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Mammals of the Greater Gila Region

Amanda K. Jones

Amanda K. Jones

Candidate

Biology

Department

This thesis is approved, and it is acceptable in quality and form for publication:

Approved by the Thesis Committee:

Dr. Joseph Cook, Chairperson

Dr. David Schmidly

Dr. Ernie Valdez

MAMMALS OF THE GREATER GILA REGION

by

AMANDA K. JONES

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THESIS

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Abstract

The Greater Gila Region is an important area for study of mammals due to its unique physiographic history, leading to high elevational relief and many associated habitats. Due to the variety of habitats, the Gila is home to a very diverse assemblage of mammal fauna: 100 native species, 95 of which are extant in the region. This paper documents these species' current and historic distributions, taxonomy, habitat affinities, current phylogeographic studies, reproductive timing, and any other pertinent information. In addition, novel phylogeographic studies for four selected species were performed to fill in gaps in previous studies where Gila sampling was lacking. Conservation recommendations (for both specific taxa and habitats) are made based on all the above information.

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INTRODUCTION

Biotic surveys over the last 150 years throughout the American Southwest produced extensive natural history collections that were aimed at documenting the diverse flora and fauna. Today, those historical inventories are helping to establish biodiversity baselines against which changing environmental conditions can be rigorously tested and evaluated (e.g., Hope et al., 2013). Baselines for historical conditions are most powerfully established through museum specimens that now provide retrospective materials and data for a myriad of investigations of environmental change (Suarez & Tsutsui 2005; McLean et al., 2015). Because these georeferenced records are backed by standardized samples (for mammals now usually preserved skins, skeletons, cryogenic tissues, and parasites), more intensive and integrated investigations of the biology of these organisms are now possible that take advantage of technological (e.g., genomics, stable isotopes) and analytical advances (e.g., ecological niche modeling).

The Grinnell Resurvey Project is an example of how a series of scientists from diverse disciplines documented numerous changes in vertebrates' body size, genetic variation, diet, and distributions over the past century in California. Those analyses were possible because extensive surveys by Joseph Grinnell in the early 1900s (http://mvz.berkeley.edu/Grinnell/main) provided a wealth of baseline information and samples. Grinnell made the prescient comment that "At this point I wish to emphasize what I believe will ultimately prove to be the greatest value of our museum. This value will not, however, be realized until the lapse of many years, possibly a century, assuming that our material is safely preserved. And this is that the student of the future will have access to the original record of faunal conditions in California and the west, wherever we now work." Without the baseline specimens that Grinnell collected, a series of innovative studies conducted by the Grinnell Resurvey (Moritz et al., 2008; Tingley et al., 2009; Bi et al., 2013; Smith et al., 2013) would have been impossible. My study aimed to contribute to the process of establishing a mammalian baseline for the Gila region.

The Greater Gila Region (hereafter Gila), covers parts of 3 counties (Catron, Grant, and Sierra) in southwestern New Mexico and is comprised of federal lands managed primarily by the Gila National Forest (133,5462 ha, U.S. Department of

Agriculture Forest Service), Bureau of Land Management (1,042,386 ha, US Department of Interior), state lands (676,864 ha, NM State Land Office), and privately-owned land, such as the Ladder Ranch (1,546,732 ha). Over the past century, this region's rich biotic diversity, dynamic geologic history, topographic and elevational relief, and abundance of archaeological and paleontological sites have established the Gila as an area of great interest to scientists, outdoor sportsman, and tourists alike. The Gila has been the focus of conservation efforts for many of New Mexico's most imperiled taxa, the Mexican spotted owl (*Strix occidentalis lucida*), the Mexican gray wolf (*Canis lupus baileyi),* Chiricahua leopard frog (*Lithobates chiricahuensis*), Mexican garter snake (*Thamnophis eques*) and 4 fish, Gila trout (*Oncorhynchus gilae,* headwater chub (*Gila nigra*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). A number of recreational and historical sites are found in the region including the Gila Cliff Dwellings, the northernmost site of the Mogollon tribe which draws 25,000-40,000 visitors per year. Despite this wealth of interest in the Gila, the region has had few systematic biotic surveys of its impressive flora and fauna.

The aim of my study of the mammals of the Gila is to: 1) summarize existing information (previous specimens, field notes, interviews); 2) collect data regarding mammalian occurrence, distribution, and abundance; 3) begin to build a comparative dataset and archive of samples to establish baseline environmental conditions for future work, especially at sites where historic data are lacking; 4) collect traditional vouchers and associated materials (e.g. tissues for use in future studies such as phylogenetics, phylogeography, epidemiology, and ecology; and 5) preserve parasites from mammal specimens for use in pathogen and parasite studies. I provide an overview of the taxonomy, primary habitat, elevational range, distribution, reproduction, pertinent phylogeographic studies, and conservation concerns, by emphasizing information principally backed by voucher specimens.

MATERIALS AND METHODS

Site Description

The Gila (Figure 1), as defined by this project, lies within Catron, Grant, and Sierra counties and extends from the Arizona/New Mexico border eastward to the Rio Grande and is roughly bounded to the north by the Plains of San Agustin and to the south by the Deming Plains. Within this region, public lands and private lands (e.g., ranches such as the Ladder Ranch and communities such as Aragon) are managed under distinct land use policies. For example, the Gila Wilderness was dedicated as the first wilderness area worldwide by the U.S. Department of Agriculture, Forest Service on 3 June 1924. Originally 305,537 ha were designated as wilderness, but in 1979 it was divided into the Gila Wilderness (225,763 ha) and the adjacent Aldo Leopold Wilderness to the east (81,752 ha) in 1979. In 1980 the Blue Range Wilderness was added near te Arizona border. The Gila National Forest at 1,214,056 ha, is the largest national forest in the Southwestern Region. On 18 June 1908, the Big Burro Mountains were added to the Gila National Forest and are included in this study (Baker et al. 1988). The Apache National Forest bounds the Gila National Forest to the west and extends into Arizona.

A considerable amount of survey effort for my project focused on the poorly documented eastern areas of the Gila, especially sites in Sierra County (Figure 1). Much of that sampling effort was completed on The Ladder Ranch, which lies west of the Rio Grande and is bounded by the summit of the Black Range to the west. The Ladder Ranch sustains desert scrub, desert grassland, piñon-juniper woodland, and ponderosa pine habitats. Bell Mountain is the highest point on the ranch at 1941 m. The primary drainages on the Ladder ranch are the perennial Animas, Palomas, and Cuchillo creeks. Seco Creek, is seasonally ephemeral. The Ladder Ranch is notable because it has not been grazed by cattle since 1992, whereas most public lands on the rest of the Gila have been consistently grazed since the late 1880s (Figure 3). A focus of the Ladder Ranch under the ownership of Ted Turner has been restoration ecology and propagation of multiple endangered species, including the bolson tortoise (*Gopherus flavomarginatus*), Chiricahua leopard frog (*Rana chiricahuensis*), and Mexican gray wolf (*Canis lupus baileyi*).

Physiography and Habitat

The Gila supports high mammal diversity (95 native, extant species), due in part to a dynamic geologic, climatologic, and biogeographic history and the confluence of multiple major biomes. Geologically termed the Datil-Mogollon Transition, the Gila is located near the southeastern edge of the Colorado Plateau, the southern extent of the Rocky Mountains, the far western boundary of the Short Grass Prairie, and northern end of the Basin & Range (Mexican Highland) physiographic provinces (Julyan, 2006). The Datil-Mogollon section includes Catron County and parts of Grant and Sierra counties and is characterized by relatively recent volcanism (Eocene, ~40 Ma) (Geology SW NM, 1965). Basin and Range characterizes southern portions of Grant and Sierra Counties and includes the Pinos Altos Range, Silver City Range, and the Burro Mountains (Big and Little) (Julyan, 2006). The Colorado Plateau and Basin and Range provinces create substantial elevational relief and complexity that supports high habitat diversity and associated high mammalian diversity.

The Gila is within the Southwest warm desert region (Riddle & Hafner, 2006), where diverse desert biomes are the result of periods of great uplift of the American Cordillera (Wilson & Pitts, 2010). Uplift caused rain shadows, accelerated aridification and formation of North American deserts that was pronounced during the early Holocene, although it was considerably more mesic in that time period than now (Sharpe, 2002). Uplift of the Continental Divide during the Pliocene-Pleistocene (~2 Ma) caused the split of the Rocky Mountain range and the Sierra Madre Occidental, and led to the formation of three North American deserts: the Chihuahuan, Mojave, and Sonoran (Wilson & Pitts, 2010).

The Chihuahuan Desert is the primary habitat of the lower elevations of the Gila and has been proposed to be the "center of desert biota" (Morafka, 1977) based on fossil data from the region (Webb, 1977). Much of the southwest mammalian desert biota is the result of isolation and subsequent divergence during the Pleistocene in the Chihuahuan desert (Findley, 1969; Morafka, 1977). Riddle & Hafner (2006) used 22 desert-adapted biotic clades (9 mammalian) and found that the “Continental West” area, consisting of the Sonoran and Coloradan, had high endemism, while the Chihuahuan had none. They further theorized that the Continental West area played a geographically central role in diversification between the Chihuahuan areas to the east and the Baja California/peninsular areas to the west (Riddle & Hafner, 2006).

The diversity in both the montane and desert habitats of the Gila was likely the result of vicariant events with isolation and divergence of organisms across time through different climatic events (Patterson, 1980; Riddle & Hafner, 2006). Patterson (1980) looked at montane mammals across New Mexico using latitude, longitude, elevation, and forested area as variables to predict vicariance, and found that the disjunction of montane mammal distributions across the state coincided with interglacial periods of the Pleistocene. During glacial periods, montane mammals would disperse to areas of lower elevation, and when climatic conditions warmed, they would recolonize montane regions and become isolated (Patterson 1980). This history of repeated isolation accounts for geographically variable montane populations, such as the red-backed vole (*Myodes gapperi)*, the golden-mantled ground squirrel (*Callospermophilus lateralis)*, and Abert’s squirrel (*Sciurus aberti*) (Findley et al., 1975).

A total of 33 of the 95 (35%) native mammal species recorded in the Gila have range limits within the Gila (Figure 4) likely due to the confluence of physiographic provinces and resulting merger of several different biomes. The Gila is at the southern termination of the Rocky Mountains and is ~ 158 km north of the northern termination of the Sierra Madres (Whiteman, 2015). Representative elements of the Chihuahuan and Sonoran deserts occur in the lower elevations of the Gila.

The Gila River remains the last major undammed river in New Mexico, although there are now plans to divert the river near the towns of Gila and Cliff (Gori et al., 2013). A major tributary to the Gila River is the San Francisco River (and its various tributaries Tularosa River and Negrito, Deep, Mineral, Whitewater and Dry creeks). Other tributaries of the Gila include Mogollon, Turkey, Sapillo, Black, Diamond, Whitewater (Black Range), Gilita and Iron creeks, among others. The Mimbres River drains the southcentral Gila into a dry bolson of the Deming Plain. Drainages that flow from the

Black Range eastward into the Rio Grande include Animas, Palomas, and Seco Creeks (among others). The Gila also encompasses a number of major landforms including the eastern Mogollon Plateau, and several large mountain ranges: Mogollon, Black Range, San Francisco, Elk, Tularosa, and Mangas mountains. Elevation ranges from 1008 m where the San Francisco and Gila rivers meet to over 3,000 m at Whitewater Baldy of the Mogollon Mountains.

Major Vegetation Types

Habitats range from desert grassland at the lowest elevation up through desert scrubland, piñon-juniper woodland, ponderosa pine forest, and mixed conifer forest and montane grassland at the highest elevations. Various mixtures of these habitats occur at many ecotonal areas and riparian habitats transect these habitats.

Detailed habitat descriptions for the region follow Peddie (1993). Habitat descriptions allow comparisons of mammalian communities throughout the Gila and across regions in the Southwest. Stenoecious species (e.g. *Euderma maculatum, Myodes gapperi, Ondatra zibethicus)* are restricted to particular habitats, while euryecious species (e.g. *Canis latrans, Mephitis mephitis, Peromyscus maniculatus)* may occur widely across several habitats. Below I briefly characterize these habitats (Table 1) and photographs of habitats (Figures 5a-i).

Number of trap nights per habitat type is also included (total number of individual traps set multiplied by number of nights they were in the field).

<u>Upper Montane (Mixed Coniferous) (1656 trap nights)</u>
<u>Elevation: 2400-3100 m</u>
<u>Aspect: see below</u>

Mixed conifer forests are characterized by blue spruce, Douglas fir, ponderosa pine, and aspen (south and west aspect). Blue spruce is found along the north and east aspects of valleys and some stands include ponderosa pine, Gambel oak, or white-fir with Douglas-fir. Understory is heavy with shrubs such as rocky mountain maple, wintergreens, and grasses such as forest ricegrass.

Lower Montane Coniferous (Ponderosa pine forest) (4397 trap nights)

Elevation: 2200-2600 M

Aspect: South

This habitat is characterized by various ponderosa pine associations including Gambel oak, silverleaf oak, or piñon pine. Understory is often sparse in this typically closed-canopy forest.

Coniferous Woodland (Piñon -juniper) (3312 trap nights)

Elevation: 1800-2100 m

Aspect: South

Piñon-juniper woodland is split into 3 elevational sub-categories: low arid, typical, and mesic (Moir & Carleton, 1987). One-seeded juniper is most common from 1800-2000 m and is replaced by alligator juniper around 2100 m. Black and blue grama grasses compose the understory.

Subalpine Montane Grassland (788 trap nights)

Elevation: 2700-3500 m

Aspect: None

Within the Gila, subalpine montane grassland habitat only occurs in the high elevations of the Mogollon Mountains and consists of roughly equal amounts of grass (blue grass and muhly grass) and forbs.

Desert Grassland (1143 trap nights)

Elevation: 1200-1700 m

Aspect: North and South

Desert grassland is dominated by blue and black grama, buffalo, and dropseed grasses, with shrubs like sagebrush and saltbush distributed throughout, and often reflecting the severity of grazing.

Desert scrubland (5420 trap nights)
Elevation: 1200-1700 m
Aspect: South

Desert scrub is dominated by creosote, although honey mesquite, prickly pear cactus, and ocotillo also occur sporadically.

Riparian (2700 trap nights)
Elevation: 1200-3200 m (see below)
Aspect: None

Riparian habitats occur throughout the Gila along major drainages and can be roughly categorized by the dominant over-story and shrubs at different elevations: higher elevations (2400-3200 m) are typified by blue spruce and willows; mid elevations (1500-3000 m) are the most common and characterized by boxelder, alder, sycamore, and narrow-leaf cottonwood; and low elevations (1200-2100 m) and are typified by hackberry and Fremont cottonwoods; overlapping elevations are characterized by ecotones between habitats. Riparian habitats are always associated with a creek or a river.

History of Surveys

The earliest surveys in southwestern New Mexico began more than 100 years ago by V.O. Bailey of the U.S. Biological Survey (USBS), who intermittently travelled New Mexico from 1889 to 1924 collecting mammal specimens. Although Bailey conducted much of the early fieldwork in New Mexico, other notable USBS employees such as C.H. Merriam, A.K. Fisher, E.A. Goldman, C.F. Birdseye, and N. Hollister also investigated and collected mammals from the Gila (specimens deposited at United States National Museum in Washington, D. C. (USNM), American Museum of Natural History in New

York (AMNH), and the Museum of Vertebrate Zoology in Berkeley, CA (MVZ). Other mammalogists soon followed in their footsteps including P.A. Stewart and E. O. Mellinger in 1938 who collected mammals from Cliff, Glenwood, and Silver City (specimens deposited at AMNH), but subsequently little fieldwork in the Gila was completed in the 1940s and 1950s. From approximately 1960 to 1996, efforts by Bruce J. Hayward and his students (including Joseph A. Cook) at Western New Mexico University (WNMU) and James S. Findley, and his students, (especially Clyde Jones, and Arthur Harris), of the University of New Mexico (UNM) resulted in collections of small mammals from the Gila. Since the early-1980s, Terry Yates (deceased), Joseph A. Cook, William L. Gannon and others at the University of New Mexico (UNM), Randy D. Jennings (WNMU), and Jennifer Frey of New Mexico State University (NMSU) continued mammal studies in the Gila with much of that effort stemming from fieldwork associated with university classes or research projects.

Of particular note for this region, Hayward (Figure 5) surveyed mammals of the Gila regularly (1961-2008) while teaching and conducting research through WNMU. In 1961, he moved to Silver City, after obtaining his doctorate from the University of Arizona. Hayward not only collected mammals from throughout the Gila with his classes, but he also conducted a concerted mammal inventory of the Gila Wilderness in the summer of 1972. He deposited 1,173 specimens in the collections of WNMU from the Gila alone. Hayward's Gila specimens and aspects of the unpublished report from his Gila Wilderness Inventory have been incorporated into this overview of the mammals of the Gila.

Additionally, there were series of expeditions of short duration by the MVZ (University of California Berkeley), Texas Tech University (TTU), University of Texas El Paso (UTEP), University of Nebraska Kearney (UNK), and Fort Hays State University Sternberg Museum in Kansas (FHSU) at various times since the 1970s. Including the Museum of Southwestern Biology (MSB) and WNMU efforts, there were at least 36 collecting expeditions to Catron County, 37 to Grant County, and 38 to Sierra County between 1955 and 2012. As an update to Findley et al.'s (1975) *Mammals of New Mexico*, Frey (2004) briefly summarized distributions of all New Mexico mammal species including those in the Gila. Later, Frey (2008) provided a brief overview of the conservation status of the mammals in the Gila.

Surveys of other biota are not lacking; there have been 5 summaries of birds (Zimmerman, 1970; Hubbard, 1971; Egbert, 1981; USDA, SW Region, 2002; Shook, 2013), 4 on fishes (Huntington, 1955; LaBounty, 1972; Anderson, 1977; Paroz & Propst, 2009), and 2 on herpetofauna (Painter, 1985; Jennings et al., 2010). While there has not been a comprehensive survey of flora of the Gila, surveys have focused on riparian (e.g. Felger & Kindscher, 2008) or woodland vegetation (Gori et al., 2014). A comprehensive database dedicated to Vascular Flora of the Gila Wilderness is available online (http://wnmu.edu/academic/nspages/gilaflora/).

Climate

In general, the Gila is dry with hot summers and mild winters. The monsoon season starts in early July and continues into early September; these months represent the period of highest annual precipitation. Precipitation varied across county and year in my study, from a low of 50.34 mm during July 2014 in Grant County to a high of 158.14 mm during September 2013 in Sierra County (Figure 6). Average temperatures are generally higher in Sierra County than Grant and Catron counties (Figure 7). The low temperature during the survey period was January 2013 for all three counties (-3.0 °C, 1.6 °C, and 3.3 °C, respectively for Catron, Grant, and Sierra counties) and the high was in June 2014 (Sierra County) and July 2014 (Catron and Grant Counties) at 28.4 °C, 19.8 °C, and 23.4 °C, respectively. Sierra County tends to be the hottest and driest of the Gila counties, and Catron is the coolest and wettest.

Field Work (2012-2014)

I surveyed mammals through a series of 29 field expeditions to the Gila from October 2012 to November 2014 with MSB personnel (Figure 8). My collecting strategy focused primarily on small mammals (rodents and bats).

Surveys for bats

Mist nets were placed over pooling areas of streams and creeks and over stock tanks and ponds to capture bats flying in to drink water (Kunz & Parsons, 2009). Mist nets ranging in size from 6 m to 18 m long and 3 m high (depending on width of waterway), were put up at dusk and checked approximately every half hour until bat activity declined. Bats were then removed and date, time, species, net location, sex, reproductive condition, and GPS location were recorded. After the bat was euthanized, ecto- and endo-parasites were sampled, tissues were frozen (heart, lung, kidney, liver, spleen) and voucher specimens were prepared, and deposited at the MSB.

Bat capture rates vary with environmental conditions, but Geluso (2012) showed that precipitation negatively influences mist net capture success in New Mexico. Similar to Geluso (2012), I captured fewer bats during wetter months, likely because more rain produces more standing pools, so bats have more sources for drinking and so are more difficult to survey. The summer of 2013 was particularly wet (Figure 6) so survey techniques for bats were expanded to include putative roosting sites, such as bridges and mines.

Although bats are traditionally assumed to either hibernate or migrate for the winter months in the United States, in New Mexico many species remain active in the winter. I surveyed bats sporadically through the winter months, particularly in November and March, the "buffer" months (Geluso, 2007), where temperatures in the Gila in November range from 4.3°C (Catron County) to 12.3°C (Sierra County), and in March from 4.5°C (Catron County) to 12.8°C (Sierra County).

Non-volant mammal surveys

Lines of Sherman live traps and snap traps were placed in each habitat or in ecotonal areas at a total of 26 sites throughout the Gila and checked each morning (within an hour of sunrise). These lines were supplemented with Tomahawk traps, Macabee gopher traps, and pitfall traps for shrews. Typically, a single trap-line consisted of 40 live traps and 40 snap traps.

Data recorded on all captures included: date, species, trap line habitat type, sex, reproductive condition, and GPS location. Individuals captured were euthanized and then processed into museum specimens (standard measurements recorded, parasites recovered, tissues frozen in liquid nitrogen, skin prepared, and deposited at the MSB) (Gardner, 1996; Yates et al., 1996; Appendix B- MSB data sheet).

Camera Trap Surveys

We included photographic data provided by Travis Perry (Furman State University in South Carolina), who used a grid of camera traps on the Ladder Ranch to collect data on large mammals between 2008 and 2012. Perry began with 16 cameras that covered 64 km^2 in 2008 and 2009 and then in 2010, he added 9 cameras to cover an additional 44 km^2, for a total of 25 cameras and approximately 100 km^2 of coverage. Cameras were situated on the southern portion of the ranch near Animas Creek (Figure 9). Additionally, to obtain information about larger species that are difficult to study, I worked with fur trappers and fur-buyers to obtain their first-hand knowledge of larger carnivores and obtain salvage carcasses that were processed into museum specimens. I also accessed records of fur-bearers and game species via New Mexico Department of Game and Fish's (NMDGF) website (http://www.wildlife.state.nm.us/hunting/harvest-reporting-information/).

Museum Studies

I visited the 4 collections with the most important (i.e., historic and voluminous) series of mammal specimens for the Gila mammal biota (MSB, WNMU, USNM, and AMNH). In addition to examination of specimens at MSB (n=7312), I reviewed specimens at the AMNH (n=273) and the NMNH (n=482). Each contained important historic records of specimens of mammals that: 1) were extirpated from the Gila (e.g. *Cynomys gunnisoni*, *Cynomys ludovicianus, Microtus pennsylvanicus, Canis lupus baileyi, Ursus arctos*); 2) rarely occur in the Gila (e.g. *Sigmodon fulviventer, Neotoma micropus, Xerospermophilus spilosoma*); or 3) are potentially experiencing a range expansion (e.g. *Sciurus arizonensis, Mephitis macroura, Nasua narica, Pecari tajacu*). Western New Mexico University has the largest number of Gila mammal specimens (n=2550) after the MSB. These specimens represent important data, such as nine specimens of *Sciurus arizonensis*, three *Castor canadensis* (very few specimen records in NM), and the first record of *Baiomys taylori*. For other museums with significant holdings (FHSU, UTEP, MVZ; Figure 10), I reviewed their online catalogues (www.vertnet.org) and searched for new species or locality records.

Species Accounts

Species accounts cover all species represented by specimens within the Gila, including extirpated species. I also include species that are potential inhabitants but are not represented by a specimen. Review of the relevant literature from the Gila and nearby regions, unpublished field notes, specimen records, and new information from my fieldwork from 2012-2014, provide a basis for updating our knowledge of the mammals of the Gila. Basic morphological descriptions of each species are included, but the reader is referred to Findley et al. (1975) for taxonomic keys with diagnostic measurements for most species. Each species account covers the following subjects:

Scientific Name and Authority: The Latin name of each mammal is given, followed by the original author and year of description. With some notable exceptions, nomenclature follows Wilson & Reeder (2005).

Common Name: After the Latin name, the common name of each mammal is given following Wilson & Reeder (2005).

Taxonomy: Following the Latin and common names, the number of subspecies for the species is given (based on Hall 1981) and followed by the number of subspecies that occur in the Gila. Subspecific names for taxa occurring in the Gila are provided with the original author and year of taxonomic description.

Description: A brief physical description of each mammal is provided to aid in field identification.

DNA Variability and Phylogeographic and Systematics Analyses: To summarize geographic genetic variation, published phylogeographic studies on mammal species are summarized when those studies included specimens from near the Gila. In four cases (*Neotoma albigula, Thomomys bottae, Notiosorex crawfordi, Perognathus flavus*), new mtDNA sequences (cytochrome b gene) were generated so that specimens from the Gila could be placed into phylogeographic context. For an additional two species, taxonomic identity was confirmed with mtDNA sequences (*Peromyscus nasutus*, *Neotoma stephensi*). Lab procedures followed salt extraction (Fleming and Cook, 1992), and amplification and Sanger sequencing methods for cytochrome b (Hope et al., 2010), used the MSB05/ MSB14 primer set. Representative cytochrome b sequences were downloaded from GenBank (http://www.ncbi.nlm.nih.gov/genbank/) to assess phylogeographic placement of Gila specimens. To graphically examine geographic variation, trees were built using Mr. Bayes 3.2 with a GTR model and 2,000,000 generations sampling every 10,000 and a burn in of 25%.

Habitat/Elevation: Habitat type, and elevational and geographic range within the Gila (based on museum records) is presented and discussed in light of variation from published reports. Distribution maps are included for each species, also based on museum records.

Reproduction: Reproductive information, such as timing and number of pregnancies per year, number of embryos per litter, and patterns of delayed implantation/fertilization are discussed.

Specimens: Specimens examined from our fieldwork as well as those from 4 museum collections (MSB, WNMU, USNM, and AMNH) are reported. Specimens are organized by county (Catron, Grant, and Sierra Counties) and by museum catalogue number.

RESULTS

Faunal Composition

There are 100 native mammal species in the Gila (95 extant), represented by 10,453 specimens in 31 museum collections and spanning the period 1851 to 2014. To place species richness in perspective, this is more mammal species than the number known for 33 states. The majority of these specimens (7,312) is housed at the MSB (Figure 10) including 2,267 specimens my project added that were collected from October 2012 to November 2014. Rodents comprise the majority of specimens with 74%, with bats a distant second with 20%. Rodents and bats, with 47 and 20 species respectively, are the most speciose mammalian Orders in the Gila (and the world). There are 5 extirpated species: *Cynomys gunnisoni, Microtus pennsylvanicus, Panthera onca, Ursus arctos, and Lontra canadensis*. There is one introduced species, *Mus musculus,* and four species that were extirpated but subsequently reintroduced: *Cynomys ludovicianus, Canis lupus baileyi, Cervus elaphus nelsoni,* and *Ovis canadensis.*

Species Checklist (95 native species extant + introduced (1) and extirpated (5))

Primates: 1 species

Hominidae**:** *Homo sapiens*

Rodentia: 47 species

Castoridae: *Castor canadensis*

Cricetidae: *Baiomys taylori, Microtus longicaudus, Microtus mogollonensis, Microtus montanus, Myodes gapperi, Peromyscus boylii, Peromyscus eremicus, Peromyscus gratus, Peromyscus leucopus, Peromyscus maniculatus, Peromyscus nasutus, Peromyscus truei, Neotoma albigula, Neotoma mexicana, Neotoma micropus, Neotoma stephensi, Ondatra zibethicus, Onychomys arenicola, Onychomys leucogaster, Onychomys torridus, Reithrodontomys megalotis, Sigmodon fulviventer, Sigmodon hispidus, Sigmodon ochrognathus*

Erethizontidae: *Erethizon dorsatum*

Geomyidae: *Thomomys bottae*

Heteromyidae: *Chaetodipus baileyi, Chaetodipus hispidus, Chaetodipus intermedius, Chaetodipus penicillatus, Dipodomys merriami, Dipodomys ordii, Dipodomys spectabilis, Perognathus flavescens, Perognathus flavus*

Sciuridae*: Ammospermophilus harrisii, Callospermophilus lateralis, Cynomys ludovicianys, Ictidomys tridecemlineatus, Otospermophilus variegatus, Sciurus aberti, Sciurus arizonensis, Tamias cinereicollis, Tamias dorsalis, Tamiasciurus hudsonicus, Xerospermophilus spilosoma*

Chiroptera: 20 species

Vespertilionidae: *Antrozous pallidus, Corynorhinus townsendii, Idionycteris phyllotis, Eptesicus fuscus, Euderma maculatum, Lasionycteris noctivagans, Lasiurus blossevillii, Lasiurus cinereus, Myotis auriculus, Myotis evotis, Myotis californicus, Myotis ciliolabrum, Myotis occultus, Myotis thysanodes, Myotis velifer, Myotis volans, Myotis yumanensis, Parastrellus hesperus*

Molossidae: *Nyctinomops macrotis, Tadarida brasiliensis*

Lagomorpha: 3 species

Leporidae: *Lepus californicus, Sylvilagus audubonii, Sylvilagus floridanus*

Soricomorpha: 2 species

Soricidae: *Notiosorex crawfordi, Sorex monticola*

Carnivora: 17 species

Canidae: *Canis latrans, Canis lupus, Urocyon cinereoargenteus, Vulpes macrotis, Vulpes velox*

Felidae: *Lynx rufus, Puma concolor*

Mephitidae: *Conepatus leuconotus, Mephitis macroura, Mephitis mephitis, Spilogale gracilis*

Mustelidae: *Mustela frenata, Taxidea taxus*

Procyonidae: *Bassariscus astutus, Nasua narica, Procyon lotor*

Ursidae: *Ursus americanus*

Artiodactyla: 6 species

Antilocapridae: *Antilocapra americana,*

Bovidae*: Ovis canadensis*

Cervidae*: Cervus elaphus, Odocoileus hemionus, Odocoileus virginianus*

Tayassuidae*: Pecari tajacu*

Reintroduced species (n =4)*: Cynomys ludovicianus, Cervus elaphus, Ovis canadensis, Canis lupus*

Extirpated Species (n =5) *Cynomys gunnisoni, Microtus pennsylvanicus, Panthera onca, Ursus arctos, Lontra canadensis*

Introduced Species: *Mus musculus*

SPECIES ACCOUNTS

Order Primates
Family Hominidae

Homo sapiens (Linneaus 1758)
Cochise, Mogollon, and Apache tribes

The first humans known to have inhabited the Gila were the Cochise, who were descendants of Bering Strait migrants who settled in New Mexico around 10,000 B.C. (Brody, 2005). The Cochise were likely ancestors of the Mogollon people, who became settled farmers around 200 A.D (Byrkitt, 1992). The Mogollon had many subsets or "branches," including the Mimbres, Jornada, Forestdale, Reserve, Pine Lawn, Point of Pines, and San Simon, of which the Mimbres, Reserve, and Pine Lawn lived in the Gila (Peregrine & Ember, 2003). The Mimbreños were farmers, farming beans and squash and hunters of bear, deer, and antelope (Brody, 2005). They began to make painted pottery, as well as tools and ornamental items, from about 1000-1150 A.D., which are now of great interest to archaeologists and anthropologists (Brody, 2005). The Mimbreños disappeared around 1150 A.D., and the Apache people replaced them around 1600 A.D. The Apache people in the Gila primarily consisted of the Chiricahua Band, including Geronimo who was born at the headwaters of the Gila River (http://mescaleroapachetribe.com/our-culture/). There is no reservation for Native Tribes currently in the Gila, although the Gila Cliff Dwellings are a National Monument dedicated to the Mogollon people.

Order Soricomorpha

Family Soricidae

Notiosorex crawfordi (Coues, 1877)

Desert Shrew

Subspecies: None

Description:

One of 2 shrews found in the Gila, desert shrews are distinguished from the montane shrew (*Sorex monticola*) by having 3 upper unicuspids (as opposed to 5) (Findley et al., 1975).

Phylogeography and Systematics:

McAliley et al. (2007) performed nuclear and mitochondrial DNA analyses and hypothesized that *N. crawfordi* represents 3 species (*N. crawfordi*, *N. cockrumi* and a third species, *N. villai*, which only occurs in northern Baja California, Mexico). Only *N. crawfordi* occurs in New Mexico, and is part of a clade that includes populations in Texas and southeast Arizona (on the western border with the Gila), where *N. crawfordi* and *N. cockrumi* are sympatric but do not hybridize (McAliley et al. 2007). Because McAliley et al. (2007) did not include sampling from the Gila, more populations of desert shrews should be examined in the western Gila.

We obtained representative mtDNA (cytochrome b) sequences from GenBank for 17 *N. crawfordi* and 19 *N. cockrumi* from across the Southwest to place 5 specimens from the Gila (all from east of the Black Range) into a phylogeographic context and to further refine the geographic structure proposed by McAliley (2007). This is the first phylogenetic tree to include samples from New Mexico; we found that although *N. crawfordi* and *N. cockrumi* occur in sympatry in the area of Arizona adjacent to the Gila, there is no signature of hybridization between the two species (Figure 11). Interestingly, *N. crawfordi* appear to be more genetically similar to *N. villai*, but are more geographically separated from *N. villai* than *N. cockrumi*. Future work should include more extensive sampling to further refine the relationships between these species.

Habitat/Elevation:

Desert shrews occur at lower elevations (2100 m or lower), most commonly in mesquite, scrub oak, and riparian habitats (Hoffmeister, 1959) and frequently inhabit woodrat middens (Armstrong, 1972). In eastern counties of Arizona (adjacent to the Gila), the desert shrew occurs in piñon-juniper and oak habitats (Hoffmeister, 1986). Although Dixon (1924) stated that permanent water is not a requirement, all but one desert shrew was captured during monsoon season when water was plentiful. One desert shrew (MSB 269044) was captured in a pitfall trap beneath a dead cottonwood log in Animas Creek just east of Ladder Ranch Headquarters. Hayward captured desert shrews in cottonwood riparian habitat at 5 sites: 4 mi west of Redrock at 1280 m, Gila River 2 mi south of Cliff, Mimbres Ranger Station, town of Gila, and Pleasanton (WNMU 1886, WNMU 4924, WNMU 5181, WNMU 2767, WNMU 3543).

Bailey (1931) stated that the desert shrew is one of the “least-known North American mammals” and little has changed in nearly a century. A total of 13 individuals were taken in this study, including 12 taken by Dan Warren on the eastern flanks of the Black Range. Warren’s shrews were taken in pitfall traps set along a riparian zone or by his pet cat (n=2), and nearly all of these were collected after a rainfall event. These specimens are now part of the MSB collection.

Reproduction:

Desert shrews in Arizona reproduce throughout the year, sometimes as early as January and can have up to 6 embryos (Hoffmeister, 1986). Although data are lacking from the Gila, pregnant desert shrews have been captured in other parts of New Mexico with 5-6 embryos from late May to mid-August and lactating from mid-July to early September.

Specimens Examined:

(Grant) MSB 156735, WNMU 1886, WNMU 2767, WNMU 3543, WNMU 4924, WNMU 5181 (Sierra) MSB 76185, MSB 292033-292038

Sorex monticola Merriam, 1890

Montane Shrew

Subspecies: 14, 1 in the Gila

Sorex monticola neomexicana Bailey 1913

Description:

The montane shrew is characterized by 5 unicuspids (see account for *N. crawfordi).* Use of the name *Sorex monticola* instead of *Sorex monticolus* was justified by Woodman (2012), who clarified and followed a similar correction made by Merriam (1895).

Phylogeography and Systematics:

Formerly referred to as *Sorex vagrans* in New Mexico (Findley et al., 1975), geographic variation in mtDNA in the montane shrew was analyzed by Demboski & Cook (2000) and Sawyer (2014). Three major clades (Coastal, Northern Continental, and Southern Continental) were identified across the North American range, and *S. monticola* from New Mexico grouped with the Southern Continental clade (Demboski & Cook, 2000).

Habitat/Elevation:

Bailey (1931) reported that the montane shrew occurs in the Mogollon Mountains (Willow Creek) and along the Mimbres Mountains (Black Range) near Kingston. Recent specimens from the Gila come from elevations ranging from 2072-3072 m. Hayward (1972) noted that during his survey of the Gila Wilderness, he collected (and recovered specimens from owl pellets) from 2333-2560 m in mixed conifer and ponderosa pine habitats. Patterson's (1980) specimen-based study of the biogeography of small mammals in New Mexico reported this species from the Black Range and Mogollon Range.

Reproduction:

Lactating female montane shrews were taken in June, although generally this species does not reproduce until after their first winter (Gillihan 2004). Hayward captured one at Iron Creek that was lactating on 25 June 1972 (WNMU 2325). Hoffmeister (1986) postulated that montane shrews have 2 litters per year in Arizona, one in April and one in August. They usually have 6-7 pups per litter.

Specimens Examined:

(Catron) MSB 3480, MSB 6404, MSB 6958, MSB 14662, MSB 24520, MSB 41352-413560, MSB 41364-41369, MSB 89329, MSB 89528, WNMU 3, WNMU 1800, WNMU 2322-2326, WNMU 2724, WNMU 2935 (Grant) WNMU 4227, WNMU 5204

Order Chiroptera
Family Vespertilionidae

Antrozous pallidus (Le Conte, 1856)

Pallid Bat

Subspecies: 6, 1 in the Gila

Antrozous pallidus pallidus (Le Conte, 1856)

Description:

The pallid bat has large ears and a distinctly pale pelage, and is distinguished from *Corynorhinus townsendii* and *Idionycteris phyllotis* in that its ears are not joined at the midline (Hermanson & O'Shea, 1983).

Phylogeography and Systematics:

Weyandt & Van Den Bussche (2007) analyzed mtDNA of pallid bats across western North America and identified 3 clades. Although they did not sample specimens in the Gila, nearby sampling from 7 other New Mexico counties revealed a "Chihuahuan" clade, which includes New Mexico, Oklahoma, Texas, and Coahuila, Mexico (Weyandt & Van Den Bussche, 2007).

Winter Activity:

Only one pallid bat specimen has been taken in the winter from the Gila, a male captured by Keith Geluso in January 2005 (MSB 124847). This specimen, as well as Anabat recordings in January and February 1996 from Saddle Rock and a male captured in winter in the Guadalupe Mountains, support the hypothesis that male pallid bats are not migratory in southern New Mexico. A female captured on 12 April 2013 (MSB 267124) represents the earliest spring record for the Gila.

Habitat/Elevation:

The pallid bat in the Gila is usually captured at lower elevations (~1450-2000 m), although Findley et al. (1975) reported them as high as 2200 m elsewhere in New Mexico. Jones (1967) reported that 41% of pallid bats in the Mogollon Mountains were captured in desert grassland or scrub, 44% in piñon-juniper, and 15% in ponderosa pine forest. Pallid bats also have been commonly taken from buildings or other roosts in human settlements around the Gila (WNMU 106, WNMU 136, WNMU 144, WNMU 1807, WNMU 3601). Jones (1967) reported that they sometimes roost in mines. I examined 4 specimens captured in 1894 from Silver City at 1810 m (USNM 66109-66112).

Reproduction:

Pallid bats exhibit delayed fertilization (Orr, 1954). Female pallid bats captured in the Gila during 2013 and 2014 were heavily lactating in mid-June, and a female with an embryo was captured on 5 June 2013 (MSB 267067). Whether reproductive phenology of pallid bats is shifting temporally due to changing environmental conditions should be monitored.

Specimens Examined:

(Catron) MSB 9437-9346, MSB 9348-9453, MSB 9463, MSB 9478, MSB 9520, MSB 10456-10459, MSB 10517, MSB 11277, MSB 11315-11316, MSB 12366, MSB 13028, MSB 75671 (Grant) MSB 13269, MSB 14029-14037, MSB 14069-14070, MSB 24847, MSB 56520, USNM 66109-66112, USNM WNMU 103-104, WNMU 106-107, WNMU 665-666, WNMU 1807, WNMU 1877, WNMU 2044, WNMU 2241, WNMU 2668, WNMU 2779, WNMU 3101, WNMU 3601, WNMU 3691, WNMU 3853, WNMU 5488, WNMU 6142 (Sierra) MSB 267067, MSB 267124

Corynorhinus townsendii Cooper, 1837

Townsend's Big-eared Bat

Subspecies: 5, 1 in the Gila

Corynorhinus townsendii pallescens (Miller, 1897)

Description:

Townsend's big-eared bat is similar to *Idionycteris phyllotis* and *Antrozous pallidus*, but lacks the lappets over the eyes found in *I. phyllotis,* and has pronounced sebaceous lumps over its nose, which *A. pallidus* lacks (Kunz and Martin 1982).

Winter Activity:

Townsend's big-eared bats hibernate in New Mexico and have been found in December, January, and February in torpor near Silver City by Hayward (>90 specimens).

Habitat/Elevation:

Jones (1967) reported that he captured Townsend's big-eared bat mostly in ponderosa pine forest, but also in piñon-juniper and desert scrubland. We captured 2 specimens (MSB 281071; 267118) during this study, both in riparian areas at low elevations (~1675m).

Reproduction:

Reproductive data for Townsend's bats in the Gila are lacking, but female Townsend's bats found by Geluso & Geluso (2004) in the Guadalupe Mountains in May were pregnant and females taken in June, July, and August were lactating. They are known to form maternity colonies in Arizona, with males also living colonially but separate from females (Hoffmeister, 1986). These bats have delayed fertilization (Hoffmeister, 1986).

Remarks:

Findley et al. (1975) and Cook (1982) reported that Townsend's big-eared bats (listed in those accounts as *Plecotus townsendii*) were difficult to capture in mist nets, and were more readily found in roosts such as mine shafts. Hayward collected 15 from old mines near Silver City and Jones (1967) reported that in the Mogollon Mountains. *C. townsendii* roosts in mines, caves, and buildings.

Perry et al. (2001) conducted a bat survey at the Ladder Ranch (part of the Gila) in the summer of 2001 but did not capture any Townsend's big-eared bats. We captured 2 from 2012-2014 in mist nets (Table 2).

Specimens Examined:

(Catron) MSB 9475-9477, MSB 11273, MSB 14506-14512, MSB 199627 (Grant) MSB 13252-13254, MSB 19620- 19624, MSB 20084-20086, MSB 24978, MSB 28766,

MSB 56540, WNMU 95, WNMU 98, WNMU 102, WNMU 137, WNMU 770, WNMU 1364, WNMU 1417, WNMU 1499, WNMU 1544, WNMU 1832, WNMU 1846, WNMU 1905, WNMU 2039, WNMU 2097, WNMU 2118, WNMU 2209, WNMU 2214, WNMU 2242-2244, WNMU 2493, WNMU 3060-3061, WNMU 3087, WNMU 3158, WNMU 3191, WNMU 3224-3225, WNMU 3284, WNMU 3370-3371, WNMU 3942, WNMU 4021, WNMU 4335, WNMU 4526, WNMU 4529-4530, WNMU 4584, WNMU 5177, WNMU 5190-5191, WNMY 5258, WNMU 5760, WNMU 5779, WNMU 6139, WNMU 6400 (Sierra) MSB 267118

Eptesicus fuscus (Palisot de Beauvois, 1796)

Big Brown Bat

Subspecies: 12, 1 in the Gila

Eptesicus fuscus pallidus Young, 1908

Description:

The big brown bat is identified by its large size, dense brown fur, and blunt, curved tragus and is the only species of *Eptesicus* in North America (Kurta & Baker, 1990).

Phylogeography and Systematics:

Turmelle et al. (2011) analyzed nuclear and mtDNA to investigate phylogeographic structure across the North American range of the big brown bat and found 3 major clades, each of which shows internal geographic structure. New Mexico falls into the “Southwestern” clade, which is further split into 4 subclades. The Gila specimens may belong to the Southern AZ-SW NM-Sonora sub-clade, because their closest sampling to the Gila was Hidalgo County (Turmell et al., 2011). This hypothesis should be further tested.

Winter Activity:

Big brown bats hibernate in New Mexico and are therefore commonly taken in surveys in November and December (Geluso, 2007). Hoffmeister (1986) reports that in Arizona, they move to lower elevation habitats during winter where they hibernate, but only for short periods.

Habitat/Elevation:

Big brown bats were commonly captured in piñon-juniper and ponderosa pine forest (2300-2500 m), and were less common in desert areas (Findley et al., 1975). We captured them often along Animas Creek in cottonwood riparian habitats near low elevation desert habitats. Hayward (1972) also captured them frequently in low elevation sycamore riparian habitats. Jones (1967) captured big brown bats primarily in ponderosa pine forest, but also in desert grassland and scrubland, piñon-juniper forest, and mixed conifer forest. I examined 3 historic (1908) big brown bat specimens captured from 2072-2438 m in the Mimbres Mountains (USNM 15487) and Diamond Creek (USNM 15488-15489).

Reproduction:

Big brown bats reportedly demonstrate delayed fertilization (Wimsatt, 1944). Pregnant big brown bats were found from late May to late June. For this study, females with a single embryo were taken on 5 June, 12 June, and 19 June, and 24 June. Hayward captured 4 lactating females in mid to-late June in 1972, 1981, and 1994 (WNMU 2548, WNMU 3610-3611, WNMU 5807). A mother was taken on 2 July with a pup attached, indicating that parturition occurs in late June (WNMU 5807).

Remarks:

Bailey (1931) reported that big brown bats are abundant across the Gila and they were the second most common bats we captured (16% of total). Jones' (1967) survey of the Mogollon Mountains found big brown bats to be the most common species. Hayward (1972) noted that when they are caught, they are usually abundant, indicating that big browns may roost in large colonies, perhaps in hollowed out trees. Hayward (1972) stated that big brown bats are active later in the night than many others, and will usually be captured between 22:00 h and 01:00 h, which we also found to be the case with our captures.

Perry et al. (2001) conducted a roost survey on the Ladder Ranch and found big brown bats roosting in rock crevices in riparian/desert scrub habitat, and also one in a tree cavity (Siberian elm, *Ulmus pumila*) in riparian habitat. This same bat, which had a radio transmitter, was found in another tree cavity 220 m away 3 days later (Perry et al. 2001).

Specimens Examined:

(Catron) MSB 3154, MSB 7584, MSB 9307, MSB 9482-9494, MSB 9600, MSB 9623-9632, MSB 10449-10450, MSB 10452-10455, MSB 10502-10504, MSB 11276, MSB 11289-11290, MSB 11300-11301, MSB 11306-11314, MSB 11623-11630, MSB 12197, MSB 12367-12371, MSB 12526, MSB 12528-12531, MSB 12918-12920, MSB 12995-13000, MSB 13848-13849, MSB 14011, MSB 14016-14018, MSB 14270-14282, MSB 14391, MSB 14402-14403, MSB 14666, MSB 14805-14811, MSB 14838, MSB 60712, MSB 85907, MSB 199626, USNM 349268-349270, USNM 506266, WNMU 74-75, WNMU 78, WNMU 2263, WNMU 2401-2402, WNMU 2548-2550, WNMU 2833, WNMU 2844, WNMU 2886, WNMU 3353-3354 (Grant) MSB 12135-12153, MSB 13268, MSB 56521-56522, MSB 125611, MSB 125614, MSB 124848, AMNH 36237, USNM 157487-157489, USNM 546926, WNMU 81, WNMU 697, WNMU 1380, WNMU 1404, WNMU 1418, WNMU 1923, WNMU 3349, WNMU 3581, WNMU 3610-3611, WNMU 3943, WNMU 4535, WNMU 4586, WNMU 4700, WNMU 4775, WNMU 5807, WNMU 6626, WNMU 6641 (Sierra) MSB 24859, MSB 267068

Euderma maculatum (J.A. Allen, 1891)

Spotted Bat

Subspecies: None

Description:

The spotted bat has large ears (40-55 mm) (Watkins 1977) and black pelage with 3 distinctive white dorsal spots.

Winter Activity:

Little is known about the spotted bat's winter activities in the Gila. A specimen was recorded using Anabat in a building in Albuquerque in January of 1997 and 1998, and a specimen was also vouchered from this location (MSB 135536) indicating that the spotted bat overwinters in New Mexico (Sherwin & Gannon, 2005). Additional study of their winter habits in the Gila should be completed.

