

**Inventory of the Terrestrial Mammals of Coronado National Memorial,
Cochise County, Arizona**

FINAL REPORT

13 December 2000

Submitted to:
National Park Service
Southern Arizona Group
Phoenix, Arizona

Submitted by:

Don E. Swann¹
Cecil R. Schwalbe, Ph.D.²
Amy J. Kuenzi¹
and
Barbara N. Alberti³

¹Wildlife and Fisheries Sciences Program
School of Renewable Natural Resources
University of Arizona

²U.S. Geological Survey
Biological Resources Division
Cooperative Park Studies Unit
University of Arizona

³Coronado National Memorial
National Park Service
Hereford, Arizona

ABSTRACT

Using techniques of small mammal trapping, infrared-triggered photography, road transects, observations, and inspection of current and historic records, we documented the presence and distribution of terrestrial mammals at Coronado National Memorial, Cochise County, Arizona. During this study we confirmed, through voucher specimens, photographs, or reliable observations, 43 species of native terrestrial mammals. Confirmed species included one marsupial, one insectivore, two rabbits and jackrabbits, 23 rodents, 13 carnivores, and three hoofed mammals. We discuss an additional 18 species of mammals that may be present but were not confirmed during this study, or occurred at the Memorial in the past but probably no longer occur. We provide databases for all mammal records at the Memorial, as well as Global Positioning Systems (GPS) locations of grids, cameras, and sightings where available. Finally, we discuss threats to mammals at the Memorial, and propose an approach for long-term monitoring of mammals at Coronado and other similar U.S. National Park areas.

TABLE OF CONTENTS

Abstract	i
Figures and tables.....	iii
Acknowledgements.....	v
Introduction.....	1
Objectives	1
Study site.....	2
Methods.....	5
Results.....	8
Discussion	16
Monitoring recommendations	22
Literature cited	23
 APPENDIX A: Summary of records for terrestrial mammals at Coronado National Memorial.....	 A-1
APPENDIX B: Summary data from trapping grids and infrared-triggered photography	B-1
APPENDIX C: Species accounts of terrestrial mammals confirmed	C-1
Marsupials.....	C-1
Insectivores	C-3
Rabbits and hares	C-5
Rodents	C-11
Carnivores	C-57
Even-toed ungulates.....	C-88
 APPENDIX D: Accounts of species of potential occurrence	 D-1

LIST OF FIGURES

1. Map of Arizona, showing location of Coronado National Memorial relative to other “sky island” mountain ranges and nearby national park areas	3
2. Vegetation map of Coronado National Memorial, from Ruffner and Johnson (1991)...	4
3. Map of Coronado National Memorial, showing locations of trapping grids	14
4. Number of individuals trapped (captures – recaptures) of nocturnal rodent species captured at Coronado National Memorial, 1996-1997	15
5. Map of Coronado National Memorial, showing locations of infrared-triggered photograph stations	17
6. Number of individual photographs of 18 mammal species taken by infrared-triggered photography at Coronado National Memorial, 1996-1997	18
7. Percentage of mammal species surviving in western National Parks as a function of the number of years since each park was established (Newmark 1995).....	21

LIST OF TABLES

1. Species of terrestrial mammals confirmed at Coronado National Memorial from September 1996 through December 2000, either by voucher specimen, voucher photograph, or confirmed sighting.....	9
2. Potential species at Coronado National Memorial not confirmed from September 1996 through December 2000.....	12
3. Number of species of native terrestrial mammals on species lists at four parks in southern Arizona, and density in number of species per 100 ha.....	20

Appendices

A-1. Key to confirmed species of terrestrial mammals at Coronado National Memorial.....	A-1
A-2. Number of nocturnal rodents trapped, per 100 trap-nights, in selected vegetation types at Coronado National Memorial	A-6
A-3. Species of terrestrial mammals (exclusive of nocturnal rodents) confirmed at	

Coronado National Memorial and number of documented observations	A-7
B-1. Data for small mammal grids trapped at Coronado National Memorial, 1996-1997	B-1
B-2. Data for infrared-triggered camera locations at Coronado National Memorial, 1996-1997	B-8

ACKNOWLEDGEMENTS

We are grateful to Superintendents Ed Lopez and Jim Bellamy and the entire paid and volunteer staff of Coronado National Memorial, without whom this project would not have been possible. Many volunteers assisted in the field, including Paul Funk, Alicia Gutzman, Heather Guest, Michael Guest, Phi Pham, Vicki Powers, Mary Helen Surovik, Will Sargent, Pete Van Cleve, Dan Bell, and Matt Goode. Henry Ruiz, David Chavez, Michael Hardin, Fred Moosman, Scott Sticha, William Smith, and Kenneth Thompson provided rides, protection, specimens, and logistical support.

In addition, we are indebted to a great deal of "behind the scenes" support. Bonnie Rainer and Mary Megill spent many hours entering data. Dave Rainer coordinated GPS and GIS aspects of the project and organized a huge amount of geographic information. Yar Petryzyn provided small mammal identification and shared his significant knowledge of Coronado and its mammals. Patty Guertin identified plants, particularly grasses. Kathy Hiett, Joan Ford, Brenda Carbajal, Carol Wakely, Mary Greene, Bill Halvorson, Mike Kunzmann, Dale Linder, Nancy Wilcox, and Sue Benson provided technical and administrative support for this research, and Dan Bell and Dale Lindner shared their photographs.

Funding for this study was provided by the NPS NRPP fund. As always, we are grateful to Lee Benson and Kathy Davis in the Southern Arizona Office (SOAR) for their vigorous support of research in Arizona's parks. Additional support for infrared-triggered photography was provided by a grant from T & E, Inc.

INTRODUCTION

Coronado National Memorial is a National Park Service (NPS) interpretive site which overlooks the probable route of Francisco Vasquez de Coronado, an early Spanish explorer of North America. Located on the Mexico-United States boundary at the junction of several major biogeographic provinces, the Memorial supports a rich flora and fauna. Studies conducted between 1988 and 1992 produced a relatively complete flora and list of vegetation (Ruffner and Johnson 1991), and knowledge of fauna has increased due to current ecological studies of bats and barking frogs (*Eleutherodactylus augusti*), and increased record-keeping by Memorial staff. However, to date there has not been a comprehensive inventory of terrestrial mammals.

Most present knowledge of terrestrial mammals at the Memorial was compiled during a study by University of Arizona researchers in 1977-78. Using trapping for nocturnal rodents, mist-netting for bats, and observations, Petryszyn and Cockrum (1979) confirmed 26 species of mammals (including 12 bat species) at the Memorial. However, they were unable to confirm an additional 31 mammals (including 17 bat species) which they believed were probably present based on range maps and historic records. Petryszyn and Cockrum (1979) believed that the most significant gaps in knowledge of mammals at the Memorial were of grassland species of nocturnal rodents, and most of the larger species they observed were not confirmed with voucher specimens or photographs. They also noted nine species which may have been present in the past but appeared to be at least locally extirpated, including such federally-listed species as the Mexican gray wolf (*Canis lupus baileyi*), black-tailed prairie dog (*Cynomys ludovicianus*), jaguarundi (*Herpailurus yagouaroundi*), ocelot (*Leopardus pardalis*), and jaguar (*Panthera onca*).

OBJECTIVES

The purpose of the present study was to fill in gaps in our knowledge of terrestrial mammals at Coronado, particularly in grassland habitats, and to combine this information with historic data to produce a baseline inventory. Our primary goal was to use a variety of techniques to confirm as many of the Memorial's terrestrial mammal species as possible. Our secondary goal was to fit these data into a geographic context, and produce range maps for the current distribution of mammals at Coronado. Although monitoring population abundances was not a goal of this study, we did measure relative abundance of nocturnal rodents, and discuss these data in the context of long-term monitoring of vertebrates at Coronado. Specific objectives were:

1. To survey terrestrial mammals using techniques that have minimal impact on animals and the environment;
2. To use voucher photographs as a method of confirming easily identified species present on the Memorial, and to collect as voucher specimens animals found dead or species difficult to identify from photographs;

3. To gather historic information on mammals at Coronado from published sources, museum collections, and historic reports;
4. To document relative abundance of selected species in different vegetation communities in the Memorial;
5. To provide this information to the Memorial in a format useful for management decisions and interpretation.

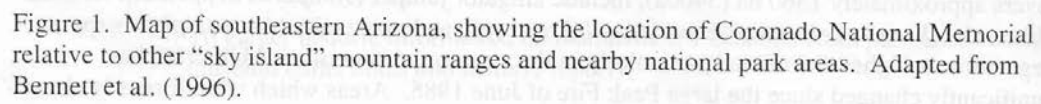
Three products are provided in the appendices of this report. Appendix A is a table of all species confirmed during this study, including how these confirmations were documented. Appendix B provides details on trapping grids and infrared-triggered camera (Trailmaster) locations. Appendices C and D give accounts of all confirmed and potential species, including historic information and current range maps. Copies of field data sheets, database files, Global Positioning Systems (GPS) files, Trailmaster photographs, field notes, and voucher photographs that are not already in Coronado National Memorial files will accompany this report.

STUDY SITE

Coronado National Memorial is located at the south end of the Huachuca Mountains, on the Mexico-United States border (Figure 1). The Huachucas are one of a number of small "sky island" mountain ranges in southeastern Arizona, southwestern New Mexico, and Mexico which lie on the edge of a number of biogeographic provinces, including the Sierra Madre Occidental to the south, the Rocky Mountains to the northeast, the Sonoran Desert to the west, and the Chihuahuan Desert to the east (Fishbein et al. 1994). As a result of this overlap, the Huachucas are biologically very diverse, and a number of mammal species that occur in the area occur either in disjunct populations or are on the edges of their range.

The Memorial contains 1900 ha (4750 acres), and preserves all of the upper watershed of Montezuma Canyon (Figure 2). The northwest portion of the Memorial reaches an elevation of approximately 2386 m (7825 feet), while the lowest elevation, approximately 1471 m (4825 feet), is in the southeast corner. Steep, wooded terrain predominates in the northern and western portions, particularly in Montezuma Canyon. The eastern portion is a broad open plain dissected by numerous drainages which flow into the San Pedro River. Riparian zones are most distinctive in the main drainages, but what little permanent or semi-permanent water there is occurs in only a few isolated seeps and steel cattle tanks. The complex geology includes metamorphosed sedimentary deposits, volcanic deposits, and more recent sedimentary deposits (Doe 1986), including limestone outcrops that form underground chambers.

The vegetation of the Memorial above 1646 m (5400 feet) is predominately in the oak series (hereafter "oak woodland") of the Madrean Evergreen Forest and Woodland association (Figure



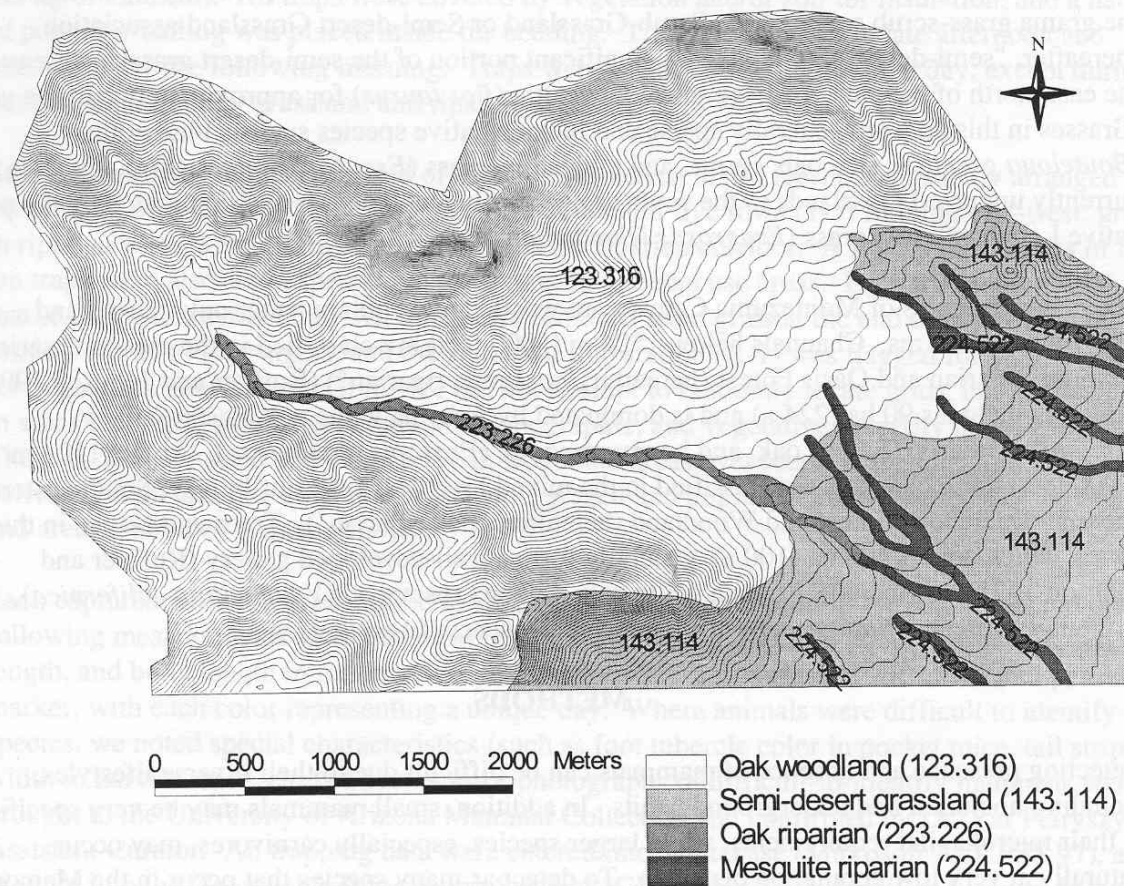


Figure 2. Vegetation map of Coronado National Memorial, from Ruffner and Johnson (1991). Based on classification system of Brown et al. (1979). For full description of vegetation see text. Winter-spring grazing occurs in the northeast 1/3 of the Memorial.

2; Ruffner and Johnson 1991). Characteristic trees and shrubs in this biotic community, which covers approximately 1360 ha (3400a), include alligator juniper (*Juniperus deppeana*), Arizona white oak (*Quercus arizonica*), Emory oak (*Q. emoryi*), and manzanita (*Arctostaphylos* spp.). Vegetation at higher elevations, particularly in the western portion of the Memorial, has significantly changed since the large Peak Fire of June 1988. Areas which were formerly closed-canopy oak woodland, which had probably developed as a result of many years of fire suppression, presently have a canopy dominated by oak with a herbaceous layer dominated by perennial grass species, particularly bunch grasses such as *Muhlenbergia* spp. and side oats grama (*Bouteloua curtipendula*). Succulents such as sotol (*Dasyllirion wheeleri*) and beargrass (*Nolina microcarpa*) are common. A total of 400 ha (1000 a) below 1646 m (5400 feet) are in the grama grass-scrub series of the Scrub-Grassland or Semi-desert Grassland association (hereafter, "semi-desert grassland"). A significant portion of the semi-desert grassland areas in the east, north of the park road, are grazed by cattle (*Bos taurus*) for approximately half the year. Grasses in this area are generally sparse and include native species such as blue grama (*Bouteloua gracilis*), side oats grama, and plains lovegrass (*Eragrostis intermedia*). Grasses in currently ungrazed grasslands to the south are generally much denser and dominated by the non-native Lehmann's lovegrass (*Eragrostis lehmanniani*).

The major channels of Montezuma Canyon are wooded and contain water only during and following rainstorms. Channels below 1524 m (5000 feet) are classified in the mesquite series of Sonoran Riparian and Oasis Forest (hereafter, "mesquite riparian") (Ruffner and Johnson 1991). This area includes 90 ha (224 a) and is dominated by Arizona white oak, desert willow (*Chilopsis linearis*), Emory oak, and honey mesquite (*Prosopis glandulosa*). Above 1524 m (5000 feet) these channels are classified in the mixed broadleaf series of Interior Southwestern Riparian Deciduous Forest and Woodland (hereafter, "oak riparian"). Trees and shrubs in this series, which covers 400 ha (100 a), generally form a well-developed gallery (Ruffner and Johnson 1991) and include Arizona white oak, Arizona rosewood (*Vauquelinia californica*), Arizona sycamore (*Platanus wrightii*), and catclaw acacia (*Acacia greggii*).

METHODS

Detecting presence and absence of mammals can be difficult due to their diverse lifestyles, including nocturnal and underground habits. In addition, small mammals may be very specific in their microhabitat requirements, while larger species, especially carnivores, may occur naturally at very low population densities. To detect as many species that occur in the Memorial as possible, we used a wide variety of techniques as outlined below.

Historic records. To gather information about the present and historic distribution of mammals at the Memorial, we surveyed sources inside and outside NPS. For all mammal species of possible occurrence, we reviewed published records, particularly Hoffmeister (1986), the primary source of such data for Arizona, and unpublished sources, particularly Petryszyn and Cockrum (1979). We also reviewed records from the University of Arizona mammal museum and other major U.S. museums. Records from wildlife observation cards at Coronado National Memorial

through November 2000 were summarized and entered into a database. Additional historic records were provided by the Memorial, the NPS Western Archeological Conservation Center in Tucson, and the Heritage Database of the Arizona Game and Fish Department (AGFD)(AGFD 1996).

Small mammal trapping. To verify species of nocturnal rodents and to determine species distribution and relative abundance, we trapped nocturnal rodents using "extra large" Sherman and Tomahawk brand live traps for small mammals (7.5 X 9 X 23.5 cm). Traps were baited with oatmeal mixed with a small amount of peanut butter (approximately one tbsp. peanut butter per 0.5 kg of oatmeal). All traps were covered by vegetation and/or soil for insulation, and a handful of polyester batting was placed inside for bedding. Traps were baited in late afternoon and checked early the following morning. Traps were usually closed during the day, except during cool weather in thick grassland and riparian areas.

Standard inventory grids consisted of 25 traps placed ten m (33 feet) apart, usually arranged in a square grid of five rows (A-E) running north-south and five rows (1-5) running east-west; grids in riparian areas were arranged to conform to the riparian corridor. A few smaller arrays of five-ten traps were also set in special microhabitats and human use areas. Each trap station was marked with surveyors tape. All traps were removed from grids at the end of each trapping session of one to four nights, and the southeast trap station (A-1) was flagged for later relocation for vegetation analysis and GPS. We did not attempt to randomly locate grids, but located them in areas that represented the geographic, topographic, and vegetative diversity of the Memorial. These included burned and unburned oak woodland areas, wet seeps, cattle tanks, riparian corridors, high and low elevation grasslands, grazed and ungrazed semi-desert grassland areas, and areas altered by human activity.

Each captured animal was identified to species, age, sex, and reproductive condition, and the following measurements were taken: weight in grams; right hind foot length, ear length, tail length, and body length in millimeters. Individuals were batch-marked with a colored permanent marker, with each color representing a unique day. Where animals were difficult to identify to species, we noted special characteristics (such as foot tubercle color in pocket mice, tail stripe width in harvest mice, etc.). Specimens or photographs of difficult-to-identify mammals were brought to the University of Arizona Mammal Collection and confirmed by Dr. Yar Petryszyn, Assistant Curator. All trapping data were entered into a database (Microsoft ACCESS 97), and brought into the Geographic Information Systems (GIS) in Program ArcView (version 3.0) to generate range maps for each species.

Infrared-triggered photography. Infrared-triggered photographs of large and medium-sized mammals were obtained using the model 1500 Trailmaster camera system (Goodson and Associates, Inc., Lenaxa, KS), where a single infrared beam is emitted by a transmitter and detected by a receiver; a photograph is taken when this beam is broken by an animal. Three units were operated continuously from October 1996 through December 1997. We did not randomly locate camera units, but placed them in vegetated areas that represented the geographic diversity

of the Memorial and were protected from direct sunlight and observation by visitors. Cameras were set out for intervals of two weeks or more at a natural water source, or baited with sardines, cat or other carnivore lure, a visual lure, or some combination of these. We recorded all changes of film and bait used, and map coordinates were obtained using GPS. We also recorded slope, aspect, and vegetation at each site. Animals in each photograph were identified to species if possible, and times and dates recorded; data were entered into ACCESS as for nocturnal rodents.

Observations. To supplement records of mammal distribution and relative abundance, we recorded all mammals observed during this study, and during field trips associated with a study of reptiles and amphibians which was initiated at the Memorial in spring 1997. We looked for mammals while driving on a road transect between the east and west boundaries; while conducting trapping and habitat analysis; and under boards and other materials while searching for reptiles. We recorded date, time, species, and location associated with each animal observed. Observations were also recorded by Memorial staff.

Voucher specimens and photographs. One specimen of each small mammal species not previously captured at Coronado National Memorial, and all trap mortalities, were taken as vouchers. Live specimens were euthanized with carbon dioxide gas according to University of Arizona animal handling protocols (Institutional Animal Care and Use Committee (IACUC), Control #94-067). Voucher specimens of medium and large mammals usually were animals killed by cars on East Montezuma Canyon Road, but occasionally parts of animals (e.g., skulls or carcasses) found dead were also collected. All specimens were deposited in the University of Arizona mammal collection. In addition to photographs taken by infrared-triggered cameras, we also voucher-photographed live individuals of ten rodent species and the desert shrew (*Notiosorex crawfordi*).

Monitoring grids. As a supplement to the small mammal inventory, two grids of 100 traps each were selected as test grids for monitoring abundance. The purpose of this monitoring was to evaluate the sample size and cost necessary for monitoring nocturnal rodents at the Memorial. One grid (9A18) was randomly located in semi-desert grassland below 1524 m (5000 feet); a second grid (2A6) was randomly located on a south-facing slope in oak savanna above 1921 m (6300 feet), within 1.6 km (1 mile) of a road. Methods were the same as described for inventory, except individual animals were uniquely marked using permanent color pens in order to develop a capture history for each. Each grid was trapped for four nights in December 1997. Abundance on each grid was estimated using Program CAPTURE for closed populations (Otis et al. 1978).

Determining relative abundance. Data from small mammal trapping was used to provide an index of abundance for each species listed in Appendix C. Comparing the abundance of one species relative to another is problematic, because the number of individuals observed reflects not only the numbers of animals present, but also how easily they can be captured. For example, pocket gophers are certainly very common at Coronado, but are rarely observed directly because they spend so much of their time underground and are difficult to trap alive. Abundance comparisons should ideally be based on estimates of *absolute* abundance or density (number of

individuals per unit area), obtained through unbiased methods, such as mark-recapture studies. However, these methods are extremely time-consuming, and usually cannot be obtained without intensive, species-specific study.

Therefore, in this study we determined indices of relative abundance using the numbers observed per unit search effort where available. For nocturnal rodents abundance classes are defined by the number of individuals captured per 100 trap nights, where <0.2 = rare, $0.2-0.5$ = uncommon, $0.5-0.9$ = common and >1.0 = very common. For other species we report relative abundance based on the combined total of infrared-triggered photographs and sightings during this study, where <3 = rare, $4-15$ = uncommon, $15-40$ = common, and >40 = very common. We do not attempt to report abundance indices for a few species that are very difficult to identify or observe, such as eastern cottontail (*Sylvilagus floridanus*) or pocket gophers.

Nomenclature and field schedule. In this report we follow the standard English and scientific nomenclature of Jones et al. (1997). Field work for this study began in September 1996 and continued through February 1998; however, the total number of species observed and range maps in Appendix C include sight and trapping records from the Memorial through November 2000. C.R. Schwalbe was the principle investigator. D.E. Swann conducted the majority of fieldwork, with assistance from A.J. Kuenzi, B.N. Alberti, and a number of volunteers.

RESULTS

Twenty-eight species of native terrestrial mammals were confirmed during this study by specimen vouchers; an additional nine species not confirmed by specimens were confirmed by unambiguous voucher photographs. We did not collect specimens of three additional confirmed species that had previously been collected by Petryszyn and Cockrum (1979); however, except for one species of pocket gopher, we observed all of the species confirmed by Petryszyn and Cockrum (1979). An additional three species of mammals were considered to be “confirmed” by reliable sightings by us or Memorial staff. Sightings were considered reliable only for species that are difficult to misidentify (e.g., black-tailed jackrabbit, *Lepus californicus*), and were observed within their expected range and habitat.

The total number of terrestrial mammals confirmed at Coronado National Memorial, including three species confirmed during 1998-2000, is 43 (Table 1). Not included in this total are domestic cattle and two other non-native species (feral dog (*Canis familiaris*) and feral cat (*Felis catus*)) that exist in the wild but probably would not survive without human assistance. We also do not include eastern cottontail because a voucher specimen is needed to unambiguously identify this species; however, we are fairly certain that we observed and photographed this

Table 1. Species of terrestrial mammals confirmed at Coronado National Memorial from September 1996 through December 2000, either by voucher specimen, voucher photograph, or confirmed sighting. For further details of species confirmation, distribution, and relative abundance, see appendices. Species marked with an asterisk (*) are not native.

<i>Order/Common Name</i>	<i>Scientific name</i>
Marsupials	
Virginia opossum	<i>Didelphis virginiana</i>
Insectivores	
Desert shrew	<i>Notiosorex crawfordi</i>
Rabbits and Hares	
Black-tailed jackrabbit	<i>Lepus californicus</i>
Desert cottontail	<i>Sylvilagus audubonii</i>
Rodents - Squirrels and Pocket Gophers	
Arizona gray squirrel	<i>Sciurus arizonensis</i>
Spotted ground squirrel	<i>Spermophilus spilosoma</i>
Rock squirrel	<i>Spermophilus variegatus</i>
Botta's pocket gopher	<i>Thomomys bottae</i>
Rodents - Pocket Mice and Kangaroo Rats	
Hispid pocket mouse	<i>Chaetodipus hispidus</i>
Rock pocket mouse	<i>Chaetodipus intermedius</i>
Sonoran Desert pocket mouse	<i>Chaetodipus penicillatus</i>
Ord's kangaroo rat	<i>Dipodomys ordii</i>
Banner-tailed kangaroo rat	<i>Dipodomys spectabilis</i>
Merriam's kangaroo rat	<i>Dipodomys merriami</i>
Silky pocket mouse	<i>Perognathus flavus</i>
Rodents - Murid Mice and Rats	
Northern pygmy mouse	<i>Baiomys taylori</i>

Table 1, continued.

