Gutierrezia sarothrae*), wild buckwheat (*Eriogonum* spp.), and other species. In the higher elevations of ELMO, in the box canyon and in pockets of greater moisture availability and cool air drainage, ponderosa pine (*Pinus ponderosa*) occurs, sometimes with an understory of three-leaf sumac (*Rhus triolobata*), alligator bark juniper (*Juniperus deppeana*), and other species.

Prior to these inventories, estimated completeness of biological inventories for mammals at ELMO was 85%, with an estimated 31 species thought to occur. Baseline inventories were recommended (Stuart 2000).

Petroglyph National Monument

Petroglyph National Monument is located in central New Mexico, within the city of Albuquerque, on the west side of the Rio Grande. The monument was established to protect the array of petroglyphs created by Native Americans and early Europeans in the basalt boulders of the area.

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Shrubland, El Morro National Monument.

The monument consists of five volcanic cinder cones, more than 27 km (17 mi) of volcanic basalt escarpment, and 2,928 ha (7,236 acres) of desert scrub, chaparral, and temperate grassland vegetation types. A sandy wash at the south end of the park also supports willows and junipers. Elevation ranges from 1,665–1,820 m (5,465–5,971 ft). Inventory efforts focused on areas not surveyed in previous studies (Parmenter and Lightfoot 1996). Parmenter and Lightfoot (1996) listed 28 mammal species based on field observations and collections at the University of

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Grassland, Petroglyph National Monument.

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Riparian vegetation, Salinas Pueblo Missions National Monument.

New Mexico's Museum of Southwestern Biology. Not all of these collections are from the park, but they are from the extensive mesa area of which the park is a part.

Prior to these inventories, estimated completeness of biological inventories for mammals at PETR was 70%, with an estimated 38 species thought to occur. Baseline inventories in newer portions of the park were recommended (Stuart 2000).

Salinas Pueblo Missions National Monument

Salinas Pueblo Missions National Monument, located near the Cibola National Forest in central New Mexico, supported the thriving American Indian trade communities of Tiwa and Tompiro during the 17th century. However, by the late 1670s, the entire Salinas District, as the Spanish had named it, was depopulated of both Native Americans and Spaniards. What remains today are pre-Spanish ruins and ruins of four mission churches at Abó, Gran Quivira, and Quarai, established in 1980 through the combination of two New Mexico State Monuments and the former Gran Quivira National Monument. SAPU is approximately 64 km (40 mi) southeast of Belen, in Torrance and Socorro counties, New Mexico, and encompasses 445 ha (1,100 acres).

Vegetation is predominantly piñon and juniper woodland with associated desert shrubland. Abó and Quarai also have areas of riparian vegetation. Elevation ranges from 1,859 to 2,011 m (6,100–6,600 ft). We worked at all three units of the monument. SAPU had not received any systematic survey of its mammal fauna prior to this inventory, other than work by Scott (1979) at Gran Quivira. The limited information in the site's database is from unverified sources, and the list of mammal species has not received critical review.

Prior to these inventories, estimated completeness of biological inventories for mammals at SAPU was unknown, although 31 species were estimated to occur. Baseline inventories were recommended (Stuart 2000).

Yucca House National Monument

Yucca House, in southwestern Colorado, was established by presidential proclamation on December 19, 1919, to protect ". . . an imposing pile of masonry of great archeological value . . ." Data on plant and animal species are lacking at YUHO. There is concern about livestock grazing and non-native weed infestations. Located between the towns of Towaoc and Cortez, Montezuma County, Colorado, at the base of Sleeping Ute Mountain, YUHO includes 14 ha (34 acres) of currently designated parkland and approximately 1,011 ha (2,500 acres) of surrounding private land, formerly owned by the Ismay family. We sampled both parcels in the inventory.

A floral survey compiled by Mesa Verde National Park (MEVE) staff shows that the dominant shrub within the monument is black greasewood; 85% of the dominant understory is non-native cheatgrass. A plant list for the monument, which is surrounded by agricultural lands, lists 67 plant species. An irrigation ditch and two stock ponds that held water up through 2001 were dry during 2002, as a result of conversion to an underground water pipeline. Marilyn Colyer of MEVE updated a list of mammalian species for YUHO in 2000. However, this list was based mostly on observations and a compilation of various other unpublished sources; recent vascular plant inventory results, including field studies and review of herbarium specimens, will soon be available (Rink

and Cully, in press). Our efforts focused on areas that included big sage (*A. tridentata*), juniper woodland, riparian areas dominated by cottonwoods, a spring near the ruins associated with a marshy area with grasses and sedges, an irrigation ditch lined with grasses and ragweed (*Ambrosia* sp.), and stock ponds surrounded by cottonwoods, willows, and tamarisk. Elevation ranges from 1,796–1,872 m (5,892–6,142 ft).

Prior to these inventories, estimated completeness of biological inventories for mammals at YUHO was 75%, with 18 species predicted to occur (on the actual park of 14 ha). Baseline inventories were recommended both for the actual parklands and for the surrounding private property then owned by Mrs. Ismay (Stuart 2000).

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Shrubland, Yucca House National Monument.

Methods

We initially prepared a list of mammals for each park that included all species that might occur in or near each park. Primary references for these lists were Armstrong (1972), Bogan et al. (1998), Cully (1981), Durrant (1952), Durrant and Robinson (1962), Findley et al. (1975), Fitzgerald et al. (1994), Guthrie and Large (1980), Hall (1981), Hooper (1941), and Valdez et al. (2002a, 2002b). Species on each list were initially designated as unconfirmed, probably present, or present. Our lists indicated cases in which documentation relied on voucher specimens in these references. Throughout our field seasons, we continually updated these lists based on our observations. In 2002, we also made a more critical assessment of the likelihood that some undocumented species ("Probably Present") do not occur ("Unconfirmed"). Finally, we critically assessed the likelihood of each species occurring after viewing and trapping all major habitats at each park.

Our final designations on mammal lists ("master lists") are as follows:

1) "unconfirmed" are those species that are unlikely to occur based on habitat availability but are known from the region, or are those species extirpated from the region without prior documentation at parks;

2) "historic" are those species that have occurred in parks in the past and have reliable documentation of their occurrence;

3) "probably present" are those species that most likely occur on the park but have gone undetected due to low abundances (e.g., some small carnivores) or lack of appropriate trapping methods (e.g., pitfall traps for shrews); and

4) "present" are those species that have reliable documentation such as voucher specimens, reliable sighting, photographs, or observations of diagnostic sign.

Using our final, updated lists allowed us to assess our progress toward documenting 90% of likely species occurring on each given park.

AZRU, ELMO, PETR, SAPU, and YUHO

Field efforts in 2001 used random as well as targeted searches and trapping. Field efforts in 2002 focused on the most speciose groups with the greatest promise of increasing the level of documentation, especially carnivores, bats, and rodents. In 2003, we made brief visits to do targeted searches for a few species we thought we might have missed in earlier work. We specifically inventoried for small terrestrial mammals, bats, and carnivores. Inventory methods included traplines, mistnetting, acoustic surveys, and track and scat surveys. Other mammal groups (e.g., ungulates) were documented opportunistically. In general, photographs were taken of most, but not all, study locations. Reference maps with study site designations keyed to tables (see Appendix B) and databases were provided in digital format.

BAND, CHCU, and ELMA

In 2003 and 2004, we primarily used targeted searches and trapping to attempt to document as many species as possible, and focused on the most speciose groups with the greatest promise of increasing our level of documentation. These groups generally included carnivores and rodents. Our inventory efforts included trapping, mistnetting, track and scat surveys, and spotlighting. Other mammals, such as ungulates, rabbits, and squirrels, generally were documented opportunistically while other types of surveys were being conducted. Study site designations and activities were provided (see Appendix C).

All parks

For each individual captured in traps and mistnets, we recorded species, age, sex, and reproductive condition. Except for a few individuals kept as voucher specimens, each individual was released unharmed at the site of capture. Voucher material was kept for most species of rodents that were previously undocumented or lacked reliable documen-

tation. Additionally, some individuals were retained for identification purposes.[†]

All trapping and observation locations were recorded using Global Positioning System (GPS) units set to UTM in either datum NAD27 or NAD83, in accordance with NPS protocol. While in the field, we recorded data onto datasheets and summarized our findings in written field notes. After returning from field efforts at parks, these data were then entered into an Excel spreadsheet provided by the Northern Colorado Plateau Network (2001–2003) and a relational database (Access) provided by the Southern Colorado Plateau Network (2003–2004).

Capture and handling of animals was performed in accordance with written protocols approved by the USGS Fort Collins Science Center, Animal Care and Use Committee. Voucher specimens (skins and skeletal material) are housed in the USGS Biological Survey collection at the Museum of Southwestern Biology, University of New Mexico (UNM). For almost all vouchers collected during this project, tissue samples of heart, kidneys and liver were preserved in liquid nitrogen and deposited in the Division of Genomic Resources at UNM. Names, both common and scientific, follow Baker et al. (2003).

Small terrestrial mammal inventories

Rodents and other small terrestrial mammals were inventoried using Havahart, Sherman, and Tomahawk live traps, pitfall arrays, and snap traps arranged in traplines (Wilson et al. 1996). Traplines typically consisted of 40–80 Sherman traps placed at 10–15-m (32–49-ft) intervals. In 2001–2003, paired transect lines ("Calhoun lines") of Sherman traps also were used; lines were typically 15 m (about 49 ft) apart. Traps were baited with old-fashioned dry oatmeal (not "quick oats" or "instant oats") and generally left open overnight. In some cases, traps were left open during daylight hours to catch diurnal species such as squirrels. In 2003, some Sherman live traps were baited with peanut butter and oatmeal folded in wax paper; these peanut butter packets were hung just inside the trap's back door. This technique was employed to investigate whether a bait containing peanut butter in Sherman live traps will increase trap success and/or increase the number of species captured (e.g., shrews).

At each park, study sites were selected so that each major type of habitat within a given park was sampled. Effort was reported as number of trap-nights (the summation of total number of traps deployed each night).

Bat inventories

At AZRU, ELMO, PETR, SAPU, and YUHO, bats were inventoried using mistnets and acoustic surveys. Mistnets were deployed across and around bodies of water in order to capture bats coming in to drink or feed on insects flying over the water (Kunz and Kurta 1988). Net size ranged from 6–20 m (18–60 ft). Mistnets were set up shortly before sunset and tended for several hours until activity declined. The number of nets used varied, depending on the size and shape of the body of water. This method is especially effective when sources of water in the landscape are limited, as this causes bats to be concentrated in a relatively small area where they are more susceptible to capture.

Acoustic surveys entailed using a bat detector and zero-crossing analysis interface module (ZCAIM; Anabat II hardware, Anabat software version 6.3f; Titley Electronics, Ballina, New South Wales, Australia) with a laptop computer to record echolocation calls. A bat detector produces audible output from the ultrasonic calls emitted by echolocating bats. The ZCAIM interfaces the audio-frequency signal from the detector to a computer. Analyses were performed using Analook software (version 4.8n, Titley Elec-

[†]We feel that collection of voucher material is extremely important for all inventory work and provides the most definitive and unequivocal evidence that a species has occurred in an area. The importance of future use of these vouchers cannot be understated, especially with recent advances in molecular tools. For example, voucher materials from specific sites are needed to determine identification of taxa that are split into multiple species, especially where newly described species are sympatric. Voucher material also is fundamentally important because distributions of mammals are not static and are continually in flux. Ranges of mammals can shift as result of both climatic and anthropogenic changes to the environment. Additionally, voucher material is important because of the potential misidentifications of closely related species, such as those in the genus *Peromsycus* (see Geluso 2004 and Geluso and Geluso 2004).

tronics, Ballina, New South Wales, Australia).

The frequency-time displays generated by the software from detected echolocation call sequences were then used to identify species based on qualitative analysis of call parameters compared to reference calls from known individuals (Fenton and Bell 1981; O'Farrell et al. 1999). This method is useful when no water is available over which to net, or when water is too ample to effectively concentrate bats over an area small enough for capture. Acoustic surveys are also useful for detecting species that are not easily captured in mistnets. Effort was recorded as net-nights (number of mistnets multiplied by number of nights) and acoustic-hours (total number of hours spent recording echolocation calls).

Because of previous studies on bats at BAND, CHCU, and ELMA (Bogan et al. 1998, Valdez et al. 2002a, 2002b), minimal effort was spent on additional inventory of bats at these parks. In a few cases, mistnets were deployed across and around bodies of water following the methods described above.

Carnivore inventories

To document carnivores, we conducted track-scat surveys, live-trapping, and spotlighting. Track-scat surveys entailed searching on foot in areas likely used by carnivores and that would show evidence of these species, such as around water sources, in canyon bottoms, in sandy soils, and around areas where humans leave refuse (e.g., campgrounds and housing areas). Tracks, scat, carcasses, and animals were documented with photographs, when possible, and with location coordinates. Occasionally, we attempted to capture small carnivores using Havahart or Tomahawk live traps baited with a variety of odoriferous baits. We used a handheld spotlight from vehicles to search for and view animals at night. Effort for carnivore inventories was quantified as distance walked (km), hours driven with spotlights, or number of trap-nights.

Opportunistic observations

During our field efforts, many mammals were observed while driving, walking, or setting and checking traplines during daylight hours. These observations were documented on datasheets, and locations were determined with GPS units. We always recorded these data for uncommon or unusual species; however, for some abundant species, such as elk at BAND, we took these data only occasionally. Opportunistic observations were the predominant means of documenting ungulates, and many other species were documented in this manner, such as squirrels and rabbits. We also recorded observations of diagnostic sign of animals such as the conspicuous workings of beavers or the middens of red squirrels. Lastly, and where possible, we examined park observation files for records of mammals. In cases where the species was distinct and unlikely to be confused with another, we generally accepted observations, especially if there were multiple occurrences. In other cases, where a species might likely be confused with another, or where there was only a single observation, we usually discounted the observation.

Data analyses

Number of species documented (species richness) and relative abundance of species (percent of all individuals detected) were calculated for each park. We also provided a summary of effort for each park, including person-days, trap-nights, net-nights, acoustic-hours, spotlighting-hours, and distance walked for carnivores, as appropriate. In order to evaluate the effort expended relative to completion of inventories, we generated species accumulation curves for the first five parks. We determined progress toward the overall level of documentation of mammals by dividing the number of species currently documented at each park by the total number of species probable (i.e., not the total number of species possible, which includes extirpated, historical, and unconfirmed species). We also performed regression analyses to compare park size with the number of species likely to occur, number of species documented, and percent of likely species documented for each park.

Results

2001–2003: AZRU, ELMO, PETR, SAPU, and YUHO

During 2001, fieldwork was conducted from June to October. We expended 168 person-days (107% of estimated) and accumulated 5,608 trap-nights, 42 mistnet-nights, and 47.1 detector-hours. Overall, we documented 50 species of mammals at the five parks. We captured 378 mammals of 26 species, including 10 species of bats, 15 species of rodents, and one species of rabbit. The most abundant species was the deer mouse (*Peromyscus maniculatus*), comprising 17.2% of all captures. Of bats captured, the most frequently encountered species was the big brown bat (*Eptesicus fuscus*; 33.3% of bats captured). We verified the occurrence of 13 additional species through observations of animals, tracks, scat, and acoustic surveys, including three species of carnivores, one ungulate, one rabbit, five bats, and three rodents. Bats comprised 10.3% of total captures and 30.0% of species captured and observed. A search of museum records and literature added 11 species to our list of confirmed species.

The number of person-days we spent on a park in 2001 was positively correlated with the number of trap-nights amassed at that park, although the R^2 value was not high (0.50). At SAPU, we deployed more traps than predicted from person-days of effort; the converse was true at PETR. Efforts (i.e., numbers of traps deployed) at SAPU were purposely increased, whereas at PETR, fewer traps were deployed—partly because our early training was conducted there. As planned, effort (person-days) was highly correlated with park size, with about 98% of variation in effort being attributed to size of the park.

In 2001, numbers of animals captured were highly correlated with numbers of trap-nights per park ($R^2 = 0.83$), suggesting that our methods were effective in capturing numbers of individuals. The relationship between number of species captured and number of captures was not as strong ($R^2 = 0.63$), suggesting that overall level of species documentation cannot be obtained solely from trapping, and that other factors (e.g., habitat factors and climate) also are important in determining capture success.

In 2002, fieldwork was conducted from May to October. We accumulated 88 person-days, 1,542 trap-nights, 28 net-nights, and 48 acoustic-hours, and covered a distance of 71.8 km on track-scat surveys toward fulfillment of our objective. We captured or observed signs of 398 mammals of 50 species, including 15 species of bats, 22 species of rodents, 2 species of lagomorphs, 10 species of carnivores, and one species of ungulate. Thirty-five species occurrences were documented in 2002 that were not documented in 2001.

Ten percent of all animals captured or observed during the 2002 inventory were piñon mice (*Peromyscus truei*), whereas deer mice were the most frequently encountered species during the 2001 inventory. This may be the result of our more targeted trapping effort during 2002, rather than the more random trapping conducted during 2001. Overall capture rate for terrestrial mammal trapping on SCPN parks was 13% in 2002, compared to 7% during 2001. Of bats captured or observed, big brown bats were again the most common.

Following the 2002 field season, level of documentation based on current working lists of mammals for each park was as follows: AZRU, 50%; ELMO, 56%; PETR, 55%; SAPU, 65%; YUHO, 85%.

During slightly more than two years of field studies in AZRU, ELMO, PETR, SAPU, and YUHO, we amassed a total of 8,311 trap-nights, 72 mistnet-nights, 48 hours of acoustic recording, 77 km of carnivore survey distance, and 1,045 actual capture events (during which species were [mostly] identified and released unharmed) that resulted in recording of individual species occurrences (50 species in 2001, 35 species in 2002, and 28 in 2003). Total number of person-days in the field was 265 (Table 1). In addition, we spent about one year's worth of person-days compiling data and writing reports.

At the end of these inventories, "data mining" in the form of examination of specimen holdings from selected museums had not yielded documentation beyond that indicat-

ed in Tables 5–9. Such "data mining" should be viewed with caution, as no museum will guarantee that animals deposited in that museum are correctly identified. The only sure method is to visit each museum and personally examine the specimen(s), a task that we were unable to accomplish. In addition to separate electronic databases provided with this report, a summary of mammals captured and observed (Table 2) and a tabulation of percent relative abundance for all mammals captured or observed during both years (Table 3) are attached. Not all figures in Table 3 are necessarily directly comparable, as different methodologies were used in sampling the various groups. Nonetheless, the abundance figures are interesting, if only to show how relatively uncommon some species are in national parks. Conversely, some species are almost overwhelmingly abundant (e.g., deer mice: 14.5% of all animals across all parks). Our summary comments for each park (below) provide some information on specific steps that can be taken to enhance levels of documentation at each park.

The general prediction from species–area relationships is that, other things being equal, larger areas will be more species-rich. Interestingly enough, when we compared number of species documented (by all means) against park size, the relationship was weakly inverse ($R^2 = 0.01$), with the smaller parks appearing to exhibit greater species diversity (Figure 1). There are several confounding factors that may contribute to this result. First of all, the ostensibly smallest park is YUHO, but we worked on adjacent parts of the Ismay property as well, and do not know at present how large an area was actually studied. In addition, Marilyn Colyer recently provided an extensive list of species that she believes occur at YUHO. For the most part, we have accepted these well-documented additions; we do not have similar contributions from other parks. Other factors likely involved in this comparison are that PETR is urban, relatively homogeneous from a small-mammal standpoint, and there is no open water over which bats can be netted. Thus, it is possible that at PETR, some species will be difficult to document, and the fauna may be somewhat impoverished.

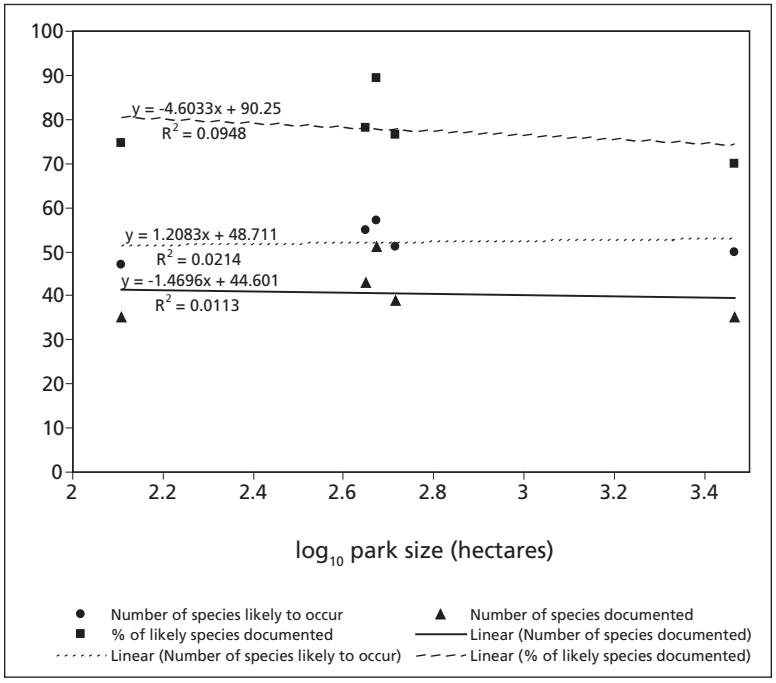


Figure 1. Relationship between park size and number of species likely to occur, number of species documented, and percent of likely species documented.

Specific details concerning each park during our inventory are presented in sections below.

Aztec Ruins National Monument

2001. In 2001, we conducted mammal inventories at AZRU on June 18–21, July 3–4 and 28–29, and August 13–16. We expended 32 person-days (114% of estimated) and accumulated 1,000 trap-nights trapping terrestrial mammals, 8 net-nights, and 13.8 detector-hours surveying for bats. We inventoried terrestrial mammals in all habitat types, and bats at the ruins and over an irrigation ditch.

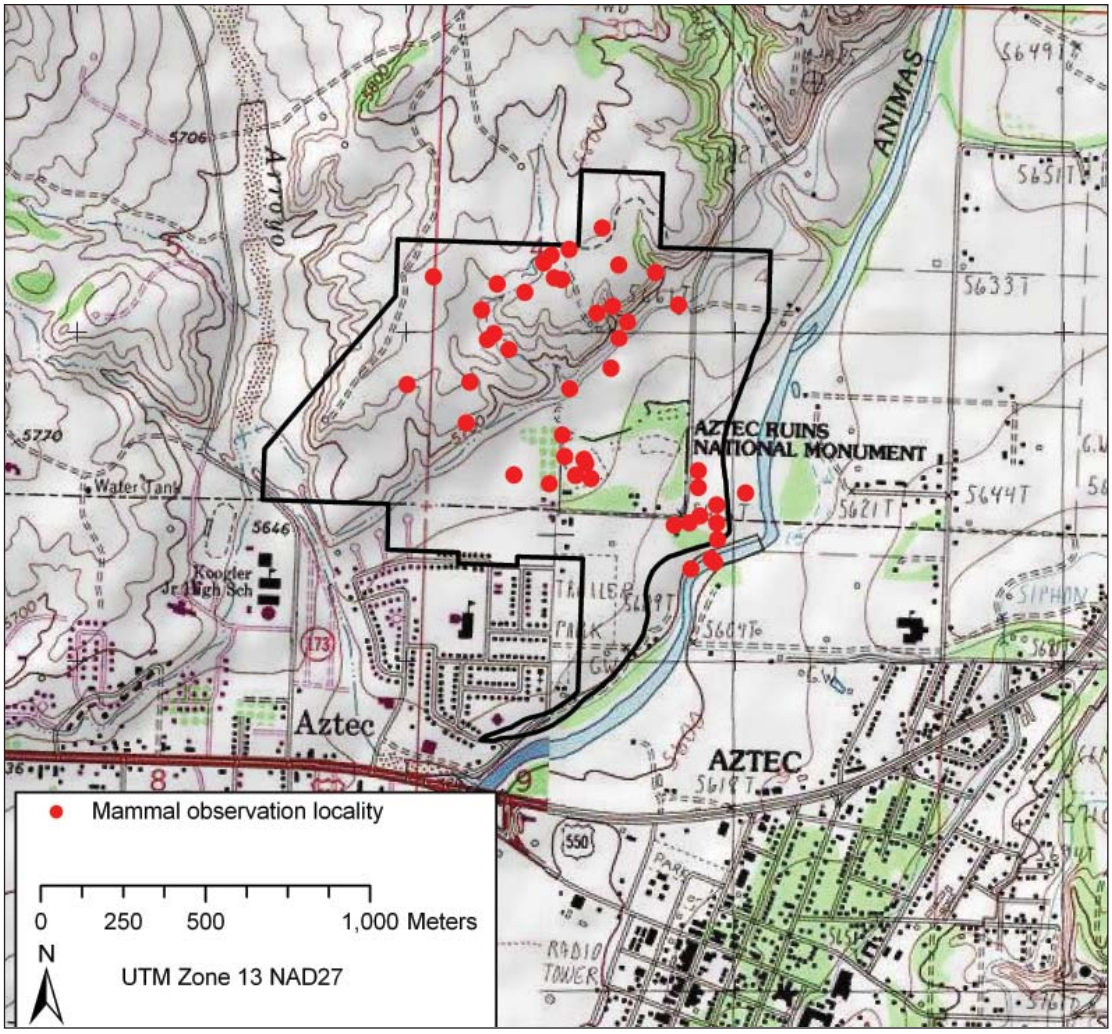
Eighty individuals of 10 species were captured, including three species of bats and seven species of rodents. Capture rate for terrestrial mammals was 7.0%. Three additional species were observed: desert cottontail (*Sylvilagus audubonii*), western spotted skunk (*Spilogale gracilis*), and mule deer (*Odocoileus hemionus*). Three were documented using acoustic surveys (see below), and two species were included based on Findley et al. (1975): spotted bat (*Euderma maculatum*; we also heard audible echolocation calls of this species on the park) and black-tailed jackrabbit (*Lepus californicus*). Three additional species are very likely to occur: rock squirrel (*Spermophilus variegatus*), meadow vole (*Microtus pennsylvanicus*), and

Botta's pocket gopher (*Thomomys bottae*; Findley et al. 1975).

Abundance varied greatly among all species captured. The most abundant terrestrial species captured at AZRU were western harvest mouse (*Reithrodontomys megalotis*) and the non-native house mouse (*Mus musculus*), representing 28.6% and 27.1% of captures in Sherman traps, respectively. Deer mice, the third most abundant species, accounted for 17.1% of captures. The least commonly captured species were northern grasshopper mouse (*Onychomys leucogaster*; 1.4%), desert cottontail (2.9%), and brush mouse (*Peromyscus boylii*; 2.9%). Females comprised 40% of animals captured. For most species, numbers of females and males were similar. The exception was deer mice, which had a female-to-male ratio of 1:5.

The location with the highest species richness for terrestrial mammals was the piñon-juniper woodland on the mesa top in the northwest corner of the park, where five species were captured. We captured four species at three other locations: the mesa top north of the ruins (piñon-juniper), the draw between the hills at the northeast corner of the park (piñon-juniper), and the irrigation ditch approximately 0.8 km northeast of the ruins (juniper and cottonwood).

Bats accounted for 12.5% of all captures and 31.8% of species documented at AZRU. Of bat captures, big brown bats were most abundant (70.0%), while pallid bats (*Antrozous pallidus*) and western small-footed myotis (*Myotis ciliolabrum*) comprised 20.0% and 10.0% of bat captures, respectively. All bats captured were females and all, except two juveniles (a western small-footed myotis



Map 1. Mammalian study sites, Aztec Ruins National Monument.

U.S. GEOLOGICAL SURVEY/TONY R. MOLLHAGEN

Pallid bat (*Antrozous pallidus*).

and a pallid bat), were lactating.

Acoustic surveys were used to detect bats concurrently with mistnetting at the irrigation ditch and the Great Kiva. One hundred fourteen sequence files were recorded, 80.7% of which contained an adequate number of complete calls to make species identifications. Preliminary analysis of echolocation recordings revealed seven species, three of which were not captured in mistnets: Yuma myotis (*M. yumanensis*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and big free-tailed bat (*Nyctinomops macrotis*). Species richness for bats was highest at the irrigation ditch and Great Kiva, where five species were documented. Species common to both sites were western small-footed myotis, pallid bat, and big brown bat. Brazilian free-tailed bat and big free-tailed bat were detected only at the Great Kiva site, and Yuma myotis was detected only at the irrigation ditch.

We confirmed the presence of 18 species of mammals at AZRU in 2001. This figure represents 69% of the species pool estimated by SCPN (26) and 31% of our 2001 estimate of species likely to occur (58). These differing estimates of species occurring at AZRU clearly affect the proportion of species documented to date. Using our list as a standard, lagomorphs are well documented (100%), but considerable verification remained to be done for bats (43% documented), rodents (30%), and carnivores (7%; Haymond et al. 2002).

2002. Efforts at AZRU in 2002 included three visits and 14 person-days, 80 trap-nights, 11 net-nights, 8.1 acoustic-hours, and a distance of 6.9 km for track-scat surveys. The majority of our efforts focused on documenting bats and carnivores. We also set two lines of rodent traps near the river, an area that was not targeted for rodents during the 2001 inventory, and conducted searches for diurnal mammals. We captured or observed 41 animals of 20 species, including 7 bats, one lagomorph, 6 rodents, 5 carnivores, and one ungulate. Capture rate for terrestrial mammals was 1% during 2002, compared with 7% during 2001. Park personnel also documented two species: red fox (*Vulpes vulpes*) and porcupine (*Erethizon dorsatum*). Fourteen species were documented in 2002 that were not documented during the 2001 inventory, including 3 species of bats, 5 rodents, and 6 carnivores.

Coyote (*Canis latrans*) was the most frequently encountered species at AZRU during 2002 (17% of individuals documented). Other common species included big brown bat (12%) and Brazilian free-tailed bat (10%). Species richness was greatest at the irrigation ditch (waypoint AZ004A), where seven species were documented using mistnets, acoustic surveys, and opportunistic observations (Haymond et al. 2003).

Our updated master list for 2002 included 58 mammal species likely to occur on the park, for which we had documented 50% of bats (up from 44% in 2001), 52% of rodents (30% in 2001), and 43% of carnivores (7% in 2001; Haymond et al. 2003). There was no change in the number of insectivores, lagomorphs, or artiodactyls documented.

2003. In May 2003, we worked at AZRU for 4 person-days and accrued 197 trap-nights. We captured or observed 55 individuals of 12 mammalian species, including 11 rodents and 1 ungulate. We documented four new species that previously had not been observed or reported from the park. These new species included muskrat (*Ondatra zibethicus*), Ord's kangaroo rat (*Dipodomys ordii*), meadow vole, and white-throated woodrat (*Neotoma albigula*). Our most significant capture at AZRU was the meadow vole, which is part of an isolated, disjunct population known to occur in mesic habitats

around Aztec, Bloomfield, and Farmington in northwestern New Mexico. Much of the marshy and dense grassy habitat found throughout the low-lying portions of this park likely serve as refugia during dry conditions.

Summary. The final level of documentation for AZRU is 74%, or 35 of 47 species that may occur (= "likely"; Table 4). Although we have reduced the number of species likely to occur (by relegating them to the status of "unconfirmed"), it seems likely that our list (Table 5) is still somewhat too inclusive. When effort is plotted against cumulative number of species (Figure 2) the curve appears to begin to level off, suggesting that we are approaching the asymptote at about 35 species. The theoretical species number predicted by the SCPN was 26 species, a figure clearly in error. Among species likely to occur but still undocumented, there are five species of bats, including two migrants and two potentially uncommon ones for which special effort would be needed to confirm their presence. Additional observation time might document two additional species of ground squirrels and the gray fox (*Urocyon cinereoargenteus*). AZRU is one of the smaller parks (130 ha or about 325 acres), and it seems unlikely that larger carnivores (e.g., bears, mountain lions) are resident in the park, although they may occur as transient animals.