Habitat/Elevation:

The spotted bat is a mid-elevation bat in the Gila (1850-2450 m), usually occurring in ponderosa pine forest and mixed conifer forests, and usually within 1.5 km of rocky outcroppings and cliffs where they likely roost (Findley et al., 1975). In Arizona, spotted bats are often captured in riparian areas near cliffs and rocks (Hoffmeister, 1986). Hayward (1972) only caught 1 specimen in his 1972 survey of the Gila Wilderness. As these bats are infrequently recorded, there are gaps in our knowledge of their natural history in New Mexico. Indeed, Jones (1967) reported that he only captured 1 during his survey of the Mogollon Mountains, in ponderosa pine forest near the town of Mogollon.

Remarks:

The spotted bat is listed as Threatened by the NMDGF. The 2014 Review of Threatened and Endangered Species of New Mexico indicates that more data are needed to determine precise threats, but they likely include pesticides, habitat and roosting area disturbances (NMDGF 2014). The spotted bat is listed as Least Concern by the IUCN red list.

Spotted bats are late night fliers in the Gila, usually only caught after midnight (Hayward, 1972). One of the few Gila specimens was found on a screen door in May at Lake Roberts (WNMU 1842).

Reproduction:

Hoffmeister (1986) reported that in Arizona, young spotted bats are born from mid-June to early July. Hayward collected a lactating female on 20 June (WNMU 2636).

Specimens Examined:

(Catron) MSB 9606, MSB 9608-9610, MSB 17285, WNMU 2636 (Grant) WNMU 1842

Idionycteris phyllotis Allen, 1916

Allen’s Big-eared Bat

Subspecies: None

Description:

Allen’s big-eared bat is discerned by its large ears, the flaps or lappets over its eyes and a keeled calcar (Czaplewski, 1983).

Winter Activity:

There are 4 winter records of Allen's big-eared bat in the Gila, 3 from Cora Miller Mine in December (WNMU 2469, WNMU 2823, WNMU 2824), as well as Anabat recordings on 10 February 1996 at Airport Tank, suggesting that they may hibernate in the Gila.

Habitat/Elevation:

Allen's big-eared bat occurs primarily in ponderosa pine forest and some high elevation riparian habitats (Findley et al., 1975). Hayward (1972) reported capturing them frequently over 2100 m in elevation in ponderosa pine and Douglas fir forests and many locality records from the Gila are over 2300 m (MSB 121992, WNMU 2412-2413, WNMU 2416-2417, WNMU 6136-6137). Jones (1967) recorded 58% of *I. phyllotis* captures from "areas of purely ponderosa pine forest," meaning not near any riparian area. He also stated that most of his captures came from roosts (Jones 1967).

Reproduction:

Pregnant female Allen's big-eared bats were taken in May and late June, with lactating females recorded up to 18 July (WNMU 2637). Parturition is probably in late May to mid-June in the Gila.

Remarks:

Perry et al. (2001) conducted a bat survey at the Ladder Ranch in the summer of 2001 and captured 2 *I. phyllotis*, whereas we captured none (Table 2).

Specimens Examined:

(Catron) MSB 9474, MSB 9518-9519, MSB 9578, MSB 9612-9613, MSB 9615, MSB 11080-11082, MSB 11084, MSB 11635, MSB 12908-12910, MSB 13013-13015, MSB 13847, MSB 14830-14836, MSB 17286, MSB 21992, USNM 348308, USNM 349273-349276, WNMU 6136-6137 (Grant) WNMU 1823, WNMU 1883, WNMU 2412-2417, WNMU 2469, WNMU 2592, WNMU 2637, WNMU 3298, WNMU 3941, WNMU 4777

Lasiurus blossevillii Lesson & Garnot, 1826

Western Red Bat

Subspecies: 3, 1 in the Gila

Lasiurus blossevillii teliotis (H. Allen, 1891)

Description:

The western red bat is the only bat species in the Gila with a distinctly red, frosted pelage

Winter Activity:

Only 28 specimens of western red bats are known for New Mexico, and all were taken from April-August, indicating that they are likely migratory. The 2 taken in 2013 were among only 4 records documented for the Gila. The 2 previously taken in the Gila were both pregnant females captured in June. Our captures were a male and a female captured in early April (MSB 267123, MSB 267125) and were likely early migrants, as they represent the earliest annual records in New Mexico. The male was smaller than the female (male forearm length = 38mm, female forearm length = 44 mm).

Habitat/Elevation:

Western red bats are usually found in riparian areas (Ammerman et al., 2012), consistent with the 2 captured for this study in cottonwood riparian areas on Animas Creek, just east of Ladder Ranch Headquarters. Hayward captured a female in Reserve in ponderosa pine habitat (WNMU 6615). Jones (1967) did not capture this bat during his survey of the Mogollon Mountains.

Reproduction:

A female western red bat with 3 embryos was captured on 13 June (WNMU 6615).

Remarks:

Perry et al.'s (2001) bat survey at the Ladder Ranch in the summer of 2001 did not capture any western red bats, whereas we captured 2 (see Table 6). Findley et al., (1975) considered this species in the Gila to be *Lasiurus borealis*, but the distribution of that species now has been restricted to further east in North America.

Specimens Examined:

(Catron) MSB 9465-9466, MSB 9517, MSB 10516, MSB 125021 (Sierra) MSB 267123

Lasiurus cinereus (Palisot de Beauvois, 1796)

Hoary Bat

Subspecies: 3, 1 in the Gila

Lasiurus cinereus cinereus (Palisot de Beauvois, 1796)

Description:

The hoary bat is a large bat (20-30 g) with short, rounded ears and frosted pelage with yellowish coloration around the head and throat (Shump & Shump, 1982).

Winter Activity:

Female hoary bats migrate through New Mexico in April and May and again in August, September, and October, while males are usually found in May and June (Findley et al., 1975); Cryan & Wolf (2003) reported capturing males and females through July in the Sandia and Manazo Mountains, and Valdez & Cryan (2009) reiterated that there is asynchronous migration of the two sexes. We captured males in May, June, and October, but did not capture any females until October. Our capture of a female hoary bat on 11 October 2013 and a male on 13 October 2013 are the latest seasonal records in the Gila.

Habitat/Elevation:

Hoary bats are tree-roosting bats found in most forested areas of the Gila. We captured them at the Ladder Ranch in riparian areas and over cattle tanks at elevations around 1450 m. Hayward captured them from 1463 m (WNMU 87) to 2529 m (WNMU 768) in elevation, largely consistent with Bell's (1980) statement that hoary bats are most frequently captured in the southwest in desert and riparian habitats. Jones (1967) documented that they occur most often in ponderosa pine forest and then in piñon-juniper forest, with occurrence in desert habitats only while migrating. I examined an historic (1908) specimen of the hoary bat from Gila, Grant County (USNM 158315).

Reproduction:

Hoary bats exhibit delayed implantation, with mating and fertilization in the fall and implantation in the spring (Druecker, 1972). Jones (1967) reported pregnant females on 14 and 15 May and 11 July in the Mogollon Mountains. All museum records of females captured with embryos (2 or 3) from the Gila are from May.

Remarks:

Hayward (1972) recorded seeing hoary bats flying early in the evening, but they were not captured in nets over water until after 2100 h. He postulated that they are likely feeding first and then later going to drink.

Specimens Examined:

(Catron) MSB 6956, MSB 9330-9337, MSB 9338-9343, MSB 9467-9473, MSB 9479-9481, MSB 9521-9522, MSB 9569-9575, MSB 9591-9596, MSB 9603-9605, MSB 9639-9640, MSB 10460-10501, MSB 11275, MSB 11297-11298, MSB 11305, MSB 11615-11622, MSB 12362-12365, MSB 12532-12543, MSB 12709-12717, MSB 12719-12724, MSB 12732, MSB 12743, MSB 12745, MSB 13016-13017, MSB 14408-14409, MSB 14539-14542, MSB 14837, MSB 69474, MSB 75672, MSB 262569, USNM 158315, WNMU 768, WNMU 1269, WNMU 2081, WNMU 2632-2633, WNMU 2641, WNMU 2668, WNMU 2993, WNMU 3796, WNMU 6132-6133, WNMU 6606-6607 (Grant) MSB 12740-12742, MSB 14693-14694, MSB 56525, MSB 262719, USNM 349272, WNMU 87-88, WNMU 1754, WNMU 2076, WNMU 2408-2411, WNMU 2501, WNMU 2522, WNMU 3102, WNMU 3620, WNMU 6605 (Sierra) MSB 265879, MSB 267045, MSB 267117

Lasionycteris noctivagans (Le Conte, 1831)

Silver-haired Bat

Subspecies: None

Description:

The silver-haired bat is distinguished by black fur with silver fringe on the dorsum. The ears are short, rounded, and hairless, and the tragus is broad and blunt (Kunz, 1982).

Winter Activity:

Silver-haired bats are migratory, but there have been reports of both sexes present in winter in New Mexico (Cryan, 2003). A specimen I collected on 13 March 2013 is the earliest female record for the Gila (MSB 269180), while the earliest male record is 15 February 1996 (MSB 89162). The latest record was a female taken on 12 December 2004 in the Big Burro Mountains by Keith Geluso (MSB 124845). These records, as well as

Anabat recordings from Saddle Rock in January 1996, indicate that some silver-haired bats remain present in the Gila during winter months.

Migration patterns throughout the range of the silver-haired bat are complex, but patterns of separate male and female migration are known to be common (Cryan, 2003). All silver-haired bats taken from June until September in the Gila are male (n=130), with 3 exceptions: a female taken on 2 June 2006 in the Mogollon Mountains by Keith Geluso (MSB 125010), one taken in the Black Range on 6 June 2006 by Keith Geluso (MSB 125013), and one taken near Willow Creek by Hayward on 5 June 1964 (WNMU 6119). From September-May, all Gila captures are females (n= 22), with five male exceptions (MSB 14268, MSB 27022, MSB 60695, MSB 89162, MSB 124844).

Habitat/Elevation:

Silver-haired bats prefer high elevations in the summer in New Mexico (Findley et al., 1975), and in the Gila, museum records indicate they occur from 2200-2500 m although Hayward captured them as low as 1447 m (WNMU 3592). They occur in piñon-juniper forest, ponderosa pine forest, and mixed conifer habitat, and Jones (1967) reported them mostly in ponderosa pine forest.

Reproduction:

Although specimens abound (218 in the Gila, 669 in New Mexico) most (78%) are male. Female reproductive data for the Gila are lacking, but female silver bats are known to exhibit delayed fertilization (Druecker, 1972).

Remarks:

Hayward found 2 individuals roosting under tree bark (WNMU 93; WNMU 6617).

This was the most commonly captured bat in 2012-2014, comprising 20% of captures.

Specimens Examined:

(Catron) MSB 3155—3156, MSB 9254-9462, MSB 9495, MSB 9523-9526, MSB 9565-9568, MSB 9579-9582, MSB 12854-12867, MSB 13018-13026, MSB 14015, MSB 14267-14268, MSB 14387-14389, MSB 14393, MSB 14405-14407, MSB 14538, MSB 14667, MSB 14812, MSB 60695-60696, MSB 262583, USNM 506263-506265, WNMU 91-93, WNMU 772, WNMU 2691, WNMU 2699, WNMU 6117-6120, WNMU 6615

(Grant) MSB 13265-13267, MSB 14383-14384, MSB 24843-24845, MSB 89162, MSB 56523-56524, MSB 262674, WNMU 698, WNMU 771, WNMU 1405-1407, WNMU 1757, WNMU 1768, WNMU 1826, WNMU 1841, WNMU 1928, WNMU 1944-1945, WNMU 2089, WNMU 2227, WNMU 2418-2422, WNMU 2640, WNMU 3104, WNMU 3592, WNMU 3612, WNMU 6116, WNMU 6610-6611

Myotis auriculus Baker & Stains, 1955

Southwestern Myotis

Subspecies: 2, 1 in the Gila

Myotis auriculus apache Hoffmeister & Krutzsch, 1955

Description:

The southwestern myotis has long ears (>17 mm) that distinguish it from all other myotis except *M. evotis*, which has sharply black ears instead of brown (Warner, 1982).

Winter Activity:

Little is known about this bat's winter habits in New Mexico (Findley et al., 1975; Cook, 1982), although there is one winter record from the Gila in February 1982 (WNMU 3852).

Habitat/Elevation:

The southwestern myotis usually occurs in ponderosa pine forest and near rocky cliffs at intermediate elevations (Cook, 1982). Hayward (1972) found this myotis to be uncommon in the Gila, whereas Cook (1982) found it to be the most common bat farther south in the Animas Mountains. There are 46 total captures in the Gila from 1960-2014. Several were captured at Rockcore Tank in ponderosa pine forest in Sierra County for the 2012-2014 survey. Hayward collected them across many low to mid elevation habitats: piñon-juniper, ponderosa pine, and cottonwood riparian (WNMU 261, WNMU 2390, WNMU 3156).

Reproduction:

Pregnant southwestern myotis were captured in the Gila in June, and lactating in late June/early July.

Specimens Examined:

(Catron) WNMU 1828, WNMU 2346, WNMU 2387, WNMU 2390 (Grant) WNMU 3156, WNMU 3761, WNMU 3852, WNMU 4776, WNMU 6631

Myotis californicus (Audubon & Bachman, 1842)

California Myotis

Subspecies: 4, 1 in the Gila

Myotis californicus californicus Audubon & Bachman, 1842

Description:

California myotis share a characteristic keeled calcar with the long-legged myotis and the western small-footed myotis, but differ in that the long-legged myotis has a distinctly furred plagiopatagia from the knee to the elbow on the ventral side of the wing, which the California and western small-footed myotis lack. *M. californicus* can be distinguished from *M. ciliolabrum* only with difficulty, but generally the ears and wing membranes of *M. californicus* will be brown as opposed to black. *M. californicus* also has a narrower rostrum than *M. ciliolabrum* (Simpson, 1993). *Myotis californicus* is the smallest myotis in the Gila.

Winter Activity:

One specimen, as well as Anabat recordings from the Burro Mountains in January indicates the California myotis may be present in the Gila during winter (MSB 124840).

Habitat/Elevation:

The California myotis is usually found in ponderosa pine forest (Findley et al., 1975) (Jones, 1967), although Hayward collected them from a variety of habitats, ranging from desert scrub, alder-sycamore riparian, to ponderosa pine forest. We captured them at Pague Tank on the Ladder Ranch, which is transitional from piñon-juniper to oak-ponderosa pine forest.

Reproduction

The California myotis exhibits delayed fertilization (Krutsch, 1954). Pregnant females were taken as early as 4 May, but were more commonly captured in mid to late June. A lactating female was taken on 3 July (UAM 41898), so parturition is probably late June or early July.

Remarks:

Hayward (1972) found that California myotis are active only in the early evening and not captured after 2100 h.

Specimens Examined:

(Catron) USNM 349203-349211, WNMU 2492 (Grant) MSB 13255-13256, MSB 24838-24840, MSB 56526-56530, MSB 56531, MSB 89160, MSB 124868, MSB 125610, WNMU 53-54, WNMU 631, WNMU 767, WNMU 1340, WNMU 1363, WNMU 1685, WNMU 1758, WNMU 1839, WNMU 1878, WNMU 2075, WNMU 2392, WNMU 2426-2427, WNMU 2991-2992, WNMU 3543, WNMU 3613, WNMU 4421, WNMU 6065-6066 (Sierra) MSB 13980-13981, MSB 25004-25005

Myotis ciliolabrum Merriam 1886

Western Small-footed Myotis

Subspecies: None

Description:

See account for *M. californicus*.

Winter Activity:

The small-footed myotis hibernates in New Mexico (Findley et al., 1975) but there is only one winter specimen for the Gila, a female taken in the Big Burro Mountains on 25 January (MSB 124841), as well as Anabat recordings in January 1996 from Saddle Rock.

Habitat/Elevation:

The small-footed myotis is generally found at low to mid-elevations (1400-1700 m) in the Gila. Seven of Hayward’s 12 captures came from ponderosa pine forest. I examined an historic specimen captured in 1894 from Silver City at 1800 m (USNM 66117).

Reproduction:

Pregnant small-footed myotis were taken in the Gila on 7 May (WNMU 2498), 21 May (MSB 279307), and 3 June (WNMU 2200).

Specimens Examined:

(Catron) MSB 9527-9528, MSB 11286, MSB 11639, MSB 13005, USNM 349206, WNMU 2498, WNMU 2638-2639, WNMU 2689 (Grant) MSB 24841-24842, MSB 24998, MSB 262718, ANMH 127206, USNM 66117, WNMU 1875, WNMU 2199-2200, WNMU 2223, WNMU 2423-2424, WNMU 6081 (Sierra) WNMU 1420

Myotis evotis (H. Allen, 1864)

Long-eared Myotis

Subspecies: 6, 1 in the Gila

Myotis evotis evotis (H. Allen, 1864)

Description:

The long-eared myotis has long (> 16mm) ears; It differs from other myotis that have long ears (Southwestern and fringed) in that the ears are black, not brown (Manning & Jones, Jr., 1989).

Winter Activity:

Long-eared myotis are known to migrate short distances, but probably spend most winter months in hibernacula (Manning & Knox Jr., 1989).

Habitat/Elevation:

The long-eared myotis is the most common myotis at elevations above 2200 m in the Gila (Hayward, 1972). We captured long-eared myotis mostly in ponderosa pine forest, and Hayward's specimens are all from either ponderosa pine or mixed conifer forest. Jones (1967) captured *M. evotis* primarily in ponderosa pine forest, but also one in mixed conifer forest. Hayward (1972) captured a long-eared myotis from Iron Creek Mesa Lake during his 1972 Gila survey that had been banded 6 years earlier.

Reproduction:

Female long-eared myotis with late-term embryos were taken from mid-May to mid-June (crown/rump lengths 16-19 mm) with parturition likely occurring in mid to late June.

Specimens Examined:

(Catron) MSB 86352, MSB 92592-92593, MSB 92596-92597, MSB 10447, MSB 11291, MSB 11634, MSB 14828, MSB 75685-75687, MSB 85908, MSB 262531,

USNM 349214-349218, USNM 506257, WNMU 1798, WNMU 1861, WNMU 2542-2543, WNMU 2547, WNMU 2681, WNMU 2683, WNMU 2685-2687, WNMU 2814-2815, WNMU 2831, WNMU 5637, WNMU 6068-6071, (Grant) WNMU 2386 2389, WNMU 2391, WNMU 2405

Myotis occultus Hollister 1909

Arizona Myotis

Subspecies: None

Description:

Like the Yuma myotis, the Arizona myotis does not have a keeled calcar, but is typically larger, and has a reddish-brown pelage and dark colored ears.

Winter Activity:

Winter activity in the Southwest and activity of males is poorly known (Fenton 1972) and needs further study.

Habitat/Elevation:

Similar to Hayward's records (1972), we captured relatively few Arizona myotis despite sampling across a wide range of elevations (1200-2700 m) and habitats. Jones (1967) reported captures in desert grassland and scrubland, ponderosa pine forest, and mixed conifer forest in the Mogollon Mountains. He also located colonies of Arizona myotis roosting along with *T. brasiliensis* and *M. yumanensis*, and most of his captures came from roosts.

Reproduction:

The Arizona myotis exhibits delayed fertilization (Cagle & Cockrum, 1943). Pregnant Arizona myotis were taken in early to late May and lactating females were found on 18 June, so parturition likely occurring in early June.

Remarks:

In New Mexico, the size of this species may be correlated with the number of sympatric species of myotis. When several myotis co-occur, *M. occultus* will be larger based on cranial measurements (Findley & Jones, 1967). In the Gila, there are 8 co-occurring myotis species, so *M. occultus* should be large.

There is evidence of hybridization between *M. occultus* and *M. lucifugus* in Colorado and New Mexico (Findley & Jones, 1967), but Hoffmeister (1986) considers the 2 to be the same species in Colorado, Arizona, and New Mexico. Piaggio et al. (2002) used mitochondrial DNA sequences to determine that *M. occultus* is distinct from *M. lucifugus.*

Specimens Examined:

(Catron) MSB 9237, MSB 9557-9558, MSB 9560-9563, MSB 9597-9599, MSB 9622, MSB 11214, MSB 11295, MSB 11304, MSB 11636, MSB 14530-14537, MSB 14669-14671, MSB 14827, MSB 14829, MSB 17288, MSB 18933, MSB 75674-75676, MSB 85915, MSB 92594, MSB 21984-21991, MSB 127028, USNM 349201, USNM 349213, USNM 349219-34221, USNM 349224-349227, USNM 349224, WNMU 4511,WNMU 2764, WNMU 2766, WNMU 6637 (Grant) MSB 14370-14371, MSB 24869, MSB 24989, MSB 21978-21981, MSB 25200-25203, WNMU 2990, WNMU 6622-6623, WNMU 6625, WNMU 6629, WNMU 6635, WNMU (Sierra) MSB 24855-24858, MSB 24861, MSB 25001, MSB 125616, MSB 125618-125631, MSB 125633-125637, MSB 125642, MSB 125644-125646

Myotis thysanodes Miller, 1897

Fringed Myotis

Subspecies: 4, 1 in Gila

Myotis thysanodes thysanodes Miller, 1897

Description:

The fringed myotis lacks a keeled calcar and can be discerned from *Myotis occultus* and *Myotis yumanensis* by a distinct fringe of hairs along the lower edge of the uropatagium.

Winter Activity:

Winter records for the fringed myotis are lacking for the Gila and indeed, most of New Mexico (Findley et al., 1975), so whether these bats are migratory or over-winter in the Gila is unknown.

Habitat/Elevation:

The fringed myotis has a wide habitat range (Findley et al., 1975), but Hayward (1972) found them uncommon in the Gila, because of a lack of roosting sites. Geluso & Geluso (2004) and Cook (1982), however, reported this species often roosting in buildings and caves elsewhere in New Mexico. Hayward captured fringed myotis in ponderosa pine forest and cottonwood riparian habitat (WNMU 2394, WNMU 5742). For the 2012-2014 survey, we captured fringed myotis in ponderosa pine forests at Rockcore Tank in Sierra County and at Apache Creek in Catron County. Jones (1967) captured them mostly in ponderosa pine forest, but also in piñon-juniper and mixed conifer forest. He noted that none were captured in desert habitats, and 35% of his specimens came from mine roosts (1967).

Reproduction:

The fringed myotis demonstrates delayed fertilization (O'Farrell & Studier, 1980). Lactating females have been captured in the Gila in early July, and museum records indicate that parturition in *M. thysanodes* is in early to mid-June.

Remarks:

The Perry et al. (2001) bat survey on the Ladder Ranch found *M. thysanodes* roosting in rock crevices near riparian, desert scrub, and piñon-juniper woodland. They also found >20 individuals roosting in a barn at Hermosa.

Specimens Examined:

(Catron) MSB 9512-9515, MSB 9641-9643, MSB 11278, MSB 14394-14400, MSB 14514-14518, MSB 14560-14585, MSB 14813-14814, MSB 92591, MSB 140930 (Grant) MSB 13263-13264, MSB 24849, MSB 24996, MSB 56535-56536, WNMU 1356, WNMU 2201, WNMU 2394-2396, WNMU 2398, WNMU 2505, WNMU 5682, WNMU 5742 (Sierra) MSB 24993-24995, MSB 25008-25010, MSB 26903, MSB 126655

Myotis velifer (J.A. Allen, 1890)

Cave Myotis

Subspecies: 5, 1 in the Gila

Myotis velifer velifer (J.A. Allen, 1890)

Description:

Cave bats are distinguished by a bare dorsal patch between their shoulder blades. *Myotis velifer*, like *M. thysanodes, M. occultus,* and *M. yumanensis*, lacks a keeled calcar, but is larger than those species.

Winter Activity:

Winter records for the cave bat are scarce and Hayward (1970) theorized that this species leaves Arizona in the winter and may hibernate in New Mexico. He also suggested that those found in the Animas Mountains may move south for winter.

Habitat/Elevation:

There are few records of cave bats in the Gila and none were recorded by Hayward in his survey (1972) or during our 2012-2014 survey. Jones (1967) only captured 2 in the Mogollon Mountains, making them the second rarest bat in his survey. He captured one in piñon-juniper and one in desert grass/scrub (Jones, 1967). Cave bats usually occur in lower elevations, in desert grassland and desert scrub (Findley et al., 1975) or oak scrub (Cook, 1982). There are only 5 specimens of cave bat from the Gila, all from the 1960s.

Reproduction:

The cave myotis shows delayed fertilization (Kunz, 1973). Cave bats form maternity colonies in Arizona of up to 15,000 individuals (Hoffmeister, 1986).

Specimens Examined:

(Catron) USNM 349222-349223 (Grant) MSB 11640, MSB 13261, ANMH 127205

Myotis volans (H. Allen, 1866)

Long-legged Myotis

Subspecies: 4, 1 in the Gila

Myotis volans interior Miller, 1914

Description:

The long-legged myotis, one of the larger myotis in New Mexico (Findley et al., 1975), has a keeled calcar and is similar to *M. ciliolabrum* and *M. californicus,* except that the ventral side of the plagiopatagia is distinctly furred from the elbow to the knee.

Winter Activity:

Findley et al. (1975) reported no winter records for the long-legged myotis, and the same is true in the Gila. Hoffmeister (1986) reported that they hibernate in Arizona. Future work is needed to determine the winter habits of this species in the Gila.

Habitat/Elevation:

The long-legged myotis typically occurs in higher elevation habitats, although Geluso & Geluso (2004) and Cook (1982) reported capturing them at intermediate elevations (~1700 m) in the Guadalupe and Animas Mountains, respectively. Almost all of Hayward's captures came from ponderosa pine habitat. Our captures came primarily from ponderosa pine forest (12 of 15 captures) but also from desert scrub habitat at Middle Mesa and Pague Tank (3 of 15 captures) on Ladder Ranch. Jones (1967) reported that most of his captures came from ponderosa pine forest, but also from piñon-juniper and mixed conifer forest.

Reproduction:

The long-legged myotis exhibits delayed fertilization (Druecker, 1972). They form maternity colonies in Arizona (Hoffmeister 1986) and maternity colonies have been found elsewhere in New Mexico (Davis & Barbour, 1970). Hayward collected pregnant females in late May and early June (WNMU 64, WNMU 66, WNMU 2407, WNMU 6109), as we did during the 2012-2014 survey. Crown-rump lengths of embryos ranged from 3.5 mm to 20 mm (n = 5).

Remarks:

Hayward (1972) found long-legged myotis to be the second-most abundant bat in the Gila, and posited that they may forage in groups, as he would frequently capture 3 or 4 close together in the same net.

Specimens Examined:

(Catron) MSB 3153, MSB 9596-9511, MSB 9644-9653, MSB 9657-9668, MSB 11281-11282, MSB 11293-11294, MSB 11296, MSB 11637-11638, MSB 12913-12916, MSB 13010-13012, MSB 14263-14266, MSB 14401, MSB 14519-14522, MSB 14668, MSB 14786-14788, MSB 14826, MSB 17284, MSB 17289, MSB 75673, MSB 141130, USNM 349228-349229, USNM 506258, WNMU 65-66, WNMU 1827, WNMU 2406-2407, WNMU 2545, WNMU 2698, WNMU 2816, WNMU 6109-6111, (Grant) MSB

13983-13985, MSB 23730, MSB 262720, WNMU 64, WNMU 240, WNMU 2053, WNMU 2393, WNMU 2832, WNMU 5681, WNMU 6636 (Sierra) MSB 13982

Myotis yumanensis (H. Allen, 1864)

Yuma Myotis

Subspecies: 6, 1 in the Gila

Myotis yumanensis yumanensis (H. Allen, 1864)

Description:

Similar to *Myotis occultus* and *Myotis velifer, M. yumanensis* lacks a keeled calcar, but is smaller than *M. velifer*, while *M. occultus* has dark ears and a brown belly instead of the silvery belly of *M. yumanensis*.

Winter Activity:

Hoffmeister (1986) noted that Yuma myotis probably migrate out of Arizona for the winter, and this pattern may also be found in the Gila as there are no winter records.

Habitat/Elevation:

Yuma myotis are desert or riparian dwelling bats usually found at lower elevations (~1500 m), although Findley et al. (1975) reported that they have been taken as high as 2100 m elsewhere in New Mexico. In the 2012-2014 survey, most were netted across creeks in cottonwood riparian areas at the Ladder Ranch from 1450-1510 m. Hayward captured them in the 1200-2000 m range, in desert scrub habitat and ponderosa pine forest (WNMU 1876, WNMU 6630). Jones (1967) stated that he captured most specimens in desert habitats and that they are more common in “open areas as suggested by Hall & Kelson (1959).” He also noted that most of his specimens were taken from roosts (Jones, 1967).

Reproduction:

Yuma myotis mate in the fall, store sperm over winter, and fertilization occurs in the spring (Dalquest, 1947). Reproductive data from the Gila are sparse, although there are records of pregnant females taken on 24 June (WNMU 2988, WNMU 2989). Based on crown/rump lengths of embryos (20 and 21 mm), parturition likely occurs in late June or early July. Hoffmeister (1986) found a maternity colony of Yuma myotis in Arizona in an attic, and they likely also form maternity colonies in New Mexico.

Specimens Examined:

(Catron) MSB 9464, MSB 9516, MSB 9529, MSB 10515, MSB 11283, MSB 13270, MSB 14513, MSB 125024, USNM 349237-349259 (Grant) MSB 14368-14369, MSB 56537-56539, WNMU 1876, WNMU 2515, WNMU 2988-2989, WNMU 6630 (Sierra) MSB 24865, MSB 24976

Parastrellus hesperus (H. Allen, 1864)

Canyon Bat

Subspecies: 2, 1 in Gila

Parastrellus hesperus maximus (Hatfield, 1936)

Description:

The canyon bat is the smallest bat in New Mexico and is easily distinguished from other similarly-sized *Myotis* by its blunt, curved tragus.

Winter Activity:

There are few winter records of canyon bats in the Gila. Anabat recordings in January and February 1996 in Saddle Rock and three captures in February 1996 in Saddle Rock are the earliest records of male canyon bats in the Gila (MSB 89161, MSB 208514, MSB 208515). One taken on 22 March 2014 is the earliest female record (MSB 270476). Canyon bats hibernate in Arizona (Hoffmeister, 1986) and likely in New Mexico (Findley et al., 1975, Geluso & Geluso, 2004).

Habitat/Elevation:

The canyon bats use rocky cliffs as roosts and are found at low elevations and usually taken in desert grassland and desert scrub habitats, but occasionally at habitats higher than piñon juniper woodland (Findley et al., 1975). We captured them on the Ladder Ranch in cottonwood riparian habitats. Jones (1967) captured most of his specimens in desert habitats, and some in piñon-juniper and ponderosa pine forest. He was unable to locate any roosts in his survey of the Mogollon Mountains (Jones, 1967). I examined an historic (1908) specimen from Redrock (USNM 157843) collected at 1338 m.

Reproduction:

We took pregnant females on 5, 11, and 12 June. They are known for delayed fertilization in spring following fall and winter mating (Krutzsch, 1975).

Remarks:

Findley et al., (1975) listed this species as *Pipistrellus hesperus*, but the genus was changed based on molecular divergence (Hoofer et al., 2006).

Specimens Examined:

(Grant) MSB 11641-11642, MSB 13244-13251, MSB 56541-56542, MSB 89161, MSB 24850, USNM 157843, WNMU 2503, WNMU 3065 (Sierra) MSB 13979, MSB 267074

Family Molossidae

Nyctinomops macrotis (Gray, 1840)

Big Free-tailed Bat

Subspecies: None

Description:

The big free-tailed bat can be discerned from the Brazilian free-tailed bat by its larger size (FA > 55 mm) and by its ears, which are joined at the base.

Habitat/Elevation:

There is 1 specimen of the big free-tailed bat in the Gila, from Willow Creek (MSB 6955) at 2450m in elevation. In other parts of New Mexico, they are common below 1800 m (Findley et al., 1975). Findley et al. (1975) reported that they occupy the "same ecological distribution in New Mexico as *T. brasiliensis*." Bailey (1931) did not report the big free-tailed bat in his survey of New Mexico.

Reproduction:

Pregnant females were captured on 30 June and lactating in July in other parts of New Mexico (Findley et al., 1975).

Remarks:

Findley et al., (1975) reported this species as *Tadarida macrotis.*

Specimens Examined:

(Catron) MSB 6955

Tadarida brasiliensis (Saint-Hilaire, 1824)

Brazilian Free-tailed Bat

Subspecies: 9, 1 in Gila

Tadarida brasiliensis mexicana Saussure, 1860

Description:

The Brazilian free-tailed bat is smaller in size (FA< 45 mm) and its ears are not joined at the base, distinguishing it from *N. macrotis*.

Phylogeography and Systematics:

Russell et al. (2005) studied Brazilian free-tailed bats from the southwestern U.S. (CA, NV, OR, UT, AZ, NM, TX, OK, KS) and Mexico to analyze genetic structure within populations and migratory groups, using 4 previously described migratory groups (Cockrum, 1969). They found that migratory groups are not differentiated from each other or from non-migratory *T. brasiliensis*. About 20% of bats from Carlsbad Caverns (Eddy Co., NM) and Eagle Creek Cave (Greenlee Co., AZ, close to border of the Gila) switched between these 2 migratory groups, based on banding data, leading to homogeneity of the seemingly distinct groups (Russell et al., 2005).

Winter Activity:

Brazilian free-tailed bats in the southwest are seasonal migrants that spend their winters in central Mexico (Cockrum, 1962). In Arizona, some stay year-round, but these do not hibernate (Hoffmeister 1986). A small colony (50-100 males and females) that resides under King Canyon Bridge in Sierra County was present on 15 November 2014, absent on 15 December 2014 and 14 March 2015 and then present again on 11 April. It is possible though that at any point these were not the same bats, and may have been transient migrators using the bridge as a “way point” on its migration route.

Habitat/Elevation:

The Brazilian free-tailed bat is usually found in low elevation piñon-juniper habitat or desert scrub and desert grassland habitats (Findley et al., 1975). Jones (1967) captured them in ponderosa pine forest, piñon-juniper woodland, and desert grassland and scrubland, but noted that few were taken from ponderosa pine forest. Bailey (1931) observed that they occurred "probably in the Gila valleys" and were abundant in towns and cities. He stated that in Carlsbad, a few emerged from the caverns on 15 March 1924 but most did not emerge until April. Hayward (1972) stated that he did not capture this species in his survey of the Gila Wilderness in 1972, likely because he was sampling higher elevations and was not near roosting sites.

Reproduction:

Female Mexican free-tailed bats mate and are fertilized in spring within 1 to 3 weeks of ovulation (DiSalvo et al., 1969). Females are pregnant upon their arrival in New Mexico (Findley et al., 1975) and pregnant females have been taken from May to mid-June throughout the state. In the Gila, pregnant females have been collected on 11 and 23 June, and lactating females on 18 and 21 June. Parturition likely occurs in mid-June.

Specimens Examined:

(Catron) MSB 5358-5361, MSB 9530-9556, MSB 9564, MSB 9601-9602, MSB 9633-9636, MSB 10513-10514, MSB 11279, MSB 12750, MSB 13844-13846, MSB 14404, MSB 21993-21994, USNM 349277-349299 (Grant) MSB 13851-13859, MSB 13986-13987, MSB 14379-14381, MSB 24846, MSB 24872-24873, MSB 24878, WNMU 111, WNMU 116, WNMU 1902, WNMU 1927, WNMU 2257, WNMU 3273, WNMU 4570, WNMU 4587, WNMU 6147, WNMU 6616-6619 (Sierra) MSB 267063, MSB 267064, MSB 267119

Order Carnivora

Family Canidae

Canis latrans Say, 1823

Coyote

Subspecies: 19 subspecies, 1 in the Gila

Canis latrans mearnsi Merriam, 1897

Description:

Coyotes occur in sympatry with recently reintroduced *Canis lupus* in some areas of the Gila, but are distinguished from Mexican wolves in that they are smaller, have longer ears, and have a shorter paw print (Bekoff, 1977).

Habitat/Elevation:

Coyotes, found throughout the Gila in nearly all habitats, are most common in grasslands (Findley et al., 1975). Hayward (1972) reported scat and hearing howls at elevations between 2500 and 3500 m. Bailey (1931) stated they "inhabit practically every part" of New Mexico. We frequently spotted them on the Ladder Ranch and obtained salvaged specimens from fur-trappers.

Reproduction:

Bailey (1931) recorded that coyote pups are born in March and April with 4-8 pups per litter.

Remarks:

Because coyotes are unprotected, unlimited numbers can be harvested at any time.

Camera traps recorded a coyote feeding on *Odocoileus hemionus* on 4 different occasions, and once on a mallard duck (*Anas platyrhynchos*).

Specimens Examined:

(Catron) MSB 142626, MSB 143825 (Grant) MSB 143826-143827, MSB 227351, MSB 230663, MSB 231442 (Grant) USNM 20356, USNM 158238 (Sierra) MSB 143823

Canis lupus Linnaeus 1758

Mexican gray wolf

Subspecies: 32, 1 in the Gila

Canis lupus baileyi Nelson & Goldman 1929

Description:

The Mexican gray wolf (22-36 kg) is larger overall than the coyote (9-16 kg) (Bekoff, 1977).

Habitat/Elevation:

Before their extirpation from the southwest, the Mexican gray wolf had its highest abundance in the Gila National Forest, estimated at about 100 wolves in the region (Bailey, 1971). They prefer ponderosa pine forest and piñon-juniper woodland habitats (Bailey, 1971).

Reproduction:

Litters of 7-8 pups were reported by Bailey (1971).

Remarks:

Mexican gray wolves were effectively extirpated from all of New Mexico by 1927, and the last recorded specimen from the Gila was from 24 km SE Reserve on 11 May 1925 (USNM 245841). Reintroduction efforts began in 1998, and at present, there are an estimated 97 Mexican gray wolves in Arizona and New Mexico. There are 21 packs in New Mexico consisting of 47 wolves that primarily roam the Gila, but they also venture into the Cibola National Forest and the San Mateo Mountains of Socorro County (http://www.fws.gov/southwest/es/mexicanwolf/pdf/NR_2015_MW_Annual_Survey.pdf).

Specimens Examined:

(Catron) MSB 231475, USNM 148855-148858, USNM 151374-151376, USNM 224582, USNM 232448, (Grant) USNM 147704, USNM 147750, USNM 158922-158927, USNM 221676, USNM 226433 (Sierra) MSB 135363-135364, MSB 142639, MSB 142756, MSB 193702, MSB 231376, USNM 211154-211156, USNM 224166-224168, USNM 228264, USNM 232451, USNM 235085-235088

Urocyon cinereoargenteus (Schreber, 1775)

Gray Fox

Subspecies: 16, 1 in Gila

Urocyon cinereoargenteus scottii Mearns, 1891

Description:

The gray fox is distinguished from other foxes by its gray appearance and the dark stripe along the dorsum of the tail (Fritzell & Haroldson, 1982).

Habitat/Elevation:

Gray foxes are usually found in lower elevation wooded areas, such as piñon-juniper and oak habitats (Findley et al., 1975), but Hayward (1972) and H. Shaw (pers. comm.) noted they are also found in ponderosa pine forest in the Gila.

Reproduction:

There are few reproductive records from the Gila, but a female gray fox was photographed with a kit in August of 2011 at the Ladder Ranch. Bailey (1931) noted that they usually have 3-4 kits born in early spring, and that he found females still lactating in May.

Remarks:

Gray fox are highly omnivorous (Hoffmeister, 1986). Camera-trap photos from the Ladder Ranch (2008-2012) show gray foxes predating on *Sylvilagus audubonii* on 40 occasions, unidentified species of *Neotoma* on 58 occasions, *Lepus californicus* on 5 occasions, and the western diamondback rattlesnake (*Crotalus atrox)* twice. In addition, gray foxes were photographed eating a gopher snake (*Pituophis catenifer), Dipodomys*, squirrels (not identifiable to species), and cactus fruit (*Opuntia* sp.). We received 10 salvaged specimens of gray fox from a fur-trapper in Grant County and recovered a dead-on-road specimen from Highway 180 near Alma. The gray fox was the second most frequently harvested furbearer in 2012-2015 in Catron, Grant, and Sierra Counties (Table 3).

In 2008, gray fox populations declined due to rabies in Grant County, and their numbers had not fully recovered by 2014 (H. Shaw, pers. comm., J. Lehmer, pers. comm.) (Figure 12). Gray fox are sometimes predated upon by coyotes and will climb trees to avoid them (J. Lehmer, pers. comm.).

Specimens Examined:

(Catron) MSB 37259, MSB 85583, MSB 143814-143815, MSB 156760, MSB 264306 (Grant) MSB 122073, MSB 143811, MSB 143818-143819, MSB 214838, MSB 214843, MSB 214870, MSB 214962, MSB 230588, MSB 230648, USNM 20359, USNM 157838, USNM 158244 (Sierra) MSB 143816

Vulpes macrotis Merriam, 1888

Kit Fox

Subspecies: 8, 1 in the Gila

Vulpes macrotis neomexicana Merriam, 1902

Description:

The kit fox has a reddish brown coat and a black-tipped tail (McGrew, 1979).

Habitat/Elevation:

Kit foxes are found at lower elevations than *U. cinereoargenteus* (Cook, 1982) in desert habitats (Findley et al., 1975). None was photographed with the Ladder Ranch camera traps (2008-2012) although there is suitable habitat. Although museum records are few, 121 individuals were reported in the NMDGF Furbearer Harvest Report for 2012-2015 (Table 3). Bailey (1931) reported that he saw kit foxes at Willow Creek on several occasions.

Reproduction:

Cook (1982) reported observing a mother with 3 kits in the Animas Mountains on 28 May and 5, 7, 23, 21, and 29 June. Bailey (1931) documented that they usually have 4 kits that stay in the den for most of their first year.

Specimens Examined:

(Grant) WNMU 6923

Vulpes velox Say, 1823

Swift Fox

Subspecies: 2, 1 in the Gila

Vulpes velox velox Say 1823

Description:

The swift fox differs from the gray fox in that it does not have a dark stripe on the tail, and from the kit fox in that it lacks a black tip to the tail (Egoscue, 1979).

Habitat/Elevation:

Neither Bailey (1931) nor Findley et al. (1975) reported the swift fox in the Gila in their respective surveys of New Mexico. There were 2 reportedly harvested in

NMDGF's 2012-2015 report (Table 3) and one museum record from Silver City (WNMU 1215) from 1966, indicating their historic occurrence in the Gila.

In New Mexico, the swift fox prefers soft soils of desert grassland where it feeds on rodents, primarily kangaroo rats (Findley et al., 1975). They are known to hybridize with kit foxes in a narrow hybrid zone in eastern New Mexico (Findley et al., 1975). Dragoo et al., (1990) proposed, based on morphometric, protein electrophoresis data and mitochondrial DNA data (Dragoo & Wayne, 2003) that in New Mexico, *V. macrotis* are a subspecies of *V. velox* (*V. v. macrotis)*. The taxonomy of these species needs to be refined.

Reproduction:

Reproductive data for the swift fox from the Gila are lacking, however a study on their reproduction in California found a mean litter size of 3 kits, with a range of 1-6, with litters born between 15 February and 5 March (Spencer et al., 1992).

Specimens Examined:

(Grant) WNMU 1215

Family Felidae

Lynx rufus (Schreber, 1777)

Bobcat

Subspecies: 12, 1 in Gila

Lynx rufus baileyi Merriam, 1890

Description:

The bobcat is about twice the size of a domestic cat, is spotted, and has a short, black-tipped tail (Lariviere & Walton, 1997).

Phylogeography and Systematics:

Reding et al. (2012) used mtDNA sequences and 15 nuclear microsatellite loci to elucidate the phylogeographic structuring of the widely distributed bobcat. They found 2 clades across North America, split into east and west. Specimens from New Mexico are in the west clade, a group that shows additional substructure with 4 subclades. Three of the subclades are present in New Mexico (A, C, and D; Gila is subclade C) (Reding et al., 2012).

Habitat/Elevation:

Bobcats occur in most habitats in the Gila, but are uncommon at high elevations (Findley et al., 1975), although I spotted one at Willow Creek (2452 m) on 4 December 2015. Their occurrence at various elevations is influenced by seasonal changes (Koehler & Hornocker, 1989), occurring at lower elevations during winter months. Hayward (1972) saw no bobcats in his 1972 survey of the Gila Wilderness.

Reproduction:

Bailey (1931) reported that bobcats usually have 2-4 kittens in a litter. A female with a kitten was photographed from a camera trap on the Ladder Ranch on August 22 of 2011.

Remarks:

Bobcats are common in the Gila, as they were the third most frequently harvested furbearer in 2012-2015 (Table 3), especially near the Gila River. We recovered 4 salvaged specimens from a fur-trapper in Grant County. In 2008, bobcat numbers in Grant County were reduced significantly (estimated 50%) by rabies, but had rebounded by 2014 (J. Lehmer, pers. comm).

Camera traps on the Ladder Ranch captured bobcats feeding on many species of small mammals, especially species of *Sylvilagus*, *Neotoma*, and *Dipodomys*.

Specimens Examined:

(Grant) MSB 157849, MSB 23074, USNM 211322, WNMU 1247-1250, WNMU 6368, WNMU 6395

Puma concolor Linnaeus, 1771

Mountain Lion

Subspecies: 6, 1 in Gila

Puma concolor azteca Merriam, 1901

Description:

The mountain lion is a large (35-65 kg), buffy-colored cat with a long tail that inhabits mountainous areas (Currier, 1983).

Phylogeography and Systematics:

Caragiulo et al. (2013) used mostly non-invasive sampling of mountain lions in northern U.S. and Central and South America to explore phylogeographic variation, concluding that mountain lions in North America lack mtDNA diversity due to a founder effect caused by recent colonization via Central America (Caragiulo et al., 2013).

McRae et al. (2005) investigated genetic diversity and gene flow in discontinuous Southwest habitats (north and south of CO/NM border) of *P. concolor* and used these data to infer post-Pleistocene colonization patterns. They found fewer alleles in northern populations than southern populations and hypothesized that northern populations colonized from the south after the Pleistocene, a hypothesis supported by microsatellite data (Culver et al. 2000).

Habitat/Elevation:

Mountain lions are found around bluffs, cliffs, and throughout mountainous areas (Findley et al., 1975). Hayward (1972) described seeing a mountain lion and sign of them in the Gila, but stated that they were uncommon in the 1970's. Mountain lions are now common on the Ladder Ranch and often spotted along the main roads of the ranch at about 1500 m (S. Dobrott, pers. comm.) and around the town of Gila, even along the river bottoms (S. MacDonald, pers. comm.).

Reproduction:

Parturition is usually from April to September, although female mountain lions can go into estrus year-round (Eaton & Verlander, 1977). Typically, 1-6 kittens are born (Robinette, 1961), and Bailey (1931) reported a litter with 4 kittens. Mother lions with a yearling and a kitten are often seen at the Ladder Ranch (H. Small, pers. comm.).

Remarks:

Bailey (1931) reported that mountain lions are most plentiful where there are higher densities of deer. Lehmer (pers. comm.) reported high mountain lion numbers near Silver City (in 2012-2014) due to abundant mule deer, and interactions with humans have increased as drought conditions bring mountain lions closer to cities (H. Shaw, pers. comm.). Bill Elmer (fide S.O. MacDonald) stated that they focus more on white-tailed (Coues) deer than mule deer where both occur

Although attacks on humans are rare, a Pinos Altos resident, Robert Nawojski, was killed and partially consumed by a mountain lion in 2008.

Mountain lions are subject to sport harvest in New Mexico and are killed for protection of bighorn sheep (*Ovis canadensis*). In 2013 in the NMDGF Game Management Units (GMUs) in the Gila, 40 mountain lions were harvested, either for sport (29), depredation (6), road kill (1), or for protection of bighorn sheep (4). The next year, 45 were harvested: sport (31), depredation (6), road kill (2), and bighorn sheep protection (6) (NMDGF, 2015).

Specimens Examined:

(Catron) USNM 264154 (Grant) USNM 263807, 263808 (Sierra) MSB 104234

Order Mephitidae

Conepatus leuconotus (Lichtenstein, 1832)

Hog-nosed Skunk

Subspecies: 3, 1 in the Gila

Conepatus leuconotus leuconotus Lichtenstein, 1832

Description:

Hog-nosed skunks have a large, upturned nose and no white coloration between the eyes, and are generally larger than other skunk species (Dragoo & Sheffield, 2009).

Habitat/Elevation:

Hog-nosed skunks usually occur in desert grassland and low to mid-elevation riparian areas (Findley et al., 1975). We captured one at the Ladder Ranch at 1496 m (MSB 279269), and recovered 10 salvaged specimens from a fur-trapper in Grant County. I examined 3 specimens collected in 1937 that were captured around the Gila River near Cliff from 1362-1653 m in elevation (AMNH 12710-12712).