Order/Common Name	Scientific name
<i>Rodents - Murid Mice and Rats (continued)</i>	
White-throated woodrat	<i>Neotoma albigula</i>
Southern grasshopper mouse	<i>Onychomys torridus</i>
Brush mouse	<i>Peromyscus boylii</i>
Deer mouse	<i>Peromyscus maniculatus</i>
White-footed mouse	<i>Peromyscus leucopus</i>
Western harvest mouse	<i>Reithrodontomys megalotis</i>
Fulvous harvest mouse	<i>Reithrodontomys fulvescens</i>
Arizona cotton rat	<i>Sigmodon arizonae</i>
Tawny-bellied cotton rat	<i>Sigmodon fulviventer</i>
Yellow-nosed cotton rat	<i>Sigmodon ochrognathus</i>
Carnivores	
Ringtail	<i>Bassariscus astutus</i>
*Feral dog	<i>Canis familiaris</i>
Coyote	<i>Canis latrans</i>
Common hog-nosed skunk	<i>Conepatus mesoleucus</i>
*Feral cat	<i>Felis catus</i>
Bobcat	<i>Lynx rufus</i>
Hooded skunk	<i>Mephitis macroura</i>
Striped skunk	<i>Mephitis mephitis</i>
American badger	<i>Taxidea taxus</i>
White-nosed coati	<i>Nasua narica</i>
Common raccoon	<i>Procyon lotor</i>
Mountain lion	<i>Puma concolor</i>
Western spotted skunk	<i>Spilogale gracilis</i>
Common gray fox	<i>Urocyon cinereoargenteus</i>
Black bear	<i>Ursus americanus</i>
Hoofed mammals	
White-tailed deer	<i>Odocoileus virginianus</i>
Mule deer	<i>Odocoileus hemionus</i>
Collared peccary	<i>Pecari tajacu</i>

species. We believe it will eventually be verified and include it in the species accounts in Appendix C.

Of the 43 confirmed species, 11 may be considered "new", because to our knowledge no voucher specimens or photographs had been taken in the past, and the species does not appear on previous species lists. For all but ten species observed, voucher photographs were obtained. Slides of these species will be deposited in archives at Coronado and the University of Arizona. Appendix A provides a summary of all confirmed species and existing records.

In addition to confirmed native and non-native species, an additional 18 native species either occur or have occurred historically within the Huachuca Mountains (Hoffmeister 1986) or nearby valleys (Table 2). This list includes some species that have been sighted near the Memorial and are likely to occur (e.g., common porcupine (*Erithizon dorsatum*) as well as others that occur nearby but are unlikely due to lack of suitable habitat (e.g., round-tailed ground squirrel (*Spermophilus tereticaudus*)). It also includes species that are not resident but range widely and may pass through the Memorial from time to time (jaguar and ocelot) and a few species that are now certainly extirpated in the area (gray wolf, grizzly bear (*Ursus arctos*)). Species accounts for all known and potential species, including summaries of historic and museum records, are provided in Appendices C and D.

Small mammal trapping. We trapped nocturnal rodents from September 1996 through December 1997 for a total of 5424 trap-nights. Locations of trapping grids are shown in Figure 3, and vegetation type and elevation for each grid are summarized in Appendix B. Photographs of each grid and data sheets with vegetation data have been provided to Coronado National Memorial.

A total of 672 captures of 17 species were made, for a mean trap success of 12.4%. A total of 498 individuals were captured. The most common species captured (Figure 4) were the brush mouse (*Peromyscus boylii*), yellow-nosed cotton rat (*Sigmodon ochrognathus*), white-throated woodrat (*Neotoma albigula*), and Sonoran Desert pocket mouse (*Chaetodipus penicillatus*).

A few species were very limited in their distribution in the Memorial. The deer mouse (*Peromyscus maniculatus*) was only captured at the "blue waterfall" seep north of the residences and two other locations. Merriam's kangaroo rat (*Dipodomys merriami*) and banner-tailed kangaroo rat (*Dipodomys spectabilis*) were only captured near the east boundary fence approximately 2.0 km (1.2 miles) south of East Montezuma Canyon Road, and Ord's kangaroo rat (*Dipodomys ordii*) was only trapped at one location in the orchard area of Montezuma Ranch. The rock pocket mouse (*Chaetodipus intermedius*) was captured rarely in rocky areas only. The tawny-bellied cotton rat (*Sigmodon fulviventer*) and southern grasshopper mouse (*Onychomys torridus*) were only captured in semi-desert grasslands below 1509 m (4950 feet).

Six species that were largely confined to grassy areas occurred in both lower elevation semi-desert grassland as well as upper elevation (above 1982 m (6500 feet)) oak savanna where grasses were abundant. These species included the Sonoran Desert pocket mouse, yellow-nosed

Table 2. Potential species at Coronado National Memorial not confirmed from September 1996 through December 2000. All have been confirmed in or nearby the Huachuca Mountains except for jaguarundis, which have never been confirmed although sightings have been reported. E = presently extirpated from Arizona. R = very rare in Arizona, occasional sightings only; see Appendix D for details. U = status unknown, never confirmed in Arizona.

<i>Order/Common Name</i>	<i>Scientific name</i>	<i>Status</i>
Insectivores		
Arizona shrew	<i>Sorex arizonae</i>	
Rabbits and Hares		
Antelope jackrabbit	<i>Lepus alleni</i>	
Eastern cottontail	<i>Sylvilagus floridanus</i>	
Rodents - Squirrels		
Black-tailed prairie dog	<i>Cynomys ludovicianus</i>	
Round-tailed ground squirrel	<i>Spermophilus tereticaudus</i>	
Rodents - Pocket Mice and Kangaroo Rats		
Bailey's pocket mouse	<i>Chaetodipus baileyi</i>	
Rodents - Murid Mice and Rats		
Mexican woodrat	<i>Neotoma mexicana</i>	
House mouse	<i>Mus musculus</i>	
Northern grasshopper mouse	<i>Onychomys leucogaster</i>	
Cactus mouse	<i>Peromyscus eremicus</i>	
Plains harvest mouse	<i>Reithrodontomys montanus</i>	
Rodents – Porcupines		
Common porcupine	<i>Erethizon dorsatum</i>	

Table 2, continued.

<i>Order/Common Name</i>	<i>Scientific name</i>	<i>Status</i>
Carnivores		
Gray wolf	<i>Canis lupus</i>	E
Jaguarundi	<i>Herpailurus yagouaroundi</i>	U
Ocelot	<i>Leopardus pardalis</i>	R
Jaguar	<i>Panthera onca</i>	R
Grizzly bear	<i>Ursus arctos</i>	E
Kit fox	<i>Vulpes macrotis</i>	

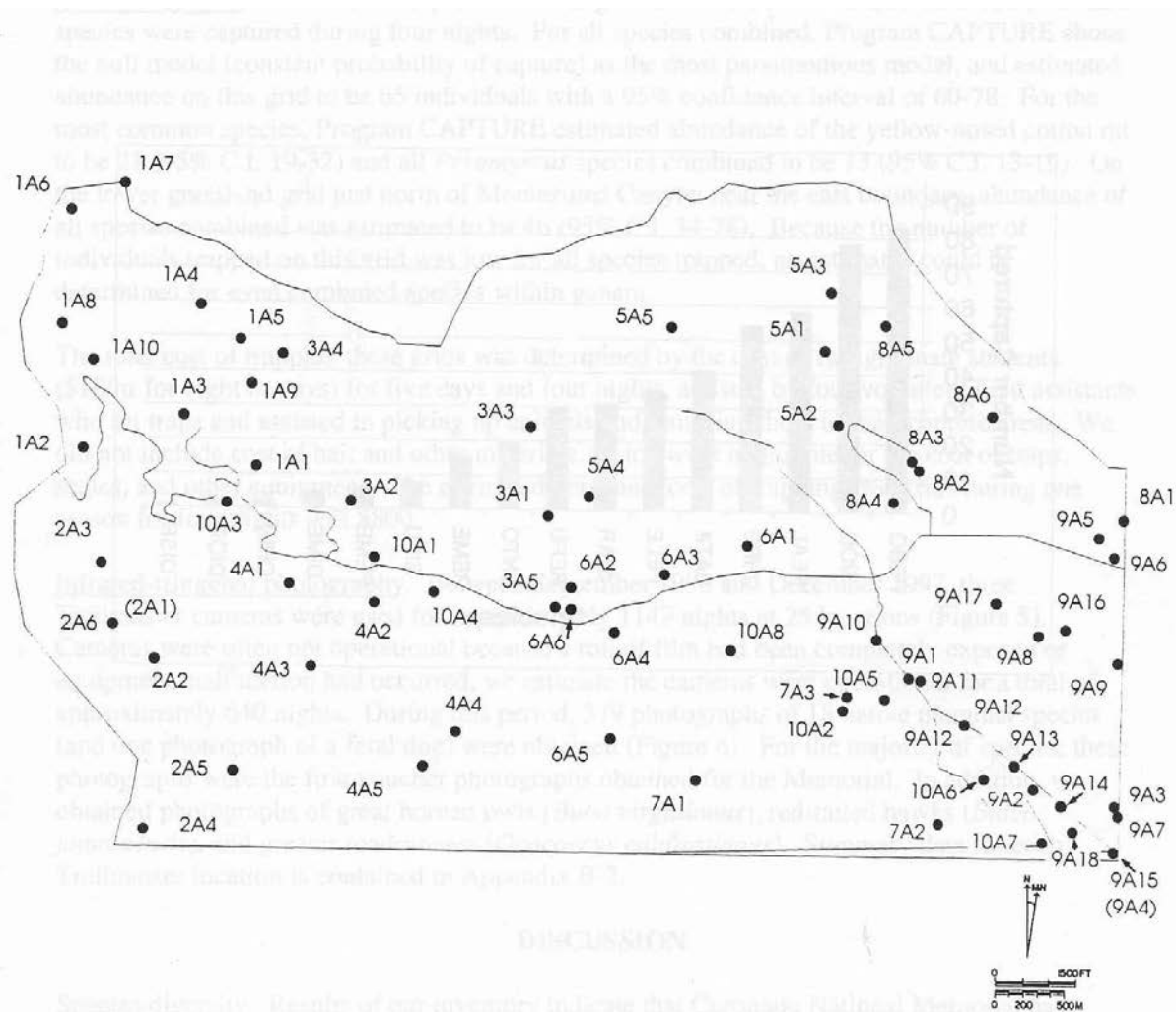


Figure 3. Map of Coronado National Memorial, showing locations of trapping grids. This map was generated by Program ArcView based on GPS locations. Roads are represented by lines. Monitoring grids are 9A18 and 2A6.

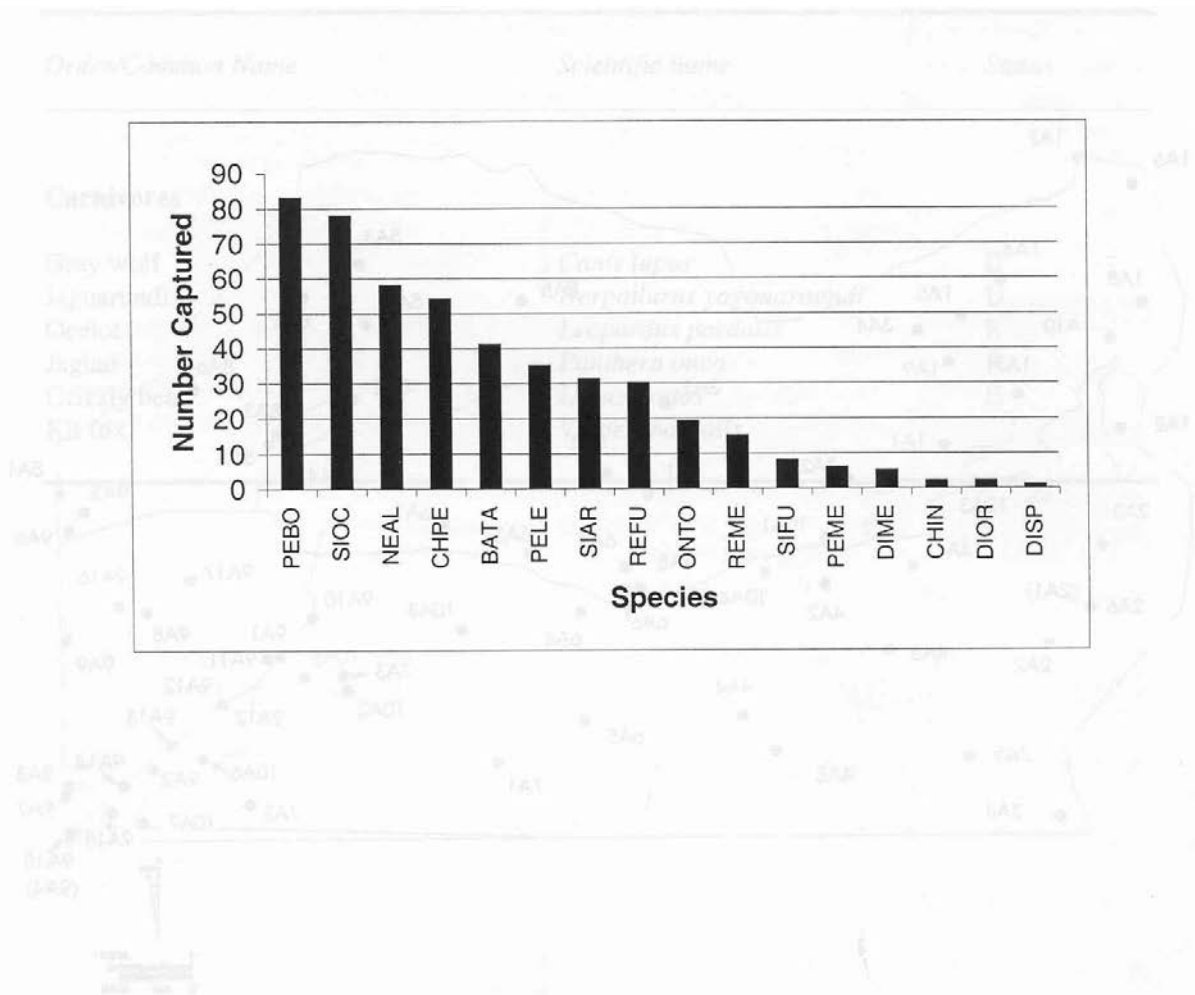


Figure 4. Number of individuals trapped (captures – recaptures) of nocturnal rodent species captured at Coronado National Memorial, 1996-1997. Based on 5424 trap-nights. Acronyms are based on scientific names: first two letters of genus name, followed by first two letters of species name. See Table 1 for guide to scientific names.

cotton rat, Arizona cotton rat, fulvous harvest mouse (*Rheithrodontomys fulvescens*), western harvest mouse (*R. megalotis*), and northern pygmy mouse (*Baiomys taylori*). Three species were nearly ubiquitous: the white-footed mouse (*Peromyscus leucopus*) was found at all elevations and vegetation associations except semi-desert grassland, and the brush mouse and white-throated woodrat were found in every vegetation association. Table A-2 lists the number of each species captured in each of the four major vegetation communities plus residential areas and seeps, with additional categories of grazed vs. ungrazed, and tree cover > grass cover vs. tree cover < grass cover.

Monitoring grids. On the 100-trap oak savanna grid near Coronado Peak, 55 individuals of nine species were captured during four nights. For all species combined, Program CAPTURE chose the null model (constant probability of capture) as the most parsimonious model, and estimated abundance on this grid to be 65 individuals with a 95% confidence interval of 60-78. For the most common species, Program CAPTURE estimated abundance of the yellow-nosed cotton rat to be 21 (95% C.I. 19-32) and all *Peromyscus* species combined to be 13 (95% C.I. 13-19). On the lower grassland grid just north of Montezuma Canyon near the east boundary, abundance of all species combined was estimated to be 46 (95% C.I. 34-78). Because the number of individuals trapped on this grid was low for all species trapped, no estimates could be determined for even combined species within genera.

The total cost of trapping these grids was determined by the cost of two graduate students (\$10/hr for eight hr days) for five days and four nights, assisted by four volunteer field assistants who set traps and assisted in picking up animals and returning them to their capture areas. We did not include cost of bait and other materials, which were negligible, or the cost of traps, scales, and other equipment. The estimated personnel cost of trapping two grids during one season for four nights was \$800.

Infrared-triggered photography. Between September 1996 and December 1997, three Trailmaster cameras were used for approximately 1142 nights at 25 locations (Figure 5). Cameras were often not operational because a roll of film had been completely exposed or equipment malfunction had occurred; we estimate the cameras were operational for a total of approximately 640 nights. During this period, 379 photographs of 18 native mammal species (and one photograph of a feral dog) were obtained (Figure 6). For the majority of species, these photographs were the first voucher photographs obtained for the Memorial. In addition, we obtained photographs of great horned owls (*Bubo virginianus*), red-tailed hawks (*Buteo jamaicensis*), and greater roadrunners (*Geococcyx californianus*). Summary data for each Trailmaster location is contained in Appendix B-2.

DISCUSSION

Species diversity. Results of our inventory indicate that Coronado National Memorial has a great diversity of mammal species for its size compared to other parks in southern Arizona (although

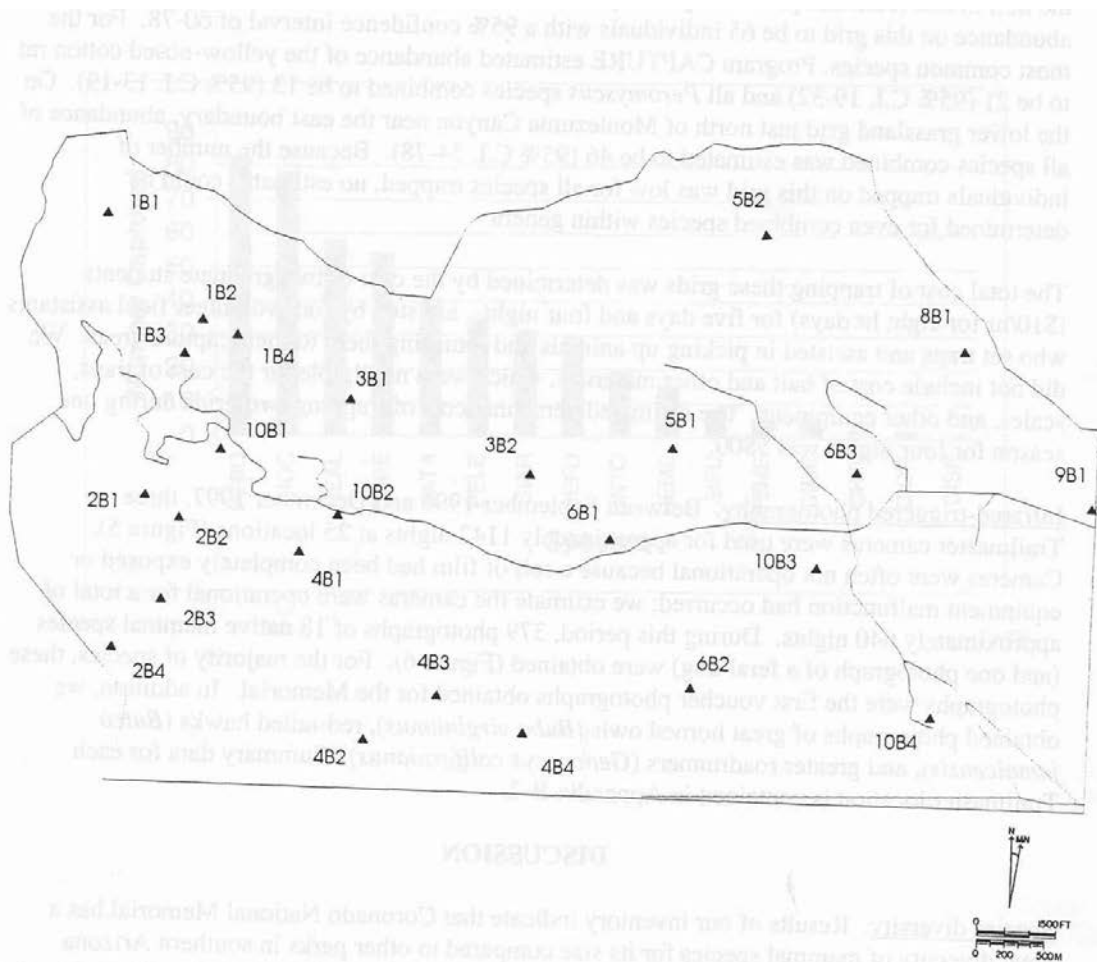


Figure 5. Map of Coronado National Memorial, showing locations of infrared-triggered photograph stations. This map was generated by Program ArcView based on Global Positioning Systems data.

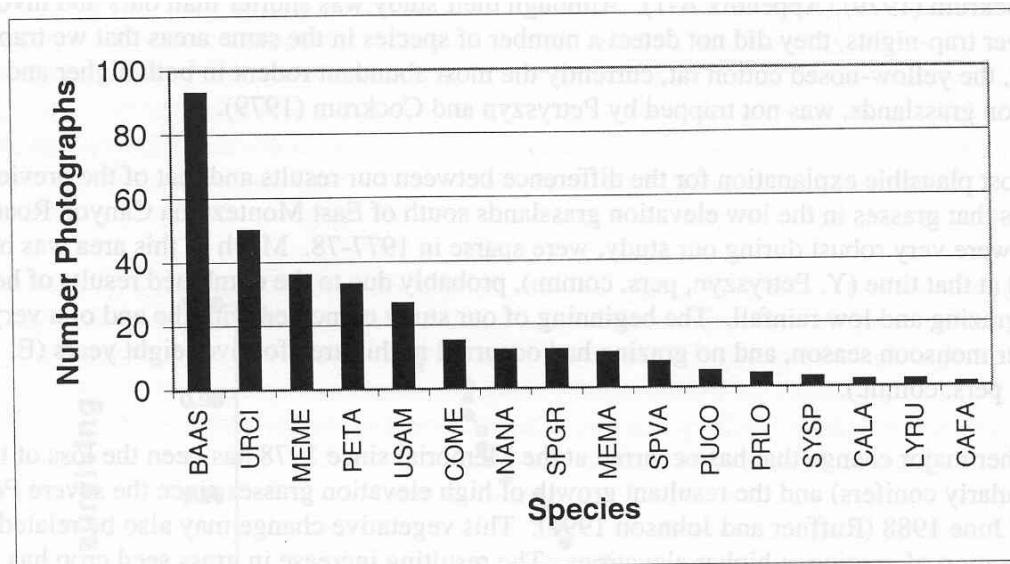


Figure 6. Number of individual photographs of 18 mammal species taken by infrared-triggered photography at Coronado National Memorial, 1996-1997. Based on approximately 1142 camera-nights. Acronyms are based on genus and species names, as in Table 4.

not as many as Tonto National Monument; Table 3). This is probably due to a number of factors, including the presence of thick grassland vegetation in ungrazed areas, which supports many species of rodents; the Memorial's location in the Huachuca Mountains, which is itself very diverse for biogeographic reasons; and the Memorial's connectivity to other natural areas nearby, including Coronado National Forest, the San Pedro River, and undeveloped areas in Mexico. In addition, small parks such as Coronado and Tonto may have higher diversity per unit area because their mammalian fauna include most of the habitat generalists (e.g., species like desert cottontail (*Sylvilagus audubonii*), mountain lion (*Puma concolor*), and white-throated woodrat (*Neotoma albigula*) that occur in larger parks. Preserving this diversity at Coronado is important, and some effort should be made to better understand why it occurs.

It is significant that this study confirmed a number of rodent species not confirmed by Petryszyn and Cockrum (1979) (Appendix A-1). Although their study was shorter than ours and involved far fewer trap-nights, they did not detect a number of species in the same areas that we trapped. Indeed, the yellow-nosed cotton rat, currently the most abundant rodent in both higher and lower elevation grasslands, was not trapped by Petryszyn and Cockrum (1979).

The most plausible explanation for the difference between our results and that of the previous study is that grasses in the low elevation grasslands south of East Montezuma Canyon Road, which were very robust during our study, were sparse in 1977-78. Much of this area was bare ground at that time (Y. Petryszyn, pers. comm.), probably due to the combined results of heavy cattle grazing and low rainfall. The beginning of our study coincided with the end of a very wet summer monsoon season, and no grazing had occurred in this area for over eight years (E. Lopez, pers. comm.).

The other major change that has occurred at the Memorial since 1978 has been the loss of trees (particularly conifers) and the resultant growth of high elevation grasses since the severe Peak Fire of June 1988 (Ruffner and Johnson 1991). This vegetative change may also be related to the cessation of grazing at higher elevations. The resulting increase in grass seed crop has clearly been favorable to small rodents. It will be interesting to track changes in the species diversity of these oak savannas if the vegetation changes to include greater amounts of oaks and pinon pine.

As a small but significant block of protected land at the south end of the Huachucas, Coronado National Memorial undoubtedly plays an important role as a refugium for many mammals, including not only grassland species, but also hunted animals such as deer (*Odocoileus* spp.) and predators such as mountain lion. Because of this, the Memorial may also play a significant role in any return of species that are presently extirpated from the area. Black-tailed prairie dogs, which probably occurred in or nearby the Memorial earlier in this century, apparently continue to persist over the border in Mexico less than 4.8 km (three miles) south of the Huachucas (Ecological Center of Sonora 1994). It is not impossible that this species could naturally recolonize protected grassland areas of the Memorial at some time in the future. Some scientists and ranchers now believe that prairie dogs are beneficial for cattle because of their role in suppressing mesquite (Weltzin 1997).