El Morro National Monument

2001. Due to a need for additional coordination regarding work at ELMO, no fieldwork was conducted there during 2001.

2002. The 2002 field season was the first year for mammal inventories at ELMO. We made three visits to the park and accrued 20 person-days, 440 trap-nights, four net-nights, 10.3 acoustic-hours, and a distance of 16.5 km during carnivore surveys. One hundred thirty-one animals were captured or observed, consisting of 13 species of bats, 1 lagomorph, 11 rodents, and 5 carnivores.

The most common species at ELMO were piñon mice and deer mice, comprising 16% and 13% of individuals encountered, respectively (Haymond et al. 2003). Capture rate for terrestrial mammals was 16% during 2002.

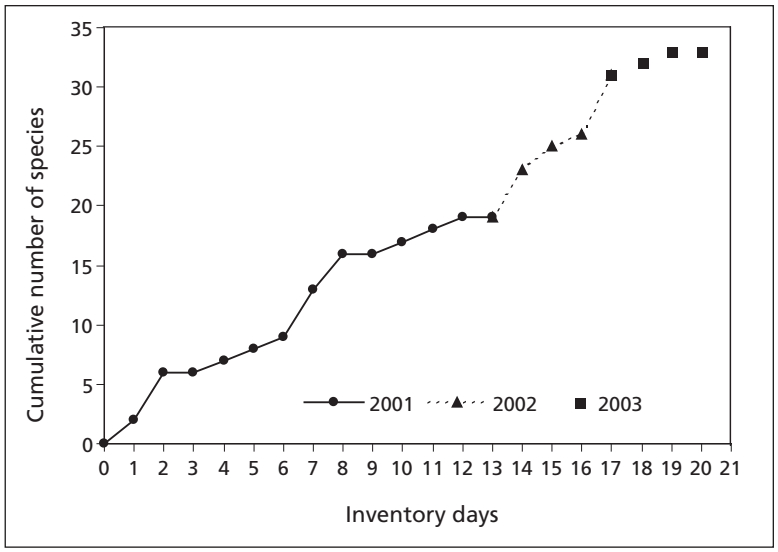


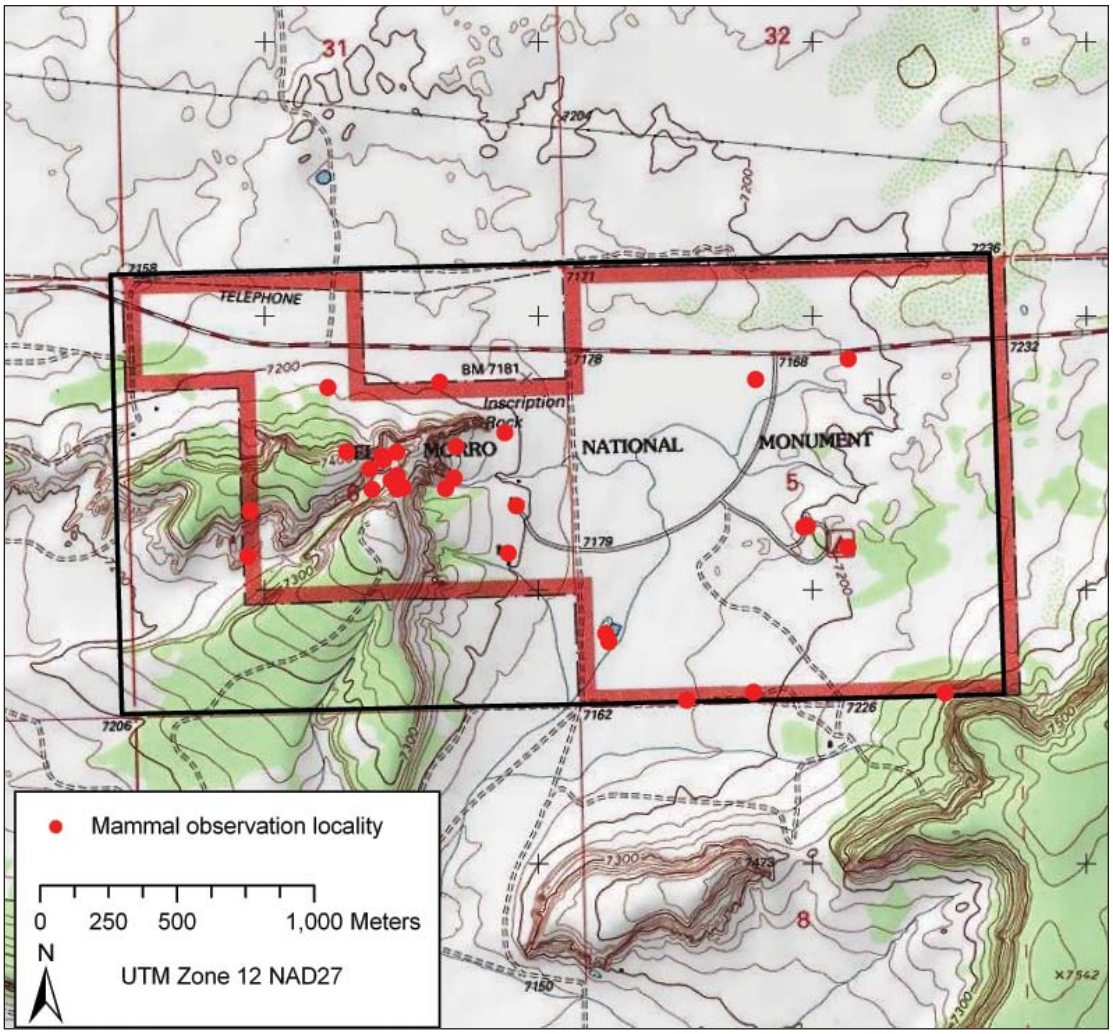
Figure 2. Species accumulation curve for mammal inventories conducted during 2001–2003 at Aztec Ruins National Monument.

The most common bat species encountered was little brown bat (*Myotis lucifugus*; 4% of all captures, 28% of bats). Species richness for locations sampled for bats was highest at the pool (waypoint EL001A), where 13 species were documented. For locations sampled for terrestrial mammals, species richness was greatest in the piñon-juniper woodland, 0.82 mi northeast of the visitor center (REL101A, REL101B), where five species were captured.

Following the first year of inventories (2002), the level of documentation for major groups of mammals at ELMO (based on the current working list of 54 mammals likely to occur on the park) was as follows: insectivores, 0%; bats, 72%; lagomorphs, 33%; rodents, 65%; carnivores, 42%; ungulates, 0% (Haymond et al. 2003).

2003. In May 2003, we worked at ELMO for three person-days and accrued 163 trap-nights. We captured or observed 34 individuals of 13 species of mammals, including 1 lagomorph, 11 rodents, and 1 ungulate. Seven species documented in 2003 were not previously observed or reported from the park. These new species included black-tailed jackrabbit, Gunnison's prairie dog (*Cynomys gunnisoni*), rock squirrel, Ord's kangaroo rat, western harvest mouse, rock mouse (*Peromyscus nasutus*), and mule deer.

Summary. The level of documentation at ELMO is currently 76% (39 of 51 species



Map 2. Mammalian study sites, El Morro National Monument.

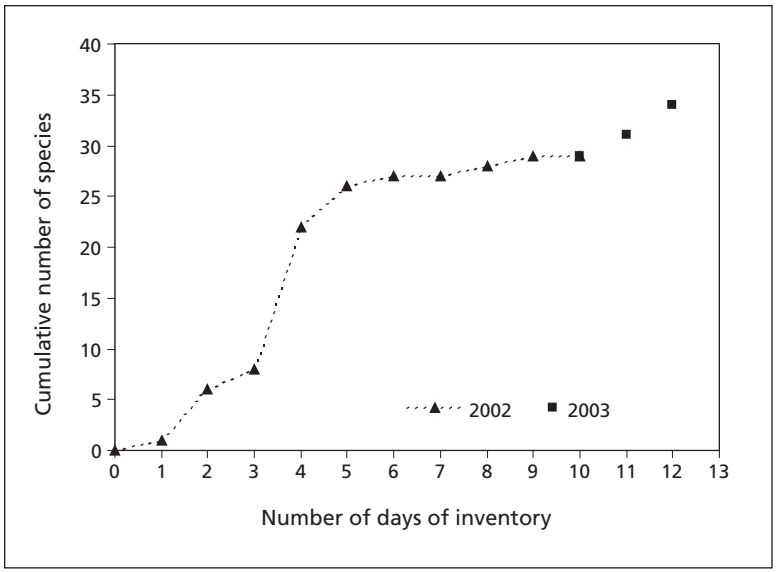


Figure 3. Species accumulation curve for mammal inventories conducted during 2001–2003 at El Morro National Monument.

documented, Table 4), an improvement of about 20% over 2002. The species accumulation curve for ELMO (Figure 3) suggests that we have not yet reached an asymptote. Again, we have documented more species than the SCPN predicted to occur in the park (31). Excluding shrews, the groups with the lowest level of documentation are bats (72%, 13 of 18 species documented), and carnivores (70%, 7 of 10 species documented; Tables 4 and 6). Additional work on bats, using both mistnetting and bat detectors, may eventually add 4–5 more species; observational work would likely add an additional three species of carnivores (ringtail and two skunks).

Petroglyph National Monument

2001. We visited PETR on June 4–6, 10–14, and 17; September 27; and October 2 and 9. Terrestrial mammals were trapped in all habi-

tats; we surveyed for bats on the west side of the monument, near Butte Volcano, in a desert scrub community using the AnaBat II system. During 70 person-days (125% of estimated), we accrued 1,772 trap-nights, captured 99 animals of six species, recorded one species, and observed three additional species. Capture rate for Sherman traps was 5.6%.

The three most abundant species captured at PETR were cactus mouse (*P. eremicus*; 35.4% of captures), deer mouse (22.2% of captures), and white-throated woodrat; 21.2% of captures; Haymond et al. 2002). Uncommon species captured were northern grasshopper mouse (4.0% of captures) and silky pocket mouse (*Perognathus flavus*; 4.0% of captures). A single desert cottontail was also captured (1.0% of captures). Many desert cottontails were also observed; this species appeared to be common on the park.

We amassed 1.2 detector-hours and six sequence file recordings during acoustic surveys for bats. Of those six files, only one

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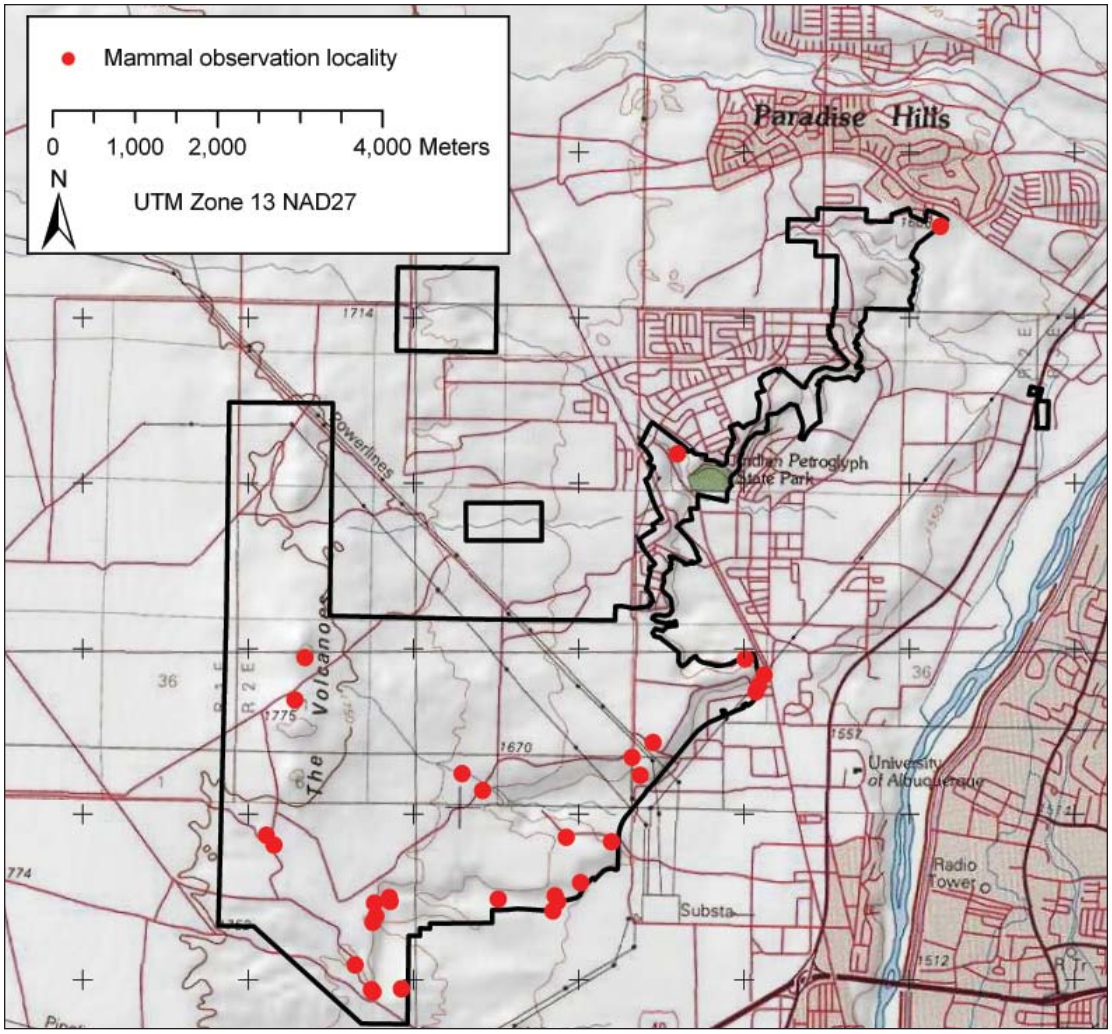
Deer mouse (*Peromyscus maniculatus*).



Map 3. Mammalian study sites, Petroglyph National Monument.

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White-throated woodrat (*Neotoma albigula*).

originated from a bat; the remainder were recordings of electrical interference. The bat detected was a big free-tailed bat, flying near Butte Volcano. While conducting acoustic surveys for bats at PETR, we experienced equipment malfunction and were unable to complete the surveys. The bat detector and associated interface device received interference from an unknown source. As a result, we were able to record only a single bat sequence file.

Species richness was highest at Vulcan Volcano, where five species were captured (white-throated woodrat, deer mouse, cactus mouse, silky pocket mouse, and northern grasshopper mouse). Two additional locations with relatively high species richness were JA Volcano (white-throated woodrat, deer mouse, silky pocket mouse, northern grasshopper mouse) and the bottom of the escarpment on the south side of Rinconada Mesa (Ord's kangaroo rat, white-throated woodrat, deer mouse, and cactus mouse). Females comprised 36% of captures at PETR. Numbers of females and males were equal for northern grasshopper mouse and silky pocket mouse, and nearly equal for deer mice. Several species exhibited disproportionate female-to-male sex ratios: Ord's kangaroo rat (1:11); white-throated woodrat (1:2); and cactus mouse (1:1.7).

In addition to the 10 species we documented in 2001, museum and literature records (Museum of Southwestern Biology [MSB]; Parmenter and Lightfoot 1996) confirmed an additional 15 species, for a total of 25 species. This figure represented 66% of the predicted number (38 species; SCPN) and 42% of our working list of known or likely species. Current levels of documentation were good for lagomorphs (67%) and rodents (75%), but work was needed on insectivores, bats, carnivores, and artiodactyls (Haymond et al. 2002).

2002. Forty-nine mammals of 13 species were documented at PETR. Species documented consisted of 3 bats, 1 lagomorph, 10 rodents, 4 carnivores, and 1 ungulate. Occurrences unique to the 2002 inventory were big brown bat, Brazilian free-tailed bat, porcupine, rock pocket mouse (*Chaetodipus intermedius*), white-tailed antelope squirrel (*Ammospermophilus leucurus*), and mule deer. We used 20 person-days, 280 trap-nights, 11.7 acoustic-hours, covered a distance of 28.6 km during carnivore surveys, and made four visits to PETR (Haymond et al. 2003).

The most common species at PETR during 2002 was the cactus mouse, which accounted for over 16% of individuals documented. Other common species included Ord's kangaroo rat (10%), white-tailed antelope squirrel (8%), silky pocket mouse (8%), deer mouse (8%), and white-throated woodrat (8%). Capture rate for terrestrial mammals was 11% during 2002, compared with 6% during 2001.

Species richness was greatest in the grasslands on Rinconada Mesa (waypoints RPE08A, RPE08B; PE001A; RPE01A, RPE01B), where four species were captured. Other sampling sites with relatively high species richness were around the Lava Shadows Annex (RPE04A, RPE04B), around the visitor center (RPE03A, RPE03B), and near the south cinder cone (RPE02A, RPE02B), where three species were captured on each trapline. Bats were rarely encountered at PETR, presumably because of the lack of standing water in the park. We watched several bats emerging from daytime roosts in lava rock outcrops in Boca Negra canyon, however.

Our updated list in 2002 included 60 mammal species likely to occur in the park. We documented 31% of bats (up from 13% in 2001), 83% of rodents (75% in 2001), 38%

of carnivores (23% in 2001), and 50% of artiodactyls (0% in 2001; Haymond et al. 2003). There was no change in the number of insectivores or lagomorphs.

2003. In May 2003, we worked at PETR for 4 person-days and accrued 170 trap-nights. We captured or observed 10 individuals of four species of mammals, including one lagomorph and three rodents. No new species were captured during our inventory efforts at this park in 2003.

Summary. We believe documentation exists for at least 35 of 50 (70%; Table 4) predicted species at PETR. Most problematic on our current list are the bats, among which we have documented only 5 of 14 likely species (Table 7). There are nearby records for all nine of the undocumented species, but establishing their presence at PETR will likely require more work with an echolocation detector, as there are few places to mistnet at the park. Alternatively, PETR may be more depauperate in terms of bats than we currently predict. Rodents seem to be well documented at PETR. Our species accumulation curve (Figure 4) for PETR suggests that we are reaching an asymptote in our current efforts at the park. The SCPN predicted a species richness of 38 species, a figure that seems realistic given the relative homogeneity of the park.

Salinas Pueblo Missions National Monument

2001. We visited Salinas Pueblo Missions on June 25–29; July 1–5, 8–12, and 24–26; and September 19–20. We trapped terrestrial mammals in each unit and each vegetation association, and netted bats at Quarai and near the dam at Abó. We expended 44 person-days (78% of estimated) and accrued 2,436 trap-nights, 31 net-nights, and 3.3 detector-hours. We captured 157 animals of 21 species and observed 6 additional species. Species captured and observed included 7 species of bats, 16 species of rodents, 2 species of rabbits, 1 species of ungulate, and 1 carnivore. Rate of capture for Sherman live traps was 5.8%. Museum records (MSB) and literature (Scott 1979) confirmed the presence of five additional species.

Three species made up more than half of

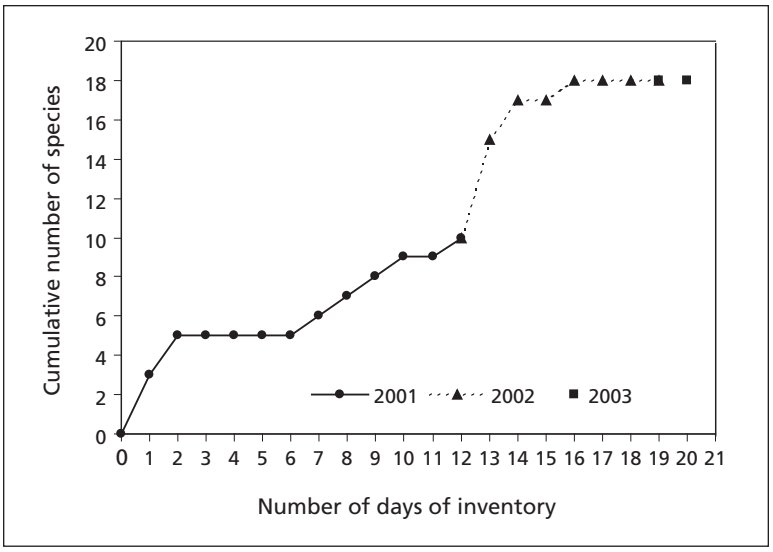
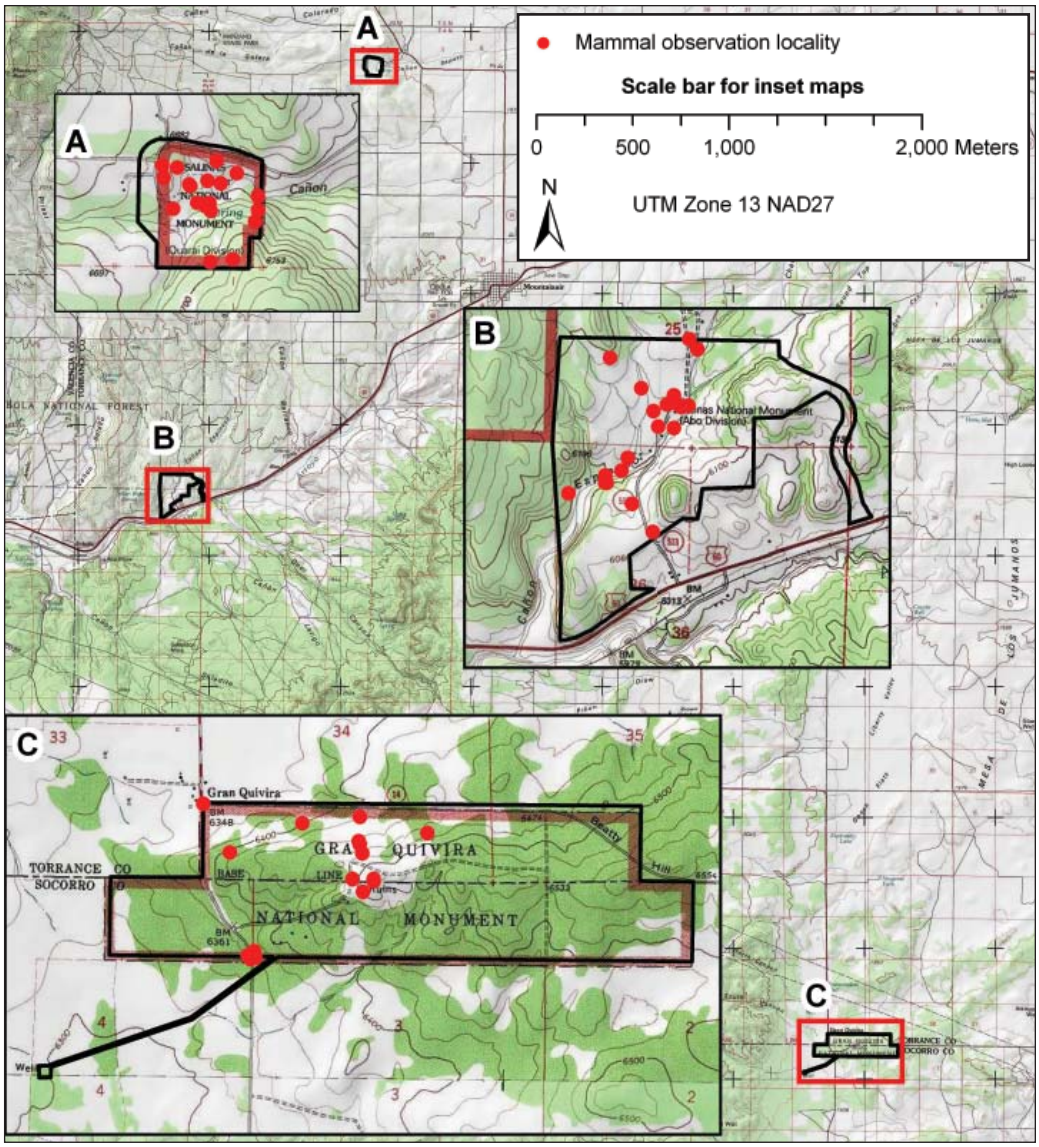


Figure 4. Species accumulation curve for mammal inventories conducted during 2001–2003 at Petroglyph National Monument.

the terrestrial mammal captures at SAPU (Haymond et al. 2002): brush mouse (19.9% of captures), white-footed mouse (*P. leucopus*; 18.4%), and white-throated woodrat (14.2%). Seven other species, each represented in the inventory by a single capture, each comprised 0.7% of total captures. Number of females and males for all terrestrial species combined were nearly equal. Individually, however, female-to-male sex ratios varied greatly. Voles (*Microtus* sp.) and white-footed mice had equal sex ratios. Females outnumbered males in captures of Ord's kangaroo rats (1.5:1), white-throated woodrats (2.3:1), northern grasshopper mice (1.8:1), silky pocket mice (4:1), and plains pocket mice (*Perognathus flavescens*, 4:0), while brush mice (1:1.8), deer mice (1:3.3), and hispid cotton rats (*Sigmodon hispidus*, 1:1.7) had more males.

Of bat captures, hoary bat (*Lasiurus cinereus;* 37.5%) and long-legged myotis (25.0%) were most abundant, while big brown bat and Yuma myotis were least abundant, each comprising 6.3% of bat captures (Haymond et al. 2002). Bats comprised 10.9% of all mammals captured at SAPU and 20.6% of all species documented. Females comprised 56.3% of bats captured. Within species, hoary bat and Yuma myotis were all non-reproductive males, while Townsend's big-eared bat (*Corynorhinus townsendii*), big brown bat, fringed myotis (*M. thysanodes*), and long-legged myotis (*M. volans*) were all females,



Map 4. Mammalian study sites, Salinas Pueblo Missions National Monument.

each having some reproductive individuals. One hundred sixty-five sequence files were recorded during acoustic surveys at Quarai, 156 of which were identifiable. Six species were recognized, all of which were also captured in mistnets at Abó.

Mammal captures at Gran Quivira accounted for 53.5% of all captures at SAPU. Additionally, 10 species were captured or observed at Gran Quivira that were not documented in other units. Abó had four species and Quarai had seven species not captured or observed in other units. Six species were captured or observed in all three units. In 2001, we documented 33 species at SAPU. This was 103% of the SCPN's predicted number of species and 55% of our current working list of likely species. Although our list of likely species was perhaps too inclusive, it is clear to us that the number of species predicted by SCPN was too low. Lagomorphs (67%) and especially rodents (87%) were moderately well documented.

2002. During the 2002 field season we made three visits to SAPU, during which time we expended 19 person-days, 502 trap-nights, 5 net-nights, 7.1 acoustic-hours, and 13.6 km of carnivore surveys. We captured and observed 109 mammals, including 4 species of bats, 1 lagomorph, 10 rodents, 4 carnivores, and 1 ungulate. Six species were new to the 2002 inventory: Brazilian free-tailed bat, silver-haired bat (*Lasionycteris noctivagans*), western pipistrelle (*Pipistrellus hesperus*),

long-tailed weasel (*Mustela frenata*), mountain lion (*Puma concolor*), and red fox.

The most frequently encountered species during 2002 was the piñon mouse (17% of individuals documented); followed by the brush mouse (14%), white-footed mouse (12%) and hoary bat (12%; Haymond et al. 2003). Capture rate for terrestrial mammals was 15% during 2002, compared with 6% in 2001.

Species richness for locations sampled for bats was greatest at the pond at Quarai (waypoint SA005A), where nine species were documented using mistnets and acoustic surveys. Species richness for locations sampled for terrestrial mammals was greatest at a heavily vegetated arroyo (RABO1A, RABO1B), an arroyo and nearby woodland (RABO3A, RABO3B), and a denuded plain (RABO6A, RABO6B) at Abó, where five species were captured on each trapline.

The 2002 list contained 60 mammal species likely to occur on the park; we documented 65% of bats (up from 41% in 2001) and 36% of carnivores (14% in 2001). There was no change in the number of insectivores, lagomorphs, rodents, or artiodactyls documented (Haymond et al. 2003).

2003. In May 2003, we worked at SAPU for 2 person-days and accrued 87 trap-nights. We captured 41 individuals of five species of mammals, including one bat and four rodents. Two additional species were documented during this visit: Botta's pocket gopher and Mogollon vole (*Microtus mogollensis*).

Summary. Overall documentation of mammals at SAPU is 78% (43 of 55 species, Table 4), with bats (85%) and rodents (92%) moderately well documented. It is primarily carnivores that are not well documented, with 7 of a likely 12 having been documented (Table 8). We suspect that our list of predicted carnivores is still too inclusive—and in fact, that few, if any, carnivores are truly resident on the smaller two units of the park. Our species accumulation curve for the park is equivocal, and we may not have reached a true asymptote (Figure 5). The SCPN's predicted number of species for the park was 31, a number that fact-based surveys easily supplanted.

U.S. GEOLOGICAL SURVEY/TONY R. MOLLHAGEN

Big free-tailed bat (*Nyctinomops macrotis*).

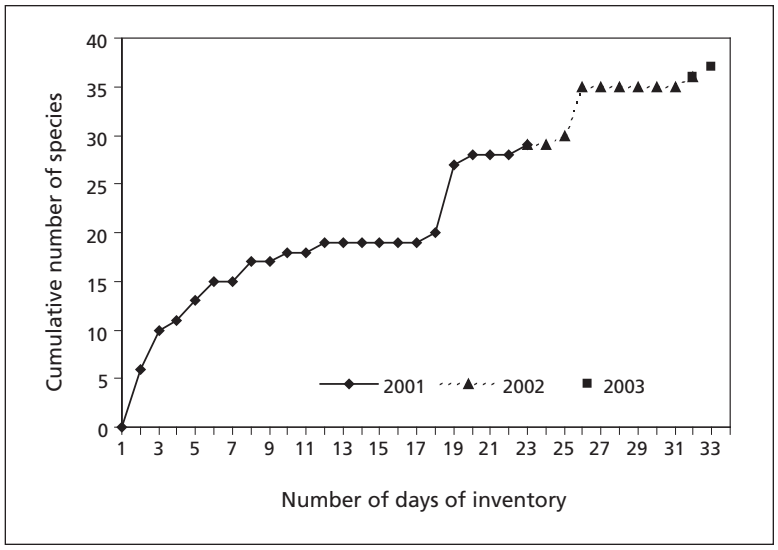
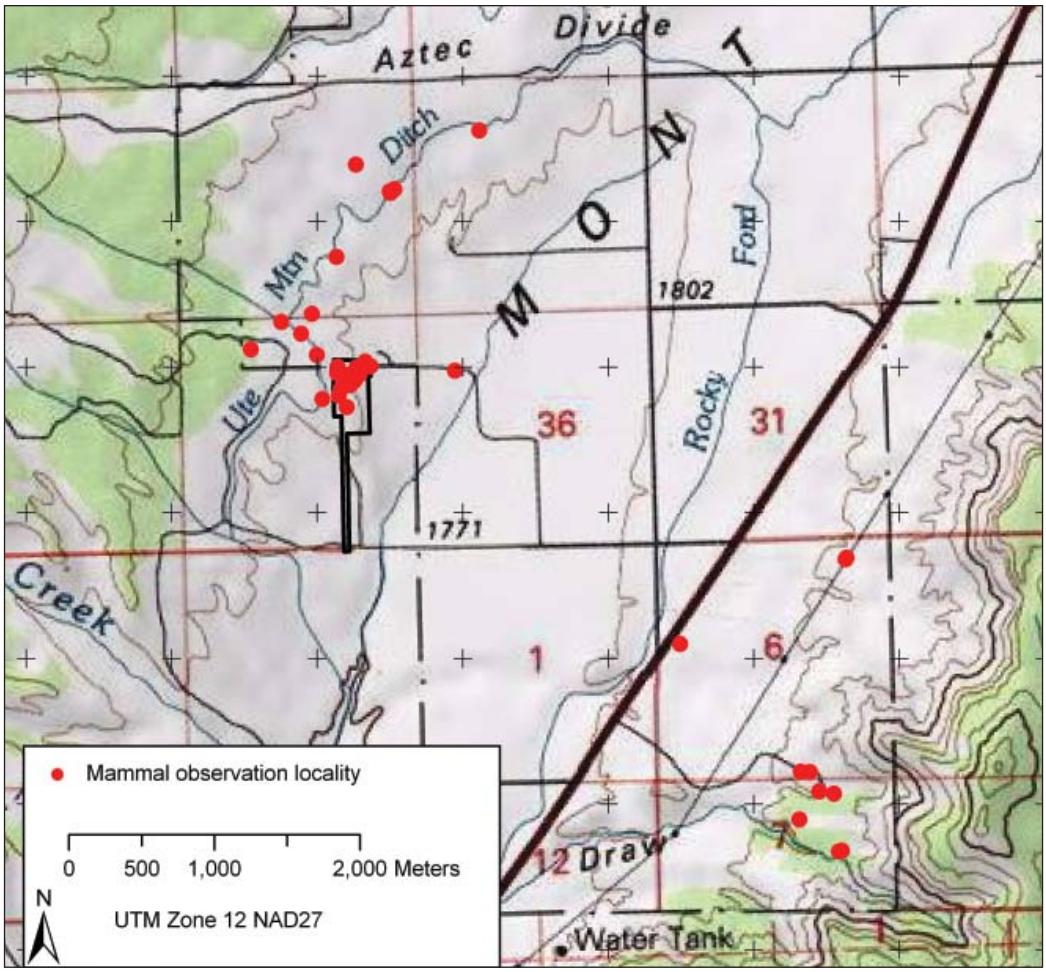


Figure 5. Species accumulation curve for mammal inventories conducted during 2001–2003 at Salinas Pueblo Missions National Monument.