Reproduction:

Reproductive records are lacking from the Gila, but Geluso & Geluso (2004) reported seeing an adult with a juvenile on 23 June 2004 in the Guadalupe Mountains.

Specimens Examined:

(Catron) MSB 32506 (Grant) AMNH 127110-127112 (Sierra) MSB 37672

Mephitis macroura Lichtenstein, 1832

Hooded skunk

Subspecies: 4, 1 in the Gila

Mephitis macroura milleri Mearns, 1897

Description:

Hooded skunks can be distinguished from the more common striped skunk by the white dorsal stripe that does not form a "V" along the back and tail (Findley et al., 1975), and by its thick, long hairs along the neck (Ten Hwang & Lariviere, 2001).

Habitat/Elevation:

Hooded skunks occur in low elevation desert grasslands (Findley et al., 1975; Cook, 1982). Bailey (1931) reported them at Redrock, Gila, and "7 miles above the Mimbres Valley Post Office". I examined historic (1908) specimens collected from Redrock, Big Burro Mountains, and the town of Gila (USNM 157837, USNM 158206, USNM 158208-158212), which may be the same specimens Bailey reported. They are infrequently recorded in southwestern New Mexico, which is the northern limit of their range, but have been photographed on the Ladder Ranch (2008-2012). This species should be more intensively monitored range-wide, but especially north of these records to see if changing environmental conditions are affecting their distribution.

Reproduction:

Bailey (1931) recorded female hooded skunks captured with 5 embryos.

Remarks:

We salvaged specimens from commercial fur-trappers in Grant County. All skunk species are unregulated in New Mexico and can be harvested at any time.

Specimens Examined:

(Grant) USNM 157837, USNM 158206, USNM 158208-157212

Mephitis mephitis (Schreber, 1776)

Striped Skunk

Subspecies: 13, 1 in the Gila

Mephitis mephitis estor Merriam, 1890

Description:

The striped skunk is black with a white stripe that forms a “V” along the dorsum (Findley et al., 1975).

Phylogeography and Systematics:

Barton & Wisely (2012) used mtDNA sequences and 8 microsatellite loci to determine phylogeographic structure across the range of the striped skunk in North America and found 4 clades: Pacific, South, Intermountain West, and Pacific Northwest. Skunks in New Mexico (all samples from Dona Ana County in their study) fell into the South clade, although some New Mexico samples parsed into the Intermountain West clade (Barton & Wisely, 2012). The relationship of Gila striped skunks to these two clades should be investigated. Barton & Wisely (2012) postulated that an ancestral clade expanded from Texas and Mexico into other U.S. regions over multiple Pleistocene expansions (colonization of New Mexico directly from Texas).

Habitat/Elevation:

Striped skunks, the most commonly encountered mephitid in the Gila, are widely distributed in desert grassland, piñon-juniper woodland, and ponderosa pine forest, but most often are associated with riparian habitats (Findley et al., 1975). Hayward (1972) stated that they are not usually found at high elevations in the Gila.

Reproduction:

Reproductive data on striped skunks are lacking from the Gila, but Geluso & Geluso (2004) reported seeing adults with juveniles in July and August in the Guadalupe Mountains.

Remarks:

Striped skunks are not particularly shy of humans; a few were captured in 2012-2014 in tomahawk traps set near our camps while humans were nearby. Cook (1982) captured one in the Animas Mountains at a garbage dump. Populations are known to fluctuate during rabies outbreaks (Wade-Smith, 1982), but they have been little studied in southwestern New Mexico. We recovered salvaged specimens from fur-trappers in Grant County.

Camera data from the Ladder Ranch show that striped skunks are prey for many predators, including great horned owls (*Bubo virginianus*) and *Puma concolor*.

Specimens Examined:

(Catron) MSB 15070 (Grant) MSB 156962, MSB 160308, AMNH 127113-127115 (Sierra) MSB 14762-14763, MSB 15071

Spilogale gracilis (Linnaeus, 1890)

Spotted Skunk

Subspecies: 7, 1 in the Gila

Spilogale gracilis gracilis Merriam, 1890

Description:

The spotted skunk is small and easily distinguished from other skunks in the Gila by its dorsal stripes; there are 3 stripes that run across the posterior end from flank to flank, and 3 pairs that run across the anterior end from ears to shoulders (Verts et al., 2001).

Habitat/Elevation:

Bailey (1931) reported specimens of the spotted skunk from the Burro Mountains, Redrock, and the head of the Mimbres River, near rocky areas, canyons, cliffs, and mountain foothills. E. A. Goldman captured a specimen from Redrock in 1908 (USNM 157859). Bailey (1931) also stated that spotted skunks were observed at Cliff, Glenwood, and near the Gila and San Francisco Rivers. In 2013 a Gila resident trapped one inside her house, and they have been spotted along the highway between the town of Gila and Silver City (S.O. MacDonald, pers. comm.).

Reproduction:

Data from the Gila are lacking, but spotted skunks are known to typically give birth in May with an average of 3.8 pups per litter (Mead, 1968b).

Specimens Examined:

(Grant) MSB 160344, USNM 157859, WNMU 3159, WNMU 6367

Family Mustelidae

Mustela frenata Lichtenstein, 1831

Long-tailed Weasel

Subspecies: 41, 1 in the Gila

Mustela frenata neomexicanus Barber & Cockerell, 1898

Description:

The long-tailed weasel is a small weasel (total length 300-550 mm) and has a black-tipped tail and a black or brown facemask, which distinguishes the subspecies *M. f. neomexicanus* (Sheffield & Thomas, 1997).

Phylogeography and Systematics:

Harding & Dragoo (2012) analyzed mtDNA from long-tailed weasels across North and Central America to evaluate phylogeographic structure of this widespread carnivore, and found 2 distinct clades in North America, east and west. Although the Gila was not represented in their study, samples from nearby Bernalillo, McKinley, Sandoval, Santa Fe, and Valencia Counties in New Mexico were found to be in the southern subclade of the west clade (division roughly along the 40°N) (Harding & Dragoo, 2012). Fossil evidence points to an early Pleistocene colonization of North America by the long-tailed weasel (Alroy, 2002) and geographic separation along the 40°N indicates subsequent isolation later in the Pleistocene (Harding & Dragoo, 2012).

Habitat/Elevation:

The long-tailed weasel, the only *Mustela* species in the Gila, is known from only a few records in the southern part of the region. They are found near brush, rocks, or any habitat with high rodent densities (Findley et al., 1975).

The long-tailed weasel is seldom trapped or seen. One specimen was found dead on the road near Tyrone in Grant County in piñon-juniper habitat (WNMU 4952). Harley Shaw (pers. comm.) reported seeing one outside his home in Hillsboro in the summer of 2002 or 2003, which is desert scrub habitat. Bailey (1931) reported that long-tailed weasels were taken from the Mogollon Mountains and Redrock. They are both diurnal and nocturnal (Soper, 1946). They range from central Canada south to Central America

(Sheffield & Thomas, 1997), so neither range limits nor activity patterns explain the lack of records, but instead point to the need for more study of long-tailed weasels in the Gila.

Reproduction:

Long-tailed weasels demonstrate delayed implantation (King, 1989); they typically breed in late August and litters of 4-5 young are born in April (Wright, 1948; Fagerstone, 1987), although there are no reproductive data from the Gila.

Remarks:

Fur trappers in New Mexico do not typically set weasel traps because of the small size of the long-tailed weasel and for fear of accidentally trapping the protected black-footed ferret (*Mustela nigripes*) (J. Lehmer, pers. comm.). None was reported in the 2012-2015 NMDGF furbearer harvest report (Table 3).

Specimens Examined:

(Grant) WNMU 4952

Taxidea taxus (Schreber, 1777)

American Badger

Subspecies: 5, 1 in Gila

Taxidea taxus berlandieri Baird, 1858

Description:

Badgers are large (up to 12 kg), squat mustelids with a distinct white dorsal stripe on the head (Long, 1973).

Habitat/Elevation:

Badgers are most often found at low elevations in desert grasslands, although they also occur in montane meadows (Findley et al., 1975). Bailey (1931) reported that badgers occur “without much regard to climate or physiographic features.” I examined 2 historic (1908) badger specimens from Lake Valley, Sierra County at 1684 m (USNM 167381-167382). Museum elevation records from the Gila range in elevation from 1396 to 1640 m.

Reproduction:

Little information is available on reproduction of badgers in the Gila. Hoffmeister (1986) reported that in Arizona, they breed in the summer and young are born the next spring as a result of delayed implantation. Bailey (1931) observed females with 4-5 young out of their den in other parts of New Mexico.

Remarks:

Vernon Bailey (1925) stated that badgers were found in proximity to prairie dog towns, but the demise of prairie dogs in southwestern New Mexico has impacted the density of this species. Badgers are less common than other mesocarnivores, such as coyotes, gray foxes, and skunks (J. Lehmer, pers. comm.); however, their burrows are common near Hillsboro where they are likely preying on rodents and invertebrates in desert scrub habitat (H. Shaw, pers. comm.). We recovered one specimen from a fur-trapper in Grant County (MSB 284713).

The badger is listed as “Threatened” by the NOM-059 (Mexican legislation) in Mexico, and so should be monitored in the Gila for possible protection.

Specimens Examined:

(Grant) MSB 214951, WNMU 628, WNMU 716, WNMU 1217, WNMU 1271, WNMU 2906 (Sierra) USNM 167381-167382

Family Procyonidae

Bassariscus astutus (Lichtenstein, 1827)

Ringtail

Subspecies: 14, 1 in the Gila

Bassariscus astutus flavus Rhoads, 1893

Description:

The ringtail has silvery pelage, and a ringed tail that is long (length of head and body); the face appears cat-like and is unmasked (Poglayen-Neuwall & Toweill, 1988).

Habitat/Elevation:

Bailey (1931) reported that ringtails occur in “warm canyons” in the Mogollon Mountains and at the base of the Black Range. Ringtails usually are found in grasslands near rocky areas or talus slopes (Findley et al., 1975) ranging from 1200-1800 m in elevation; however, Hayward (1972) noted that Paul Harvey, the fire lookout at Mogollon Baldy (3236 m) in the 1970s, saw one high in the Mogollon Mountains. There is also a specimen from Hardscrabble Pass in Colorado at 2953 m (DMNS 7672), indicating that high elevation records are uncommon, but documented. We captured a juvenile along Animas Creek, 2 km east of the Ladder Ranch Headquarters at 1450 m (MSB 263609). I examined an historic (1937) specimen from Whitewater Canyon near Glenwood at 1661 m (AMNH 127253) and one from 1908 captured at Redrock at 1300 m (USNM 157860).

Reproduction:

In North America, female ringtails breed once a year from February to May and usually have 1-4 young (Poglayen-Neuwall, 1980). There are no reproductive data for ringtail in the Gila.

Specimens Examined:

(Catron) MSB 196611, MSB 11201 (Grant) MSB 156963, AMNH127253, USNM 157860, WNMU 2761, WNMU 6791, WNMU 3368, WNMU 5194

Nasua narica (Linnaeus, 1776)

White-nosed Coati

Subspecies: 4, 1 in the Gila

Nasua narica molaris Merriam, 1902

Description:

The coati has brown pelage with white ears and white nose, and a long (length of head and body), faintly ringed tail that is carried vertically (Gompper, 1995).

Habitat/Elevation:

Coatis occur in a variety of habitats but seem to prefer riparian areas (Gompper, 1995). Museum records from the Gila indicate that they occur at elevations from 1400 to 2100 m.

Reproduction:

In Arizona, parturition is in late June and usually consists of 1-6 young, but 3 is most common (Kaufman, 1962). For about 2 years after birth, young coatis stay with their mother in large mixed troops that consist of other mothers and young (Gompper, 1995).

Remarks:

Bailey (1931) never saw coatis in New Mexico, but wrote that his colleague E. A. Goldman reported one killed in the Animas Valley. Gompper (1995) reported that coati in New Mexico only occur as far north as the Gila River, and that these records are likely lone dispersers. Breeding populations were not known to extend farther north than the Peloncillo Mountains; however, Geluso (2009) observed an entire band in the Big Burro Mountains of the Gila in 2004. Later, a juvenile was collected in the Big Burros (MSB 140072), indicating that breeding probably occurs in the southern Gila. Pairs have been spotted near the Catwalk and along Animas Creek, south of Ladder Ranch (H. Shaw, pers. comm.).

Coatis were recently (2008-2011) photographed on 4 occasions (December 2008, January and April 2009, and February 2011) by camera traps at the Ladder Ranch (Figure 13), and troops have been sighted near Mogollon Creek, in the Mangas Creek and Mimbres valleys, and near Glenwood/Alma (S. O. MacDonald, pers. comm.). Frey et al. (2013) used anecdotal evidence of coatis in New Mexico and Arizona to assess the use and reliability of personal observation records when no specimens are available. Our new camera records are consistent with northward and eastward expansion beyond the coatis' previously known range so their range should be closely monitored. There is one record east of Socorro that is dubious, as it consists only of an unconfirmed tissue sample.

Coatis are protected furbearers and cannot be harvested in New Mexico.

Specimens Examined:

(Grant) MSB 140072, MSB 156969, MSB 157858, MSB 268390

Procyon lotor (Linnaeus, 1758)

Raccoon

Subspecies: 22, 1 in the Gila

Procyon lotor mexicanus Baird, 1858

Description:

The raccoon is easily recognized by its black and white facemask and ringed tail; its pelage is gray and mottled (Lotze & Anderson, 1979).

Habitat/Elevation:

Raccoons are most often found in riparian areas, but have been spotted near Emory Pass (2497 m) in the Black Range (J. A. Cook, pers. obs.) and are found throughout Grant County, even away from permanent water sources (J. Lehmer, pers. comm). I spotted a raccoon on 14 March 2013 at night along the Animas Creek east of the Ladder Ranch headquarters. Hayward (1972) stated that raccoons were common at the Gila Center (near Gila Hot Springs) and were likely expanding north along the Gila River tributaries. They are common in the Gila valley near the river (S.O. MacDonald, pers. comm.).

Reproduction:

Young raccoons are usually born in April or May, and 2-5 kits per litter are typical. Photographs from the Ladder Ranch show a female with one young in June.

Remarks:

Raccoons are omnivorous opportunists and human commensals, as well as zoonotic hosts of several pathogens (e.g. rabies) (Figure 12).

Specimens Examined:

(Catron) MSB 87715, MSB 13145 (Grant) MSB 85631, MSB 284706, WNMU 1221-1223, WNMU 3275

Family Ursidae

Ursus americanus Pallas, 1780

Black Bear

Subspecies: 16, 1 in the Gila

Ursus americanus amblyceps Baird, 1859

Description:

The only bear species now found in the Gila is the black bear as New Mexico's last grizzly bear, *Ursus arctos*, was reportedly killed in the Mogollon Mountains in 1931

(Julyan, 2006). Black bears are smaller than grizzly bears, lack humped shoulders, and pelage coloration varies from light brown to black (Larieviere, 2001).

Phylogeography and Systematics:

Van den Bussche et al. (2009) used mtDNA to broadly elucidate black bear colonization patterns across North, Central, and South America and included samples from the Mogollon Mountains. They found that the Mogollon population is most closely related to populations from Manitoba, Minnesota, the Ozark Mountains, and the Ouachita Mountains, leading them to conclude that bears in New Mexico colonized from the north along the Continental Divide (Van den Bussche et al., 2009). The type locality for the subspecies, *U. a. amblyceps,* is from abandoned "Fort Webster" near Santa Rita in Grant County (Baird 1859).

Habitat/Elevation:

Black bears are found in montane conifer forests (Findley et al., 1975), and Hayward (1972) reported them at elevations of 1800-2800 m. In Hillsboro they venture into desert scrub to feed on prickly pear fruit (H. Shaw, pers. comm.), and in lowland areas around the town of Gila, perhaps most often when food is scarce at higher elevations (S.O. MacDonald, pers. comm.).

Black bears are common residents of the Gila and records are numerous. According to Bailey (1931), a report by Gila National Forest supervisor Douglas Rodman stated that black bears cause "slight damage only to stock…damage done by them is of little importance compared with that done by lions and wolves," which may indicate that black bears were spared the intensive bounty hunting that decimated grizzly, wolf, and mountain lion populations in the Gila. I examined historic (1915, 1917, 1918, 1920) specimens from Black Canyon of the Black Range, Turkey Creek, Pinos Altos, and near Chloride, collected at elevations from 1422-2700 m (USNM 225293, USNM 228270, USNM 235096, USNM 236097, USNM 235099-235101).

Reproduction:

Black bears were photographed by Ladder Ranch camera traps in April and May and with young in May and July.

Remarks:

In 2013, 80 bears were harvested in the Gila GMUs: sport (63), depredation (14), and roadkill (3). In 2014, 63 bears were harvested: sport (54), depredation (7), and roadkill (2) (NMDGF, 2015). A dead juvenile was found at the Ladder Ranch in February of 2014 (MSB 268474) where juvenile mortality is not uncommon (S. Dobrott, pers. comm.).

Specimens Examined:

(Grant) USNM 225293, USNM 235096, USNM 235099 (Sierra) MSB 142898, USNM 228270, USNM 231355-231357, USNM 235097, USNM 235100-235101

Order Lagomorpha

Family Leporidae

Lepus californicus Gray, 1837

Black-tailed Jackrabbit

Subspecies: 6, 1 in the Gila

Lepus californicus texianus Waterhouse, 1848

Description:

Black-tailed jackrabbits are larger than cottontail rabbits (length of hind foot >130 mm) and the only jackrabbits found in the Gila (Findley et al., 1975); they are distinguished by a black stripe down the tail (Orr, 1940).

Habitat/Elevation:

Throughout New Mexico black-tailed jackrabbits are found in desert grassland and desert scrubland, piñon-juniper woodland, and occasionally up into ponderosa pine forest (Findley et al., 1975). Hayward (1972) observed that they occur in the Gila in piñon-juniper and desert grassland habitats. Museum records range from 1676 to 2310 m in elevation in the Gila and black-tailed jackrabbits seem to prefer open, often grazed, grassland habitats (Hoffmeister, 1986).

Reproduction:

A female black-tailed jackrabbit was collected on the Ladder Ranch on 24 May 2014 with 4 embryos (MSB 281062) and a lactating female was taken on 28 June 2014 in the Tularosa Mountains (MSB 278445). Aside from these records, there is little information on the reproductive cycle of jackrabbits in the Gila; this species is known to fluctuate substantially in numbers between years.

Specimen Examined:

(Catron) MSB 82026-82028, MSB 88976, MSB 231411, MSB 265719 (Grant) MSB 16829-16835, MSB 15820, MSB 18877-18881, MSB 140067 (Sierra) MSB 15068, MSB 268295

Sylvilagus audubonii Baird, 1858

Desert Cottontail

Subspecies: 7, 2 in the Gila

Sylvilagus audubonii warreni Nelson, 1907

Sylvilagus audubonii cedrophilus Nelson 1907

Description

The desert cottontail is largely morphologically indistinguishable from the eastern cottontail, so habitat segregation has been proposed as a means of providing tentative identification. Cottontails found in piñon-juniper, desert grassland, and desert scrubland habitats are *S. audubonii*, while those found in ponderosa pine and mixed conifer forest habitats are usually *S. floridanus* (Hayward, 1972; Findley et al., 1975; Geluso & Geluso, 2004).

Habitat/Elevation:

In Arizona, Hoffmeister (1986) recorded that *S. audubonii* is found in desert scrubland, sometimes venturing into piñon-juniper habitat. We captured them in low elevation riparian habitat, desert grassland, and ponderosa pine forest.

Reproduction:

Hoffmeister (1986) noted that *S. audubonii* has up to 5 litters a year with 1-6 pups per litter. We captured females (n=3) with 3-4 embryos on 4 and 24 June.

Remarks:

Camera data from the Ladder Ranch shows cottontails falling prey to *Bubo virginianus*, *Lynx rufus*, and *Urocyon cinereoargenteus*. The type locality for the subspecies, *S. a. cedrophilus,* is "Cactus Flat, 20 mi. N of Cliff" in Grant County (Nelson 1907). Further comparative work (i.e, ecological, genetic, and behavioral) on the two cottontails of the Gila is needed.

Specimens Examined:

(Catron) MSB 50580-50582, MSB 82046-82047, MSB 82060*, MSB 82062, MSB 89180, MSB 89622-89624* (Grant) MSB 15815-15823, MSB 16031, MSB 16836-16841, MSB 18863-18876, MSB 43499, MSB 82444, MSB 140806, MSB 156768, MSB 157217, MSB 157877 (Sierra) MSB 41566, MSB 64364, MSB 75773

Sylvilagus floridanus Allen, 1890

Eastern Cottontail

Subspecies: 18, 1 in Gila

Sylvilagus floridanus holzneri Mearns, 1896

Description:

See account for *S. audubonii*. Frey (2004) proposed that *Sylvilagus* on the Mogollon Plateau in Catron and Grant counties could be *S. nuttallii*, *S. holzneri,* or *S. cognatus,* and that work needs to be done to determine these complex relationships in the Gila.

Habitat/Elevation:

In Arizona, Hoffmeister (1986) reported that *S. floridanus* is found in mountainous areas. We captured them in ponderosa pine forest.

Reproduction:

Hoffmeister (1986) noted that *S. floridanus* will have fewer litters with more young per litter (5-6), while *S. audubonii* will have up to 5 litters a year but fewer young per litter (1-6).

Specimens Examined:

(Catron) MSB 3157, MSB 82061, MSB 85813, MSB 89673, MSB 198773 (Grant) MSB 96812

Order Artiodactyla

Family Antilocapridae

Antilocapra americana (Ord, 1815)

Pronghorn Antelope

Subspecies: 5, 1 in the Gila

Antilocapra americana mexicana Merriam, 1901

Description:

Pronghorn have two white patches on the rump and forked horns that are present in males and females (Findley et al., 1975).

Habitat/Elevation:

Pronghorn occur primarily in open desert grasslands (Findley et al., 1975). Hayward (1972) reported a herd of about 150 often seen around Gila Center, but otherwise they are most frequently seen in large grassland expanses along the edges of the mountain ranges of the Gila. Pronghorn are often observed at the Ladder Ranch in desert grassland and desert scrubland, on the Deming Plain, near Buckhorn, on the Plains of San Agustin, near Mule Creek, Sacaton Mesa, and Mangas valley (S. O. MacDonald, pers. comm.).

Reproduction:

Pronghorn fawn in July in the Animas Mountains (Cook, 1982) and it is likely the same for the Gila, although data are lacking. Usually 2 fawns are born, about 250 days after mating (Hepworth & Blunt, 1966).

Remarks:

Pronghorn were once rare in New Mexico due to over-exploitation, with numbers estimated at 1200 in 1915 (Findley et al., 1975), but subsequent protection has resulted in their now common occurrence throughout the desert grasslands surrounding the Gila. In 2013, 195 bucks were harvested, and in 2014, 211 bucks and 2 does were harvested (NMDGF, 2015).

Specimens Examined:

(Sierra) MSB 86329, MSB 87751-87753, MSB 88904-88908

Family Bovidae

Ovis canadensis Shaw, 1804

Big-horned Sheep

Subspecies: 6, 1 in the Gila

Ovis canadensis canadensis Shaw, 1804

Ovis canadensis nelsoni Merriam, 1897

Description:

Big-horned sheep have large, curved horns and white rump with a black or brown striped tail (Shackleton, 1985).

Habitat/Elevation:

Records of bighorn sheep in the Gila are few, with one specimen from Glenwood from 1994 (MSB 71699) and 8 from the captive herd at Redrock Wildlife Refuge. Bighorn sheep numbers throughout New Mexico have increased over the past century due to a substantial investment in management. Bailey (1931) stated “it is doubtful if at the present time any sheep occur within the limits of New Mexico except in the Guadalupe Mountains and the San Andres Mountains.” He went on to mention that one bighorn had been reported killed at Whiterock of the Gila in 1907, and a beaver trapper had stated that bighorns were numerous along the San Francisco River in 1825 (Bailey, 1931).

Bighorn sheep prefer rocky cliff and bluffs around both montane and desert grasslands (Shackleton, 1985) and often use this difficult terrain to avoid predators (Bailey, 1931).

Reproduction:

Bighorn sheep breed in the fall and usually have one lamb, although 2 are sometimes born (Shackleton, 1985).

Remarks:

At present there are 3 populations in the Gila: the San Francisco herd, the Turkey Creek herd, and the Redrock herd. The Redrock herd consists of the desert bighorn subspecies (*O. canadensis nelsoni*), while the San Francisco and Turkey Creek herds are introduced Rocky Mountain bighorn (*O. c. canadensis)* (NMDGF, 2015). Bighorn sheep are subject to limited sport hunting, although none has been harvested from these 3 populations since 2012.

Specimens Examined:

(Catron) MSB 71699, MSB 86337 (Grant) MSB 65001-65002, MSB 71711-71717

Family Cervidae

Cervus elaphus Linnaeus, 1758

Elk/Wapiti

Subspecies: 18, 1 in the Gila

Cervus elaphus nelsoni,

Description:

Elk or wapiti are the largest ungulates in the Gila; their antlers have a prominent brow tine, and their rump patch is yellow (Findley et al., 1975).

Habitat/Elevation:

Elk are usually found in ponderosa pine or mixed conifer forest at elevations from 2300 to 3000 m in the Gila (Hayward, 1972) but they are expanding into low elevation grasslands, as they are commonly observed at the Ladder Ranch in the Animas Creek valley at 1500 m, and along the Gila River near Buckhorn, Mangas, and Fort Bayard (S. O. MacDonald, pers. comm.). Elk often graze alongside javelina and mule deer in the cultivated fields at the Ladder Ranch.

Reproduction:

Elk calve in May and June (Findley et al., 1975) and cows are seen with calves at the Ladder Ranch in June and July.

Remarks:

Elk that now occur throughout New Mexico were reintroduced to New Mexico starting in 1910. Native New Mexican elk (*Cervus elaphus merriami*) were extirpated from the Gila by 1900 because of “relentless hunting pressures” (NMDGF) but previously occurred in the Mogollon Mountains in high numbers (Bailey, 1931).

Reintroduction of elk from Colorado and Yellowstone National Park herds (*Cervus elaphus nelsoni*) occurred from 1910 to 1966 throughout New Mexico (NMDGF, 2015) and has resulted in large populations throughout the Gila.

In 2013 in the Gila, 1686 bulls and 1017 cows were harvested, and in 2014, 1133 bulls and 819 cows were harvested (NMDGF, 2015).

Specimens Examined:

None.

Odocoileus hemionus, Rafinesque 1817

Mule Deer

Subspecies: 10, 1 in the Gila

Odocoileus hemionus crooki, Mearns 1897

Description:

Mule deer can be distinguished from white-tailed deer by their antlers (mule deer antlers split at the main beam, while white-tails have all tines branching from one main beam), and by their white rump patch and black-tipped tail (Findley et al., 1975).

Phylogeography and Systematics:

Latch et al. (2009) used mtDNA analyses across 70 North American mule deer populations (no sampling in the Gila, NM populations were from Eddy and Colfax Counties) and recovered 11 haplogroups. Mule deer in the Guadalupe Mountains of southeastern New Mexico are most closely related to deer from west Texas, while populations from southeastern Arizona are distinctive and related to populations associated with the Sonoran Desert (Latch et al., 2009). The Gila may be a region of intergrade between 2 haplogroups and future work should examine this possibility.

Habitat/Elevation:

Mule deer occur broadly across elevations and habitats and are more arid adapted than white-tailed deer (Findley et al., 1975).

Elk and mule deer are often sympatric (see account for *C. elaphus*) and may compete for browse in New Mexico (Sandoval, 2005).

Reproduction:

Cameras on the Ladder Ranch show female mule deer with 1-2 fawns in most fall and winter months (September, November, December, January, and February) and also in July. A male was photographed with 2 young in November.

Remarks:

In 2013, 1376 bucks and 41 does were harvested, and in 2014, 1579 bucks and 56 does were harvested in the Gila, although mule deer and white-tailed deer are not distinguished in those reports (NMDGF, 2015).

Specimens Examined:

(Catron) MSB 85628, MSB 140282 (Grant) MSB 284711 (Sierra) MSB 88909

Odocoileus virginianus Zimmerman, 1780

White-tailed Deer

Subspecies: 38, 1 in the Gila

Odocoileus virginianus couesi

Description:

See account for *O. hemionus*.

Habitat/Elevation:

White-tailed deer are found across a wide range of elevations (760-3050 m) and habitats in southwestern New Mexico, although most are found in oak associated woodlands (1200-1830 m) (NMDGF, 1993).

Findley et al. (1975) reported 7 specimens in the Gila, 5 in Catron County and 2 in Grant County, housed at USNM. There are 3 other museum records within the Gila, one from Eagle Peak (MSB 23) from 1944, one from the Mogollon Mountains (MVZ 29235) from 1917, and one near the San Francisco River (USNM 15040) from 1885. While white-tailed deer populations declined in the middle of the last century, in recent decades their numbers may be increasing along the southern border of the Gila (S.O. MacDonald, pers. comm.).

Reproduction:

Fawns are born from July-September, most in August (NMDGF, 1993).

Remarks:

NMDGF reports two record Boone & Crockett bucks from Grant County (hunted in 1981 and 1988). Other sport hunter kills from Grant County in 2013, Catron County in 2014 are available online (http://www.whitetailslam.com/slam-page/certified/Desert-Whitetail-Coues/P20).

Specimens Examined:

None

Family Tayassuidae

Pecari tajacu Reichenbach, 1835

Javelina/White-collared Peccary

Subspecies: 14, 1 in Gila

Pecari tajacu sonoriensis Mearns, 1897

Description:

Javelina resemble a feral hog, but are smaller, have a distinct white collar around the neck, and have 3 rather than 4 hind toes (Findley et al., 1975).

Habitat/Elevation:

Throughout their range, javelina occur in desert scrubland, piñon-juniper woodland, ponderosa pine forest, and low and mid-elevation riparian areas (Cook, 1982; Albert, 2004). A group of 9 was sighted below Emory Pass (2497 m) in the Black Range in September 2011 (J. A. Cook, pers. comm.), and they are often seen grazing in the cultivated fields of the Ladder Ranch near Animas Creek (1494 m).

Reproduction:

Javelina were observed with young at the Ladder Ranch in the summer months, and camera data from the Ladder Ranch documented adults with young in January, April, May, September, and October.

Remarks:

Bailey (1931) reported that javelina only occurred in the southwest and extreme southeast corner of the state. Hayward (1972) stated that javelina occurrence in the Gila Wilderness in 1972 was hypothetical and based on only a few observations. They are now quite common near Gila and Cliff (S.O. MacDonald, pers. comm.). In 2004, the range of javelina was documented as far north as the Zuni Indian Reservation (Albert et al., 2004) and likely correlates with warming climate (Albert et al., 2004).

In 2013, throughout southern New Mexico, 199 males and 173 females were harvested. In 2014, 158 males and 121 females were harvested (NMDGF, 2015).

Specimens Examined:

(Catron) MSB 25146, MSB 89025, MSB 92564, MSB 142627, MSB 142646, MSB 142903 (Grant) MSB 92715, MSB 267453, WNMU 6373 (Sierra) MSB 247568

Order Rodentia

Family Cricetidae

Baiomys taylori Thomas, 1887

Northern Pygmy Mouse

Subspecies: 7, 1 in the Gila

Baiomys taylori ater Blossom & Burt, 1942

Description:

The northern pygmy mouse is small (length of head and body < 65 mm) and looks similar to the western harvest mouse, but the incisors are not grooved (Findley et al., 1975).

Habitat/Elevation:

The northern pygmy mouse occurs in low and mid-elevation riparian grasslands (Findley et al., 1975). Bailey (1931) did not report the northern pygmy mouse in his survey of New Mexico, and Findley et al. (1975) did not report any records from the Gila. Hayward took one specimen in 2008 near the Grant/Hidalgo border close to Lordsburg (WNMU 6916), and Keith Geluso took 2 specimens from 5.7 km N, 2.1 km E of Gila in June 2014.

Reproduction:

There is one reproductive record from Grant County, a female northern pygmy mouse pregnant with 3 embryos and lactating taken on 22 June 2014. There are also museum records from nearby Hidalgo County of a female pregnant with 3 embryos taken on 3 October, so there are probably multiple reproductive cycles per year. This species is known to periodically experience population eruptions (Cook, 1982; Abuzeineh et al., 2011).

Specimens Examined:

(Grant) MSB 270095-270096, WNMU 6916

Myodes gapperi (Vigors, 1830)

Southern Red-backed Vole

Subspecies: 3, 1 in Gila

Myodes gapperi limitis Bailey 1913

Description:

The southern red-backed vole is a small rodent (116-172 g) with a short, bicolored tail (30-50 mm) and distinctly reddish dorsum (Merritt, 1981).

Habitat/Elevation:

The southern red-backed vole occurs in mesic areas of mixed conifer forests, and in the Mogollon Mountains on the more mesic, north-facing slopes (Findley et.al., 1975). Hayward (1972) caught them in rockslides at Willow Creek in his 1972 survey and noted they are usually captured above 3000 m. Most Gila specimens range from 2700-3285 m.

Reproduction:

Hayward collected lactating red-backed voles in July (WNMU 2351) and September (WNMU 2765, WNMU 3780). Bailey (1931) reported they typically bear 4-6 young per litter.

Remarks:

The isolated Gila population represents the southernmost distribution of the southern red-backed vole. Findley et al. (1975) observed that specimens in the Mogollon Mountains of the Gila are larger and have darker pelage than those found farther north in the Sangre de Cristos and Valles Caldera. The type locality for the subspecies, *M. g. limitis,* is “Willow Creek, 8500 ft., a branch of the Gilita, Mogollon Mountains” in Catron County (Bailey 1913).

Specimens Examined:

(Catron) MSB 6114-6115, MSB 6969-6971, MSB 27136-27137, MSB 157839, WNMU 388, WNMU 2163, WNMU 2350-2351, WNMU 2604, WNMU 2765, WNMU 3777

Microtus longicaudus (Merriam, 1888)

Long-tailed Vole

Subspecies: 17, 1 in Gila

Microtus longicaudus longicaudus, Merriam 1888

Description:

This vole is characterized by a long tail that is more than 1/3 the length of the body (Smolen & Keller, 1987) with the average length in Gila at 54.5 mm (n=36).

Phylogeography and Systematics:

Conroy & Cook (2000) used mtDNA to investigate geographic variation of the long-tailed vole and infer Quaternary biogeographic history. They found that voles in New Mexico fall within the Southern Rockies clade, perhaps reflecting isolation in a southern refugium during the Last Glacial Maximum (Conroy & Cook, 2000). Specimens from the Gila were not included in that study and should be examined given their potential long-term isolation from other southwestern US populations.

Habitat/Elevation:

The long-tailed vole is found in high elevation habitats (> 2400 m) with thick forb cover. Findley et al. (1975) noted that these mesophiles are restricted to relatively wet habitats. We captured long-tailed voles with Mexican voles in montane meadow at Willow Creek, and they have been known to co-occur with *M. montanus* as well (Hoffmeister, 1986).

Reproduction:

We captured female long-tailed voles with 3-5 embryos in September 2014. Hoffmeister (1986) reported they are usually pregnant from April to September in Arizona.

Remarks:

Hoffmeister noted that in Arizona, when *M. longicaudus* is caught with *M. mogollonensis*, the latter is usually more common. We only captured them in sympatry at

Willow Creek, where we found *M. longicaudus* to be more common (*M. longicaudus*, n=23; *M. mogollonensis*, n=10).

Specimens Examined:

(Catron) MSB 2022-2026, MSB 2966, MSB 3151-3152, MSB 6405-6416, MSB 6494-6495, MSB 6961-6967, MSB 23709-23737, MSB 28940-28946, MSB 59927-59929, MSB 78848-78853, MSB 82073, MSB 82102-82104, MSB 82121, MSB 82123-82126, MSB 89668, MSB 91704, MSB 146170, MSB 164109-164114

Microtus mogollonensis Mearns 1890

Mogollon Vole

Subspecies: 12, 1 in Gila

Microtus mogollonensis mogollonensis, Mearns 1890

Description:

The Mogollon vole is distinguished from the long-tailed vole by a shorter tail (average length in the Gila is 31.3 mm, n=28).

Phylogeography and Systematics:

Crawford et al. (2011) investigated populations of the Mexican vole (*M. mexicanus*) in the United States and Mexico, and proposed that U.S. populations are a distinct species, the Mogollon vole (*M. mogollonensis*), based on level of genetic divergence. They also found 2 phylogeographic clades within *M. mogollonensis* based on mtDNA variation. They reported that voles from the Gila are part of the western clade and hypothesized that fluctuating climate during the Pleistocene isolated populations in New Mexico mountain ranges from northern populations.

Habitat/Elevation:

The Mogollon vole is found in grasslands of ponderosa pine and mixed conifer forests (Findley et al., 1975), where I also found them. Hayward (1972) noted that Mogollon voles occur along streams and are often taken with the long-tailed vole, where the Mogollon vole is usually found in denser cover in meadows (Hayward, 1972).

Reproduction:

Pregnant female Mogollon voles were taken most frequently in August and October according to museum records, but the earliest record is 23 May. There are typically 2-3 embryos. Pregnant females were taken at Willow Creek in mid-September and in Aragon in mid-October.

Remarks:

We collected specimens at Willow Creek (n=10) along with long-tailed voles, although in smaller numbers (see *M. longicaudus* account). They were also taken at the Apache Creek Campground (n=9) and along the Mimbres River (n=1).

Specimens Examined:

(Catron) MSB 2964-2965, MSB 3143-3150, MSB 5577-5617, MSB 7573-7583, MSB 14663-14665, MSB 23738-23741, MSB 54666-54671, MSB 59947-59999, MSB 60001-60013, MSB 60048, MSB 78861-78862, MSB 78864-78873, MSB 82037, MSB 82066-82067, MSB 82119-82120, MSB 82136-82142, MSB 82147-82148, MSB 82160, MSB 82174, MSB 82176-82180, MSB 86357, MSB 89071-89077, MSB 89089, MSB 89273, MSB 145973-145974, MSB 146186-146187

Microtus montanus (Peale 1848)

Montane Vole

Subspecies: 18, 1 in the Gila

Microtus montanus arizonensis, Bailey 1898

Description:

The montane vole is brownish-black in color and the tail is > 35 mm in length (Findley et al., 1975).

Habitat/Elevation:

Findley et al. (1975) stated that the montane vole does not occur in the Mogollon Mountains, and Hayward (1972) did not record captures of the montane vole in his survey. Bailey (1931) also did not report that they occur in the Gila, however, there are 2 specimens from 9 km west of Aragon, 7 from Centerfire Bog in Catron County, and 5 from “No specific locality” in Catron County (n=14).

Reproduction:

Data are lacking for the Gila, but Hoffmeister (1986) reported that in Arizona, the montane vole bears 3-5 embryos per litter (average 4.4). Museum records show that young are born in March, May, June, and August in other parts of New Mexico.

Remarks:

The subspecies that occurs in the Gila was listed as "Endangered" by NMDGF in 1979. The threat is listed in terms of pressures on an already small, isolated population that is put in further danger by anthropogenic activities (grazing, water diversion, and wetland conversion) as well as potential for diminished habitat with climate change (NMDGF, 2014). The montane vole is listed as "Least Concern" by the IUCN red list. There are 11 records from Catron County (2 localities) before 1994, and 15 from Catron County (5 localities) from 1994-2008 (note: 9 records are in the Apache National Forest of Catron County), which may indicate that the montane vole's range is greater than when assessed in 1979, or has expanded. Further work on the status and distribution of the montane vole in the Gila is needed.

Specimens Examined:

(Catron) MSB 60026, MSB 60028-60033, MSB 164728-164729, MSB 240401-240405

Neotoma albigula Hartley, 1894

White-throated Woodrat

Subspecies: 15, 1 in the Gila

Neotoma albigula albigula Hartley, 1894

Description:

White-throated woodrats are one of 4 species of woodrat found in the Gila and are distinguished by their brown pelage and throat hairs that are white to the base (Findley et al., 1975).

Phylogeography and Systematics:

Edwards et al. (2001) used mtDNA to investigate the phylogeographic structure among subspecies of *N. albigula*. They found 2 clades, east and west of the Rio Grande, which correspond to boundaries of *N. a. albigula* (west) and *N. a. leucodon* (east), which they then proposed be recognized as different species (Edwards et al., 2001).

We analyzed mtDNA (cytochrome b) variation of *N. albigula* in the Gila to place these specimens into a phylogeographic context across the Southwest, and to examine the geographic division proposed by Edwards et al (2001). We found evidence of 2 major clades within *Neotoma albigula* that appear to be in contact in the Gila. An eastern clade includes specimens from Texas and the counties of McKinley, Socorro, Otero, and the northern end of Sierra in New Mexico, and a western clade includes all specimens from Arizona, Chihuahua, and from the southern end of Sierra County (Figure 13). *Neotoma leucodon* also meets these two clades of *N. albigula* in this region. Bradley & Mauldin (2016) produced a *Neotoma* tree from cytochrome b data that placed New Mexico *Neotoma albigula* samples (Otero and McKinley Counties) in a separate clade from all other *Neotoma albigula* and postulated that these may be a new species, based on genetic divergence of 6.18%. In our study, these specimens grouped most closely with specimens from northern Sierra County and Socorro County; these specimens should be included in any further phylogenetic analyses.

We found one specimen previously described as *N. albigula* to actually be *N. leucodon*, on the west side of the Rio Grande at Hillsboro (MSB 157277), which indicates that the Rio Grande is not the barrier between *N. albigula* and *N. leucodon*. Further investigation of phylogeography of *N. albigula* with additional fine-scale sampling and loci from the Gila should refine the dynamics of this structure and potential contact.

Habitat/Elevation:

Neotoma albigula were captured in the Gila from 1188 m to 2834 m. We typically found them near talus areas where prickly pear cactus is abundant. At higher elevations (> 2100 m) they are often sympatric with *Neotoma mexicana* (Findley et al.1975; Cook 1982). We found these species sympatric at one locality, 6 km N of Silver City below Gomez Peak (ca. 2000 m), although most of those specimens were *N. albigula* (n=20) and only 2 were *N. mexicana* (n=2). Hayward (1972) stated that in the Gila, white-throated woodrats are usually replaced by the Mexican woodrat at elevations over 2100 m. We found this to be the case at all localities with ponderosa pine or mixed conifer forest (Alexander Peak, Black Canyon, Cooney Canyon, Corduroy Canyon, Eagle Peak, Willow Creek).

Reproduction:

Hayward collected a pregnant female white-throated woodrat on 27 January in 1986 (WNMU 5724), and our earliest capture of a pregnant female was 8 February 2014 (MSB 268464). Other than these early records, pregnant females have been found in March, May, June, and September, likely indicating multiple litters per year. They have 1-2 young per litter.

Remarks:

Many specimens of white-throated woodrats were found with botfly (*Cuterebra americana)* larvae under the skin in the 2012-2014 survey, usually on the ventral side of the throat. February represents the earliest time of year white-throated woodrats were found with botfly larvae.

Specimens Examined:

(Catron) MSB 145969-145970, MSB 146005, MSB 146229, MSB 165671, MSB 199608, MSB 199633-199634, MSB 199685 (Grant) MSB 4248, MSB 24224, MSB 76241, MSB 82614, MSB 140082, MSB 140154, MSB 140588, MSB 140597-140600, MSB 140602, MSB 140606, MSB 140627, MSB 140630, MSB 140643, MSB 140645, MSB 140654, MSB 140882-140884, MSB 157216, MSB 157219, MSB 157222, MSB 157225-157226, MSB 157230, MSB 157287, MSB 157317, MSB 157319, MSB 165713-165717, MSB 196225, 566MSB 214980, MSB 262607, MSB 262639, MSB 262648, MSB 262673, MSB 262688, MSB 262698, MSB 262709, MSB 262714, MSB 265850

Neotoma mexicana Baird 1855

Mexican Woodrat

Subspecies: 26, 1 in the Gila

Neotoma mexicana pinetorum, Merriam 1893

Description:

Mexican woodrats differ from *N. albigula* by throat hairs that are gray basally, not white. *Neotoma mexicana* are also found at higher elevations in the Gila than *N. albigula*.

Phylogeography and Systematics:

Edwards & Bradley (2002) investigated phylogeographic relationships of Mexican woodrats in the southwest U.S. and Mexico using mtDNA from 6 subspecies. They found evidence for 4 clades, with all *N. mexicana* in the U.S. forming one clade that is sister to the clade from northern Mexico (Edwards & Bradley, 2002). While samples from the Gila were not included in their studies, the authors did include 5 samples from nearby Socorro County (Edwards & Bradley, 2002).

Habitat/Elevation:

Hayward (1972) recorded that *N. mexicana* is usually found on hillsides, while *N. albigula* occurs in nearby valleys. Findley et al. (1975) reported that Mexican woodrats, when found with white-throated woodrats, occur in more mesic areas among boulders, while white-throated woodrats occur in arid areas. In the Gila, Mexican woodrats are most commonly found from 2100-3000 m in ponderosa pine forest and occasionally in mixed conifer forest. At Willow Creek, in an ecotone of ponderosa pine and mixed conifer forest, all *N. mexicana* recorded were in the ponderosa pine forest (n=58).

Reproduction:

Pregnant Mexican woodrats were collected from April to July with 2-3 young per litter.

Specimens Examined:

(Catron) MSB 2968, MSB 6972, MSB 7549-7559, MSB 16063, MSB 61290-61299, MSB 61301-61302, MSB 82031-82036, MSB 82065, MSB 82096, MSB 82110, MSB 82159, MSB 85720-85721, MSB 86360-86361, MSB 89271, MSB 89519-89520, MSB 89522-89524, MSB 91705, MSB 91712-91723, MSB 92589, MSB 125017, MSB 145979, MSB 145981, MSB 145983, MSB 146051, MSB 146227, MSB 146233, MSB 166202-166203, MSB 262282 (Grant) MSB 6948-6949, MSB 140642, MSB 156733, MSB 268317 (Sierra) MSB 2579, MSB 6911-6912, MSB 61303-61304, MSB 61306-61309

Neotoma micropus Baird, 1855

Southern Plains Woodrat

Subspecies: 5, 1 from Gila

Neotoma micropus canescens Allen, 1891

Description:

The southern plains woodrat has a distinctly silvery pelage, while the white-throated woodrat is brown, and lacks the gray throat hairs of the Mexican woodrat (Findley et al., 1975).

Habitat/Elevation:

Bailey (1931) stated that E. A. Goldman recovered one southern plains woodrat specimen along the Mimbres River, but the white-throated woodrat was much more common at that locality. Hayward captured 11 specimens in and around Silver City from 1961-1969 in desert scrub habitat, often among prickly pear cactus. Six specimens were collected 14 miles (21 km) south of Silver City in a 1937 survey conducted by P. A. Stewart and E. O. Mellinger (AMNH 127125-127130). The southern plains woodrat is known to prefer desert grassland habitat and sides of arroyos around shrubs, in habitat that is not talus (Findley et al., 1975).

Reproduction:

Hayward captured a female with 2 embryos on 23 September between Silver City and Tyrone (WNMU 1336) and a lactating female with 2 young on 10 October about 21 km SW of Silver City (WNMU 1081).

Specimens Examined:

(Grant) AMNH 127125-127130, WNMU 588, WNMU 1078-1087, WNMU 1336

Neotoma stephensi Goldman, 1905

Stephen's Woodrat

Subspecies: 1, 1 in the Gila

Neotoma stephensi stephensi Goldman, 1905

Description:

Stephen's woodrats are similar to white-throated woodrats in coloration, but their tails have noticeably longer hairs (Findley et al., 1975).

Habitat/Elevation:

Stephen's woodrats have been recorded in the Gila from 1280 to 1920 m. We collected one in piñon-juniper habitat 7 km N of Silver City (MSB 284741), and Hayward collected 17 specimens 4 km NW of Fort Bayard, and I examined a specimen from 1937 captured in Whitewater Canyon near Glenwood (AMNH 127121). Findley et al. (1975) noted that Stephen's woodrats are found in rocky areas but are not as dependent on rocks as white-throated woodrats, and they often construct middens under junipers. Hayward (1972) did not find Stephen's woodrat in his survey of the Gila Wilderness.