Table 3. Number of species of native terrestrial mammals on species lists at four parks in southern Arizona, and density in number of species per 100 ha.

Park area	Area (ha)	No. Mammals	Density
Organ Pipe Cactus NM	133,830	50	0.037
Saguaro NP	36,531	49	0.134
Coronado NM	1,900	43	2.263
Tonto NM	461	30	6.508

In addition, the Memorial provides a potential refugium for jaguars, ocelots, and gray wolves moving northward, should these species increase in number. However, for most larger mammals, Coronado National Memorial does not contain sufficient area to contain the entire home range for even a small population. If development and loss of habitat in the San Pedro Valley continues, it is very possible that more species will disappear from the Memorial, as has been documented for other western national parks (Newmark 1995; Figure 7). Species with relatively large home ranges at the Memorial include black bear, mountain lion, bobcat (*Lynx rufus*), white-nosed coati (*Nasua narica*), and others.

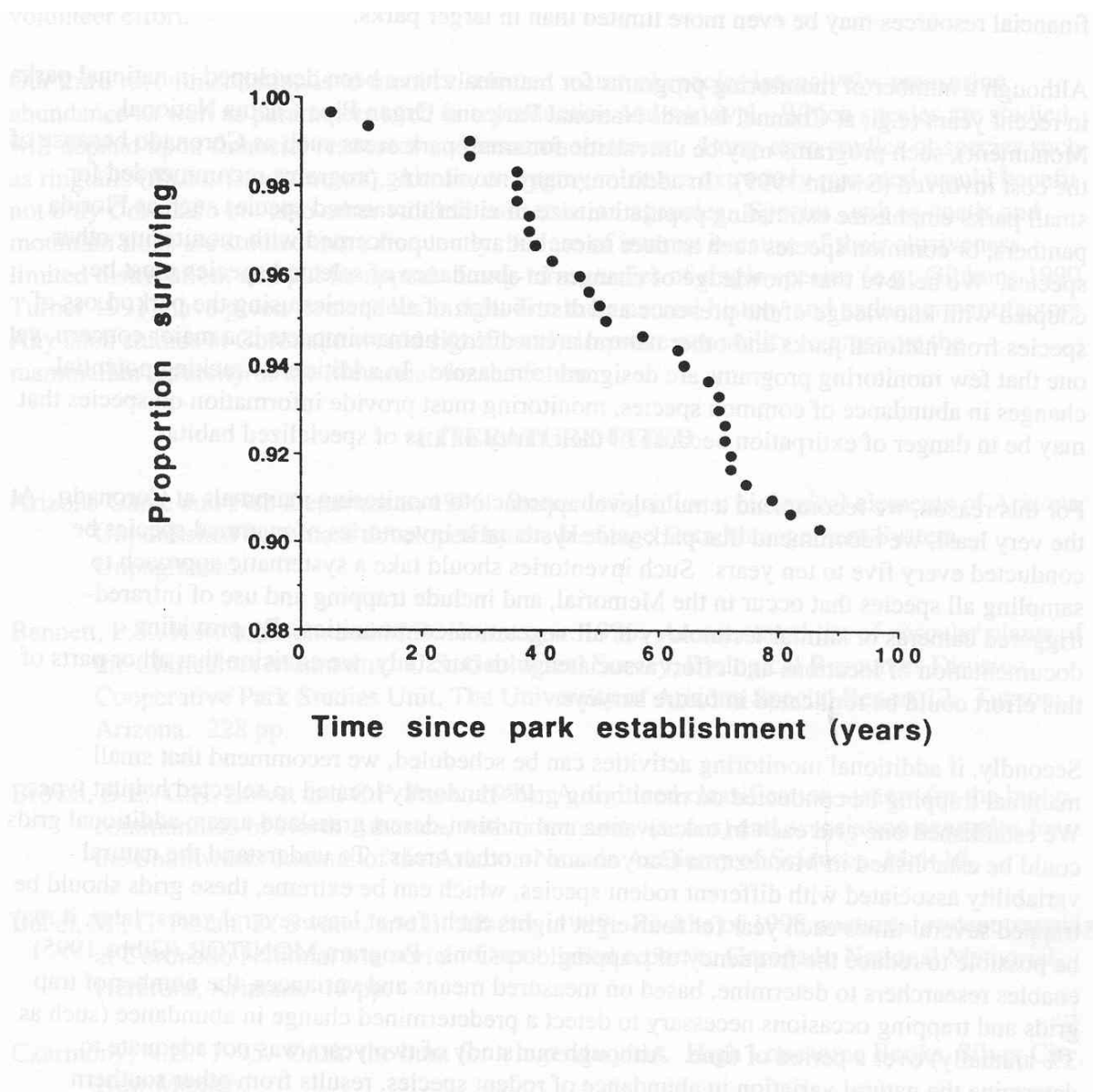


Figure 7. Percentage of mammal species surviving in western national parks as a function of the number of years since each park was established. From Newmark (1995).

MONITORING RECOMMENDATIONS

Monitoring vertebrate animals in national parks is essential if the NPS is to fulfill the important mission of preserving biodiversity on its lands that is presently mandated by the agency (NPS-75 1992). However, monitoring of vertebrates can be time-consuming and expensive. Many mammal species are difficult to observe and count, and their populations often fluctuate greatly due to natural causes. Monitoring is particularly difficult in small park areas where human and financial resources may be even more limited than in larger parks.

Although a number of monitoring programs for mammals have been developed in national parks in recent years (e.g., at Channel Islands National Park and Organ Pipe Cactus National Monument), such programs may be unrealistic for small park areas such as Coronado because of the cost involved (Swann 1999). In addition, many monitoring programs recommended for small parks emphasize estimating population size of either threatened species such as Florida panthers, or common species such as deer mice, but are not concerned with monitoring other species. We believe that knowledge of changes in abundance of selected species must be coupled with knowledge of the presence and distribution of all species using the park. Loss of species from national parks and other natural areas due to human impacts is a major concern, yet one that few monitoring programs are designed to measure. In addition to tracking potential changes in abundance of common species, monitoring must provide information on species that may be in danger of extirpation because of their rarity or loss of specialized habitat.

For this reason, we recommend a multi-level approach to monitoring mammals at Coronado. At the very least, we recommend that park-wide systematic inventories of mammal species be conducted every five to ten years. Such inventories should take a systematic approach to sampling all species that occur in the Memorial, and include trapping and use of infrared-triggered cameras or similar technology in all vegetation communities. By providing documentation of locations and effort associated with our study, we envision that all or parts of this effort could be replicated in future surveys.

Secondly, if additional monitoring activities can be scheduled, we recommend that small mammal trapping be conducted on monitoring grids randomly located in selected habitat types. We established one grid each in oak savanna and in semi-desert grassland areas; additional grids could be established in Montezuma Canyon and in other areas. To understand the natural variability associated with different rodent species, which can be extreme, these grids should be trapped several times each year for four-eight nights each, for at least several years; later, it may be possible to reduce the frequency of trapping occasions. Program MONITOR (Gibbs 1995) enables researchers to determine, based on measured means and variances, the number of trap grids and trapping occasions necessary to detect a predetermined change in abundance (such as 3% annually) over a period of time. Although our study of two years was not adequate to

determine the natural variation in abundance of rodent species, results from other southern Arizona studies (e.g., Petryszyn 1982) suggest variance may be extreme. For example, the estimated abundance of cotton rats on monitoring Grid 2A6 has ranged from 21 individuals in 1997 to five in 1999 (Bucci et al. 1999). High natural variability increases the number of grids that must be sampled in order to detect significant levels of change.

Our estimated costs for annual monitoring of large grids (\$800) should be considered a minimum estimate. Monitoring these grids in 1998 and 1999 was more expensive (Bucci et al. 1999) because we trapped for a longer period. The greater number of trap-nights provided more accurate population estimates, and the higher costs were at least partly off-set by a large volunteer effort.

Our third recommendation is to monitor selected mammal species intensively, measuring abundance as well as parameters such as reproduction and survival. Which species are studied will depend upon financial resources and researcher interest. Long-term studies of species such as ringtails (*Bassariscus astutus*), skunks, or pygmy mice are extremely rare, and would benefit not only Coronado but also other wildlife conservation agencies. Species such as coatis and mountain lions are studied more frequently, but are of interest because of their elusiveness, limited distribution, and public appeal. Long-term studies of single species (e.g., Gibbons 1990, Turner 1991) have given tremendous insight into their natural history and endangerment factors. Any such studies at Coronado would significantly improve our ability to preserve the mammalian diversity of the Memorial for the future.

LITERATURE CITED

- Arizona Game and Fish Department, 1996. Status designations: biological elements of Arizona. Unpublished document developed by the Heritage Data Management System. Unpaginated.
- Bennett, P.S., R.R. Johnson, and M.R. Kunzmann. 1996. An annotated list of vascular plants of the Chiricahua Mountains. U.S. Geological Survey, Biological Resources Division, Cooperative Park Studies Unit, The University of Arizona Special Report 12. Tucson, Arizona. 228 pp.
- Brown, D.E., C.H. Lowe, and C.P. Pase. 1979. A digitized classification system for the biotic communities of North America, with community (series) and association examples for the Southwest. *Journal of the Arizona-Nevada Academy of Sciences* 14:1-16.
- Bucci, M., C. Dolan, D. Swann, and B. Alberti. 1999. Results of 1998 nocturnal rodent trapping at Coronado National Memorial. Unpublished report to Coronado National Memorial, Hereford, Arizona. 13 pp.
- Czarmony, N.B. 1995. Onza: the hunt for a legendary cat. High Lonesome Books, Silver City,

New Mexico.

- Davis, R., and O.G. Ward. 1988. A vacant "*Microtis* niche" now occupied by the yellow-nosed cotton rat (*Sigmodon ochrognathus*) on an isolated mountain in southeastern Arizona. *Journal of Mammalogy* 69:362-365.
- Davis, R. and R. Sidner. 1992. Mammals of the woodland and forest habitats in the Rincon Mountains of Saguaro National Monument, Arizona. Technical Report No. 47, NPS/WRUA/NRTR-92/06. 62pp.
- Doe, M.F. 1986. Geology in the vicinity of Montezuma's Cave, southern Huachuca Mountain, Cochise County, Arizona. Unpublished report submitted to NPS-SOAR, Phoenix, Arizona.
- Ecological Center of Sonora. 1994. Management plan for the protected area of wild and aquatic flora and fauna in the Sierras of la Mariquita-la Elenita-Rio San Pedro, in the municipalities of Cananea, Naco and Sata Cruz, Sonora, Mexico. Unpublished report by the ECS and System of Protected Natural Areas in the State of Sonora, Hermosillo, Sonora.
- Fishbein, M., R. Felger, and F. Garza. Another jewel in the crown: a report on the flora of the Sierra de los Ajos, Sonora, Mexico. Pp. 126-134 in L.F. DeBano, G.J. Gottfried, R.H. Hamre, C.B. Edminster, P.F. Ffolliot, and A. Ortega-Rubio, Biodiversity and Management of the Madrean Archipelago: The Sky Islands of Southwestern United States and Northwestern Mexico. USDS NFS Gen. Tech. Rept. RM-GTR-264. 669pp.
- Gibbs, J.P. 1995. Program MONITOR. Unpublished software program for monitoring wildlife populations.
- Gilbert, B. 1973. Chulo. New York: Alfred A. Knopf. 290 pp.
- Girmendonk, A.L. 1994. Ocelot, jaguar, and jaguarundi sighting reports: Arizona and Sonora, Mexico. Unpublished report, AGFD Nongame and Endangered Wildlife Program, Phoenix, Arizona. 16pp.
- Hoffmeister, D.F. 1986. Mammals of Arizona. University of Arizona Press. Tucson, Arizona. 602pp.
- Jones, J.K. Jr., R.S. Hoffmann, D.W. Rice, C. Jones, R.J. Barker, M.D. Engstrom, R.D. Bradley, D.J. Schmidly, C.A. Jones, and R. J. Barker. 1997. Revised checklist of North American mammals north of Mexico. Occasional papers of the Museum of Texas Tech. Univ. No. 173:1-19.

- Newmark, W.D. 1995. Extinction of mammal populations in Western North American national parks. *Conservation Biology* 9:512- 526.
- NPS-75. 1992. Natural resource inventory and monitoring guideline. National Park Service, Washington, D.C. 37pp.
- Otis, D.L., K.P. Burnham, G.C. White, and D.R. Anderson. 1978. Statistical inference from capture data on closed animal populations. *Wildlife Monographs* 62:1-135.
- Petryszyn, Y. 1982. Population dynamics of nocturnal desert rodents: a nine year study. Ph.D. Dissertation, University of Arizona, Tucson. 108pp.
- Petryszyn, Y, and E.L. Cockrum. 1979. A survey of the mammals of Coronado National Memorial, Arizona. Pages 96-124 *in* E.L. Cockrum, C.H. Lowe, S.M. Russell, D. Danforth, T.B. Johnson, and Y. Petryszyn, 1979. Survey of the vertebrate fauna of Coronado National Memorial. Technical Report 5, NPS Cooperative Park Studies Unit, University of Arizona. 124pp.
- Risser, A.C. 1963. A study of the coati mundi *Nasua narica* in southern Arizona. Masters thesis, University of Arizona, Tucson. 77pp.
- Ruffner, G. A. and R.A. Johnson. 1991. Plant ecology and vegetation mapping at Coronado National Memorial, Cochise County, Arizona. CPSU-UA Tech. Rep. No. 41. 75pp.
- Swann, D.E. 1999. Evaluating approaches for monitoring terrestrial vertebrates in US national parks: an example from Tonto National Monument, Arizona. Master's thesis, School of Renewable Natural Resources, University of Arizona, Tucson. 175pp.
- Swann, D.E., B.N. Alberti, and C.R. Schwalbe. 1998. A survey of native cats in southeastern Arizona using infrared-triggered photography. Final report to T & E, Inc., Las Cruces, New Mexico. 20pp.
- Turner, R. 1991. Long-term saguaro population studies at Saguaro National Park. Pps. 3-11 *in* C.P. Stone and E.S. Bellantoni, eds. Proceedings of the symposium on research at Saguaro National Monument. Tucson, AZ. 277pp.
- Welles, P. 1959. A report on the Coues Deer at Coronado National Memorial. Unpublished report to Regional Director of Region 3 of the National Park Service, Arizona.
- Weltzin, J.F., S. Archer, and R.K. Heitschmidt. 1997. Small-mammal regulation of vegetation structure in a temperate savanna. *Ecology* 78:751-763.

APPENDIX A: SUMMARY OF RECORDS OF TERRESTRIAL MAMMALS
AT CORONADO NATIONAL MEMORIAL

Table A-1. Key to confirmed species of terrestrial mammals at Coronado National Memorial. Based on 1977-78 study (Petryszyn and Cockrum 1979), this study, and wildlife sightings database compiled by Memorial staff.

^aRecent photographs exist in Coronado photo archives. ^bEastern cottontails are included on this list, but it is not possible to confirm this species based on sightings or photographs without a voucher specimen. ^cSpecies confirmed during trapping in long-term monitoring program, 2000.

Species	Confirmed, (specimen) 1977-1978	Observed only, 1977-78	Confirmed, (specimen) this study	Photo, this study	Observed only, this study	Observed, CORO database
Marsupials						
Virginia opossum <i>Didelphis virginiana</i>				X ^a		X
Insectivores						
Desert shrew <i>Notiosorex crawfordi</i>			X	X		
Rabbits and Hares						
Black-tailed jackrabbit <i>Lepus californicus</i>		X			X	X
Desert cottontail <i>Sylvilagus audubonii</i>	X		X			X
Eastern cottontail <i>Sylvilagus floridanus</i>				X ^b		
Rodents – Squirrels and Pocket Gophers						
Arizona gray squirrel <i>Sciurus arizonensis</i>		X		X ^a	X	X
Spotted ground squirrel <i>Spermophilus spilosoma</i>			X ^c			
Rock squirrel <i>Spermophilus variegatus</i>		X	X	X		X

Table A-1, continued.

Species	Confirmed, (specimen) 1977-1978	Observed only, 1977-78	Confirmed, (specimen) this study	Photo, this study	Observed only, this study	Observed, CORO database
<i>Rodents – Squirrels and Pocket Gophers (continued)</i>						
Botta's pocket gopher <i>Thomomys bottae</i>	X		X			
S. pocket gopher <i>Thomomys umbrinus</i>	X					
<i>Rodents - Pocket Mice and Kangaroo Rats</i>						
Hispid pocket mouse <i>Chaetodipus hispidus</i>	X		X	X		
Rock pocket mouse <i>Chaetodipus intermedius</i>	X				X	
Sonoran Desert pocket mouse <i>Chaetodipus penicillatus</i>	X		X	X		
Ord's kangaroo rat <i>Dipodomys ordii</i>			X	X		
Banner-tailed kangaroo rat <i>Dipodomys spectabilis</i>			X	X		
Merriam's kangaroo rat <i>Dipodomys merriami</i>			X	X		
Silky pocket mouse <i>Perognathus flavus</i>			X ^c			

Table A-1, continued.

Species	Confirmed, (specimen) 1977-1978	Observed only, 1977-78	Confirmed, (specimen) this study	Photo, this study	Observed only, this study	Observed, CORO database
<i>Rodents - Murid Mice</i>						
Northern pygmy mouse <i>Baiomys taylori</i>			X	X		
White-throated woodrat <i>Neotoma albigula</i>	X		X	X		
S. grasshopper mouse <i>Onychomys torridus</i>	X			X		
Deer mouse <i>Peromyscus maniculatus</i>	X		X			
White-footed mouse <i>Peromyscus leucopus</i>	X		X			
Brush mouse <i>Peromyscus boylii</i>	X		X	X		
Western harvest mouse <i>Reithrodontomys megalotis</i>	X		X			
Fulvous harvest mouse <i>Reithrodontomys fulvescens</i>	X		X	X		
Arizona cotton rat <i>Sigmodon arizonae</i>			X	X		
Tawny-bellied cotton rat <i>Sigmodon fulviventer</i>			X			
Yellow-nosed cotton rat <i>Sigmodon ochrognathus</i>			X	X		

Table A-1, continued.

Species	Confirmed, (specimen) 1977-1978	Observed only, 1977-78	Confirmed, (specimen) this study	Photo, this study	Observed only, this study	Observed, CORO database
<i>Carnivores</i>						
Ringtail <i>Bassariscus astutus</i>		X		X		X
Feral dog <i>Canis familiaris</i>				X		X
Coyote <i>Canis latrans</i>		X	X	X		X
Common hog-nosed skunk <i>Conepatus mesoleucus</i>				X		X
Mountain lion <i>Puma concolor</i>				X		X
Feral cat <i>Felis catus</i>					X	
Bobcat <i>Lynx rufus</i>			X	X		X
Hooded skunk <i>Mephitis macroura</i>			X	X		X
Striped skunk <i>Mephitis mephitis</i>				X		X
White-nosed coati <i>Nasua narica</i>			X	X		X
Common raccoon <i>Procyon lotor</i>				X		X

Table A-1, continued.

Species	Confirmed, (specimen) 1977-1978	Observed only, 1977-78	Confirmed, (specimen) this study	Photo, this study	Observed only, this study	Observed, CORO database
<i>Carnivores (continued)</i>						
Western spotted skunk <i>Spilogale gracilis</i>			X	X		X
American badger <i>Taxidea taxus</i>						X
Common gray fox <i>Urocyon cinereoargenteus</i>		X		X		X
Black bear <i>Ursus americanus</i>				X		X
Hoofed mammals						
Mule deer <i>Odocoileus hemionus</i>						X
White-tailed deer <i>Odocoileus virginianus</i>		X	X	X		X
Collared peccary <i>Pecari tajacu</i>		X	X	X		X

Table A-2. Number of nocturnal rodents trapped, per 100 trap-nights, in selected vegetation types at Coronado National Memorial.

Vegetation types: 1 = in and around buildings, 2=semi-desert grassland (grazed), 3=mesquite riparian, 4=oak riparian, <50% tree cover, 5=oak riparian, >50% tree cover, 6=oak woodland, <50% tree cover, 7=oak woodland, >50% tree cover, 8=seeps with permanent water or moisture, 9=semi-desert grassland (ungrazed).

Species	Vegetation Type								
	1	2	3	4	5	6	7	8	9
<i>Baiomys taylori</i>	0	0	3.2	0	0	0.2	0	0	0.2
<i>Chaetodipus hispidus</i>	0	0.2	1.0	0	0	0.1	0	0	0
<i>C. intermedius</i>	0	0.2	0	0	0	0	0.1	0	1.1
<i>C. penicillatus</i>	1.6	1.5	3.5	1.9	0.9	0.3	0	0	1.5
<i>Dipodomys merriami</i>	0	0	0	0	0	0	0	0	0.3
<i>D. ordii</i>	0	0	0	0	0	0	0	0	0.1
<i>D. spectabilis</i>	0	0	0	0	0	0	0	0	0.1
<i>Neotoma albigula</i>	4.2	0.2	1.1	1.9	1.3	2.0	0.7	2.8	0
<i>Onychomys torridus</i>	0	0.2	0.2	0	0	0	0	0	1.0
<i>Peromyscus boylii</i>	1.6	0.5	0.8	1.9	0.4	2.5	2.7	2.8	0.1
<i>P. leucopus</i>	0	0	0.2	0	0.9	1.4	0.7	2.3	0
<i>P. maniculatus</i>	0	0	0	0	0.1	0	0	2.3	0
<i>Reithrodontomys fulvescens</i>	1.6	0	2.0	0	0	0.8	0	0.6	0.5
<i>R. megalotis</i>	0	0	0	0	0	0.3	0	0	0.6
<i>Sigmodon arizonae</i>	0.8	0	1.0	0	0	0.1	0	2.3	1.1
<i>S. fulviventer</i>	0	0	0	0	0	0	0	0	0.5
<i>S. ochrognathus</i>	1.6	0	0.3	1.9	0	2.6	0.1	0.6	1.1

Table A-3. Species of terrestrial mammals (exclusive of nocturnal rodents) confirmed at Coronado National Memorial and number of documented observations, including photographs by infrared-triggered photography, approximate number of observations during road transects and time-area constrained search, and number of observations recorded in CORO sightings database, 1972-1997. ^aIncludes sightings by staff. ^bSome sightings listed as desert cottontail may be eastern cottontail, see Appendix C.

Species	No. Infrared-Triggered Photographs	No. Observations	No. Observations, CORO Database
Insectivores			
Desert shrew <i>Notiosorex crawfordi</i>	0	7 ^a	0
Rabbits and Hares			
Black-tailed jackrabbit <i>Lepus californicus</i>	0	4	43
Desert cottontail <i>Sylvilagus audubonii</i>	1	81 ^b	25
Eastern cottontail <i>Sylvilagus floridanus</i>	2	0 ^b	0
Rodents – Squirrels and Pocket Gophers			
Arizona gray squirrel <i>Sciurus arizonensis</i>	0	0	10
Rock squirrel <i>Spermophilus variegatus</i>	8	38	17
Botta's pocket gopher <i>Thomomys bottae</i>	0	0	0
Southern pocket gopher <i>Thomomys umbrinus</i>	0	0	0

Table A-3, continued.

Species	No. Infrared- Triggered Photographs	No. Observations	No. Observations, CORO Database
<i>Carnivores</i>			
Ringtail <i>Bassariscus astutus</i>	93	0	11
Feral dog <i>Canis familiaris</i>	1	0	1
Coyote <i>Canis latrans</i>	2	3	43
Common hog-nosed skunk <i>Conepatus mesoleucus</i>	15	1	1
Mountain lion <i>Puma concolor</i>	5	1	15
Feral cat <i>Felis catus</i>	0	1	0
Bobcat <i>Lynx rufus</i>	2	1	20
Hooded skunk <i>Mephitis macroura</i>	11	0	3
Striped skunk <i>Mephitis mephitis</i>	36	4	0
White-nosed coati <i>Nasua narica</i>	12	2	357
Common raccoon <i>Procyon lotor</i>	4	0	2
Western spotted skunk <i>Spilogale gracilis</i>	12	1	0

Table A-3, continued.

Species	No. Infrared- Triggered Photographs	No. Observations	No. Observations, CORO Database
American badger <i>Taxidea taxus</i>	0	0	1
Common gray fox <i>Urocyon cinereoargenteus</i>	50	12	57
Black bear <i>Ursus americanus</i>	27	0	11
Hoofed mammals			
Mule deer <i>Odocoileus hemionus</i>	0	0	5
White-tailed deer <i>Odocoileus virginianus</i>	0	157	1187
Collared peccary <i>Pecari tajacu</i>	33	2	84

APPENDIX B: SUMMARY DATA FROM TRAPPING GRIDS AND
INFRARED-TRIGGERED PHOTOGRAPHY

Table B-1. Data for nocturnal rodent grids trapped at Coronado National Memorial, 1996-1997. Elevation is in feet. "None" refers to no rodents trapped at the site. For vegetation, first two letters refer to vegetation community and grazing. OW=oak woodland, OR=oak riparian, MR=mesquite riparian, SE=wet seep, GG=grazed semi-desert grassland, UG=ungrazed semi-desert grassland, RR=residential. Last two letters refer to cover. TC=% tree cover exceeds grass cover, GC=% grass cover exceeds tree cover. For species, first two letters refer to first two letters of genus name, second two letters refer to first two letters of species name.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
01A1	5850	OWTC	25	(none)	-
01A10	6550	OWGC	50	NEAL	2
01A10				PEBO	5
01A2	6725	OWGC	50	PEBO	1
01A2				PELE	1
01A2				REME	1
01A3	6050	OWTC	75	PEBO	1
01A4	7050	OWGC	75	PEMA	1
01A5	6775	OWTC	75	PELE	1
01A5				PESP	1
01A6	7675	OWGC	50	NEAL	3
01A6				PEBO	3
01A6				PELE	3
01A7	7775	OWGC	49	NEAL	3
01A7				PELE	2
01A8	6900	OWTC	25	NEAL	1
01A8				PEBO	1
01A8				PELE	1
01A9	6400	ORTC	50	NEAL	2
01A9				PEBO	1
01A9				PELE	2
02A1	6650	OWGC	73	NEAL	1
02A1				PEBO	1
02A1				PELE	4
02A1				REFU	1
02A1				SI0C	2
02A2	6550	OWGC	40	REFU	3
02A2				REME	2
02A2				SI0C	4

Table B-1, continued .