Yucca House National Monument

2001. Work was conducted at YUHO and the adjacent Ismay property on June 28–July 2, July 30–August 1, and September 13. Most of the effort at YUHO emphasized mistnetting at existing stock ponds on the Ismay property. Twenty-two person-days (137% of estimated, although the estimate was for a smaller area), 400 trap-nights, and 26 net-nights were used to document 21 species. We captured 42 mammals of 12 species and observed 9 additional species. Rate of captures



Map 5. Mammalian study sites, Yucca House National Monument and vicinity.

for terrestrial mammals in Sherman traps was 10.5%.

Species diversity was relatively low at YUHO. Nearly half of the captures in Sherman traps were deer mice (48.3%; Haymond et al. 2002). Other common species were piñon mice (31.0%) and brush mice (13.8%). Uncommon species captured included western harvest mouse and white-throated woodrat, each comprising 3.4% of total captures. Females comprised 53.6% of captured terrestrial mammals. Sex ratios were nearly equal for deer mice and piñon mice, whereas female brush mice outnumbered males by 3:1.

Number of species captured varied greatly by location. Species richness was highest at a site 1.3 km (0.8 mi) north of the Ismay house in a sagebrush community, where four species were captured. This was the only location where a white-throated woodrat was captured. The only location to yield a western harvest mouse capture was the north pond west of the Ismay house, where two animals were captured. Deer mice were captured at all trapping locations.

Bats comprised 30.9% of all captures and 54.5% of all species observed and captured. The most abundant bat captured was big brown bat (38.5% of bat captures; Haymond et al. 2002). Males comprised 69.2% of bats captured, all of which were non-reproductive. Of captured females, one long-eared myotis was lactating. Acoustic surveys for bats were used in conjunction with mistnetting at stock ponds for 28.8 detector-hours. Three hundred nineteen sequence files were recorded, 83.4% of which contained an adequate number of good quality calls to assign species identifications. Ten species were detected using acoustic methods, four of which were not captured in mistnets: western pipistrelle, California myotis (*M.*

californicus), big free-tailed bat, and Brazilian free-tailed bat.

The pond east of U.S. Highway 491, approximately 0.2 km (0.1 mi) south of Road B on the Ismay property, was the most speciose location, with nine species of bat documented by mistnets and acoustic surveys. Seven species were documented at the middle pond and five were documented at both the north and south ponds.

In early February, we received an updated list of mammal observations for YUHO from Marilyn Colyer. With an exception or two, we added these records to our own, thus documenting the occurrence of 45 species at YUHO and the adjacent Ismay property (Table 3). This was well above the predicted species richness for YUHO (18 species, but likely for 14 ha), and was 78% of our list of species likely to occur. Some of our documentation relies on records from nearby localities (Armstrong 1972), but we believe most of these species occur throughout this area. Bats, lagomorphs, and rodents were reasonably well documented, but work is needed to document additional species of carnivores.

2002. Efforts at YUHO resulted in the capture or observation of 22 mammals consisting of 3 species of bats, 2 lagomorphs, 1 rodent, 4 carnivores, and 1 ungulate. We accumulated 7 person-days, 6 net-nights, 9.3 acoustic-hours, and a carnivore survey distance of 6.2 km during three visits. Four species of bats not documented previously were recorded during 2002, using acoustic surveys: little brown bat, Yuma myotis, and Townsend's big-eared bat.

Deer mice were the most frequently encountered species at YUHO during 2002, and comprised over 19% of individuals captured (Haymond et al. 2003). Coyotes were also relatively common, accounting for over 15% of individuals observed. Capture rate for terrestrial mammals was 6% during 2002, compared with 11% during 2001. The most common bats at YUHO were big brown bats and long-legged myotis, with each accounting for 8% of individuals.

Species richness for locations sampled for bats was greatest at the south stock pond,

U.S. GEOLOGICAL SURVEY/KEITH GELUSO

Least chipmunk (*Neotamias minimus*).

west of the Ismay house (waypoint YU001A), where 11 species were documented using mistnets and acoustic surveys. Species richness for locations sampled for terrestrial mammals was greatest around the ruins (YU15C) and near the road junction and irrigation ditch (RYU10A, RYU10B), where two species were captured on each trapline.

Our list for 2002 included 54 mammal species likely to occur in the park. We believe we documented 100% of bats (up from 80% in 2001). There was no change in the number of insectivores, lagomorphs, rodents, carnivores, or artiodactyls documented.

2003. In May 2003, we worked at YUHO for 2 person-days and accrued 64 trap-nights. We captured 11 individuals of 4 species of mammals; all species were rodents. Two species had not been documented previously: the montane vole (*Microtus montanus*) and Mogollon vole. The captures of *M. mexicanus* represent one of the northernmost records of this species in its distribution. During September and November, we returned to YUHO for an additional six days and added 400 trap-nights of effort that resulted in the capture of our first specimens of silky pocket mouse.

Summary. Level of documentation for mammals at YUHO and the adjacent former Ismay property is 89%, with all groups except insectivores above 85% documented (Table 4). The number of species predicted by the SCPN was 18, although this was probably

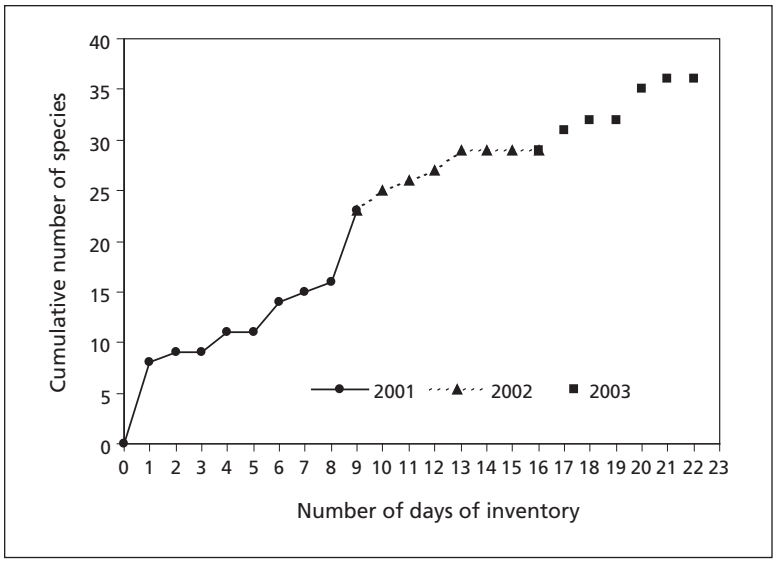


Figure 6. Species accumulation curve for mammal inventories conducted during 2001–2003 at Yucca House National Monument.

only for the actual parklands (14 ha). The level of documentation (Table 9) at YUHO has been enhanced by good local knowledge of the park and surrounding lands, especially by Dr. Al Spencer and Ms. Marilyn Colyer, both of whom have contributed their data to this project. As noted, insectivores are undersampled at YUHO but documentation of shrews, other than opportunistically, will require considerable labor and time and in setting pitfall traps.[†] Our species accumulation curve for YUHO (Figure 6) suggests we are approaching an asymptote in cumulative number of species obtained.

2003–2004: BAND, CHCU, and ELMA

During the 2003 and 2004 field seasons, we worked 276 person-days, accrued 9,764 trap-nights, accumulated 26 net-nights, drove 15.5 hours spotlighting, and walked 373 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 10). Overall, we documented 70 species of mammals at the three parks (Table 11). We captured or observed sign of 2,312 mammals, including 2 species of insectivores, 13 species of bats, 4 species of lagomorphs, 36 species of rodents, 11 species of carnivores, and 4 species of ungulates (Table 11).

The most frequently encountered mammal was the deer mouse (417 captures), which occurs at all three parks (Table 11). A total of three individual shrews were captured during our two-year effort (Table 11); the most frequently captured species was the montane shrew (*Sorex monticolus*). The most frequently netted bat was the silver-haired bat (Table 11), which accounted for 24% of all observations of bats. The most frequently observed lagomorph was the desert cottontail (Table 11), which accounted for 40% of all observations of lagomorphs. The ubiquitous deer mouse was the most frequently observed rodent, accounting for 28% of all observations of rodents. The most frequently observed carnivore was the coyote (Table 11), which accounted for 36% of all observations of carnivores. The most frequently observed ungulate was the elk (*Cervus elaphus*; Table 11), which accounted for 59% of all ungulate sightings. The total number and percent relative abundance of mammals at the three parks (Table 12) shows that the deer mouse had highest relative abundance of all mammals during our survey, followed by the piñon mouse and elk.

Our master lists of mammals that occur at BAND, CHCU, and ELMA (Tables 13, 14, and 15) reflect our current understanding of mammals at the parks and provide specific reference on species status at each park. Following our field efforts and examination of pertinent references, our level of documentation was 89% at BAND, 94% at CHCU, and 90% at ELMA (Table 16).

Specific details concerning each park during our inventory are presented below. We begin each section with overall results for that park, followed by specific detail concerning each mammalian order.

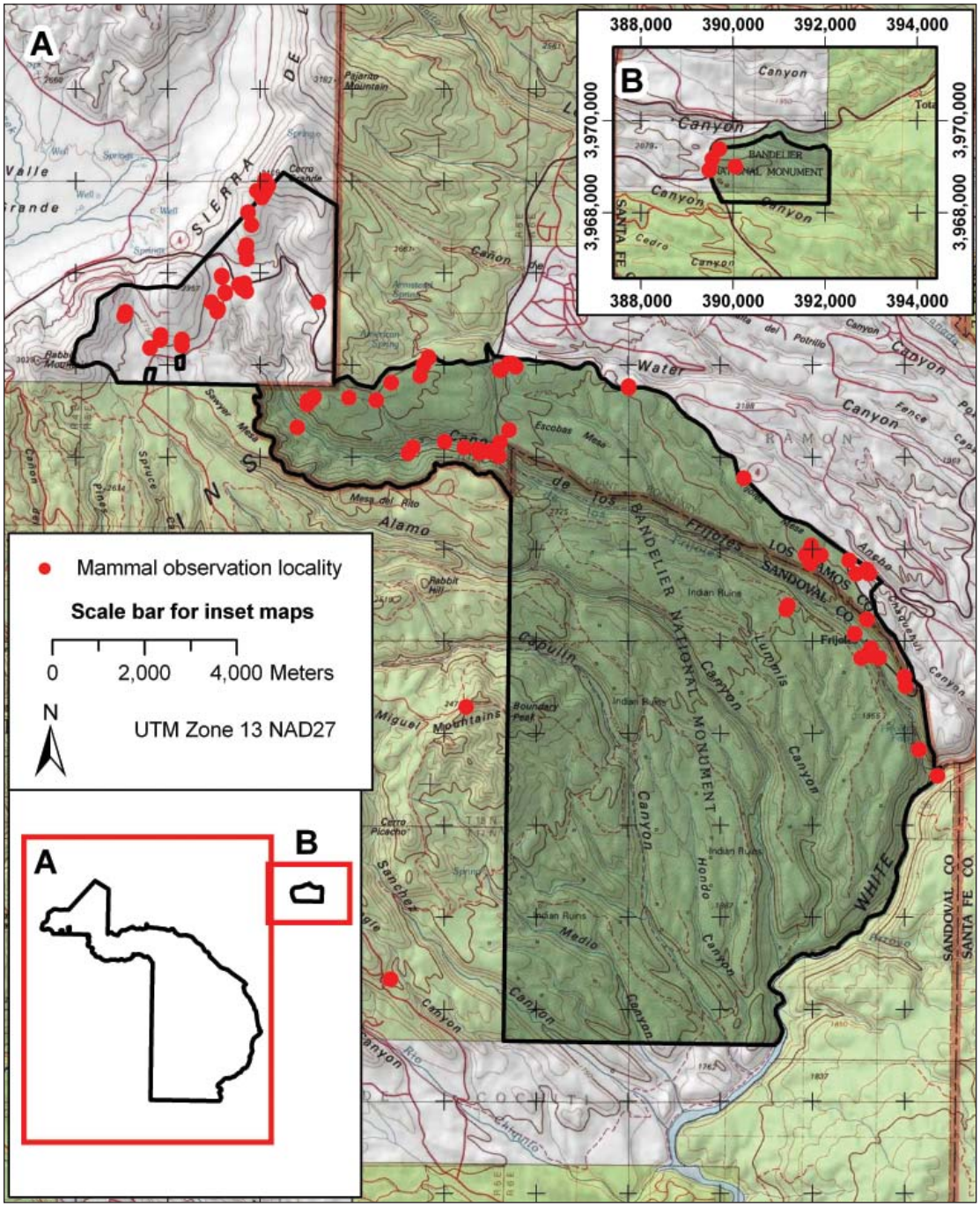
Bandelier National Monument

In 2003 and 2004, we worked 132 person-days, accrued 3,682 trap-nights, accumulated 13 net-nights, drove 4 hours spotlighting, and walked 178 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 10). Overall, we documented 50 species of mammals at BAND (Table 11). We captured or observed sign of 996 mam-

[†]In late summer 2004, MEVE staff and volunteers deployed 125 pitfall traps for 40 days (5,000 trap-nights) around the YUHO study area. No shrews were captured.

mals, including 2 species of insectivores, 12 species of bats, 3 species of lagomorphs, 22 species of rodents, 9 species of carnivores, and 2 species of ungulates (Table 11).

At present, we have documentation of 59 extant and 2 extirpated species of mammals at BAND (Table 13). This number far exceeds the predicted species richness of 44 (Stuart 2000), and reflects the diversity of habitats available for mammals at the park. Currently, the overall level of documentation for BAND is 89%, with levels of documentation ranging from 33% to 100% for specific mammalian orders (Table 16). At present, insectivores have the lowest documentation at 33%; bats, lagomorphs, and ungulates have documentation of 100% (Table 16). We determined that the previous level of documentation of mammals at BAND was 85% (Table 16).



Map 6. Mammalian study sites, Bandelier National Monument.

This relatively high level of documentation is a reflection of information gathered from previous unpublished reports by Bogan et al. (1998) and Guthrie and Large (1980). Without these prior investigations, documentation of mammals would be almost nonexistent for BAND. During our field efforts, we confirmed many small mammals at BAND reported by Guthrie and Large (1980) and secured voucher material of 2 species of insectivores, 2 species of bats, 1 species of lagomorph, and 18 species of rodents.

Insectivores. To date, two species of shrews (montane shrew and northern water shrew [*Sorex palustris*]) have been positively confirmed to occur at BAND. However, we suspect that up to six species of shrews inhabit the park. These additional species probably occur at BAND because they have been captured in other regions of the Jemez Mountains (see Findley et al. 1975 and Kirkland and Findley 1996) in habitats that occur within park boundaries. Recently, we have received shipments of preserved shrews (and other small mammals) that were collected in insect pitfall traps associated with another project at the park. We have yet to prepare these specimens in a manner that will allow us to identify these individuals to species. This collection certainly will improve the knowledge of soricids at BAND.

During the summer of 2004, we trapped for many nights in Cañon de los Frijoles in search of the water shrew. On June 22, we captured an adult male along Rio de los Frijoles in a Sherman live trap. This individual represents a new park record, and only the sixth individual of *S. palustris* known from the Jemez Mountains. Additionally, our capture may represent the first capture of this shrew in the Jemez Mountains since the early 1970s. Our findings suggest that *S. palustris* is more widespread in the area, although it is relatively uncommon.

Bats. At BAND, 15 species of bats are known to occur (Table 13). Guthrie and Large (1980) originally reported 12 species at the park, but Bogan et al. (1998) discovered an additional three species (western pipistrelle, spotted bat, and big free-tailed bat). During our present inventory, we captured or heard the audible echolocation calls of 12 species of bats (Table 13). Of the 15 species known to occur at BAND, we feel that the spotted bat and big free-tailed bat are of special interest to BAND and the state.

These species have a relatively patchy distribution across their entire range and are captured infrequently in mistnets. Much detailed information concerning the ecology and natural history of these species is yet to be determined. Radio-tracking studies have located roosting sites of both species in the Jemez Mountains (Bogan et al. 1998), and diet analyses of *N. macrotis* from the Jemez showed that this species consumed an unusual variety of arthropods (Sparks and Valdez 2003). During our present investigation, we heard the distinctive and diagnostic audible calls of both species almost nightly at the Juniper Campground. At higher elevations, we generally heard only calls of spotted bats.

Lagomorphs. Four species of lagomorphs reside at BAND (Table 13). Guthrie and Large (1980) originally documented only three species, including the desert cottontail, mountain cottontail (*S. nuttallii*), and black-tailed jackrabbit. During our inventory, we observed desert and mountain cottontail, but not black-tailed jackrabbit. In addition, we also discovered the American pika (*Ochotona princeps*) at higher elevations on Cerro Grande. On June 30, 2004, we observed a minimum of three adults and one subadult on a felsameer slope southwest of Cerro Grande. In 2003, we only heard pikas and observed their fecal pellets on this same slope. In the Jemez Mountains, pikas previously have been documented from the Jemez Mountains at Pajarito Mountain, Goat Peak, and Los Alamos ski area, the southeast edge of Valle Grande, 1.3 km south of Pajarito Mountain, Chicoma Mountain, and Redondo Peak (Swickard et al. 1971, Findley et al. 1975). Swickard et al. (1971) also reported the diagnostic droppings of pikas in horizontal crevices at the edge of the cliffs overlooking the northwest branch of Frijoles Canyon. These authors reported that pikas inhabited almost all suitable rockslides in the mountain range above 2,589 m (9,150 ft). Thus, these data suggest that pikas have always occurred on BAND. In light of recent data from the Great Basin concerning extirpation among isolated populations of pika (Beever et al. 2003), we propose that pikas may serve as

an important indicator for future long-term monitoring at BAND by the NPS. Beever et al. (2003) reported that biogeographic, climatic, and human influence all appear to be plausible causes of recent extirpation of pikas, and that the synergistic influences of these factors may magnify possible threats. These authors point out that losses of pika populations can occur without apparent changes in habitat.

Rodents. Twenty-five species of rodents are known to occur at BAND (Table 13). Guthrie and Large (1980) reported 24 species, and we documented 22 species during our field efforts. We documented one new species of rodent for the park, the bushy-tailed woodrat (*Neotoma cinerea*). We captured multiple individuals at higher elevations on Cerro Grande associated with rocky habitats in 2003 and 2004. During our efforts, we also captured eight southern red-backed voles (*Clethrionomys gapperi*). Guthrie and Large (1980) only reported red-backed voles in the blue spruce forest atop Cerro Grande at 3,048 m (10,000 ft). We discovered that these voles were more widespread on the park and occurred at elevations as low as 2,774 m (9,100 ft) in mixed coniferous forests south of New Mexico Highway 4 in the extreme western part of BAND. Although bushy-tailed woodrats and red-backed voles are not as conspicuous as pikas, we propose that these species also may serve as important indicators for future long-term monitoring at BAND. As with pikas, these populations represent some of the southernmost populations of these species in North America. Because these outlying populations are isolated from populations to the north, and because their habitat is limited to higher elevations of BAND, populations at BAND surely will serve as important indicators of the health of these high-elevation, montane ecosystems in the future.

During 2003 and 2004, we captured six individuals of rock pocket mouse on dry, rocky slopes of Cañon de los Frijoles and in similar habitats on the Tsankawi Unit. Guthrie and Large (1980) reported this species only from piñon-juniper slopes on the north side of the mouth of Alamo Canyon at 1,737 m (5,700 ft). Records from BAND represent (a) the northernmost record of this species throughout its distribution, (b) two new county records, and (c) a 48-km range extension. Gennaro (1968) examined the distribution of this species at the northern limits of its range and discovered that its limits coincide with the 69°F isotherm for average annual maximal temperatures. Suitable habitat existed above this isotherm, but no mice were trapped. These data potentially suggest that environments in the region have warmed over the past few decades and mice have moved northward. Additional research on rock pocket mouse distribution, as well as examination of temperatures over the last few decades in the region, would likely lead to a better understanding of the ecology of this species. We propose that this species also may serve as an important indicator for future long-term monitoring at BAND.

U.S. GEOLOGICAL SURVEY/KEITH GELUSO

Red-backed vole (*Clethrionomys gapperi*).

During summer 2004, we trapped on multiple nights in Cañon de los Frijoles for the meadow jumping mouse (*Zapus hudsonius*). Our attempt to capture this mouse was unsuccessful in the park. We still suspect that *Z. hudsonius* occurs at BAND in appropriate habitats, such as along the stream in upper parts of Cañon de los Frijoles. Unfortunately, our efforts to capture this species were hampered by a raccoon that continually molested more than half of our traps each night. In fact, this individual even learned how to remove small mammals from traps, which further hampered our efforts to document the jumping mouse.

Recently, we confirmed the identification of voucher specimens of chipmunks (Colorado chipmunk [*Neotamias quadrivittatus*] and least chipmunk [*N. minimus*]) and mice (brush mouse and northern rock mouse) at BAND, using skull characteristics. Because these two pairs of species are similar in external characteristics, there is a relatively high potential to misidentify individuals using only external features, even when examining a series of study skins from the same location. We agree with Armstrong (1972), that upon superficial examination, Colorado and least chipmunks are difficult to identify even when specimens are in hand. In short, we originally thought that some chipmunks captured at high elevations from Cerro Grande might be Colorado chipmunks; however, after further investigations of skull size, we are confident that all of these high-elevation specimens are least chipmunks. We did reconfirm that two specimens originally believed to be *N. quadrivittatus* were, in fact, Colorado chipmunks. One specimen was from a piñon-juniper woodland at lower elevations; however, our other voucher was captured at a relatively high elevation in a mixed coniferous forest on a trapline with red-backed voles and Mexican woodrats (*Neotoma mexicana*). According to Findley et al. (1975), least chipmunks are most common on edges of spruce-fir forest, with Colorado chipmunks more common in lower ponderosa and mixed coniferous forests. We are confident of most of our identifications of chipmunks at BAND; however, some captures (and releases) of supposed least chipmunks in mixed coniferous and ponderosa pine forests are potentially problematic, especially without any vouchers from these habitats.

We also confirmed the identification of brush mice and northern rock mice at BAND. Using a tooth character described by Hoffmeister (1986), we discovered that both species are present in the park. It appears that adult mice (i.e., those with fairly worn molars) are moderately easy to identify based on pelage coloration; however, subadult individuals (i.e., those not in juvenile gray pelage but in recent adult pelage) are extremely hard to identify without examining the tooth character (see below in CHCU and ELMA).

Carnivores. Eleven species of carnivores are known to occur at BAND (Table 13). Guthrie and Large (1980) reported all 11 species, and we documented nine species during our field efforts. Guthrie and Large (1980) also reported potential sightings of red fox along New Mexico Highway 4. This species probably occurs in the park, but there are no confirmed sightings or records.

Artiodactyls. Four species of ungulates are known from BAND (Table 13). At present, only mule deer and elk inhabit the park; bighorn sheep (*Ovis canadensis*) and feral ass (*Equus asinus*), an exotic, have been extirpated from the park.

Chaco Culture National Historical Park

In 2003 and 2004, we worked 75 person-days, accrued 3,072 trap-nights, accumulated 4 net-nights, drove 5.5 hours spotlighting, and walked 87 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 10). Overall, we documented 33 species of mammals at CHCU (Table 11). We captured or observed sign of 579 mammals, including 3 species of bats, 2 species of lagomorphs, 19 species of rodents, 6 species of carnivores, and 3 species of ungulates (Table 11).

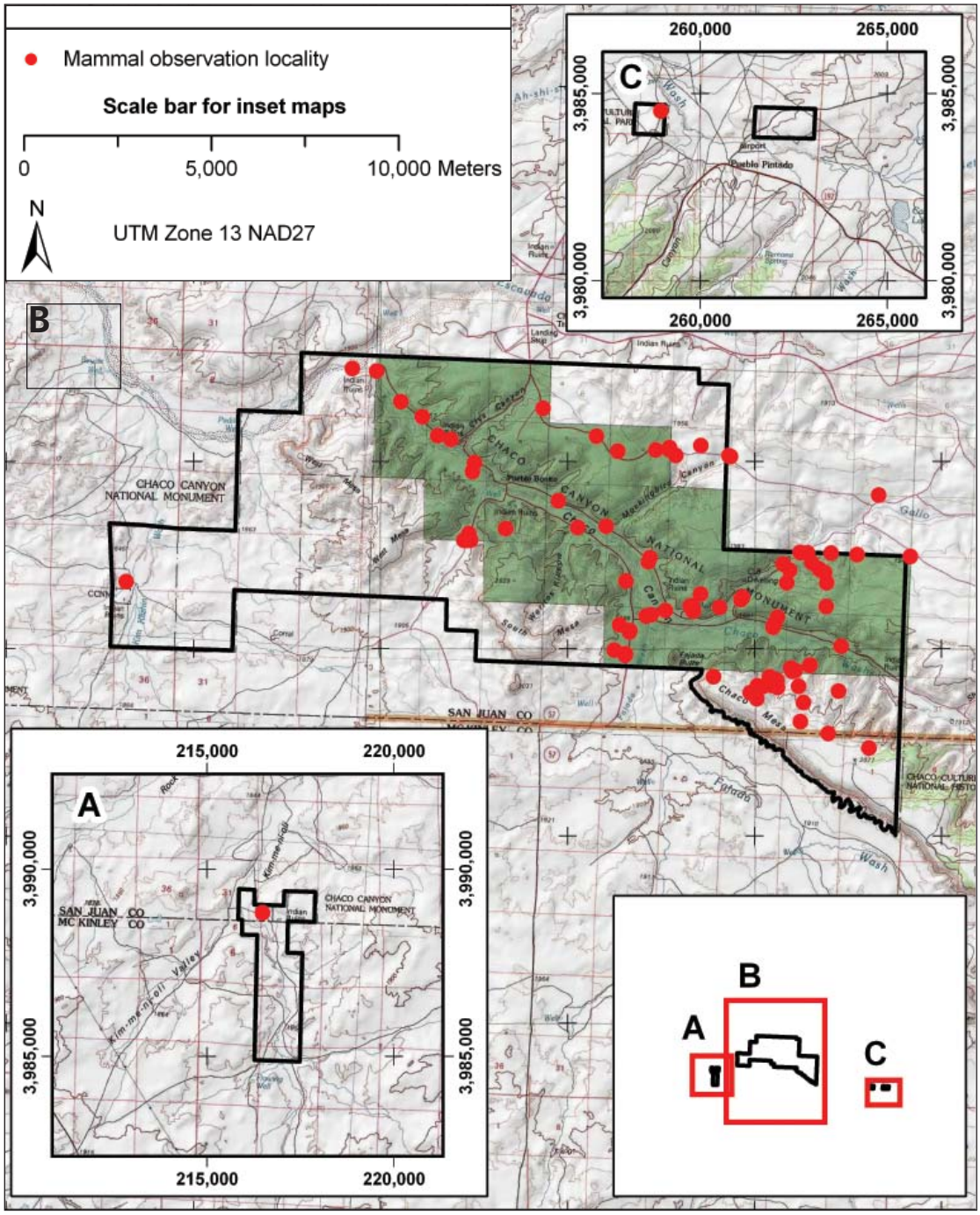
At present, we have documentation of 50 extant mammal species at CHCU, plus 1 historically documented species (Table 14). This number modestly exceeds the predicted species richness of 44 (Stuart 2000). Currently, the overall level of documentation for CHCU is 94%, with levels of documentation ranging from 75 to 100% for specific mammalian orders (Table 16).

At present, ungulates have the lowest documentation at 75%, and insectivores, bats, lagomorphs, and rodents have documentation of 100% (Table 16). We determined that the previous level of documentation of mammals at BAND was 79% (Table 16). This relatively high level of documentation is a reflection of information gathered from previous unpublished reports by Valdez et al. (2002a) and Cully (1981). Additionally, there are a number of species with prior voucher material housed at various museums (see Findley et al. 1975). During our field efforts, we confirmed many small mammals at CHCU and secured voucher material of 16 species of rodent and 1 species of carnivore

(Table 14).

Insectivores. One species of shrew is known from CHCU. On July 1, 1999, E. W. Valdez observed a Crawford's desert shrew (*Notiosorex crawfordi*) while mistnetting bats at the park. The individual was observed along the base of a canyon wall near a mine on the east side of South Mesa (E. Valdez, pers. comm.; 0236769E, 3991262N).

Bats. Fifteen species of bats are known from CHCU (Table 14). Valdez et al. (2002a) originally reported 14 species at the park, but our efforts revealed one additional species (big free-tailed bat). In 2003 and 2004, we heard the conspicuous, audible calls of *N. macrotis* on many evenings at the VIP campground in the NPS housing area. Valdez et al. (2002a) only reported calls of the spotted bat at Wijiji Ruins and at the confluence of Chaco Wash



Map 7. Mammalian study sites, Chaco Culture National Historical Park.

NATIONAL PARK SERVICE/JOHN GOOD

Coyote (*Canis latrans*).

and the Chaco River. During our field efforts, we also heard the audible calls of spotted bats at the VIP campground in both 2003 and 2004. On June 9, 2004, with the aid of a spotlight, we observed a spotted bat as it flew low over the campground. We suspect that our observations of big free-tailed bat and spotted bat are the result of individuals being attracted to the sewage disposal ponds (a permanent source of water) just above the campground. In summer 2003 and early summer 2004, the region was in an extreme drought, and water sources were limited in the park.

During our inventory, we examined places netted by Valdez et al. (2002a) and found no available water for bats except for the sewage disposal ponds. We actually observed bats drinking out of the southernmost sewage pond. Of the 15 species known to occur at CHCU, we feel that the spotted bat, big free-tailed bat, and Yuma myotis are of special interest to CHCU and New Mexico. Both the big free-tailed bat and spotted bat are relatively patchy in distribution across their entire range; thus, these records add to our understanding of their distribution and abundance. The Yuma myotis is of interest because it is generally thought to occur in areas with permanent watercourses (Findley et al. 1975). We would classify Chaco Wash, the Chaco River, and auxiliary pools of water along canyon floors as intermittent sources of water. Thus, data reported by Valdez et al. (2002a) suggest that Yuma myotis may not always be associated with permanent sources of water in the state.