Reproduction:

Records indicate that female Stephen's woodrats are lactating as early as March (WNMU 1065) and as late as September (WNMU 3969). One pregnant female (with a single embryo) was taken at 4 km NW of Fort Bayard on 14 September (WNMU 4391).

Specimens Examined:

(Catron) MSB 56645, MSB 56655, MSB 76242 (Grant) MSB 26887, MSB 196451, MSB 166521-166522, MSB 262660, AMNH127121

Ondatra zibethicus (Linnaeus, 1776)

Muskrat

Subspecies: 22, 1 in the Gila

Ondatra zibethicus pallidus Mearns, 1890

Description:

The muskrat looks like a large vole, and has a distinctly laterally compressed tail for swimming (Findley et al., 1975).

Habitat/Elevation:

There are few muskrat specimens from the Gila. Bailey (1931) stated that 3 broken skulls (status unknown) were recovered from a bone cave near Reserve. Hayward observed muskrats below the mouth of the Mogollon Creek and William Rogers saw one at the mouth of the Middle Fork of the Gila River (Hayward, 1972).

Reproduction:

Muskrats make a breeding den of cattails and other plants (Hoffmeister, 1986) to raise litters of 4-8 (Schacher & Pelton, 1975). In southern latitudes, they breed throughout the year and usually have 3 litters annually (O'Neil, 1949).

Remarks:

Hayward (1972) speculated that the muskrat's scarcity may be due to a lack of cattails in the Gila drainages, as these habitats are now scarce in the Gila, and which the muskrat uses as a main source of forage and cover. With new federal grazing regulations on the Gila National Forest that aim to keep cattle from riparian areas, this species may increase its abundance and distribution.

Specimens Examined:

(Catron) MSB 60473, MSB 61613 (Grant) MSB 145922

Onychomys arenicola (Mearns, 1896)

Mearn's Grasshopper Mouse

Subspecies: None

Description:

Grasshopper mice are stocky mice with short, thick tails (McCarty, 1978). Mearn's grasshopper mice look similar to southern grasshopper mice, but are smaller overall.

Phylogeography and Systematics:

Riddle (1995) used mtDNA to determine that *O. arenicola* and *O. leucogaster* form one clade that is sister to *O. torridus* (Riddle, 1995).

Habitat/Elevation:

Mearn's grasshopper mice generally occur at low to mid-elevations (1200-1700 m).

Reproduction:

Reproductive data are lacking for the Gila, but Cook (1982) captured pregnant female Mearn's grasshopper mice on 25 May, and 5 & 6 June in the nearby Animas Mountains. Geluso & Geluso (2004) captured pregnant females on 11 March and 15 May and lactating females on 15 May and 8 August in the Guadalupe Mountains. Both publications reported 2-5 embryos per litter.

Specimens Examined:

(Catron) MSB 199719 (Catron) MSB 56644, MSB 60466 (Sierra) MSB 5641, MSB 66223, MSB 267131

Onychomys leucogaster (Wied-Neuwied, 1841)

Northern Grasshopper Mouse

Subspecies: 13, 1 in the Gila

Onychomys leucogaster ruidosae Stone & Rehn, 1903

Descriptions:

The northern grasshopper mouse is the largest of the 3 species of grasshopper mouse that occur in the Gila and has a short, fat tail that is often white-tipped (McCarty, 1978).

Phylogeography and Systematics:

See account for *O. arenicola.*

Habitat/Elevation

Northern grasshopper mice are found in sandy, desert grasslands and are often collected with Ord's kangaroo rat (Findley et al., 1975). Because they are found at lower elevations (~1500 m), Hayward (1972) did not capture them in his 1972 survey of the Gila Wilderness, but it is puzzling that we also did not capture them in the 2012-2014 survey.

Reproduction:

There are museum records of female northern grasshopper mice with embryos taken in the Gila in March, June, and October, with 3 to 5 embryos.

Remarks:

Onychomys leucogaster has been implicated in spread of plague, *Yersinia pestis* (Thomas, 1988; Stapp et al., 2008). Thomas (1988) reviewed relevant literature and found that fleas collected from *O. leucogaster* across the western U.S. were known to be host-specific to other rodents and lagomorphs, and 26 of these flea species were known vectors of plague. Stapp et al. (2008) collected blood from small rodents captured in and around a prairie dog town (*C. ludovicianus*) before, during, and up to 2 years after a plague outbreak. These researchers found that *O. leucogaster* was the only small rodent (of 4 species) that was consistently positive for *Y. pestis* antibodies, which always occurred simultaneously with prairie dog mortality (Stapp et al., 2008). Kraft & Stapp (2013) researched use of *Cynomys ludovicianus* burrows by *O. leucogaster* in Colorado, and found that *O. leucogaster* will use burrows of many different colonies, and thus have very high flea burdens (8.1 fleas per mouse, 7 species of fleas) and increased rates of *Y. pestis* transmission.

During the 2012-2014 survey, we collected ectoparasites from most sites for future analysis of host/parasite dynamics.

Specimens Examined:

(Catron) MSB 269, MSB 92575, MSB 166959 (Grant) MSB 5810 (Sierra) MSB 8028-8032, MSB 12300-12311, MSB 12395-12415, MSB 29888-29889, MSB 66120, MSB 76184, MSB 263629

Onychomys torridus (Coues, 1874)

Southern Grasshopper Mouse

Subspecies: 9, 1 in the Gila

Onychomys torridus torridus Coues, 1874

Description:

Southern grasshopper mice are smaller and have a longer and thinner tail than northern grasshopper mice (McCarty, 1975). Where the 2 species are sympatric, *O. torridus* inhabits lower elevations than *O. leucogaster* (Gennaro, 1968).

Phylogeography and Systematics:

See account for *O. arenicola.*

Habitat/Elevation:

In the Gila, southern grasshopper mice typically occur from 1500-1900 m. For his 1972 survey, Hayward (1972) reported capturing them only on TJ Mesa (near the Gila Cliff Dwellings) at about 1800 m. He also captured them around Hanna Mountain, the

Burro Mountains, and around Silver City and Fort Bayard before and after his 1972 survey. In the 2012-2014 survey, northern grasshopper mice were taken at the Ladder Ranch in relatively high numbers in the "Pasture", a mesa east of ranch headquarters along the main road above Animas Creek, and on a mesa close to Cuchillo Creek. Those sites are desert grassland habitats at 1560 and 1594 m, respectively.

Reproduction:

Museum records indicate pregnant female southern grasshopper mice were found in June and October in the Gila, usually with 3 embryos, although up to 6 embryos were recorded (WNMU 1458).

Remarks:

Grasshopper mice are carnivorous, eating other rodents, lizards, and arthropods (Chew, 1965). At localities where we captured grasshopper mice, other rodent captures in snap traps were often partially consumed, probably by grasshopper mice.

Specimens Examined:

(Grant) MSB 4241-4242, MSB 167652-167658

Peromyscus boylii (Baird, 1855)

Brush Mouse

Subspecies: 4, 1 in the Gila

Peromyscus boylii rowleyi Allen, 1893

Description:

Brush mice are distinguished by a long tail (average in the Gila is 97.4 mm, n=394) that is tipped with brushy hairs and a dusky patch that fully covers the ankle; its ears are smaller than those of the piñon mouse and the northern rock mouse, and the tail is longer and less bicolored than the deer mouse (Kalcounis-Rueppell & Spoon, 2008).

Habitat/Elevation:

The brush mouse occurs in the Gila from 1188 to 2400 m, although they are most frequently encountered between 1400 and 2000 m. Brush mice were captured in desert grassland, desert scrub, piñon-juniper woodland, and ponderosa pine forest. Hayward

(1972) stated that brush mice are mostly found in piñon-juniper woodland in the Gila Wilderness, usually below 2100 m.

Reproduction:

Brush mice typically have 3-4 embryos per litter and pregnant females were captured as early as 12 March and as late as 26 November, but usually in July, August and September.

Remarks:

Brush mice were the most frequently captured small mammal (324 specimens) during the study of 2012-2014.

Specimens Examined:

(Catron) MSB 6973, MSB 16066-16069, MSB 16072, MSB 23871, MSB 26880-26886, MSB 66881, MSB 66882-66891, MSB 82074-82092, MSB 89275, MSB 89478, MSB 89489-89492, MSB 89498-89499, MSB 89667, MSB 146209-146210, MSB 169350, MSB 169353-169370-169372, (Grant) MSB 6950-6952, MSB 56572-56578, MSB 63019, MSB 63021, MSB 64787-64789, MSB 66829-66830, MSB 66901, MSB 76243-764246, MSB 82449, MSB 89163, MSB 124881, MSB 169417-169483, MSB 262646, MSB 262650-262652, MSB 262654, MSB 262656, MSB 264866-264867, MSB 264869, MSB 264872, MSB 264880, MSB 264883-264894, MSB 264897-264898, MSB 264930-264940, MSB 268311 (Sierra) MSB 1191, MSB 1193, MSB 6917-6918, MSB 41693, MSB 42462-42463, MSB 49828, MSB 53057-53058, MSB 269127

Peromyscus eremicus (Baird, 1857)

Cactus Mouse

Subspecies: 14, 2 in the Gila

Peromyscus eremicus anthonyi (Merriam, 1887)

Peromyscus eremicus eremicus (Baird, 1858)

Description:

Cactus mice are pale yellow laterally and similar in appearance to brush mice (*P. boylii),* but the tail is almost naked and lacks the tuft at the end (Findley et al., 1975).

Phylogeography and Systematics:

Riddle et al. (2000) used mtDNA to elucidate phylogeographic relationships of 26 populations of the cactus mouse in the Southwest and found 3 reciprocally monophyletic clades. Cactus mice in New Mexico (Gila was not sampled, closest sampling was from Dona Ana County) were in the "western" clade, which spans Arizona, New Mexico, and northern Mexico.

Habitat/Elevation:

Findley et al. (1975) found the cactus mouse most commonly on south-facing slopes that are often covered with prickly pear cactus in the Gila, which was also the case for the 2012-2014 survey. Cactus mice were also found in rocky areas with mesquite. Similarly, Geluso & Geluso (2004) reported that temperature regimes on mountain slopes may account for differences in abundances of this species in the Guadalupe Mountains and the same may hold true for the mountain ranges of the Gila, where cactus mice are found between 1400-1700 m.

Reproduction:

Pregnant cactus mice were recorded as early as January in the Gila and as late as October, indicating more than one litter per year. They usually carry 3 embryos but as many as 8 have been documented in museum records.

Specimens Examined:

(Grant) MSB 4208-4209, MSB 56584, MSB 56586-56589, MSB 60599-60603

Peromyscus gratus Merriam, 1898

Osgood's Mouse

Subspecies: 4, 1 in the Gila

Peromyscus gratus

Description:

Osgood's mouse is differentiated from the morphologically similar piñon mouse only by genetics and karyotype (Ceballos, 2014).

Habitat/Elevation:

Osgood's mouse is saxicolous, occurring near rocky areas with little cover (Ceballos, 2014). There are only two specimens from the Gila (from Elk Mountains) that were identified using mtDNA. Osgood's mouse is probably more common in the Gila, but difficulty in identifying them morphologically has masked their presence and further study of this taxon in the Gila is clearly warranted.

Reproduction:

Data from the Gila and indeed, all of New Mexico, are lacking, but in Mexico, Osgood's mouse reproduces from May to December with an average of 3 embryos per litter (Ceballos, 2014).

Specimens Examined:

(Catron) MSB 89509, MSB 89512

Peromyscus leucopus (Rafinesque, 1818)

White-footed Mouse

Subspecies: 17, 1 in the Gila

Peromyscus leucopus tornillo Mearns, 1896

Description:

The white-footed mouse may be confused with the deer mouse (*P. maniculatus*), with which it shares a tail that is about the length of the head and body, but it is less sharply bicolored than that of the deer mouse (Lackey et al., 1985). The hind foot measurement is also somewhat larger in the white-footed mouse (>22 mm, while the deer mouse is < 22 mm).

Habitat/Elevation:

Hayward (1972) reported capturing a few specimens along the West Fork of the Gila River and stated that these were unusual records for that elevation and habitat. Most white-footed mice in the Gila were found in desert grassland and desert scrub, but we captured 9 in ponderosa pine forest of the Mogollon Mountains and 2 in ponderosa pine forest of the Black Range.

Reproduction:

Pregnant female white-footed mice were taken in March, June, and October, with 3-5 embryos.

Specimens Examined:

(Catron) MSB 89374, MSB 89485-89485, MSB 89510-89511, MSB 89513
(Grant) MSB 56590-56598, MSB 56599, MSB 56600, MSB 56601, MSB 56605-56621, MSB 56223, MSB 56627-56643, MSB 64871, MSB 64897, MSB 172534-172540, MSB 264873, MSB 268318

Peromyscus maniculatus (Wagner, 1845)

Deer Mouse

Subspecies: 71, 2 in the range

Peromyscus maniculatus rufinus Merriam, 1890

Peromyscus maniculatus blandus Osgood, 1904

Description:

See account for *P. leucopus*.

Phylogeography and Systematics:

Dragoo et al. (2006) sequenced mtDNA from the North American range of the deer mouse and included many samples from New Mexico (only 2 in the Gila). They found 6 lineages of deer mice across their range, with a possible hybrid zone in the Gila (Dragoo et al., 2006), with *P. maniculatus* near the Gila (Hidalgo) grouping with the SW New Mexico clade while those from Socorro Co. grouped with the Rocky mountain clade (Dragoo et al., 2006), and the Burro Mountains are a likely area for contact between these distinctive clades.

Habitat/Elevation:

The deer mouse is the most widespread mouse in North America (Kays and Wilson, 2002). Findley et al. (1975) reported that deer mice are most common in high elevation habitats and Hayward's account (1972) agrees with that. We captured highest numbers of deer mice in ponderosa pine and mixed conifer habitat, but also some in desert scrub and piñon-juniper habitats (1500-1821 m).

Reproduction:

Female deer mice typically bear 3-5 embryos, with records as early as February and as late as November.

Remarks:

Hayward (1972) found that *P. maniculatus* is sympatric with *P. boylii* in areas with dense brush and with *P. leucopus* in open areas in the Gila. Hayward (1972) usually captured more males than females on the first night of trapping and posited that males are wandering over larger areas than females.

Specimens Examined:

(Catron) MSB 286, MSB 2967, MSB 6974-6978, MSB 7545, MSB 9223-9231, MSB 9772-9773, MSB 15707, MSB 23810-23829, MSB 23848-23870, MSB 23872-23874, MSB 23876-23885, MSB 28947-28948, MSB 60319-60331, MSB 60349, MSB 82044, MSB 82068-82072, MSB 82082, MSB 82105, MSB 82112-82113, MSB 82114-82118, MSB 82143-82146, MSB 82149-82154, MSB 82181-82183, MSB 86358-86359, MSB 87744-87746, MSB 89387-89388, MSB 89477, MSB 89483, MSB 89500, MSB 89503-89507, MSB 89666, MSB 91702-91703, MSB 91718-91721, MSB 92576, MSB 92579, MSB 92581-92588, MSB 92590, MSB 92600, MSB 92617, MSB 92675, MSB 125096, MSB 140093, MSB 141128, MSB 141897, MSB 175249-175250, MSB 175251, MSB 175252, MSB 262506, MSB 262518, MSB 262555, MSB 265765 (Grant) MSB 4212-4213, MSB 5745-5746, MSB 5820-5821, MSB 6953-6954, MSB 9305, MSB 56622, MSB 56224-56626, MSB 56604, MSB 60594-60595, MSB 64825-64826, MSB 76247, MSB 175335, MSB 264865, MSB 268302, MSB 268312, MSB 268315 (Sierra) MSB 6915-6916, MSB 76183, MSB 13652, MSB 13663, MSB 13711, MSB 41560, MSB 42466-42467, MSB 53059

Peromyscus nasutus (J.A. Allen, 1891)

Northern Rock Mouse

Subspecies: 2, 1 in the Gila

Peromyscus nasutus nasutus J.A. Allen, 1891

Description:

The northern rock mouse's ear size is intermediate between *P. boylii* (~20 mm) and *P. truei* (~24 mm) (Findley et al., 1975). All 3 species were captured in Black Canyon in June 2014.

Habitat/Elevation:

In the Gila, the northern rock mouse is found in ponderosa pine and mixed conifer forests. Findley et al. (1975) reported that they are often found near large boulders. This was the least frequently captured *Peromyscus* in the 2012-2014 study. Hayward (1972) did not capture them in his 1972 survey of the Gila Wilderness.

Reproduction:

Two pregnant female northern rock mice were captured on 20 May and 24 June, each with 3 embryos (MSB 278361, MSB 279257).

Specimens Examined:

(Catron) MSB 23875 (Grant) MSB 56579-56580, MSB 56581-56583, MSB 61009-61011, MSB 63020, MSB 66892-66900 (Sierra) MSB 63055-63057

Peromyscus truei (Shufeldt, 1885)

Piñon Mouse

Subspecies: 13, 1 in Gila

Peromyscus truei truei Shufeldt, 1885

Description:

The piñon mouse is easily recognized by very large ears (≥ 24mm), of length equal to or greater than the hind foot (Hoffmeister, 1981).

Habitat/Elevation:

The piñon mouse is a high elevation mouse, found usually between 1700-2500 m in ponderosa pine and mixed conifer forest in the Gila. Findley et al. (1975) reported it was the commonest mammal in piñon-juniper forests throughout New Mexico. Hayward (1972) noted that the piñon mouse is quite uncommon in the Gila Wilderness, where it appears to rely primarily on oak associations. We captured them in ponderosa pine forest and also found that they were more numerous when ponderosa was mixed with oak (10 km E Cliff, Black Canyon, Cooney Canyon, Corduroy Canyon).

Reproduction:

The earliest record of a pregnant piñon mouse is 6 March with 4 embryos (CR=3 mm) (WNMU 961). All other Gila records of pregnant females are in May, June, September, and October, and lactating females in June, July, and September.

Specimens Examined:

(Catron) MSB 7539-7548, MSB 9232-9235, MSB 11513, MSB 16071, MSB 91717, MSB 146208, MSB 146213, MSB 146238, MSB 177556-177559, MSB 262515, MSB 262553, MSB 262556 (Grant) MSB 60455, MSB 177593-177596, MSB 177597-177598, MSB 177601, MSB 264868, MSB 264870, MSB 264874-264875, MSB 264877, MSB 264879, MSB 264881-2648872, MSB 264899, MSB 263929 (Sierra) MSB 1992, MSB 6919

Reithrodontomys megalotis (Baird, 1857)

Western Harvest Mouse

Subspecies: 23, 2 in the Gila

Reithrodontomys megalotis aztecus (Allen, 1893)

Reithrodontomys megalotis megalotis (Baird, 1858)

Description:

The incisors of the western harvest mouse have a vertical groove that distinguishes them from *Peromyscus* species (Findley et al., 1975).

Habitat/Elevation:

We captured the western harvest mouse in mixed conifer forest, ponderosa pine forest, piñon-juniper forest, and desert scrub, usually close to riparian habitat. Hayward (1972) characterized western harvest mice as a grassland species, and collected them at Gilita Creek and Middle White Creek, the latter of which he found puzzling due to that area's lack of grass. Most of Hayward's captures came from meadows in ponderosa pine forest.

Reproduction:

Pregnant western harvest mice have been captured as late as October and as early as January and there are likely several reproductive cycles throughout the year. The number of embryos is usually 3-4, but as many as 7 and as few as 1 have been noted in museum records.

Remarks: The curious distribution in New Mexico of *Reithrodontomys montanus*, south of the Gila in Hidalgo County and to the northwest in Socorro County, but no records from the Gila, suggests that all harvest mice should be carefully diagnosed. A thorough investigation of the distribution and status of these two species (*R. megalotis* and *montanus*), as well as the more southerly distributed species, *R. fulvescens*, in southwestern New Mexico is critically needed.

Specimens Examined:

(Catron) MSB 179463-179465 (Grant) MSB 179551-179557

Sigmodon fulviventer J.A. Allen, 1889

Tawny-bellied Cotton Rat

Subspecies: 5, 1 in the Gila

Sigmodon fulviventer minima Mearns, 1894

Description:

The tawny-bellied cotton rat is discerned from other cotton rats by its large size (206-222 g) and its buffy, cream-colored belly (Baker & Shump, Jr., 1978).

Habitat/Elevation:

The tawny-bellied cotton rat prefers dense grass in low to mid elevations (Mohlhenrich, 1961; Cook, 1982).

I examined historic specimens (1906, 1908-1909) of the tawny-bellied cotton rat housed at USNM from Silver City, 1.5 mi west of Mimbres, and from Las Palomas Creek. Bailey (1931) reported a colony near Silver City in a "weedy field." Specimens were also plentiful in the 1950s and 1960s throughout the Gila. These historic specimens show that tawny-bellied cotton rats were once common in the Gila, but seem to have decreased over time. Findley et al. (1975) speculated that tawny-bellied cotton rats were being outcompeted throughout southwest New Mexico by the hispid cotton rat, which shares a similar range and habitat preference. Hayward (1972) did not report the tawny-bellied cotton rat in his survey of the Gila Wilderness and we did not capture them.

Reproduction:

Museum records show female tawny-bellied cotton rats with 2-3 embryos in early May.

Specimens Examined:

(Grant) MSB 5742, MSB 5767-5777, MSB 5802-5809, MSB 5817-5819, MSB 5822-5834 (Sierra) MSB 5637-5640, MSB 5642-5649, MSB 5652-5654, MSB 5656-5659, MSB 5664, MSB 5666

Sigmodon hispidus Say & Ord, 1825

Hispid Cotton Rat

Subspecies: 14, 1 in the Gila

Sigmodon hispidus berlandieri Baird, 1855

Description:

Hispid cotton rats lack the orange snout of the yellow-nosed cotton rat and the buff-colored belly of the tawny-bellied cotton rat (Findley et al., 1975), although coloration varies with soil coloration in New Mexico (Gennaro, 1968).

Phylogeography and Systematics:

Bradley et al. (2008) updated work by Carroll et al. (2005) on phylogeographic relationships within the *S. hispidus* complex, a paraphyletic group composed of 3 species (*S. hirsutus, S. toltecus*, and *S. hispidus).* Bradley et al. (2008) found evidence of 2 subclades within the *S. hispidus* species, east and west, with specimens from Mexico, Arizona, New Mexico, Kansas, Oklahoma, Missouri, and west Texas to the west, and specimens from east Texas, Louisiana, Florida, and Tennessee to the east. Specimens from New Mexico group with the west subclade (Bradley et al., 2008).

Habitat/Elevation:

Hispid cotton rats are restricted to grasslands in New Mexico (Findley et al., 1975) at low elevations (1400-1500 m), and Hayward (1972) did not encounter them in his 1972 survey of the Gila Wilderness. Hispid cotton rats collected in the 2012-2014 study were captured in lush grass beneath sycamore/cottonwood riparian areas at the Ladder Ranch, and they were abundant in grass along the Gila River near Gila/Cliff in 2015 (S.O. MacDonald, pers. comm.).

Reproduction:

Pregnant female hispid cotton rats (with 3-4 embryos) were usually taken in spring (March and April), although museum records document pregnancy as late as

October and as early as February are known, likely indicating that the species breeds multiple times a year.

Remarks:

Geluso's capture (2009) on the southwest side of the Mogollon Mountains represents a northern distributional record in New Mexico and may indicate a range shift.

Specimens Examined:

(Grant) MSB 5778-5781, MSB 56659-56665, MSB 125023, MSB 263890, MSB 268405-268406

Sigmodon ochrognathus Bailey, 1902

Yellow-nosed Cotton Rat

Subspecies: None

Description:

The yellow-nosed cotton rat has an orange colored snout and is smaller (130-133 g) than *S. fulviventer* and *S. hispidus* (Baker & Shump, Jr., 1978).

Habitat/Elevation:

Bailey (1931) did not report the yellow-nosed cotton rat in his survey of New Mexico and Findley et al. (1975) did not record their occurrence in the Gila. There are 4 specimens from the Big Burro Mountains and Middle Box of the Gila River at elevations from 1350 to 1980 m, as well as 2 that we added from north of Silver City. In other parts of New Mexico, the yellow-nosed cotton rat prefers desert scrub and desert grassland habitat (Findley et al., 1975). These recent Gila records constitute a northern range extension of > 100 km for this species in New Mexico.

Reproduction:

We captured a female yellow-nosed cotton rat with 4 embryos just north of Silver City at the base of Gomez Peak on 28 September (MSB 284736), which is the first reproductive record from the Gila.

Specimens Examined:

(Grant) MSB 124219, MSB 124221, MSB 125022, MSB 181030, MSB 284736

Family Heteromyidae

Chaetodipus baileyi (Merriam, 1894)

Bailey's Pocket Mouse

Subspecies: 8, 1 in the Gila

Chaetodipus baileyi baileyi Merriam, 1894

Description:

Bailey's pocket mouse is large (head and body length > 95 mm, tail longer than head and body), and its tail is tufted (Findley et al., 1975).

Phylogeography and Systematics:

Riddle et al. (2000) used mtDNA to show that *C. baileyi* is composed of 3 clades: east, northern west, and southern west (Riddle et al., 2000). The oldest of these clades fragmented east and west of the Colorado River, with New Mexico in the east clade (although no specimens from the Gila were included in that study) and populations west of the Colorado River in the west clade (Riddle et al., 2000).

Habitat/Elevation:

Bailey's pocket mouse occurs in desert grasslands and desert scrub similar to the rock pocket mouse, but prefers sandy valleys while the rock pocket mouse prefers talus areas (Bailey, 1931). Findley et al. (1975) recorded that Bailey's pocket mouse only occurs in New Mexico in the Peloncillo Mountains, but Hayward captured one on 13 May 1972 at Ash Creek, just SW of Cliff (WNMU 2502). Since then, many specimens have been collected at elevations of 1188-1539 m along the southern edges of the Gila in Grant County, mostly near Redrock, Silver City, and Cliff. Bailey's pocket mouse may have been present but undetected in Grant County prior to Findley et al. (1975).

Reproduction:

A female Bailey's pocket mouse was captured on 8 April with 4 embryos (MSB 124225).

Specimens Examined:

(Grant) MSB 124222, MSB 124225, WNMU 2502

Chaetodipus hispidus (Baird, 1858)

Hispid Pocket Mouse

Subspecies: 4, 1 in the Gila

Chaetodipus hispidus paradoxus Merriam, 1889

Description:

The hispid pocket mouse is similar in size to Bailey's pocket mouse, but lacks the tufted tail; it is larger than the rock pocket mouse and the desert pocket mouse (Paulson, 1988).

Phylogeography and Systematics:

Andersen & Light (2012) used mtDNA to identify 4 clades within the hispid pocket mouse, likely corresponding to isolation during the pluvial/interpluvial periods of the Pleistocene. The Deming Plains represents a division between the Sonoran Desert clade (includes Hidalgo County) and the Chihuahuan desert clade (includes eastern New Mexico) (Andersen & Light, 2012). Individuals from the Gila were not included in that study, indicating that further work in the region is needed.

Habitat/Elevation:

The hispid pocket mouse prefers open areas in desert grassland and desert scrub (Bailey 1931); Bailey reported specimens from Redrock, Gila, and Dry Creek between the San Francisco and Gila rivers. There are now 2 additional specimens from Apache Mine, which is near the border of Grant and Hidalgo counties (MSB 50536, MSB 50537), and 2 specimens from Fort Bayard, collected by Hayward and John Embick (WNMU 3325-3526). No specimens have been recorded since 1977.

Reproduction:

Data are lacking from the Gila, but Jones et al. (1983) reported that there may be 2 to 3 litters per year in the Great Plains, with number of embryos varying from 2 to 9.

Specimens Examined:

(Grant) MSB 50536-50537, WNMU 3325-3326

Chaetodipus intermedius (Merriam, 1889)

Rock Pocket Mouse

Subspecies: 10, 1 in the Gila

Chaetodipus intermedius intermedius (Merriam, 1889)

Description:

The rock pocket mouse is similar in size to the desert pocket mouse, but has stiff guard hairs on the rump that are noticeably longer than the surrounding pelage (Findley et al., 1975).

Habitat/Elevation:

Rock pocket mice are strongly tied to rocky areas, such that Findley et al. (1975) termed them "completely saxicolous." They are found in the Gila at low elevations (~1400 m) in desert grassland and desert scrub habitats, and were often taken in the 2012-2014 survey in and along canyons and washes. Rock pocket mice were the most frequently captured heteromyid (n= 217) in the 2012-2014 survey. Not surprisingly, Hayward (1972) did not report capturing this species in his 1972 survey of the Gila Wilderness, which only included mid- and high-elevation localities.

Reproduction:

Pregnant female rock pocket mice have been taken in March and June and usually have 3-4 embryos.

Remarks:

In areas where rock pocket mice are common, we captured far fewer *Peromyscus* than usual.

Specimens Examined:

(Grant) MSB 4143-4149, MSB 4153, MSB 24226, MSB 156900, MSB 157215, MSB 262637, MSB 262655, MSB 262657, MSB 262682, MSB 262684, MSB 262710 (Sierra) MSB 227299, MSB 229320, MSB 231022, MSB 263580-263583, MSB 263586, MSB 263588, MSB 263592, MSB 263613, MSB 263664, MSB 263676, MSB 264032, MSB 264034-264035, MSB 264041, MSB 264311, MSB 264597, MSB 265616, MSB 267113-267114, MSB 269130

Chaetodipus penicillatus (Woodhouse, 1852)

Desert Pocket Mouse

Subspecies: 6, 1 in the Gila

Chaetodipus penicillatus pricei Allen, 1894

Description:

The desert pocket mouse is similar in appearance to the rock pocket mouse but lacks the long guard hairs on the rump and is noticeably smaller than Bailey's and the hispid pocket mouse (Findley et al., 1975).

Phylogeography and Systematics:

Jezkova et al. (2009) researched phylogeographic relationships across the range of the desert pocket mouse using mtDNA and found 2 major clades corresponding roughly to the Mojave and Sonora deserts, which likely diverged in the Pleistocene. Specimens from the Gila (Grant County) and near the Gila (Hidalgo County) cluster with populations at the northern edge of the Sonora clade (Jezkova et al., 2009).

Habitat/Elevation:

The desert pocket mouse occurs in desert habitats with sand/silt, as opposed to the talus habitats preferred by the rock pocket mouse (Findley et al., 1975). While we did not capture any specimens in the 2012-2014 survey, previous MSB and WNMU collectors have taken most (33 of 43) specimens near Redrock and the surrounding Burro Mountains, which is low elevation (1300-1700 m).

Reproduction:

There are few reproductive museum records from the Gila, but a female with 4 embryos was recorded on 17 September (WNMU 3259) and a lactating female on 12 June (WNMU 3595).

Specimens Examined:

(Grant) MSB 4150-4152, MSB 7201, MSB 56563-56568, MSB 56570-56571, MSB 66852

Dipodomys merriami Mearns, 1890

Merriam's Kangaroo Rat

Subspecies: 19, 2 in the Gila

Dipodomys merriami ambiguous (Merriam, 1890)

Dipodomys merriami olivaceus (Mearns, 1890)

Description:

Merriam's kangaroo rat is the most common kangaroo rat in the Gila and is easily distinguished from Ord's kangaroo rat by having only 4 toes on the hind-foot; the banner-tailed kangaroo rat is noticeably larger and has a white-tipped tail (Findley et al., 1975).

Habitat/Elevation:

Findley et al. (1975) suggested that *D. merriami* is outcompeted in friable soils when sympatric with *D. ordii*. *D. merriami* are found in desert grassland at low elevations (~1350m) in the Gila.

Reproduction:

Female Merriam's kangaroo rats usually have 1-2 embryos and pregnant females were captured in March, April, and June.

Remarks:

All 3 kangaroo rat species were taken together on the same mound at the Ladder Ranch. Across the entire 2-year study, we captured 189 kangaroo rats from the 3 species; 83% were Merriam's kangaroo rat, 13% were Ord's, and 3.7% were banner-tailed.

Geluso (2009) reported a new distributional record for Merriam's kangaroo rat in the Gila when he captured a female in the Big Burro Mountains, but acknowledged this record was likely from a long-present population that had not been sufficiently surveyed. Hayward had a 1972 capture from 5 mi SE of Cliff (WNMU 2552), and Dusty Hunt, Hayward's collaborator, had 3 captures in 1970 from 10 mi S of Cliff along the Gila River (Geluso, 2009).

Specimens Examined:

(Grant) MSB 156711, MSB 156714, MSB 156723-156725, MSB 156730, MSB 156741-156743, MSB 156746-156747, MSB 156781-156783, MSB 156874, MSB 156876, MSB 156894, MSB 156897, MSB 156902, MSB 157218, MSB 196429, MSB 196436, MSB 198729, MSB 198731 (Sierra) MSB 2083, MSB 6208, MSB 6220-6222, MSB 6232, MSB 8035-8040, MSB 11720-11722, MSB 13600-13601, MSB 13607, MSB 13610-13611, MSB 13644-13651, MSB 13665, MSB 21643, MSB 41515-41517, MSB 41527, MSB 41561-41565, MSB 42464, MSB 157203-157204, MSB 157237, MSB 157244, MSB 157310, MSB 263589, MSB 263600, MSB 263636-263637, MSB 267130, MSB 267137, MSB 269122

Dipodomys ordii Woodhouse, 1853

Ord's Kangaroo Rat

Subspecies: 34, 1 in the Gila

Dipodomys ordii ordii Woodhouse, 1853

Description:

Ord's kangaroo rat is distinguished from Merriam's kangaroo rat in having 5 toes on the hind foot instead of 4, while the banner-tailed kangaroo rat is much larger than both Merriam's and Ord's kangaroo rats (Findley et al., 1975).

Habitat/Elevation:

Findley et al. (1975) reported that Ord's kangaroo rat prefers friable soils throughout New Mexico at low elevations (1300-1800 m), although museum records indicate specimens as high as 2130 m in the Gila. Hayward (1972) reported they are rare in the Gila due to lack of suitable soil for their mounds.

Reproduction:

Findley et al. (1975) noted that reproductive timing of Ord's kangaroo rat is highly variable. They have been found lactating or pregnant in the Gila in September, October, and March, and usually have 2 embryos.

Specimens Examined:

(Catron) MSB 15049 (Grant) MSB 140605, MSB 140646, MSB 141311, MSB 157220, MSB 196276, MSB 262649, MSB 263880 (Sierra) MSB 4490-4491, MSB 13593-13593, MSB 13602-13606, MSB 13608, MSB 13612-13640, MSB 13654-13662, MSB 41519, MSB 70079-70084, MSB 86349

Dipodomys spectabilis Merriam, 1890

Banner-tailed Kangaroo Rat

Subspecies: 7, 2 in the Gila

Dipodomys spectabilis baileyi Goldman, 1923

Dipodomys spectabilis spectabilis Merriam, 1890

Description:

The banner-tailed kangaroo rat is much larger than the other 2 species that occur in the Gila and has a white-tipped tail (Findley et al., 1975).

Habitat/Elevation:

Banner-tailed kangaroo rats were the least frequently captured heteromyid rodent in the 2012-2014 survey (n=11). Findley et al. (1975) noted that the banner-tailed kangaroo rat seems to prefer less sandy soils, which make for better burrows. Traps placed near banner-tail mounds in the 2012-2014 survey captured all 3 species of kangaroo rat on the Ladder Ranch. We saw extensive mounding activity of this species northwest of Winston, New Mexico in 2014.

Reproduction

A female banner-tailed kangaroo rat was captured with embryos in March in Redrock (WNMU 6477). Bailey (1931) observed that they have 3-4 young that are born in early or late spring.

Remarks:

The banner-tailed kangaroo rat is listed as "Near Threatened" by the IUCN red list. Their mounds can be seen along Highway 180 to Deming, and near Faywood in Mimbres Valley (S.O. MacDonald, pers. comm.).

Specimens Examined:

(Catron) MSB 89021, MSB 89146 (Grant) MSB 157239 (Sierra) MSB 70076, MSB 157312

Perognathus flavescens Merriam, 1889

Plains Pocket Mouse

Subspecies: 8, 1 in the Gila

Perognathus flavescens melanotis, Osgood, 1900

Description:

The plains pocket mouse is similar in appearance to the silky pocket mouse but is larger (total length >120 mm) and lacks the dark markings on the dorsum and has less buffy patches behind the ears (Monk & Jones, Jr., 1996; Findley et al., 1975).

Habitat/Elevation:

There are few specimens of the plains pocket mouse in the Gila, and Findley et al. (1975) suggested that *P. flavescens* was less common and more difficult to trap than *P. flavus*. All specimens are from Sierra County in Monticello Canyon, which is ~1500 m in elevation. Findley et al. (1975) reported the plains pocket mouse occurs in sandy deserts and grasslands, and sometimes in piñon-juniper.

Reproduction:

Data are lacking from the Gila, but Monk & Jones (1996) stated there are 2 or perhaps 3 litters per year, and average number of pups per litter is 4.5.

Specimens Examined:

(Sierra) MSB 12299, MSB 25095, MSB 27855-27856, MSB 100616

Perognathus flavus, Baird 1855

Silky Pocket Mouse

Subspecies: 14, 1 in the Gila

Perognathus flavus flavus Baird, 1855

Description:

See account for *P. flavescens*.

Phylogeography and Systematics:

Neiswenter & Riddle (2010) used mtDNA and a portion of a nuclear gene (IRBP) to illuminate the evolutionary history of the *Perognathus flavus* species group. Four clades were discovered. Those populations nearest the Gila fell into 2 clades: the *P. flavus* clade (Socorro County and along the border of Catron and Cibola Counties) and the *P. merriami* clade (Hidalgo Counties, with some specimens that are not considered to be *P. flavus*). These 2 clades were the most genetically diverse and broadly distributed clades (Neiswenter & Riddle, 2010). Both clades contain multiple phylogroups, including 3 phylogroups in the *P. merriami* clade, of which specimens near the Gila would be considered northern Chihuahuan desert, and 4 phylogroups within the *P. flavus* clade, of which specimens near the Gila would be considered northern Chihuahuan Desert-Colorado Plateau (Neiswenter & Riddle, 2010).

We generated mtDNA (cytochrome b) sequences from 6 specimens of *P. flavus* from the Gila and compared these to 11 GenBank records across the southwest to place the Gila material into a phylogeographic context. We uncovered 3 major clades in the region (Figure 14). One clade contains all but one Sierra County specimen, a specimen near Beaverhead Ranger Station in Catron County, and a specimen from Cochise County, AZ. The second clade contains 1 specimen from Sierra County (Ladder Ranch), 1 from Catron County (near Beaverhead Ranger Station), 1 from Cochise County, AZ, and 1 from Chihuahua, MX. Geographic areas that are genetically separate indicate that either there is a recent divergence event within *P. flavus*, or that a high level of genetic variability has been maintained within this population. Clearly the phylogeographic history of *P. flavus* is very complex and bears further sampling and study with more loci.

Habitat/Elevation:

In the Gila, silky pocket mice are usually captured in desert grassland and desert scrub habitats, although Findley et al. (1975) reported that they are sometimes taken in piñon-juniper habitat. We captured most often in desert grassland, but also took 2 in oak-piñon-juniper-ponderosa pine ecotone near Beaverhead Ranger Station in October 2014 (MSB 284563-284562). Silky pocket mice are typically found in the Gila at elevations from 1400-2255 m, although they are most common around 1600 m. Hayward (1972) reported only capturing these mice on TJ Mesa near the Gila Cliff Dwellings for his 1972 survey.

Reproduction:

Two pregnant female silky pocket mice (with 4 embryos) were captured during this study, on 4 and 18 June 2014 (MSB 270584) (MSB 278332). Findley et al. (1975) reported pregnant females throughout New Mexico from March through October, and Bailey (1931) stated there are usually 3-6 young, and 2 or more litters per year.

Specimens Examined:

(Catron) MSB 8660-8682 (Grant) MSB 56562, MSB 60542-60543 (Sierra) MSB 13641, MSB 13642, MSB 13643, MSB 24861, MSB 263655, MSB 263673

Family Sciuridae

Ammospermophilus harrisii (Audubon & Bachman, 1854)

Harris's Antelope Squirrel

Subspecies: 2, 1 in the Gila

Ammospermophilus harrisii harrisii Audubon & Bachman, 1854

Description:

Harris's antelope squirrel is easily distinguished by 2 white stripes that run laterally from shoulder to rump, and the way the tail curls over its back (Caire, 1978).

Phylogeography and Systematics:

Mantooth et al. (2013) investigated evolutionary relationships of species of *Ammospermophilus* across their current distribution using 6 mitochondrial genes and 2 nuclear genes, and including an assessment of species distribution models. They discovered 3 lineages within the *Ammospermophilus* genus, of which *A. harrisii* fell into the "*A. leucurus* north clade", which probably diverged around 4 Mya (Mantooth et al., 2013). *Ammospermophilus harrisii* was found to be polyphyletic with 2 distinct lineages, one lineage from Mexico and western Arizona, and one from New Mexico and 2 from Arizona (Mantooth et al., 2013).

Habitat/Elevation:

Harris's antelope squirrel is a desert inhabitant that likely invaded New Mexico from the southwest (Findley et al., 1975). Bailey (1931) reported that they were only found in extreme southwestern New Mexico when he conducted his survey and there are only 2 records from the Gila, both near Redrock. Hayward (1972) did not encounter them in his 1972 survey of the Gila Wilderness.

Reproduction:

Reproductive data for Harris's antelope squirrel are lacking from the Gila but Hoffmeister (1986) reported 6-10 young per litter (average 7.3) in Arizona.

Specimens Examined:

(Grant) MSB 4240, MSB 29655

Callospermophilus lateralis (Say, 1823)

Golden-mantled Ground Squirrel

Subspecies: 13, 1 in the Gila

Callospermophilus lateralis arizonensis Bailey, 1913

Description:

The golden-mantled ground squirrel has white stripes running along the dorsum from shoulder to rump that are bordered by a black stripe; the color over the head and shoulders is golden brown (Bartels & Thompson, 1993).

Habitat/Elevation:

Golden-mantled ground squirrels are found in montane grasslands, although Findley et al. (1975) noted that they were observed in piñon-juniper habitat in other parts of New Mexico. Hayward (1972) stated that golden-mantled ground squirrels are common in the Gila as low as 2100 m and that they thrive near picnic areas and cabins where they forage on human refuse. We captured them in montane grassland habitat at Willow Creek.

Reproduction:

Bailey (1931) reported that young golden-mantled ground squirrels are born in late spring and emerge in early summer, and that females produce one litter a year.

Remarks:

Findley et al. (1975) stated that golden-mantled ground squirrels in the Gila are separated from other populations in northern New Mexico and have darker fur under their tails than northern populations. A more intensive study of geographic variation in this species should be conducted across its range.

Hoffmeister (1986) reported that variation in hibernation in golden-mantled ground squirrels in Arizona was dependent on elevation. Hibernation status in the Gila is unknown, but in the San Francisco Mountains to the west of the Gila, this species hibernates from October and November to April or May.

Specimens Examined:

(Catron) MSB 3096-3114, MSB 5133-5168, MSB 6472-6473, MSB 82099-82100, MSB 82161-82166, MSB 82168-82173, MSB 86355, MSB 89261-89265, MSB 89536-89537, MSB 89539-89540, MSB 89653-89657, MSB 92577, MSB 92602, MSB

92608-92609, MSB 140094-140095, MSB 140122, MSB 140778, MSB 234691 (Grant) MSB 2949, MSB 3161-3168, MSB 6471, MSB 6474, MSB 23996

Cynomys ludovicianus Ord, 1815

Black-tailed Prairie Dog

Subspecies: 2, 1 in the Gila

Cynomys ludovicianus ludovicianus Ord, 1815

Description:

Black-tailed prairie dogs can be distinguished from Gunnison's prairie dog by their black-tipped tail; this is the only prairie dog that remains in the boundary of the Gila.

Habitat/Elevation:

Black-tailed prairie dogs prefer open grasslands and form large colonies that are often more heavily occupied than other prairie dog species (Hoogland, 1995).

Reproduction:

There is typically one litter per year with a range of 1-6 young per litter (Thorington et al., 2012).

Remarks:

Bailey (1931) reported that 1/3 of Grant County was supposed to have been occupied by black-tailed prairie dogs, and they were also known at the time to be common in the Gila River and San Francisco River valleys, and in Lake Valley (toward the southeast end of the Gila). Although they were once numerous, there are has not been a specimen of the black-tailed prairie dog from the Gila since 1937. Efforts to reintroduce them to the Ladder Ranch began in 1997, wherein 30 prairie dogs were translocated from the MacGregor Ranch, north of El Paso (Truett & Savage, 1998). Today there still remains a small population of 75-100 animals on the Ladder Ranch (S. Dobrott, pers. comm.), and this is the only known population in the Gila.

I examined 10 specimens from a single locality (14 miles south of Silver City) taken over 3 days (April 1937) housed at AMNH.

Specimens Examined:

(Grant) AMNH 127142-127151, USNM 15197, USNM 051278, USNM 51279-51280, USNM 66060, USNM 67849, USNM 148291, USNM 157856, USNM 158196 (Sierra) USNM 167578

Ictidomys tridecemlineatus (J.A. Allen, 1821)

Thirteen-lined Ground Squirrel

Subspecies: 9, 1 in the Gila

Ictidomys tridecemlineatus blanca Armstrong 1971

Description:

The pelage of the thirteen-lined ground squirrel has a distinctive pattern of alternating lines and dots running from the head to tail (Hall & Kelson, 1959).

Habitat/Elevation:

There are 8 specimens of the thirteen-lined ground squirrel from the Gila, all from Catron County, which is near their southern distributional limit in the state. Findley et al. (1975) noted that they are common only in shortgrass plains, such as on the Plains of San Agustin, but Gila records are from 2000 to 2400 m.

Reproduction:

In the southern portion of the thirteen-lined ground squirrels' range there are sometimes 1-2 litters per year, numbering 6-13 young per litter (Thorington et al. 2012).

Specimens Examined:

(Catron) MSB 19364, MSB 60553, MSB 82093, MSB 82157-82158, MSB 89534, MSB 91711

Otospermophilus variegatus (Erxleben, 1777)

Rock Squirrel

Subspecies: 8, 1 in the Gila

Otospermophilus variegatus grammurus Say, 1823

Description:

The rock squirrel is a large squirrel with stippled gray, black, and white pelage and a long tail (> 135 mm) (Findley et al., 1975; Oaks et al., 1978).

Habitat/Elevation:

The rock squirrel is common along roads in the Gila at low to mid-elevations (1400-2000 m) in desert grassland, desert scrubland, and piñon-juniper habitats, and is usually associated with talus areas. Hayward (1972) reported they are common at Gila Center (near Gila Cliff Dwellings) and may also occur on the western slope of the Mogollon Mountains. Bailey (1931) documented them in the Tularosa Mountains. We captured rock squirrels from the Ladder Ranch, Rockcore Tank, Black Canyon, and along the Mimbres River, and salvaged roadkill specimens from Highway 180 (junction with Highway 12 and junction with Forest Road 232) and Highway 35.

Reproduction:

Lactating female rock squirrels were taken on 24 May at the Ladder Ranch (MSB 281059) and on 8 September (MSB 281089). Bailey (1931) stated that they probably have 2 or more litters per year, which Hoffmeister (1986) also stated to be the case in Arizona.

Remarks:

Findley et al. (1975) reported finding rock squirrels as late as December and as early as March in Albuquerque and stated that they do not always hibernate in the southern part of the state. Bailey (1931) stated that rock squirrels are active until October or November; their seasonal activity in the Gila should be further investigated.

Specimens Examined:

(Catron) MSB 263484, MSB 263878 (Grant) MSB 6201, MSB 64417, MSB 263894, MSB 267565, MSB 268306 (Sierra) MSB 267122

Tamias cinereicollis (Allen, 1890)

Gray-shouldered Chipmunk

Subspecies: 2, 2 in the Gila

Tamias cinereicollis cinereicollis Allen, 1890

Tamias cinereicollis cinereus Bailey, 1893

Description:

The gray-shouldered chipmunk is differentiated by the gray collar that extends from its neck to shoulders and 5 black stripes alternating with 4 pale stripes, which distinguishes it from the cliff chipmunk (Hilton & Best, 1993).

Phylogeography and Systematics:

Sullivan et al. (2014) used DNA sequence variation from multiple genetic loci to investigate evolutionary relationships and divergence of species of the genus *Tamias*. They reported that *T. dorsalis* and *T. cinereicollis* form a hybrid zone in the Gila, based on 3 samples from Catron County (*T. cinereicollis*) and 6 from Grant County (*T. dorsalis*) (Sullivan et al., 2014). Further investigation of this hybrid zone is needed.