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
02A3				NEAL	3
02A3	6575	OWGC	75	PEBO	4
02A3				SIAR	2
02A3				SIOC	6
02A4	5975	OWGC	50	PEBO	2
02A5	6250	OWGC	75	NEAL	1
02A5				PEBO	3
02A5				SIOC	2
02A6	6650	OWGC	396	BATA	4
02A6				CHPE	3
02A6				NEAL	8
02A6				PEBO	3
02A6				PELE	9
02A6				PEMA	1
02A6				PESP	1
02A6				REFU	8
02A6				REME	1
02A6				SIOC	17
03A1	5650	SEGC	100	NEAL	4
03A1				PEBO	1
03A1				PELE	4
03A1				PEMA	4
03A1				SIAR	4
03A2	5725	OWTC	75	(none)	-
03A3	6450	OWGC	73	CHPE	2
03A3				NEAL	2
03A3				PEBO	3
03A3				SIOC	5
03A4	6850	OWGC	72	NEAL	4
03A5	5350	OWTC	75	PEBO	5
04A1	5775	OWTC	75	NEAL	2
04A1				PEBO	2
04A2	5775	OWTC	75	PEBO	1
04A3	6450	OWTC	75	PEBO	2

Table B-1, continued.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
04A3				PELE	2
04A4	6250	OWGC	75	NEAL	2
04A4				PEBO	1
04A4				PELE	1
04A4				REME	1
04A5	6075	OWGC	50	NEAL	1
04A5				PEBO	1
05A1	5550	OWGC	75	PEBO	1
05A1				SIOC	6
05A2	5400	GGGC	75	CHPE	3
05A2				PEBO	1
05A3	6000	SEGC	76	NEAL	1
05A3				PEBO	4
05A3				REFU	1
05A3				SIOC	1
05A4	5725	OWGC	100	CHHI	1
05A4				PEBO	8
05A4				REFU	1
05A5	5700	OWGC	50	PEBO	2
05A5				PELE	1
06A0	5275	OWGC	5	(none)	-
06A1	5225	OWGC	50	PEBO	2
06A1				PELE	1
06A2	5350	OWGC		NEAL	2
06A2				PELE	1
06A3	5250	OWTC	75	(none)	-
06A4	5250	OWTC	49	CHIN	1
06A4				NEAL	2
06A4				PEBO	3
06A4				SIOC	1
06A5	6150	OWTC	50	PEBO	5
06A5				PELE	1
06A5				PESP	1
06A6	5300	RRRR	22	PEBO	2

Table B-1, continued.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
07A1	5075	UGGC	74	BATA	3
07A1				CHHI	3
07A1				CHPE	3
07A1				SIAR	2
07A2	4875	MRGC	75	BATA	2
07A2				CHHI	1
07A2				CHPE	2
07A2				NEAL	2
07A2				PEBO	2
07A2				PELE	1
07A2				REFU	1
07A2				SIAR	1
07A3	5050	UGGC	50	CHHI	3
07A3				CHPE	2
08A1	4950	GGGC	75	CHHI	1
08A1				CHPE	2
08A1				ONTO	1
08A2	5190	GGGC	15	(none)	-
08A3	5200	GGGC	100	CHPE	1
08A4	5175	GGGC	62	(none)	-
08A5	5900	GGGC	75	CHIN	1
08A5				NEAL	1
08A5				PEBO	1
08A6	5300	ORTC	49	CHPE	2
08A6				NEAL	1
08A6				PEBO	5
09A1	5025	UGGC	50	SIOC	1
09A10				BATA	1
09A10				CHHI	1
09A10				CHPE	9
09A11	5050	UGGC	100	BATA	4
09A11				CHHI	2
09A11				CHPE	6
09A11				SIAR	1

Table B-1, continued.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
09A11				SIOC	1
09A12	4975	UGGC	100	CHHI	2
09A12				SIOC	1
09A13	4925	UGGC	100	BATA	3
09A13				CHHI	1
09A13				CHPE	1
09A13				DIME	1
09A13				SIOC	1
09A14	4875	UGGC	100	ONTO	2
09A14				SIAR	1
09A15	4840	UGGC	100	CHHI	2
09A15				CHPE	1
09A16	4975	UGGC	54	BATA	1
09A16				DIOR	2
09A17	5000	RRRR	97	CHPE	2
09A17				NEAL	5
09A17				REFU	2
09A17				SIAR	1
09A17				SIOC	2
09A18	4860	UGGC	400	BATA	3
09A18				CHHI	1
09A18				ONTO	4
09A18				REFU	6
09A18				REME	6
09A18				SIAR	4
09A18				SIOC	3
09A2	4880	UGGC	75	ONTO	2
09A2				REFU	1
09A2				REME	1
09A2				SIAR	1
09A2				SIOC	3
09A3	4830	UGGC	94	BATA	1
09A3				CHHI	2
09A3				ONTO	4

Table B-1, continued.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
09A3				SIAR	1
09A3				SIFU	2
09A3				SIOC	2
09A4	4830	UGGC	122	BATA	7
09A4				CHHI	1
09A4				CHPE	2
09A4				ONTO	2
09A4				REFU	1
09A4				REME	2
09A4				SIAR	9
09A4				SIFU	6
09A4				SIOC	7
09A4				SISP	1
09A5	4950	MRGC	48	CHHI	1
09A5				CHPE	1
09A5				NEAL	1
09A6	4925	MRGC	50	CHPE	4
09A7	4830	UGGC	20	CHPE	1
09A7				DIME	4
09A7				DISP	1
09A8	4975	UGGC	50	PEBO	1
09A9	4850	UGGC	100	BATA	2
09A9				ONTO	3
09A9				REME	1
10A0	5200	ORGC	5	SIOC	1
10A1	5475	ORTC	20	(none)	-
10A2	5025	ORGC	49	CHPE	1
10A2				NEAL	1
10A2				PEBO	1
10A2				SIOC	1
10A2				SISP	1
10A3	5725	ORTC	50	PEBO	3
10A4	5400	ORTC	15	(none)	
10A5	5050	ORGC	10	(none)	

Table B-1, continued.

Grid#	Elevation	Vegetation	TrapNights	Species	#Trapped
10A6	4925	MRGC	100	BATA	8
10A6				CHPE	3
10A6				ONTO	1
10A6				PEBO	1
10A6				REFU	2
10A6				SIAR	1
10A6				SIOC	7
10A7	4850	MRGC	100	BATA	2
10A7				CHHI	2
10A7				CHPE	3
10A7				NEAL	1
10A7				REFU	3
10A7				SIAR	3
10A7				SIOC	4
10A8			45	NEAL	2

Table B-2. Data for infrared-triggered camera locations at Coronado National Memorial, 1996-1997. Includes number of photographs of each species for each location. OW=oak woodland, OR=oak riparian, MR=mesquite riparian, SE=wet seep, GG=grazed semi-desert grassland, UG=ungrazed semi-desert grassland, RR=residential. TC=% tree cover exceeds grass cover, GC=% grass cover exceeds tree cover. English names for birds: *Buteo jamaicensis*=Red-tailed Hawk, *Bubo virginianus*= Great Horned Owl, *Geococcyx californianus*=Greater Roadrunner.

TM#	Elevation	Vegetation	Genus	Species	#Photos
01B1	6700	OWTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	1
01B2	6250	SEGC	<i>Odocoileus</i>	<i>virginianus</i>	3
01B3	6000	ORTC	<i>Buteo</i>	<i>jamaicensis</i>	4
01B3	6000	ORTC	<i>Conepatus</i>	<i>mesoleucus</i>	1
01B3	6000	ORTC	<i>Puma</i>	<i>concolor</i>	1
01B3	6000	ORTC	<i>Mephitis</i>	<i>macroura</i>	2
01B3	6000	ORTC	<i>Odocoileus</i>	<i>virginianus</i>	8
01B3	6000	ORTC	<i>Bubo</i>	<i>virginianus</i>	10
01B3	6000	ORTC	<i>Ursus</i>	<i>americanus</i>	19
01B4	6400	ORTC	<i>Bassariscus</i>	<i>astutus</i>	6
01B4	6400	ORTC	<i>Puma</i>	<i>concolor</i>	2
01B4	6400	ORTC	<i>Mephitis</i>	<i>macroura</i>	1
01B4	6400	ORTC	<i>Spermophilus</i>	<i>variegatus</i>	3
01B4	6400	ORTC	<i>Ursus</i>	<i>americanus</i>	6
02B1	6100	ORTC	(none)		
02B2	6100	ORTC	<i>Bassariscus</i>	<i>astutus</i>	6
02B2	6100	ORTC	<i>Spermophilus</i>	<i>variegatus</i>	1
02B2	6100	ORTC	<i>Spilogale</i>	<i>putorius</i>	2
02B3	6400	OWTC	<i>Bassariscus</i>	<i>astutus</i>	1
02B3	6400	OWTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	3
02B4	6100	ORTC	<i>Bassariscus</i>	<i>astutus</i>	15
02B4	6100	ORTC	<i>Sylvilagus</i>	<i>audubonii</i>	2
02B4	6100	ORTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	2
03B1	6100	OWTC	<i>Bassariscus</i>	<i>astutus</i>	12
03B1	6100	OWTC	<i>Conepatus</i>	<i>mesoleucus</i>	3
03B1	6100	OWTC	<i>Mephitis</i>	<i>mephitis</i>	1
03B1	6100	OWTC	<i>Nasua</i>	<i>nasua</i>	2
03B1	6100	OWTC	<i>Odocoileus</i>	<i>virginianus</i>	1
03B1	6100	OWTC	<i>Spilogale</i>	<i>putorius</i>	2
03B1	6100	OWTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	2
03B2	5600	ORTC	(none)		

Table B-2, continued.

TM#	Elevation	Vegetation	Genus	Species	#Photos
04B1	5850	ORTC	<i>Bassariscus</i>	<i>astutus</i>	12
04B1	5850	ORTC	<i>Nasua</i>	<i>nasua</i>	2
04B1	5850	ORTC	<i>Spermophilus</i>	<i>variegatus</i>	1
04B1	5850	ORTC	<i>Spilogale</i>	<i>putorius</i>	1
04B1	5850	ORTC	<i>Pecari</i>	<i>tajacu</i>	1
04B1	5850	ORTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	4
04B2	6100	ORTC	<i>Bassariscus</i>	<i>astutus</i>	15
04B2	6100	ORTC	<i>Spilogale</i>	<i>putorius</i>	3
04B2	6100	ORTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	1
04B3	6025	OWTC	<i>Bassariscus</i>	<i>astutus</i>	2
04B3	6025	OWTC	<i>Conepatus</i>	<i>mesoleucus</i>	1
04B3	6025	OWTC	<i>Mephitis</i>	<i>mephitis</i>	13
04B4	6150	OWTC	<i>Bassariscus</i>	<i>astutus</i>	19
04B4	6150	OWTC	<i>Puma</i>	<i>concolor</i>	1
04B4	6150	OWTC	<i>Nasua</i>	<i>nasua</i>	1
04B4	6150	OWTC	<i>Spilogale</i>	<i>putorius</i>	2
04B4	6150	OWTC	<i>Bubo</i>	<i>virginianus</i>	1
05B1	5450	OWTC	(none)		
05B2	5450	OWTC	<i>Mephitis</i>	<i>mephitis</i>	16
05B2	6000	SEGC	<i>Odocoileus</i>	<i>virginianus</i>	1
06B1	5225	OWTC	<i>Odocoileus</i>	<i>virginianus</i>	21
06B1	5225	OWTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	1
06B2	5175	ORGC	(none)		
06B3	5175	OWTC	<i>Odocoileus</i>	<i>virginianus</i>	1
08B1	5300	ORTC	<i>Spermophilus</i>	<i>variegatus</i>	2
08B1	5300	ORTC	<i>Pecari</i>	<i>tajacu</i>	13
08B1	5300	ORTC	<i>Ursus</i>	<i>americanus</i>	2
09B1	4925	MRGC	<i>Conepatus</i>	<i>mesoleucus</i>	1
09B1	4925	MRGC	<i>Geococcyx</i>	<i>californianus</i>	1
09B1	4925	MRGC	<i>Mephitis</i>	<i>mephitis</i>	2
09B1	4925	MRGC	<i>Urocyon</i>	<i>cinereoargenteus</i>	12
10B1	5700	ORTC	<i>Bassariscus</i>	<i>astutus</i>	1
10B1	5700	ORTC	<i>Lynx</i>	<i>rufus</i>	1
10B1	5700	ORTC	<i>Mephitis</i>	<i>macroura</i>	1

Table B-2, continued.

TM#	Elevation	Vegetation	Genus	Species	#Photos
10B1	5700	ORTC	<i>Mephitis</i>	<i>mephitis</i>	1
10B1	5700	ORTC	<i>Spilogale</i>	<i>putorius</i>	1
10B1	5700	ORTC	<i>Urocyon</i>	<i>cinereoargenteus</i>	13
10B2	5500	ORTC	<i>Bassariscus</i>	<i>astutus</i>	1
10B2	5500	ORTC	<i>Mephitis</i>	<i>macroura</i>	3
10B2	5500	ORTC	<i>Nasua</i>	<i>nasua</i>	1
10B2	5500	ORTC	<i>Odocoileus</i>	<i>virginianus</i>	5
10B3	5100	SEGC	<i>Canis</i>	<i>familiaris</i>	1
10B3	5100	SEGC	<i>Canis</i>	<i>latrans</i>	2
10B3	5100	SEGC	<i>Puma</i>	<i>concolor</i>	1
10B3	5100	SEGC	<i>Geococcyx</i>	<i>californianus</i>	2
10B3	5100	SEGC	<i>Lynx</i>	<i>rufus</i>	1
10B3	5100	SEGC	<i>Mephitis</i>	<i>macroura</i>	4
10B3	5100	SEGC	<i>Mephitis</i>	<i>mephitis</i>	3
10B3	5100	SEGC	<i>Nasua</i>	<i>nasua</i>	6
10B3	5100	SEGC	<i>Odocoileus</i>	<i>virginianus</i>	21
10B3	5100	SEGC	<i>Procyon</i>	<i>lotor</i>	4
10B3	5100	SEGC	<i>Sylvilagus</i>	<i>audubonii</i>	1
10B3	5100	SEGC	<i>Pecari</i>	<i>tajacu</i>	19
10B3	5100	SEGC	<i>Urocyon</i>	<i>cinereoargenteus</i>	2
10B4	4950	MRGC	<i>Bassariscus</i>	<i>astutus</i>	6
10B4	4950	MRGC	<i>Conepatus</i>	<i>mesoleucus</i>	9
10B4	4950	MRGC	<i>Neotoma</i>	<i>albigula</i>	5
10B4	4950	MRGC	<i>Spermophilus</i>	<i>variegatus</i>	1
10B4	4950	MRGC	<i>Spilogale</i>	<i>putorius</i>	1
10B4	4950	MRGC	<i>Urocyon</i>	<i>cinereoargenteus</i>	9

APPENDIX C: SPECIES ACCOUNTS OF TERRESTRIAL MAMMALS
CONFIRMED AT CORONADO NATIONAL MEMORIAL
BY TAXONOMIC CLASS

Infraclass Metatheria
Order Marsupialia (pouched animals)
Family DIDELPHIDAE (opossums)

VIRGINIA OPOSSUM

Didelphis virginiana

Current status: Confirmed

Habitat: Generalist

Number of observations, this study: None (but see below)

Number of infrared-triggered photographs: None

Number of records in Memorial database: None prior to 2000

Abundance: Unknown

Voucher photo: Jim Bellamy, 21 November 2000

Specimen, this study: None

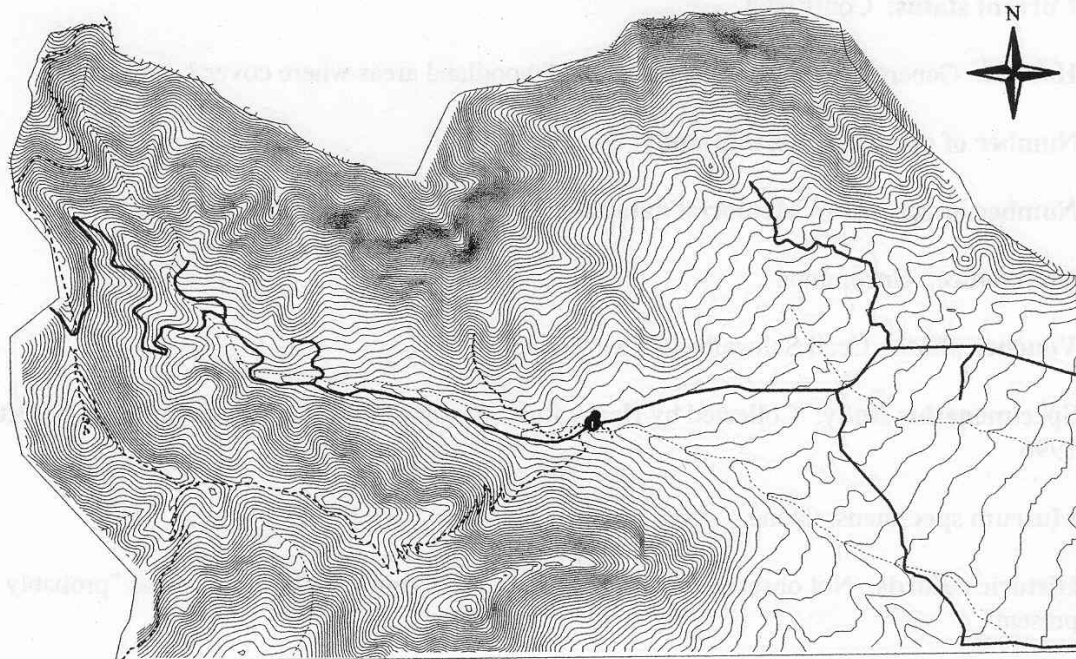
Museum specimens: None

Historic records: Not observed by Petryszyn and Cockrum (1979).

Comments: When our field study ended in 1998, no opossums had been observed at the Memorial, but in October 2000, David Chavez and Jim Bellamy observed and photographed an individual at the Visitor Center. This is the first known record from Coronado National Memorial.

The Mexican subspecies of the opossum has only recently entered Arizona. Hoffmeister (1986) reported that he could find no evidence that Mexican opossums occurred naturally in the state at that time. However, during the past decade sightings of this species have increased steadily. During 1995-1996 DES, AJK and others trapped opossums, including juveniles, on the Santa Rita Experimental Range in the Santa Rita Mountains, and individuals were photographed in the late 1990's on the road to Palominas and in Miller Canyon (Marty Cordano, pers. comm.).

Virginia opossum *Didelphis virginiana*



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Insectivora (insectivores)
Family SORICIDAE (shrews)

DESERT SHREW

Notiosorex crawfordi

Current status: Confirmed

Habitat: Generalist in desert, grassland, and woodland areas where cover is present

Number of observations, this study: 7

Number of records in Memorial database: None

Abundance: Uncommon

Voucher photo: Cecil Schwalbe (CRS), 9 October 1997

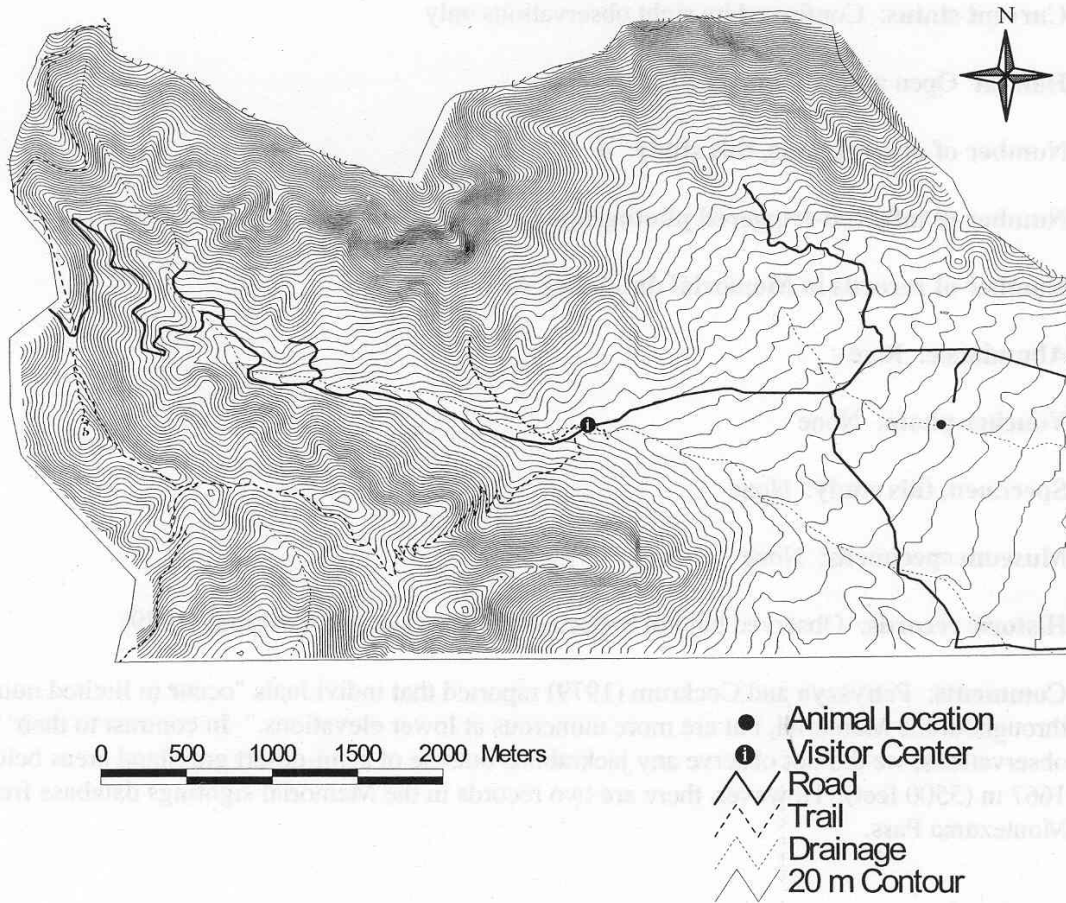
Specimen, this study: Collected by Henry Ruiz, Coronado National Memorial staff, 7 October 1996

Museum specimens: None

Historic records: Not observed by Petryszyn and Cockrum (1979), but listed as "probably present"

Comments: A desert shrew was captured by Henry Ruiz during October 1997 in the grasslands at Montezuma Ranch, who observed five others at the same time. The captured individual lived in captivity until January, 2000. One other shrew was observed in 1997 at Montezuma Ranch (by Chris Scott, a volunteer on this study). Shrews are secretive and rarely seen even when common in an area, but are sometimes observed during reptile surveys while turning dead vegetation, rocks, and boards. We doubt that shrews are common at Coronado because we rarely encountered them while searching for reptiles in 1997-1998.