Lagomorphs. Two species of rabbits are known from CHCU, the desert cottontail and black-tailed jackrabbit (Table 14). Both Cully (1981) and our inventory documented these species at CHCU. A third species of rabbit might occur, the eastern cottontail (*S. floridanus*). We have only included it on the master list as unconfirmed because appropriate habitats for this species do not appear to exist at CHCU. Specimens of eastern cottontail are known from higher, more mesic habitats on Mt. Taylor. On a couple of occasions on Chacra Mesa and at Pueblo Pintado, we observed some cottontails that appeared to have shorter ears. This trait helps to separate these two species in other parts of its distribution, but it was not mentioned in Findley et al. (1975) as a meaningful trait in New Mexico. We feel it would be advantageous to collect specimens from Chacra Mesa to verify that the cottontails there are truly desert cottontail. Some recent work suggests that eastern cottontails from mountainous portions of western New Mexico represent another species, the Manzano mountain cottontail (*S. cognatus;* see Frey 2004).

Rodents. Twenty-one species of rodents have been documented from CHCU, including one historically reported species (Table 14). Of the 20 extant species, 17 were documented by Cully (1981), and we documented 19 species during our field efforts. In 2003, we captured two new species for the park, the brush mouse and western white-throated woodrat. The brush mouse was documented in brushy areas along bottoms of north-facing canyon walls and in rocky situations on Chacra Mesa. Western white-throated woodrats were captured in shrubby habitats on canyon floors, in rocky situations along canyon walls, and in rocky habitats on Chacra Mesa. These species are known from similar habitats across New Mexico (Findley et al. 1975), but were not detected during the survey by Cully (1981, 8,600 trap-nights). Thus, they may represent recent colonization events at CHCU; alternatively, their close morphological similarities with other species may have caused them to be overlooked.

Additional study of distributions and population sizes of woodrats at CHCU might be of interest. Our data suggest that white-

throated woodrats may have recently colonized the park and the distribution of bushy-tailed woodrats may have been reduced, at least on Chacra Mesa. An alternative explanation is that Cully (1981) misidentified some woodrats at CHCU.

We found white-throated woodrats to inhabit shrubby habitats on canyon floors, rocky habitats on canyon walls, and rocky habitats on Chacra Mesa, including areas with piñon-juniper woodland. Bushy-tailed woodrats were discovered to occur only in rocky habitats associated with steep cliff walls. We also found Stephen's woodrats at CHCU; they were most common on Chacra Mesa and north-facing canyon walls.

According to Hoffmeister (1986), *N. cinerea* in northern Arizona lives in cliffs and rocky crevices, and the presence of protective shelters in rocky walls appears more important than vegetative type. Findley et al. (1975) report that *N. cinerea* from northwestern New Mexico occurs along the bases of sandstone cliff s and lesser rock outcrops. These comments are in agreement with our captures of *N. cinerea* along steep cliff walls at CHCU. Hoffmeister (1986) notes that in Arizona, N. stephensi are found most frequently in piñon juniper woodland, especially where rocks are present; we documented *N. stephensi* in similar shrubby habitats. However, Cully (1981) reported *N. stephensi* from a wash dominated by perennial cover, grasses, and rabbitbrush and in a shrubby habitat dominated by saltbush and greasewood. In other parts of New Mexico, *N. albigula* is not dependent on rocks and occurs in a variety of habitats (Findley et al. 1975; Geluso and Geluso 2004; K. Geluso unpublished data). Thus, Cully's captures of Neotoma on canyon floors lacking rocks might actually have been *N. albigula*, and some of Cully's (1981) captures of *N. cinerea* may have been *stephensi*.

We confirmed the identification of brush mice at CHCU using a tooth character described by Hoffmeister (1986). Originally, we determined that a few individuals captured were brush mice based solely on pelage characteristics. Our identifications of these individuals were supported by the tooth characteristic. In contrast, we had six voucher specimens where the identification was problematic using pelage coloration. At first, we suspected these individuals might represent northern rock mice based on gray/yellow coloration of the dorsum. However, the tooth character revealed that all these individuals were brush mice, many of which were subadults based on the tooth wear. Again, it appears that adult mice (i.e., those with fairly worn molars) are moderately easy to identify by pelage coloration, but subadult individuals (i.e., those not in juvenile gray pelage but in recent adult pelage) are difficult to identify without examining the skulls. Adult brush mice generally can be distinguished from adult northern rock mice by the presence of orange/reddish coloration on the dorsum and rump; adult northern rock mice have a yellow/gray coloration on dorsum and rump.

Carnivores. Nine species of carnivores are known from CHCU (Table 14). Cully (1981) reported five species, and we documented six species during our field efforts. It is likely that three species of mesocarnivores will be found at CHCU eventually: ringtail (*Bassariscus astutus*), northern raccoon (*Procyon lotor*), and long-tailed weasel. We suspect these species currently occur at the park in low abundance. There is one documented record of an American black bear (*Ursus americanus*) from CHCU. On May 17, 2000, an individual was observed by the housing area. Photographs of tracks in the soil were taken by park personnel and placed in NPS files at the park.

Artiodactyls. Three species of ungulates are

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Mule deer (*Odocoileus hemionus*).

known from CHCU (Table 14). One of these, elk, is a relatively recent arrival to the park. Only within the last 10 years have elk been observed at CHCU. Today, approximately 50 individuals roam the park, including bulls, cows, and calves (B. Shattuck, pers. comm.). A study by researchers at New Mexico State University is currently investigating the usage and impacts of elk on different habitats in the park. We commonly observed elk on Chacra Mesa and along Chaco Wash. During our inventory, we found a horn sheath of a domestic goat (*Capra hircus*). Park employees report that feral individuals occasionally wander on park property.

El Malpaís National Monument

In 2003 and 2004, we worked 69 person-days, accrued 3,010 trap-nights, accumulated 9 net-nights, drove 6 hours spotlighting, and walked 108 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 10). Overall, we documented 45 species of mammals at ELMA (Table 11). We captured or observed sign of 737 mammals, including 12 species of bats, 2 species of lagomorphs, 20 species of rodents, 8 species of carnivores, and 3 species of ungulates (Table 11).

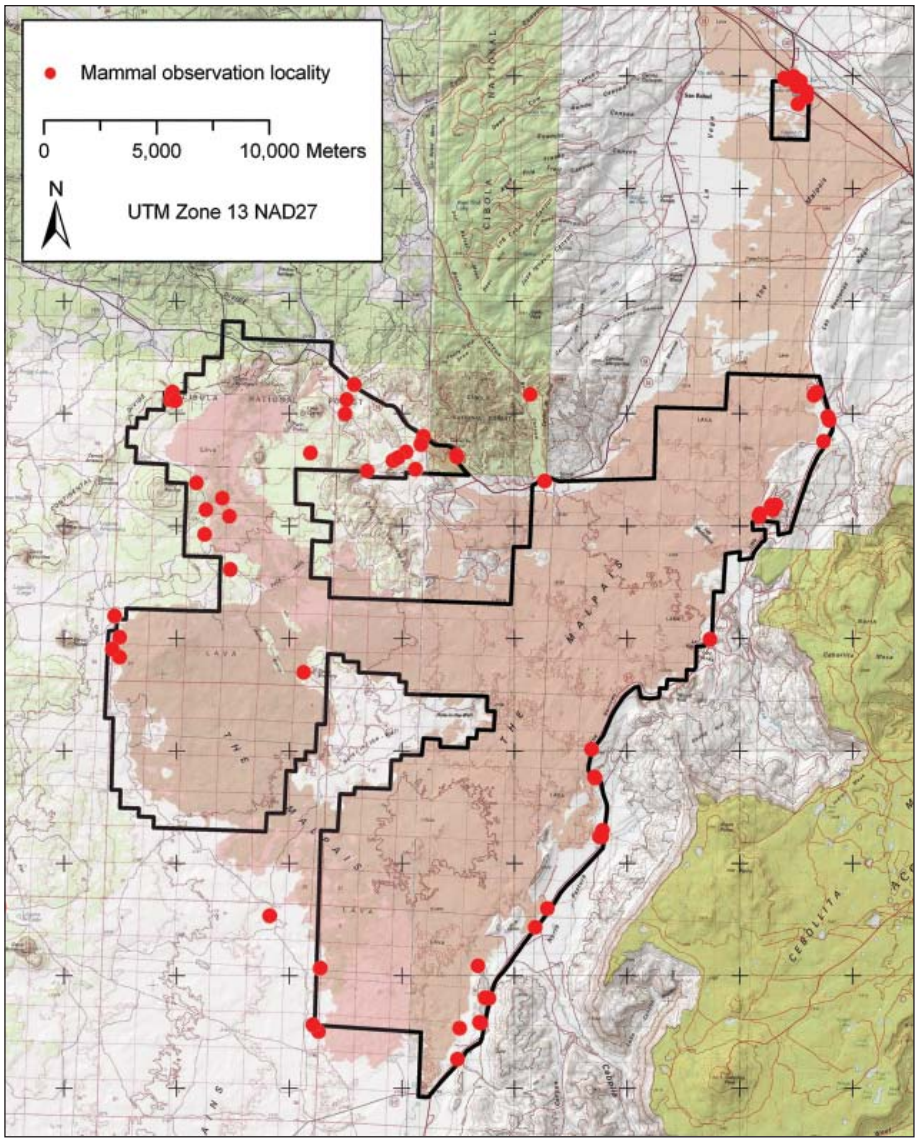
At present, we have documentation of 53 extant species of mammals at ELMA (Table 15). This number modestly exceeds the predicted species richness of 48 (Stuart 2000). Currently, the overall level of documentation for ELMA is 90%, with levels of documentation ranging from 0 to 100% for specific mammalian orders (Table 16). At present, shrews have the lowest documentation, at 0%, and bats, rabbits, and ungulates have the highest documentation, at 100% (Table 16). The previous level of documentation of mammals at ELMA was 66% (Table 16). This moderate level of documentation is a reflection of information gathered from an unpublished report by Valdez et al. (2002b) and from Hooper (1941). During our field efforts, we confirmed additional small mammals at ELMA and secured voucher material of one species of bat and 17 species of rodents (Table 15).

Insectivores. To date, there are no documented records of shrews from ELMA (Table 15). We suspect that Crawford's desert shrew occurs in grassland habitats around the edge of lava fields. The montane shrew may occur in the area, but this species is generally found at elevations above 7,500 ft in mesic situations (Findley et al. 1975). Both species of shrew may occur around ponds in the northwestern part of ELMA and in grassland habitats in the disjunct parcel of land near Grants, New Mexico.

Bats. Fourteen species of bats are known from ELMA (Table 15). Valdez et al. (2002b) originally reported 16 species. Valdez et al. (2002b) reported captures of the southwestern myotis (*Myotis auriculus*) from the park. We have examined their voucher material from ELMA and find these specimens are best referred to as long-eared myotis (*M. evotis*). Valdez et al. (2002b) also report the occurrence of Yuma myotis from the park, but noted that their documentation was problematic as this record was based on ultrasonic recordings. The calls may actually represent California myotis. Until more definitive evidence is presented for these two species, we have not included them as part of the mammalian fauna of the park (Table 15).

Valdez et al. (2002b) reported on the first records of spotted bats in Cibola County, on New Mexico Highway 117 between La Ventana Natural Arch and the Lava Falls parking lot. During our present inventory, we also heard the conspicuous, audible calls of spotted bats on park property near La Ventana Natural Arch in 2004.

On two occasions in 2004, we netted the entrance to the Bat Cave in the El Calderón Area. On May 27, we captured 10 Brazilian free-tailed bats, 4 Townsend's big-eared bats, and 2 California/western small-footed bats (*Myotis californicus*/*ciliolabrum*). We estimated the outflight of Brazilian free-tailed bats at approximately 75–100 individuals. We captured both sexes of *T. brasiliensis*, only female *C. townsendii*, and only male *M. californicus*/*ciliolabrum*. On August 27, we again netted the entrance to the Bat Cave and captured 50 *T. brasiliensis* (41 males and 9 females) and 1 *M. ciliolabrum,* but could not observe the outflight of bats. On August 28, we observed the emergence of bats from outside the lava tube. We would conservatively estimate the outflight of bats at 15,000–20,000 individuals. The outflight was continuous for almost an hour. As discussed



Map 8. Mammalian study sites, El Malpaís National Monument.

by Valdez et al. (2002b), we feel that the Bat Cave in the El Calderon area is very susceptible to human disturbance. Examination of the floor at the entrance to the cave showed a considerable number of human footprints, although there is a precautionary sign to inform and discourage public entry. We propose that consideration be given to exclude humans from this and other caves containing large numbers or maternity colonies of bats.

Lagomorphs. Two species of rabbits are known from ELMA, the desert cottontail and black-tailed jackrabbit (Table 15). Both Hooper (1941) and our inventory documented these species at the park.

Rodents. Twenty-two species of rodents are known from ELMA (Table 15). Hooper (1941) documented 14 species, and we documented 21 species during our inventory. In 2003 and 2004, our efforts yielded eight species previously undocumented at ELMA, including the Colorado chipmunk, spotted ground squirrel (*Spermophilus spilosoma*), plains pocket mouse, banner-tailed kangaroo rat (*Dipodomys spectabilis*), western harvest mouse, piñon mouse, tawny-bellied cotton rat (*Sigmodon fulviventer*), and Mogollon vole (*Microtus mogollonensis*). Many of these species were reported in the region by Hooper (1941), but documentation was lacking from ELMA or on lands immediately adjacent to park property.

Our most significant capture at ELMA was

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Desert cottontail (*Sylvilagus audubonii*).

the discovery of the tawny-bellied cotton rat. Our records of *S. fulviventer* represent a 108-km westward expansion of this species into west-central New Mexico. Individuals were captured in both 2003 and 2004, suggesting that grassy habitats on the disjunct part of the park near Grants provides a refugium for this and other grassland species during drought years (Geluso et al. 2005).

Both the Mogollon vole and western harvest mouse are of interest today because Hooper (1941) reported both species as rare in the region. Hooper captured only a single vole and two harvest mice during his entire survey in the region. In contrast, we captured six voles and 27 harvest mice during our inventory. Hooper (1941) noted that rarity of both species is probably due, in large part, to the scarcity of suitable habitats. Hooper reported that grass, weeds, and other low-lying vegetation were sparse and kept heavily grazed by livestock. The lack of grazing on lands administered by the NPS appears beneficial for grassland species.

The small parcel of land near Grants likely was acquired for the construction of the information center along Interstate 40. However, biologically, this land represents an important and unique habitat in the region. If additional lands in the area become available for purchase, the NPS may wish to consider purchasing such property. With additional surveys, other species of mammals not yet documented in the park may be found in these grassy and potentially mesic habitats. These species include the montane shrew, Crawford's desert shrew, white-footed mouse, southern plains woodrat (*Neotoma micropus*), meadow vole, house mouse, and northern raccoon.

The identifications of brush mice and northern rock mice at ELMA were confirmed using a tooth character described by Hoffmeister (1986). Originally, we determined that a handful of individuals kept as vouchers were brush mice, based solely on pelage characters. Our identifications of these individuals were supported by the tooth character. In addition, some individuals kept as voucher northern rock mice were confirmed with pelage and tooth characters. However, we discovered that a handful of subadult vouchers originally identified as northern rock mice were actually best referred to as brush mice.

Carnivores. Eleven species of carnivores have been documented from ELMA (Table 15). Hooper (1941) discovered that seven species were present, and our efforts documented nine species. We strongly suspect that an additional three species occur at ELMA but have gone undetected. These species include the northern raccoon, American badger (*Taxidea taxus*), and western spotted skunk. Our documentation of the red fox in west-central New Mexico suggests that it is more widespread in the state than previously thought (see Mikesic and Larue 2003). Only scattered records of red fox exist across the state, with most records located in the northwest and north-central parts of New Mexico. The record of white-backed hog-nosed skunk (*Conepatus leuconotus*) from ELMA is interesting to note. This record by Hooper (1941) represents one of the northernmost records for New Mexico. To our knowledge, there are no recent records for central or northern parts of the state in at least the last 50 years.

Artiodactyls. Five species of ungulates have been documented from ELMA, including one historically reported species (Table 15). Of the four extant species, two were documented by Hooper (1941). We documented three species during our field efforts.

Discussion

Our efforts to document mammalian species on these eight parks should be viewed as a work in progress. This is because several factors affect these efforts. One especially problematic question is exactly what list of species should be used as the measuring stick against which documentation is assessed. We have chosen to use a list of species that we deem "likely" to occur, based on our work, our knowledge of mammals of the Colorado Plateau, and pertinent references. These likely species are those listed as "Present" and "Probably Present" on our master species lists (Tables 5–9 and 13–15).

For smaller parks, this method may be somewhat too inclusive. For larger parks (such as BAND, CHCU, and ELMA), we suspect that this method better reflects current mammalian fauna. Current lists for those three parks probably are good "working" lists, at least at this point in time. Typically, it is those parks that had some demonstrated level of previous work, or for which a knowledgeable employee is present, that are closest to a 90% level of documentation.

Our estimates for inventory completeness increased moderately from those used by the SCPN as "starting points" for this inventory effort; see Figure 7 (Stuart 2000). The sources of the original estimates are unknown, but were probably local park staff. We believe that many parks overestimated the extent of documentation, perhaps because they worked from a smaller, less-inclusive list than we are using. Small, poorly-known, and secretive species such as bats and small rodents frequently were overlooked. Additionally, park staff may have been unaware of previous work, as it is not always well-documented or well-known in park files. Although at first glance the percentages appeared relatively accurate, the total number of species predicted in parks fell well short of total likely species.

Park size undoubtedly influences species diversity, and a variety of mathematical algorithms incorporate size in attempting to predict the numbers of species (but not actual species) that may occur in a park. However, the algorithms used by the SCPN to estimate species richness of mammals

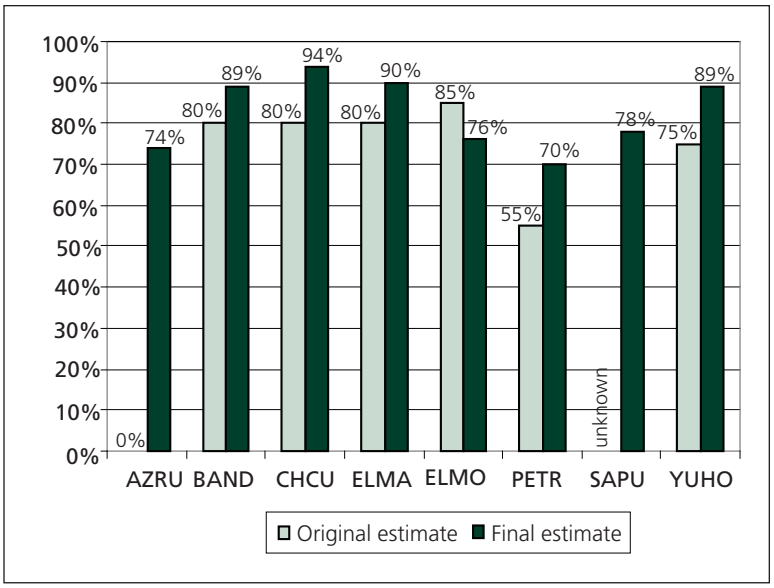

Figure 7. Estimates of inventory completeness.

on the parks (Stuart 2000) were flawed. In all cases but one, our documented species richness exceeded—usually considerably—these estimates. Our results at documenting species occurrence on SCPN parks during 2001–2003 were roughly the same (70–78%) regardless of size; the greatest level of documentation was for the smallest unit (YUHO, 89%). In 2003–2004, those figures were as follows (NPS estimate, followed by our final estimate): BAND (44%, 66%), CHCU (44%, 53%), and ELMA (48%, 59%).

Our previous experience in this effort has been that documentation levels are typically highest for larger parks. Although we predict more species of mammals at larger parks, it is not clear to us whether documentation would be predicted to be "easier" on large parks. Nonetheless, greater habitat diversity may lead to more places that can be sampled (e.g., pools for mistnetting bats), larger populations of some species (especially resident carnivores) that might make them relatively easier to document, a tendency to attract researchers who initiated studies that document mammals, and a greater likelihood that there will be resident NPS naturalists, biologists, or knowledgeable employees.

Another factor in assessing species occurrence is the biology of the animals that we are trying to document. It is a biological axiom that only a few species are truly common and most others are much less common to rare. The occur-

rence of common, widespread, and abundant species, such as deer mice, is easy to document, and our results offer visible proof of this (Tables 11 and 12). However, less common and rare species can be very difficult to document, and absolute absence is difficult to prove.

Long-term climate trends, as well as local weather conditions, also can affect inventory efforts. During much of our effort, the region was in a moderate to severe drought. In general, rodent populations are lower during drought than at times of greater precipitation. Other, more proximate factors that may interfere with inventory efforts include inclement weather, which can depress activity of small mammals (and mammalogists) and the efficiency of methods used to inventory them. Rainfall can dissolve bait, cause traps to trigger, and turn mistnets into soggy, nonfunctional curtains.

Aspects of climate and, especially, availability of water also affect our ability to inventory bats. Bats are dependent on the availability of roosting sites, water sources, and adequate prey. The extent of available water in a given area, as well as subtleties of pond shape and size, can affect capture success of bats (Kunz and Kurta 1988; K. N. Geluso, pers. comm.). Typically, captures of bats in mistnets are lower when water is abundant, as the bats seem to be more dispersed over the landscape. When water sources are fewer, bats tend to concentrate at those waterholes that are available (mammalogists exploit this tendency when possible).

Finally, landscape changes at the parks can affect our results. For example, portions of BAND burned prior to our inventory efforts in 2003, and we do not know how, or if, that influenced our results at that park. Likewise, subtle seasonal changes in the natural history of different species or the physical environment may influence inventory efforts.

Conclusions

We believe the task of documenting 90% of expected species of mammals in these eight national parks was successful, given available time and funding. We obtained higher levels of overall documentation for the 3-park work when compared both to our previous efforts in the Northern Colorado Plateau Network and the earlier 5-park work in the SCPN (see Figure. 7). To some extent, this may reflect the talents of the field mammalogists conducting the inventory. However, it seems more likely that the earlier work on bats at BAND, CHCU, and ELMA, subsequently allowed us the luxury of a more focused effort on non-volant mammals. The earlier work on bats, using methods consistent with the later inventories, essentially provided for the equivalent of a four-year effort at BAND, CHCU, and ELMA. For biologists and administrators contemplating new inventories, this is worth noting.

AZRU, ELMO, PETR, SAPU, and YUHO

We documented the more common species and were relatively successful at documenting the less common species. Now, at AZRU, ELMO, PETR, SAPU, and YUHO, there remain an additional 10–15 expected species that we were unable to document. Probably not all of these 10–15 species occur on any one park, but finding those that do will require effort beyond the two-year duration of our work. Our comments in the summary for each park note those groups for which we think some additional work would be fruitful and provide some idea of the difficulty of that task. For AZRU, ELMO, PETR, SAPU, and YUHO, insectivore documentation varies from 0 to 100%, bats from 57 to 100%, lagomorphs from 0 to 75%, carnivores from 44 to 93%, and artiodactyls from 0 to 100%.

BAND, CHCU, and ELMA

At BAND, CHCU, and ELMA, the number of species requiring additional effort is about six species per park. Documentation of insectivores varies from 0 to 100%, bats appear complete at 100%, lagomorphs appear complete at 100%, rodents vary from 92 to 100%, carnivores vary from 79 to 85%, and artiodactyls vary from 75 to 100%.

Recommendations

The following list represents some of the most significant or important issues concerning future monitoring or documentation of mammals at BAND, CHCU, and ELMA:

Bandelier National Monument

a) monitor populations of mammals (e.g., American pika, bushy-tailed woodrat, southern red-backed vole) restricted to high elevations;

b) search for additional species of shrews with pitfall traps;

c) trap upper regions of canyons (e.g., Cañon de los Frijoles) in fairly lush, low-growing vegetation adjacent to streams for the meadow jumping mouse; and

d) monitor the response of mammals (from shrews to ungulates) in prescribed burns as well as areas burned by catastrophic fires (e.g. the Cerro Grande fire).

Chaco Culture National Historical Park

a) trap for Crawford's desert shrew using pitfall traps to properly document its occurrence in the park;

b) mistnet large, open sources of water for the big free-tailed bat;

c) determine if only one species of cottontail occurs on Chacra Mesa by obtaining some voucher specimens;

d) monitor populations of woodrats throughout the park in various habitats;

e) use mid- to large-sized Tomahawk traps to attempt to document a number of mesocarnivores suspected to occur at the park; and

f) examine the response of vegetation to the recent encroachment of elk on the park.

El Malpaís National Monument

a) trap for shrews using pitfall traps in grassy habitats in the disjunct parcel of land by Interstate 40;

b) monitor the status of small mammals on this same parcel of land (i.e., the continued presence of tawny-bellied cotton rat, the possible expansion of white-footed mouse into the region, and the expected house mouse); and determine if the colony of Brazilian free-tailed bats at the Bat Cave represents a maternity colony.

All parks

If it is important to document remaining species, careful thought should be given to the following:

a) Inventories are different than monitoring, and the two should not be confused.

b) Inventories require specialists who are familiar with the region and its species.

c) A standard museum voucher specimen is the only evidence that is unequivocal.

d) Rare and uncommon species still needing documentation are unlikely to be found as a result of random surveys.

e) Levels of precision for associated data (e.g., GPS coordinates) should be determined in advance and with thought given to the mobility of the species.

f) Sufficient time must be allocated to accomplish the task.

g) Sufficient funding must be allocated to accomplish the task.

h) The overall task should be realistic, given available time and funding, and investigators should not be saddled with a plethora of additional tasks (e.g., database building, photography, etc.) that may have little or no bearing on their primary task of an inventory of a given group of species.

i) By definition, inventories of groups of organisms on national parks is a "field" task; investigators should not have to choose between spending time in the field versus spending time in the office.

We have been asked to provide our comments on the next phase of this program, namely monitoring. We are aware that intensive discussions have already occurred on this topic, and will keep our comments to a minimum. We encourage parks and networks to consider assigning priority for monitoring to:

a) species known to be declining on the basis of statistically defensible trend data, where such data exist;

b) species that are unique to a given park, or a region within which a park occurs;

and

c) areas or habitats that are unique to a park, especially those areas that appear to have high biological diversity (noted in text and tables in this report).

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Tables

Table 1. Field schedule and summary of effort for mammal inventories conducted during 2001–2003 at AZRU, ELMO, PETR, SAPU, and YUHO.

Date(s)	Park visited	Observer(s)	Person-days	Trap-nights	Net-nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
June 4–6, 2001	PETR	M. Bogan S. Haymond E. Valdez and field technicians	35	1,012				small mammal traplines
June 10–14, 2001	PETR	D. Chavez E. Taylor C. Ramotnik L. Garcia	16	440				small mammal traplines
June 17, 2001	PETR	D. Chavez E. Taylor L. Garcia	3	80				small mammal traplines
June 18–21, 2001	AZRU	D. Chavez C. Ramotnik E. Taylor L. Garcia	12	440				small mammal traplines
June 25–29, 2001	SAPU	M. Bogan D. Chavez T. Hayward E. Taylor	14	800				small mammal traplines
June 28–July 2, 2001	YUHO	E. Valdez R. Rodriguez	10		17			mistnet; acoustic sampling
July 1–5, 2001	SAPU	D. Chavez E. Taylor T. Hayward	14	800				small mammal traplines
July 3–4, 2001	AZRU	E. Valdez R. Rodriguez	4		4			mistnet; acoustic sampling
July 8–12, 2001	SAPU	D. Chavez E. Taylor	10	836				small mammal traplines
July 24–26, 2001	SAPU	E. Valdez R. Rodriguez	6		8			mistnet; acoustic sampling
July 28–29, 2001	AZRU	E. Valdez R. Rodriguez	4	80	4			small mammal traplines; mistnet; acoustic sampling
July 30–August 1, 2001	YUHO	E. Valdez R. Rodriguez	12	240	9			small mammal traplines; mistnet; acoustic sampling
August 13–16, 2001	AZRU	D. Chavez E. Taylor	8	400				small mammal traplines
September 13, 2001	YUHO	D. Chavez S. Haymond	2	160				small mammal traplines
September 19–20, 2001	SAPU	D. Chavez	2	160				small mammal traplines

Table 1. Field schedule and summary of effort for mammal inventories conducted during 2001–2003 at AZRU, ELMO, PETR, SAPU, and YUHO, cont.

Date(s)	Park visited	Observer(s)	Person-days	Trap-nights	Net-nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
September 27, 2001	PETR	D. Chavez S. Haymond E. Valdez	3	120				small mammal traplines
October 2, 2001	PETR	D. Chavez S. Haymond	2	80				small mammal traplines
October 9, 2001	PETR	S. Haymond	1	40				small mammal trapline
May 20–22, 2002	AZRU	L. Harding S. Haymond E. Valdez	7	80	8	5.0	6.9	mistnets, small mammal traplines, acoustic surveys, track-scat survey, small carnivore traplines
May 22–25, 2002	PETR	L. Harding S. Haymond E. Valdez	10	160		5.0	23.2	small mammal traplines, acoustic surveys, track-scat survey
May 25–28, 2002	SAPU	P. Cryan L. Harding S. Haymond E. Valdez	11	9	5	7.1	13.6	mistnets, acoustic surveys, track-scat survey, small carnivore traplines
May 29, 2002	PETR	L. Harding S. Haymond E. Valdez C. Viana	4	40		2.1	5.4	acoustic surveys, small mammal traplines, spotlighting
June 3–9, 2002	YUHO	S. Haymond E. Valdez	6		6	9.3		mistnets, acoustic surveys
	PETR	M. Bogan	4					area searches
June 10–14, 2002	PETR	S. Haymond E. Valdez	6	80		4.6		small mammal traplines, acoustic surveys
	ELMO	M. Bogan C. Ramotnik	8	320				small mammal traplines
June 18–21, 2002	SAPU	M. Bogan C. Ramotnik	8	493				small mammal traplines; snap traps
July 2–3, 2002	YUHO	L. Harding	1				6.2	track-scat survey
July 15–18, 2002	ELMO	S. Haymond E. Valdez L. Harding	8		4	10.3	16.5	mistnets, acoustic surveys, track-scat survey, spotlighting
July 19, 2002	AZRU	E. Valdez	1		3	3.1		mistnets, acoustic surveys
August 22, 2002	SAPU	P. Cryan E. Valdez	2		2	1.5		mistnets, acoustic surveys
September 19–21, 2002	YUHO	M. Bogan C. Ramotnik	6	240				small mammal traplines
October 4–6, 2002	AZRU	M. Bogan	3					opportunistic

Table 1. Field schedule and summary of effort for mammal inventories conducted during 2001–2003 at AZRU, ELMO, PETR, SAPU, and YUHO, cont.

Date(s)	Park visited	Observer(s)	Person-days	Trap-nights	Net-nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
October 16–17, 2002	ELMO	M. Bogan C. Ramotnik	4	120				small mammal traplines
May 1–4, 2003	AZRU	K. Geluso	4	197				small mammal traplines; snap traps
May 2–3, 2003	YUHO	K. Geluso	2	64				small mammal traplines; snap traps
May 4–6, 2003	ELMO	K. Geluso	3	163				small mammal traplines
May 7–8, 2003	SAPU	K. Geluso	2	87	2			small mammal traplines; gopher traps; snap traps; mistnets
May 12–13, 2003	PETR	K. Geluso	2	170				small mammal traplines; snap traps
September 12–14, 2003	YUHO	T. Mollhagen	3	160				small mammal traplines
November 11–13, 2003	YUHO	L. Harding	3	240			5.0	small mammal traplines; track-scat survey
Total			**265**	**8,311**	**72**	**48.0**	**77.0**	

Table 2. Summary of mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO.