Habitat/Elevation:

The gray-shouldered chipmunk is found in mesic, high elevation forests (mixed conifer and ponderosa pine) and usually replaces *T. dorsalis* at these elevations (Hayward, 1972; Findley et al., 1975). We captured them at Rockcore Tank, Willow Creek, and near Eagle Peak, which are all ponderosa pine and mixed conifer forests.

Reproduction:

In Arizona, pregnant female gray-shouldered chipmunks have been taken from late April until mid-June, with litters usually consisting of 4-6 young (Hoffmeister, 1986). Bailey (1931) reported that they have one litter a year.

Remarks:

Hoffmeister (1986) noted that gray-shouldered chipmunks are hibernators, but have been known to emerge occasionally in winter in Arizona. Bailey (1931) stated they do not hibernate in the Gila, but this should be further assessed.

Specimens Examined:

(Catron) MSB 2957-2963, MSB 3121-3134, MSB 3136-3142, MSB 6233-6234, MSB 8846-8847, MSB 9138-9145, MSB 16716-16718, MSB 82043, MSB 82063-82064, MSB 82095, MSB 82097-82098, MSB 82107-82108, MSB 82127-82135, MSB 82175, MSB 89251, MSB 89255, MSB 89541-89545, MSB 89552-89555, MSB 89659, MSB 91700-91701, MSB 92601, MSB 140096, MSB 140123, MSB 146004, MSB 146006, MSB 146047, MSB 262521-262522, MSB 262529-262530, MSB 262567 (Grant) MSB 2950-2955, MSB 3174-3195, MSB 5395 (Sierra) MSB 9135-9137

Tamias dorsalis (Baird, 1855)

Cliff Chipmunk

Subspecies: 6, 1 in the Gila

Tamias dorsalis dorsalis Baird, 1855

Description:

The cliff chipmunk is the most common chipmunk in the Gila and is notable for the very pale or absent stripes on its back (Hilton & Best, 1993).

Phylogeography and Systematics:

See account for *T. cinereicollis* fro comments on evolutionary relationships and hybridization. The type locality for *Tamias dorsalis* is now abandoned "Fort Webster, copper-mines of the Mimbres" near present site of Santa Rita in Grant County (Baird 1855).

Habitat/Elevation:

We captured cliff chipmunks on rocky cliffs, near habitats ranging from riparian, to desert scrub, pinion-juniper, and ponderosa pine forest. Hayward (1972) reported taking them only at low elevation habitats in his survey. Cliff chipmunks were recorded in the Gila as high as 2800 m, although 1400-1900 m is most common. The cliff chipmunk seems to have a wide range, as Findley et al. (1975) noted this species is found throughout New Mexico from "lower woodlands to forest zones."

Reproduction:

Bailey (1931) stated that cliff chipmunks breed early in the year and that he saw "half-grown" young by mid-May. Lactating females were collected on 8 September in Pinos Altos (DMNS 11826).

Specimens Examined:

(Catron) MSB 5348-5353, MSB 5355, MSB 7585-7586, MSB 7881, MSB 23172, MSB 69481, MSB 82109, MSB 82155-82156, MSB 89658, MSB 145978 (Grant) MSB 56543-56544, MSB 192070-192072, MSB 281033 (Sierra) MSB 2010, MSB 15047, MSB 263662, MSB 264013, MSB 267054, MSB 267095, MSB 269057, MSB 269072, MSB 281058

Tamiasciurus fremonti (Erxleben, 1777)

Red Squirrel

Subspecies: 25, 1 in the Gila

Tamiasciurus fremonti mogollonensis (Mearns, 1890)

Description:

The red squirrel is a tree-dwelling squirrel that is readily discerned by its reddish dorsum and smaller size compared to other tree squirrels (total length < 360 mm) (Findley et al., 1975). In the Mogollon Mountains, they are darker and more yellow in comparison to *T. hudsonicus* populations in other parts of New Mexico (Findley et al., 1975).

Phylogeography and Systematics:

Arbogast et al. (2001) used mtDNA and allozyme data to investigate the evolutionary history of *Tamiasciurus* species across their North American range. They found 3 clades within *Tamiasciurus*, of which *T. hudsonicus* from New Mexico and Arizona grouped in the southwestern clade, which includes only populations from these 2 states (Arbogast et al., 2001). New Mexico samples were from Sandoval County, and Arizona samples were from Apache County, close to the Gila.

Hope et al. (2016) expanded previous work on geographic structure and the systematics of the 3 nominal species of *Tamiasciurus* by exploring phylogeographic variation using mtDNA, nuclear DNA, ecological niche models, with range wide sampling. Specimens from the Gila grouped with the Southwest Sky-Islands clade (Pinaleño Mountains, Kaibab, Mogollon Mountains, San Mateo Mountains, and Sacramento Mountains), and the Gila population is most closely related to specimens from Arizona than to other New Mexico populations. Additionally, Hope et al. (2016) concluded that specimens from the Southwest Sky Islands clade, including populations in the Gila, should be recognized as *T. fremonti*, rather than *T. hudsonicus.*

Habitat/Elevation:

The red squirrel is most common in mixed conifer forest (Findley et al., 1975), but is also found in ponderosa pine forest. In both forest types, they will sometimes overlap with *Sciurus aberti* (Findley et al., 1975). Hayward (1972) noted that the red squirrel is the most common squirrel in the higher elevations of the Gila and is found from about 2300-3050 m. We captured them at Willow Creek.

Reproduction:

Female red squirrels may have 2 litters a year in Arizona (Hoffmeister, 1986) but Bailey (1931) stated that they have one litter a year in New Mexico. Bailey documented young born in the spring or early summer that emerge from the nest by early August.

Specimens Examined:

(Catron) MSB 2969, MSB 3115-3119, MSB 5169-5182, MSB 6202, MSB 62090, MSB 68256-68260, MSB 75351-75356, MSB 75358-75373, MSB 85717-85718, MSB 89366, MSB 89531, MSB 141315, MSB 198475 (Grant) MSB 3172-3173, MSB 6940-6947, MSB 75709 (Sierra) MSB 15063

Sciurus aberti Woodhouse, 1852

Abert's Squirrel

Subspecies: 8, 1 in the Gila

Sciurus aberti aberti Woodhouse, 1852

Description:

Abert's squirrels are tree squirrels easily discerned by their large, tufted ears (Nash & Seaman, 1977).

Phylogeography and Systematics:

Lamb et al. (1997) used mtDNA to illuminate phylogeographic relationships within *S. aberti* from 22 populations across their range and found divisions into 2 phylogeographic regions: east and west. There were 5 samples from the Mogollon Mountains and Pinos Altos range of the Gila, which grouped in the west clade along with Arizona (Lamb et al., 1997). The authors postulated that Abert's squirrels dispersed north from central-west New Mexico in 2 directions as reflected by 2 distinct haplotypes found across northern New Mexico, Colorado, Utah, and northern Arizona (Lamb et al., 1997).

Habitat/Elevation:

Abert's squirrels occur in ponderosa pine forest and extend into mixed conifer forests (Findley et al., 1975) although Bailey (1931) reported that they are "strictly" tied to ponderosa pine forests due to reliance on ponderosa seeds. According to museum records, Abert's squirrels are most commonly encountered from 2133-2438 m. They were spotted during the 2012-2014 survey along North Star Road in Black Canyon and near Alexander Peak.

Reproduction:

Bailey (1931) reported lactating Abert's squirrels in August and September, and "half- grown" young after 24 May. He stated that 3-4 young per litter seems to be the norm.

Remarks:

Some geographic variation is known in the Gila, with squirrels in the Mogollon Mountains having black bellies while other populations (e.g., Black Range) are completely black (Bailey, 1931). Abert's squirrels are sometimes known to co-occur with *Tamiasciurus (hudsonicus) fremonti* (Hayward, 1972).

Specimens Examined:

(Catron) MSB 2034, MSB 3120, MSB 15067, MSB 60681, MSB 61596-61598, MSB 64436, MSB 82094, MSB 82547, MSB 85719, MSB 89265, MSB 89269, MSB 89532, MSB 141341, MSB 196628, MSB 198303, MSB 198430-198431, MSB 198744 (Grant) MSB 2956, MSB 6107, MSB 6298, MSB 24055, MSB 57447, MSB 61592, MSB 61594, MSB 61599, MSB 146001, MSB 155938, MSB 157359, MSB 157878, MSB 199718 (Sierra) MSB 2035-2036, MSB 13384

Sciurus arizonensis Coues, 1867

Arizona Gray Squirrel

Subspecies: 3, 1 in the Gila

Sciurus arizonensis arizonensis Coues, 1867

Description:

The Arizona gray squirrel is a tree squirrel similar to Abert's squirrel but lacks ear tufts (Best & Riedel, 1993) and has similar coloration to the rock squirrel but has white fringe on the tail (Findley et al., 1975).

Habitat/Elevation:

Bailey (1931) reported that the Arizona gray squirrel is common along the San Francisco River, and Findley et al. (1975) recounted that it is “limited to the deciduous riparian forest of the San Francisco drainage in Catron Co.” However, as Hayward (1972) observed, Arizona gray squirrels have been extending their range up the Gila and San Francisco drainages and east towards the Rio Grande. I examined 2 specimens from 1937 captured near the Sacaton Landing Strip (AMNH 127032-127033) and one from 1928 captured in the Mogollon Mountains near Big Dry Creek (AMNH 127260). Findley et al. (1975) reported that they are usually found in ponderosa pine forest, and Hayward’s captures came from low-elevation riparian habitat and piñon-juniper woodland, as also reported by Frey et al. (2008).

Reproduction:

Hayward recovered a road-killed Arizona gray squirrel near his home 6 km north of Silver City that was pregnant with 4 embryos on 2 March 1985 (WNMU 4781).

Remarks:

Frey et al. (2008) reported evidence of range expansion of Arizona gray squirrels eastward into Sierra County of the Gila, including several personal observations, 2 photographs, and 1 specimen (MSB 124820) from Sierra County. Our camera data from the Ladder Ranch (Figure 13) show Arizona gray squirrels in May of 2008, January, June, and September of 2009, and October of 2010, providing additional evidence (time-stamped and geo-tagged photographs) of this likely range extension eastward. Frey et al. (2008) asserts that lack of historic records from the Ladder Ranch belies a range expansion. Clearly the distribution of the Arizona gray squirrel bears continued monitoring in New Mexico.

Arizona gray squirrels are listed as “Threatened” in Mexico (NOM-059) and “Data Deficient” by IUCN, and are proposed here as in need of further conservation assessment.

Specimens Examined:

(Catron) MSB 6980, MSB 12054, MSB 13387, MSB 264028, WNMU 1778 (Grant) MSB 24076-24077, MSB 141298, MSB 157846, MSB 157855, AMNH 127032-127033, AMNH 127260, WNMU 1447, WNMU 2247, WNMU 4301, WNMU 4781, WNMU 5430, WNMU 5460, WNMU 5784, WNMU 6202

Xerospermophilus spilosoma (Bennett, 1833)

Spotted Ground Squirrel

Subspecies: 12, 2 in the Gila

Xerospermophilus spilosoma canescens Merriam, 1890

Xerospermophilus spilosoma marginatus Bailey, 1902

Description:

The spotted ground squirrel is brown with small white spots along the dorsum (that are not in a linear pattern, like the thirteen-lined ground squirrel) and lacks a bushy tail (Streubel & Fitzgerald, 1978).

Habitat/Elevation:

I examined historic spotted ground squirrel specimens housed at USNM, including 2 collected from Silver City in 1894, and 2 from Deer Creek in Grant County from 1908. Bailey (1931) also reported the spotted ground squirrel near Silver City, along the Gila River, and close to what is now Truth or Consequences. Hayward captured 5 specimens around Silver City in desert grassland and piñon-juniper habitats, and S.O. MacDonald (pers. comm.) has seen them recently around Cliff. Findley et al. (1975) reported the spotted ground squirrel near Silver City and Tyrone in Grant County, and in Monticello Canyon, Las Palomas, and near Chloride in Sierra County. This species prefers desert grassland habitat (Findley et al., 1975) and desert scrub (Cook, 1982).

Reproduction:

Reproductive data from the Gila are lacking for the spotted ground squirrel, but Hoffmeister (1986) stated that in Arizona, the spotted ground squirrel has 2 litters per year, with the first as early as May and the second as late as August.

Specimens Examined:

(Catron) MSB 91710, MSB 92578 (Grant) MSB 23958 (Sierra) MSB 13653, MSB 16597

Family Geomyidae

Thomomys bottae (Eydoux & Gervais, 1836)

Bottae's Pocket Gopher

Subspecies: 229, 3 in the Gila

Thomomys bottae collinus Goldman, 1931

Thomomys bottae fulvus (Woodhouse, 1852)

Thomomys bottae opulentus Goldman, 1935

Description:

Bottae's pocket gopher is the only pocket gopher in the Gila; their pelage and size varies with soil characteristics (Jones & Baxter, 2004).

Phylogeography and Systematics:

Patton & Smith (1990) used allozyme data (25 loci) to investigate the phylogenetics of *Thomomys*. They sampled across southwest U.S. and Mexico (including 2 specimens from Catron, 3 from Grant, and 1 from Sierra Counties of the Gila) and grouped these with specimens from southeast California through west Texas as the "Basin and Range" group (Patton & Smith 1990).

To test these findings, Smith (1998) sequenced the cytochrome b gene of *Thomomys* across the southwest U.S. and Mexico, including 3 specimens from New Mexico (1 from Grant County) and found that the specimen from Grant County was most closely related to the specimen from Graham Mountains in Arizona and one from Coahuila, MX. Wickliffe et al. (2004) then used the cytochrome b gene to further investigate phylogenetics of *T. bottae* in the southwest U.S. and Mexico, and to add samples from Texas. They included 5 specimens from New Mexico, all from Otero County, and found that *T. bottae* from southwest Texas, Otero Mesa of New Mexico, and northern Mexico were most closely related to each other and sister to *T. bottae* from Cloudcroft in Otero County, Socorro County, and Lincoln County (Wickliffe et al. 2004). Unfortunately, they did not include specimens from the Gila.

We generated mtDNA (cytochrome b) from specimens of *T. bottae* from the Gila and compared those to records from across the Southwest to place the Gila specimens into a phylogeographic context. In agreement with Smith (1998), we found that specimens from the Gila were more closely related to those from Arizona (Santa Catalina Mountains, Bradshaw Mountains, and Sierra Ancha), than to specimens from other nearby sites in New Mexico (Socorro County, Otero County, and Lincoln County) (Figure 15). Additional work with denser sampling along the northern, southern and eastern peripheries of the Gila should provide a more rigorous perspective on divergence and biogeographic history of this widespread species that shows tremendous geographic structure.

Habitat/Elevation:

Bottae's pocket gopher was found and captured at almost every locality sampled between 1188-2743 m. Hayward (1972) reported Bottae's pocket gophers at all elevations and localities in the Gila except Mogollon Baldy. He observed that they are typically found near canyons with alluvial soils, and Findley et al. (1975) reported Bottae's pocket gophers are found in most habitats with friable soils. Their size and pelage, which tends to match soil color can be quite variable and has led to the naming of numerous subspecies (Smith & Paton, 1988). The size of Bottae's pocket gopher is also related to the soil, with smaller gophers usually found in areas with hard, dry soil. The smallest Bottae's gophers recorded in New Mexico occur near the edge of the Gila in Truth or Consequences (Follingstad, 1968).

Reproduction:

Female Bottae's pocket gophers with embryos were taken from February to August, but most are captured in June and July with 1-2 embryos per litter.

Remarks:

While pocket gophers seldom venture above ground, camera data from the Ladder Ranch showed one being killed by an owl while outside its burrow.

Specimens Examined:

(Catron) MSB 5183, MSB 7563-7564, MSB 7566-7572, MSB 15065, MSB 26896-26897, MSB 54665, MSB 66604-66605, MSB 85973-85973, MSB 89557-89560, MSB 92611, MSB 92646, MSB 96195, MSB 125101-125102, MSB 183359-183361, MSB 262570-262571, MSB 265737 (Grant) MSB 3169-3171, MSB 4232-4236, MSB 16043, MSB 25188, MSB 56545, MSB 140628, MSB 140644, MSB 141309-141310, MSB 230593, MSB 231255 (Sierra) MSB 13099-13126, MSB 13332-13334, MSB

41520-41521, MSB 41523, MSB 41526, MSB 41528-41534, MSB 42465, MSB 53044, MSB 53055, MSB 263616, MSB 264036, MSB 269106, MSB 269117, MSB 269217

Family Castoridae

Castor canadensis Hemprich, 1820

American Beaver

Subspecies: 24, 1 in the Gila

Castor canadensis frondator Mearns, 1897

Description:

The beaver is a large rodent that is easily recognizable by its large, dorso-ventrally flattened tail (Findley et al., 1975).

Habitat/Elevation:

Beaver probably occur in all major tributaries in the Gila, but specimens are few. Hayward (1972) reported that they are found below 2400 m, but we found an active dam at the Willow Creek Campground at 2560 m. Findley et al. (1975) did not include Hayward's specimens from the Gila River, 8 km north of Cliff and 0.8 km south of Cliff (WNMU 500, WNMU 624). Although Findley et al. (1975) did not report those records, they noted that streams in the Mogollon Mountain could support beavers. The impact of new management guidelines that restrict grazing in riparian areas of the Gila on beaver should be assessed.

Reproduction:

Bailey (1931) observed beaver litters with 4 young in New Mexico.

Remarks:

Beavers historically were numerous in the Gila, as Bailey (1931) stated that a trapper could catch 250 a month, and the journal of explorer/fur trapper James Pattie documented capturing as many as 30 beaver in one night from the Gila River, and 36 from the San Francisco River, although some forks of these drainages had no beavers (Pattie, 1833). Extensive trapping and removal of cottonwood trees has posed a threat to survival of the beaver in the Southwest in the past (Hoffmeister, 1986). Restoration of the

Gila River has resulted in their rebound near Gila and Cliff (S.O. MacDonald, pers. comm.).

Specimens Examined:

(Grant) WNMU 500, WNMU 624, WNMU 3276

Family Erethizontidae

Erethizon dorsatum Linnaeus, 1758

American Porcupine

Subspecies: 7, 1 in the Gila

Erethizon dorsatum couesi Mearns, 1897

Description:

Porcupines are large rodents (> 3.5 kg) with quills along the dorsum (Woods, 1973).

Habitat/Elevation:

Porcupines are infrequently encountered, probably because they are primarily arboreal. Hayward (1972) reported one in his 1972 survey at 1828 m. Other records are from 1400 to 1900 m in piñon-juniper habitat. Findley et al. (1975) reported that they are found across all habitats but are most common in mixed conifer forests. Bailey (1931) found porcupines to be common in the Mogollon Mountains, and reported that J.S. Ligon found 1 apparently eaten by a mountain lion. They used to be more common in late 1980s-early 1990s along the Gila River near Gila and Cliff, but were infrequently seen in the last decade (S.O. MacDonald, pers. comm.).

Reproduction:

Hoffmeister (1986) stated that female porcupines have one young per year, which is usually born in April or May. He posited that this relatively low fecundity may be due to their longevity (9 years in the wild).

Specimens Examined:

(Grant) WNMU 627, WNMU 717, WNMU 1214, WNMU 5432, WNMU 5620, WNMU 6469

EXTIRPATED SPECIES

Order Rodentia

Family Sciuridae

Cynomys gunnisoni Baird, 1855

Gunnison's Prairie Dog

Gunnison's is one of 2 prairie dogs extirpated from the Gila (the black-tailed prairie dog has been reintroduced at the Ladder Ranch). E. A. Goldman and N. Hollister reported them from the northern portion of the Mogollon Mountains (Bailey, 1931), but no specimens have been taken from the Gila since 1961. They were found in desert and montane grasslands up to ~3050 m (Findley et al., 1975). While they are common in other parts of New Mexico, they can sometimes be decimated by outbreaks of bubonic plague (Findley et al., 1975). Bailey (1931) stated that a large part of their population in New Mexico was just north of the Mogollon Mountains. Neville & Johnson (2007) predicted that Gunnison's prairie dogs could occur throughout most of Catron County. There are still old mounds near upper Negrito Creek, and active colonies near to the Gila in the western plains of San Agustin (S.O. MacDonald, pers. comm.).

Bailey (1931) documented that Gunnison's prairie dogs have 4 to 6 young per litter, and found a female with embryos on 4 May. Prairie dogs in general have low fecundity due to low offspring survivorship, delayed sexual maturity, and only one litter per year (Hoogland, 2001). Gunnison's were found to have litters of 3 to 4 at time of emergence from the nursery burrow (Hoogland, 2001).

Specimens Examined:

(Catron) MSB 15056, MSB 85573 (Grant) WNMU 146

Family Cricetidae

Microtus pennsylvanicus Ord, 1815
Meadow Vole

The meadow vole is widespread in Canada and Alaska, but populations in the Southwest are relicts of a wetter period (Anderson & Hubbard, 1971). There are only 4 recent (i.e. not fossil) specimens of the meadow vole in the Gila, all taken near the Tularosa River close to Aragon (AMNH 217046-217047). These specimens were taken in 1917 by J.S. Ligon (Anderson & Hubbard, 1971). A population in northern Chihuahua also was determined to have been extirpated, likely due to overgrazing and drought conditions (List, 2010).

We trapped near Aragon and Apache Creek in an attempt to find meadow voles, but only found *Microtus mogollonensis*. Findley et al. (1975) described the meadow vole as a "hydrosere" dependent on grass and sedges and permanent water. Although there appears to be permanent water in this area, the grass has been heavily grazed to such an extent as to apparently preclude the meadow vole.

Preliminary phylogeographic data supports 3 distinct clades across the range of the meadow vole, with the New Mexico populations grouped with a central clade that spans from the Gila northward along the Rocky Mountains into Alberta and Manitoba, Canada (Jackson et al., In Prep).

Specimens Examined:

(Catron) AMNH 217046-217047

Order Carnivora
Family Felidae

Panthera onca Linnaeus, 1758
Jaguar

Bailey (1931) reported jaguars in New Mexico in Socorro County, Otero County, San Miguel County, and Hidalgo County, as well as in the San Andres, Sacramento, Magdalena, and Datil Mountains, and on the western slope of the Caballo Mountains. Given these localities, it is likely that the jaguar once roamed the Gila. The latest and nearest record to the Gila is a photograph taken in 2006 in the Animas Mountains (McCain & Childs, 2008). Review of the records from New Mexico and Arizona over the past 100 years indicates that jaguars are mostly found in montane habitats, usually within 100 km of the Mexican border (Brown & Lopez-Gonzalez, 2000).

Family Mustelidae

Lontra canadensis Schreber, 1777
North American River Otter

The river otter is known in New Mexico from only one specimen, a male taken in the Gila near Cliff in 1953 (MSB 50000), although Bailey (1932) recorded sightings in the Gila drainage made in 1906.

There are efforts underway by conservationists to restore the river otter to the major drainages of New Mexico (www.amigosbravos.org). NMDGF published a “feasibility study” on reintroductions in 2006, which concluded that “suitable habitat and conditions” for the river otter do exist (in the Gila, upper and lower Gila River and Lower San Francisco River), but greatest chance of success is in the upper Rio Grande (NMDG&F, 2006). These efforts in the Gila and San Francisco drainages are stalled given concerns about impacts on endemic fishes and the desires of the current New Mexico Game Commission, but a plan will be resubmitted in 2019 if a more receptive governmental oversight board is in place (S.O. MacDonald, pers. comm.).

Specimens Examined:

(Grant) MSB 50000

Family Ursidae

Ursus arctos Linnaeus, 1758

Grizzly bear

Grizzly bears were once common in the Gila, especially in the Gila and San Francisco river valleys and the foothills of the Mogollon Mountains (Bailey, 1931). Of the 17 New Mexico museum records, 13 are from the Gila. The last documented grizzly bear in the state was killed in the Mogollon Mountains in 1931 (Julyan & Smith 2006). Specimens housed at USNM include three, a mother with two cubs, taken in the Black Range north of Chloride (USNM 223393-223395). Other Gila records are from Grant County along the Mimbres River and Catron County from the Mogollon Mountains.

Specimens Examined:

(Catron) USNM 177674, USNM 230651 (Grant) USNM A990, USNM A995, USNM 67404-67405, USNM 147468-147469 (Sierra) USNM 223393-223396, USNM 262373

DISCUSSION

Topographic relief, biome confluence and variation, and the dynamic geologic history of the Gila region have produced a highly diverse mammal fauna (59% of total mammal species richness for New Mexico). An increasing number of paleontological sites also have allowed for new insights into the history of the mammalian fauna. I briefly review the paleontological records and phylogeographic studies that are relevant to the mammalian fauna and then discuss threats facing the mammals of the region.

Deeper Time- The Paleontological Record

There are 19 paleontological sites in the Gila (see map) that span from the Eocene to the Pleistocene (Table 5). From these sites, 137 mammal specimens representing 9 orders have been identified including: Soricomorpha (n=4), Xenarthra (n=3), Chiroptera (n=1), Carnivora (n=18), Artiodactyla (n=29), Perissodactyla (n=24), Proboscidea (n=14), Rodentia (n=35), and Lagomorpha (n=9) (Stearns, 1942; Cosgrove, 1947; Wills, 1988; Morgan et al., 2011; Morgan, 2015). Those specimens represent 28 extant taxa and 51 extinct taxa (rodents, sloths, mammoths, mastodons, carnivores, lagomorphs, horses, camels, a rhinoceros, and a tapir), with the majority from the Pliocene and Pleistocene (14 sites) (Morgan, 2015; Morgan et al., 2011) (Tables 6 & 7).

Fossil and subfossils of extant taxa in the Gila are *Bison bison, Ovis canadensis, Sorex monticola, Lynx rufus, Canis latrans, Tamiasciurus hudsonicus, Thomomys bottae, Microtus longicaudus, Microtus mogollonensis*, and *Sylvilagus floridanus*. Fossils of the genera *Dipodomys*, *Neotoma, Spermophilus*, *Bassariscus*, *Spilogale*, and *Odocoileus* that could not be identified to species have also been found (Morgan, 2015; Morgan et al., 2011). Extinct specimens closely related to extant Gila species include *Stockoceros* and *Capromeryx*, extinct members of the antilocaprid family; *Eocoileus*, a cervid; *Platygonus* and *Catagonus,* tayassuids; *Borophagus hilli, Canis lepophagus*, and *Cerdocyon texanus*, candids; *Plionarctos*, an ursid; *Hypolagus vetus, Sylvilagus hibbardi, and Notolagus lepusculus,* leporids*; Jacobomys sp., Jaywilsonomys ojinagaensis, Neotoma quadriplicatus, Ondatra idahoensis, Ogmodontomys poaphagus, Repomys panacaensis, Sigmodon medius*, cricetid rodents; *Geomys paenebursarius* and *Geomys minor*, geomyid rodents; and *Otospermophilus bensoni*, a sciurid rodent (Morgan, 2015; Morgan et al., 2011). There are also specimens of extant mammals that do not currently occur in the Gila including: *Marmota flaviventris, Urocitellus elegans, Thomomys talpoides, Neotoma cinerea, Microtus pennsylvanicus* (which was extirpated in last ~ 50 years), *Sylvilagus nuttallii,* and *Vulpes velox* (Morgan, 2015; Morgan, 2011). The rich fossil history suggests a dynamic history of mammalian community assembly in the region.

Phylogeography

Phylogeography, the use of molecular data to infer genetic relationships of populations across the range of a species, can be very useful for reconstructing historical demography and biogeographic history of species, and to infer the likely biotic and abiotic events that led to current geographic structure (Avise, 2000). Many phylogeographic studies have focused on desert mammals from the Mojave, Sonora, and Chihuahua deserts to reconstruct their historical biogeography (Riddle, 1995; Riddle, 1996; Riddle et al., 2000; Mantooth et al., 2013). Desertification in the southwest began in the Tertiary and continued into the Neogene with mountain uplift, creating rain shadows and deserts (Riddle, 1995), and this process isolated many mammal populations. During the Oligocene, dry tropical habitats were replaced with seasonal dry woodland and savannah (Riddle, 1995). As mountains uplifted (Sierra Madre Occidental, Colorado Plateau) and Basin and Range habitat spread in the middle Neogene, diversity and "provinciality" of these fauna increased in western North America (Riddle et al., 2000). During the Miocene and Pliocene of the Neogene, the 3 provinces of the Gila (Basin and Range, Colorado Plateau, and Mexican Plateau/Chihuahuan desert) developed and divided the region, and corresponding habitats began to appear (semi-desert/woodland, grassland/savannah, semi-desert/sub-tropical, respectively) (Riddle, 1995). These events set the background for divergence of many southwestern mammal lineages during glacial/interglacial cycles of the Pleistocene (Conroy & Cook, 2000; Jezkova, 2009; Andersen & Light, 2012).

Relatively few species from the Gila have been studied phylogeographically. Of the species that were investigated, many represent either 2 clades (*Chaetodipus penicillatus, Microtus mogollonensis, Neotoma albigula, Sigmodon hispidus, Lynx rufus*) or 3 (*Antrozous pallidus, Eptesicus fuscus, Chaetodipus baileyi, Peromyscus eremicus, Sciurus aberti, Notiosorex crawfordi*) (Riddle, 1995; Lamb et al., 1997; Riddle et al., 2000; Edwards et al., 2001; McAliley et al., 2007; Weyandt & Bussche, 2007; Bradley et al., 2008; Jezkova et al., 2009; Crawford et al., 2011; Turmelle, 2011; Reding et al., 2012). Geographic locations of clade divisions vary, potentially due to inadequate sampling effort. Some species (*C. penicillatus, A. pallidus, P. eremicus, S. aberti, N. crawfordi)* roughly parse across the 3 North American desert regions (Lamb et al., 1997; Riddle et al., 2000; McAliley et al., 2007; Weyandt & Bussche, 2007; Jezkova et al., 2009; Turmelle et al., 2011), whereas others have idiosyncratic divisions (*M. mogollonensis, N. albigula, S. hispidus, T. hudsonicus, L. rufus,* (Arbogast et al., 2001; Edwards et al., 2001; Bradley et al., 2008; Crawford et al., 2011; Reding et al., 2012).

Some species have more complex phylogeographic histories due to dynamic events of the Quaternary and these are represented by multiple clades; *Chaetodipus* *hispidus* has 4 clades across its range, as do *Mephitis mephitis*, *Perognathus flavus, Neotoma mexicana*, *Thomomys bottae,* and *Sorex monticola* (Demboski & Cook, 2001; Edwards & Bradley, 2002; Wickliffe et al., 2004; Neiswenter & Riddle, 2010; Andersen & Light, 2012; Barton & Wisely, 2012). *Microtus longicaudus* (Conroy & Cook, 2000) and *Mustela frenata* (Harding & Dragoo, 2012) each have 5 clades; within the 2 (east and west) North American clades of *M. frenata*, there are north and south subclades along the 40° N (Harding & Dragoo, 2012).

Only 2 potential hybrid zones for mammals have been formally identified for the Gila, although a number of other possibilities are now detailed in the species accounts. The first is between lineages of *Peromyscus maniculatus*, where the Rocky Mountain clade potentially comes into contact with the Southwestern New Mexico clade in the southern Gila (Dragoo et al., 2006). The second is between 2 species of *Tamias, T. cinereicollis* and *T. dorsalis,* which is indicated by mtDNA exchange between the two in Catron and Grant counties (Sullivan et al., 2014).

There have been only 10 phylogeographic studies to date that include samples from the Gila,). Only one distinct mammal lineage has been described from the state of New Mexico, perhaps due to the paucity of phylogeographic studies. Arbogast (2001) found a distinct lineage of *Tamiasciurus hudsonicus* in New Mexico (Sandoval County) and Arizona (Apache County, adjacent to the Gila), which Hope et al. (2016) propose should be called *T. fremonti* based on mtDNA, nuDNA, and ecological niche modeling.

As part of this study, we conducted mtDNA investigations of 4 species (*Notiosorex crawfordi*, *Neotoma albigula, Perognathus flavus*, and *Thomomys bottae*) that were previously studied phylogeographically, but had sampling gaps in the Gila. Below are the results of these preliminary studies.

Investigation of *Notiosorex crawfordi* corroborated findings of the previous study of this Southwest endemic (McAliley et al., 2007), finding specifically that New Mexico has a single species, *N. crawfordi*. There is no signature of hybridization between *N. crawfordi* and *N. cockrumi* where they are nearly parapatric in and around the Gila. Our data also show an interesting phenomenon that bears further study: *N. crawfordi* and *N.*

villai are more closely related genetically than are *N. crawfordi* and *N. cockrumi*, but are more geographically separated.

We found evidence of 2 clades of *Neotoma albigula* in New Mexico, Arizona, and Mexico: a northeastern clade (McKinley, Socorro, Otero, and northern Sierra Counties) and a southwestern clade (Chihuahua, MX, all Arizona Counties, and southern Sierra County). Interestingly, there appears to be a contact zone in the Gila (~Hillsboro, Sierra County) where the southwest clade of *N. albigula* and *N. leucodon* meet. This is also noteworthy given that *N. leucodon* was proposed to not occur west of the Rio Grande (Edwards et al., 2001), and our data show that it occurs near Hillsboro and on the Ladder Ranch, west of the Rio Grande.

Investigation of *Perognathus flavus* yielded 2 potential clades within the Gila, with specimens from the same locality (within 1.65 km of each other) parsing into separate clades. These data indicate that either there has been a relatively recent divergence following an isolation event, or that high genetic variation has been maintained with this population for a relatively long period of time. More intensive sampling and genetic study needs to be done to refine these preliminary findings.

Thomomys bottae is an excellent study mammal, as it has a relatively great number of subspecies and has a substantial background of hybridization and divergence studies. We found evidence of 2 clades in New Mexico, Arizona, and Texas: an eastern clade (eastern New Mexico and Texas) and a western clade (western New Mexico and Arizona), which indicates that *T. bottae* from the Gila are more closely related to populations in eastern Arizona than to other populations in New Mexico, which is similar to findings for *Tamiasciurus fremonti* (Hope et al., In Press), and points to the need for further study of isolation and divergence patterns of small mammals in western New Mexico and eastern Arizona.

Species of Concern

Frey (2010) addressed potential mammal species of concern in the Gila in an assessment that included mammals from Apache and Greenlee Counties in Arizona and Luna and Hidalgo Counties in New Mexico. She modified the methods of Yu & Dobson

(2000) to assess rarity and to assign species risk at the regional scale based on 6 criteria (high or low local population, large or small geographic range, broad or narrow habitat specificity), which then correspond to 8 classes of rarity. Only one of these classes is "common" and over 90% of the Gila mammal species in her assessment fell into one of the 7 classes of rarity (Frey, 2010). Species with high local population, large geographic distribution, and broad habitat specificity were given a score of 1, and all other species a score of 0 (Frey, 2010). This score was then added to the sum of the 6 risk criteria, with "Most Common" species receiving a rank of 4, and "Most Rare" species receiving a rank of 1. This assessment resulted in > 90% of the mammal species of the Gila being classified as rare, and 50% at risk for habitat loss (Frey, 2010).

The management implications of Frey's (2010) paper are overwhelming, given that conservation plans would be needed for > 90% of mammal species. This approach has merit, but only in light of continued study aimed at more carefully documenting distribution and status of most species in the Gila. Additionally, general inventory studies (including our own study) may suffer from sampling bias that can confound some approaches to establishing conservation priorities (Reddy & Davalos, 2003). Still, spatially extensive and site intensive collections that are made over time provide critical infrastructure for interpreting the impact of changing environmental conditions on mammals. Much more comprehensive work needs to be done on the complete mammal fauna composition of the Gila before rigorous and effective conservation plans for the mammalian fauna will be possible. This is not to say that conservation actions for select species are not warranted now.

Frey (2010) concluded that 11 species were "extremely rare" including the extirpated *Lontra canadensis.* Two bats, *Myotis evotis,* which we captured 14 specimens from 5 localities, and *Myotis auriculus*, which we captured 6 specimens from 3 localities, and *Peromyscus nasutus*, which we captured 8 specimens from 2 localities, were on this list. Although our survey did not produce large numbers of these species, the repeated encounter of these species, suggest that their status should be more intensively studied before concluding that they are "extremely rare." Much more work needs to be done to gather specimens and associated data from more localities, both historically sampled and new localities, to fully and accurately assess the status of species.

A potentially more tractable first step to summarizing conservation status may be to compile risk assessments across geographic scales, from global (International Union for Conservation of Nature-IUCN, and Convention on International Trade on Endangered Species-CITES), to national (Endangered Species Act-ESA) and regional (NMDGF) (MacDonald & Cook, 2007), and then focus more intensively on those species that emerge as potentially in peril. Using the above criteria along with the distributions and relative abundances obtained by this survey, I determined that 7 species should be considered for immediate (or reinvigorated) conservation assessment and monitoring: *Euderma maculatum, Lasiurus blossevillii, Canis lupus baileyi, Microtus montanus, Microtus pennsylvanicus, Dipodomys spectabilis*, and *Sciurus arizonensis.* These 7 taxa are 7.4% of the species evaluated in this study (Table 8).

Sciurus arizonensis is included due to its "data deficient" status and that this species is listed as "Threatened" in Mexico (Coronel-Arellano et al., 2016). There is speculation as to whether the Arizona gray squirrel is expanding its range east and north through New Mexico or simply previously went undetected in the eastern Gila (Frey et al., 2008), but in any case the lack of data on its distribution in southwestern New Mexico marks it as a candidate for concern in the Gila. *Sciurus arizonensis* is strongly associated with riparian forest habitat (Frey et al., 2008) so conservation of that habitat is imperative to this species' persistence and recent steps to lessen the impact of grazing should improve conditions for this species, but no one has assessed that possibility.

Euderma maculatum was designated as "Threatened" by NMDGF in 1988, although the 2014 Biennial Review of Threatened and Endangered Species of New Mexico stated that "Geluso (2006) was able to document the persistence of this species at most historic sites of occurrence in New Mexico and at 4 new sites." Hayward (1972) stated that *E. maculatum* is a late night flyer (after midnight), which could mask detection because nets are often closed before midnight. A conservation plan for *E. maculatum* in the Rocky Mountain Region recommended protection of habitat (both for insect prey and roost sites), minimization of insecticide use, limited takes, and further study as the primary conservation methods (Luce & Keinath, 2007). These also should be considered in the Gila, but without specimens a number of potential studies of this species will be intractable.

Microtus montanus arizonensis was listed as "Endangered" by NMDGF in 1979 as the only known records of occurrence are in Catron County. In 2008, NMDGF attempted to implement a recovery plan for both *M. montanus* and *Zapus hudsonius*, but those plans were not approved. Survey efforts (1998 and 2000 by NMDGF, 2004 by J. K. Frey) found populations of *M. montanus* persisting in Catron County, and identified 4 new sites. *Zapus hudsonius* is not known from the region.

The meadow vole, *M. pennsylvanicus*, should be considered for further study, as our survey efforts failed to find the species from 2 localities where *M. pennsylvanicus* was previously documented (12 km and 11 km SW of Aragon in the Gila, taken on 16 February and 12 April 1915. We also did not detect the species further north near San Rafael in Cibola County, about 140 km north of the Gila, so the loss of populations at the southern end of the species range is problematic. Riparian habitat around Aragon is severely over-grazed, greatly reducing the riparian grass-sedge habitat that *M. pennsylvanicus* needs to thrive and potentially causing the extirpation of the historically documented population (Anderson, 1961; Findley et al., 1975). Overgrazing is the purported cause of their extirpation from Galeana Marsh in Chihuahua, MX (List, 2010). Recommendations made for the conservation plan for *M. montanus* potentially could be applied to *M. pennsylvanicus*, as protection of riparian and high grass-cover habitats in the San Francisco watershed would enhance the conservation of both species in the Gila.

Dipodomys spectabilis is listed as "Near Threatened" by IUCN throughout its range due to loss of desert grassland habitat to encroaching mesquite and creosote (Linzey et al., 2008) and a history of federally funded poisoning campaigns to lessen impacts to livestock. Mitigation of anthropogenic impacts that directly impact kangaroo rats or lead to shrubby encroachment should be implemented to protect *D. spectabilis*. We captured 10 specimens during the 2012-2014 survey at 2 localities on the Ladder Ranch and observed a population north of Dusty in Sierra County. Further survey and study efforts should attempt to map the distribution of this species and estimate the relative abundance of these populations in the Gila.

Both species of prairie dogs (*Cynomys gunnisoni* and *C. ludovicianus*) were extirpated from the Gila, although a small population of *C. ludovicianus* has been reintroduced (see species account). These extirpations can be attributed to concerted efforts by the federal government to control species deemed "noxious" or "injurious," which included prairie dogs, ground squirrels, pocket gophers, jackrabbits, and "similar rodent pests" (Bell, 1921). *Dipodomys spectabilis* was considered "not of great economic significance" but still received a "death sentence" where it existed in areas dedicated to agriculture (Vorhies & Taylor, 1922), and ranchers in Animas noted that prairie dogs and banner-tailed kangaroo rats were "objects for destruction by federal agents" (Alexander, 1932). These poisoning campaigns began as early as 1912 and were intensified by 1930 when Congress passed the Animal Damage Control Act (Dunlap, 1988). In New Mexico from 1916-1920, 2,047,646 acres of land (1916-177,010 acres; 1917-95,435 acres; 1918-1,167,094 acres; 1919- 951 acres; 1920- 607,156 acres) were treated with poisoned baits (Bell, 1921).

The subspecies *Canis lupus baileyi* is listed as "Endangered" by NMDGF and the ESA, while *Canis lupus* is listed as Appendix II by CITES as a species that may not currently be threatened with extinction but could become so (https://www.cites.org/eng/app/index.php). Mexican gray wolves were extirpated from all of New Mexico by 1927, and the last recorded specimen from the Gila was from 24 km SE Reserve on 11 May 1925 (USNM 245841). The greatest historic abundance was in the Gila (Robinson, 2005). Plans to recover Mexican gray wolves began in 1977 and were executed in 1998 with the release of 11 wolves into the Blue Range of the Gila Wilderness (Hedrick & Frederickson, 2007).

Efforts to recover the Mexican gray wolf have been stymied by political pressures, local opposition, conflicts between state and federal managers, and the original designation of the program under ESA section 10(j) as "non-essential, experimental" which states that the goal is to prevent Mexican gray wolf from going extinct, but not necessarily to fully recover them (43 Federal Register 9607, 1978; David Parson, pers.

comm.). Revisions to the rules for the Mexican gray wolf program were published in January 2015 by U.S. Fish & Wildlife Service (USFWS, 2015), which designated the Mexican gray wolf as an endangered subspecies, and revised the non-essential, experimental rules such that USFWS is able to “achieve necessary population growth, distribution, and recruitment that would contribute to the persistence of, and improve the genetic variation within the experimental population.” This rule changed the acceptable population size from 100 wolves to 300-325 wolves and expanded the southern boundary of the recovery area in Arizona and New Mexico and also allowed for releases from an expanded area (80 Federal Register, 2015). Arizona Department of Game and Fish (ADGF) filed a lawsuit in June, 2015 against USFWS because USFWS has not updated the Mexican gray wolf recovery plan since 1998 (David Parson, pers. comm.) and 4 conservation groups jointly filed a lawsuit against USFWS in July 2015 in opposition to the rule change that would cap the wolf population at 300-325, and keep the population south of I-40 (David Parsons, pers. comm.). USFWS has stated that they will produce a new recovery plan by November 2017 (David Parson, pers. comm.).

The primary threats to the wild population of Mexican gray wolf according the most recent Conservation Assessment (USFWS, 2010) are illegal shooting, small population size, inbreeding, and inadequate regulatory protection. From 1998-2014, there were 111 deaths of wild wolves in New Mexico and Arizona, of which 54.9% were “Illegal Mortality” (shooting or trapping) (second largest cause of mortality was “Natural Causes” with 18.9%) (USFWS, 2010). This high morality demonstrates the need for more stringent investigation and prosecution of illegal shootings.

After the current Governor, Susanna Martinez, was sworn into office on 1 January 2011, NMDGF discontinued its participation in the Mexican wolf recovery program. Since then, the NMDGF Game Commission appointed by Martinez has denied a permit to the Ladder Ranch for a Mexican gray wolf captive facility, which it had held since 1998. The appeal of the closure of this facility was denied in January 2016.

Migrating tree bat *Lasiurus blossevillii*, although not mentioned in any of the official conservation assessments, is recommended for additional conservation study. While they are not year-long residents, these tree bats migrate through the Gila every year. While other migrating tree bats are found in moderate numbers (*L. cinereus*, 20 specimens taken in this study, and *Lasionycteris noctivagans*, 40 taken in this study), only 5 *L. blossevillii* have ever been captured in the Gila. These bats roost in large deciduous trees (Mager & Nelson, 2001) so their roosting sites are at risk from threats like catastrophic fire and loss of deciduous trees via riparian habitat conversion. Industrial scale wind farms south of the Gila may heavily impact migratory bats such as *Lasiurus*, although the impacts can be mitigated (Baerwald & Barclay, 2011).

Habitats of Concern

Protection of riparian habitats, most importantly along the Mimbres and Gila River and tributaries including the San Francisco River, would help address the habitat requirements of *L. blossevillii*, *M. pennsylvanicus*, and *S. arizonensis*, and so should be considered a top conservation priority. The Gila River has been proposed for diversion in the amount of 14,000 acre/feet/year (Gori et al., 2014). The flow variability that characterizes the Gila River creates many different habitat types (riparian forest, wetlands, and floodplains) with varied flow across different seasons, which then serve to increase biodiversity (Gori et al., 2014). The proposed diversion would decrease both number and extent of mid-size flows and negatively impact:

• Preservation and perpetuation of riparian forest (affecting roosting sites for bats and habitat/food for Arizona gray squirrels).

• Connection of the river to the floodplains (affecting habitat for hydroseric species).

• Aquatic habitat (fish-prey for many mammal species, such as *Procyon lotor*).

• Reproduction and emergence of aquatic and aquatic-associated invertebrates (decreased food supply for riparian-associated bats) (Fukui 2006; Valdez & O’Shea 2014).

• Vegetation productivity for food resources (*S. arizonensis, Microtus* species).

In addition to the above-mentioned species, beavers (*C. canadensis*) and muskrats (*O. zibethicus*) are also at risk with proposed diversion, due to their status as riparian obligates (Gori et al., 2014). Their current status in the Gila is largely unknown and more work is needed to quantify their actual abundance and distribution.

Desert grasslands are at risk of declining; one study in the Jornada Experimental Range in southwest New Mexico discovered that shrub cover has increased by > 12% and grassland has decreased by > 16% from 1937 to 2003 (Laliberte et. al., 2004). Desert grassland obligate species, like *Dipodomys* and potentially *Onychomys, Chaetodipus,* and *Perognathus,* may be at risk if open grasslands continue to decline. There have been no studies on mammalian population responses to shrub encroachment in the southwest U.S., but a study in South Africa showed decreased species richness (R^2=.74) with increased shrub cover, and total rodent abundance showed a bell-shaped relationship, wherein abundance rose until ~15% cover then declined dramatically (Blaum et al., 2006). A study at the same site found similarly mixed results for mesocarnivore species, ranging from no significant impact of shrub encroachment on 3 species, to decline and rise then decline at ~15% cover in 2 species (Blaum et al., 2007).

General Threats to Gila Mammal Biota

Fire

Fires are a natural part of the ecosystems of the Southwest, and in fact "national forests of the region average more fires per year than any other region" (Pyne, 1982). The Southwest has a history of myriad fire types (lightning caused, indigenous traditional and war fires, prescribed burns, and accidental fires) and has one of the largest concentrations of lightning-caused fires in the world (Pyne, 1982). Recent catastrophic fires (Table 9) and subsequent flooding may have caused damage to ecosystems of the Gila. The catastrophic nature of these disturbances is largely due to fire suppression and other management practices of the last 70 years (e.g. anthropogenically-mediated drought), which resulted in build-up of litter layers and slash that fuel intense, stand-replacement fires (Covington & Moore, 1994; Keane et al., 2002).