Desert shrew *Notiosorex crawfordii*



Infraclass Eutheria
Order Lagomorpha (rabbits and kin)
Family LEPORIDAE (rabbits and jackrabbits)

BLACK-TAILED JACKRABBIT

Lepus californicus

Current status: Confirmed by sight observations only

Habitat: Open areas in desert and grasslands

Number of observations, this study: 4

Number of infrared-triggered photographs: None

Number of records in Memorial database: 43

Abundance: Rare

Voucher photo: None

Specimen, this study: None

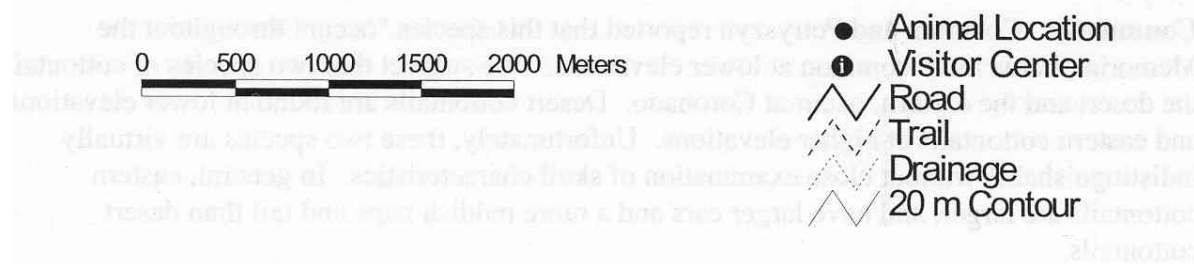
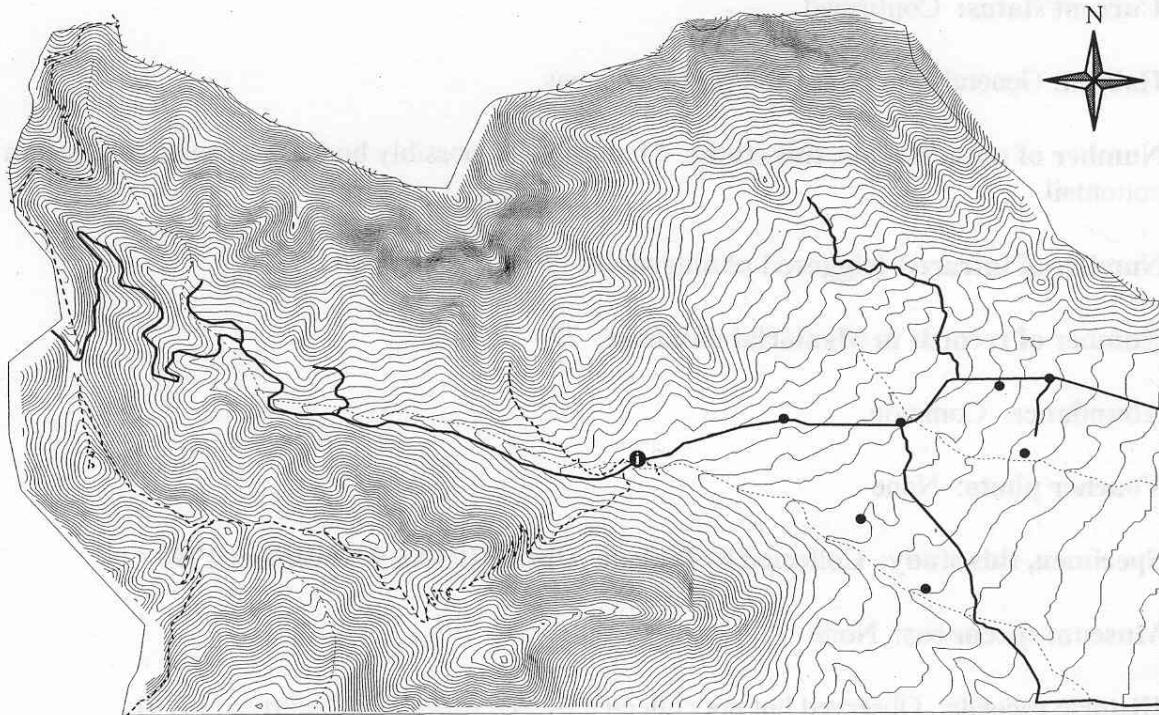
Museum specimens: None

Historic records: Observed but not collected by Petryszyn and Cockrum (1979)

Comments: Petryszyn and Cockrum (1979) reported that individuals "occur in limited numbers throughout the Memorial, but are more numerous at lower elevations." In contrast to their observations, we did not observe any jackrabbits outside of semi-desert grassland areas below 1667 m (5500 feet). However, there are two records in the Memorial sightings database from Montezuma Pass.

Black-tailed jackrabbit

Lepus californicus



Infraclass Eutheria
Order Lagomorpha (rabbits and kin)
Family LEPORIDAE (rabbits and jackrabbits)

DESERT COTTONTAIL

Sylvilagus audubonii

Current status: Confirmed

Habitat: Generalist in desert and grassland areas

Number of observations, this study: 81 cottontails, possibly both this species and eastern cottontail

Number of infrared-triggered photographs: 1

Number of records in Memorial database: 27

Abundance: Common

Voucher photo: None

Specimen, this study: Collected by Barbara Alberti (BNA), 9 November 1997

Museum specimens: None

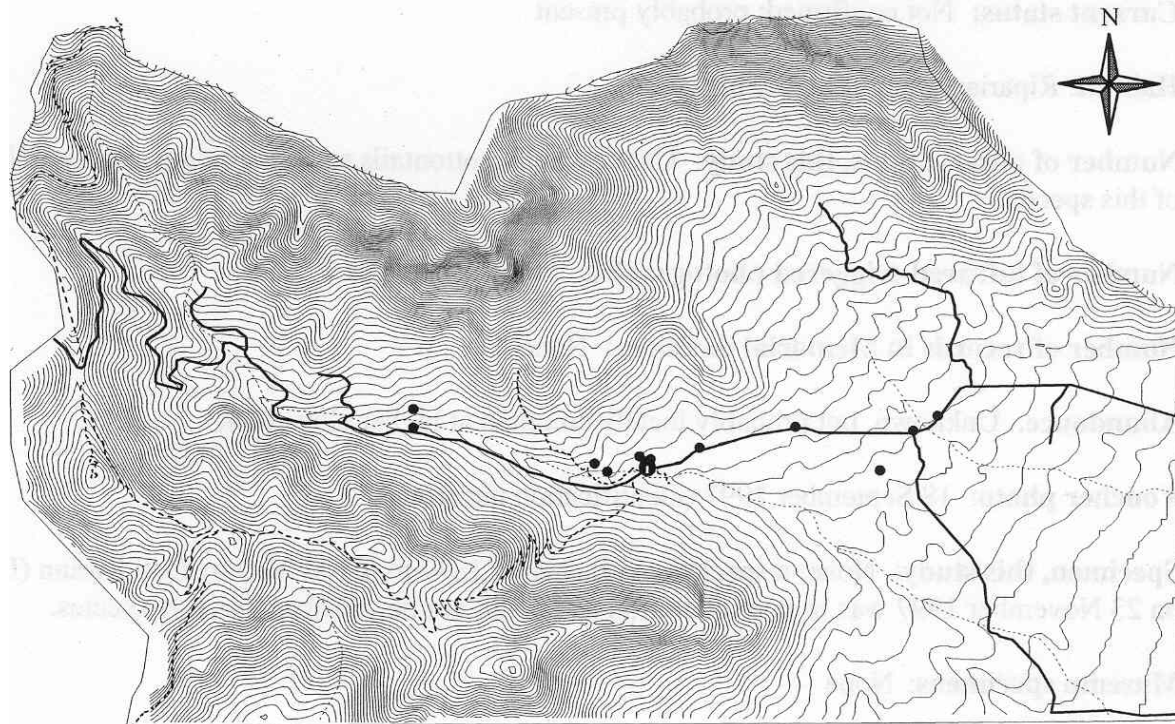
Historic records: Observed but not collected by Petryszyn and Cockrum (1979)

Comments: Cockrum and Petryszyn reported that this species "occurs throughout the Memorial, but is more common at lower elevations." We suspect that two species of cottontail, the desert and the eastern, occur at Coronado. Desert cottontails are found at lower elevations, and eastern cottontails at higher elevations. Unfortunately, these two species are virtually indistinguishable without close examination of skull characteristics. In general, eastern cottontails are larger, and have larger ears and a more reddish nape and tail than desert cottontails.

Desert cottontails are certainly more common at Coronado than eastern cottontails, and are one of the most common mammal seen by visitors. They are frequently observed between the east boundary and the Visitor Center.

Desert Cottontail

Sylvilagus audubonii



0 500 1000 1500 2000 Meters

- Animal Location
- ⦿ Visitor Center
- Road
- - - Trail
- x - x - Drainage
- | - | - 20 m Contour

Infraclass Eutheria
Order Lagomorpha (rabbits and kin)
Family LEPORIDAE (rabbits and jackrabbits)

EASTERN COTTONTAIL

Sylvilagus floridanus

Current status: Not confirmed; probably present

Habitat: Riparian areas at higher elevations

Number of observations, this study: Unknown (81 cottontails seen, including some possibly of this species)

Number of infrared-triggered photographs: 2 (but see below)

Number of records in Memorial database: None

Abundance: Unknown, but probably locally common at higher elevations

Voucher photo: 18 September 1997 (identification uncertain)

Specimen, this study: None; a specimen collected at 1879 m (6200 feet) by Don Swann (DES) on 23 November 1997 was in poor condition and could not be confirmed as this species.

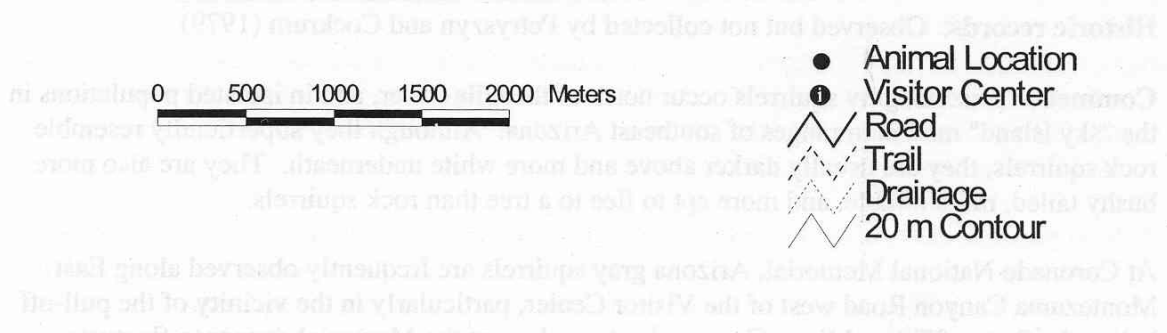
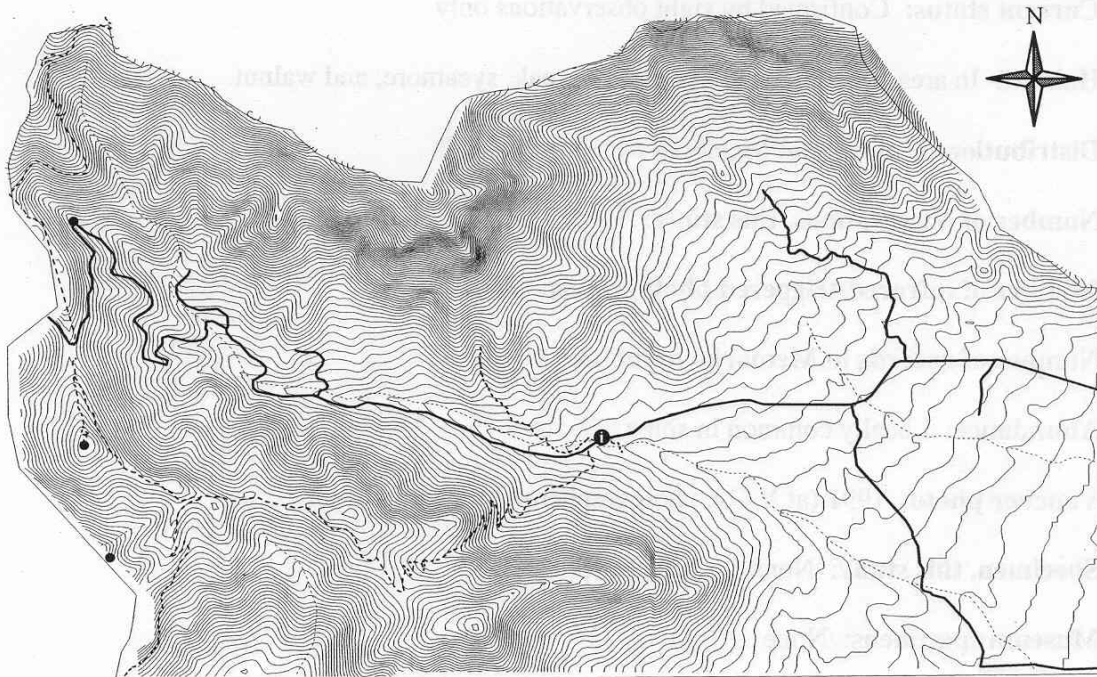
Museum specimens: None

Historic records: Not observed or reported by Petryszyn and Cockrum (1979)

Comments: Eastern and desert cottontails are virtually indistinguishable without close examination of skull characteristics (see account for desert cottontail). In general, eastern cottontails occur in Arizona at higher elevations and in riparian areas.

The species of cottontail that occurs at high elevations in the Memorial, and is frequently seen at Coronado Pass, is probably the eastern cottontail. This species is impossible to distinguish from desert cottontail without a specimen, and we did not collect any during this study. Trailmaster photographs from Yaqui Canyon appear to be of this species. On the range map (opposite), we assumed that cottontails observed above 1818 m (6000 feet) were eastern cottontails.

Eastern Cottontail *Sylvilagus floridanus*



Infraclass Eutheria
Order Rodentia (rodents)
Family SCIURIDAE (squirrels)

ARIZONA GRAY SQUIRREL
Sciurus arizonensis

Current status: Confirmed by sight observations only

Habitat: In areas of deciduous trees such as oak, sycamore, and walnut.

Distribution: Throughout Memorial except grasslands

Number of observations, this study: 7

Number of infrared-triggered photographs: None

Number of records in Memorial database: 10

Abundance: Locally common in some oak areas

Voucher photo: 1991 (at V.C.), photographer unknown

Specimen, this study: None

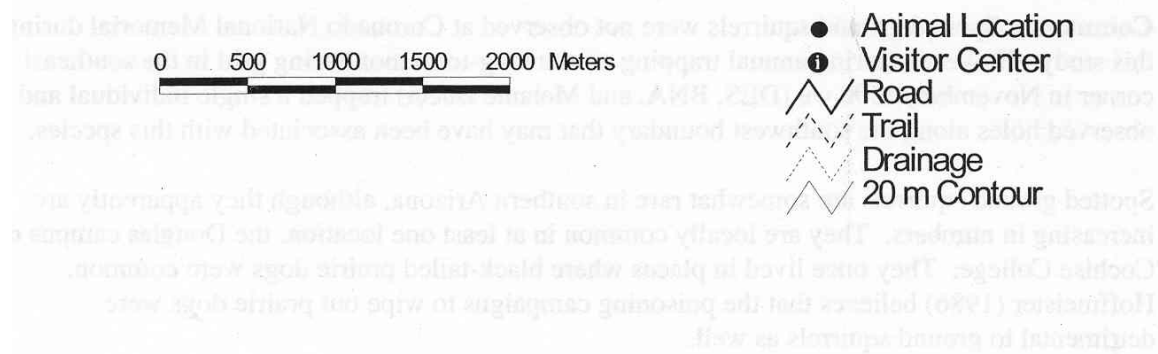
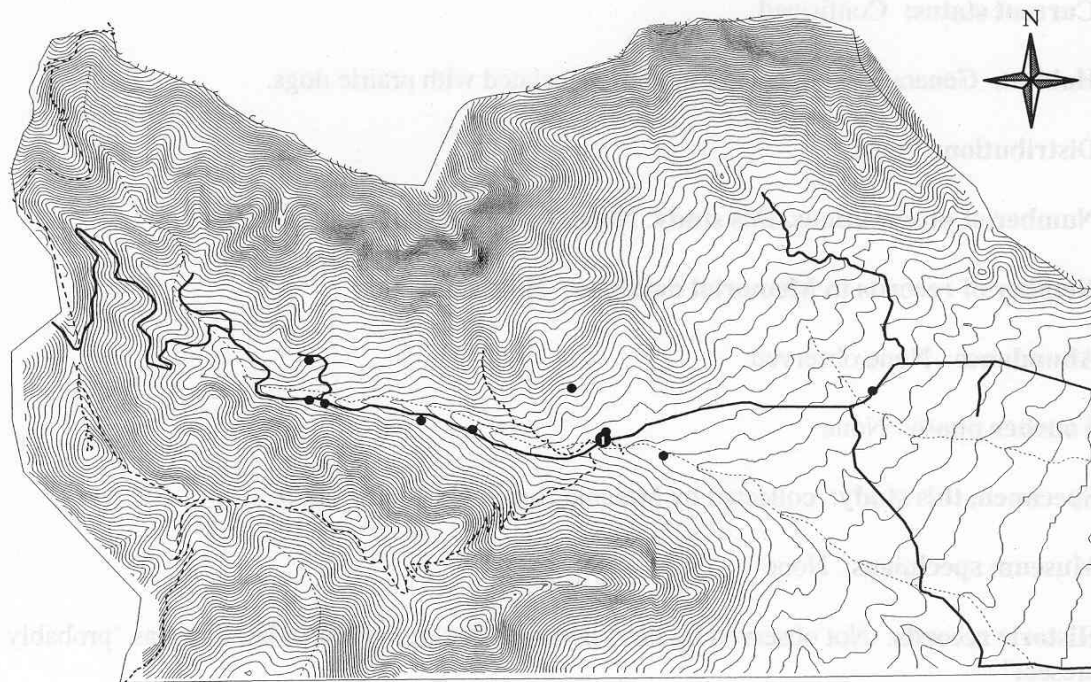
Museum specimens: None

Historic records: Observed but not collected by Petryszyn and Cockrum (1979)

Comments: Arizona gray squirrels occur north of the Gila River, and in isolated populations in the "sky island" mountain ranges of southeast Arizona. Although they superficially resemble rock squirrels, they are usually darker above and more white underneath. They are also more bushy tailed, more nimble, and more apt to flee to a tree than rock squirrels.

At Coronado National Memorial, Arizona gray squirrels are frequently observed along East Montezuma Canyon Road west of the Visitor Center, particularly in the vicinity of the pull-off below the State of Texas Mine. Gray squirrel numbers at the Memorial appear to fluctuate greatly, probably increasing during years when a large acorn crop occurs (BNA, pers. observ.).

Arizona gray squirrel *Sciurus arizonensis*



Infraclass Eutheria
Order Rodentia (rodents)
Family SCIURIDAE (squirrels)

SPOTTED GROUND SQUIRREL

Spermophilus spilosoma

Current status: Confirmed

Habitat: Generalist in open areas, often associated with prairie dogs.

Distribution: None

Number of observations, this study: None (but see below)

Number of records in Memorial database: None until 2000

Abundance: None observed

Voucher photo: None

Specimen, this study: collected by Melanie Bucci, November 2000

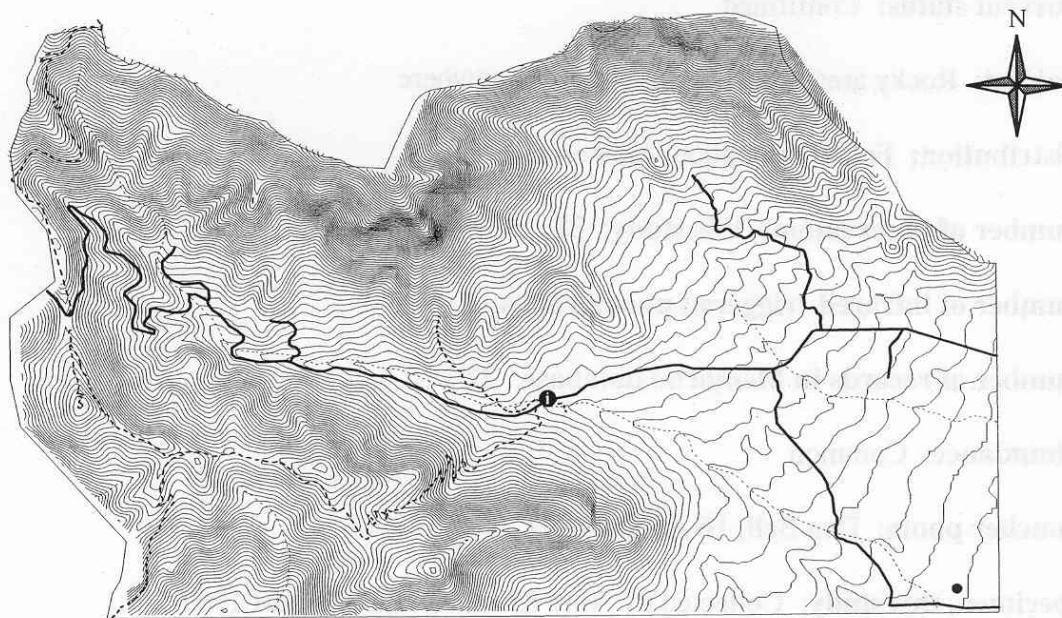
Museum specimens: None

Historic records: Not observed by Petryszyn and Cockrum (1979), but listed as "probably present"

Comments: Spotted ground squirrels were not observed at Coronado National Memorial during this study. However, during annual trapping on the long-term monitoring grid in the southeast corner in November, 2000 we (DES, BNA, and Melanie Bucci) trapped a single individual and observed holes along the southwest boundary that may have been associated with this species.

Spotted ground squirrels are somewhat rare in southern Arizona, although they apparently are increasing in numbers. They are locally common in at least one location, the Douglas campus of Cochise College. They once lived in places where black-tailed prairie dogs were common. Hoffmeister (1986) believes that the poisoning campaigns to wipe out prairie dogs were detrimental to ground squirrels as well.

Spotted ground squirrel *Spermophilus spilosoma*



0 500 1000 1500 2000 Meters



- Animal Location
- ⓞ Visitor Center
- Road
- - - Trail
- ... Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Rodentia (rodents)
Family SCIURIDAE (squirrels)

ROCK SQUIRREL

Spermophilus variegatus

Current status: Confirmed

Habitat: Rocky areas usually, but possible anywhere

Distribution: Found throughout Memorial

Number of observations, this study: 38

Number of infrared-triggered photographs: 8

Number of records in Memorial database: 22

Abundance: Common

Voucher photo: Dan Bell, 16 August 1997

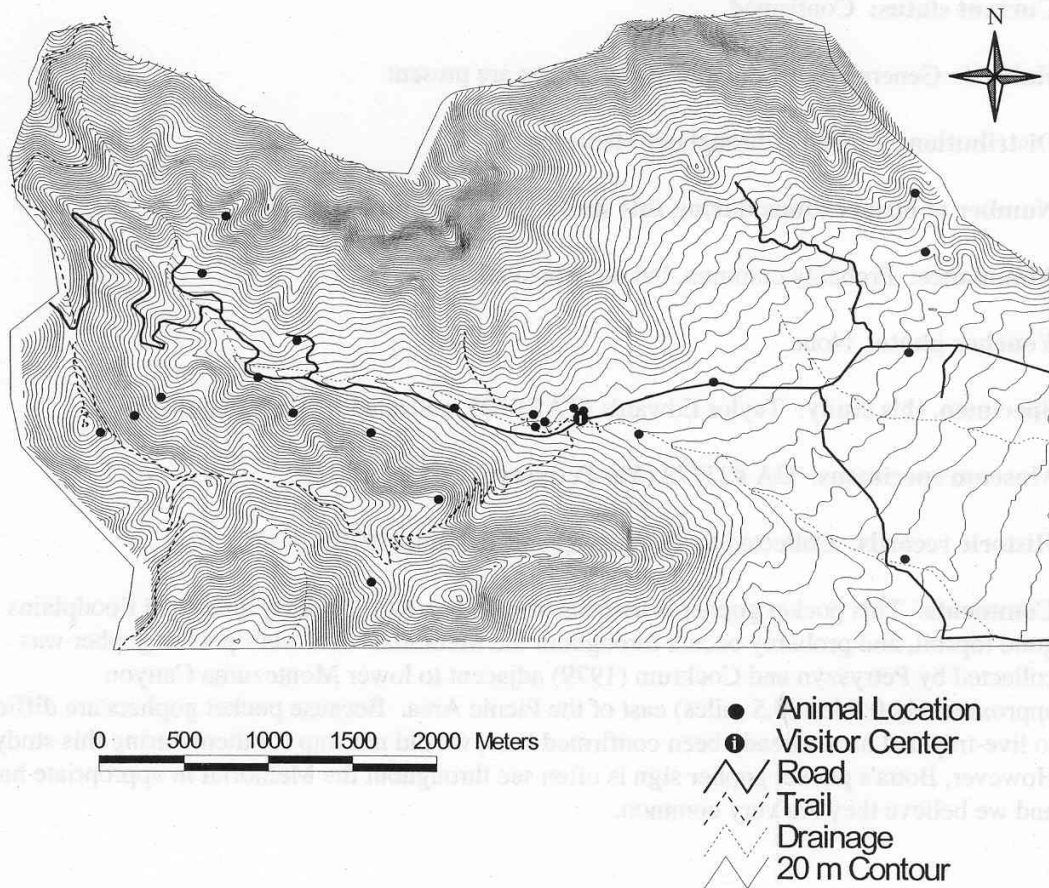
Specimen, this study: Collected by Amy Kuenzi (AJK), August 1997

Museum specimens: None

Historic records: Observed but not collected by Petryszyn and Cockrum (1979)

Comments: Petryszyn and Cockrum noted that rock squirrels "occur in rocky situations throughout the Memorial," and we observed the same pattern. As the Memorial is very rocky, rock squirrels occur throughout! Rock squirrels superficially resemble Arizona gray squirrels, but are apt to be more brownish; see additional comments under that species. They are currently far more common than gray squirrels, even in oak woodland areas.