		Park code						
Order	**Scientific name**	**AZRU**	**ELMO**	**PETR**	**SAPU**	**YUHO**	**YUHO/ Ismay**	**Total**
Chiroptera	*Myotis californicus*	1	1		1		3	6
	Myotis ciliolabrum	7	3	3	3		11	27
	Myotis evotis		2				6	8
	Myotis lucifugus	1	5				2	8
	Myotis sp.				1			1
	Myotis thysanodes		4		5		5	14
	Myotis volans		2		7		8	17
	Myotis yumanensis	3	1		3		2	9
	Lasionycteris noctivagans				10			10
	Pipistrellus hesperus				1		3	4
	Eptesicus fuscus	15	11	3	2		14	45
	Lasiurus cinereus		1		21		2	24
	Euderma maculatum	1	1				6	8
	Idionycteris phyllotis	1						1
	Corynorhinus townsendii		1		5		1	7
	Antrozous pallidus	7	5		3			15
	Tadarida brasiliensis	6	4	2	3		5	20
	Nyctinomops macrotis	2		2			2	6
Lagomorpha	*Sylvilagus audubonii*	4	1	2	2		2	11
	Sylvilagus sp.				1			1
	Lepus californicus		1	2	1		1	5
Rodentia	*Neotamias dorsalis*		2					2
	Neotamias minimus				1			1
	Ammospermophilus leucurus			4				4
	Spermophilus variegatus	2	1	2	2	1	1	9
	Spermophilus?				1			1
	Cynomys gunnisoni	2					1	3
	Thomomys bottae	1			2			3
	Perognathus flavescens		4		5			9
	Perognathus flavus	8		13	9		2	32
	Chaetodipus intermedius			2				2
	Dipodomys ordii	1	5	17	15			38
	Castor canadensis	1						1
	Reithrodontomys megalotis	23	2		7	6	9	47
	Peromyscus boylii	2	12		45		4	63
	Peromyscus crinitus						1	1
	Peromyscus eremicus			46	1			47
	Peromyscus leucopus	1			60			61
	Peromyscus maniculatus	31	19	26	17	5	53	151

Table 2. Summary of mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO, cont.

		Park code						
Order	**Scientific name**	**AZRU**	**ELMO**	**PETR**	**SAPU**	**YUHO**	**YUHO/ Ismay**	**Total**
Rodentia, cont.	*Peromyscus nasutus*		1					1
	Peromyscus truei	10	19		22		46	97
	Onychomys leucogaster	2	1	5	12			20
	Sigmodon hispidus				12			12
	Neotoma albigula	2	3	25	28		2	60
	Neotoma mexicana		5					5
	Neotoma sp.	1	1					2
	Microtus mogollensis		1		14	1		16
	Microtus montanus					3		3
	Microtus pennsylvanicus	4						4
	Microtus sp.				1			1
	Ondatra zibethicus	1						1
	Mus musculus	21			1			22
	Erethizon dorsatum		2	2	2			6
Carnivora	*Canis latrans*	7	4	4	6	7	2	30
	Vulpes macrotis						1	1
	Vulpes vulpes				1			1
	Urocyon cinereoargenteus		2				1	3
	Ursus americanus		2					2
	Bassariscus astutus						2	2
	Procyon lotor	1				1		2
	Mustela frenata		1		1			2
	Taxidea taxus	1	1				1	3
	Spilogale gracilis	1						1
	Mephitis mephitis	3					1	4
	Puma concolor				3			3
	Lynx rufus	1				2	1	4
Artiodactyla	*Odocoileus hemionus*	3		1	3		1	8
Total		**178**	**131**	**161**	**340**	**26**	**202**	**1,038**

Table 3. Percent relative abundance for mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO.

		Park code						
Order	**Scientific name**	**AZRU**	**ELMO**	**PETR**	**SAPU**	**YUHO**	**YUHO/Ismay**	**Total**
Chiroptera	*Myotis californicus*	0.6	0.8		0.3		1.5	0.6
	Myotis ciliolabrum	3.9	2.3	1.9	0.9		5.4	2.6
	Myotis evotis		1.5				3.0	0.8
	Myotis lucifugus	0.6	3.8				1.0	0.8
	Myotis sp.				0.3			0.1
	Myotis thysanodes		3.1		1.5		2.5	1.3
	Myotis volans		1.5		2.1		4.0	1.6
	Myotis yumanensis	1.7	0.8		0.9		1.0	0.9
	Lasionycteris noctivagans				2.9			1.0
	Pipistrellus hesperus				0.3		1.5	0.4
	Eptesicus fuscus	8.4	8.4	1.9	0.6		6.9	4.3
	Lasiurus cinereus		0.8		6.2		1.0	2.3
	Euderma maculatum	0.6	0.8				3.0	0.8
	Idionycteris phyllotis	0.6						0.1
	Corynorhinus townsendii		0.8		1.5		0.5	0.7
	Antrozous pallidus	3.9	3.8		0.9			1.4
	Tadarida brasiliensis	3.4	3.1	1.2	0.9		2.5	1.9
	Nyctinomops macrotis	1.1		1.2			1.0	0.6
Lagomorpha	*Sylvilagus auduboni*	2.2	0.8	1.2	0.6		1.0	1.1
	Sylvilagus sp.				0.3			0.1
	Lepus californicus		0.8	1.2	0.3		0.5	0.5
Rodentia	*Neotamias dorsalis*		1.5					0.2
	Neotamias minimus				0.3			0.1
	Ammospermophilus lecurus			2.5				0.4
	Spermophilus variegatus	1.1	0.8	1.2	0.6	3.8	0.5	0.9
	Spermophilus?				0.3			0.1
	Cynomys gunnisoni	1.1					0.5	0.3
	Thomomys bottae	0.6			0.6			0.3
	Perognathus flavescens		3.1		1.5			0.9
	Perognathus flavus	4.5		8.1	2.6		1.0	3.1
	Chaetodipus intermedius			1.2				0.2
	Dipodomys ordii	0.6	3.8	10.6	4.4			3.7
	Castor canadensis	0.6						0.1
	Reithrodontomys megalotis	12.9	1.5		2.1	23.1	4.5	4.5
	Peromyscus boylii	1.1	9.2		13.2		2.0	6.1
	Peromyscus crinitus						0.5	0.1
	Peromyscus eremicus			28.6	0.3			4.5
	Peromyscus leucopus	0.6			17.6			5.9
	Peromyscus maniculatus	17.4	14.5	16.1	5.0	19.2	26.2	14.5
	Peromyscus nasutus		0.8					0.1
	Peromyscus truei	5.6	14.5		6.5		22.8	9.3

Table 3. Percent relative abundance for mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO, cont.

Order	Scientific name	Park code						Total
		AZRU	ELMO	PETR	SAPU	YUHO	YUHO/Ismay	
Rodentia, cont.	*Onychomys leucogaster*	1.1	0.8	3.1	3.5			1.9
	Sigmodon hispidus				3.5			1.2
	Neotoma albigula	1.1	2.3	15.5	8.2		1.0	5.8
	Neotoma mexicana		3.8					0.5
	Neotoma sp.	0.6	0.8					0.2
	Microtus mogollensis		0.8		4.1	3.8		1.5
	Microtus montanus					11.5		0.3
	Microtus pennsylvanicus	2.2						0.4
	Microtus sp.				0.3			0.1
	Ondatra zibethicus	0.6						0.1
	Mus musculus	11.8			0.3			2.1
	Erethizon dorsatum		1.5	1.2	0.6			0.6
Carnivora	*Canis latrans*	3.9	3.1	2.5	1.8	26.9	1.0	2.9
	Vulpes macrotis						0.5	0.1
	Vulpes vulpes				0.3			0.1
	Urocyon cinereoargenteus		1.5				0.5	0.3
	Ursus americanus		1.5					0.2
	Bassariscus astutus						1.0	0.2
	Procyon lotor	0.6				3.8		0.2
	Mustela frenata		0.8		0.3			0.2
	Taxidea taxus	0.6	0.8				0.5	0.3
	Spilogale gracilis	0.6						0.1
	Mephitis mephitis	1.7					0.5	0.4
	Puma concolor				0.9			0.3
	Lynx rufus	0.6				7.7	0.5	0.4
Artiodactyla	*Odocoileus hemionus*	1.7		0.6	0.9		0.5	0.8
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4. Level of documentation for major groups of mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO.

Order	Number of species possible	Number of species likely	Number of species present			Percent of likely species		
			2001	2002	FINAL	2001	2002	FINAL
AZRU								
Insectivora	3	1	0	0	0	0	0	0
Chiroptera	17	15	7	8	9	47	53	60
Lagomorpha	3	2	2	2	2	100	100	100
Rodentia	23	19	7	12	16	37	63	84
Carnivora	17	9	1	6	7	11	67	78
Artiodactyla	3	1	1	1	1	100	100	100
Total	**66**	**47**	**18**	**29**	**35**	**38%**	**62%**	**74%**
ELMO								
Insectivora	3	1	0	0	0	0	0	0
Chiroptera	18	18	0	13	13	0	72	72
Lagomorpha	3	2	0	1	2	0	50	100
Rodentia	24	19	0	11	16	0	58	84
Carnivora	16	10	0	5	7	0	50	70
Artiodactyla	3	1	0	0	1	0	0	100
Total	**67**	**51**	**0**	**30**	**39**	**0%**	**59%**	**76%**
PETR								
Insectivora	3	1	0	0	0	0	0	0
Chiroptera	14	14	2	5	5	14	36	36
Lagomorpha	3	3	2	2	2	67	67	67
Rodentia	28	22	18	20	21	82	91	95
Carnivora	16	8	3	5	6	38	63	75
Artiodactyla	3	2	0	1	1	0	50	50
Total	**67**	**50**	**25**	**33**	**35**	**50%**	**66%**	**70%**
SAPU								
Insectivora	4	1	0	0	0	0	0	0
Chiroptera	18	13	7	11	11	54	85	85
Lagomorpha	3	3	2	2	2	67	67	67
Rodentia	32	24	20	20	22	83	83	92
Carnivora	16	12	2	5	7	17	42	58
Artiodactyla	5	2	1	1	1	50	50	50
Total	**78**	**55**	**32**	**39**	**43**	**58%**	**71%**	**78%**

Table 4. Level of documentation for major groups of mammals captured or observed during 2001–2003 inventories at AZRU, ELMO, PETR, SAPU, and YUHO, cont.

Order	Number of species possible	Number of species likely	Number of species present			Percent of likely species		
			2001	2002	FINAL	2001	2002	FINAL
YUHO								
Insectivora	4	1	0	0	0	0	0	0
Chiroptera	17	16	12	15	15	75	94	94
Lagomorpha	3	3	3	3	3	100	100	100
Rodentia	24	21	15	15	19	71	71	90
Carnivora	16	13	11	11	11	85	85	85
Artiodactyla	4	3	2	2	3	67	67	100
Total	**68**	**57**	**43**	**46**	**51**	**75%**	**81%**	**89%**

Table 5. Master list of mammals of Aztec Ruins National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex merriami*	Merriam's shrew	Unconfirmed	
	Sorex nanus	dwarf shrew	Unconfirmed	
	Notiosorex crawfordi	desert shrew	Probably present	Hall 1981
Chiroptera	*Myotis californicus*	California myotis	Present	USGS acoustic file, 2002
	Myotis ciliolabrum	western small-footed bat	Present	USGS voucher, 2001
	Myotis evotis	long-eared myotis	Unconfirmed	
	Myotis lucifugus	little brown bat	Present	USGS acoustic file, 2002
	Myotis thysanodes	fringed myotis	Unconfirmed	
	Myotis volans	long-legged myotis	Probably present	
	Myotis yumanensis	Yuma myotis	Present	USGS capture, 2001
	Lasionycteris noctivagans	silver-haired bat	Probably present	
	Pipistrellus hesperus	western pipistrelle	Probably present	
	Eptesicus fuscus	big brown bat	Present	USGS capture, 2001
	Lasiurus cinereus	hoary bat	Probably present	
	Euderma maculatum	spotted bat	Present	USGS vocaliz., 2001; Findley et al. 1975
	Idionycteris phyllotis	Allen's big-eared bat	Probably present	one fragmented call heard
	Corynorhinus townsendii	Townsend's big-eared bat	Probably present	
	Antrozous pallidus	pallid bat	Present	USGS voucher, 2001
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS acoustic file, 2001
	Nyctinomops macrotis	big free-tailed bat	Present	USGS vocalization, 2001
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS observation, 2001; Findley et al. 1975
	Sylvilagus nuttallii	mountain cottontail	Unconfirmed	
	Lepus californicus	black-tailed jackrabbit	Present	Findley et al. 1975
Rodentia	*Neotamias quadrivittatus*	Colorado chipmunk	Unconfirmed	
	Ammospermophilus leucurus	white-tailed antelope squirrel	Probably present	
	Spermophilus spilosoma	spotted ground squirrel	Probably present	
	Spermophilus variegatus	rock squirrel	Present	USGS observation, 2002
	Cynomys gunnisoni	Gunnison's prairie-dog	Present	USGS observation, 2002
	Thomomys bottae	Botta's pocket gopher	Present	USGS observation, 2002
	Perognathus flavescens	plains pocket mouse	Probably present	
	Perognathus flavus	silky pocket mouse	Present	USGS voucher, 2003; Findley et al. 1975
	Dipodomys ordii	Ord's kangaroo rat	Present	USGS voucher, 2003
	Castor canadensis	American beaver	Present	USGS observation, 2002
	Reithrodontomys megalotis	western harvest mouse	Present	USGS voucher, 2001; Findley et al. 1975
	Peromyscus boylii	brush mouse	Present	USGS capture, 2001; Findley et al. 1975
	Peromyscus crinitus	canyon mouse	Unconfirmed	Findley et al. 1975

Table 5. Master list of mammals of AZRU, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Peromyscus maniculatus*	deer mouse	Present	USGS capture, 2001; Findley et al. 1975
	Peromyscus truei	piñon mouse	Present	USGS voucher, 2003; Findley et al. 1975
	Onychomys leucogaster	northern grasshopper mouse	Present	USGS voucher, 2003
	Neotoma albigula	white-throated woodrat	Present	USGS voucher, 2003
	Neotoma mexicana	Mexican woodrat	Unconfirmed	
	Neotoma stephensi	Stephen's woodrat	Unconfirmed	
	Microtus pennsylvanicus	meadow vole	Present	USGS voucher, 2003
	Ondatra zibethicus	common muskrat	Present	USGS observation, 2002
	Mus musculus	house mouse	Present	USGS voucher, 2001; Findley et al. 1975
	Erethizon dorsatum	common porcupine	Present	NPS observation, 2002
Carnivora	*Canis latrans*	coyote	Present	USGS observation, 2002
	Canis lupus	gray wolf	Unconfirmed	may have occurred historically
	Vulpes macrotis	kit fox	Unconfirmed	
	Vulpes vulpes	red fox	Present	NPS observation, 2002
	Urocyon cinereoargenteus	common gray fox	Probably present	
	Ursus americanus	black bear	Unconfirmed	
	Ursus arctos	grizzly bear	Unconfirmed	may have occurred historically
	Bassariscus astutus	ringtail	Unconfirmed	
	Procyon lotor	common raccoon	Present	USGS observation, 2002
	Mustela frenata	long-tailed weasel	Probably present	
	Mustela nigripes	black-footed ferret	Unconfirmed	may have occurred historically
	Mustela vison	American mink	Unconfirmed	
	Taxidea taxus	American badger	Present	USGS observation, 2002
	Spilogale gracilis	western spotted skunk	Present	USGS observation, 2001
	Mephitis mephitis	striped skunk	Present	USGS voucher, 2002
	Puma concolor	mountain lion	Unconfirmed	
	Lynx rufus	bobcat	Present	USGS observation, 2002
Artiodactyla	*Cervus elaphus*	elk	Unconfirmed	
	Odocoileus hemionus	mule deer	Present	UGSS observation, 2001
	Antilocapra americana	pronghorn	Unconfirmed	

Table 6. Master list of mammals of El Morro National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex merriami*	Merriam's shrew	Unconfirmed	
	Sorex nanus	dwarf shrew	Unconfirmed	
	Notiosorex crawfordi	desert shrew	Probably present	
Chiroptera	*Myotis auriculus*	southwestern myotis	Probably present	
	Myotis californicus	California myotis	Present	USGS acoustic file, 2002
	Myotis ciliolabrum	Western small-footed bat	Present	USGS acoustic file, 2002
	Myotis evotis	long-eared myotis	Present	USGS voucher, 2002
	Myotis lucifugus	little brown bat	Present	USGS voucher, 2002
	Myotis thysanodes	fringed myotis	Present	USGS voucher, 2002
	Myotis volans	long-legged myotis	Present	USGS voucher, 2002
	Myotis yumanensis	Yuma myotis	Present	USGS acoustic file, 2002
	Lasionycteris noctivagans	silver-haired bat	Probably present	Findley et al. 1975; Zuni Mts.
	Pipistrellus hesperus	Western pipistrelle	Probably present	
	Eptesicus fuscus	big brown bat	Present	USGS voucher, 2002
	Lasiurus cinereus	hoary bat	Present	USGS acoustic file, 2002
	Euderma maculatum	spotted bat	Present	USGS vocalization, 2002
	Idionycteris phyllotis	Allen's big-eared bat	Probably present	
	Corynorhinus townsendii	Townsend's big-eared bat	Present	USGS acoustic file, 2002
	Antrozous pallidus	pallid bat	Present	USGS voucher, 2002
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS acoustic file, 2002
	Nyctinomops macrotis	big free-tailed bat	Probably present	
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS observation, 2002
	Sylvilagus floridanus	Eastern cottontail	Unconfirmed	
	Lepus californicus	black-tailed jackrabbit	Present	
Rodentia	*Neotamias dorsalis*	cliff chipmunk	Present	USGS voucher, 2002
	Neotamias quadrivittatus	Colorado chipmunk	Probably present	Findley et al. 1975; Zuni Mts.
	Spermophilus spilosoma	spotted ground squirrel	Unconfirmed	
	Spermophilus variegatus	rock squirrel	Present	USGS observation, 2003
	Cynomys gunnisoni	Gunnison's prairie-dog	Present	USGS observation, 2003
	Sciurus aberti	Abert's squirrel	Unconfirmed	Findley et al. 1975; Zuni Mts.
	Thomomys bottae	Botta's pocket gopher	Present	USGS observation, 2003
	Perognathus flavescens	Plains pocket mouse	Present	USGS voucher, 2002
	Perognathus flavus	silky pocket mouse	Probably present	Findley et al. 1975
	Dipodomys ordii	Ord's kangaroo rat	Present	USGS voucher, 2003
	Dipodomys spectabilis	banner-tailed kangaroo rat	Unconfirmed	
	Reithrodontomys megalotis	western harvest mouse	Present	USGS voucher, 2003
	Peromyscus boylii	brush mouse	Present	USGS voucher, 2002

Table 6. Master list of mammals of ELMO, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Peromyscus maniculatus*	deer mouse	Present	USGS voucher, 2002
	Peromyscus truei	piñon mouse	Present	USGS voucher, 2002
	Peromyscus nasutus	northern rock mouse	Present	USGS voucher, 2003; Findley et al. 1975
	Onychomys leucogaster	northern grasshopper mouse	Present	USGS voucher, 2002
	Neotoma albigula	white-throated woodrat	Present	USGS voucher, 2002
	Neotoma mexicana	Mexican woodrat	Present	USGS voucher, 2002
	Neotoma micropus	southern plains woodrat	Unconfirmed	
	Neotoma stephensi	Stephen's woodrat	Probably present	
	Microtus mogollensis	Mogollon vole	Present	USGS voucher, 2002
	Mus musculus	house mouse	Unconfirmed	
	Erethizon dorsatum	common porcupine	Present	USGS observation, 2002
Carnivora	*Canis latrans*	coyote	Present	USGS observation, 2002
	Canis lupus	gray wolf	Unconfirmed	
	Vulpes macrotis	kit fox	Unconfirmed	
	Vulpes vulpes	red fox	Unconfirmed	
	Urocyon cinereoargenteus	common gray fox	Present	USGS observation, 2002
	Ursus americanus	black bear	Present	USGS observation, 2002
	Ursus arctos	grizzly bear	Unconfirmed	
	Bassariscus astutus	ringtail	Probably present	
	Procyon lotor	common raccoon	Unconfirmed	
	Mustela frenata	long-tailed weasel	Present	USGS observation, 2002
	Mustela nigripes	black-footed ferret	Unconfirmed	Findley et al. 1975; "Agua Fria"
	Taxidea taxus	American badger	Present	USGS observation, 2002
	Spilogale gracilis	western spotted skunk	Probably present	
	Mephitis mephitis	striped skunk	Probably present	Findley et al. 1975; Zuni Mts.
	Puma concolor	mountain lion	Present	Observations by park staff
	Lynx rufus	bobcat	Present	Observations by park staff
Artiodactyla	*Cervus elaphus*	elk	Unconfirmed	
	Odocoileus hemionus	mule deer	Present	USGS observation, 2003
	Antilocapra americana	pronghorn	Unconfirmed	

Table 7. Master list of mammals of Petroglyph National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex merriami*	Merriam's shrew	Unconfirmed	
	Sorex nanus	dwarf shrew	Unconfirmed	
	Notiosorex crawfordi	desert shrew	Probably present	
Chiroptera	*Myotis californicus*	California myotis	Probably present	
	Myotis ciliolabrum	western small-footed bat	Present	USGS acoustic file, 2002
	Myotis lucifugus	little brown bat	Probably present	presumably = *M. velifer* of Parmenter and Lightfoot
	Myotis thysanodes	fringed myotis	Probably present	
	Myotis yumanensis	Yuma myotis	Probably present	
	Lasionycteris noctivagans	silver-haired bat	Present	MSB specimen
	Pipistrellus hesperus	western pipistrelle	Probably present	
	Eptesicus fuscus	big brown bat	Present	USGS acoustic file, 2002
	Lasiurus cinereus	hoary bat	Probably present	
	Euderma maculatum	spotted bat	Probably present	Findley et al. 1975
	Corynorhinus townsendii	Townsend's big-eared bat	Probably present	
	Antrozous pallidus	pallid bat	Probably present	
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS acoustic file, 2002
	Nyctinomops macrotis	big free-tailed bat	Present	USGS vocalization, 2001
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS voucher, 2001; MSB specimen
	Sylvilagus floridanus	eastern cottontail	Probably present	
	Lepus californicus	black-tailed jackrabbit	Present	USGS observation, 2001
Rodentia	*Neotamias dorsalis*	cliff chipmunk	Unconfirmed	
	Ammospermophilus leucurus	white-tailed antelope squirrel	Present	USGS voucher, 2002
	Spermophilus spilosoma	spotted ground squirrel	Present	MSB specimen
	Spermophilus variegatus	rock squirrel	Present	MSB specimen; USGS observation, 2002
	Cynomys gunnisoni	Gunnison's prairie-dog	Unconfirmed	may have occurred historically
	Cynomys ludovicianus	black-tailed prairie-dog	Unconfirmed	may have occurred historically
	Thomomys bottae	Botta's pocket gopher	Present	MSB specimen
	Chaetodipus intermedius	rock pocket mouse	Present	MSB specimen; USGS voucher, 2002
	Perognathus flavescens	plains pocket mouse	Present	MSB specimen
	Perognathus flavus	silky pocket mouse	Present	USGS voucher, 2001
	Chaetodipus hispidus	hispid pocket mouse	Unconfirmed	
	Dipodomys merriami	Merriam's kangaroo rat	Present	MSB specimen
	Dipodomys ordii	Ord's kangaroo rat	Present	USGS capture, 2001
	Dipodomys spectabilis	banner-tailed kangaroo rat	Present	MSB specimen
	Reithrodontomys megalotis	western harvest mouse	Present	MSB specimen

Table 7. Master list of mammals of PETR, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Reithrodontomys montanus*	plains harvest mouse	Present	MSB specimen
	Peromyscus boylii	brush mouse	Unconfirmed	
	Peromyscus eremicus	cactus mouse	Present	USGS voucher, 2003
	Peromyscus leucopus	white-footed mouse	Present	MSB specimen
	Peromyscus maniculatus	deer mouse	Present	USGS capture, 2001
	Peromyscus truei	piñon mouse	Present	MSB specimen
	Peromyscus nasutus	northern rock mouse	Probably present	Parmenter and Lightfoot 1996
	Onychomys leucogaster	northern grasshopper mouse	Present	USGS capture, 2001
	Onychomys torridus	southern grasshopper mouse	Unconfirmed	
	Neotoma albigula	white-throated woodrat	Present	USGS capture, 2001
	Neotoma micropus	southern plains woodrat	Present	MSB specimen
	Mus musculus	house mouse	Present	MSB specimen
	Erethizon dorsatum	common porcupine	Present	USGS observation, 2002
Carnivora	*Canis latrans*	coyote	Present	USGS observation, 2001
	Canis lupus	gray wolf	Unconfirmed	possibly occurred historically
	Vulpes macrotis	kit fox	Unconfirmed	
	Vulpes vulpes	red fox	Unconfirmed	
	Urocyon cinereoargenteus	common gray fox	Present	NPS observation
	Ursus americanus	black bear	Present	transient
	Ursus arctos	grizzly bear	Unconfirmed	possibly occurred historically
	Bassariscus astutus	ringtail	Unconfirmed	
	Procyon lotor	common raccoon	Unconfirmed	
	Mustela frenata	long-tailed weasel	Probably present	
	Mustela nigripes	black-footed ferret	Unconfirmed	
	Taxidea taxus	American badger	Present	Parmenter and Lightfoot 1996
	Spilogale gracilis	western spotted skunk	Probably present	
	Mephitis mephitis	striped skunk	Present	Parmenter and Lightfoot 1996
	Puma concolor	mountain lion	Unconfirmed	
	Lynx rufus	bobcat	Present	NPS observation, 2002
Artiodactyla	*Cervus elaphus*	elk	Unconfirmed	
	Odocoileus hemionus	mule deer	Present	USGS observation, 2002
	Antilocapra americana	pronghorn	Probably present	NPS observation

Table 8. Master list of mammals of Salinas Pueblo Missions National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex merriami*	Merriam's shrew	Unconfirmed	
	Sorex monticolus	montane shrew	Unconfirmed	
	Sorex nanus	dwarf shrew	Unconfirmed	
	Notiosorex crawfordi	desert shrew	Probably present	
Chiroptera	*Myotis auriculus*	southwestern myotis	Unconfirmed	
	Myotis californicus	California myotis	Unconfirmed	
	Myotis ciliolabrum	western small-footed bat	Present	USGS acoustic file, 2002
	Myotis evotis	long-eared myotis	Unconfirmed	
	Myotis lucifugus	little brown bat	Probably present	
	Myotis thysanodes	fringed myotis	Present	USGS voucher, 2001
	Myotis volans	long-legged myotis	Present	USGS voucher, 2001
	Myotis yumanensis	Yuma myotis	Present	USGS voucher, 2001
	Lasionycteris noctivagans	silver-haired bat	Present	USGS voucher, 2003
	Pipistrellus hesperus	western pipistrelle	Present	USGS acoustic file, 2002
	Eptesicus fuscus	big brown bat	Present	USGS voucher, 2001
	Lasiurus borealis	eastern red bat	Unconfirmed	
	Lasiurus cinereus	hoary bat	Present	USGS voucher, 2001
	Euderma maculatum	spotted bat	Unconfirmed	
	Corynorhinus townsendii	Townsend's big-eared bat	Present	USGS voucher, 2001
	Antrozous pallidus	pallid bat	Present	USGS voucher, 2001
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS voucher, 2002
	Nyctinomops macrotis	big free-tailed bat	Probably present	
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS observation, 2001
	Sylvilagus floridanus	eastern cottontail	Probably present	
	Lepus californicus	black-tailed jackrabbit	Present	USGS observation, 2001
Rodentia	*Neotamias quadrivittatus*	Colorado chipmunk	Present	USGS capture, 2001
	Ammospermophilus interpres	Texas antelope squirrel	Probably present	
	Spermophilus spilosoma	spotted ground squirrel	Unconfirmed	
	Spermophilus tridecemlineatus	thirteen-lined ground squirrel	Unconfirmed	
	Spermophilus variegatus	rock squirrel	Present	USGS observation, 2001
	Cynomys gunnisoni	Gunnison's prairie-dog	Unconfirmed	occurs near Quarai
	Cynomys ludovicianus	black-tailed prairie-dog	Unconfirmed	may have occurred historically
	Thomomys bottae	Botta's pocket gopher	Present	USGS voucher, 2003
	Geomys bursarius	plains pocket gopher	Present	Findley et al. 1975; MSB specimen
	Cratogeomys castanops	yellow-faced pocket gopher	Unconfirmed	
	Perognathus flavescens	plains pocket mouse	Present	USGS voucher, 2002
	Perognathus flavus	silky pocket mouse	Present	USGS voucher, 2002

Table 8. Master list of mammals of SAPU, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Chaetodipus hispidus*	hispid pocket mouse	Unconfirmed	
	Dipodomys ordii	Ord's kangaroo rat	Present	USGS voucher, 2001; Findley et al. 1975
	Dipodomys spectabilis	banner-tailed kangaroo rat	Present	Findley et al. 1975
	Reithrodontomys megalotis	western harvest mouse	Present	USGS voucher, 2002
	Reithrodontomys montanus	plains harvest mouse	Unconfirmed	
	Peromyscus boylii	brush mouse	Present	USGS voucher, 2001; Findley et al. 1975
	Peromyscus leucopus	white-footed mouse	Present	USGS voucher, 2001; Findley et al. 1976
	Peromyscus maniculatus	deer mouse	Present	USGS capture, 2001; Findley et al. 1977
	Peromyscus truei	piñon mouse	Present	USGS voucher, 2001; Findley et al. 1978
	Peromyscus nasutus	northern rock mouse	Probably present	
	Onychomys leucogaster	northern grasshopper mouse	Present	USGS voucher, 2002; Findley et al. 1975
	Sigmodon hispidus	hispid cotton rat	Present	USGS voucher, 2001
	Neotoma albigula	white-throated woodrat	Present	USGS voucher, 2002; Findley et al. 1975
	Neotoma mexicana	Mexican woodrat	Present	Findley et al. 1975
	Neotoma micropus	southern plains woodrat	Present	?+G65MSB?
	Microtus longicaudus	long-tailed vole	Present	USGS capture, 2001; pending identification
	Microtus mogollensis	Mogollon vole	Present	USGS voucher, 2003
	Ondatra zibethicus	common muskrat	Unconfirmed	
	Mus musculus	house mouse	Present	USGS capture, 2001
	Erethizon dorsatum	common porcupine	Present	USGS observation, 2001
Carnivora	*Canis latrans*	coyote	Present	USGS observation, 2001; Findley et al. 1975
	Canis lupus	gray wolf	Present historically	Bailey 1932
	Vulpes macrotis	kit fox	Probably present	see Findley et al. 1975 for nearby locality
	Vulpes vulpes	red fox	Present	USGS observation, 2002
	Urocyon cinereoargenteus	common gray fox	Present	USGS observation, 2002
	Ursus americanus	black bear	Probably present	
	Ursus arctos	grizzly bear	Unconfirmed	Likely occurred historically
	Bassariscus astutus	ringtail	Probably present	
	Procyon lotor	common raccoon	Unconfirmed	
	Mustela frenata	long-tailed weasel	Present	USGS observation, 2002
	Mustela nigripes	black-footed ferret	Unconfirmed	may have occurred historically
	Taxidea taxus	American badger	Present	Findley et al. 1975

Table 8. Master list of mammals of SAPU, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Carnivora, cont.	*Spilogale gracilis*	western spotted skunk	Probably present	
	Mephitis mephitis	striped skunk	Present	Observation by park staff
	Puma concolor	mountain lion	Present	USGS observation, 2002
	Lynx rufus	bobcat	Probably present	
Artiodactyla	*Cervus elaphus*	elk	Unconfirmed	
	Odocoileus hemionus	mule deer	Present	USGS observation, scat, 2001
	Antilocapra americana	pronghorn	Probably present	
	Bos bison	bison	Unconfirmed	may have occurred historically
	Ovis canadensis	bighorn sheep	Unconfirmed	nearby animals from northern NM