Fire disturbance holds consequences for mammals of the Gila, especially forest-associated mammals like the tree-roosting bats, *L. blossevillii, L. cinereus,* and *L. noctivagans* (Griffin, 1970; Kunz, 1982; Shump & Shump, 1982) and also for riparian associated species. The tree squirrels, *Sciurus aberti, Sciurus arizonensis, Tamias cinereicollis*, and *Tamiasciurus fremontii* (Findley et al., 1975; Patton, 1975; Merriam, 1890), may be heavily impacted by catastrophic fires. Ream (1981) found that *T. hudsonicus* will not inhabit areas that experienced stand-replacing fires, and Allard-Duchene et al. (2014) found that *T. hudsonicus* will inhabit a manually thinned area about 20 years sooner than a burned area. A study in the Coconino National Forest of Arizona found that prescribed burns were negatively correlated with occurrence of *Tamias cinereicollis* (Converse et al., 2006)

Climate Change

Climate data from local weather stations show temperatures in the Gila National Forest, Aldo Leopold National Forest, Ladder Ranch, and surrounding areas has increased while precipitation has decreased since the early 1900s (Girvetz et al., 2009). Moritz et al. (2008) and Rubidge et al. (2010) have shown that climate can affect mammalian ranges. Moritz et al. (2008) conducted one of the Grinnell resurvey projects that investigated mammalian range shifts in the Sierra Nevada Mountains. They found generally that low elevation species expanded their ranges upward in elevation, while high elevation species contracted their ranges (Moritz et al., 2008), although some species showed idiosyncratic movements. Based on that study, I expect potential range shifts in mountainous areas of the Greater Gila Region with range expansion in *Reithrodontomys megalotis, Peromyscus truei,* and *Sorex monticola* and range contraction in *Microtus longicaudus* and *Otospermophilus lateralis*. Such changes can increase extinction risks for high elevation species, as mountaintops have a finite range to occupy (McDonald & Brown, 1992, Parmesan, 2006).

Bats are also at risk. Adams (2010) showed a significant decrease in insectivorous bat reproduction in years with lower precipitation in the Front Range of Colorado. Rebelo et al. (2010) hypothesized that many bat species will be at risk of extinction due to rising temperatures and declining precipitation and it is likely that some populations in the Gila will be locally extirpated in the future with increasing drought conditions. Several New Mexico bat species roost communally and dehydration presents significant challenges due to the high temperature and low humidity of the microclimates within roosts. Communal maternity roosts may be challenged by the increased physiological stress of nursing mothers due to milk production (Adams, 2008). Therefore, the ability of female bats to survive and raise young hinges on ready access to water. Given projected trends for warming and drying across the Southwest, reproductive success and survival of bat pups in New Mexico may be severely reduced. Sherwin et al. (2012) published a review paper examining potential risk factors for bats with changing climate and identified food, roosts, reproduction, and distribution as potential risks. Reduced precipitation may cause decreased food supply for insectivorous and frugivorous bats, habitat availability may be decreased for tree-roosting bats, issues with ability to reproduce as outlined above by Adams (2008) (2010) are likely, and species with a small range or a high-latitude range will likely have less ability to moderate the effects of any dramatic environmental change (Sherwin et al., 2012).

As most bat species migrate or hibernate, their phenology should be carefully monitored in relation to climate trends to determine whether these two variables are related. This potential correlation requires geo-referenced specimens to mark the time and place of species' hibernation, migration, and reproduction. To that end, we have included new records for Gila counties for earliest capture, latest capture, and earliest embryo (Table 10).

Grazing Disturbance

The Greater Gila Region has a long history of grazing, beginning in the late 1880s when Texans began moving into the area with their cattle, notable among these is the Shelley family near Cliff. Shortly thereafter the Stock Raising Homestead Act of 1916 allowed for fencing of all the various allotments and encouraged cattle growers to make "water improvements" (Rice et al., 2008). After the designation of the Gila Wilderness and the Aldo Leopold Wilderness, some of these allotments were reduced, resulting in 18 wilderness allotments with 334,751 hectares and 95 non-wilderness allotments with 531,343 hectares. This also resulted in a reduction of overall AUMs (Animal Unit Month per acre, where one cow with a calf grazing for one month is 1 AUM). The AUM value fluctuates from year to year with variables like precipitation and livestock purchase price. There was a large decrease of AUMs on the 18 wilderness-designates allotments for years 1928 to 2007 (from 83,499 to 18,772 ha). The allotments designated as non-wilderness have also decreased AUMs for years 1928 to 2007 (from 96,563 to 46,976 ha). However, once conditions for cattle growers improved after 2007, AUMs increased 260% (Ashcroft et al., 2012). These data show the number of livestock in the region is not static. Although designation of the wilderness areas caused a drop in total AUMs for the Greater Gila Region, fluctuations continue with large numbers of livestock continuing to graze.

Livestock grazing has been scrutinized as a possible threat to biodiversity (Fleischner, 2002; Milchunas & Lauenroth, 1993; Jones 2000). Hayward et al. (1997) performed small mammal surveys for 10 years at San Simon Cienega (at the Arizona/New Mexico border) across 4 plots, 2 grazed and 2 ungrazed. They found total abundance of small mammals was about 50% less in grazed plots, and *Sigmodon hispidus* and *Reithrodontomys megalotis* were especially sensitive to the effects of grazing (Hayward et al., 1997). Similarly, a study by Moser & Whitmore (2000) found significantly greater abundance of small mammals, species richness, and diversity (based on Shannon-Weiner and Simpson indices of diversity) on sites that were ungrazed when compared with grazed sites. They also discovered that shrews were only captured on ungrazed sites (Moser & Whitmore, 2000).

CONCLUSIONS

The Greater Gila Region of New Mexico is notable for its dynamic geologic and paleontological history that has led to a high mammalian diversity. Key components of this diversity may be in peril due to climate change, fire, grazing disturbances, and industrial energy sources. To preserve the contribution that this area makes to the Southwest's biodiversity, further research is recommended that will surely lead to greater insights into mammalian communities and spur conservation of this important area of the Southwest.

Appendix A- Gazetteer of localities: 2012-2014 Survey

Ladder Ranch:

-1 km N, 10 km W of Caballo (26-28 October 2012)-riparian and desert scrub

-3.4, 5 km ENE of Animas Peak (11-15 March 2013)-riparian and desert scrub

-Ladder Ranch Headquarters (26 March 2013)-riparian

-3.4 km northeast of Animas Peak (12-14 April 2013)-riparian and desert grassland

-9 km N Myers Mesa (23-25 May 2013)-piñon-juniper, desert scrub

-Pague Tank (4-7 June 2013)-piñon-juniper

-Palomas Creek (10-14 June 2013)-riparian, desert scrub

SW Animas Creek, 3.85 km ENE Bell Mountain (17-20 June 2013)-riparian, desert grassland

Animas Creek, 7.5 km north of Animas Peak (7-9 September 2013)-riparian

Seco Creek, 3.4 km west of Indian Peak (8-9 February 2014)-ponderosa, piñon-juniper

Cuchillo Creek (17-21 March 2014)-riparian, desert grass scrub

1.5 km N Bell Mountain (24-25 May 2014)-riparian

Wanda Tank, Cave Creek (2-6 June 2014) desert grassland, desert scrub, riparian

0.8 km NE of Lost Arrowhead Mine (12-13 June 2014)-desert grassland

1.35 km west of Animas Creek (17-18 June 2014)-desert grassland, desert scrub

1.56 km east of Saladone Tank (19-20 June 2014)-desert grassland, desert scrub

Gila National Forest

Mogollon Mountains, Gila River 10 km N, 10 km E Cliff (11-13 October 2012)*-riparian, desert scrub

Rockcore Tank, NM Highway 59 & Forest Road 226 (20-22 May 2013)-ponderosa pine

20.9 km N Mimbres, along Mimbres River, in Cooney Canyon (10-13 October 2013)*-riparian, ponderosa pine

0.75 km SE of Alexander Peak (11-13 April 2014)-piñon-juniper, ponderosa pine

Yates Canyon, Black Range (19-23 May 2014)-ponderosa pine, mixed conifer

Black Canyon, 1.51 km SE Middle Mesa (24-26 June 2014)*-riparian, ponderosa pine

Eagle Peak, Forest Service Road 233(28-29 June 2014)*-ponderosa pine, mixed conifer

Willow Creek Campground (12-13 September 2014)*riparian, ponderosa pine, mixed conifer, montane grassland

Apache Creek Campground (14 September, 2014)*-riparian, ponderosa pine

3 km SW of Tyrone Mine (26-28 September 2014)*-ponderosa pine

2 km E Beaverhead Ranger Station (8-11 October 2014)*-piñon-juniper, ponderosa pine

Aragon, NM along Highway 12, mile marker 27.8 (24-26 October)*-riparian, ponderosa pine

Other

20 Village Rd, Silver City (26-28 September 2014)*-piñon-juniper

*indicates re-survey site

Appendix B- Data Page

Loclity:____

Project: Mammals of Gila, Mammal Class 2014   Dates:___________________ GPS

Name:_______________

Habitat Type (check one):

________ Shortgrass Plains (blue grama, honey mesquite, Ephedra, and yucca)

________ Sacaton Grassland (sacaton grass, Thurber's pepperwood, sunflower, silver-leaf nightshade)

________ Sycamore riparian (sycamore, Arizona walnut, desert willow, pale wolf-berry)

________ Cottonwood riparian (cottonwood, Goodding's willow)

________ Oak savannah (desert scrub oak, alligator juniper, agave, sideoats grama, manzanita)

________ Oak Woodland (Gambel's oak, Arizona oak)

________ Pinion-Juniper (Pinion pine, one-seeded juniper)

________ Ponderosa (ponderosa pine, Gambel's oak, alligator juniper)

________ Mixed Conifer (Douglas fir, Apache pine, Ponderosa pine)

________ Chapparral (mountain mahogany, manzanita, silverleaf oak)

Estimation of vegetative cover %   Tree ______   Shrub ________   Forb_________   Other notes?

Date______________
Trapline Name__________

Shermans ___ Museum Sp. ___ Rat traps ___ Pitfalls___ Macabees ___ Tomahawks___

____

Species   NK #

GPS Waypoint

Date______________
Trapline Name__________

Shermans ___ Museum Sp. ___ Rat traps ___ Pitfalls___ Macabees ___ Tomahawks___

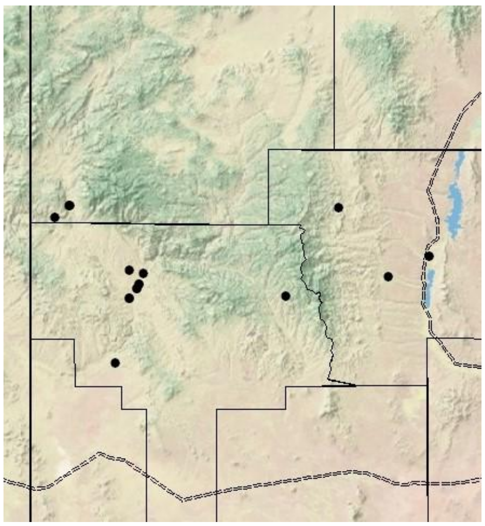
____

Species   NK #

GPS Waypoint

Appendix C- Maps of the Gila study area showing the distributions of those species with exact collecting localities. Dots on the maps refer to localities listed in the specimens collected, specimens examined, and additional records referred to in the individual species accounts.

SORICOMORPHA



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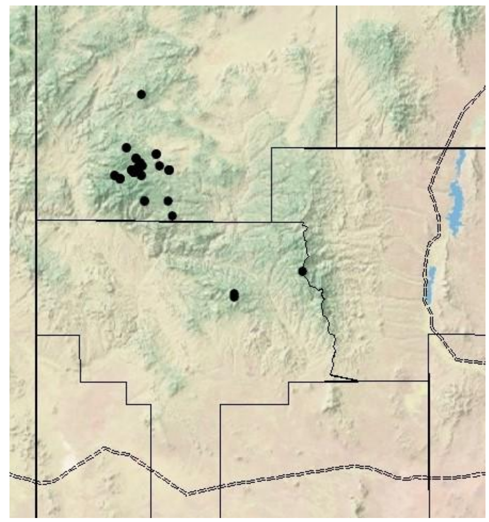
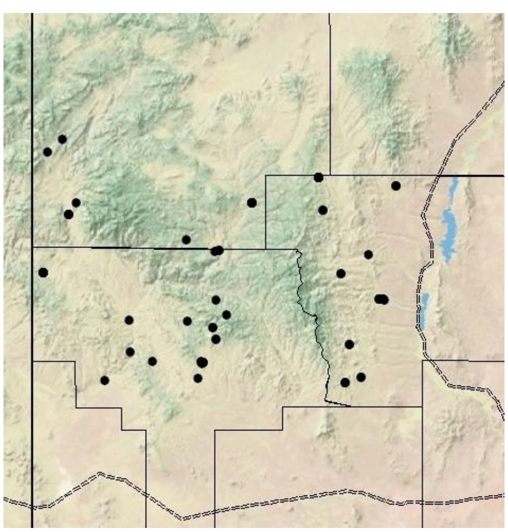


Sorex monticola

CHIROPTERA



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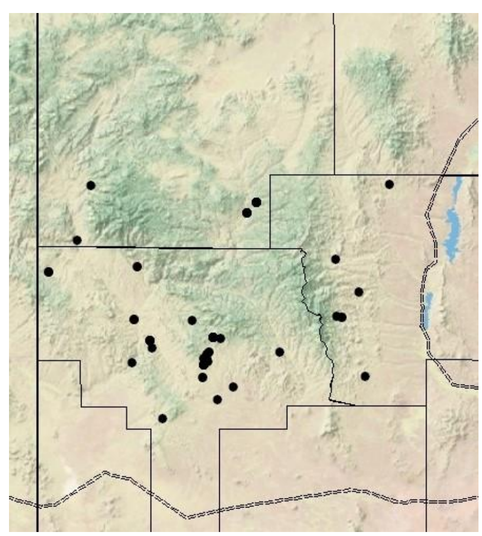

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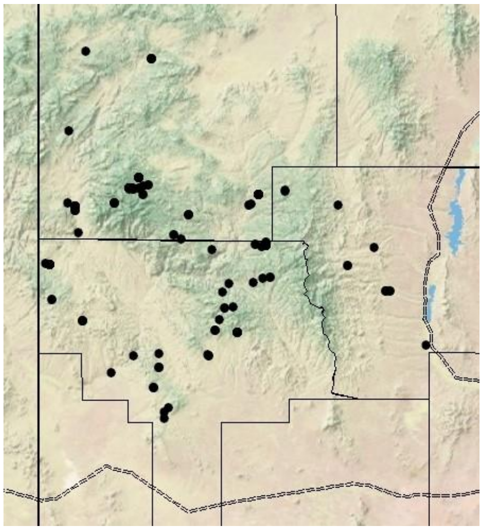
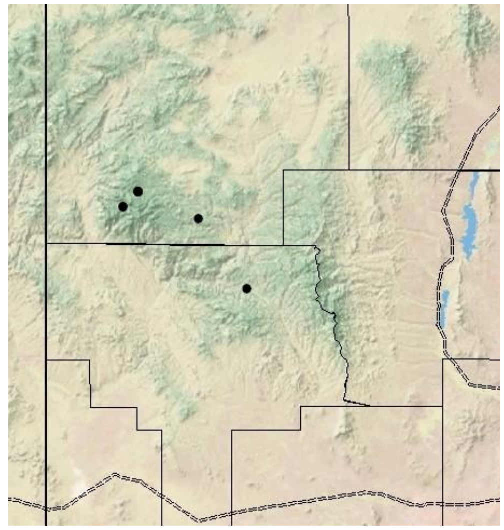


Eptesicus fuscus



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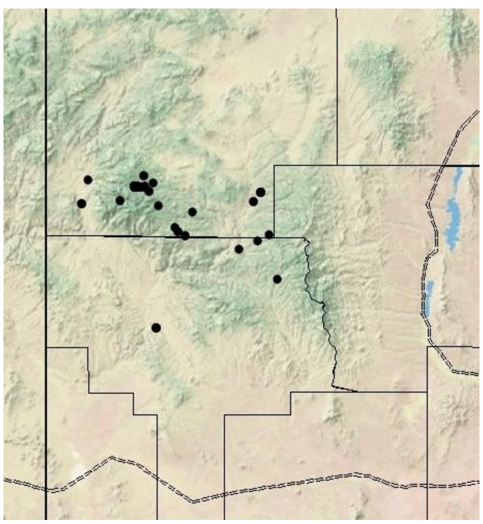

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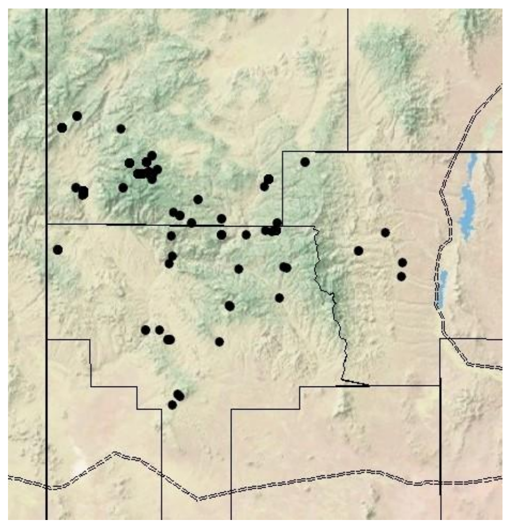
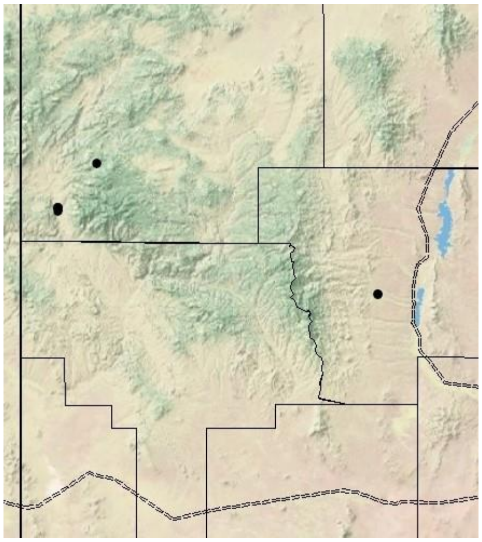
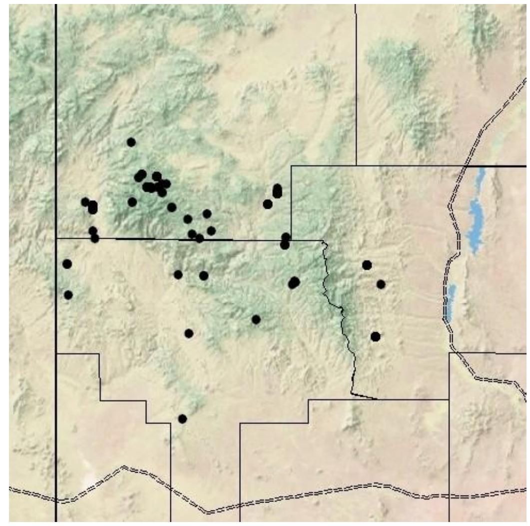


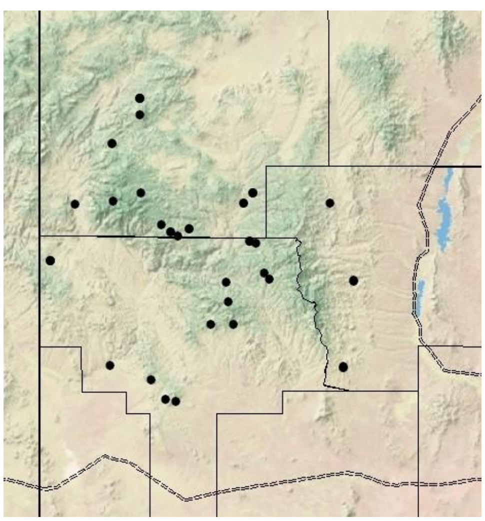
Lasionycteris noctivagans



Lasiurus blossevillii



Lasiurus cinereus



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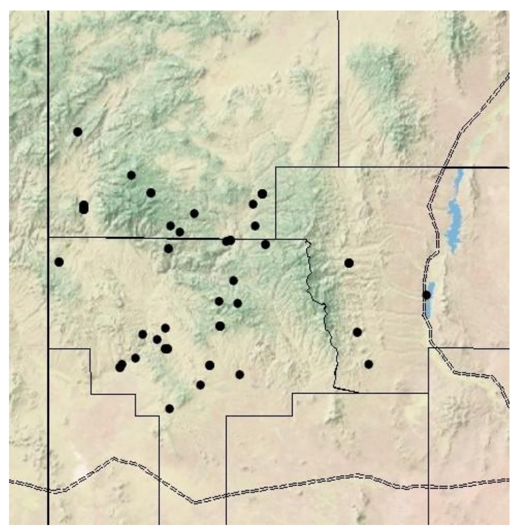

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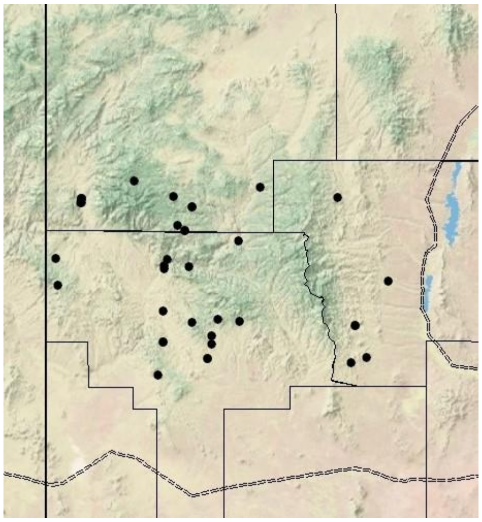

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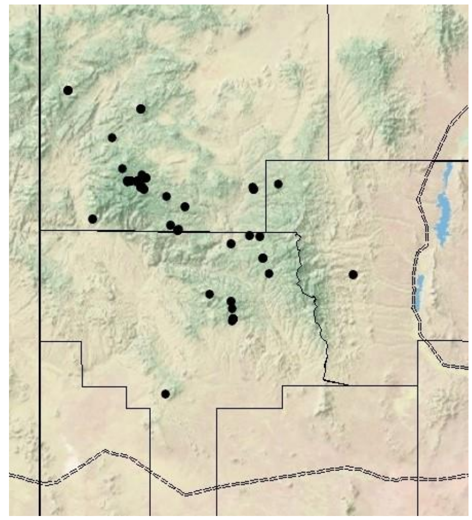

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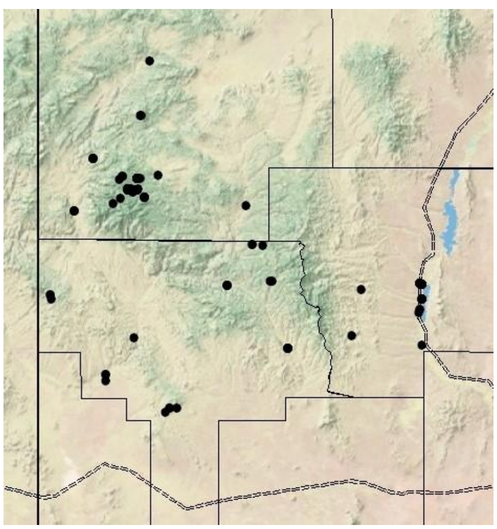

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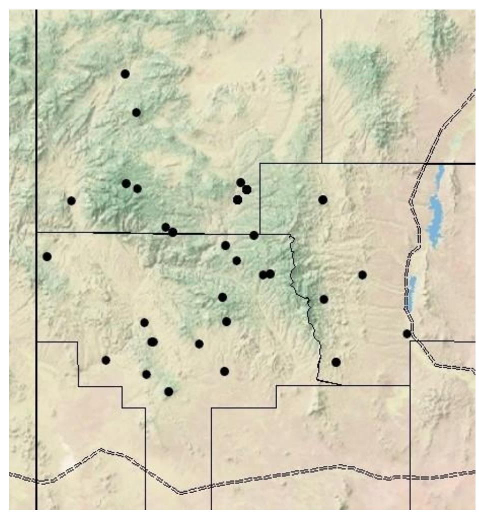

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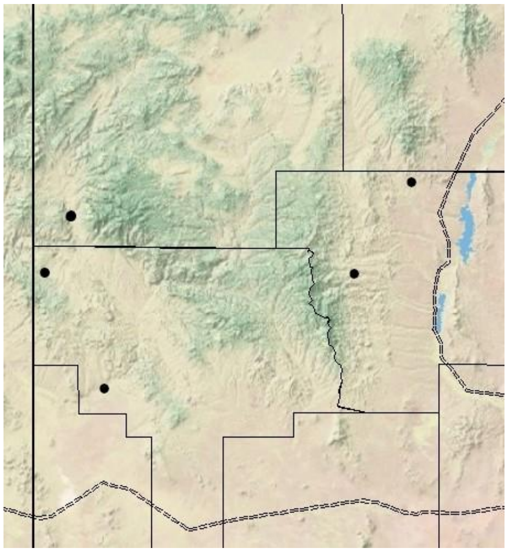
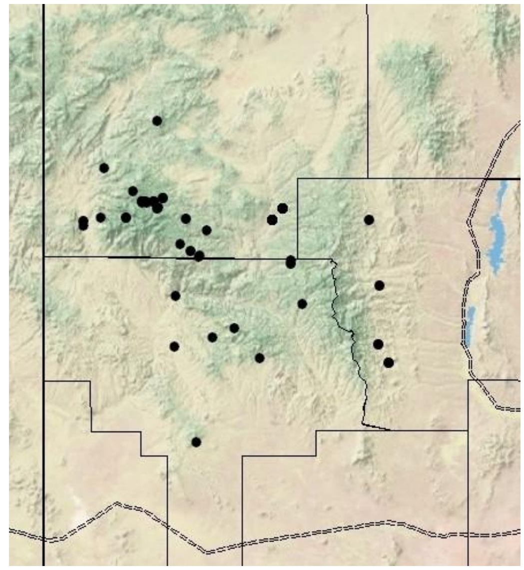


Myotis velifer



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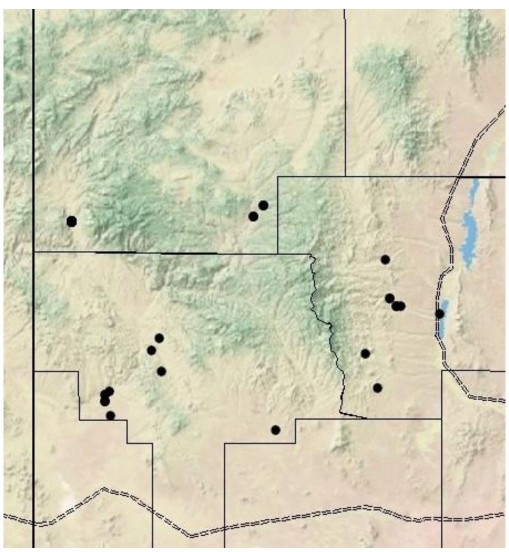

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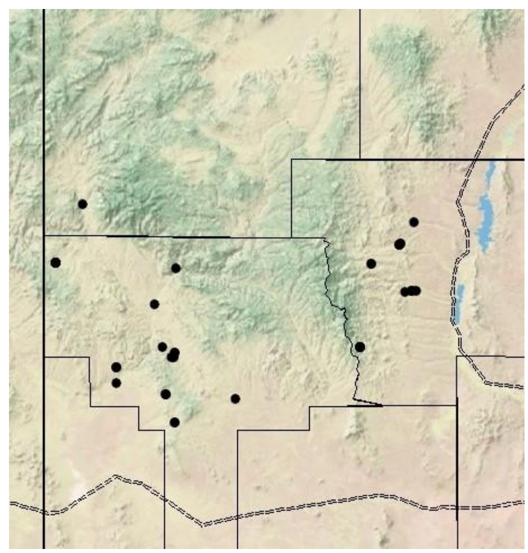

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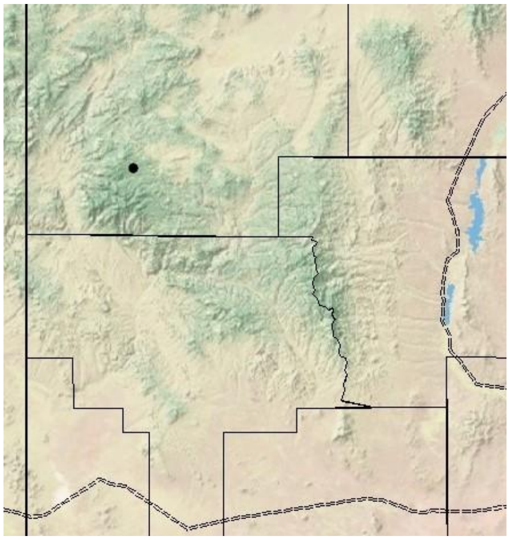

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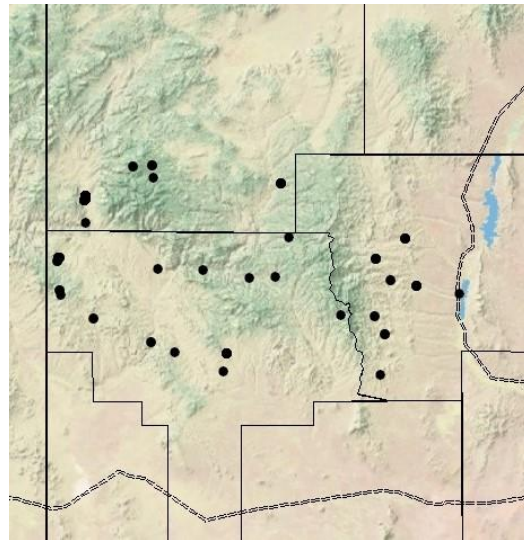
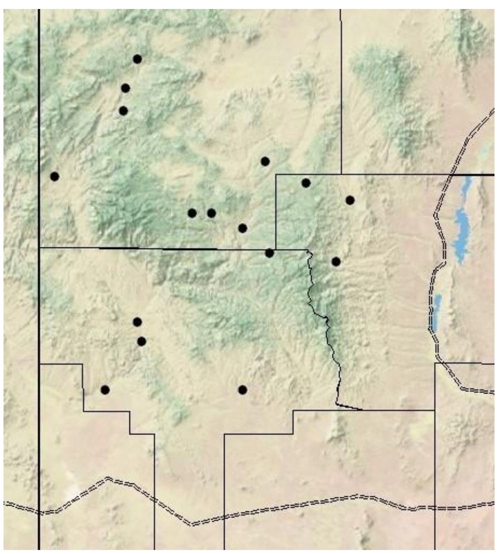


Tadarida brasiliensis

CARNIVORA



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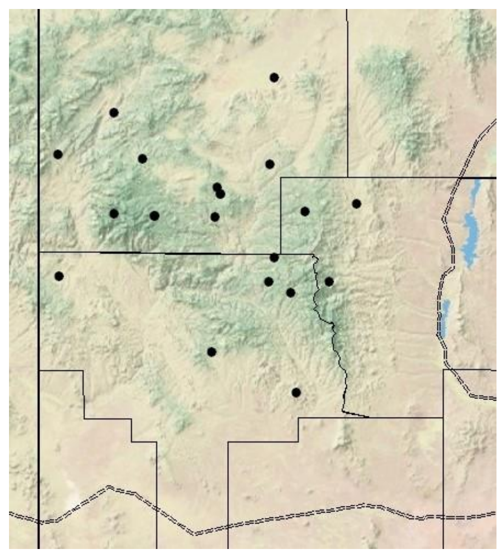

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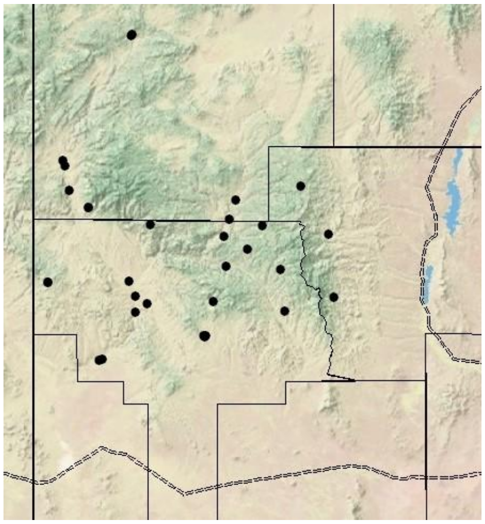

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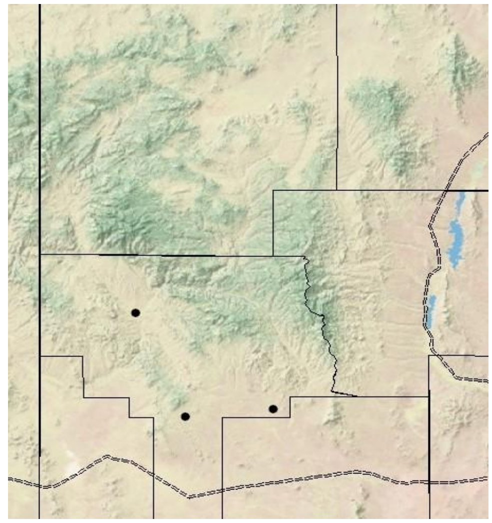

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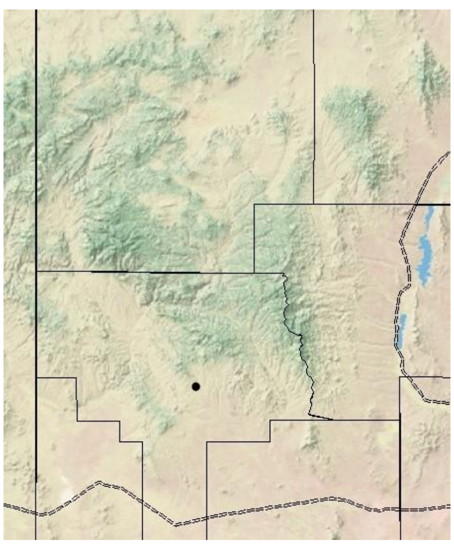

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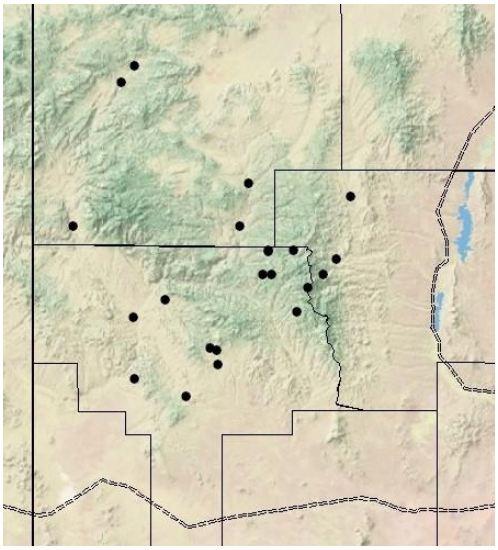

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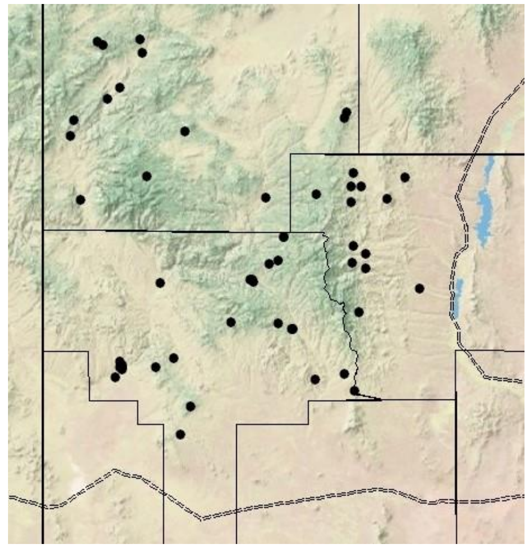

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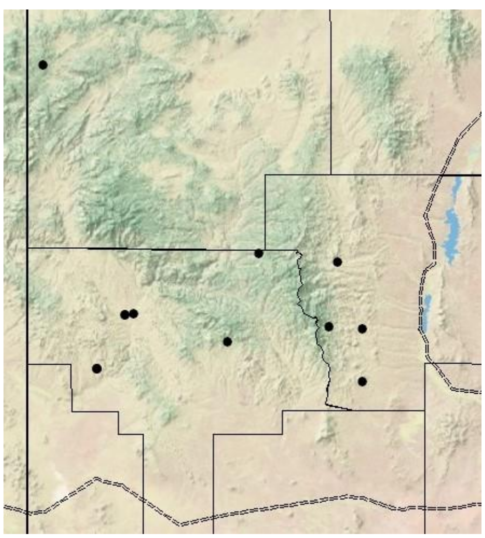

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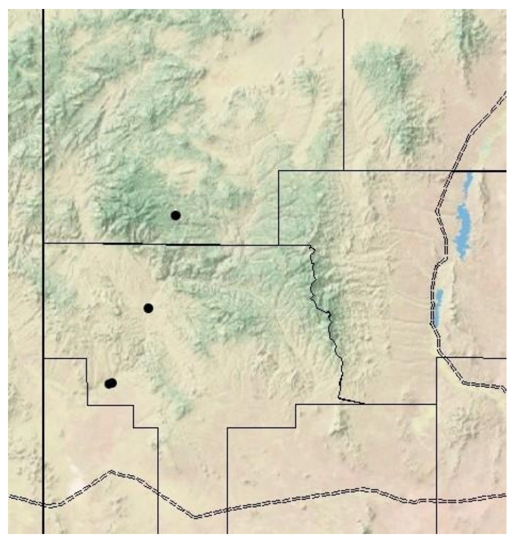

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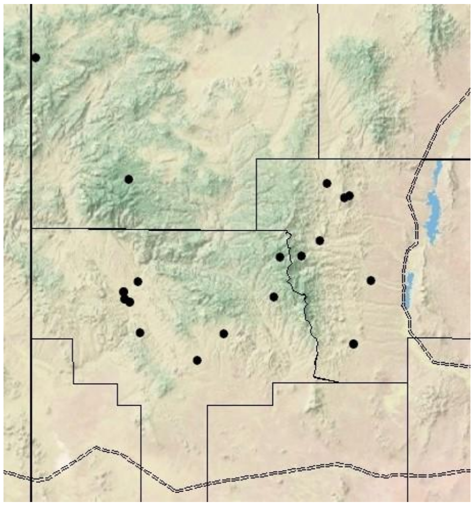

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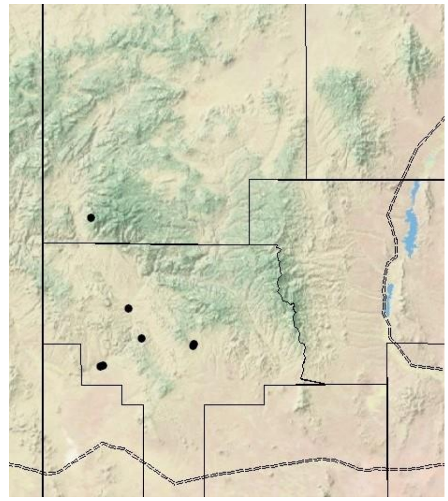

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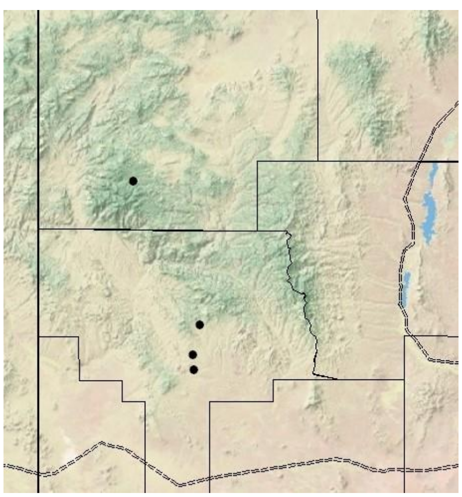

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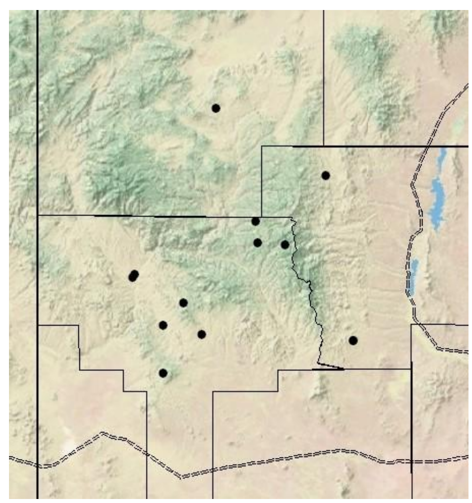

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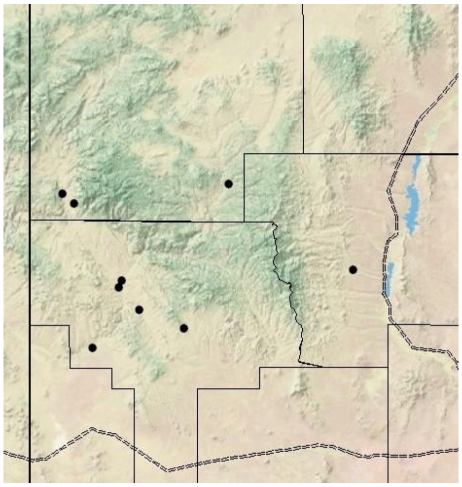

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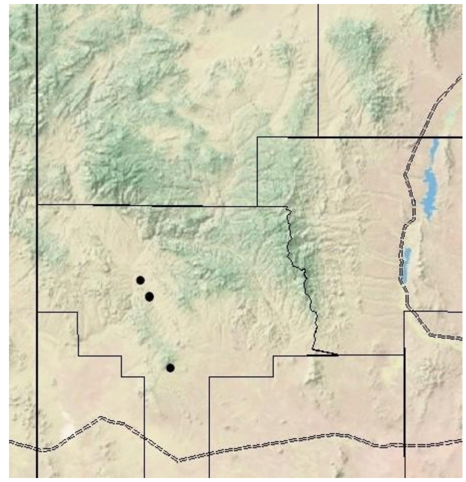

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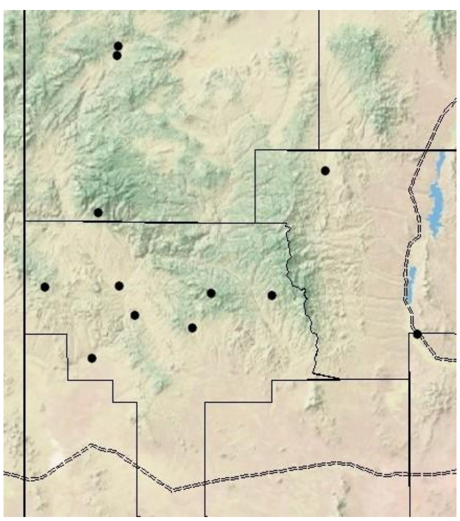

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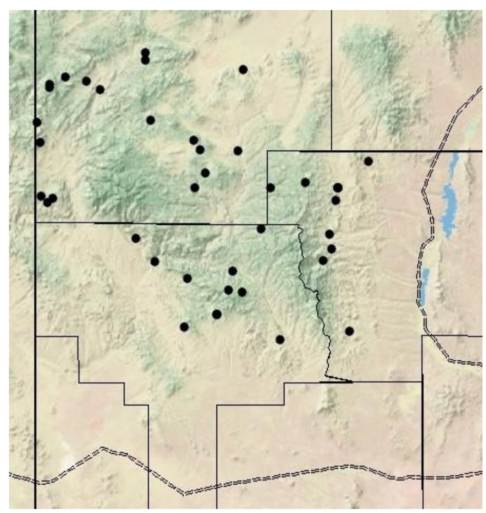
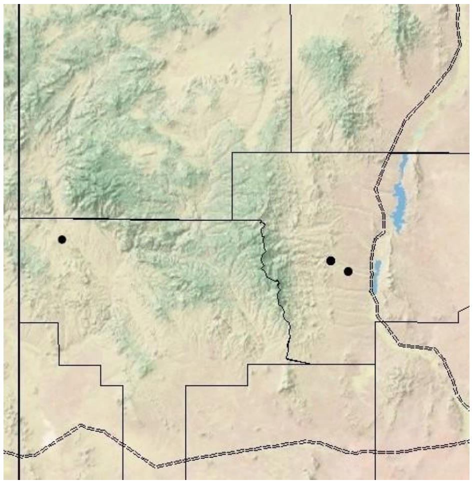


Ursus americanus

ARTIODACTYLA



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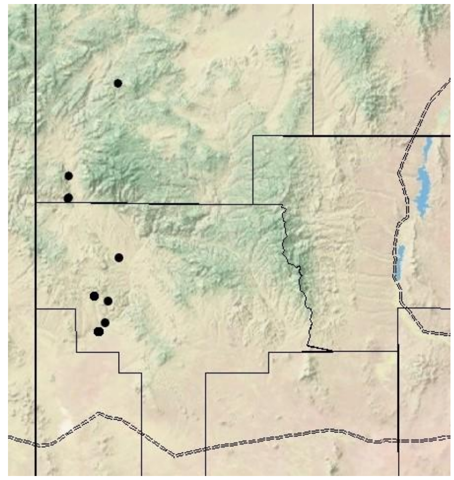

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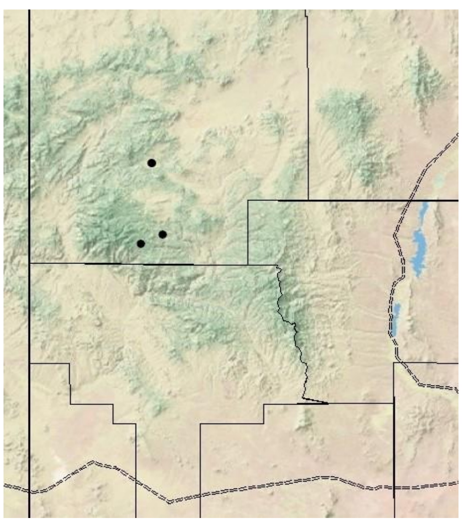

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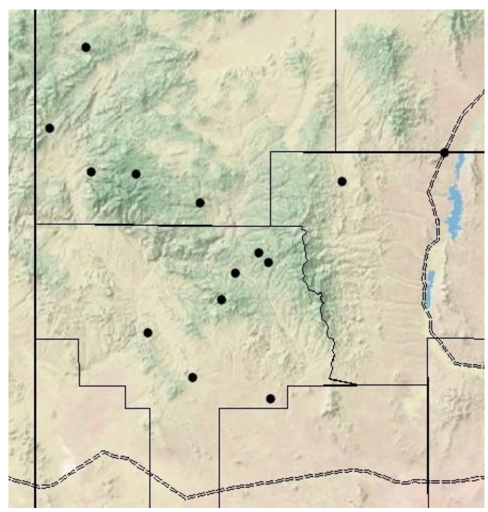

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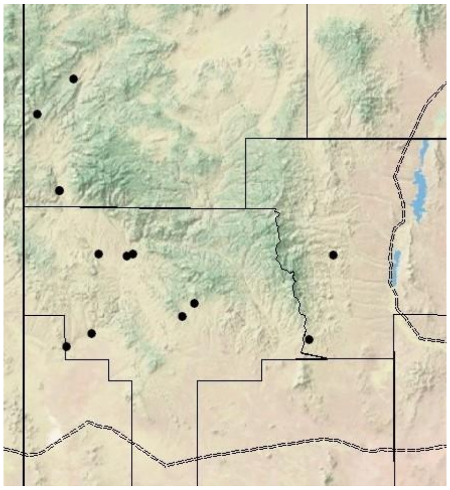
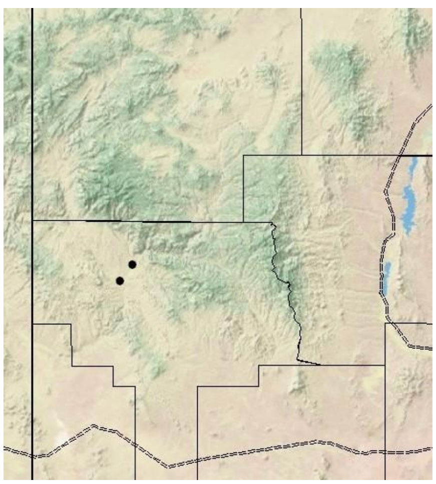