Rock squirrel *Spermophilus variegatus*



Infraclass Eutheria
Order Rodentia (rodents)
Family GEOMYIDAE (pocket gophers)

BOTTA'S POCKET GOPHER

Thomomys bottae

Current status: Confirmed

Habitat: Generalists in soft soils where plants are present

Distribution: Probably throughout Memorial

Number of observations during this study: No direct observations

Abundance: Probably common, but no data available

Voucher photo: None

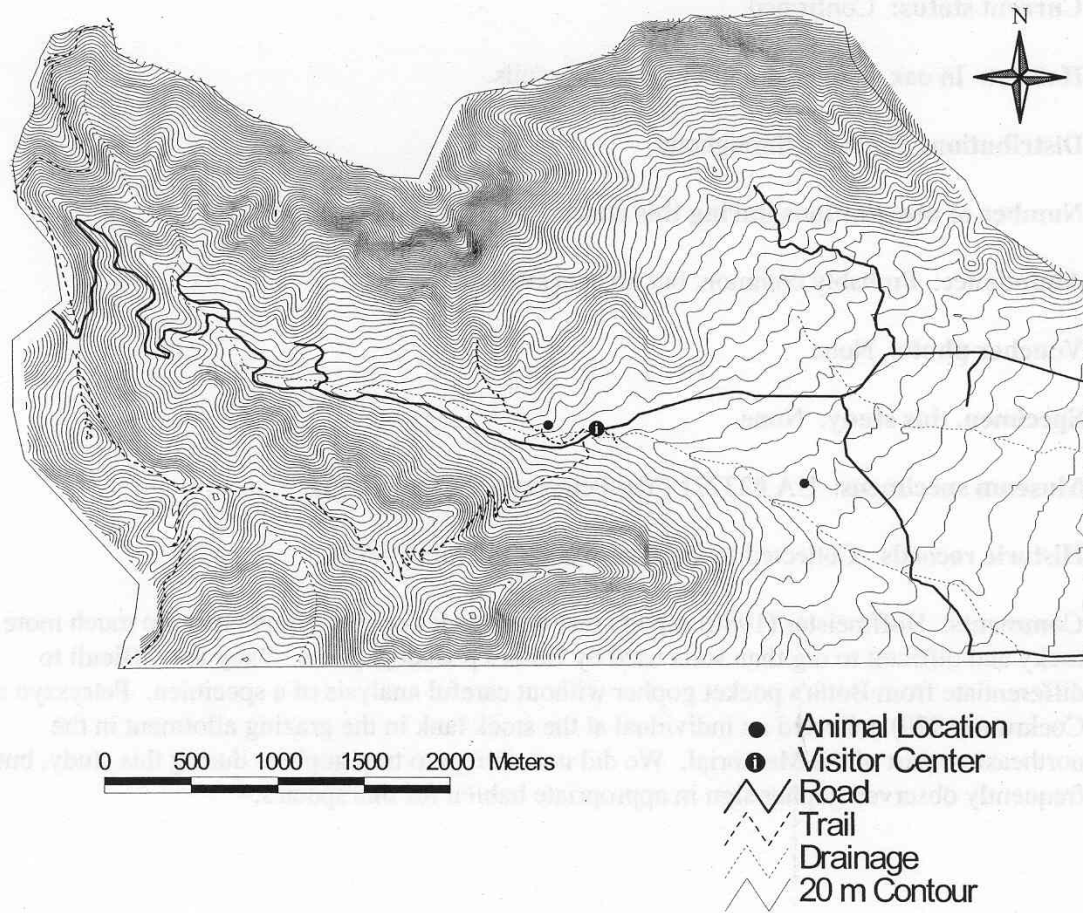
Specimen, this study: Taylor Edwards (TAE) #25, collected by BNA, April 1997

Museum specimens: UA #23772 (Yar Petryszyn, 18 June 1977)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: This pocket gopher is associated with burrows in grassy areas and floodplains with good topsoil, and probably occurs throughout the Memorial. A Botta's pocket gopher was collected by Petryszyn and Cockrum (1979) adjacent to lower Montezuma Canyon approximately 0.8 km (0.5 miles) east of the Picnic Area. Because pocket gophers are difficult to live-trap and have already been confirmed here, we did not trap for them during this study. However, Botta's pocket gopher sign is often seen throughout the Memorial in appropriate habitat, and we believe they are very common.

Botta's pocket gopher *Thomomys bottae*



Infraclass Eutheria
Order Rodentia (rodents)
Family GEOMYIDAE (pocket gophers)

SOUTHERN POCKET GOPHER

Thomomys umbrinus

Current status: Confirmed

Habitat: In oak woodland in rocky, shallow soils.

Distribution: Probably throughout

Number of observations during this study: No direct observations

Abundance: Probably common, but no data available

Voucher photo: None

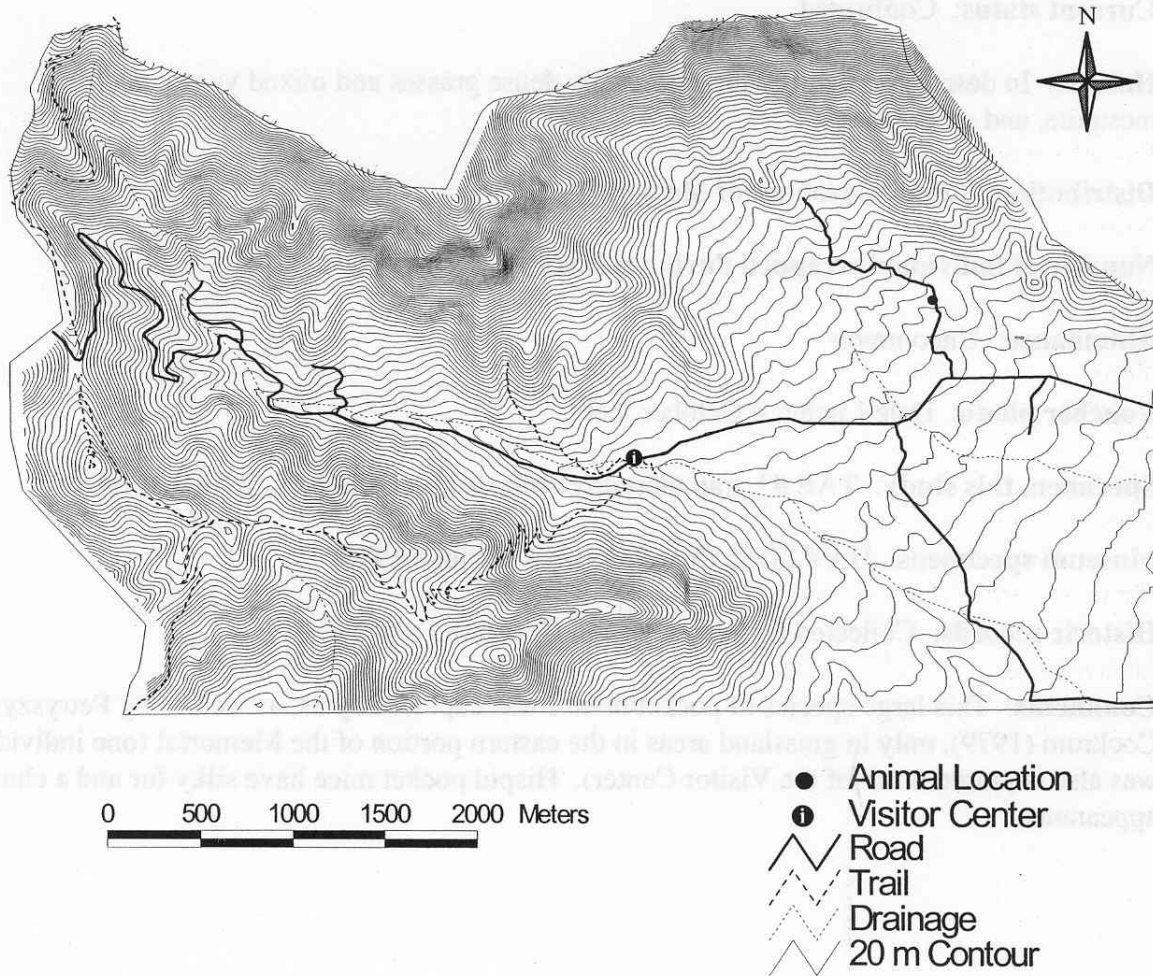
Specimen, this study: None

Museum specimens: UA #23771 (Yar Petryszyn, 21 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: Hoffmeister (1986) reports that this species occurs in soils that are much more rocky and difficult to dig than soils used by Botta's pocket gophers. They are difficult to differentiate from Botta's pocket gopher without careful analysis of a specimen. Petryszyn and Cockrum (1979) collected an individual at the stock tank in the grazing allotment in the northeastern part of the Memorial. We did not attempt to trap gophers during this study, but frequently observed gopher sign in appropriate habitat for this species.

Southern pocket gopher *Thomomys umbrinus*



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

HISPID POCKET MOUSE

Chaetodipus hispidus

Current status: Confirmed

Habitat: In desert grasslands with moderately dense grasses and mixed yucca, ocotillo, mesquite, and other plants.

Distribution: Lower elevations of Memorial

Number of individuals trapped during this study: 24

Abundance: Uncommon

Voucher photo: Dale Linder, 4 October 1997

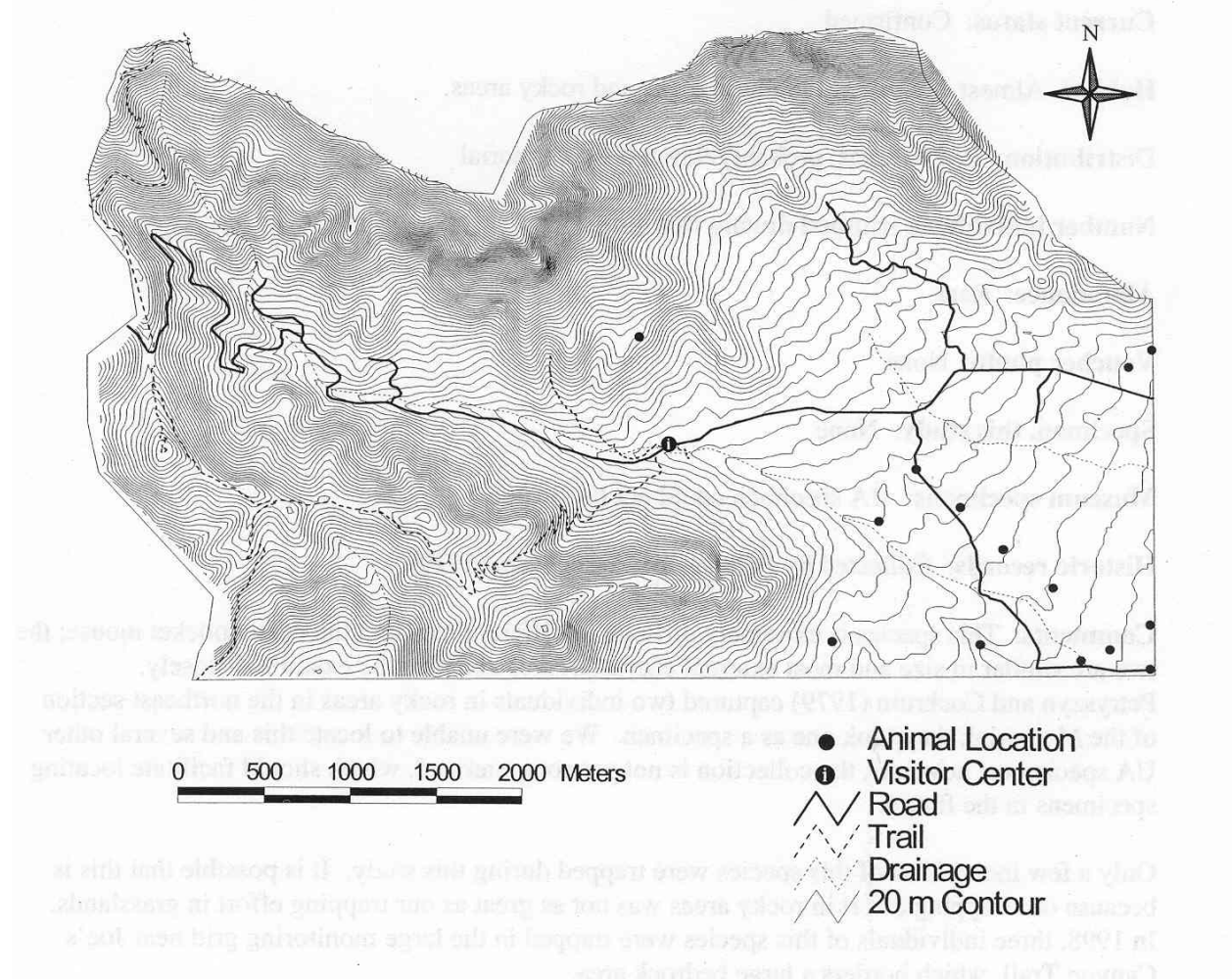
Specimen, this study: TAE #3, trap mortality collected by DES/AJK, 9 August 1997

Museum specimens: UA #23755 (Yar Petryszyn, 12 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: This large species of pocket mouse was captured by us, as well as by Petryszyn and Cockrum (1979), only in grassland areas in the eastern portion of the Memorial (one individual was also captured north of the Visitor Center). Hispid pocket mice have silky fur and a chunky appearance.

Hispid pocket mouse *Chaetodipus hispidus*



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

ROCK POCKET MOUSE

Chaetodipus intermedius

Current status: Confirmed

Habitat: Almost exclusively found in rocks and rocky areas.

Distribution: Rocky areas, probably throughout Memorial

Number individuals trapped during this study: 2

Abundance: Rare

Voucher photo: None

Specimen, this study: None

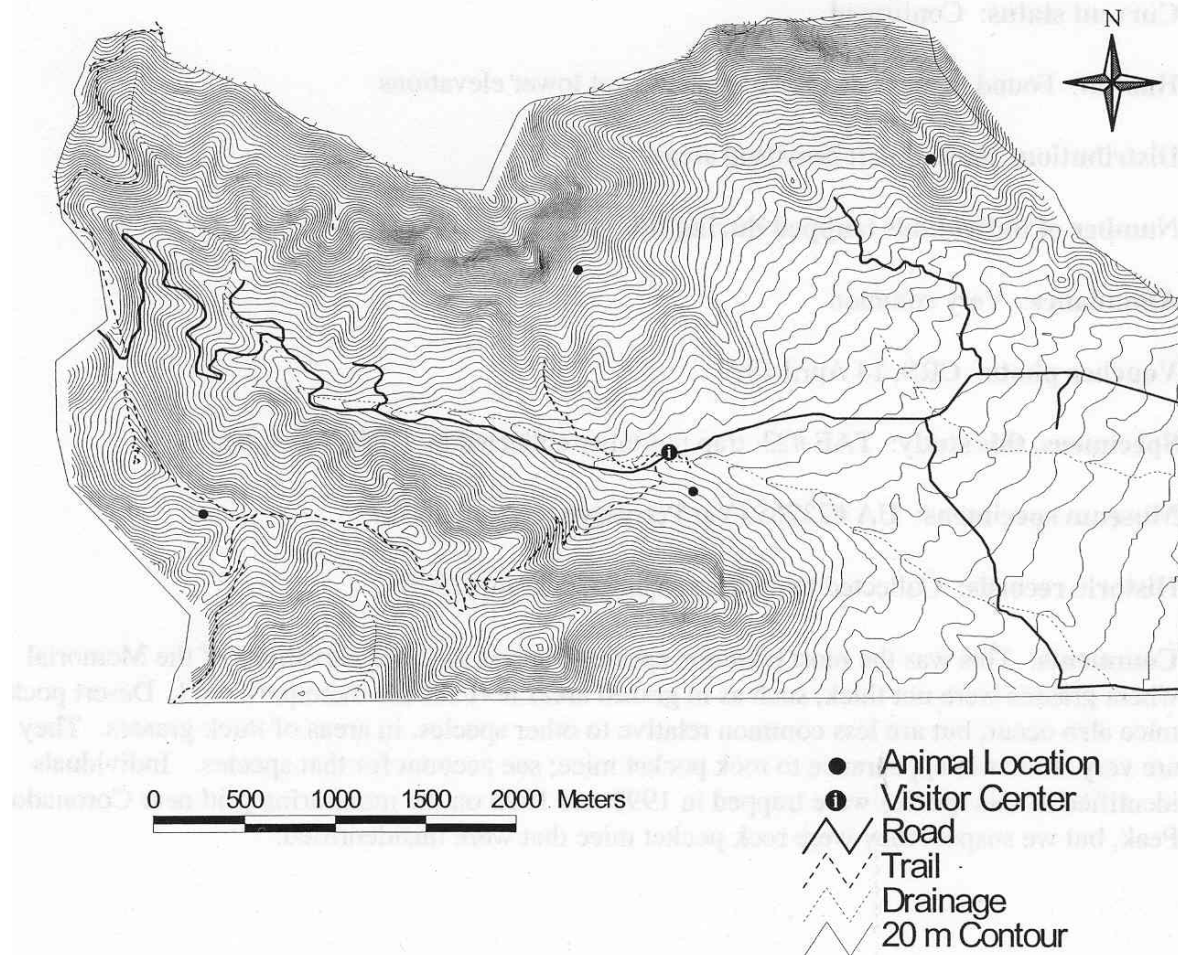
Museum specimens: UA specimen could not be located

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: This species is extremely difficult to differentiate from the desert pocket mouse; the two are similar in size and most external characteristics and must be examined closely. Petryszyn and Cockrum (1979) captured two individuals in rocky areas in the northeast section of the Memorial; they took one as a specimen. We were unable to locate this and several other UA specimens; however, the collection is not yet computerized, which should facilitate locating specimens in the future.

Only a few individuals of this species were trapped during this study. It is possible that this is because our trapping effort in rocky areas was not as great as our trapping effort in grasslands. In 1998, three individuals of this species were trapped in the large monitoring grid near Joe's Canyon Trail, which borders a large bedrock area.

Rock pocket mouse *Chaetodipus intermedius*



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

DESERT POCKET MOUSE

Chaetodipus penicillatus

Current status: Confirmed

Habitat: Found in areas of sparse vegetation at lower elevations

Distribution: Semi-desert grassland areas

Number of individuals trapped during this study: 54

Abundance: Very common

Voucher photo: CRS, 14 April 1997

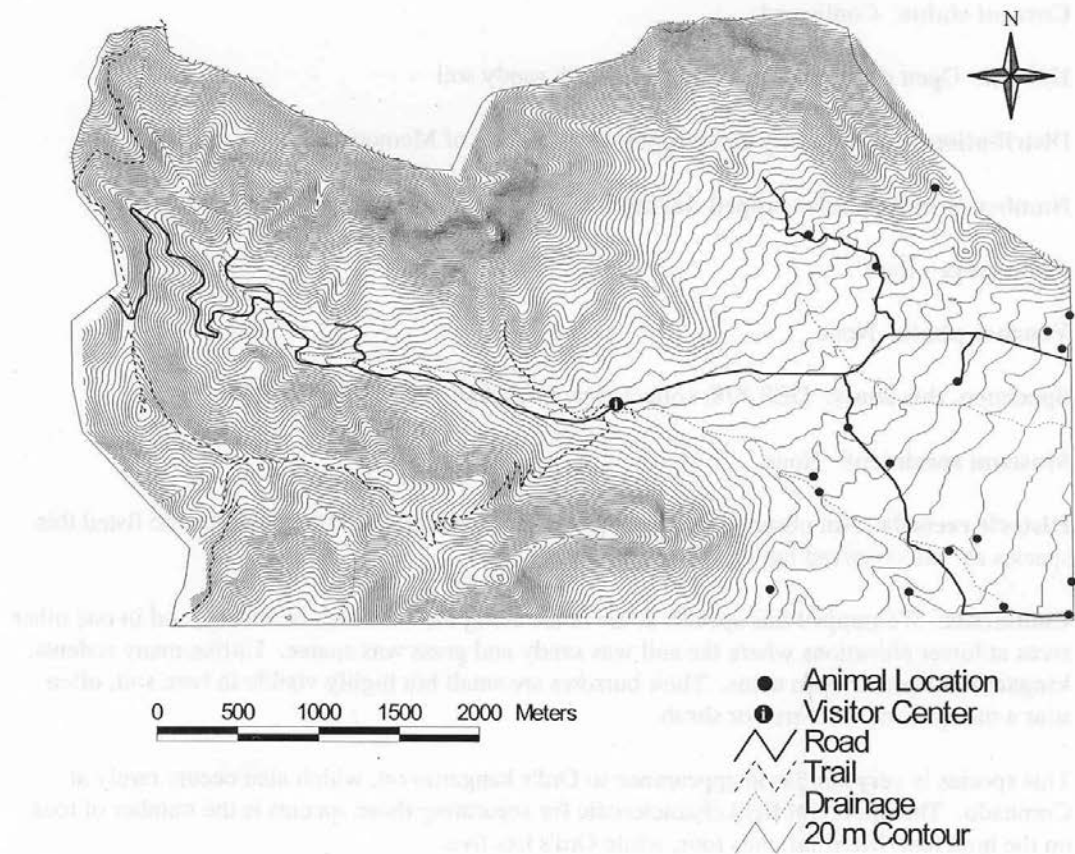
Specimens, this study: TAE #23, trap mortality collected by DES, 7 October 1996

Museum specimens: UA #23765 (Yar Petryszyn, 16 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: This was the most common species trapped in lower elevations of the Memorial where grasses were not thick, such as in grazed areas north of the main park road. Desert pocket mice also occur, but are less common relative to other species, in areas of thick grasses. They are very similar in appearance to rock pocket mice; see account for that species. Individuals identified as this species were trapped in 1998 and 1999 on the monitoring grid near Coronado Peak, but we suspect they were rock pocket mice that were misidentified.

Sonoran desert pocket mouse *Chaetodipus penicillatus*



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

MERRIAM'S KANGAROO RAT

Dipodomys merriami

Current status: Confirmed

Habitat: Open desert and grassland areas with sandy soil

Distribution: Trapped only along southeast boundary of Memorial

Number of individuals trapped during this study: 5

Abundance: Rare

Voucher photo: None

Specimen, this study: DES #78, collected by DES/AJK, 11 November 1996

Museum specimens: None

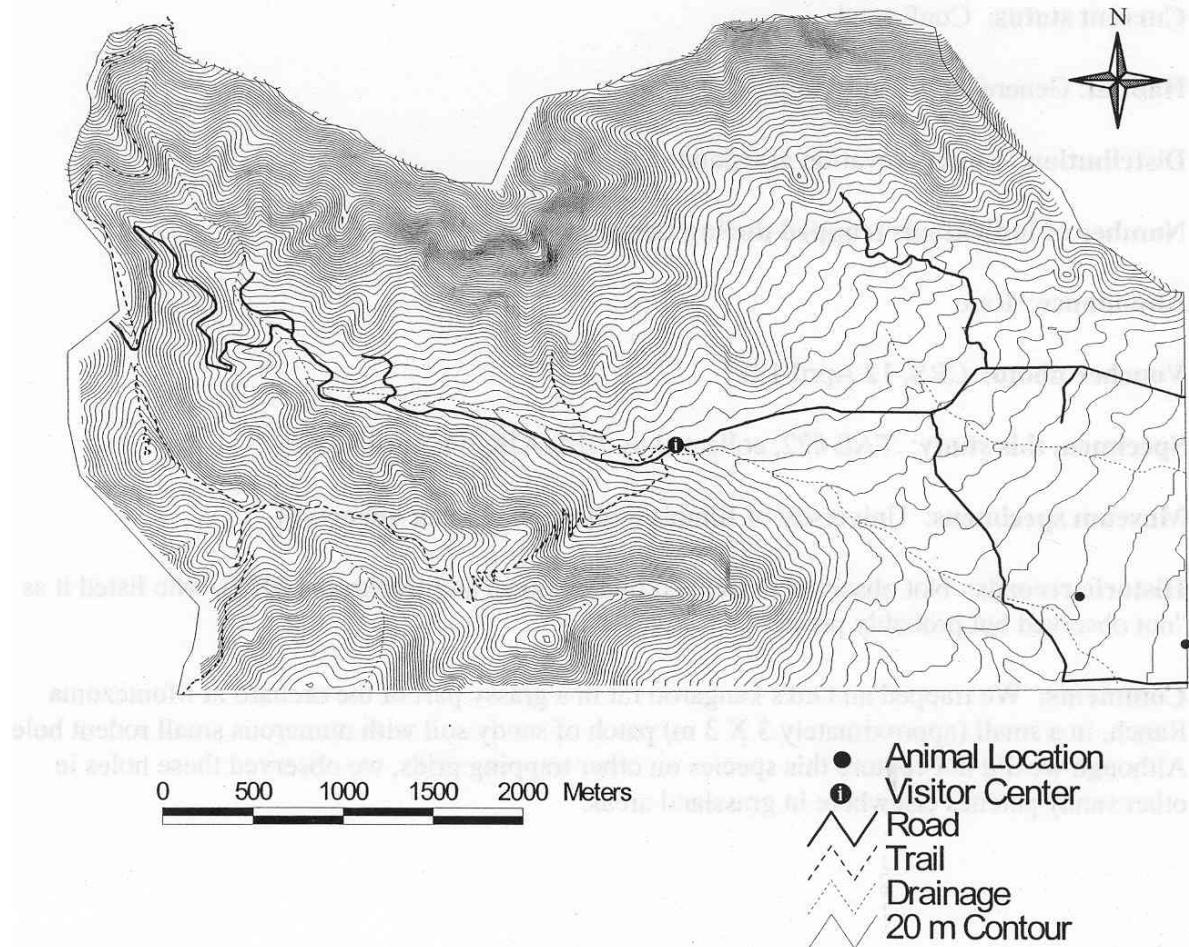
Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed this species as "not observed but probably present"

Comments: We trapped this species at the fence along the southeast boundary, and in one other areas at lower elevations where the soil was sandy and grass was sparse. Unlike many rodents, kangaroo rats prefer open areas. Their burrows are small but highly visible in bare soil, often near a mesquite or other tree or shrub.

This species is very similar in appearance to Ord's kangaroo rat, which also occurs rarely at Coronado. The important field characteristic for separating these species is the number of toes on the hind feet; Merriam's has four, while Ord's has five.