Table 9. Master list of mammals of Yucca House National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex merriami*	Merriam's shrew	Unconfirmed	
	Sorex nanus	dwarf shrew	Unconfirmed	
	Sorex preblei	Preble's shrew	Unconfirmed	
	Notiosorex crawfordi	desert shrew	Probably present	
Chiroptera	*Myotis californicus*	California myotis	Present	USGS voucher, 2001
	Myotis ciliolabrum	western small-footed bat	Present	USGS voucher, 2001
	Myotis evotis	long-eared myotis	Present	USGS voucher, 2001
	Myotis lucifugus	little brown bat	Present	USGS acoustic file, 2002
	Myotis thysanodes	fringed myotis	Present	USGS voucher, 2001
	Myotis volans	long-legged myotis	Present	USGS voucher, 2001
	Myotis yumanensis	Yuma myotis	Present	USGS acoustic file, 2002
	Lasionycteris noctivagans	silver-haired bat	Probably present	
	Lasiurus cinereus	hoary bat	Present	USGS capture, 2001
	Pipistrellus hesperus	western pipistrelle	Present	USGS acoustic file, 2001
	Eptesicus fuscus	big brown bat	Present	USGS voucher, 2001
	Euderma maculatum	spotted bat	Present	USGS vocalization, 2001
	Corynorhinus townsendii	Townsend's big-eared bat	Present	USGS acoustic file, 2002
	Idionycteris phyllotis	Allen's big-eared bat	Unconfirmed	unknown from CO
	Antrozous pallidus	pallid bat	Present	Armstrong 1972; Moqui
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS acoustic file, 2001
	Nyctinomops macrotis	big free-tailed bat	Present	USGS acoustic file, 2001
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS observation, 2001
	Sylvilagus nuttallii	mountain cottontail	Present	M. Colyer, MEVE, 2001
	Lepus californicus	black-tailed jackrabbit	Present	Armstrong 1972; Moqui
Rodentia	*Neotamias rufus*	Hopi chipmunk	Present	observed, A. Spencer 2000
	Neotamias minimus	least chipmunk	Present	observed, A. Spencer 2001
	Ammospermophilus leucurus	white-tailed antelope squirrel	Present	observed E side, M. Colyer, 1999, 2002
	Spermophilus variegatus	rock squirrel	Present	USGS observation, 2001
	Cynomys gunnisoni	Gunnison's prairie dog	Present	USGS observation, 2001
	Thomomys bottae	Botta's pocket gopher	Present	Armstrong 1972; Moqui
	Perognathus flavescens	plains pocket mouse	Unconfirmed	= apache
	Perognathus flavus	silky pocket mouse	Present	USGS voucher, 2003
	Dipodomys ordii	Ord's kangaroo rat	Unconfirmed	Armstrong 1972; Moqui
	Castor canadensis	American beaver	Present	M. Colyer, MEVE, 2002, 2004
	Reithrodontomys megalotis	western harvest mouse	Present	USGS voucher, 2002
	Peromyscus boylii	brush mouse	Present	USGS voucher, 2001
	Peromyscus crinitus	canyon mouse	Present	USGS voucher, 2003
	Peromyscus maniculatus	deer mouse	Present	USGS voucher, 2001

Table 9. Master list of mammals of YUHO, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Peromyscus truei*	piñon mouse	Present	USGS voucher, 2001
	Onychomys leucogaster	northern grasshopper mouse	Probably present	
	Neotoma albigula	white-throated woodrat	Present	USGS voucher, 2001
	Neotoma cinerea	bushy-tailed woodrat	Probably present	observed by A. Spencer on Owl Point
	Neotoma mexicana	Mexican woodrat	Unconfirmed	Armstrong 1972; Moqui
	Microtus mogollensis	Mogollon vole	Present	USGS voucher, 2003
	Microtus montanus	Montane vole	Present	USGS voucher, 2003
	Ondatra zibethicus	common muskrat	Present	M. Colyer, MEVE, 2002
	Mus musculus	house mouse	Present	M. Colyer, MEVE, 2002
	Erethizon dorsatum	common porcupine	Present	M. Colyer, MEVE, 2002
Carnivora	*Canis latrans*	coyote	Present	USGS observation, 2001
	Canis lupus	gray wolf	Unconfirmed	Likely occurred historically
	Vulpes macrotis	kit fox	Present	tracks, 2003; Armstrong 1972: McElmo Can.
	Vulpes vulpes	red fox	Probably present	
	Urocyon cinereoargenteus	common gray fox	Present	scat, 2003; Armstrong 1972: "McElmo"
	Ursus americanus	black bear	Present	M. Colyer, MEVE, 2002
	Ursus arctos	grizzly bear	Unconfirmed	Likely occurred historically
	Bassariscus astutus	ringtail	Present	USGS observed scat, 2003
	Procyon lotor	common raccoon	Present	USGS observation, 2003
	Mustela frenata	long-tailed weasel	Probably present	Armstrong 1972; Ute Peak
	Mustela nigripes	black-footed ferret	Unconfirmed	may have occurred historically
	Taxidea taxus	American badger	Present	USGS observation, 2001
	Spilogale gracilis	western spotted skunk	Present	Armstrong 1972; Moqui
	Mephitis mephitis	striped skunk	Present	USGS observation, 2002
	Puma concolor	mountain lion	Present	M. Colyer, MEVE, 2002
	Lynx rufus	bobcat	Present	USGS observation, 2003
Artiodactyla	*Cervus elaphus*	elk	Present	occasional, M. Colyer, MEVE, 2002
	Odocoileus hemionus	mule deer	Present	M. Colyer, MEVE, 2002
	Antilocapra americana	pronghorn	Present	M. Colyer, MEVE, 2002
	Ovis canadensis	bighorn sheep	Unconfirmed	M. Colyer, MEVE, 2002

Table 10. Field schedule and summary of effort for mammalian inventories during 2003–2004 at BAND, CHCU, and ELMA.

Date(s)	Park visited	Observer(s)	Person-days	Trap-nights	Net-nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
May 19–23, 2003	CHCU	L. Harding	5			2.5	33	diurnal track-scat surveys, nocturnal spotlighting surveys
May 24–28, 2003	ELMA	L. Harding	5			2	36	diurnal track-scat surveys, nocturnal spotlighting surveys
June 2–11, 2003	BAND	L. Harding	10			2	99	diurnal track-scat surveys, nocturnal spotlighting surveys
June 6–19, 2003	BAND	K. Geluso V. Ashe J. Hoffman J. White	54		5			small mammal traplines, mistnetting for bats
June 16–20, 2003	CHCU	L. Harding	5			2	33	diurnal track-scat surveys, nocturnal spotlighting surveys
June 28– July 7, 2003	CHCU	K. Geluso V. Ashe J. Hoffman J. White	37					small mammal traplines
June 30–July 4, 2003	ELMA	L. Harding	5			1	36	diurnal track-scat surveys, nocturnal spotlighting surveys
July 5–8, 2003	BAND	L. Harding	4			2	40	diurnal track-scat surveys, nocturnal spotlighting surveys
July 16–24, 2003	ELMA	K. Geluso V. Ashe J. Hoffman J. White	33		2			small mammal traplines, mistnetting for bats
July 30–August 2, 2003	ELMA	K. Geluso V. Ashe	8	441				small mammal traplines
August 11–15, 2003	ELMA	L. Harding	5			1	36	diurnal track-scat surveys, diurnal track-scat surveys
August 17–20, 2003	BAND	L. Harding	4				39	
May 25–28, 2004	ELMA	K. Geluso R. Ligon	8	286	2			small mammal traplines, mistnetting for bats
June 2–11, 2004	CHCU	K. Geluso R. Ligon	20	671	4			small mammal traplines, mistnetting for bats
June 17–July 1, 2004	BAND	K. Geluso J. Mink R. Ligon J. Hoffman	60		8			small mammal traplines, mistnetting for bats
August 26–30, 2004	ELMA	K. Geluso	5	238	5	2		small mammal traplines, mistnetting for bats, nocturnal spotlighting surveys

Table 10. Field schedule and summary of effort for mammalian inventories during 2003–2004 at BAND, CHCU, and ELMA, cont.

Date(s)	Park visited	Observer(s)	Person-days	Trap-nights	Net-nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
Oct 19–25, 2004	CHCU	K. Geluso	7	466		1		small mammal traplines, nocturnal spotlighting surveys
December 20, 2004	CHCU	K. Geluso	1	15			21	diurnal mammal search
Total			**276**			**15.5**	**373**	

Trips to parks are listed in chronological order including dates, parks, observers, effort, and sampling methods.

Table 11. Summary of mammals captured or observed during 2003–2004 at BAND, CHCU, and ELMA.

		2003				2004				
Order	**Scientific name**	**BAND**	**CHCU**	**ELMA**	**Total**	**BAND**	**CHCU**	**ELMA**	**Total**	**Grand total**
Insectivora	*Sorex monticolus*	--	--	--	--	2	--	--	2	2
	Sorex palustris	--	--	--	--	1	--	--	1	1
Chiroptera	*Myotis californicus*	--	--	--	--	--	--	1	1	1
	Myotis ciliolabrum	1	--	--	1	1	--	3	4	5
	Myotis ciliolabrum/californicus	--	--	--	--	6	--	11	17	17
	Myotis evotis	10	--		44	9	--	16	25	69
	Myotis thysanodes	--	--	7	7	14	--	11	25	32
	Myotis volans	8	--	3	11	23	--	--	23	34
	Lasiurus cinereus	6	--	1	7	3	--	1	4	11
	Lasionycteris noctivagans	55	--	--	55	31	--	4	35	90
	Eptesicus fuscus	4	--		23	2	--	5	7	30
	Euderma maculatum	2	--	--	2	1	1	4	6	8
	Corynorhinus townsendii	--	--	2	2	1	--	4	5	7
	Antrozous pallidus	--	--	--	--	2	1	1	4	4
	Tadarida brasiliensis	--	--	--	--	1	--	64	65	65
	Nyctinomops macrotis	1	1	--	2	1	3	--	4	6
Lagomorpha	*Ochotona princeps*	2	--	--	2	4	--	--	4	6
	Sylvilagus audubonii	1	4	--	5	1	5	3	9	14
	Sylvilagus nuttallii	2	--	--	2	4	--	--	4	6
	Sylvilagus spp.	--	--	--	--	1	2	1	4	4
	Lepus californicus	--	1	1	2	--	1	2	3	5
Rodentia	*Neotamias dorsalis*	--	--	3	3	--	--	7	7	10
	Neotamias minimus	20	--	--	20	31	--	--	31	51
	Neotamias quadrivittatus	22	4	1	27	18	3	--	21	48
	Neotamias spp.	--	--	--	--	8	--	--	8	8
	Ammospermophilus leucurus	--	8	--	8	--	8	--	8	16
	Spermophilus lateralis	6	--	--	6	9	--	--	9	15
	Spermophilus spilosoma	--	--	--	--	--	--	1	1	1
	Spermophilus variegatus	6	--	3	9	6	3	4	13	22
	Cynomys gunnisoni	--	2	7	9	--	13	5	18	27
	Sciurus aberti	5	--	--	5	3	--	--	3	8
	Tamiasciurus hudsonicus	5	--	--	5	6	--	--	6	11
	Thomomys bottae	6	--	1	7	1	1	--	2	9
	Thomomys talpoides	1	--	--	1	--	--	--	--	1
	Perognathus flavescens	--	4	4	8	--	2	--	2	10
	Perognathus flavus	1	9		64	--	16	7	23	87
	Chaetodipus intermedius	4	--	--	4	2	--	--	2	6
	Dipodomys ordii	--	1		14	--	9	--	9	23
	Dipodomys spectabilis	--	5	2	7	--	3	--	3	10
	Castor canadensis	2	--	--	2	--	--	--	--	2

Table 11. Summary of mammals captured or observed during 2003–2004 at BAND, CHCU, and ELMA, cont.

		2003				2004				
Order	**Scientific name**	**BAND**	**CHCU**	**ELMA**	**Total**	**BAND**	**CHCU**	**ELMA**	**Total**	**Grand total**
Rodentia, cont.	*Reithrodontomys megalotis*	--	3		19	--	6	11	17	36
	Peromyscus boylii	9	6	5	20	--	7	5	12	32
	Peromyscus crinitus	--	27	--	27	--	32	--	32	59
	Peromyscus leucopus	1	--	--	1	--	--	--	--	1
	Peromyscus maniculatus	37	58		154		50	45		417
	Peromyscus nasutus	27	--		49	3	--	9	12	61
	Peromyscus truei	15	5		41	12	50	23	85	126
	Peromyscus boylii/nasutus	18	--	4	22	--	--	--	--	22
	Onychomys leucogaster	--	48	9	57	--	6	1	7	64
	Sigmodon fulviventer	--	--		13	--	--	9	9	22
	Neotoma albigula	5	4		43	3	15	9	27	70
	Neotoma cinerea	2	--	--	2	2	8	--	10	12
	Neotoma mexicana	20	--		35	27	--	12	39	74
	Neotoma stephensi	--	2	--	2	--	17	--	17	19
	Neotoma spp. (juv.)	--	--	--	--	--	2	--	2	2
	Clethrionomys gapperi	1	--	--	1	7	--	--	7	8
	Microtus longicaudus	18	--	--	18	69	--	--	69	87
	Microtus mogollonensis	--	--	--	--	--	--	6	6	6
	Microtus montanus	2	--	--	2	17	--	--	17	19
	Erethizon dorsatum	--	6	1	7	--	1	--	1	8
Carnivora	*Canis latrans*	23	22		62	1	5	5	11	73
	Vulpes macrotis	--	3	4	7	--	--	--	--	7
	Urocyon cinereoargenteus	12	2	4	18	1	--	--	1	19
	Ursus americanus	22	--	8	30	--	--	--	--	30
	Bassariscus astutus	2	--	--	2	--	--	1	1	3
	Procyon lotor	7	--	--	7	4	--	--	4	11
	Mustela frenata	1	--	1	2	--	--	--	--	2
	Taxidea taxus	--	2	--	2	--	--	--	--	2
	Mephitis mephitis	1	--	--	1	--	--	--	--	1
	Puma concolor	1	4	4	9	--	--	--	--	9
	Lynx rufus	15	23	7	45	--	1	--	1	46
Artiodactyla	*Cervus elaphus*	39	6		62	23	17	5	45	107
	Odocoileus hemionus	15	17	5	37	4	13	11	28	65
	Antilocapra americana	--	--	9	9	--	--	--	--	9
	Capra hircus	--	1	--	1	--	--	--	--	1
Totals										**2,312**

Table 12. Total number and percent relative abundance of observations during 2003–2004 mammalian inventories at BAND, CHCU, and ELMA.

Order	Scientific name	Number				Percent			
		BAND	CHCU	ELMA	Total	BAND	CHCU	ELMA	Total
Insectivora	*Sorex monticolus*	2	--	--	2	0.20	--	--	0.09
	Sorex palustris	1	--	--	1	0.10	--	--	0.04
Chiroptera	*Myotis californicus*	--	--	1	1	--	--	0.14	0.04
	Myotis ciliolabrum	2	--	3	5	0.20	--	0.41	0.22
	Myotis ciliolabrum/californicus	6	--	11	17	0.60	--	1.49	0.74
	Myotis evotis	19	--	50	69	1.91	--	6.78	2.98
	Myotis thysanodes	14	--	18	32	1.41	--	2.44	1.38
	Myotis volans	31	--	3	34	3.11	--	0.41	1.47
	Lasiurus cinereus	9	--	2	11	0.90	--	0.27	0.48
	Lasionycteris noctivagans	86	--	4	90	8.63	--	0.54	3.89
	Eptesicus fuscus	6	--	24	30	0.60	--	3.26	1.30
	Euderma maculatum	3	1	4	8	0.30	0.17	0.54	0.35
	Corynorhinus townsendii	1	--	6	7	0.10	--	0.81	0.30
	Antrozous pallidus	2	1	1	4	0.20	0.17	0.14	0.17
	Tadarida brasiliensis	1	--	64	65	0.10	--	8.68	2.81
	Nyctinomops macrotis	2	4	--	6	0.20	0.69	--	0.26
Lagomorpha	*Ochotona princeps*	6	--	--	6	0.60	--	--	0.26
	Sylvilagus audubonii	2	9	3	14	0.20	1.55	0.41	0.61
	Sylvilagus nuttallii	6	--	--	6	0.60	--	--	0.26
	Sylvilagus spp.	1	2	1	4	0.10	0.35	0.14	0.17
	Lepus californicus	--	2	3	5	--	0.35	0.41	0.22
Rodentia	*Neotamias dorsalis*	--	--	10	10	--	--	1.36	0.43
	Neotamias minimus	51	--	--	51	5.12	--	--	2.21
	Neotamias quadrivittatus	40	7	1	48	4.02	1.21	0.14	2.08
	Neotamias spp.	8	--	--	8	0.80	--	--	0.35
	Ammospermophilus leucurus	--	16	--	16	--	2.76	--	0.69
	Spermophilus lateralis	15	--	--	15	1.51	--	--	0.65
	Spermophilus spilosoma	--	--	1	1	--	--	0.14	0.04
	Spermophilus variegatus	12	3	7	22	1.20	0.52	0.95	0.95
	Cynomys gunnisoni	--	15	12	27	--	2.59	1.63	1.17
	Sciurus aberti	8	--	--	8	0.80	--	--	0.35
	Tamiasciurus hudsonicus	11	--	--	11	1.10	--	--	0.48
	Thomomys bottae	7	1	1	9	0.70	0.17	0.14	0.39
	Thomomys talpoides	1	--	--	1	0.10	--	--	0.04
	Perognathus flavescens	--	6	4	10	--	1.04	0.54	0.43
	Perognathus flavus	1	25	61	87	0.10	4.32	8.28	3.76
	Chaetodipus intermedius	6	--	--	6	0.60	--	--	0.26
	Dipodomys ordii	--	10	13	23	--	1.73	1.76	0.99
	Dipodomys spectabilis	--	8	2	10	--	1.38	0.27	0.43

Table 12. Total number and percent relative abundance of observations during 2003–2004 mammalian inventories at BAND, CHCU, and ELMA, cont.

Order	Scientific name	Number				Percent			
		BAND	CHCU	ELMA	Total	BAND	CHCU	ELMA	Total
Rodentia, cont.	*Castor canadensis*	2	--	--	2	0.20	--	--	0.09
	Reithrodontomys megalotis	--	9	27	36	--	1.55	3.66	1.56
	Peromyscus boylii	9	13	10	32	0.90	2.25	1.36	1.38
	Peromyscus crinitus	--	59	--	59	--	10.19	--	2.55
	Peromyscus leucopus	1	--	--	1	0.10	--	--	0.04
	Peromyscus maniculatus	205	108	104	417	20.58	18.65	14.11	18.04
	Peromyscus nasutus	30	--	31	61	3.01	--	4.21	2.64
	Peromyscus truei	27	55	44	126	2.71	9.50	5.97	5.45
	Peromyscus boylii/nasutus	18	--	4	22	1.81	--	0.54	0.95
	Onychomys leucogaster	--	54	10	64	--	9.33	1.36	2.77
	Sigmodon fulviventer	--	--	22	22	--	--	2.99	0.95
	Neotoma albigula	8	19	43	70	0.80	3.28	5.83	3.03
	Neotoma cinerea	4	8	--	12	0.40	1.38	--	0.52
	Neotoma mexicana	47	--	27	74	4.72	--	3.66	3.20
	Neotoma stephensi	--	19	--	19	--	3.28	--	0.82
	Neotoma spp. (juv.)	--	2	--	2	--	0.35	--	0.09
	Clethrionomys gapperi	8	--	--	8	0.80	--	--	0.35
	Microtus longicaudus	87	--	--	87	8.73	--	--	3.76
	Microtus mogollonensis	--	--	6	6	--	--	0.81	0.26
	Microtus montanus	19	--	--	19	1.91	--	--	0.82
	Erethizon dorsatum	--	7	1	8	--	1.21	0.14	0.35
Carnivora	*Canis latrans*	24	27	22	73	2.41	4.66	2.99	3.16
	Vulpes macrotis	--	3	4	7	--	0.52	0.54	0.30
	Urocyon cinereoargenteus	13	2	4	19	1.31	0.35	0.54	0.82
	Ursus americanus	22	--	8	30	2.21	--	1.09	1.30
	Bassariscus astutus	2	--	1	3	0.20	--	0.14	0.13
	Procyon lotor	11	--	--	11	1.10	--	--	0.48
	Mustela frenata	1	--	1	2	0.10	--	0.14	0.09
	Taxidea taxus	--	2	--	2	--	0.35	--	0.09
	Mephitis mephitis	1	--	--	1	0.10	--	--	0.04
	Puma concolor	1	4	4	9	0.10	0.69	0.54	0.39
	Lynx rufus	15	24	7	46	1.51	4.15	0.95	1.99
Artiodactyla	*Cervus elaphus*	62	23	22	107	6.22	3.97	2.99	4.63
	Odocoileus hemionus	19	30	16	65	1.91	5.18	2.17	2.81
	Antilocapra americana	--	--	9	9	--	--	1.22	0.39
	Capra hircus	--	1	--	1	--	0.17	--	0.04
Totals		**996**	**579**	**737**	**2,312**				

Table 13. Master list of mammals of Bandelier National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex cinereus*	masked shrew	Probably present	Kirkland & Findley 1996
	Sorex merriami	Merriam's shrew	Probably present	
	Sorex monticolus	montane shrew	Present	Guthrie and Large 1980; USGS 2004-voucher
	Sorex nanus	dwarf shrew	Probably present	Findley et al. 1975
	Sorex palustris	water shrew	Present	USGS 2004-voucher
	Sorex preblei	Preble's shrew	Probably present	Kirkland & Findley 1996
Chiroptera	*Myotis californicus*	California myotis	Present	Bogan et al. 1998
	Myotis ciliolabrum	western small-footed myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
	Myotis evotis	long-eared myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
	Myotis thysanodes	fringed myotis	Present	Bogan et al. 1998; USGS 2004-captures
	Myotis volans	long-legged myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
	Myotis yumanensis	Yuma myotis	Present	Bogan et al. 1998
	Lasiurus cinereus	hoary bat	Present	Bogan et al. 1998; USGS 2003, 2004-captures
	Lasionycteris noctivagans	silver-haired bat	Present	Bogan et al. 1998; USGS 2003, 2004-voucher
	Pipistrellus hesperus	western pipistrelle	Present	Bogan et al. 1998
	Eptesicus fuscus	big brown bat	Present	Bogan et al. 1998; USGS 2003, 2004-voucher
	Euderma maculatum	spotted bat	Present	Bogan et al. 1998; USGS 2003, 2004-audible calls
	Corynorhinus townsendii	Townsend's big-eared bat	Present	Bogan et al. 1998; USGS 2004-capture
	Antrozous pallidus	pallid bat	Present	Bogan et al. 1998; USGS 2004-captures
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	Bogan et al. 1998; USGS 2004-sightings
	Nyctinomops macrotis	big free-tailed bat	Present	Bogan et al. 1998; USGS 2003, 2004-audible calls
Lagomorpha	*Ochotona princeps*	American pika	Present	USGS 2003, 2004-sightings
	Sylvilagus audubonii	desert cottontail	Present	USGS 2003, 2004-sightings
	Sylvilagus nuttallii	mountain cottontail	Present	USGS 2003, 2004-voucher
	Lepus californicus	black-tailed jackrabbit	Present	Guthrie and Large 1980
Rodentia	*Neotamias minimus*	least chipmunk	Present	USGS 2003, 2004-voucher
	Neotamias quadrivittatus	Colorado chipmunk	Present	USGS 2003, 2004-voucher
	Spermophilus lateralis	golden-mantled ground squirrel	Present	USGS 2003, 2004-captures
	Spermophilus variegatus	rock squirrel	Present	USGS 2003, 2004-voucher
	Cynomys gunnisoni	Gunnison's prairie dog	Unconfirmed	
	Sciurus aberti	Abert's squirrel	Present	USGS 2003, 2004-sightings
	Tamiasciurus hudsonicus	red squirrel	Present	USGS 2003, 2004-sightings

Table 13. Master list of mammals of BAND, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Thomomys bottae*	Botta's pocket gopher	Present	USGS 2003, 2004-voucher
	Thomomys talpoides	northern pocket gopher	Present	USGS 2003, 2004-voucher
	Perognathus flavus	silky pocket mouse	Present	USGS 2003, 2004-voucher
	Chaetodipus intermedius	rock pocket mouse	Present	USGS 2003, 2004-voucher
	Castor canadensis	American beaver	Present	USGS 2003-diagnostic sign
	Reithrodontomys megalotis	western harvest mouse	Present	Guthrie and Large 1980
	Peromyscus boylii	brush mouse	Present	USGS 2003-voucher
	Peromyscus leucopus	white-footed mouse	Present	USGS 2003-voucher
	Peromyscus maniculatus	deer mouse	Present	USGS 2003, 2004-voucher
	Peromyscus nasutus	northern rock mouse	Present	USGS 2003, 2004-voucher
	Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher
	Neotoma albigula	western white-throated woodrat	Present	USGS 2003, 2004-voucher
	Neotoma cinerea	bushy-tailed woodrat	Present	USGS 2003, 2004-voucher
	Neotoma mexicana	Mexican woodrat	Present	USGS 2003, 2004-voucher
	Clethrionomys gapperi	southern red-backed vole	Present	USGS 2003, 2004-voucher
	Microtus longicaudus	long-tailed vole	Present	USGS 2003, 2004-voucher
	Microtus montanus	montane vole	Present	USGS 2003, 2004-voucher
	Ondatra zibethicus	common muskrat	Present	Guthrie and Large 1980
	Zapus hudsonius	meadow jumping mouse	Probably present	Swickard et al. 1971
	Erethizon dorsatum	North American porcupine	Present	Guthrie and Large 1980
Carnivora	*Canis latrans*	coyote	Present	USGS 2003, 2004-sightings
	Canis lupus	gray wolf	Unconfirmed	Extirpated
	Vulpes vulpes	red fox	Probably present	Guthrie and Large 1980
	Urocyon cinereoargenteus	common gray fox	Present	USGS 2003, 2004-sightings
	Ursus americanus	American black bear	Present	USGS 2003-tracks and scat
	Ursus arctos	grizzly bear	Unconfirmed	Extirpated
	Bassariscus astutus	ringtail	Present	USGS 2003-scat; NPS-photo
	Procyon lotor	northern raccoon	Present	USGS 2003, 2004-sightings
	Mustela erminea	ermine	Present	Guthrie and Large 1980
	Mustela frenata	long-tailed weasel	Present	USGS 2003-capture just off park
	Lontra canadensis	northern river otter	Unconfirmed	Extirpated
	Taxidea taxus	American badger	Present	Guthrie and Large 1980
	Spilogale gracilis	western spotted skunk	Probably present	nearest record in Bernalillo Co., Findley et al. 1975
	Mephitis mephitis	striped skunk	Present	USGS 2003-scat
	Puma concolor	mountain lion	Present	USGS 2003-scat, NPS sightings
	Lynx rufus	bobcat	Present	USGS 2003-tracks and scat
Artiodactyla	*Equus asinus*	feral ass	Historic	Non-native, presumed extirpated
	Cervus elaphus	elk	Present	USGS 2003, 2004-sightings
	Odocoileus hemionus	mule deer	Present	USGS 2003, 2004-sightings

Table 13. Master list of mammals of BAND, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Artiodactyla, cont.	*Ovis canadensis*	bighorn sheep	Historic	Findley et al. 1975; MSB

Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. Species with previously published voucher material are also shown in this column (MSB = Museum of Southwestern Biology, University of New Mexico).

Table 14. Master list of mammals of Chaco Culture National Historical Park, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Notiosorex crawfordi*	Crawford's desert shrew	Present	Sighting, E. W. Valdez, pers. comm.
Chiroptera	*Myotis californicus*	California myotis	Present	Valdez et al. 2002a
	Myotis ciliolabrum	western small-footed myotis	Present	Valdez et al. 2002a
	Myotis evotis	long-eared myotis	Present	Valdez et al. 2002a
	Myotis thysanodes	fringed myotis	Present	Valdez et al. 2002a
	Myotis volans	long-legged myotis	Present	Valdez et al. 2002a
	Myotis yumanensis	Yuma myotis	Present	Valdez et al. 2002a
	Lasiurus cinereus	hoary bat	Present	Valdez et al. 2002a
	Lasionycteris noctivagans	silver-haired bat	Present	Valdez et al. 2002a
	Pipistrellus hesperus	western pipistrelle	Present	Valdez et al. 2002a
	Eptesicus fuscus	big brown bat	Present	Valdez et al. 2002a
	Euderma maculatum	spotted bat	Present	Valdez et al. 2002a; USGS 2004-sighting
	Corynorhinus townsendii	Townsend's big-eared bat	Present	Valdez et al. 2002a
	Antrozous pallidus	pallid bat	Present	USGS 2004-capture; MSB
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	Valdez et al. 2002a
	Nyctinomops macrotis	big free-tailed bat	Present	USGS 2003, 2004 audible calls heard
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	USGS 2003, 2004-sighting; AMNH
	Sylvilagus floridanus	eastern cottontail	Unconfirmed	nearest record from Mt Taylor; Findley et al. 1975
	Lepus californicus	black-tailed jackrabbit	Present	USGS 2003-sighting
Rodentia	*Neotamias quadrivittatus*	Colorado chipmunk	Present	USGS 2003, 2004-voucher; MVZ
	Ammospermophilus leucurus	white-tailed antelope squirrel	Present	USGS 2003, 2004-voucher; MSB; UUM; AMNH
	Spermophilus spilosoma	spotted ground squirrel	Present	MSB
	Spermophilus variegatus	rock squirrel	Present	USGS 2004-sighting
	Cynomys gunnisoni	Gunnison's prairie dog	Present	USGS 2003, 2004-sighting; MSB
	Thomomys bottae	Botta's pocket gopher	Present	USGS 2003, 2004-voucher
	Perognathus flavus	silky pocket mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ
	Perognathus flavescens	plains pocket mouse	Present	USGS 2003, 2004-voucher; MSB
	Dipodomys ordii	Ord's kangaroo rat	Present	USGS 2003, 2004-voucher; MSB; MVZ; AMNH
	Dipodomys spectabilis	banner-tailed kangaroo rat	Present	USGS 2003, 2004-voucher; MVZ; USNM
	Castor canadensis	American beaver	Historic	Pueblo Bonito-USNM
	Reithrodontomys megalotis	western harvest mouse	Present	USGS 2003, 2004-voucher; MVZ;
	Peromyscus boylii	brush mouse	Present	USGS 2003, 2004-voucher

Table 14. Master list of mammals of CHCU, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Peromyscus crinitus*	canyon mouse	Present	USGS 2003, 2004-voucher; MSB; MHP; USNM
	Peromyscus maniculatus	deer mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ
	Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher; MVZ; USNM
	Onychomys leucogaster	northern grasshopper mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ; USNM
	Neotoma albigula	western white-throated woodrat	Present	USGS 2003, 2004-voucher
	Neotoma cinerea	bushy-tailed woodrat	Present	USGS 2004-voucher; MSB; USNM
	Neotoma stephensi	Stephen's woodrat	Present	USGS 2003, 2004-voucher; MSB
	Erethizon dorsatum	North American porcupine	Present	USGS 2003, 2004-scat and quills; USNM
Carnivora	*Canis latrans*	coyote	Present	USGS 2003, 2004-sightings; USNM; AMNH
	Canis lupus	gray wolf	Unconfirmed	Extirpated
	Vulpes macrotis	kit fox	Present	USGS 2003-sighting
	Urocyon cinereoargenteus	common gray fox	Present	USGS 2003-tracks and scat
	Ursus americanus	American black bear	Present	NPS documentation
	Bassariscus astutus	ringtail	Probably present	nearest record in Valencia Co., Findley et al. 1975
	Procyon lotor	northern raccoon	Probably present	nearest record in San Juan Co., Findley et al. 1975
	Mustela frenata	long-tailed weasel	Unconfirmed	
	Mustela nigripes	black-footed ferret	Unconfirmed	Extirpated
	Taxidea taxus	American badger	Present	USGS 2003-burrow; USNM
	Spilogale gracilis	western spotted skunk	Present	MSB
	Mephitis mephitis	striped skunk	Present	MSB
	Puma concolor	mountain lion	Present	USGS 2003-scat
	Lynx rufus	bobcat	Present	USGS 2003-voucher; MSB
Artiodactyla	*Cervus elaphus*	elk	Present	USGS 2003, 2004-sightings
	Odocoileus hemionus	mule deer	Present	USGS 2003, 2004-sightings
	Antilocapra americana	pronghorn	Possibly present	Observed along NM Hwy 550
	Capra hircus	goat	Present	USGS 2003-horn sheath; exotic

Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. Species with previously published voucher material are also shown in the "Reference/Observation" column with museum acronyms. All museum acronyms can be found in Findley et al. 1975, where all previously published voucher specimens are reported.