Pecari tajacu

RODENTIA



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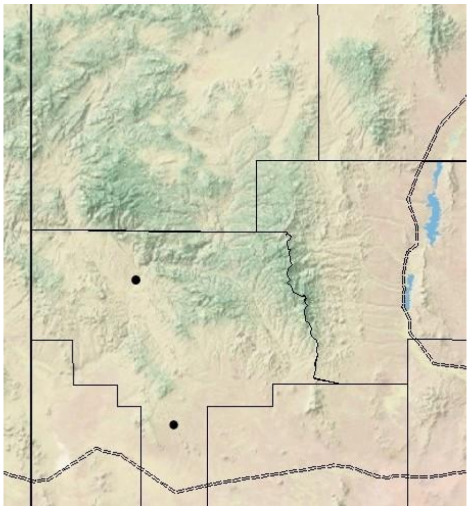

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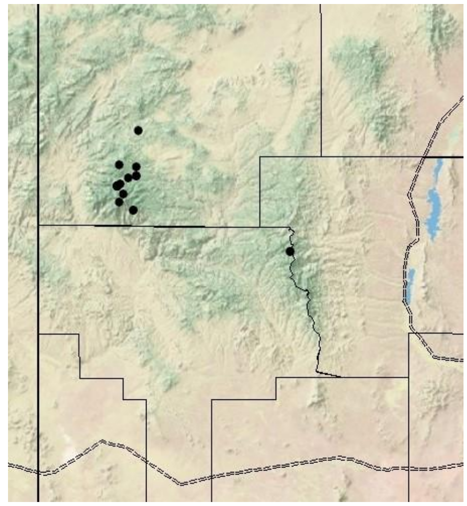

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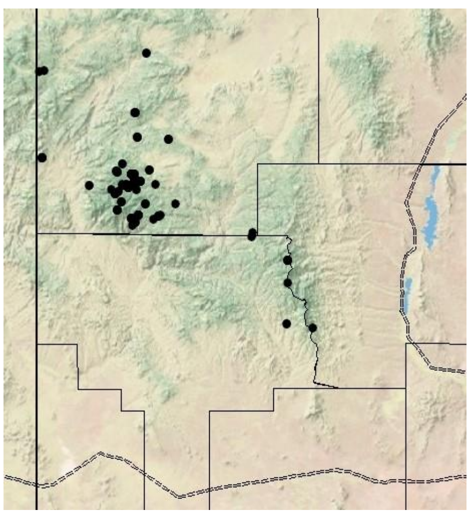

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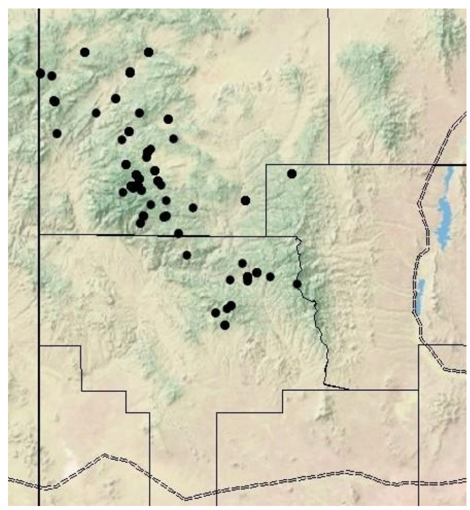

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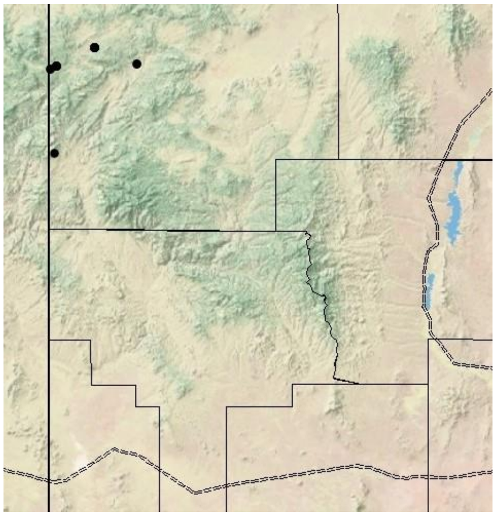
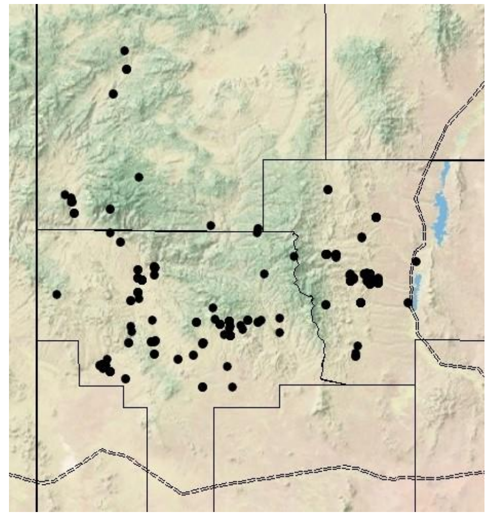


Microtus montanus



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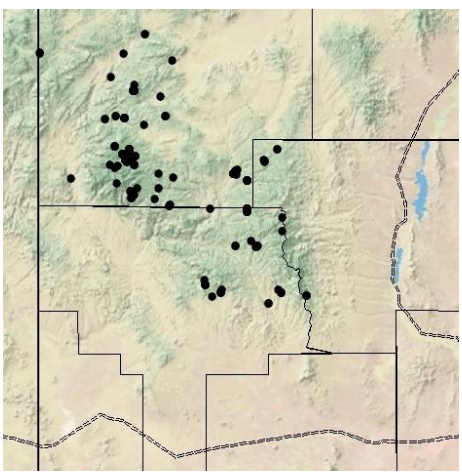

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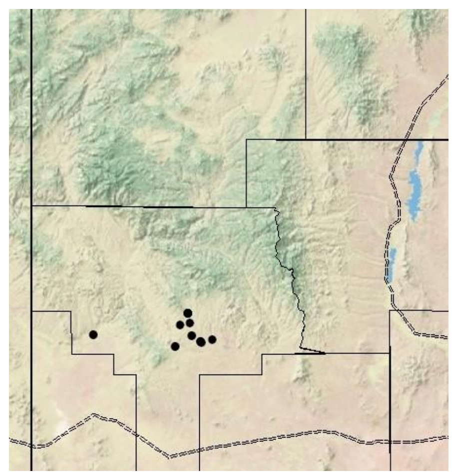
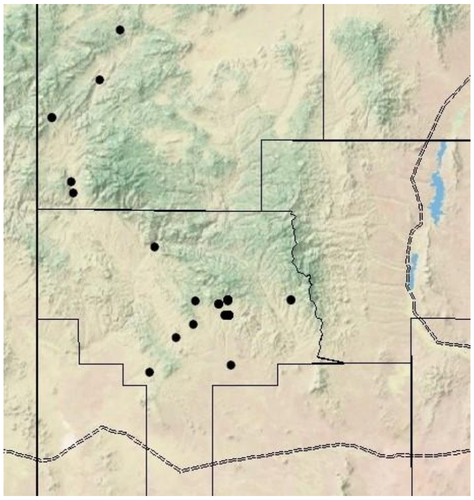
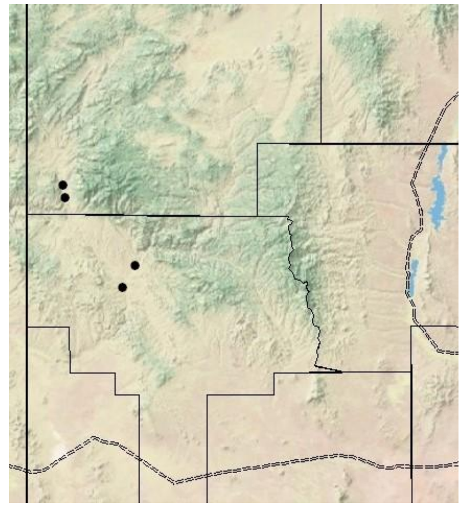


Neotoma micropus



Neotoma stephensi



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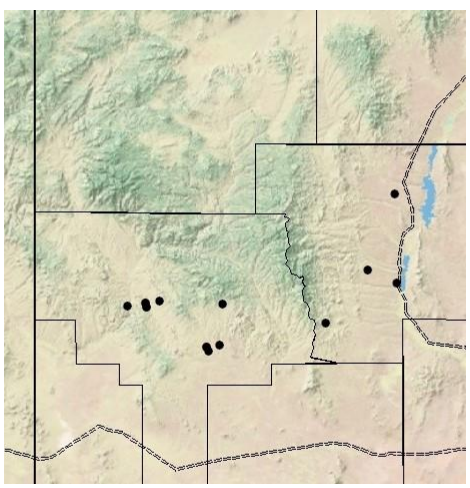

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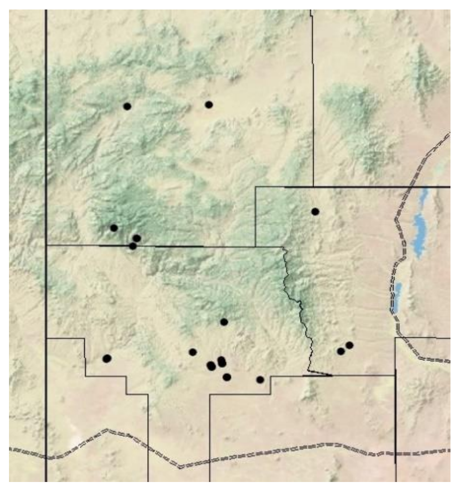
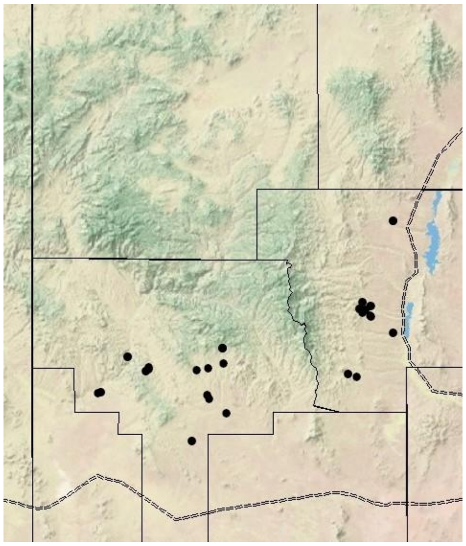


Onychomys leucogaster



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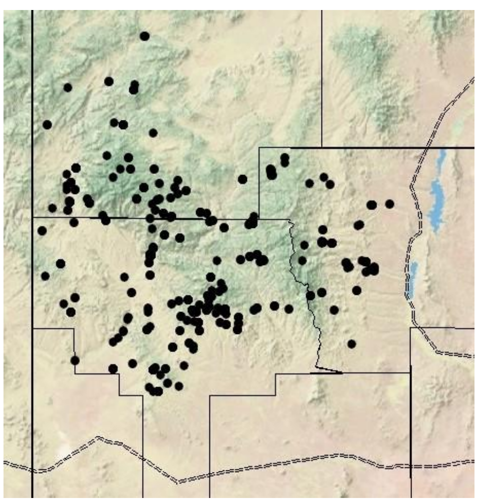
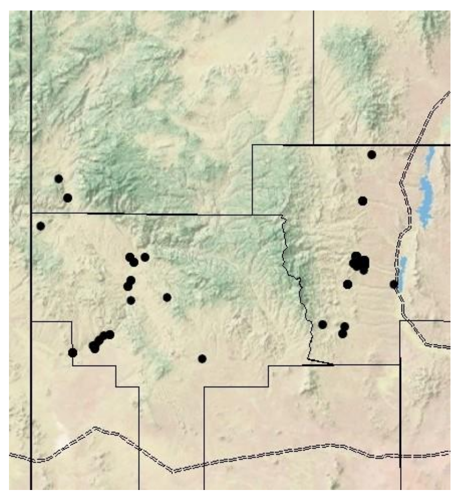


Peromyscus boylii



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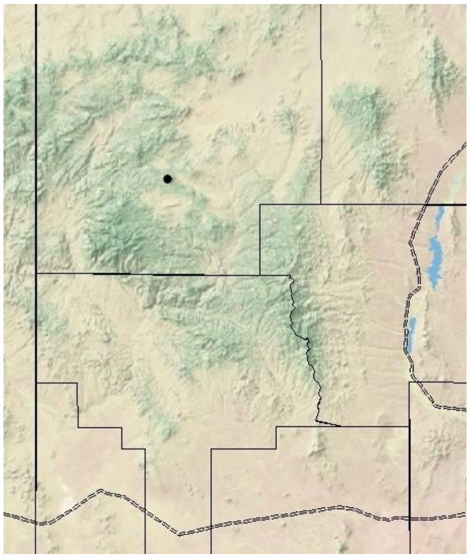

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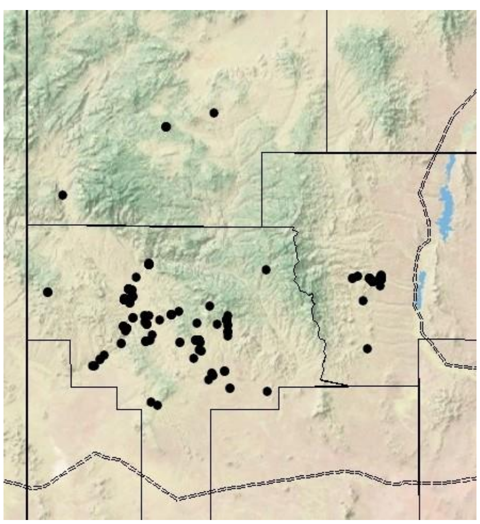
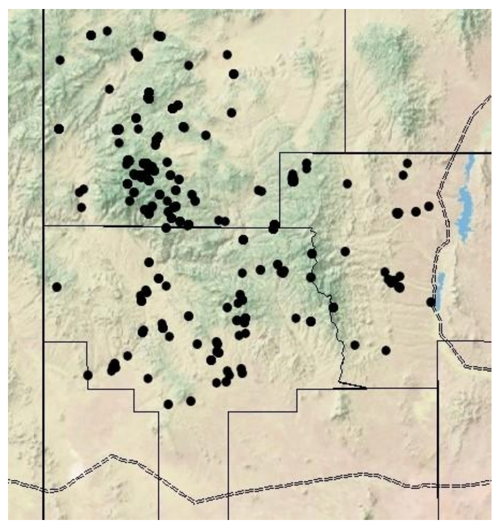


Peromyscus leucopus



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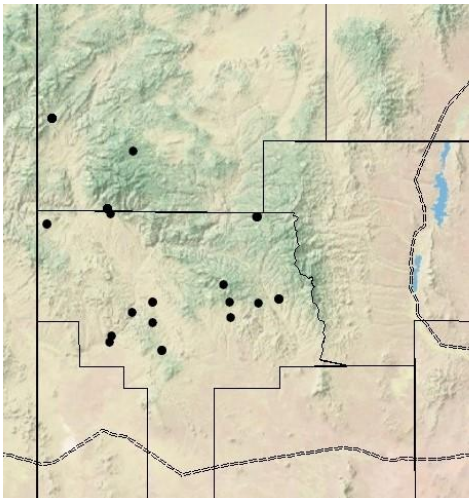

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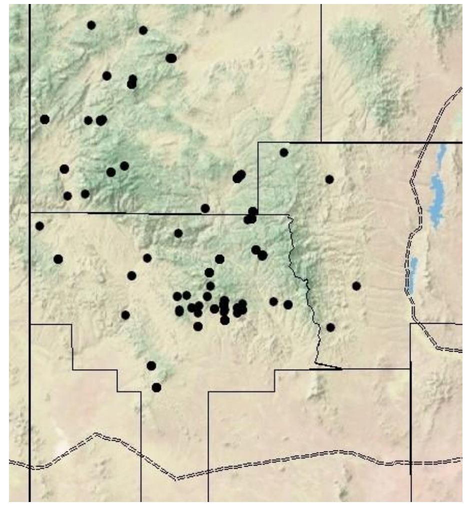

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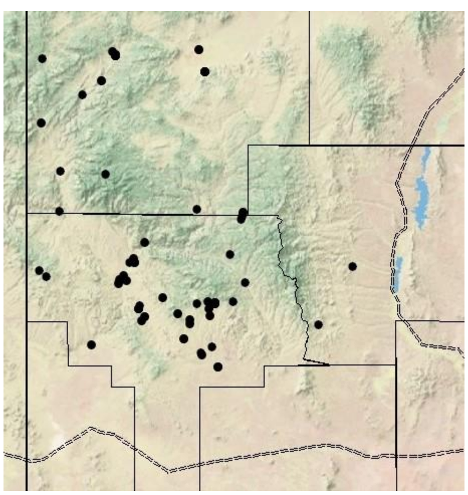

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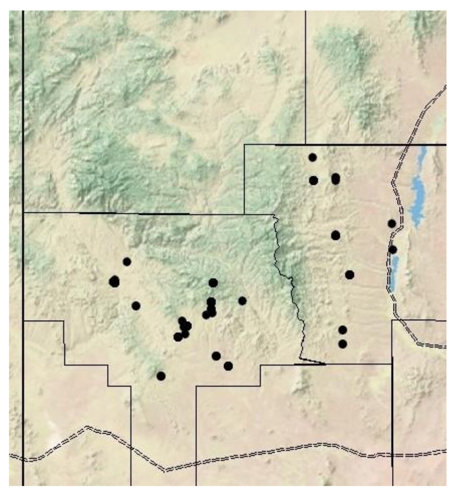
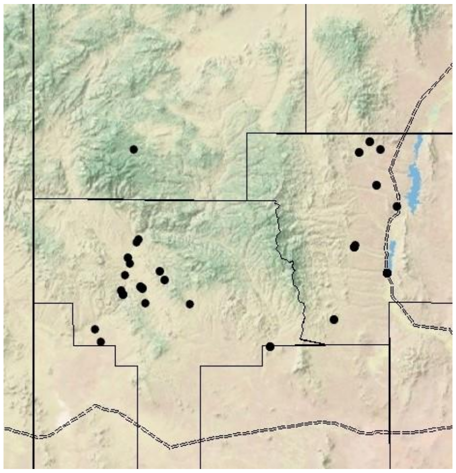
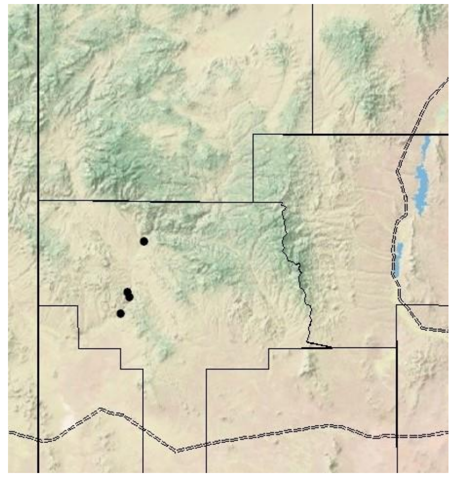


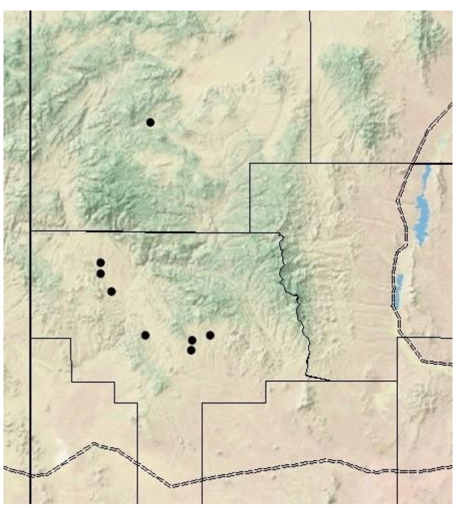
Sigmodon fulviventer



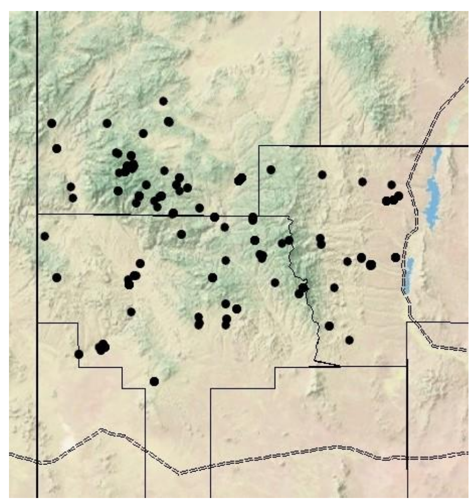
Sigmodon hispidus



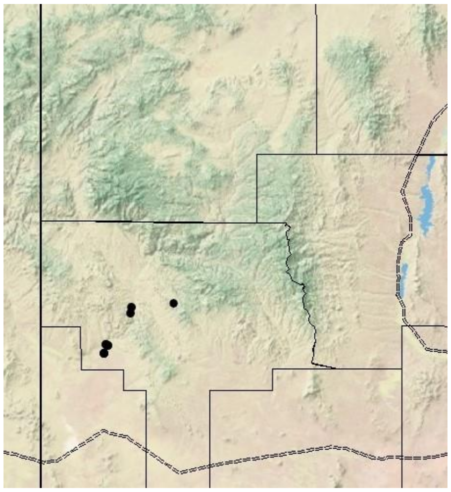
Sigmodon ochrognathus



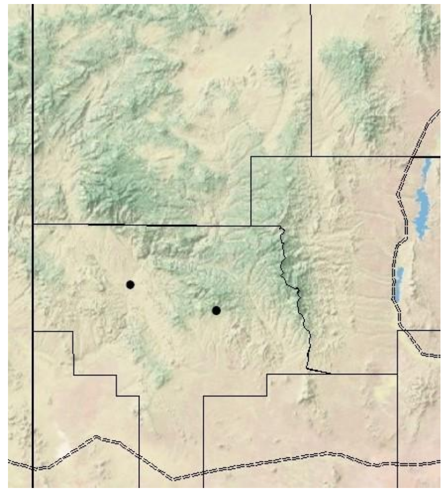
Erethizon dorsatum



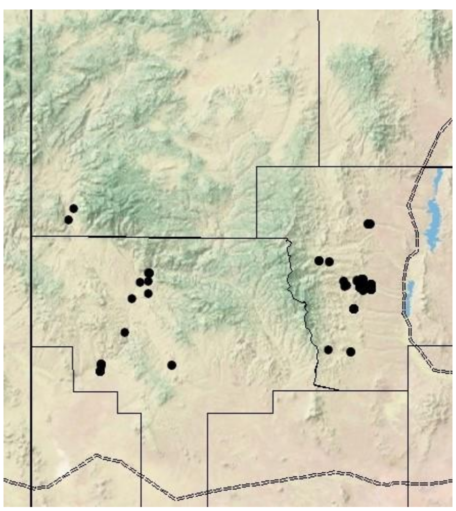
Thomomys bottae



Chaetodipus baileyi



Chaetodipus hispidus



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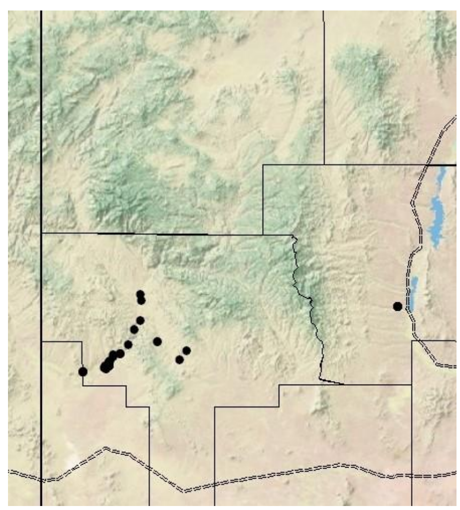

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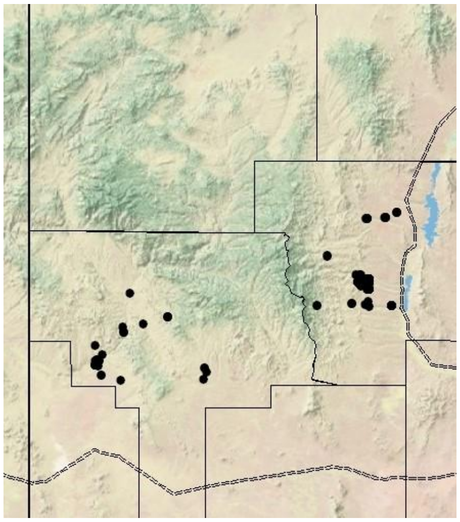

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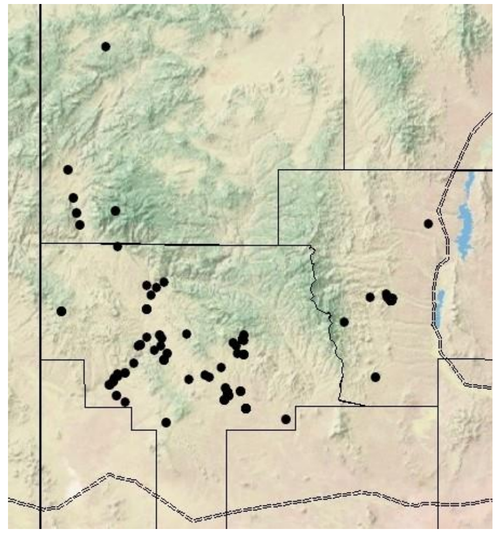

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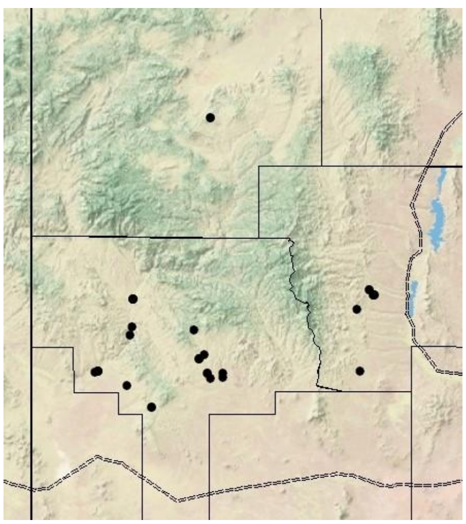
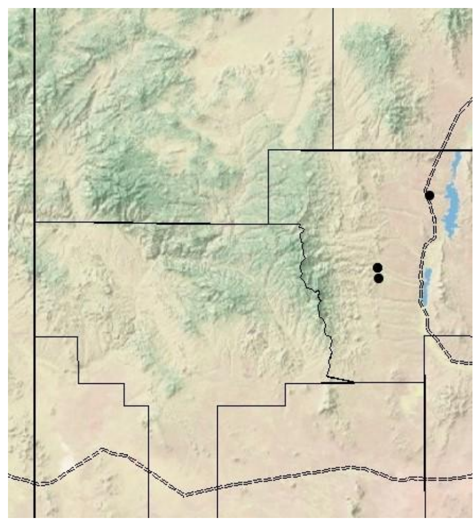
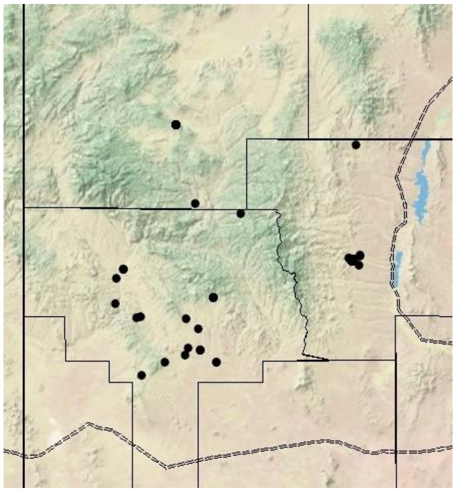


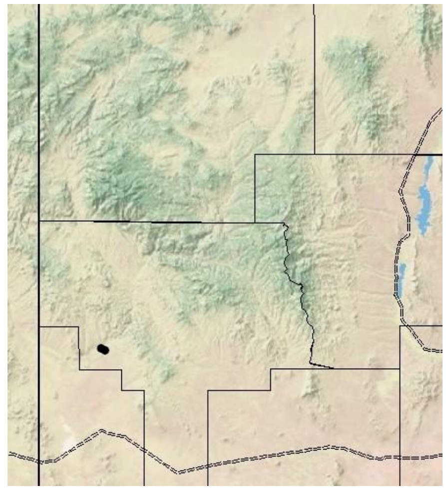
Dipodomys spectabilis



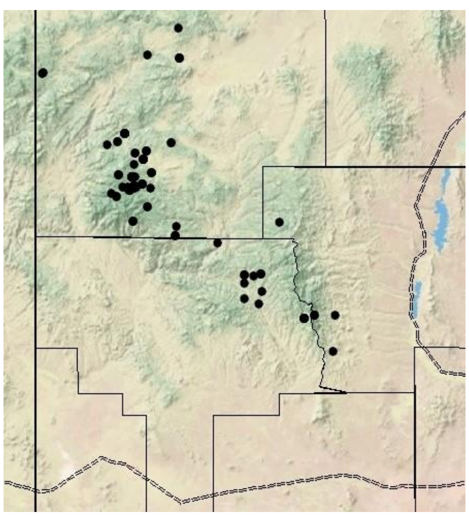
Perognathus flavescens



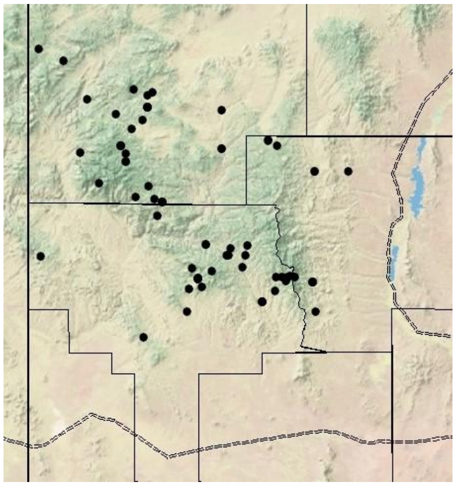
Perognathus flavus



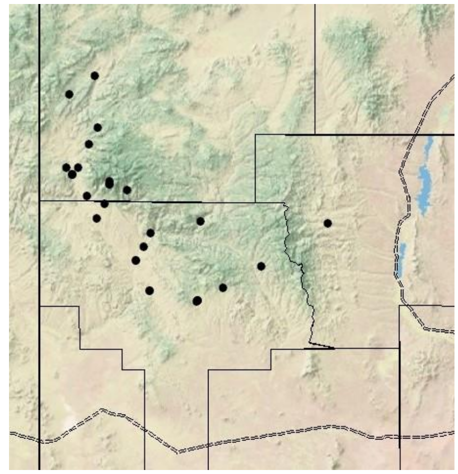
Ammospermophilus harrisii



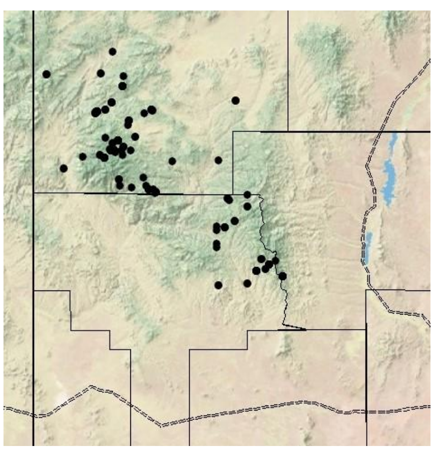
Callospermophilus lateralis



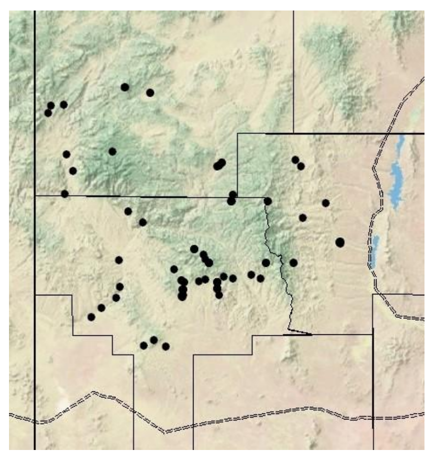
Sciurus aberti



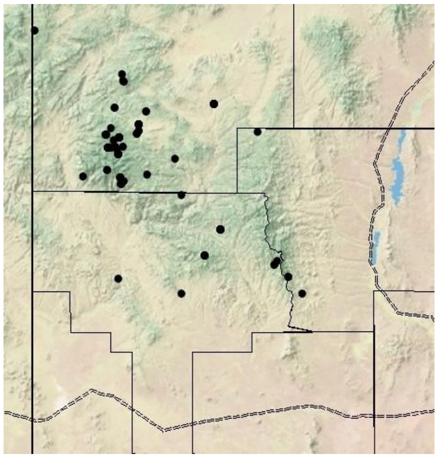
Sciurus arizonensis



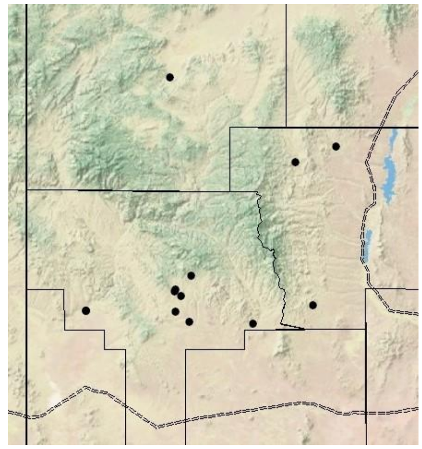
Tamias cinereicollis



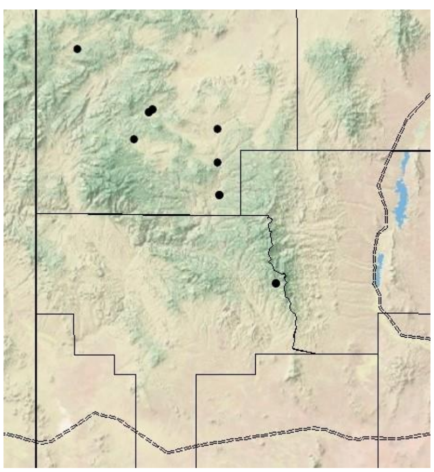
Tamias dorsalis



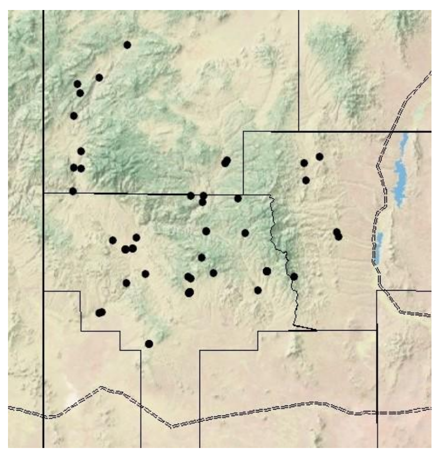
Tamiasciurus fremonti



Xerospermophilus spilosoma

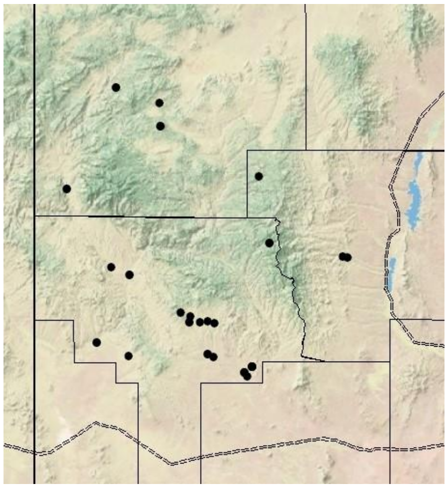


Ictidomys tridecemlineatus

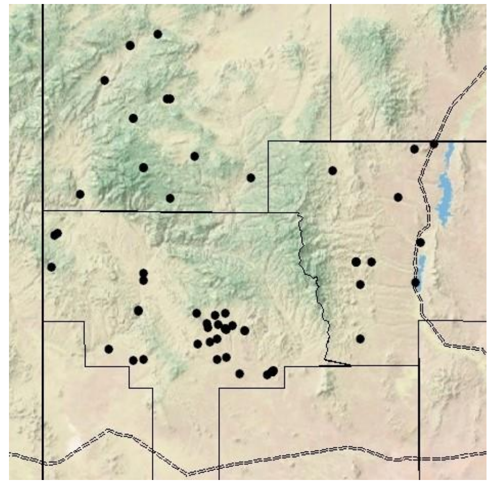


Otospermophilus variegatus

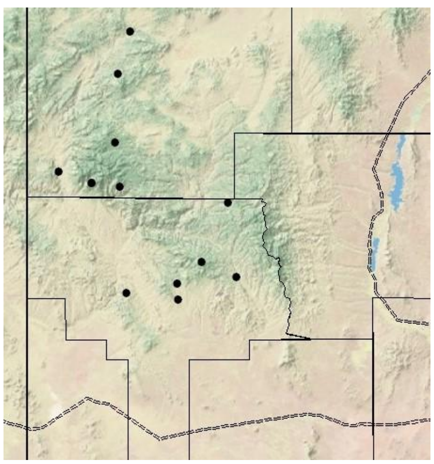
LAGOMORPHA



Lepus californicus



Sylvilagus audubonii



Sylvilagus floridanus

Figures

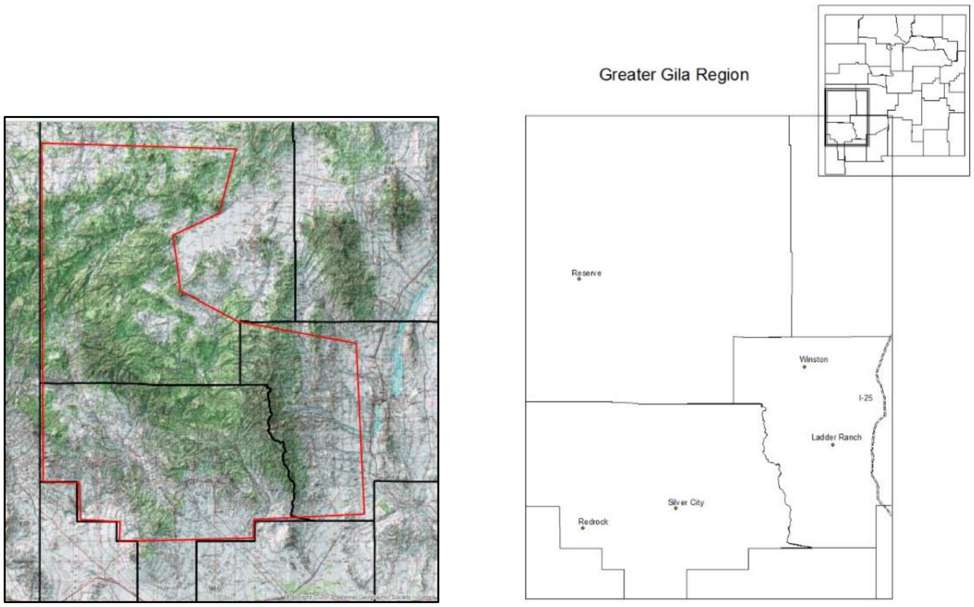


Figure 1. The Greater Gila Region (Gila), encompassing parts of Catron, Grant, and Sierra Counties. The western boundary is the border of New Mexico and Arizona, and the eastern border is the Rio Grande. The northern boundary is the southern end of the Plains of San Agustin (roughly U.S. Highway 12), and the southern boundary is the Deming Plain (roughly US Highway 180).

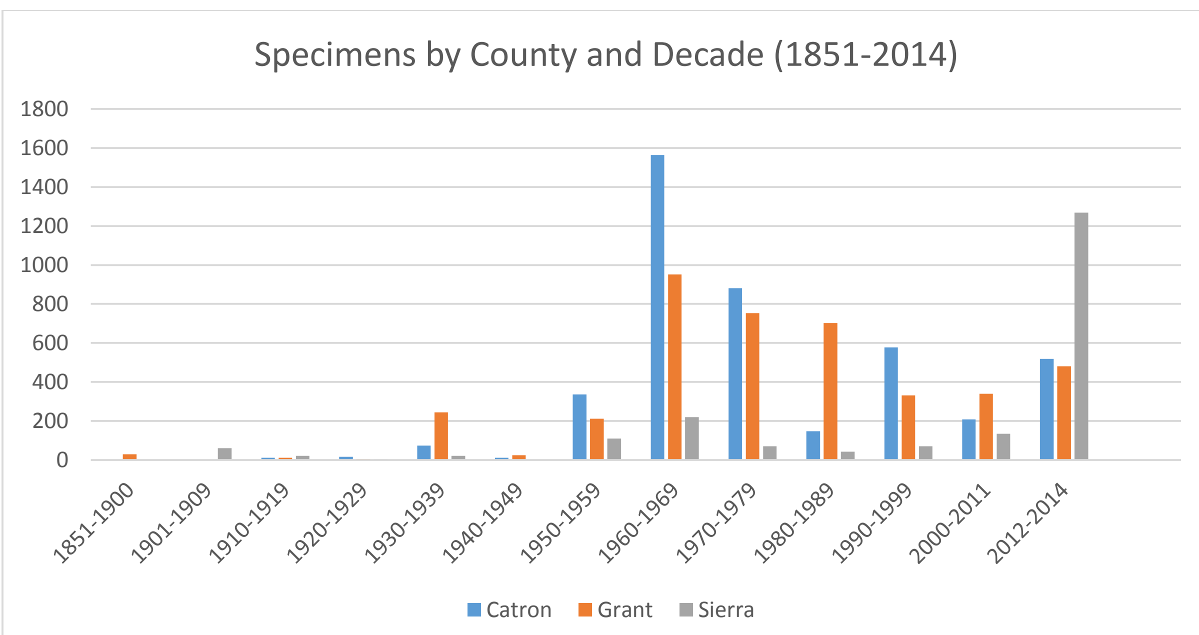


Figure 2. Number of specimens in VertNet collected by decade and county beginning in 1851 and continuing through 2014 (www.vertnet.org).

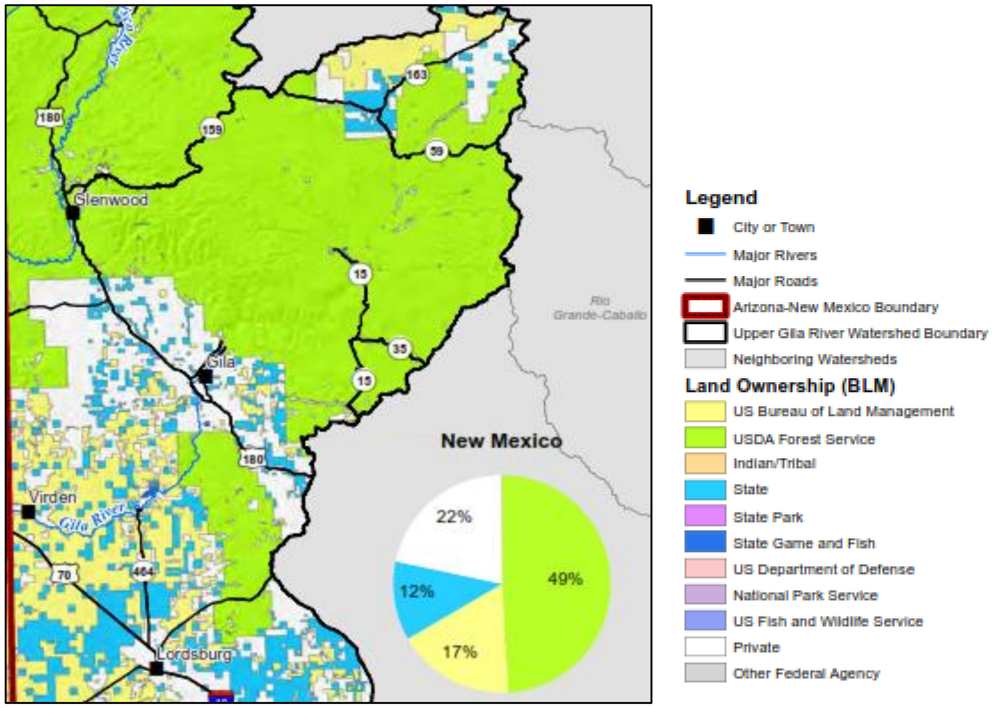


Figure 3. Land ownership in the Gila with the majority managed by USDA Forest Service.

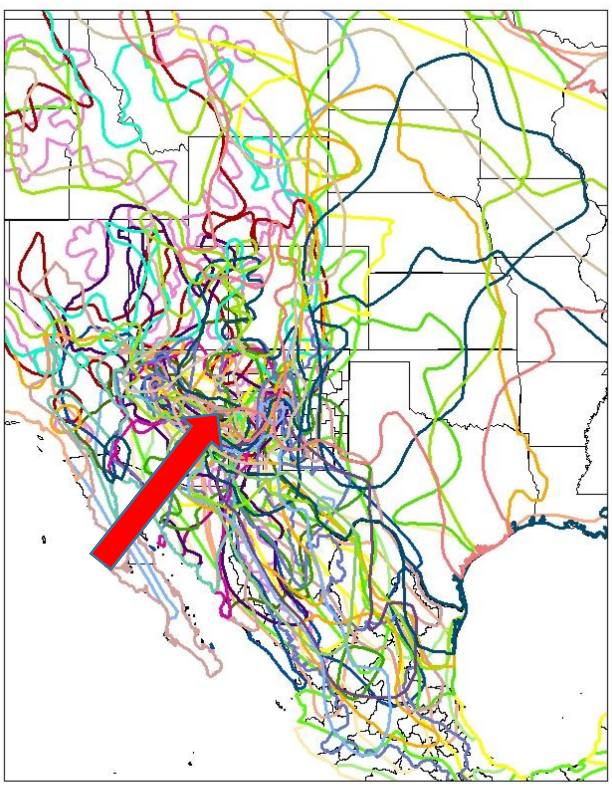


Figure 4. Some 33 species of mammals have their distributional limit in the Gila.

Figure 5. Photos (location) of habitats of the Gila as defined in this study: a) Mixed conifer forest habitat (Willow Creek); b) Montane grassland (Willow Creek); c) Ponderosa pine forest (Apache Creek, photo Marjorie McConnell); d) Piñon pine and juniper woodland (Hillsboro); e) Desert scrub (Ladder Ranch); f) Desert scrub, south facing slope (Hillsboro); g) Desert grassland (Ladder Ranch); h) High elevation riparian (Willow Creek, photo by Marjorie McConnell); i) Low elevation riparian (Ladder Ranch, Animas Creek, photo by Marjorie McConnell).

Figure 5 a

Figure 5 b

Figure 5 c

Figure 5 d

Figure 5 e

Figure 5 f (south facing)

Figure 5 g

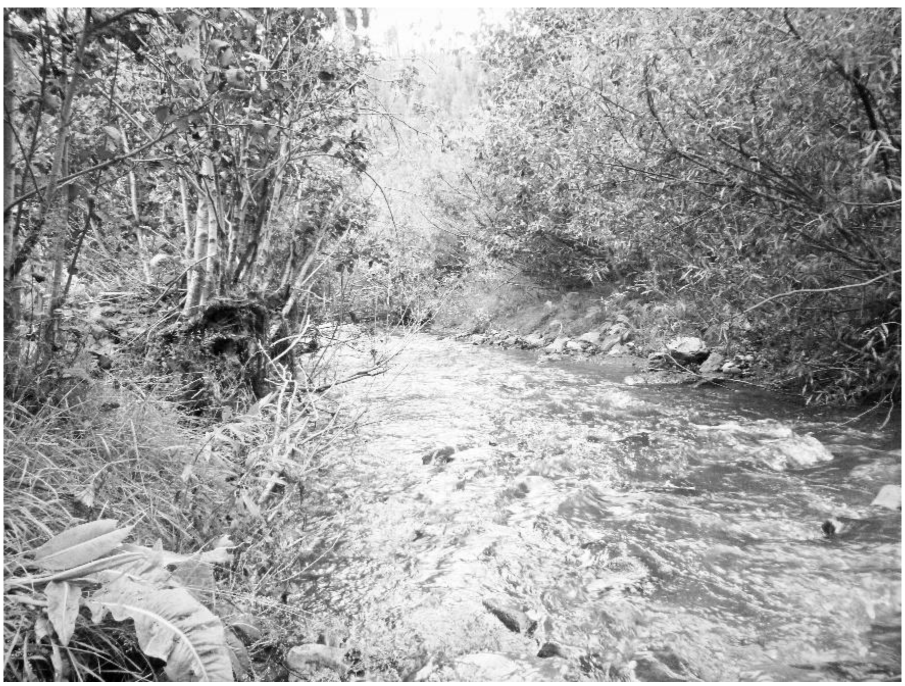


Figure 5 h

Figure 5 i

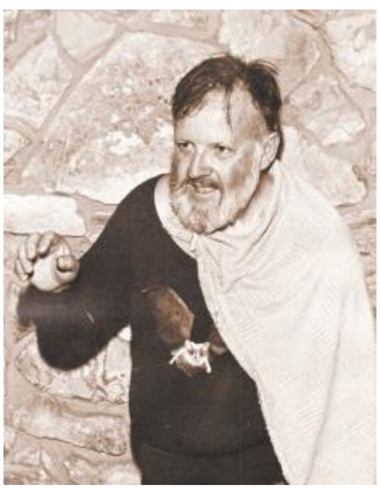


Figure 6. Bruce J. Hayward (deceased), professor emeritus at Western New Mexico University, collected and prepared 2184 specimens from New Mexico including 1251 from the Gila (photo by Mark Erickson).