Merriam's kangaroo rat

Dipodomys merriami



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

ORD'S KANGAROO RAT

Dipodomys ordii

Current status: Confirmed

Habitat: Generalist in sandy soils

Distribution: Lower elevation grasslands

Number of individuals trapped during this study: 2

Abundance: Rare

Voucher photo: CRS, 12 April 1997

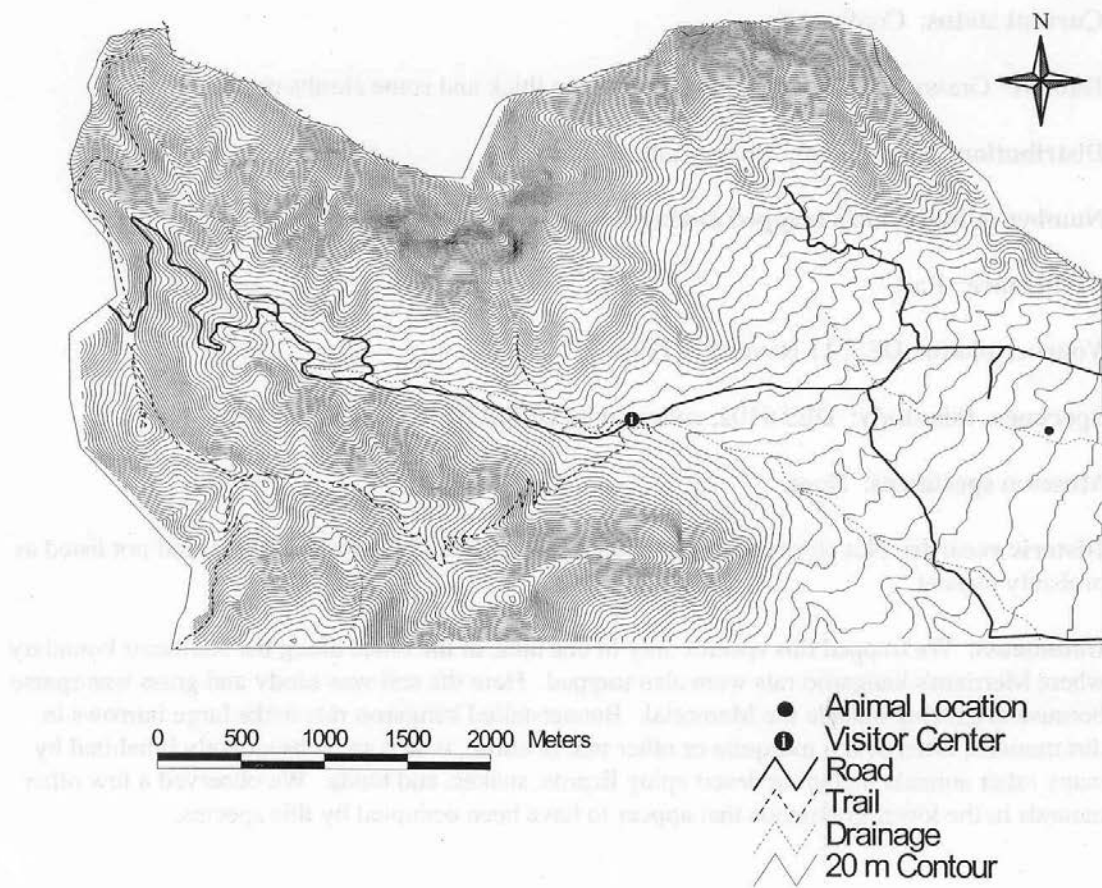
Specimen, this study: TAE #22, collected by DES/AJK, 11 April 1997

Museum specimens: University of Illinois (collection number unknown)

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: We trapped an Ord's kangaroo rat in a grassy part of the orchard at Montezuma Ranch, in a small (approximately 3 X 3 m) patch of sandy soil with numerous small rodent holes. Although we did not capture this species on other trapping grids, we observed these holes in other sandy patches elsewhere in grassland areas.

Ord's kangaroo rat *Dipodomys ordii*



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

BANNER-TAILED KANGAROO RAT

Dipodomys spectabilis

Current status: Confirmed

Habitat: Grassy areas where grasses are not too thick and some shrubs present

Distribution: Trapped only along southeast boundary

Number of individuals trapped during this study: 1

Abundance: Rare

Voucher photo: DES, 11 November 1996

Specimen, this study: DES #102, collected by DES/AJK, 10 November 1996

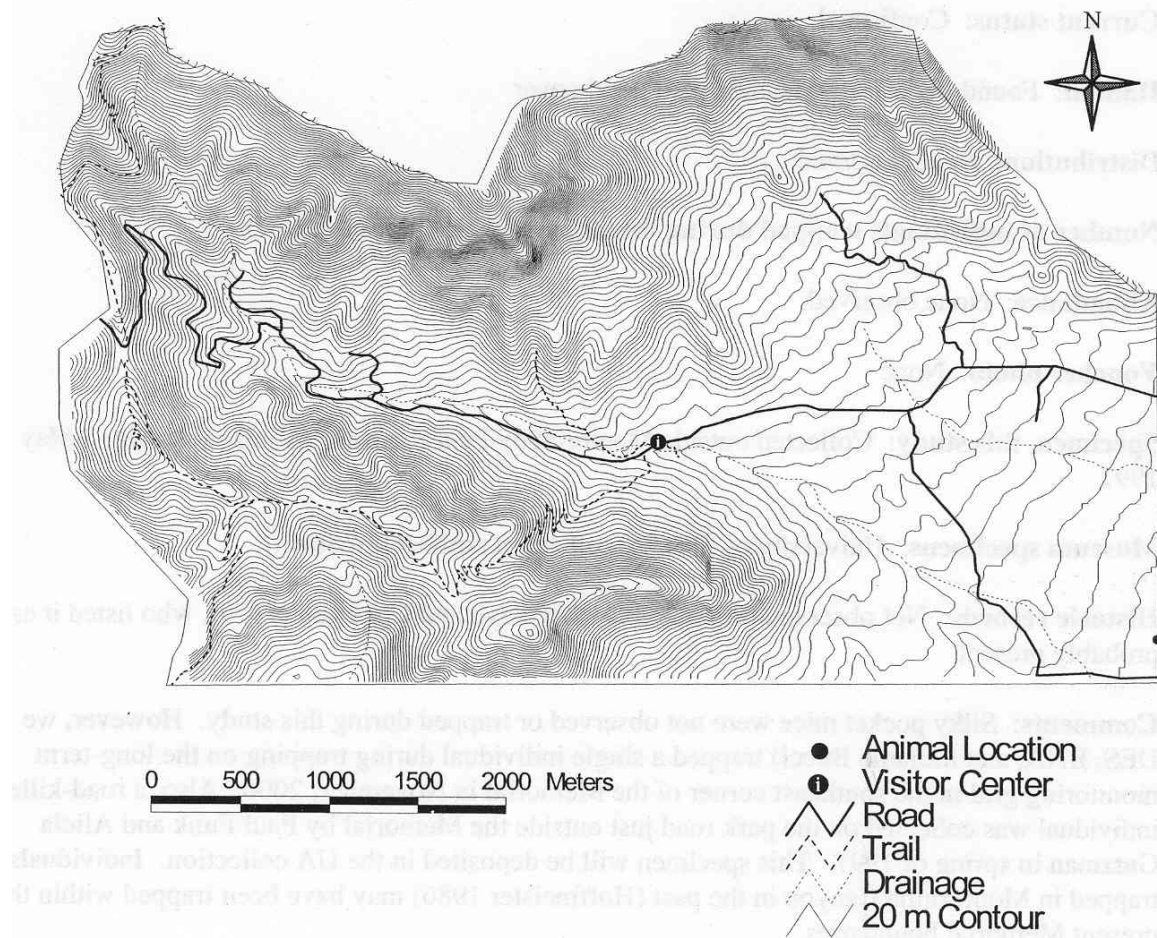
Museum specimens: None

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), and not listed as probably present

Comments: We trapped this species only in one area, at the fence along the southeast boundary where Merriam's kangaroo rats were also trapped. Here the soil was sandy and grass was sparse because of grazing outside the Memorial. Banner-tailed kangaroo rats make large burrows in dirt mounds, often near a mesquite or other tree or shrub, which are subsequently inhabited by many other animals including desert spiny lizards, snakes, and toads. We observed a few other mounds in the lower grasslands that appear to have been occupied by this species.

Banner-tailed kangaroo rat

Dipodomys spectabilis



Infraclass Eutheria
Order Rodentia (rodents)
Family HETEROMYIDAE (kangaroo rats and pocket mice)

SILKY POCKET MOUSE

Perognathus flavus

Current status: Confirmed

Habitat: Found in desert grasslands with good cover

Distribution: None observed

Number of individuals trapped during this study: None (but see below)

Abundance: None observed

Voucher photo: None

Specimen, this study: Collected outside Memorial by Paul Funk and Alicia Gutzman, 2 May 1997

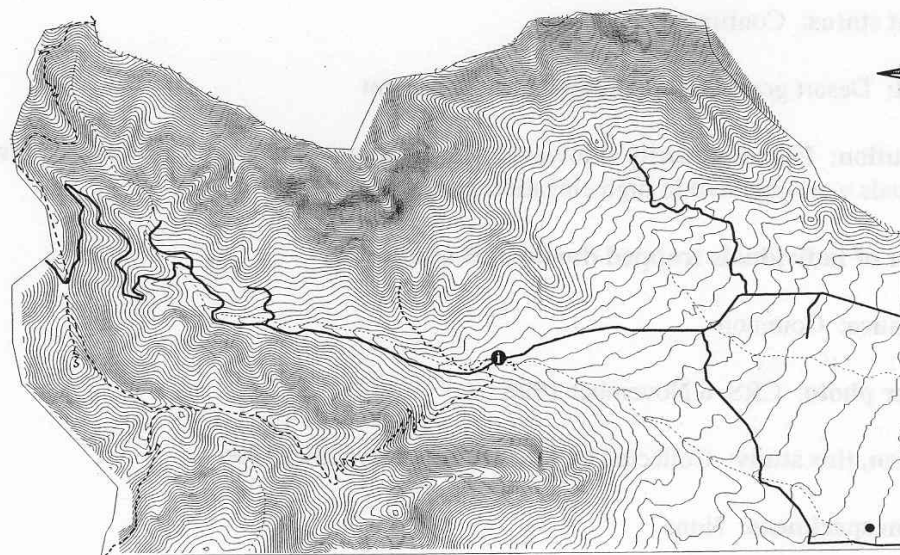
Museum specimens: University of Illinois (collection number unknown)

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed it as probably present

Comments: Silky pocket mice were not observed or trapped during this study. However, we (DES, BNA, and Melanie Bucci) trapped a single individual during trapping on the long-term monitoring grid in the southeast corner of the Memorial in November, 2000. Also, a road-killed individual was collected on the park road just outside the Memorial by Paul Funk and Alicia Gutzman in spring of 1997. This specimen will be deposited in the UA collection. Individuals trapped in Montezuma Canyon in the past (Hoffmeister 1986) may have been trapped within the present Memorial boundaries.

This is a small species, easily distinguished from other pocket mice by its short tail and small feet.

Silky pocket mouse *Perognathus flavus*



0 500 1000 1500 2000 Meters

- Animal Location
- i Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

NORTHERN PYGMY MOUSE

Baiomys taylori

Current status: Confirmed

Habitat: Desert grasslands with thick grasses present

Distribution: Found primarily at lower elevations in grassland areas; however, a few individuals were captured in high elevation grasslands

Number of individuals trapped during this study: 41

Abundance: Common

Voucher photo: CRS, 8 November 1996

Specimen, this study: Collected by DES/AJK, 8 November 1996

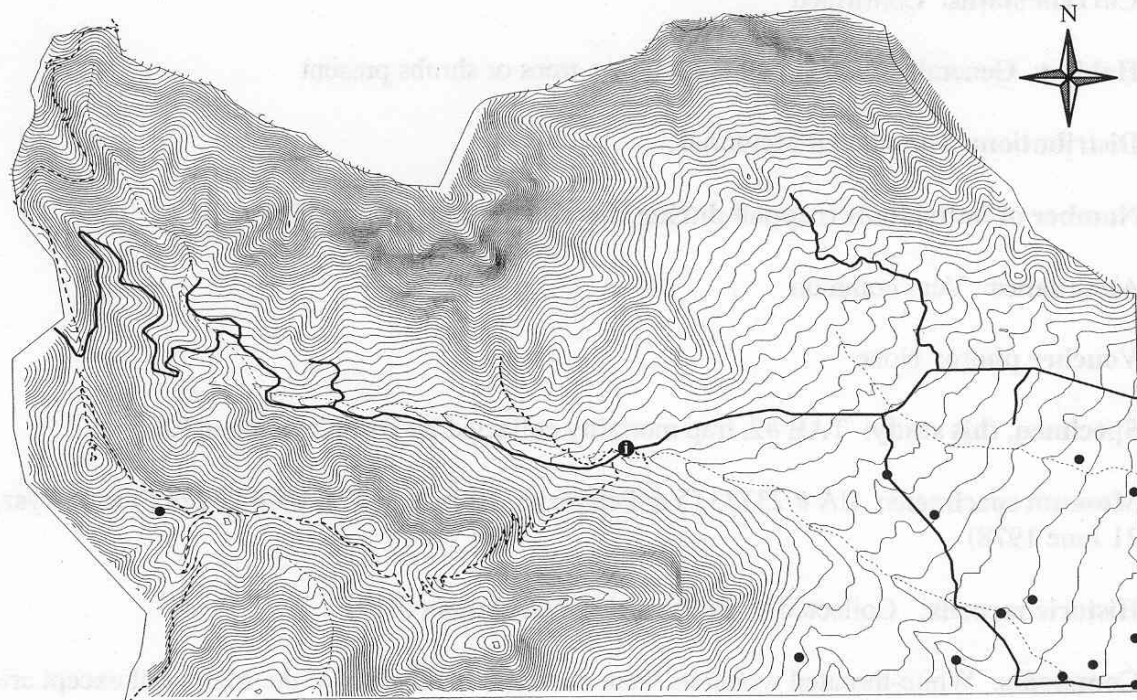
Museum specimens: None

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: We trapped this species in areas of thick grass at lower elevations, where it was common in both upland and riparian areas. We also trapped a few individuals at approximately 1818 m (6000 feet) in areas of thick grass. Hoffmeister (1986) reports that northern pygmy mice have a limited distribution in Arizona; in their grassland habitat, they seem to prefer microhabitat that receives more than the usual amount of water. This very small rodent is the only pygmy mouse that occurs in the United States.

Northern pygmy mouse

Baiomys taylori



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- - - Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

WHITE-THROATED WOODRAT

Neotoma albigula

Current status: Confirmed

Habitat: Generalist found in all areas where trees or shrubs present

Distribution: Throughout Memorial

Number of individuals trapped during this study: 58 (plus one observed)

Abundance: Very common

Voucher photo: None

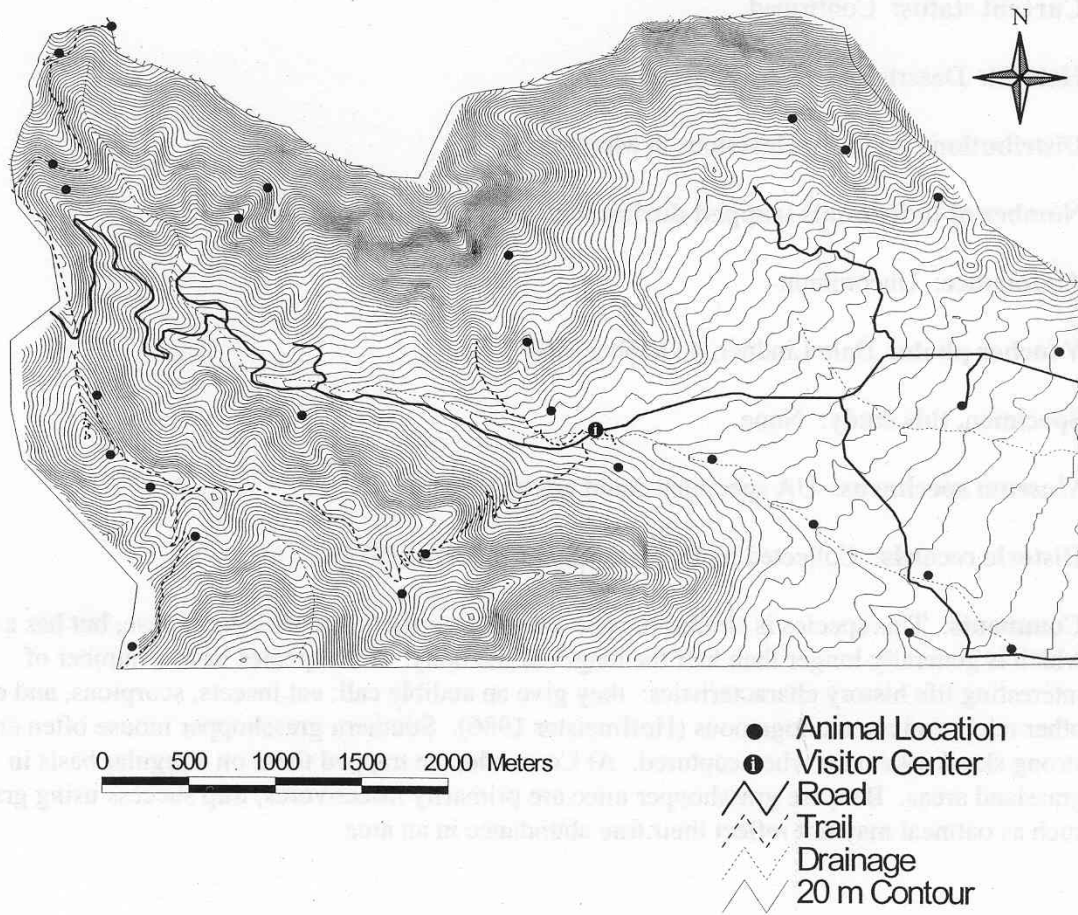
Specimen, this study: TAE #2, trap mortality collected by DES, 7 October 1996

Museum specimens: UA # 23773 (Yar Petryszyn, 16 June 1977), UA# 23774 (Yar Petryszyn, 21 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: White-throated woodrats were observed in all areas of the Memorial except areas of native grassland. This is a large species that constructs highly visible nests of wood, cactus, stones and other materials.

White-throated woodrat *Neotoma albigula*



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

SOUTHERN GRASSHOPPER MOUSE

Onychomys torridus

Current status: Confirmed

Habitat: Deserts and desert grasslands

Distribution: At lower elevations in Memorial.

Number of individuals trapped during this study: 19

Abundance: Uncommon

Voucher photo: Dale Lindner, 4 October 1997

Specimen, this study: None

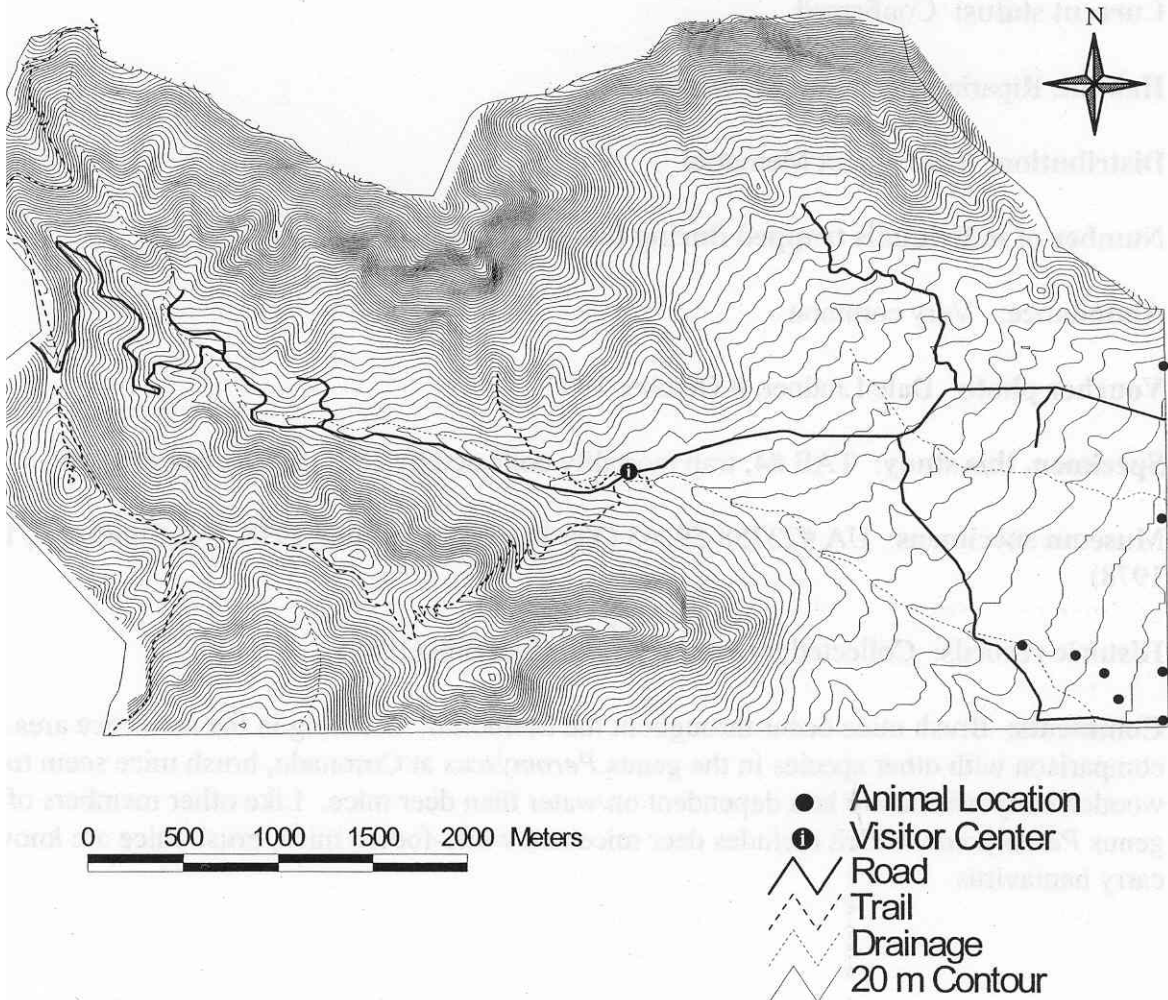
Museum specimens: UA specimen could not be located

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: This species is similar in appearance to northern grasshopper mouse, but has a tail which is generally longer than half the length of the body. Both species have a number of interesting life history characteristics: they give an audible call; eat insects, scorpions, and even other mice; and are monogamous (Hoffmeister 1986). Southern grasshopper mouse often emit a strong skunk-like odor when captured. At Coronado, we trapped them on a regular basis in grassland areas. Because grasshopper mice are primarily insectivores, trap success using grain such as oatmeal may not reflect their true abundance in an area.

Southern grasshopper mouse

Onychomys torridus



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

BRUSH MOUSE

Peromyscus boylii

Current status: Confirmed

Habitat: Riparian areas and oak woodlands

Distribution: Throughout Memorial

Number of individuals trapped during this study: 83

Abundance: Very common

Voucher photo: Dale Lindner, 4 October 1997

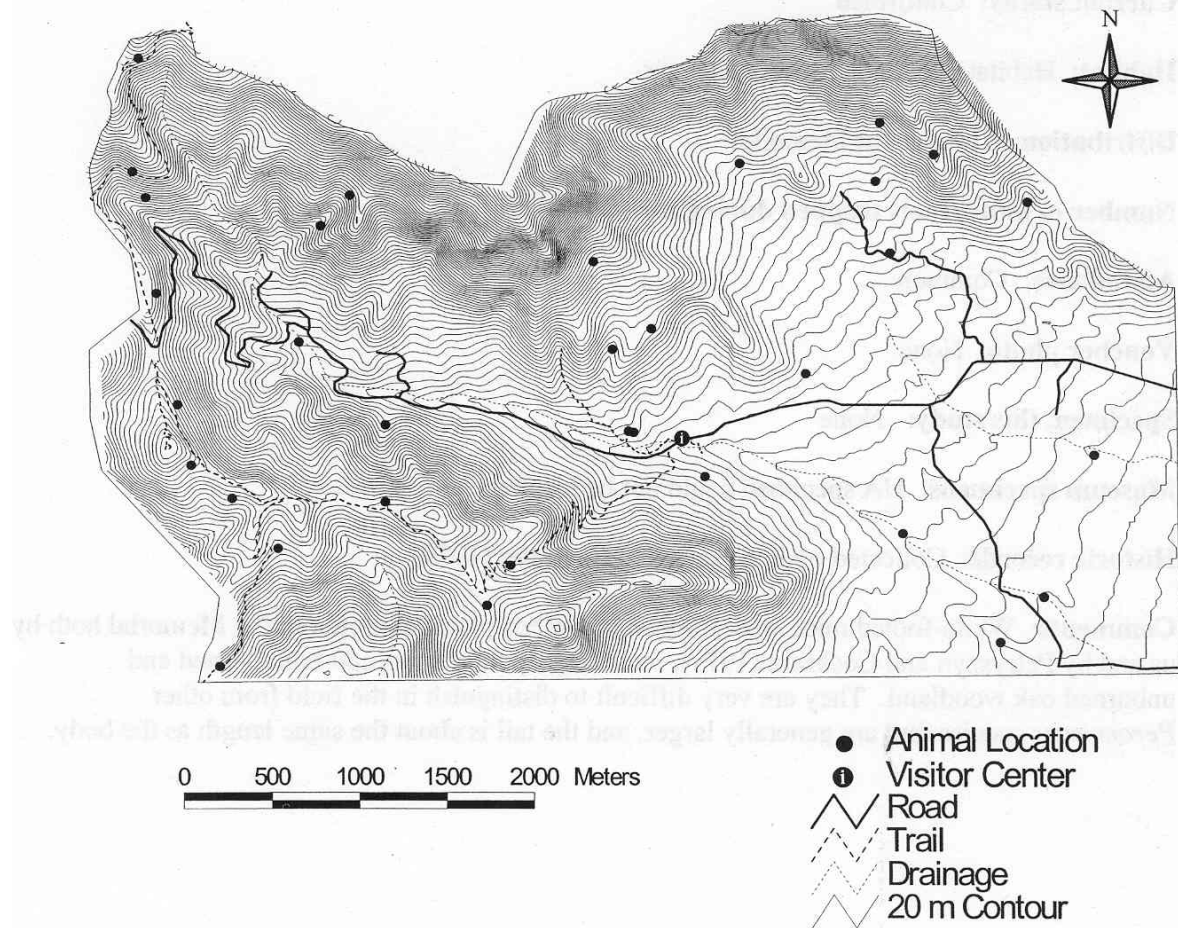
Specimen, this study: TAE #4, trap mortality collected by DES, 16 December 1996

Museum specimens: UA #23758-59, 63 (Yar Petryszyn 16 June 1978, "McCourtney", 18 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: Brush mice occur throughout the Memorial, including in the residence area. In comparison with other species in the genus *Peromyscus* at Coronado, brush mice seem to favor wooded canyons and are less dependent on water than deer mice. Like other members of the genus *Peromyscus*, which includes deer mice and white-footed mice, brush mice are known to carry hantavirus.