Table 15. Master list of mammals of El Malpaís National Monument, including those with uncertain status.

Order	Scientific name	Common name	Park status	Reference/Observation
Insectivora	*Sorex monticolus*	montane shrew	Unconfirmed	
	Notiosorex crawfordi	Crawford's desert shrew	Probably present	nearest record in Valencia Co., Findley et al. 1975
Chiroptera	*Myotis californicus*	California myotis	Present	USGS 2004
	Myotis ciliolabrum	western small-footed myotis	Present	Hooper 1941; USGS 2004-voucher
	Myotis evotis	long-eared myotis	Present	Hooper 1941; USGS 2003, 2004
	Myotis thysanodes	fringed myotis	Present	Hooper 1941; USGS 2003, 2004
	Myotis volans	long-legged myotis	Present	Hooper 1941; USGS 2003
	Lasiurus cinereus	hoary bat	Present	USGS 2003
	Lasionycteris noctivagans	silver-haired bat	Present	Hooper 1941; USGS 2004
	Pipistrellus hesperus	western pipistrelle	Present	Valdez et al. 2002b-audible just off park
	Eptesicus fuscus	big brown bat	Present	Hooper 1941; USGS 2003, 2004
	Euderma maculatum	spotted bat	Present	USGS 2004-audible
	Corynorhinus townsendii	Townsend's big-eared bat	Present	USGS 2003, 2004
	Antrozous pallidus	pallid bat	Present	USGS 2004
	Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS 2004
	Nyctinomops macrotis	big free-tailed bat	Present	Valdez et al. 2002b-audible just off park
Lagomorpha	*Sylvilagus audubonii*	desert cottontail	Present	Hooper 1941; USGS 2003, 2004-sighting
	Sylvilagus floridanus	eastern cottontail	Unconfirmed	see Hooper 1941 reported as S. nuttallii
	Lepus californicus	black-tailed jackrabbit	Present	Hooper 1941; USGS 2003; 2004-sighting
Rodentia	*Neotamias dorsalis*	cliff chipmunk	Present	Hooper 1941; USGS 2003; 2004-voucher
	Neotamias quadrivittatus	Colorado Chipmunk	Present	USGS 2003-voucher
	Spermophilus spilosoma	spotted ground squirrel	Present	USGS 2004-sighting just off park
	Spermophilus variegatus	rock squirrel	Present	Hooper 1941; USGS 2003, 2004-sightings
	Cynomys gunnisoni	Gunnison's prairie dog	Present	Hooper 1941; USGS 2003, 2004-sightings
	Sciurus aberti	Abert's squirrel	Present	Hooper 1941; NPS observation
	Tamiasciurus hudsonicus	red squirrel	Unconfirmed	Extirpated from region? see Hooper 1941
	Thomomys bottae	Botta's pocket gopher	Present	Hooper 1941; USGS 2003-voucher
	Perognathus flavus	silky pocket mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
	Perognathus flavescens	plains pocket mouse	Present	USGS 2003-voucher

Table 15. Master list of mammals of ELMA, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Rodentia, cont.	*Dipodomys ordii*	Ord's kangaroo rat	Present	Hooper 1941; USGS 2003-voucher
	Dipodomys spectabilis	banner-tailed kangaroo rat	Present	USGS 2003-voucher
	Reithrodontomys megalotis	western harvest mouse	Present	USGS 2003, 2004-voucher
	Peromyscus maniculatus	deer mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
	Peromyscus leucopus	white-footed mouse	Unconfirmed	
	Peromyscus boylii	brush mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
	Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher
	Peromyscus nasutus	northern rock mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
	Onychomys leucogaster	northern grasshopper mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
	Sigmodon fulviventer	tawny-bellied cotton rat	Present	USGS 2003, 2004-voucher
	Neotoma albigula	western white-throated woodrat	Present	Hooper 1941; USGS 2003, 2004-voucher
	Neotoma micropus	southern plains woodrat	Unconfirmed	see Hooper 1941
	Neotoma mexicana	Mexican woodrat	Present	Hooper 1941; USGS 2003, 2004-voucher
	Neotoma stephensi	Stephen's woodrat	Probably present	see Hooper 1941; Findley et al. 1975
	Microtus pennsylvanicus	meadow vole	Unconfirmed	Possibly extinct in area (Frey 2004)
	Microtus mogollonensis	Mogollon vole	Present	USGS 2003, 2004-voucher
	Mus musculus	house mouse	Probably present	
	Erethizon dorsatum	North American porcupine	Present	Hooper 1941, USGS 2003-scat
Carnivora	*Canis latrans*	coyote	Present	Hooper 1941; USGS 2003, 2004-sighting
	Canis lupus	gray wolf	Unconfirmed	Extirpated; see Hooper 1941
	Vulpes macrotis	kit fox	Present	USGS 2003-tracks and scat
	Vulpes vulpes	red fox	Present	USGS 2003-tracks
	Urocyon cinereoargenteus	common gray fox	Present	Hooper 1941; USGS 2003-tracks
	Ursus americanus	American black bear	Present	USGS 2003-tracks
	Ursus arctos	grizzly bear	Unconfirmed	Extirpated
	Bassariscus astutus	ringtail	Present	Hooper 1941; USGS 2004-sighting
	Procyon lotor	northern raccoon	Probably present	nearest record from Mt. Taylor, Hooper 1941
	Mustela frenata	long-tailed weasel	Present	Hooper 1941; USGS 2003-sighting off park
	Mustela nigripes	black-footed ferret	Unconfirmed	Extirpated; Hooper 1941 reports in area
	Taxidea taxus	American badger	Probably present	see Hooper 1941

Table 15. Master list of mammals of ELMA, including those with uncertain status, cont.

Order	Scientific name	Common name	Park status	Reference/Observation
Carnivora, cont.	*Spilogale gracilis*	western spotted skunk	Probably present	nearest record is Thoreau, Findley et al. 1975
	Mephitis mephitis	striped skunk	Present	Hooper 1941
	Conepatus leuconotus	white-backed hog-nosed skunk	Present	Hooper 1941; extirpated since Hooper?
	Puma concolor	mountain lion	Present	USGS 2003-tracks and scat; NPS observation
	Lynx rufus	bobcat	Present	Hooper 1941; USGS 2003-tracks and scat
Artiodactyla	*Pecari tajacu*	collared peccary	Present	Albert et al. 2004-voucher
	Cervus elaphus	elk	Present	USGS 2003, 2004-sightings
	Odocoileus hemionus	mule deer	Present	Hooper 1941; USGS 2003, 2004-sightings
	Antilocapra americana	pronghorn	Present	USGS 2003-sighting
	Ovis canadensis	bighorn sheep	Historic	Extirpated; Hooper 1941; Findley et al. 1975

Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. We considered a number of localities reported by Hooper (1941) to be part of ELMA even though some are just outside park boundaries. Some of these localities are either surrounded by park property or within a mile of park property. The localities include near Flagpole Crater, north side Flagpole Crater, Porter's Ranch, nine miles south-southeast of Grants, eleven miles south-southeast of Grants, and Point of Malpaís (Hooper 1941).

Table 16. Levels of documentation (numbers and percentages) of mammals at BAND, CHCU, and ELMA, prior to and following inventories in 2003 and 2004.

Order	Total species possible	Total species likely	Previously documented species	Number of species present			Percent of likely species		Percent originally known	Final % of likely species
				2003	2004	Final	2003	2004		
BAND[1]										
Insectivora	6	6	1	1	2	2	17%	33%	17%	33%
Chiroptera	15	15	15	15	15	15	100%	100%	100%	100%
Lagomorpha	4	4	3	4	4	4	100%	100%	75%	100%
Rodentia	27	26	24	25	25	25	96%	96%	92%	96%
Carnivora	16	13	11	11	11	11	85%	85%	85%	85%
Artiodactyla	4	2	2	2	2	2	100%	100%	100%	100%
Total	**72**	**66**	**56**	**58**	**59**	**59**	**88%**	**89%**	**85%**	**89%**
CHCU[2]										
Insectivora	1	1	0	1	1	1	100%	100%	0%	100%
Chiroptera	15	15	14	15	15	15	100%	100%	93%	100%
Lagomorpha	3	2	2	2	2	2	100%	100%	100%	100%
Rodentia	21	20	18	20	20	20	100%	100%	90%	100%
Carnivora	14	11	7	9	9	9	81%	81%	63%	81%
Artiodactyla	4	4	1	3	3	3	75%	75%	25%	75%
Total	**58**	**53**	**42**	**50**	**50**	**50**	**94%**	**94%**	**79%**	**94%**
ELMA[3]										
Insectivora	2	1	0	0	0	0	0%	0%	0%	0%
Chiroptera	14	14	14	14	14	14	100%	100%	100%	100%
Lagomorpha	3	2	2	2	2	2	100%	100%	100%	100%
Rodentia	28	24	14	21	22	22	88%	92%	58%	92%
Carnivora	17	14	7	11	11	11	79%	79%	50%	79%
Artiodactyla	5	4	2	4	4	4	100%	100%	50%	100%
Total	**69**	**59**	**39**	**52**	**53**	**53**	**88%**	**90%**	**66%**	**90%**

Total species possible include extirpated and unconfirmed species, which we do not considered part of the current mammalian fauna. Total species likely are those species with confirmed documentation and those reasonably suspected to occur in the park (i.e., probably present). Percentages are based on "total species likely."

[1]Species previously documented from the park are based on park reports by Bogan et al. (1998) for bats and Guthrie and Large (1980) for all other mammals.

[2]Species previously documented from the park are based on Valdez et al. (2002a) for bats, Cully (1981) for other mammals, and Findley et al. (1975) for specimens housed at the Museum of Southwestern Biology.

[3]Species previously documented from the park are based on Valdez et al. (2002b) for bats, Hooper (1941) for other mammals, and Albert et al. (2004) for peccary.

Appendices

Appendix A. Scientific and common names of mammals in this report.

Order	Scientific name	Common name
Insectivora	*Notiosorex crawfordi*	Crawford's desert shrew
	Sorex cinereus	masked shrew
	Sorex merriami	Merriam's shrew
	Sorex monticolus	montane shrew
	Sorex nanus	dwarf shrew
	Sorex palustris	water shrew
	Sorex preblei	Preble's shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Corynorhinus townsendii	Townsend's big-eared bat
	Eptesicus fuscus	big brown bat
	Euderma maculatum	spotted bat
	Idionycteris phyllotis	Allen's big-eared bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus borealis	Eastern red bat
	Lasiurus cinereus	hoary bat
	Myotis auriculus	Southwestern myotis
	Myotis californicus	California myotis
	Myotis ciliolabrum	western small-footed myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown bat
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Nyctinomops macrotis	big free-tailed bat
	Pipistrellus hesperus	western pipistrelle
	Tadarida brasiliensis	Brazilian free-tailed bat
Lagomorpha	*Lepus californicus*	black-tailed jackrabbit
	Ochotona princeps	American pika
	Sylvilagus audubonii	desert cottontail
	Sylvilagus cognatus	Manzano mountain cottontail
	Sylvilagus floridanus	eastern cottontail
	Sylvilagus nuttallii	mountain cottontail
Rodentia	*Ammospermophilus interpres*	Texas antelope squirrel
	Ammospermophilus leucurus	white-tailed antelope squirrel
	Sciurus aberti	Abert's squirrel
	Spermophilus lateralis	golden-mantled ground squirrel
	Spermophilus spilosoma	spotted ground squirrel
	Spermophilus tridecemlineatus	thirteen-lined ground squirrel

Appendix A. Scientific and common names of mammals in this report, cont.

Order	Scientific name	Common name
Rodentia, cont.	*Spermophilus variegatus*	rock squirrel
	Tamiasciurus hudsonicus	red squirrel
	Castor canadensis	American beaver
	Cynomys gunnisoni	Gunnison's prairie dog
	Cynomys ludovicianus	black-tailed prairie dog
	Dipodomys merriami	Merriam's kangaroo rat
	Dipodomys ordii	Ord's kangaroo rat
	Dipodomys spectabilis	banner-tailed kangaroo rat
	Sigmodon fulviventer	tawny-bellied cotton rat
	Sigmodon hispidus	hispid cotton rat
	Erethizon dorsatum	porcupine
	Cratogeomys castanops	yellow-faced pocket gopher
	Geomys bursarius	plains pocket gopher
	Thomomys bottae	Botta's pocket gopher
	Thomomys talpoides	northern pocket gopher
	Clethrionomys gapperi	southern red-backed vole
	Microtus longicaudus	long-tailed vole
	Microtus mogollonensis	Mogollon vole
	Microtus montanus	montane vole
	Microtus pennsylvanicus	meadow vole
	Mus musculus	house mouse
	Neotamias dorsalis	cliff chipmunk
	Neotamias minimus	least chipmunk
	Neotamias quadrivittatus	Colorado chipmunk
	Neotamias rufus	Hopi chipmunk
	Neotoma albigula	white-throated woodrat
	Neotoma cinerea	bushy-tailed woodrat
	Neotoma mexicana	Mexican woodrat
	Neotoma micropus	southern plains woodrat
	Neotoma stephensi	Stephen's woodrat
	Ondatra zibethicus	muskrat
	Chaetodipus hispidus	hispid pocket mouse
	Chaetodipus intermedius	rock pocket mouse
	Onychomys leucogaster	northern grasshopper mouse
	Onychomys torridus	southern grasshopper mouse
	Perognathus flavescens	plains pocket mouse
	Perognathus flavus	silky pocket mouse
	Peromyscus boylii	brush mouse
	Peromyscus crinitus	canyon mouse
	Peromyscus eremicus	cactus mouse

Appendix A. Scientific and common names of mammals in this report, cont.

Order	Scientific name	Common name
Rodentia, cont.	*Peromyscus leucopus*	white-footed mouse
	Peromyscus maniculatus	deer mouse
	Peromyscus nasutus	northern rock mouse
	Peromyscus truei	piñon mouse
	Reithrodontomys megalotis	western harvest mouse
	Reithrodontomys montanus	plains harvest mouse
	Zapus hudsonius	meadow jumping mouse
Carnivora	*Bassariscus astutus*	ringtail
	Conepatus leuconotus	white-backed hog-nosed skunk
	Mephitis mephitis	striped skunk
	Canis latrans	coyote
	Canis lupus	gray wolf
	Lontra canadensis	northern river otter
	Lynx rufus	bobcat
	Mustela erminea	ermine
	Mustela frenata	long-tailed weasel
	Mustela nigripes	black-footed ferret
	Mustela vision	American mink
	Procyon lotor	northern raccoon
	Puma concolor	mountain lion
	Spilogale gracilis	western spotted skunk
	Taxidea taxus	American badger
	Urocyon cinereoargenteus	gray fox
	Ursus americanus	American black bear
	Ursus arctos	grizzly bear
	Vulpes macrotis	kit fox
	Vulpes vulpes	red fox
Artiodactyla	*Antilocapra americana*	pronghorn
	Bos bison	bison
	Capra hircus	domestic goat
	Cervus elaphus	elk
	Equus asinus	feral ass
	Odocoileus hemionus	mule deer
	Ovis canadensis	bighorn sheep
	Pecari tajacu	collared peccary

Appendix B. Study sites in AZRU, ELMO, PETR, SAPU, and YUHO.

Table B1. Activities at study sites in Aztec Ruins National Monument.

	UTM (NAD27)				
Location ID	Easting	Northing	Date	Observer(s)	Sampling method
AZ001A	232516	4080564	05/20/02	S. Haymond, L. Harding	opp. obs.
AZ001C	232648	4080981	10/04/02	M. Bogan	opp. obs.
AZ002A	232498	4080827	06/28/01	E. Valdez, R. Rodriguez	acoustic
AZ002A	232498	4080827	07/28/01	E. Valdez, R. Rodriguez	acoustic, mist net, trapline
AZ002A	232498	4080827	05/20/02	S. Haymond, E. Valdez	acoustic
AZ002C	232623	4080890	10/04/02	M. Bogan	opp. obs.
AZ003A	232947	4080369	05/21/02	S. Haymond, E. Valdez	trapline
AZ003C	767331	4080983	10/04/02	M. Bogan	opp. obs.
AZ004A	232866	4080280	05/21/02	S. Haymond, E. Valdez	acoustic
AZ004A	232866	4080280	07/19/02	E. Valdez	acoustic, mist net
AZ004C	232944	4080474	10/04/02	M. Bogan	opp. obs.
AZ005A	232483	4080621	07/04/01	E. Valdez, R. Rodriguiez	acoustic
AZ005C	232888	4080578	10/04/02	M. Bogan	opp. obs.
AZ006C	232475	4080686	10/04/02	M. Bogan	opp. obs.
AZ007A	232541	4080613	07/04/01	E. Valdez, R. Rodriguiez	acoustic
AZ008C	767264	4080705	10/04/02	M. Bogan	opp. obs.
AZ009C	232547	4080600	10/04/02	M. Bogan	opp. obs.
AZ01B	232759	4081181	05/20/02	L. Harding	tracking
AZ02B	767416	4081114	05/20/02	L. Harding	tracking
AZ03B	767289	4081052	05/20/02	L. Harding	tracking
AZ04B	767312	4080963	05/20/02	L. Harding	tracking
AZ05B	767503	4081163	05/20/02	L. Harding	tracking
AZ06B	767331	4081134	05/21/02	L. Harding	tracking
AZ07B	767267	4080830	05/21/02	L. Harding	tracking
AZ08B	767379	4080937	05/21/02	L. Harding	tracking
AZ09B	232938	4080299	05/21/02	L. Harding	tracking
AZ12B	232927	4080310	05/21/02	L.Harding	Havaharts
RAZ11	232945	4080419	06/18/01	D. Chavez, E. Taylor	trapline
RAZ12	233032	4080510	06/18/01	D. Chavez, E. Taylor	trapline
RAZ13A, B	232893	4080441	06/18/01	D. Chavez, E. Taylor	trapline
RAZ14	232888	4080527	06/18/01	D. Chavez, E. Taylor	trapline
RAZ15	767468	4081207	06/19/01	D. Chavez, E. Taylor	trapline
RAZ16	767136	4081144	06/19/01	D. Chavez, E. Taylor	trapline
RAZ17A, B	767527	4080537	06/20/01	D. Chavez, E. Taylor	trapline
RAZ18	232647	4081204	06/21/01	D. Chavez, E. Taylor	trapline
RAZ19	232673	4081030	06/22/01	D. Chavez, E. Taylor	trapline
RAZ20A, B	232861	4080420	08/13/01	D. Chavez, E. Taylor	trapline
RAZ21A, B	232815	4080413	08/13/01	D. Chavez, E. Taylor	trapline
RAZ22A, B	232496	4081251	08/14/01	D. Chavez, E. Taylor	trapline
RAZ23A, B	767490	4081231	08/14/01	D. Chavez, E. Taylor	trapline

Table B1. Activities at study sites in AZRU, cont.

Location ID	UTM (NAD27) Easting	UTM (NAD27) Northing	Date	Observer(s)	Sampling method
RAZ24A, B	232828	4081083	08/15/01	D. Chavez, E. Taylor	trapline
RAZ25A, B	232562	4080554	08/16/01	D. Chavez, E. Taylor	trapline
RAZ26	767418	4080557	05/02/03	K. Geluso	trapline
RAZ27	232597	4081316	05/01/03	K. Geluso	trapline
RAZ28	232580	4081057	05/01/03	K. Geluso	trapline
RAZ29	232473	4081160	05/01/03	K. Geluso	trapline, opp. obs.
RAZ30	232628	4081078	05/03/03	K. Geluso	trapline
RAZ31	767077	4080811	05/20/02	K. Geluso	trapline
RAZ31	767077	4080811	05/03/03	K. Geluso	trapline

Location identifiers are keyed to UTM Coordinates (NAD27), date(s) the sites were visited, individuals making observations on specific dates, and activities undertaken by those individuals. The UTM coordinates for each location in this table are accurate. However, some locations may not reconcile with the respective sites depicted on the companion map (see included CD). A few of the map markers were moved to render the marker tags legible.

Table B2. Activities at study sites in El Morro National Monument.

Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
	Easting	Northing			
EL001A	741698	3880523	07/15/02	S. Haymond, E. Valdez	acoustic, mist net
EL001A	741698	3880523	08/19/02	S. Haymond, E. Valdez	acoustic
EL002A	742967	3880229	07/15/02	S. Haymond	opp. obs.
EL002A	742967	3880229	07/18/02	S. Haymond, E. Valdez	acoustic
EL003A	742245	3879840	07/16/02	S. Haymond, E. Valdez	acoustic, mist net
EL004A	741483	3880368	07/17/02	E. Valdez	acoustic
EL01B	741461	3880399	07/16/02	L.Harding	tracking
EL02B	741481	3880502	07/16/02	L.Harding	tracking
EL03B	741427	3880489	07/16/02	L.Harding	tracking
EL04B	741435	3880475	07/16/02	L.Harding	tracking
EL05B	741384	3880440	07/16/02	L.Harding	tracking
EL06B	741392	3880366	07/16/02	L.Harding	tracking
EL07B	740946	3880288	07/16/02	L.Harding	tracking
EL08B	741638	3880758	07/17/02	L.Harding	tracking
EL09B	741230	3880738	07/17/02	L.Harding	tracking
EL10B	740938	3880122	07/17/02	L.Harding	tracking
EL11B	741506	3880373	07/17/02	L.Harding	tracking
ELOWLB	741482	3880417	07/16/02	L.Harding	tracking
REL101a, b	743130	3880843	06/12/02	M. Bogan	trapline
REL98a, b	743129	3880156	06/11/02	M. Bogan	trapline
RELG1	742541	3879597	05/04/03	K. Geluso	trapline
RELG2	742256	3879810	05/04/03	K. Geluso	trapline
RELG3	742981	3880233	05/04/03	K. Geluso	trapline
RELG4	743484	3879623	05/05/03	K. Geluso	trapline
RELG5	742792	3880768	05/05/03	K. Geluso	trapline
RELG6	742784	3879626	05/04/03	K. Geluso	opp. obs.
RELG7	741888	3880134	05/05/03	K. Geluso	opp. obs.
RELIRa, b	741876	3880573	06/13/02	M. Bogan	trapline
RELNIa, b	741298	3880503	10/17/02	M. Bogan	trapline
RELPOLa, b	741691	3880408	06/13/02	M. Bogan	trapline
RELSIR	741659	3880369	10/16/02	M. Bogan	trapline
RELVC	741918	3880307	06/12/02	M. Bogan	trapline

Location identifiers are keyed to UTM Coordinates (NAD27), date(s) the sites were visited, individuals making observations on specific dates, and activities undertaken by those individuals. The UTM coordinates for each location in this table are accurate. However, some locations may not reconcile with the respective sites depicted on the companion map (see included CD). A few of the map markers were moved to render the marker tags legible.

Table B3. Activities at study sites in Petroglyph National Monument.

Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
	Easting	Northing			
PE001A	341848	3887719	05/22/02	S. Haymond, E. Valdez	acoustic, opp. obs., trapline
PE004A	338220	3887745	05/24/02	S. Haymond, E. Valdez	trapline
PE006A	344012	3889874	05/22/02	S. Haymond, E. Valdez, M. Medrano	opp. obs.
PE007A	339716	3886945	05/29/02	S. Haymond, E. Valdez	acoustic
PE008A	346373	3895102	06/10/02	S. Haymond, E. Valdez	acoustic
PE010A	344175	3889551	06/11/02	S. Haymond, E. Valdez	acoustic
PE012A	343191	3892352	06/12/02	S. Haymond, E. Valdez	acoustic
PE01B	339529	3886924	05/23/02	L. Harding	tracking
PE02B	339545	3886764	05/23/02	L. Harding	tracking
PE03B	339506	3886691	05/23/02	L. Harding	tracking
PE04B	339293	3886177	05/23/02	L. Harding	tracking
PE05B	339491	3885878	05/23/02	L. Harding	tracking
PE06B	342643	3888685	05/24/02	L. Harding	tracking
PE07B	340586	3888488	05/24/02	L. Harding	tracking
RPE01A,B	342741	3888468	05/23/02	S. Haymond, E. Valdez	trapline
RPE03A,B	344243	3889680	06/11/02	S. Haymond	Sherman live traps
RPE04A,B	344144	3889477	06/11/02	E. Valdez	Sherman live traps
RPE08A,B	340836	3888285	05/24/02	L. Harding	Sherman live traps
RPE09	341686	3886830	06/04/01	S. Haymond	trapline
RPE09	341686	3886830	06/05/01	S. Haymond	trapline
RPE10	341711	3887013	06/04/01	M. Bogan	trapline
RPE11	341025	3886972	06/05/01	S. Haymond	trapline
RPE12	341742	3886942	06/05/01	M. Bogan	trapline
RPE13	342392	3887665	06/05/01	E. Valdez	trapline
RPE14	342019	3887172	06/06/01	E. Valdez	trapline
RPE15	342896	3888866	06/11/01	D. Chavez, E. Taylor	trapline
RPE16A, B	339706	3886991	06/12/01	D. Chavez, E. Taylor	trapline
RPE17	338688	3889890	09/27/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPE17	338688	3889890	10/01/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPE18	338312	3887627	09/27/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPE18	338312	3887627	10/09/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPE19	338564	3889380	09/27/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPE19	338564	3889380	10/01/01	D. Chavez, S. Haymond, E. Valdez	trapline
RPEG1	339509	3885850	05/12/03	K. Geluso	trapline
RPEG2	339854	3885889	05/12/03	K. Geluso	trapline

Location identifiers are keyed to UTM Coordinates (NAD27), date(s) the sites were visited, individuals making observations on specific dates, and activities undertaken by those individuals. The UTM coordinates for each location in this table are accurate. However, some locations may not reconcile with the respective sites depicted on the companion map (see included CD). A few of the map markers were moved to render the marker tags legible.

Table B4. Activities at study sites in Salinas Pueblo Missions National Monument.

Park code	Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
		Easting	Northing			
SAPU/ABO	RABO1A,B	373850	3812747	06/18/02	M. Bogan	trapline
SAPU/ABO	RABO2A, B	373854	3813113	06/19/02	M. Bogan	trapline
SAPU/ABO	RABO3A, B	373900	3813057	06/19/02	M. Bogan	trapline
SAPU/ABO	RABO4A, B	373653	3812052	06/19/02	M. Bogan	trapline
SAPU/ABO	RABO5A, B	373516	3812460	06/20/02	M. Bogan	trapline
SAPU/ABO	RABO6A, B	373771	3812804	06/21/02	M. Bogan	trapline
SAPU/ABO	RABO7A, B	373539	3812206	06/21/02	M. Bogan	trapline
SAPU/ABO	RSA15A, B	373788	3812758	07/08/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA15A, B	373788	3812758	07/09/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA16A, B	373770	3812624	07/08/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA16A, B	373770	3812624	07/09/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA17A, B	373419	3813011	07/10/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA17A, B	373419	3813011	07/11/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA18A, B	373590	3812843	07/10/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA18A, B	373590	3812843	07/11/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA19A, B	373658	3812717	07/12/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA20A, B	373811	3812739	07/12/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA21A, B	373684	3812632	07/12/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	RSA22	373732	3812754	07/12/01	D. Chavez, E. Taylor	trapline
SAPU/ABO	SA004A	373472	3812389	07/23/01	E. Valdez, R. Rodriguez	mist net, opp. obs.
SAPU/ABO	SA004A	373472	3812389	05/26/02	S. Haymond, E. Valdez	acoustic, mist net, opp. obs.
SAPU/ABO	SA004A	373482	3812386	05/27/02	S. Haymond, E. Valdez, P. Cryan	mist net
SAPU/ABO	SA004A	373472	3812389	08/22/02	P. Cryan, E. Valdez	acoustic, mist net
SAPU/ABO	SA008A	373392	3812362	07/26/01	E. Valdez, R. Rodriguez	mist net
SAPU/ABO	SA04B	373400	3812322	05/27/02	L. Harding	tracking
SAPU/ABO	SA05B	373391	3812323	05/27/02	L. Harding	tracking
SAPU/ABO	SA06B	373189	3812264	05/27/02	L. Harding	tracking
SAPU/GRNQ	RSA01A, B	399471	3791243	06/25/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA02A, B	399528	3791314	06/25/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA03A, B	399413	3791314	06/25/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA04A, B	399530	3791301	06/25/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA05A, B	399454	3791657	06/26/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA05A, B	399454	3791657	06/27/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA06A, B	399447	3791523	06/26/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA06A, B	399447	3791523	06/27/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA07A, B	398837	3790894	06/28/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA07A, B	398837	3790894	06/29/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA08A, B	398873	3790917	06/28/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA08A, B	398873	3790917	06/29/01	D. Chavez, E. Taylor	trapline
SAPU/GRNQ	RSA23A, B	399467	3791456	09/19/01	D. Chavez	trapline
SAPU/GRNQ	RSA24A, B	399453	3791506	09/19/01	D. Chavez	trapline
SAPU/GRNQ	RSA25A, B	398853	3790873	09/20/01	D. Chavez	trapline

Table B4. Activities at study sites in SAPU, cont.

Park code	Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
		Easting	Northing			
SAPU/GRNQ	RSA26A, B	398878	3790880	09/20/01	D. Chavez	trapline
SAPU/GRNQ	SA003A	398592	3791728	05/26/02	S. Haymond	opp. obs.
SAPU/GRNQ	SA01B	399825	3791567	05/25/02	L. Harding	tracking
SAPU/GRNQ	SA02B	399136	3791621	05/26/02	L. Harding	tracking
SAPU/GRNQ	SA03B	398739	3791461	05/26/02	L. Harding	tracking

Activities in each of the three units are tabulated separately; Abo and Gran Quivira are on the first page; Quarai is on the second page. Location identifiers are keyed to UTM Coordinates (NAD27), date(s) the sites were visited, individuals making observations on specific dates, and activities undertaken by those individuals. The UTM coordinates for each location in this table are accurate. However, some locations may not reconcile with the respective sites depicted on the companion map (see included CD). A few of the map markers were moved to render the marker tags legible.

Table B5. Activities at study sites in Yucca House National Monument.