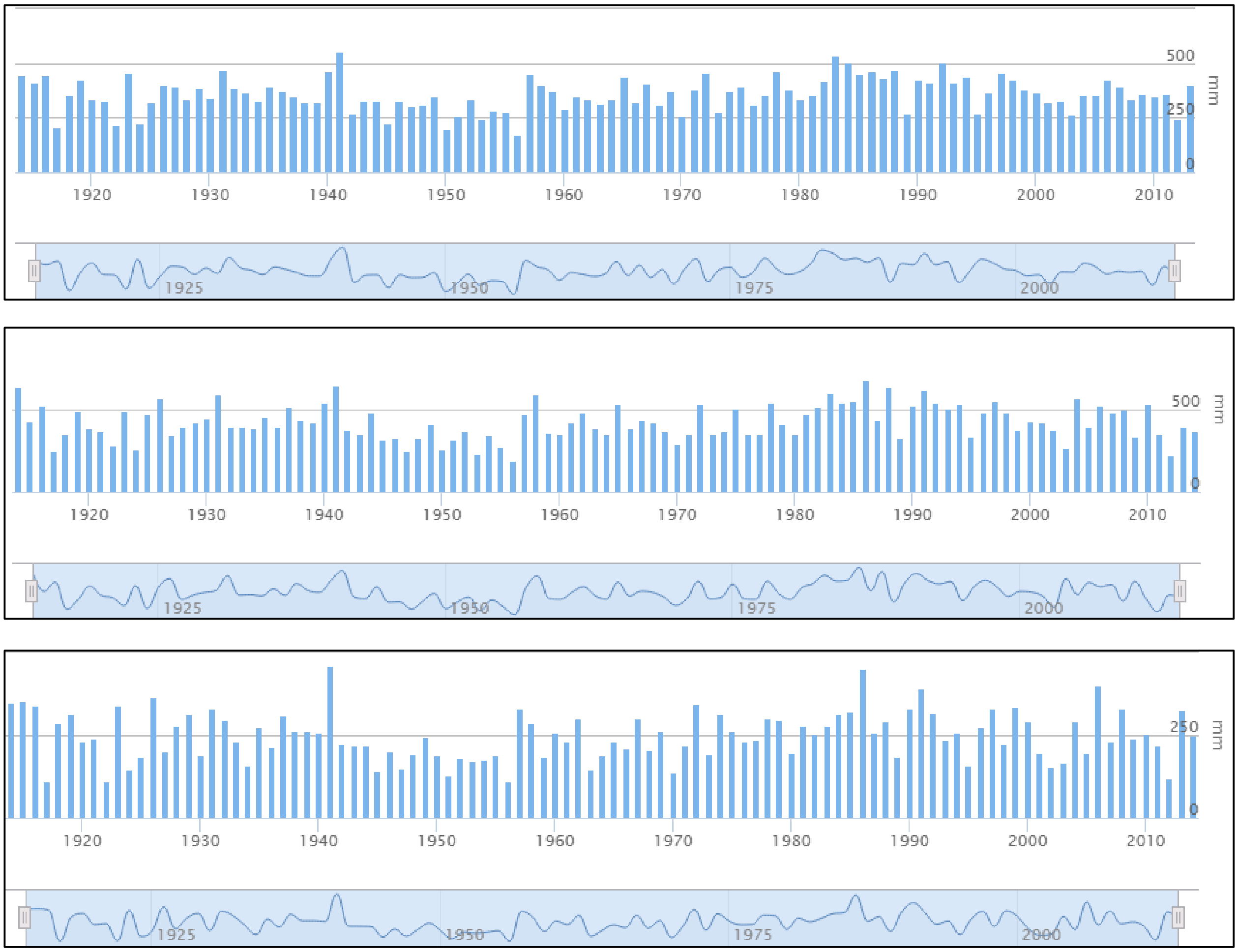
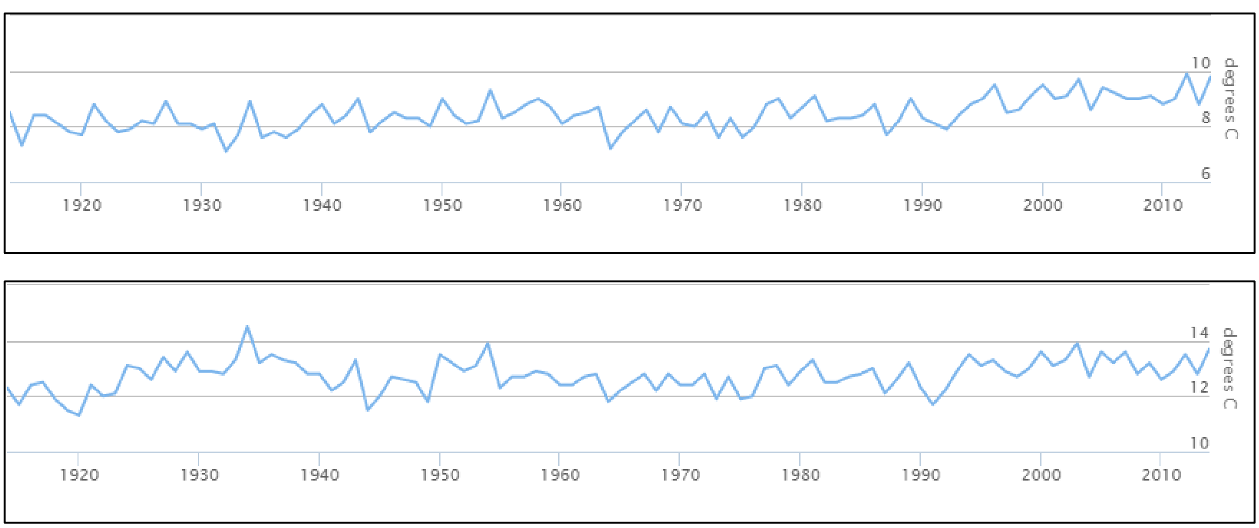


Figure 7. Annual precipitation records for the Gila for 1912-2014 for: a) Catron County, b) Grant County, and c) Sierra County (PRISM Climate Group, Oregon State University, http.//prism.oregonstate.edu, 5 November 2015).



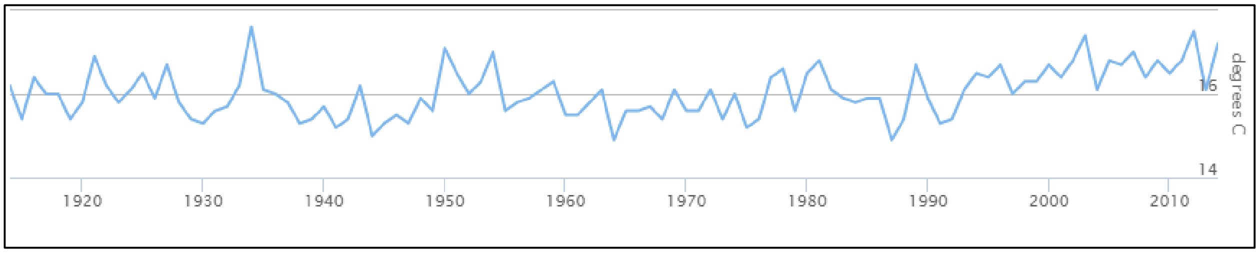


Figure 8. Annual temperature records for the Gila for 1912-2014 for: a) Catron County, b) Grant County, and c) Sierra County (PRISM Climate Group, Oregon State University, http.//prism.oregonstate.edu, 5 November 2015).

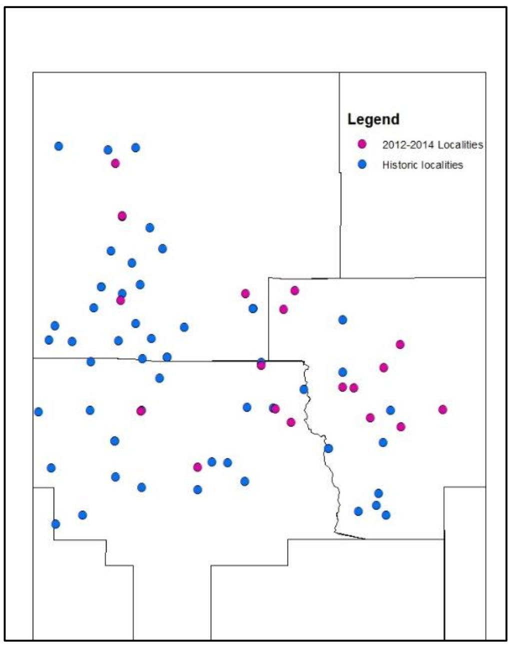


Figure 9. Mammalian collecting localities for the Gila, including collection localities from 1892-2011 (historic), and localities sampled during this study (2012-2014).

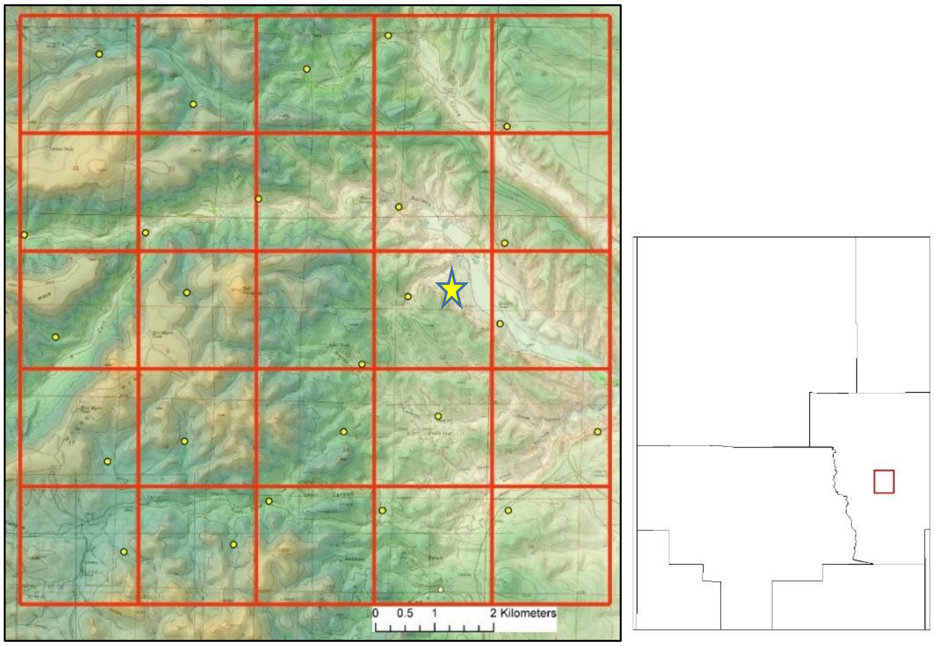


Figure 10. Camera-trap localities on the Ladder Ranch established and maintained by Travis Perry (Furman University) across 100 km² ((10 X 10 km grid) on the Ladder Ranch (map courtesy of Travis Perry). Yellow star indicates Ladder Ranch Headquarters near Animas Creek.

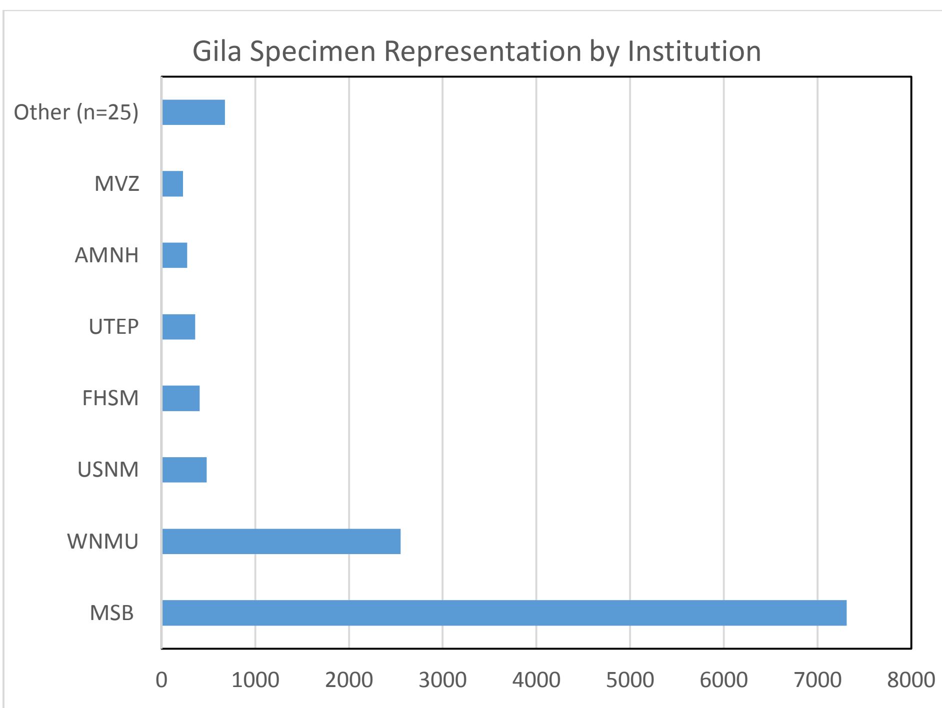


Figure 11. Number of specimens held by the institutions with largest Gila holdings. Museum of Vertebrate Zoology (MVZ); American Museum of Natural History (AMNH);

University of Texas El Paso (UTEP); Fort Hays Sternberg Museum (FHSM); U.S. National Museum (USNM); Western New Mexico University (WNMU); Museum of Southwestern Biology (MSB).

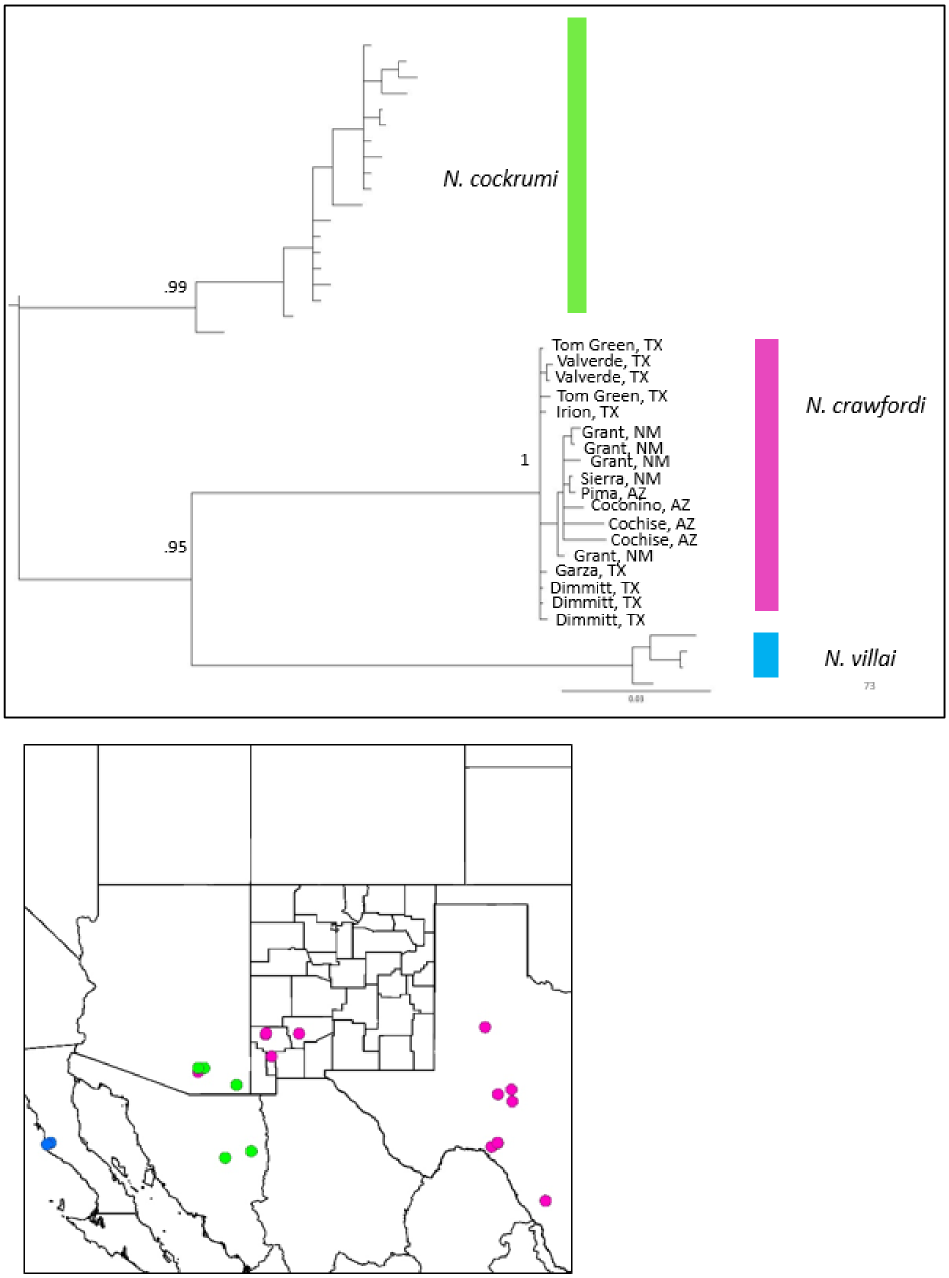


Figure 12. Phylogeographic variation in desert shrews. a) Bayesian phylogenetic tree derived from sequences of cytochrome b gene for three species of *Notiosorex* b) Corresponding map of distribution of 3 species of *Notiosorex*.

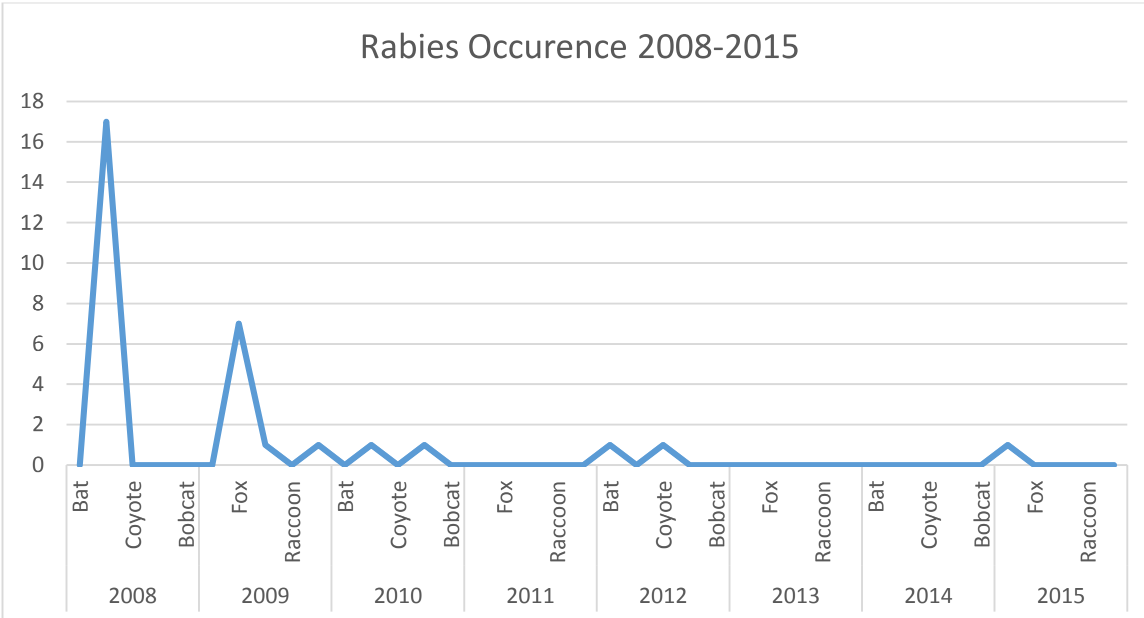


Figure 13. Rabies occurrence in the Gila as reported by New Mexico Department of Game and Fish.

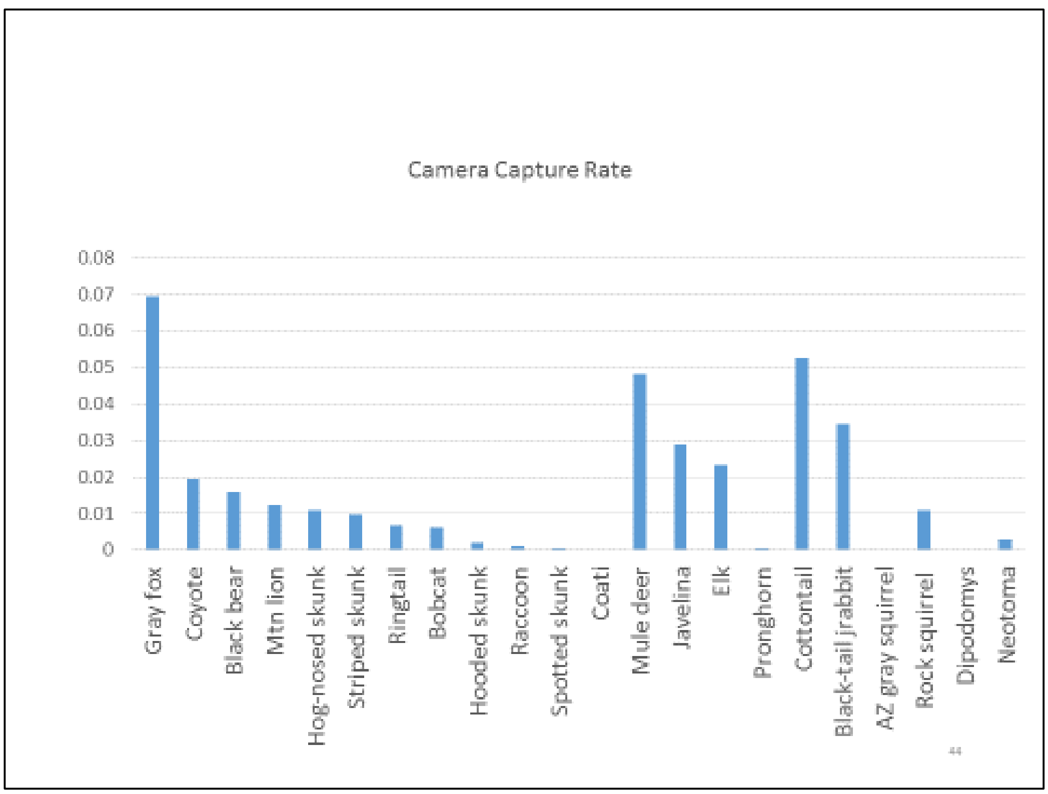


Figure 14. Photo capture rate for the 16 cameras covering 64 km² that were in operation from 2008-2012, and 9 additional cameras covering 44 km² operated from 2010-2012. Frequency rates were obtained by counting the number of individual photos of a species

divided by sampling effort (calculated as number of cameras multiplied by number of days operational.

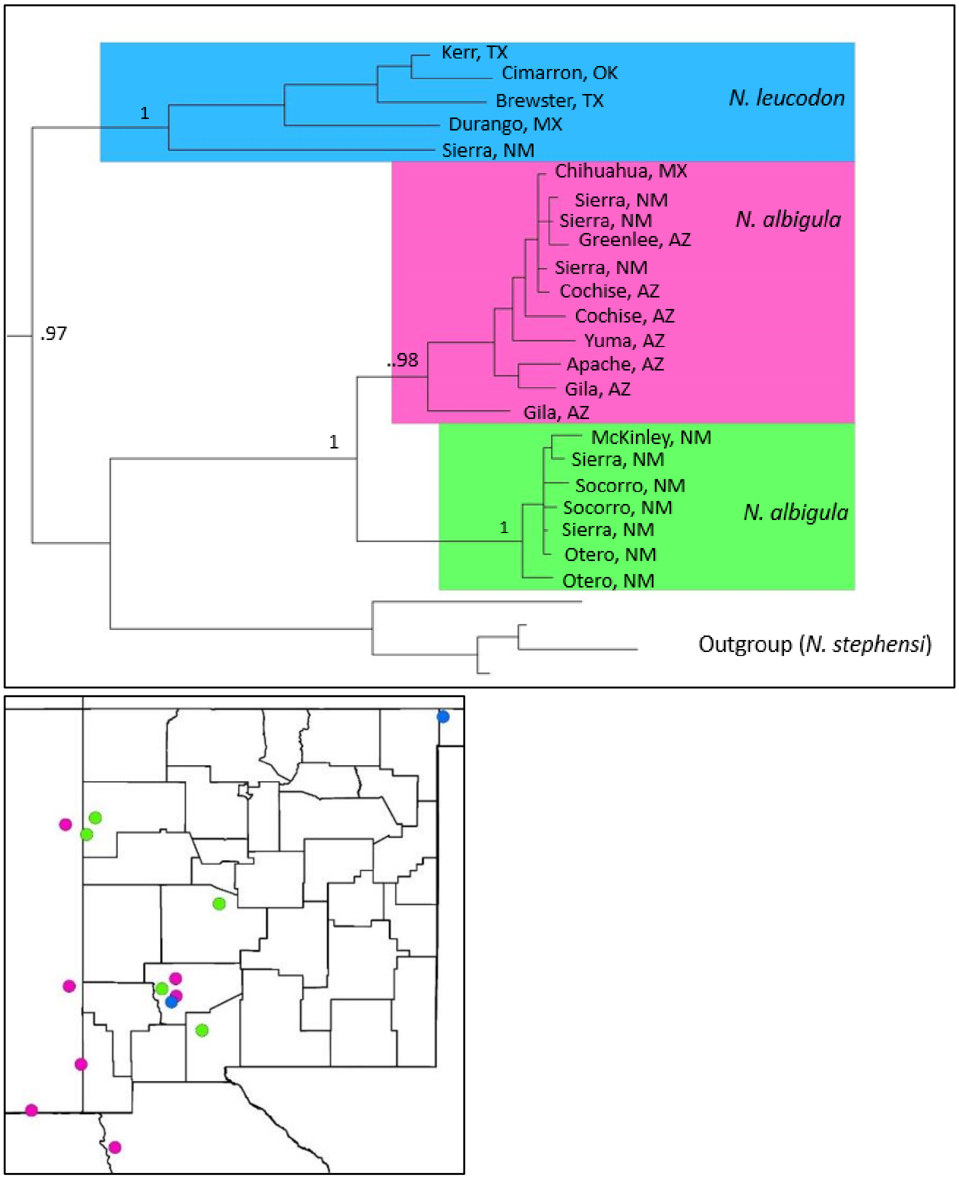


Figure 15. Phylogeographic variation in *Neotoma albigula* and *Neotoma leucodon* a) Bayesian phylogenetic derived from the cytochrome b gene for *N. albigula* and *N. leucodon* b) Corresponding map of *N. albigula* clades and *N. leucodon*.

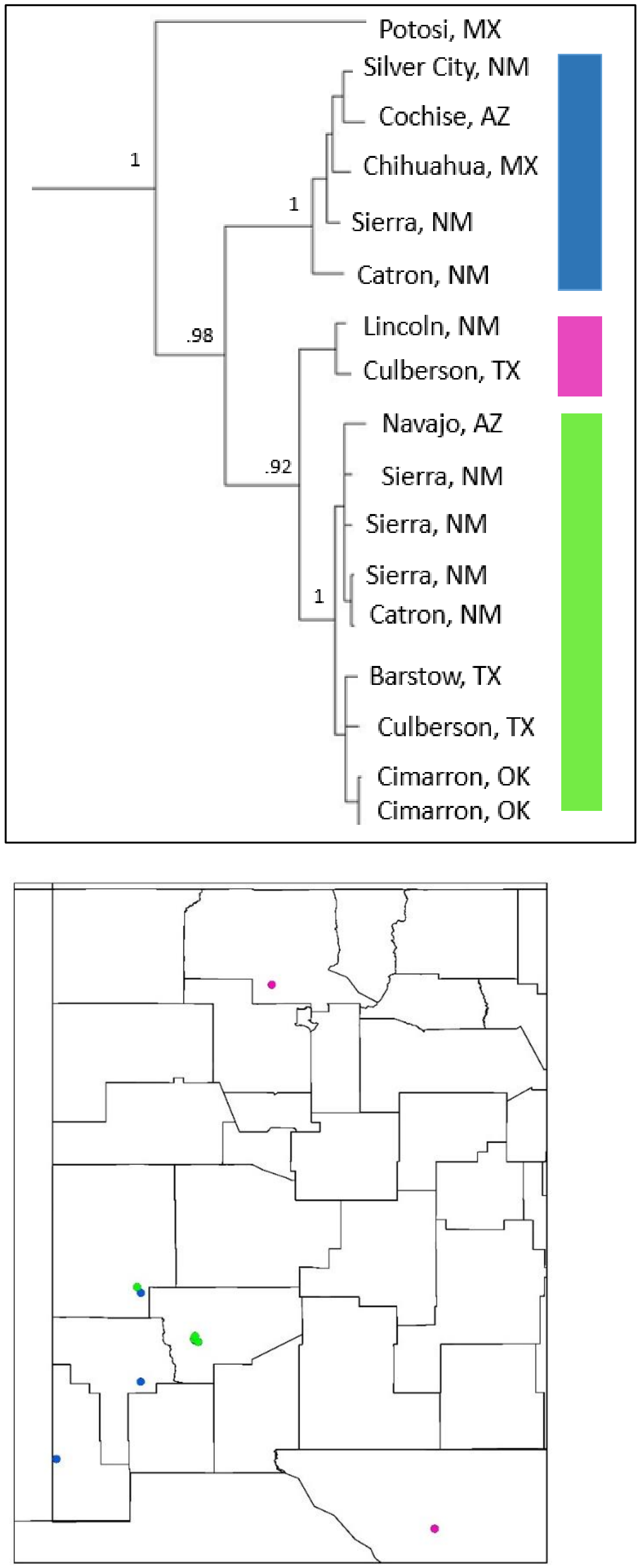
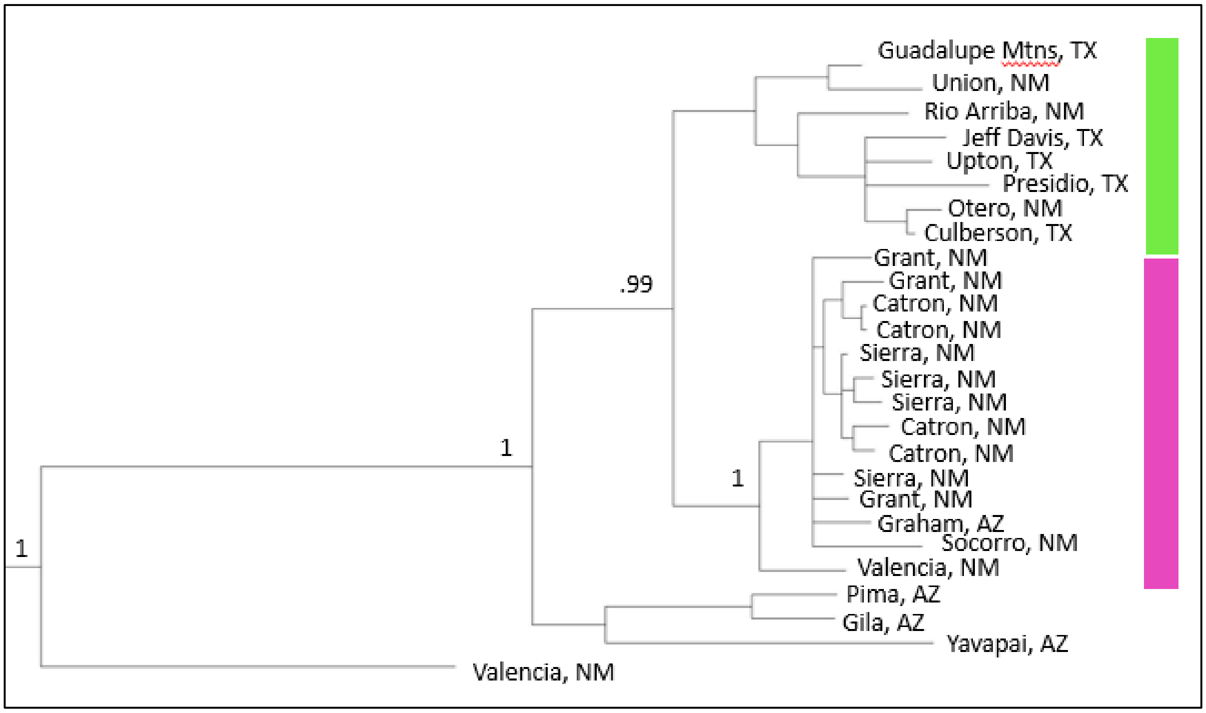


Figure 16. Phylogeographic variation in the flavus pocket mouse. a) Bayesian phylogenetic tree derived from the cytochrome b gene for *Perognathus flavus* b) Corresponding map of distribution of *P. flavus* clades.



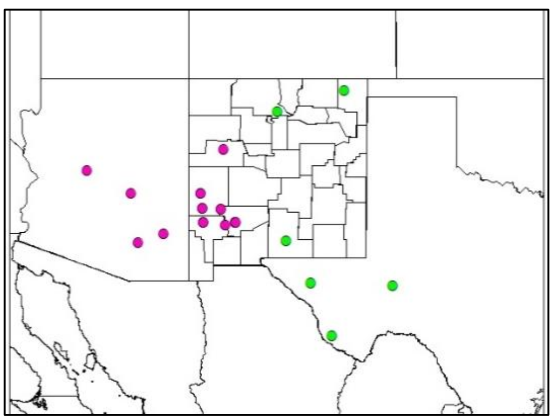


Figure 17. Phylogeographic variation in Bottae's pocket gopher. a) Bayesian phylogenetic tree derived from the cytochrome b gene for *T. bottae* b) Corresponding map of distribution of *T. bottae* clades.

TABLES

Common Name	Latin Name	Habitat Type
Blue spruce	*Picea pungens*	Mixed Conifer
Douglas fir	*Pseudotsuga menziesii*	Mixed Conifer
Ponderosa pine	*Pinus ponderosa*	Mixed Conifer Forest/Ponderosa Pine Forest
Aspen	*Populus tremula*	Mixed Conifer
White fir	*Abies concolor*	Mixed Conifer
Rocky mountain maple	*Acer glabrum*	Mixed Conifer
Wintergreen	*Galtheria procumbens*	Mixed Conifer
Forest ricegrass	*Achnatherum hymenoides*	Mixed Conifer
Gambel oak	*Quercas gambelii*	Mixed Conifer/Ponderosa Pine Forest
Silverleaf oak	*Quercas hypoleucoides*	Ponderosa Pine Forest
Pinyon pine	*Pinus edulis*	Ponderosa Pine Forest
One-seeded juniper	*Juniperus monosperma*	Pinyon-Juniper Woodland
Alligator juniper	*Juniperus deppeana*	Pinyon-Juniper Woodland
Oatgrass	*Arrhenatherum elatius*	Montane Grassland
Bluegrass	*Poa occidentalis*	Montane Grassland
Muhly	*Muhlenbergii pauciflora*	Montane Grassland
Sagebrush	*Artemesia tridentata*	Desert Grassland
4-winged saltbush	*Atriplex canescens*	Desert Grassland
Black grama grass	*Bouteloua eriopoda*	Desert Grassland/Pinyon-Juniper Woodland
Blue grama grass	*Bouteloua gracilis*	Desert Grassland/Pinyon-Juniper Woodland
Buffalo grass	*Bouteloua dactyloides*	Desert Grassland/Pinyon-Juniper Woodland
Spike dropseed	*Sporobolus contractus*	Desert Grassland/Pinyon-Juniper Woodland
Ocotillo	*Fouquieria splendens*	Desert Scrubland
Honey mesquite	*Prosopsis glandulosa*	Desert Scrubland
Prickly pear cactus	*Opuntia engelmanni*	Desert Scrubland
Bailey's yucca	*Yuccca baileyi*	Desert Scrubland
Creosote	*Larrea tridentate*	Desert Scrubland
Tea-leaf willow	*Salix planifolia*	Riparian-high elevation
Boxelder	*Acer negundo*	Riparian-high elevation
Alder	*Alnus cordata*	Riparian-mid elevation
Sycamore	*Plantanus occidentalis*	Riparian-mid elevation
Narrowleaf cottonwood	*Populus augustifolia*	Riparian-mid elevation
Hackberry	*Celtis occidentalis*	Riparian-low elevation
Fremont cottonwood	*Populus fremonti*	Riparian-low elevation

Table 1. Dominant plant species that are characteristic of mammalian habitats within the Gila.

Species	Perry et al 2001 captures (183)	Jones et al 2015 captures (101)
Antrozous pallidus	4.9%	7.9%
C. townsendii	-	1.9%
Eptesicus fuscus	26%	15.8%
Idionycteris phyllotis	1.1%	-
Lasionycteris noctivagans	17%	10.9%
Lasiurus blossevillii	-	1.9%
Lasiurus cinereus	16.9%	12.9%
Myotis auriculus	2.7%	2.9%
Myotis californicus/ciliolabrum	7%	2.9%
Myotis evotis	-	1%
Myotis occultus	-	2.9%
Myotis thysanodes	9.8%	1.9%
Myotis volans	2.7%	1.9%
Myotis yumanensis	4.9%	7.9%
Parastrellus hesperus	6%	9.9%
Tadarida brasiliensis	-	15.8%

Table 2. Bat species captured during Perry et al.'s (2001) survey on the Ladder Ranch and species captured during 2012-2014 on the Ladder Ranch.

County	Swift fox	Kit fox	Gray fox	Ringtail	Badger	Bobcat	Raccoon	Years
Catron	0	7	300	2	11	188	1	2012-2013
Grant	2	15	434	26	14	201	4	2012-2013
Sierra	2	8	95	9	4	48	11	2012-2013
Catron	0	36	295	0	11	124	0	2014-2015
Grant	0	36	332	18	9	77	5	2014-2015
Sierra	0	19	118	3	6	46	2	2014-2015

Table 3. Numbers of furbearers captured by commercial trappers in the Gila as reported by New Mexico Department of Game and Fish, 2012-2015.

Species	N=	Average number embryos	Standard Deviation
Clethrionomys gapperi	1	4	N/A
Microtus longicaudus	19	4	1.247
Microtus mogollonensis	8	2.5	.5
Neotoma albigula	24	1.791	.779
Neotoma mexicana	8	2.125	.834
Neotoma micropus	1	2	N/A
Neotoma stephensi	1	1	N/A
Onychomys arenicola	0		

Onychomys leucogaster	9	3.555	.726
Onychomys torridus	0		
Peromyscus boylii	23	3.260	1.096
Peromyscus eremicus	8	2.125	.835
Peromyscus leucopus	5	4.2	1.095
Peromyscus maniculatus	51	4.235	1.422
Peromyscus nasutus	2	3	0
Peromyscus truei	23	3.863	1.424
Reithrodontomys megalotis	5	4.2	.836
Sigmodon fulviventer	5	2.2	.836
Sigmodon hispidus	5	3.8	1.483
Sigmodon ochrognathus	2	4.5	.707
Chaetodipus baileyi	1	7	N/A
Chaetodipus intermedius	13	3	.912
Dipodomys merriami	15	2.066	.593
Dipodomys ordii	2	1.5	.707
Dipodomys spectabilis	1	3	N/A
Perognathus flavus	2	3	N/A
Sciurus arizonensis	1	4	N/A
Thomomys bottae	14	2.071	.997

Table 4. Reproductive information from museum specimens of rodents collected in the study site (data obtained from http.//arctos.database.museum/SpecimenSearch.cfm,).

Era	Period		Epoch	Nalma
Cen.	Quaternary		**Holocene-** **Pleistocene**- Canovas Creek, Shelton Canyon, San Francisco River, Sapillo Creek **Wisconsin**-Doolittle Cave, Tularosa Cave, Bat Cave	Rancholabrean Irvingtonian Blancan Hemphilian
	Tertiary	Neogene	**Pliocene**-Engle Basin (Elephant Butte, Cuchillo Negro Creek, Truth or Consequences), Palomas Basin (Williamsburg, Palomas Creek, Kelly Canyon, Caballo) **Miocene**-Mangas Basin (Walnut Canyon, Glenwood, Buckhorn)	
		Paleogene	**Oligocene**- Taylor Creek **Eocene**-Rubio Peak **Paleocene**-	

Table 5. Paleontological sites in the Gila by geological period.

Taxon	1	2	3	4	5	6	7	8	9
Soricomorpha-Soricidae									
Sorex sp.	X								
Sorex monticola							X		
Carnivora									
Bassariscus sp.									X
Borophagus hilli									X?
Canis latrans	X								
Lynx rufus	X								
Artiodactyla									

Antilocaprid sp.		X							
Capromeryx sp.					X				
Stockoceros sp.	X								
Bison bison					X				
Platygonus sp.		X							
Blancocamelus meadi									X
Camelops hesternus	X								
Camelops traviswhitei									X?
Gigantocamelus spatulus								X	
Hemiauchenia blancocoensis									X?
Perrisodactyla									
Tapirus sp.								X	
Equus calobatus								X?	
Equus conversidens	X			X					
Equus cumminsi								X?	
Equus occidentalis	X								
Equus sp. (large)		X							
Equus sp. (small)		X							
Equus scotti								X	X
Equus simplicidens								X	X
Proboscidea									
Mammuthus columbi	X								
Mammuthus imperator			X						
Stegomastodon primitivus								X	X
Rodentia									
Chaetodipus/ Perognathus sp.							X		
Tamias minimus							X		
Tamiascuirus hudsonicus	X								
Urocitellus sp.	X								
Thomomys bottae							X		

Thomomys talpoides	X								
Neotoma sp.	X						X		
Marmota flaviventris						X			
Microtus sp.	X								
Microtus mogollonensis							X		
Microtus pennsylvanicus							X		
Peromyscus sp.							X		
Lagomorpha									
Lepus sp.	X								
Sylvilagus nuttallii	X								

Table 6. Mammal fossils listed by site for the Gila: 1) Canovas, 2) Shelton, 3) San Francisco River, 4) Sapillo Creek, 5) Doolittle Cave, 6) Tularosa Cave, 7) Bat Cave, 8) Elephant Butte, and 9) Cuchillo Negro.

Taxon	1	2	3	4	5	6	7	8	9	10
Xenarthra										
Megalonyx leptostomus	X?									
Paramylodon gabanii		X?								
Glyptotherium arizonae					X					
Chiroptera										
Vespertilionidae sp.							X			
Soricomorpha										
Scalopus sp.	X?									
Scalopus blancoensis					X					
Carnivora										
Borophagus hilli	X?									
Canis lepophagus	X?				X		X			
Cerdocyon texanus						X				
Vulpes velox			X							
Taxidea sp							X			
Spilogale sp.					X					
Felidae sp.		X				X	2X			
Ursidae sp.							X			
Plionarctos sp.						X				
Artiodactyla										
Unknown Artiodactyla							X			
Antilocaprid sp.						X				
Capromeryx arizonesis					X					
Capromeryx tauntoenis	X?									
Ovis canadensis			X							
Alforjas sp.						X				
Camelops sp.							X			
Hemiauchenia blancocoensis		X			X		X			
Megatylopus sp.						X				
Pleiolama sp.						X				
Navahoceros lascrucensis					X					

Edoileus sp.						X				
Odocoileus sp	X?									
Catagonus sp.						X				
Platygonus sp.							X?			
Platygonus bicalcaratus	X									
Perrisodactyla										
Astrohippus stockii						X				
Dinohippus mexicanus						X				
Nannippus peninsulatus		X					X			
Neohipparion eurystyle								X		
Equus sp.		X	X	X						
Equus scotti					X					
Equus simplicidens	X						X			
Teloceros fossiger								X		
Duchesneodus uitensis										X
Proboscidea										
Desmatochoerus megalodon									X?	
Mammut raki			X							
Megaoreodon grandis									X?	
Montanatylopus matthewi										X
Stegomastodon sp.	X?	X			X		X?			
Rhynchotherium sp.								X		
Rodentia										
Unknown Rodentia						X				
Jaywilsonomys ojinagaensis										X
Dipodomys sp.					X					
Spermophilus sp.	X									
Spermophilus bensoni							X			
Geomys minor	X									
Geomys paenebursarius		X?			X					
Thomomys bottae			X							
Jacobomys sp.	X									
Ondatra idahoensis				X						
Baiomys sp.							X			
Bensonomys sp.					X					
Neotoma sp.		X		X	X					

Neotoma cinerea			X							
Neotoma quadriplicata	X									
Repomys panacaensis							X			
Microtus longicaudus			X							
Ogmodontomys poaphagus							X			
Sigmodon medius	X				X					
Lagomorpha										
Lepus sp.		X								
Hyoplagus vetus	X									
Notolagus lepusculus	X									
Sylvilagus floridanus			X							
Sylvilagus hibbardi					X					
Leporidae sp.						X	X	X		

Table 7. Mammal fossils listed by site for the Gila. 1) Truth or Consequences, 2) Williamsburg, 3) Palomas Creek, 4) Kelly Canyon, 5) Caballo, and 6) Walnut.

Taxon	NMDGF	ESA	IUCN	CITES	Extirpated
Rodentia					
Cynomys gunnisoni			LC		Yes
Cynomys ludovicianus			LC		Yes
Sciurus arizonensis			Data Deficient		
Dipodomys spectabilis			Near Threatened		
Microtus montanus arizonensis	Endangered		LC		
Microtus pennsylvanicus			LC		Yes
Chiroptera					
Euderma maculatum	Threatened		LC		
Carnivora					
Canis lupus baileyi	Endangered	Endangered	LC	A II	
Lontra canadensis			LC		Yes

Panthera onca		Endangered	Near Threatened	A I	Yes
Ursus arctos			LC		Yes

Table 8. Species of concern as identified by various lists (NMDGF= New Mexico Department of Game and Fish; ESA= Endangered Species Act; IUCN Red List= International Union for Conservation of Nature; and CITES= Convention on International Trade in Endangered Species).

Fire	Date Began	Place of Origin	Hectares Burned
Whitewater-Baldy Complex	24 May 2012 (when two fires merged)	E of Glenwood	120, 533 (largest in NM history)
Silver Fire	7 June 2013	Kingston	56,131
Signal Fire	11 May 2014	16 km N Silver City	2,219

Table 9. Catastrophic fires in the Gila during the 2012-2014 survey (http.//inciweb.nwcg.gov).

Species	Earliest male capture	Earliest female capture	Latest male capture	Earliest embryo
Antrozous pallidus Pallid bat		12 April 2013 - 2 days		5 June 2013 - 2 days
Eptesicus fuscus Big brown bat		12 April 2014 - 2 days		22 May 2013 - 10 days
Lasionycteris noctivagans Silver-haired bat		13 March 2013 - 30 days		
Lasiurus blossevillii Western red bat	13 April 2013 - 60 days	13 April 2013 - 60 days		
Myotis evotis Long-eared myotis	21 May 2013 -10 days	13 April 2014 - 17 days		
Myotis ciliolabrum Small-footed myotis		21 May 2013 - 2 days		21 May 2013 - 2 days
Myotis thysanodes Fringed myotis	21 May 2013 - 9 days			21 May 2013 - 16 days
Myotis volans Long-legged myotis			13 Oct. 2013 +15 days	21 May 2013 - 10 days
Myotis yumanensis Yuma myotis			9 Oct. 2014 +17 days	12 June 2014 - 12 days
Parastrellus hesperus Canyon bat		22 March 2014 - 33 days		
Tadarida brasiliensis Mexican free-tailed bat			9 Oct. 2014 +19 days	11 June 2013 1st record

Table 10. New occurrence and reproductive phenology records for 3 Gila counties for bat species including earliest capture, latest capture, and earliest embryo.

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