Park code	Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
		Easting	Northing			
YUHO	RYU14	705269	4124996	09/21/02	M. Bogan	trapline
YUHO	RYU22	705193	4124947	09/13/01	D. Chavez, S. Haymond	trapline
YUHO	RYUG1	705256	4124906	05/02/03	K. Geluso	trapline
YUHO	RYUG3	705288	4124946	05/02/03	K. Geluso	trapline
YUHO	YU01B	705228	4124877	07/03/02	L. Harding	tracking
YUHO	YU02B	705212	4124881	07/03/02	L. Harding	tracking
YUHO	YU03B	705163	4124849	07/03/02	L. Harding	tracking
YUHO	YU04B	705135	4124959	07/03/02	L. Harding	tracking
YUHO	YU05B	705149	4124804	07/03/02	L. Harding	tracking
YUHO	YU06B	705516	4126211	07/03/02	L. Harding	tracking
YUHO	YU07B	705504	4126196	07/03/02	L. Harding	tracking
YUHO	YU08B	704962	4125367	07/03/02	L. Harding	tracking
YUHO	YU15c	705367	4125006	09/21/02	M. Bogan	trapline
YUHO	YUDOVE	705132	4125757	07/03/02	L. Harding	tracking
YUHO/Ismay	RYU10	704997	4125083	09/19/02	M. Bogan	trapline
YUHO/Ismay	RYU11	705034	4124781	09/19/02	M. Bogan	trapline
YUHO/Ismay	RYU12	705330	4125038	09/20/02	M. Bogan	trapline
YUHO/Ismay	RYU13	705946	4124975	09/20/02	M. Bogan	trapline
YUHO/Ismay	RYU16	705139	4125002	07/30/01	E. Valdez, R. Rodriguez	trapline
YUHO/Ismay	RYU17	705531	4126221	07/31/01	E. Valdez, R. Rodriguez	trapline
YUHO/Ismay	RYU18	706113	4126626	08/01/01	E. Valdez, R. Rodriguez	trapline
YUHO/Ismay	RYU19A, B	705265	4126391	09/13/01	D. Chavez, S. Haymond	trapline
YUHO/Ismay	RYU20A, B	704753	4125310	09/13/01	D. Chavez, S. Haymond	trapline
YUHO/Ismay	RYU21A, B	704543	4125122	09/13/01	D. Chavez, S. Haymond	trapline
YUHO/Ismay	RYUG2	705202	4124725	05/02/03	K. Geluso	trapline
YUHO/Ismay	YU001A	705139	4124987	06/29/01	E. Valdez, R. Rodriguez	acoustic, mist net
YUHO/Ismay	YU001A	705139	4124987	07/30/01	E. Valdez, R. Rodriguez	acoustic, mist net
YUHO/Ismay	YU001A	705139	4124987	06/03/02	S. Haymond, E. Valdez	acoustic, mist net, opp. obs.
YUHO/Ismay	YU002A	705497	4126207	06/30/01	E. Valdez, R. Rodriguez	acoustic
YUHO/Ismay	YU002A	705497	4126207	07/01/01	E. Valdez, R. Rodriguez	acoustic, mist net
YUHO/Ismay	YU002A	705497	4126207	07/31/01	E. Valdez, R. Rodriguez	acoustic
YUHO/Ismay	YU002A	705497	4126207	06/04/02	S. Haymond, E. Valdez	acoustic, mist net
YUHO/Ismay	YU003A	704889	4125229	06/05/02	S. Haymond, E. Valdez	acoustic, opp. obs.
YUHO/Ismay	YU005A	706113	4126626	07/02/01	E. Valdez, R. Rodriguez	acoustic, opp. obs.
YUHO/Ismay	YU17A	705531	4126221	07/31/01	E. Valdez, R. Rodriguez	mist net, opp. obs.
YUHO/IsmayE	RYUH1	708450	4122086	11/12/03	L. Harding	trapline
YUHO/IsmayE	RYUH1	708450	4122086	11/13/03	L. Harding	trapline
YUHO/IsmayE	RYUH2	708604	4121679	11/12/03	L. Harding	trapline
YUHO/IsmayE	RYUH2	708604	4121679	11/13/03	L. Harding	trapline
YUHO/IsmayE	RYUH3	708385	4122220	11/12/03	L. Harding	trapline
YUHO/IsmayE	RYUH3	708385	4122220	11/13/03	L. Harding	trapline
YUHO/IsmayE	RYUT1	708637	4123692	09/12/03	T. Mollhagen	trapline
YUHO/IsmayE	RYUT2	707494	4123098	09/13/03	T. Mollhagen	trapline

Table B5. Activities at study sites in YUHO, cont.

Park code	Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
		Easting	Northing			
YUHO/IsmayE	YU002B	708551	4122070	11/11/03	L. Harding	tracking
YUHO/IsmayE	YU003B	708450	4122086	11/11/03	L. Harding	tracking
YUHO/IsmayE	YU004A	708630	4123681	06/28/01	E. Valdez, R. Rodriguez	acoustic, mist net
YUHO/IsmayE	YU005B	708585	4121674	11/11/03	L. Harding	tracking
YUHO/IsmayE	YU006B	708322	4122222	11/11/03	L. Harding	tracking
YUHO/IsmayE	YU011B	708312	4121894	11/11/03	L. Harding	tracking

Activities in each of the three units are tabulated separately; the monument itself and respectively the west and east Ismay properties. Location identifiers are keyed to UTM Coordinates (NAD27), date(s) the sites were visited, individuals making observations on specific dates, and activities undertaken by those individuals. The UTM coordinates for each location in this table are accurate. However, some locations may not reconcile with the respective sites depicted on the companion map (see included CD). A few of the map markers were moved to render the marker tags legible.

Appendix C. Study sites in BAND, CHCU, and ELMA.

Table C1. Activities at study sites in Bandelier National Monument.

Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
	Easting	Northing			
BAAPAC-LEH1	375660	3966173	6/8/03	L. Harding	Opportunistic
BAAPS-LEH1	375667	3966161	8/19/03	L. Harding	Opportunistic
BABMT-LEH1	380012	3965538	6/5/03	L. Harding	Opportunistic
BABMT-LEH2	380007	3965503	7/8/03	L. Harding	Targeted
BABP-LEH1	376483	3958568	8/17/03	L. Harding	Opportunistic
BACG-LEH1	371663	3967780	6/4/03	L. Harding	Opportunistic
BACG-LEH2	371663	3967780	6/10/03	L. Harding	Targeted
BAEM-LEH1	377558	3965964	6/11/03	L. Harding	Opportunistic
BAFCF-LEH1	385184	3960468	6/6/03	L. Harding and W.B.	Opportunistic
BAHWY-LEH1	382515	3963539	7/6/03	L. Harding	Opportunistic
BANAS-LEH1	373268	3967372	7/7/03	L. Harding	Targeted
BAPOND-LEH1	371175	3967911	6/10/03	L. Harding	Targeted
BAPOND-LEH2	371169	3967941	7/6/03	L. Harding	Targeted
BASLT-LEH1	385184	3960468	6/9/03	L. Harding	Opportunistic
BATSK-LEH1	389487	3968920	6/7/03	L. Harding	Opportunistic
BATUSP-LEH1	374840	3952652	8/18/03	L. Harding	Opportunistic
BAUCT-LEH1	385184	3960468	6/3/03	L. Harding	Opportunistic
BAUFT-LEH1	385184	3960468	7/6/03	L. Harding	Opportunistic
RBA01A-B	383979	3962084	6/6/03	J. Hoffman, J. White	Targeted
RBA02A-B	383966	3962043	6/6/03	K. Geluso, V. Ashe	Targeted
RBA03A	371544	3967744	6/6/03	J. Hoffman, K. Geluso	Targeted
RBA04A	371596	3967692	6/7/03	K. Geluso, J. Hoffman, V. Ashe, J. White	Opportunistic
RBA05A	371612	3967665	6/6/03	K. Geluso, J. Hoffman	Targeted
RBA06A-B	371705	3967601	6/6/03	J. White, V. Ashe	Targeted
RBA07A-B	383859	3961879	6/7/03	K. Geluso	Targeted
RBA08A-B	383858	3961860	6/7/03	K. Geluso	Targeted
RBA09A-B	383984	3961989	6/7/03	J. Hoffman	Targeted
RBA10A-B	383958	3961693	6/7/03	J. White, V. Ashe	Targeted
RBA11A-B	385328	3959676	6/8/03	K. Geluso, J. Hoffman	Targeted
RBA12A-B	385196	3959717	6/8/03	K. Geluso, J. Hoffman	Targeted
RBA13A-B	385059	3959633	6/8/03	J. White, V. Ashe	Targeted
RBA14A-B	385193	3959690	6/8/03	J. White, V. Ashe	Targeted
RBA15A-B	385276	3959846	6/8/03	K. Geluso	Random
RBA16A	371178	3967918	6/10/03	K. Geluso, J. White, J. Hoffman, V. Ashe, L. Harding	Targeted
RBA17A	371677	3968498	6/10/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Targeted
RBA18A-B	371710	3968608	6/10/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Targeted
RBA19A	371815	3969045	6/10/03	K. Geluso, J. Hoffman, V. Ashe, J. White	Targeted
RBA20A	371743	3969320	6/10/03	K. Geluso, J. Hoffman, V. Ashe, J. White	Targeted
RBA21A	372182	3969892	6/10/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Targeted

Table C1. Activities at study sites at BAND, cont.

Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
	Easting	Northing			
RBA22A	372111	3969752	6/10/03	K. Geluso, J. Hoffman, V. Ashe, J. White	Targeted
RBA23A-B	384952	3961460	6/11/03	V. Ashe, J. Hoffman	Targeted
RBA24A	384799	3961754	6/11/03	J. White, K. Geluso	Targeted
RBA25A-B	386000	3959222	6/12/03	K. Geluso	Targeted
RBA26A-B	384921	3960161	6/12/03	K. Geluso, V. Ashe, J. White	Targeted
RBA27A-B	386026	3959016	6/12/03	J. White, V. Ashe	Targeted
RBA28A-B	386318	3957639	6/13/03	K. Geluso, J. White, V. Ashe	Targeted
RBA29A	386318	3957639	6/13/03	K. Geluso, J. White, V. Ashe	Targeted
RBA30A	386717	3957073	6/13/03	K. Geluso, J. White, V. Ashe	Targeted
RBA31A-B	371242	3967582	6/14/03	V. Ashe	Targeted
RBA32A-B	371248	3967559	6/14/03	K. Geluso	Targeted
RBA33A-B	370944	3967366	6/14/03	J. White	Targeted
RBA34A-B	371714	3968306	6/15/03	J. Hoffman, J. White	Targeted
RBA35A-B	371091	3967207	6/15/03	J. White	Targeted
RBA36A-B	371071	3967161	6/15/03	K. Geluso, V. Ashe	Targeted
RBA37A-B	371093	3967220	6/15/03	J. Hoffman	Targeted
RBA38A	385461	3959633	6/16/03	V. Ashe	Opportunistic
RBA39A	369612	3966368	6/17/03		Targeted
RBA40A-B	385226	3961463	6/17/03	K. Geluso	Targeted
RBA41A-B	385186	3961561	6/17/03	J. Hoffman, V. Ashe	Targeted
RBA42A-B	385244	3961470	6/17/03	J. White	Targeted
RBA43A-B	370307	3966556	6/18/03	J. White	Targeted
RBA44A-B	370304	3966421	6/18/03	J. Hoffman	Targeted
RBA45A-B	370293	3966514	6/18/03	V. Ashe, K. Geluso	Targeted
RBA46			6/1/03	K. Geluso	Opportunistic
RBA47			6/15/03	K. Geluso, V. Ashe, J. White, J. Hoffman	Opportunistic
RBA48A-B	377408	3966032	6/18/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Targeted
RBA49A-B	377224	3965890	6/18/04	K. Geluso, J. Mink	Targeted
RBA50A-B	377206	3965898	6/18/04	R. Ligon, J. Hoffman	Targeted
RBA51A	377480	3966033	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA52			6/18/04	K. Geluso, J. Mink, R. Ligon	Targeted
RBA53			6/18/04	J. Mink, R. Ligon	Opportunistic
RBA54A	374525	3965236	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA55A	373173	3965306	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA56A	373933	3965289	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA57A	374850	3965617	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA58A-B	373031	3965149	6/19/04	K. Geluso, R. Ligon	Targeted
RBA59A-B	372812	3964648	6/20/04	K. Geluso, J. Mink,	Targeted
RBA60A-B	373140	3965271	6/19/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Targeted
RBA61A-B	373038	3965232	6/19/04	J. Mink, J. Hoffman	Targeted
RBA62A-B	373152	3964510	6/20/04	R. Ligon, J. Hoffman	

Table C1. Activities at study sites at BAND, cont.

Location ID	UTM (NAD27)		Date	Observer(s)	Sampling method
	Easting	Northing			
RBA63A	375480	3965766	6/21/04	K. Geluso, R. Ligon, J. Hoffman, J. Mink	Opportunistic
RBA64A-B	376739	3964169	6/21/04	K. Geluso, R. Ligon, J. Hoffman, J. Mink	Opportunistic
RBA65A-B	375319	3964211	6/21/04	R. Ligon, J. Hoffman,	Targeted
RBA66A-B	375219	3964083	6/21/04	K. Geluso, J. Mink	Targeted
RBA67A-B	376014	3964333	6/21/04	R. Ligon, J. Hoffman	Targeted
RBA68A	377216	3964318	6/22/04	K. Geluso	Opportunistic
RBA69A	389704	3969376	6/23/04	K. Geluso	Opportunistic
RBA70A-B	377072	3964136	6/23/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Targeted
RBA71A-B	376435	3964207	6/23/04	K. Geluso, J. Hoffman	Targeted
RBA72A-B	376766	3964093	6/23/04	K. Geluso,J. Mink, R. Ligon	Targeted
RBA73A	377410	3964585	6/24/04	K. Geluso	Opportunistic
RBA74A	371178	3967918	6/24/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Targeted
RBA75A-B	375558	3966007	6/24/04	K. Geluso, J. Mink, R. Ligon	Targeted
RBA76A	389493	3968925	6/25/04	J. Mink, J. Hoffman	Targeted
RBA77A-B	389553	3969158	6/25/04	J. Mink, R. Ligon	Targeted
RBA78A-B	390050	3968996	6/25/04	K. Geluso	Targeted
RBA79A	384190	3961866	6/25/04	J. Mink, R. Ligon	Opportunistic
RBA80A-B	376964	3964126	6/26/04	J. Mink, R. Ligon	Targeted
RBA81A-B	377191	3964018	6/26/04	K. Geluso, J. Hoffman	Targeted
RBA82A-B	383463	396028	6/27/04	J. Mink	Targeted
RBA83A-B	383472	3960779	6/27/04	R. Ligon	Targeted
RBA84A-B	383433	3960688	6/27/04	J. Hoffman	Targeted
RBA85A-B	369052	3967070	6/28/04	K. Geluso, J. Mink	Targeted
RBA86A-B	369086	3967155	6/28/04	J. Mink, K. Geluso	Targeted
RBA87A-B	369837	3966547	6/28/04	J. Hoffman	Targeted
RBA88A-B	369845	3966656	6/28/04	R. Ligon	Targeted
RBA89A	369612	3966368	6/28/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Targeted
RBA90A-B	371638	3967707	6/30/04	K. Geluso, J. Mink, R. Ligon, J. Hoffman	Opportunistic
RBA91A	371933	3969787	6/30/04	K. Geluso, J. Mink	Targeted
RBA92A-B	371702	3968509	6/30/04	J. Mink	Targeted
RBA93A	371743	3969317	6/30/04	J. Mink	Targeted
RBA94A-B	372110	3970018	6/30/04	J. Hoffman	Targeted
RBA95A-B	372042	3969638	6/30/04	R. Ligon	Targeted

Table C2. Activities at study sites in Chaco Culture National Historical Park.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
CHCHACRA-LEH1	241092	3989413	5/21/03	L. Harding	Opportunistic
CHCLME-LEH1	242319	3990063	6/19/03	L. Harding	Opportunistic
CHCLYS-LEH1	232458	3994722	6/20/03	L. Harding	Opportunistic
CHKINBKL-LEH1	757301	3987933	5/22/03	L. Harding	Opportunistic
CHMOCK-LEH1	236030	3993264	6/17/03	L. Harding	Opportunistic
CHRD-LEH1	239063	3991099	6/18/03	L. Harding	Opportunistic
CHSML-LEH1	233341	3993201	5/23/03	L. Harding	Opportunistic
CHWASH-LEH1	232515	3994955	5/19/03	L. Harding	Opportunistic
CHWMESA-LEH1	770108	3995880	5/20/03	L. Harding	Targeted
CHWTCO-LEH1	240778	3992246	6/18/03	L. Harding	Opportunistic
RCH01A	238280	3991131	6/28/03	K. Geluso, V. Ashe, J. White	Targeted
RCH02A-B	236656	3990441	6/29/03	J. White, V. Ashe	Targeted
RCH03A-B	236389	3990635	6/29/03	K. Geluso, J. White, V. Ashe	Targeted
RCH04A-B	236666	3990480	6/29/03	K. Geluso	Targeted
RCH05A-B	236541	3989813	6/29/03	K. Geluso	Targeted
RCH06A-B	236550	3989858	6/29/03	J. White, V. Ashe	Targeted
RCH07A-B	236246	3989956	6/29/03	K. Geluso, J. White, V. Ashe	Targeted
RCH08A-B	241223	3992568	6/30/03	K. Geluso	Targeted
RCH09A-B	241226	3992559	6/30/03	V. Ashe	Targeted
RCH100A			12/19/04	K. Geluso	
RCH10A-B	241420	3992550	6/30/03	J. White, J. Hoffman	Targeted
RCH11A-B	238378	3991017	6/30/03	K. Geluso	Targeted
RCH12A-B	238354	3990996	6/30/03	J. White	Targeted
RCH13A-B	238328	3991147	6/30/03	V. Ashe, J. Hoffman	Targeted
RCH14A	232365	3993066	7/1/03	K. Geluso, J. Hoffman, J. White, V. Ashe	Targeted
RCH15A-B	232416	3992889	7/1/03	J. Hoffman	Targeted
RCH16A-B	232367	3992894	7/1/03	V. Ashe	Targeted
RCH17A-B	232389	3992890	7/1/03	K. Geluso, J. White	Targeted
RCH18A-B	232264	3992883	7/1/03	V. Ashe, K. Geluso	Targeted
RCH19A-B	232230	3992889	7/1/03	J. White	Targeted
RCH20A-B	232288	3992889	7/1/03	J. Hoffman	Targeted
RCH21A-B	241490	3989557	7/3/03	J. White	Targeted
RCH22A-B	240968	3989476	7/3/03	K. Geluso	Targeted
RCH23A-B	241471	3989544	7/3/03	V. Ashe	Targeted
RCH24A-B	241012	3989391	7/3/03	J. Hoffman	Targeted
RCH25A-B	240515	3990599	7/5/03	J. Hoffman	Targeted
RCH26A-B	240497	3990566	7/5/03	J. White	Targeted
RCH27A-B	240531	3990659	7/5/03	K. Geluso, V. Ashe	Targeted
RCH28A-B	240618	3990836	7/5/03	J. White, J. Hoffman, K. Geluso, V. Ashe	Targeted

Table C2. Activities at study sites at CHCU, cont.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
RCH29A-B	237726	3995363	7/6/03	J. White	Targeted
RCH30A-B	237727	3995303	7/6/03	K. Geluso, V. Ashe	Targeted
RCH31A-B	237720	3995311	7/6/03	J. Hoffman	Targeted
RCH32A	237361	3995303	7/6/03	K. Geluso, V. Ashe	Targeted
RCH33A-B	239354	3995129	7/6/03	J. White	Targeted
RCH34A-B	239320	3995149	7/6/03	J. Hoffman	Targeted
RCH35A-B	239336	3995126	7/6/03	K. Geluso, V. Ashe	Targeted
RCH36			6/28/03	V. Ashe	Opportunistic
RCH37			7/1/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Opportunistic
RCH38			7/2/03	K. Geluso	Opportunistic
RCH39			7/3/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Opportunistic
RCH40			7/7/03	K. Geluso, V. Ashe, J. White, J. Hoffman	Opportunistic
RCH40A	238562	3995421	6/3/04	K. Geluso, R. Ligon	Opportunistic
RCH41A	237894	3995155	6/3/04	K. Geluso, R. Ligon	Opportunistic
RCH42A	238291	3991130	6/2/04	K. Geluso, R. Ligon	Opportunistic
RCH44A	235773	3995666	6/3/04	K. Geluso, R. Ligon	Targeted
RCH45A-B	234342	3996412	6/3/04	K. Geluso, R. Ligon	Targeted
RCH46A	237616	3991017	6/3/04	K. Geluso, R. Ligon	Targeted
RCH47A	237102	3990864	6/3/04	K. Geluso, R. Ligon	Targeted
RCH48A	239679	3991367	6/4/04	K. Geluso, R. Ligon	Targeted
RCH49A	240765	3992252	6/4/04	K. Geluso, R. Ligon	Targeted
RCH50A-B	240863	3991750	6/4/04	K. Geluso, R. Ligon	Targeted
RCH51A-B	240944	3992091	6/4/04	K. Geluso, R. Ligon	Targeted
RCH52A	237162	3992317	6/6/04	K. Geluso, R. Ligon	Opportunistic
RCH53A-B	234749	3993943	6/5/04	K. Geluso, R. Ligon	Targeted
RCH54A-B	235275	3993233	6/5/04	K. Geluso, R. Ligon	Targeted
RCH55A-B	236556	3991804	6/5/04	K. Geluso, R. Ligon	Targeted
RCH56A-B	237206	3992426	6/5/04	K. Geluso, R. Ligon	Targeted
RCH57A	241534	3992294	6/6/04	K. Geluso,	Opportunistic
RCH58A	241875	3992031	6/7/04	K. Geluso,	Opportunistic
RCH59A-B	241918	3991124	6/6/04	K. Geluso	Targeted
RCH60A-B	241928	3991750	6/6/04	K. Geluso	Targeted
RCH61A	242745	3992507	6/6/04	R. Ligon	Opportunistic
RCH62A-B	244164	3992455	6/6/04	R. Ligon	Targeted
RCH63A-B	242045	3992543	6/6/04	R. Ligon	Targeted
RCH64A	769517	3997442	6/7/04	K. Geluso, R. Ligon	Opportunistic
RCH65A	241733	3992118	6/6/04	K. Geluso	Opportunistic
RCH66A	231888	3995578	6/8/04	K. Geluso, R. Ligon	Opportunistic
RCH67A-B	770172	3997414	6/7/04	K. Geluso, R. Ligon	Targeted

Table C2. Activities at study sites at CHCU, cont.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
RCH68A-B	230541	3996591	6/7/04	K. Geluso, R. Ligon	Targeted
RCH69A-B	231118	3996194	6/7/04	K. Geluso, R. Ligon	Targeted
RCH70A-B	231531	3995682	6/7/04	K. Geluso, R. Ligon	Targeted
RCH71A	238558	3991452	6/8/04	K. Geluso, R. Ligon	Targeted
RCH72A	240597	3989160	6/9/04	K. Geluso, R. Ligon	Targeted
RCH73A-B	240445	3989018	6/9/04	K. Geluso, R. Ligon	Targeted
RCH74A-B	240231	3988991	6/10/04	K. Geluso, R. Ligon	Targeted
RCH75A-B	240074	3989006	6/10/04	K. Geluso, R. Ligon	Targeted
RCH80A-B	240616	3988964	10/19/04	K. Geluso, K. Peterson	Targeted
RCH81A-B	240431	3989021	10/20/04	K. Geluso, K. Peterson	Targeted
RCH82A-B	240403	3989250	10/20/04	K. Geluso, K. Peterson	Targeted
RCH83A	237237	3990899	10/19/04	K. Geluso	Opportunistic
RCH84A-B	239635	3991305	10/21/04	K. Geluso, K. Peterson, B. Shattuck	Targeted
RCH85			10/19/04	K. Geluso	
RCH86A-B	258950	3984528	10/22/04	K. Geluso	Targeted
RCH87A	763829	3991384	10/23/04	K. Geluso	Targeted
RCH88A	757308	3988021	10/23/04	K. Geluso	Targeted
RCH89A	761244	39512642	10/24/04	K. Geluso	Targeted
RCH90A-B	761217	3651338	10/24/04	K. Geluso	Targeted
RCH91A	241182	3988989	12/20/04	K. Geluso	Opportunistic
RCH92A	241309	3988557	12/20/04	K. Geluso	Opportunistic
RCH93A	241228	3988046	12/20/04	K. Geluso	Opportunistic
RCH94A	240059	3988656	12/20/04	K. Geluso	Opportunistic
RCH95A	239887	3988821	12/20/04	K. Geluso	Opportunistic
RCH96A	238906	3989250	12/20/04	K. Geluso	Opportunistic
RCH97A	243066	3987344	12/20/04	K. Geluso	Opportunistic
RCH98A	241969	3987730	12/20/04	K. Geluso	Opportunistic
RCH99A	242247	3988861	12/20/04	K. Geluso	Opportunistic

Table C3. Activities at study sites in El Malpaís National Monument.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
RD7950-LEH1	243319	3994094	5/20/03	L. Harding	Opportunistic
ELARCH-LEH1	770235	3875427	6/30/03	L. Harding	Targeted
ELBTA-LEH1	765007	3870693	5/28/03	L. Harding	Targeted
ELCEB-LEH1	230914	3852147	7/2/03	L. Harding	Targeted
ELCENC-LEH1	769058	3863197	5/28/03	L. Harding	Targeted
ELCENC-LEH2	769058	3863188	8/14/03	L. Harding, M. Ireland, K. Haldeman	Targeted
ELCORRAL-LEH1	770207	3874770	5/25/03	L. Harding	Targeted
ELCSR-LEH1	768197	3852265	8/12/03	L. Harding	Random
ELELCA-LEH1	773679	3873588	7/1/03	L. Harding	Opportunistic
ELJUG-LEH1	228380	3850432	8/13/03	L. Harding	Targeted
ELLFA-LEH1	227558	3847660	8/13/03	L. Harding	Targeted
ELLOWO-LEH1	768774	3872938	5/26/03	L. Harding, A.Blaakman	Targeted
ELNARR-LEH1	233794	3858562	7/3/03	L. Harding	Targeted
ELNBT-LEH1	765365	3869924	7/4/03	L. Harding	Targeted
ELPOCG-LEH1	762479	3875264	8/11/03	L. Harding	Targeted
ELSAB-LEH1	243714	3873769	8/15/03	L. Harding	Targeted
ELWMWA-LEH1	756201	3851961	5/27/03	L. Harding	Targeted
REL01A-B	233868	3856173	7/16/03	K. Geluso, V. Ashe	Targeted
REL02A-B	233760	3856180	7/16/03	J. Hoffman	Targeted
REL03A-B	233796	3856176	7/16/03	J. White	Targeted
REL04A	233906	3856472	7/16/03	K. Geluso, V. Ashe, J. Hoffman, J. White	Targeted
REL05A-B	233567	3858816	7/17/03	K. Geluso, V. Ashe	Targeted
REL06A-B	233546	3858839	7/17/03	J. White	Targeted
REL07A-B	233589	3858791	7/17/03	K. Geluso, V. Ashe	Targeted
REL08A	243902	3874862	7/18/03	K. Geluso, J. Goheen	Targeted
REL09A-B	243949	3874786	7/18/03	V. Ashe	Targeted
REL10A-B	243970	3874694	7/18/03	J. White	Targeted
REL11A	243288	3875804	7/18/03	J. Goheen, K. Geluso	Targeted
REL12A-B	243422	3875951	7/18/03	J. White, V. Ashe	Targeted
REL13A	762499	3875248	7/19/03	K. Geluso, V. Ashe, J. Goheen, J. White	Targeted
REL14A-B	762545	3874889	7/19/03	K. Geluso, J. White	Targeted
REL15A-B	762432	3874906	7/19/03	J. Goheen, V. Ashe	Targeted
REL16A-B	762442	3874952	7/19/03	V. Ashe	Targeted
REL17A-B	241981	3889922	7/20/03	K. Geluso	
REL18A-B	242011	3889900	7/20/03	V. Ashe	Targeted
REL19A-B	242062	3889863	7/20/03	J. White, J. Hoffman	Targeted
REL20A-B	242394	3889966	7/20/03	K. Geluso	Targeted
REL21A-B	242297	3889926	7/20/03	J. White, V. Ashe	Targeted
REL22A-B	242399	3889989	7/20/03	K. Geluso, J. Hoffman	Targeted
REL23A-B	228690	3849016	7/21/03	J. White	Targeted

Table C3. Activities at study sites at ELMA, cont.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
REL24A-B	228865	3848996	7/21/03	K. Geluso, V. Ashe	Targeted
REL25A-B	228738	3849017	7/21/03	J. Hoffman	Targeted
REL26A	228445	3847924	7/21/03	K. Geluso, V. Ashe	Targeted
REL27A-B	228471	3847891	7/21/03	J. White	Targeted
REL28A-B	228503	3847899	7/21/03	J. Hoffman	Targeted
REL29A-B	231460	3852991	7/21/03	K. Geluso, J. Hoffman, J. White, V. Ashe	Targeted
REL30A	240892	3870545	7/22/03	K. Geluso	Targeted
REL31	240848	3870470	7/22/03	J. White	Targeted
REL32A-B	240867	3870411	7/22/03	J. Hoffman, V. Ashe	Targeted
REL33A-B	241610	3870937	7/22/03	V. Ashe	Targeted
REL34A-B	241466	3870710	7/22/03	J. Hoffman	Targeted
REL35A	241400	3870914	7/22/03	K. Geluso, J. White	Targeted
REL36	242689	3889776	7/23/03	K. Geluso	Targeted
REL37A-B	242661	3889753	7/23/03	K. Geluso, J. Hoffman	Targeted
REL38A-B	242527	3889553	7/23/03	J. White, V. Ashe	Targeted
REL39A-B	242673	3889765	7/23/03	J. Hoffman	Targeted
REL40A-B	231326	3872001	7/30/03	K. Geluso	Targeted
REL41A-B	231340	3872000	7/30/03	V. Ashe	Targeted
REL42A-B	227425	3873137	7/31/03	K. Geluso	Targeted
REL43A-B	227421	3873132	7/31/03	V. Ashe	Targeted
REL44A-B	227425	3873078	7/31/03	K. Geluso	
REL45A-B	227446	3873069	7/31/03	V. Ashe	Targeted
REL46A	770541	3876066	8/1/03	K. Geluso, V. Ashe	Targeted
REL47A-B	242968	3889325	8/1/03	K. Geluso	Targeted
REL48A-B	242959	3889075	8/1/03	V. Ashe	Targeted
REL49A-B	242431	3889929	5/25/04	K. Geluso, R. Ligon	Targeted
REL50A-B	242391	3889965	5/25/04	K. Geluso, R. Ligon	Targeted
REL51A-B	763803	3871315	5/26/04	K. Geluso, R. Ligon	Opportunistic
REL52A-B	773629	3873641	5/25/04	K. Geluso, R. Ligon	Opportunistic
REL53A	773749	3873980	5/25/04	K. Geluso, R. Ligon	Opportunistic
REL54A	230691	3875846	5/26/04	K. Geluso, R. Ligon	Targeted
REL55A	770531	3876113	5/26/04	K. Geluso, R. Ligon	Targeted
REL56A	764299	3870128	5/26/04	K. Geluso, R. Ligon	Targeted
REL57A-B	764327	3869041	5/26/04	K. Geluso, R. Ligon	Targeted
REL58A	765522	3867564	5/26/04	K. Geluso, R. Ligon	Targeted
REL59A	773501	3872490	5/27/04	K. Geluso, R. Ligon	Targeted
REL60A	772963	3873229	5/27/04	K. Geluso, R. Ligon	Targeted
REL61A-B	772503	3872826	5/27/04	K. Geluso, R. Ligon	Targeted
REL62A	771353	3872300	5/27/04	K. Geluso, R. Ligon	Targeted
REL63A	772629	3872942	5/28/04	K. Geluso, R. Ligon	Opportunistic
REL64A	762499	3875248	8/26/04	K. Geluso, R. Ligon	Targeted

Table C3. Activities at study sites at ELMA, cont.

Location ID	UTM (NAD27)		Date	Observers	Sampling method
	Easting	Northing			
REL65A-B	760783	3863429	8/26/04	K. Geluso	Targeted
REL66A-B	760534	3863730	8/26/04	K. Geluso	Targeted
REL67A-B	760816	3864241	8/26/04	K. Geluso	Targeted
REL68A	227461	3846283	8/28/04	K. Geluso	Opportunistic
REL69A	233416	3860073	8/28/04	K. Geluso	Opportunistic
REL70A-B	770558	3850064	8/28/04	K. Geluso	Targeted
REL71A-B	770448	3847509	8/28/04	K. Geluso	Targeted
REL72A-B	770686	3847267	8/28/04	K. Geluso	Targeted
REL73A	238673	3864956	8/29/04	K. Geluso	Targeted
REL74A-B	242342	3889904	8/29/04	K. Geluso	Targeted
REL75A-B	242513	3889881	8/29/04	K. Geluso	Targeted
REL76A	773501	3872490	8/27/04	K. Geluso	Targeted
REL77A	242577	3888770	8/29/04	K. Geluso	Opportunistic
REL78A	760545	3865174	8/26/04	K. Geluso	Opportunistic

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