Brush mouse *Peromyscus boylii*



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

WHITE-FOOTED MOUSE

Peromyscus leucopus

Current status: Confirmed

Habitat: Habitat generalist in wooded areas

Distribution: Throughout Memorial

Number of individuals trapped during this study: 35

Abundance: Common

Voucher photo: None

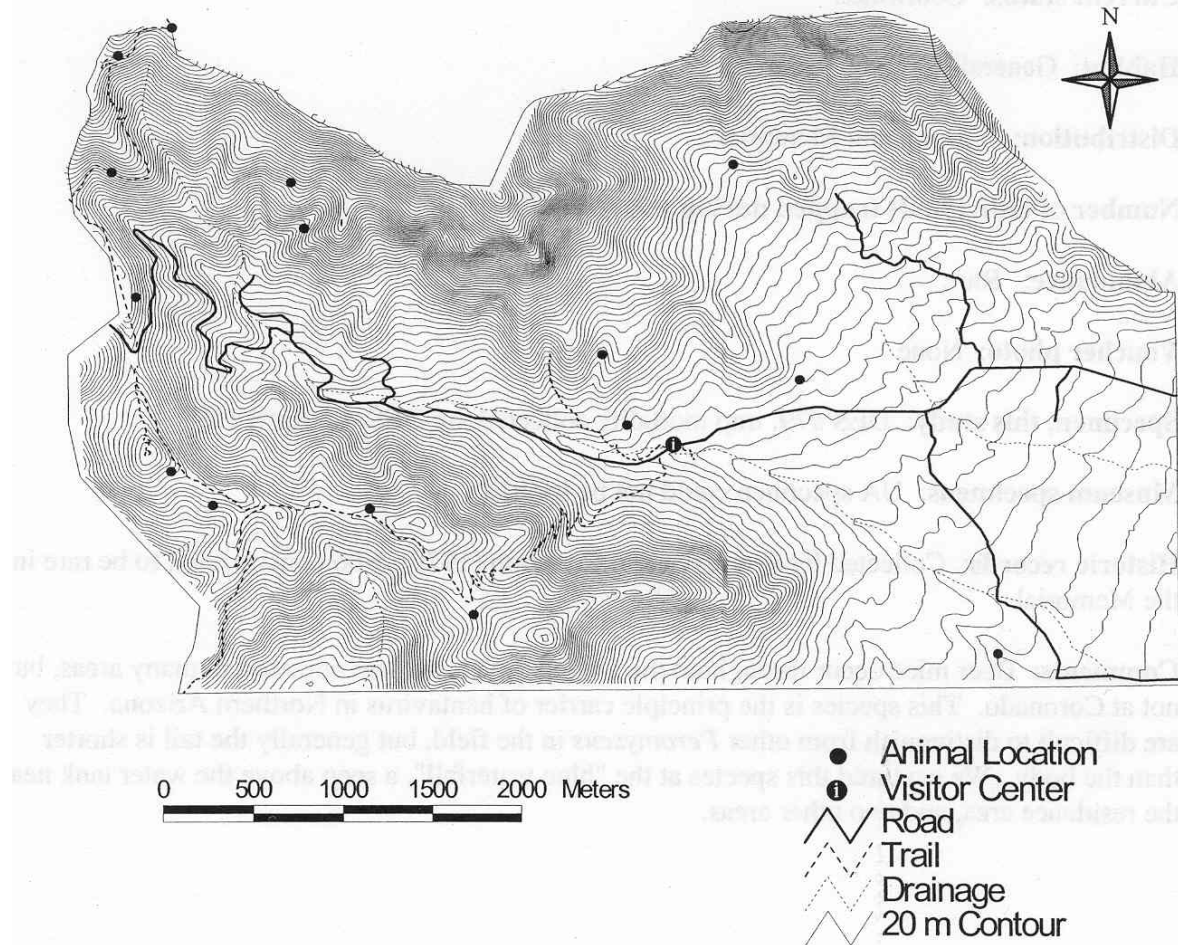
Specimen, this study: None

Museum specimens: UA specimen could not be located

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: White-footed mice were trapped in various places throughout the Memorial both by us and by Petryszyn and Cockrum (1979), including riparian areas and both burned and unburned oak woodland. They are very difficult to distinguish in the field from other *Peromyscus* species, but are generally larger, and the tail is about the same length as the body.

White-footed mouse *Peromyscus leucopus*



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

DEER MOUSE

Peromyscus maniculatus

Current status: Confirmed

Habitat: Generalist in wooded areas

Distribution: Throughout Memorial

Number of individuals trapped during this study: 6

Abundance: Rare

Voucher photo: None

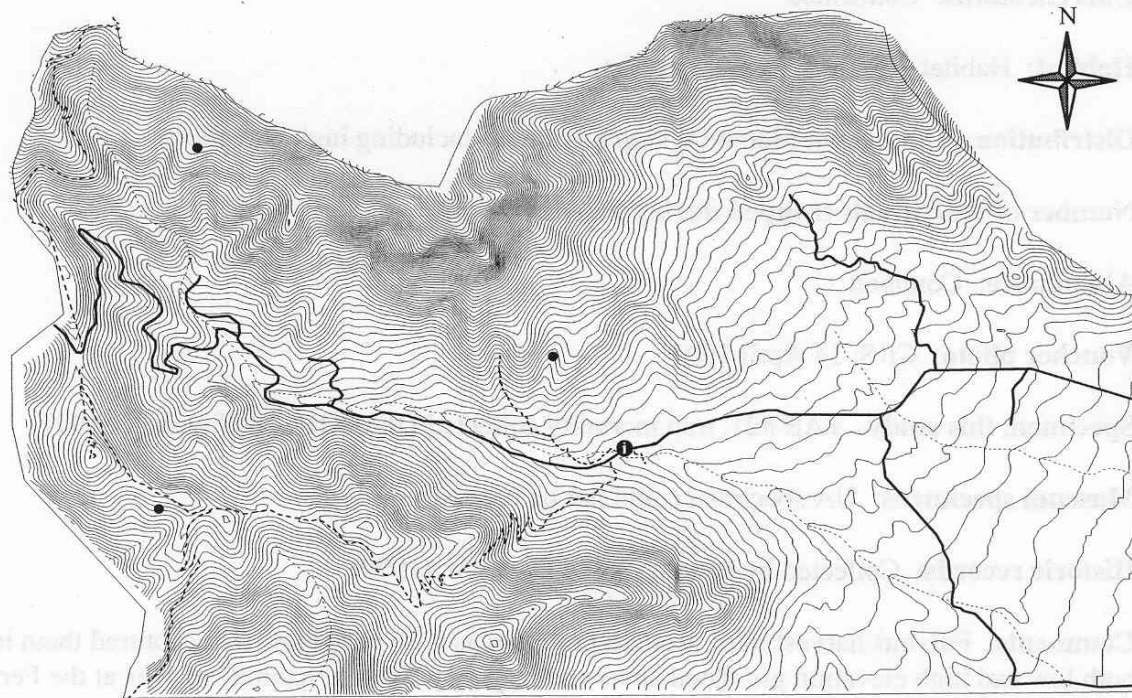
Specimen, this study: DES #79, trap mortality collected by DES, 12 April 1997

Museum specimens: UA specimen could not be located

Historic records: Collected by Petryszyn and Cockrum (1979), who considered it to be rare in the Memorial

Comments: Deer mice occur throughout the United States, and are common in many areas, but not at Coronado. This species is the principle carrier of hantavirus in Northern Arizona. They are difficult to distinguish from other *Peromyscus* in the field, but generally the tail is shorter than the body. We captured this species at the "blue waterfall", a seep above the water tank near the residence area, and two other areas.

Deer mouse *Peromyscus maniculatus*



0 500 1000 1500 2000 Meters

- Animal Location
- i Visitor Center
- Road
- - - Trail
- - - Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

FULVOUS HARVEST MOUSE

Reithrodontomys fulvescens

Current status: Confirmed

Habitat: Habitat generalist in grassy areas

Distribution: Throughout Memorial in grassy areas, including high elevations

Number of individuals trapped during this study: 30

Abundance: Common

Voucher photo: CRS, 14 April 1997

Specimen, this study: TAE #21, trap mortality collected DES/AJK, 18 November 1997

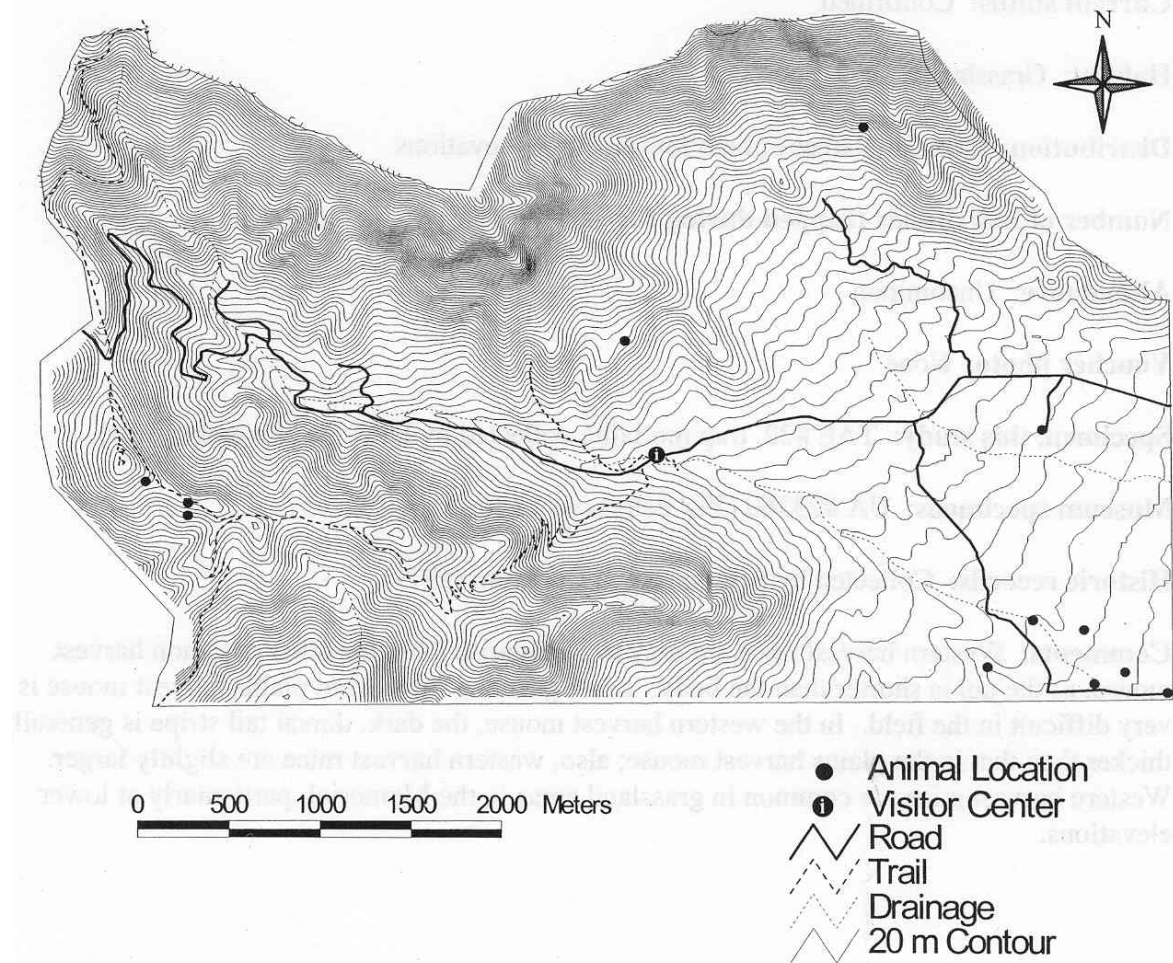
Museum specimens: UA specimen could not be located

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: Fulvous harvest mice seem to prefer areas with tall grass. We captured them in both low and high elevation grassland areas and in grassy riparian habitat, such as at the Fern Grotto. This species can be distinguished from the other harvest mice by a tail which is longer than the body. It is one of the more common rodents in the Memorial.

Fulvous harvest mouse

Reithrodontomys fulvescens



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

WESTERN HARVEST MOUSE

Reithrodontomys megalotis

Current status: Confirmed

Habitat: Grasslands

Distribution: Grassland areas at both low and high elevations

Number of individuals trapped during this study: 15

Abundance: Uncommon

Voucher photo: None

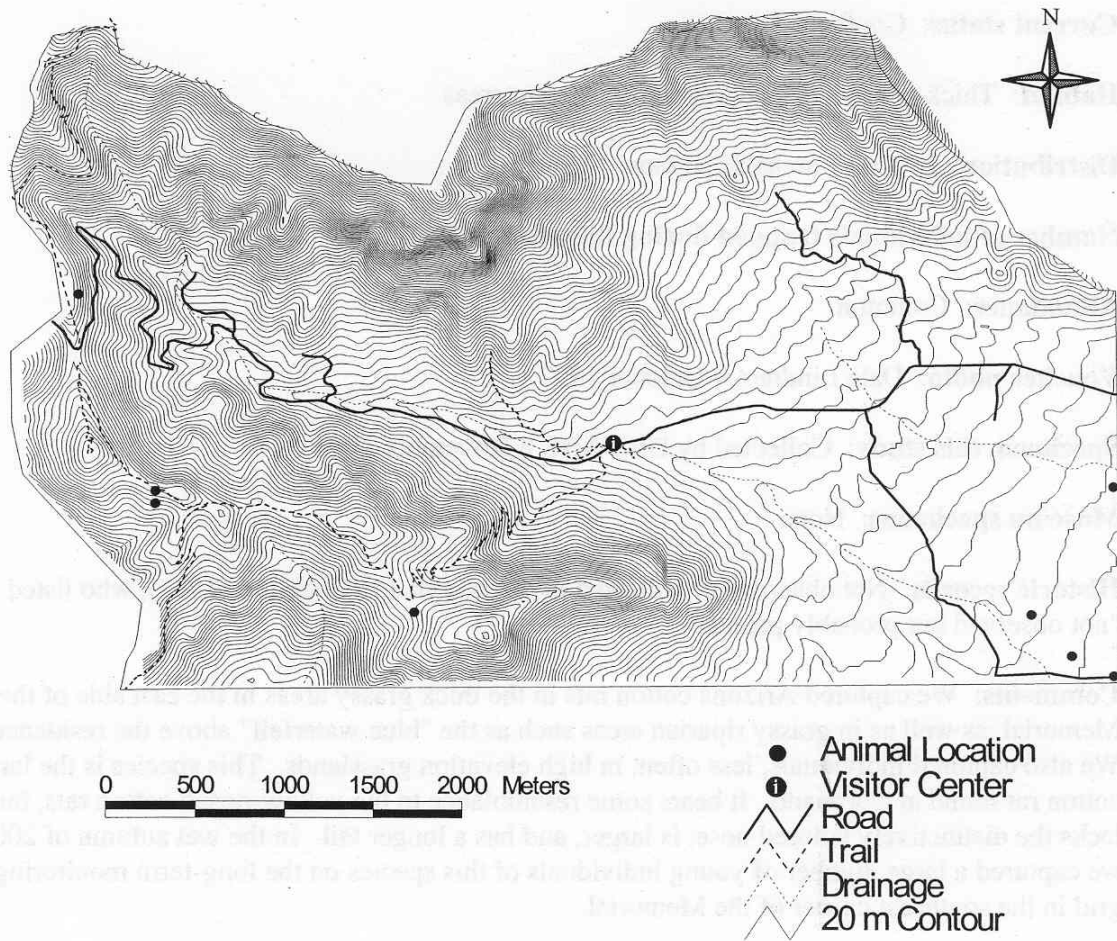
Specimen, this study: TAE #22, trap mortality collected by DES, 25 November 1996

Museum specimens: UA #23760 (Yar Petryszyn 18 June 1978)

Historic records: Collected by Petryszyn and Cockrum (1979)

Comments: Western harvest mice are easy to distinguish from the other common harvest mouse, as the tail is shorter than the body. Distinguishing them from plains harvest mouse is very difficult in the field. In the western harvest mouse, the dark, dorsal tail stripe is generally thicker than that in the plains harvest mouse; also, western harvest mice are slightly larger. Western harvest mice are common in grassland areas in the Memorial, particularly at lower elevations.

Western harvest mouse *Reithrodontomys megalotis*



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

ARIZONA COTTON RAT

Sigmodon arizonae

Current status: Confirmed

Habitat: Thick grassy areas, particularly riparian areas

Distribution: In grassy areas throughout Memorial

Number of individuals trapped during this study: 31

Abundance: Common

Voucher photo: Dale Lindner, 4 October 1997

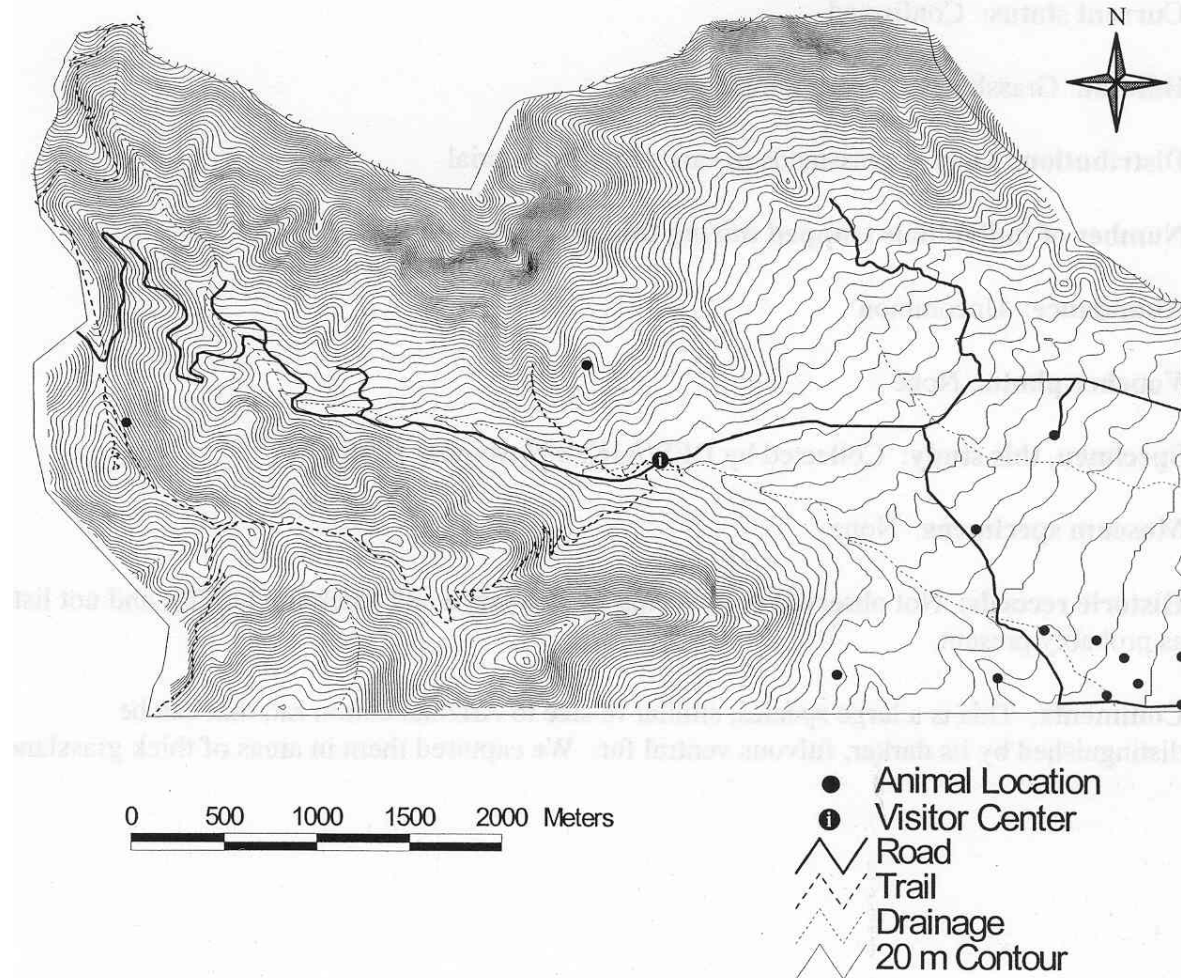
Specimen, this study: Collected by DES/AJK, 8 November 1996

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: We captured Arizona cotton rats in the thick grassy areas in the east side of the Memorial, as well as in grassy riparian areas such as the "blue waterfall" above the residences. We also captured individuals, less often, in high elevation grasslands. This species is the largest cotton rat found at Coronado. It bears some resemblance to the yellow-nosed cotton rats, but lacks the distinctively colored nose, is larger, and has a longer tail. In the wet autumn of 2000 we captured a large number of young individuals of this species on the long-term monitoring grid in the southeast corner of the Memorial.

Arizona cotton rat *Sigmodon arizonae*



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

TAWNY-BELLIED COTTON RAT

Sigmodon fulviventer

Current status: Confirmed

Habitat: Grasslands at lower elevations

Distribution: Only in grasslands in east part of Memorial

Number of individuals trapped during this study: 8

Abundance: Uncommon

Voucher photo: None

Specimen, this study: Collected by DES/AJK, 8 November 1996

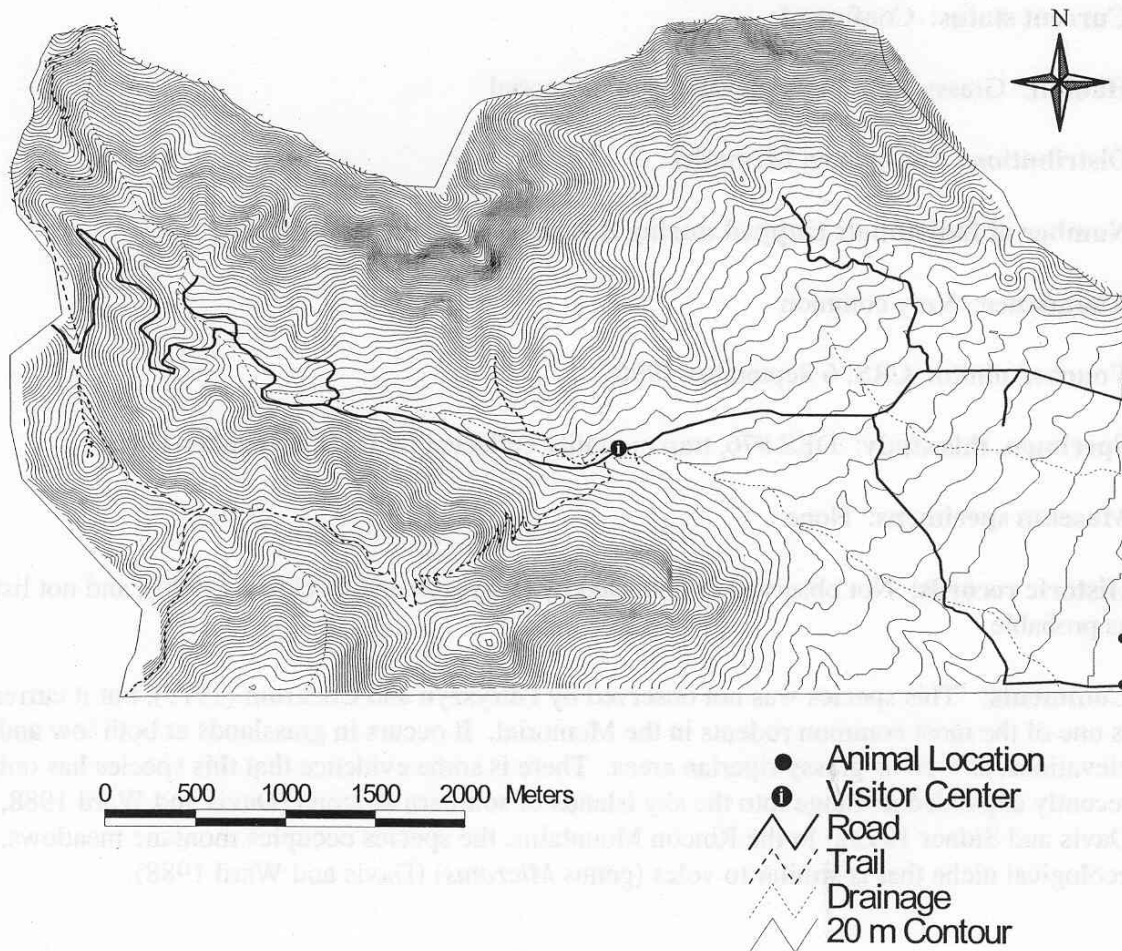
Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), and not listed as probably present

Comments: This is a large species, similar in size to Arizona cotton rat, that can be distinguished by its darker, fulvous ventral fur. We captured them in areas of thick grassland.

Tawny-bellied cotton rat

Sigmodon fulviventer



Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

YELLOW-NOSED COTTON RAT

Sigmodon ochrognathus

Current status: Confirmed

Habitat: Grassy areas at all elevations in Memorial

Distribution: Throughout Memorial

Number of individuals trapped during this study: 78 (plus 5 observed)

Abundance: Very common

Voucher photo: CRS, 6 September 1996

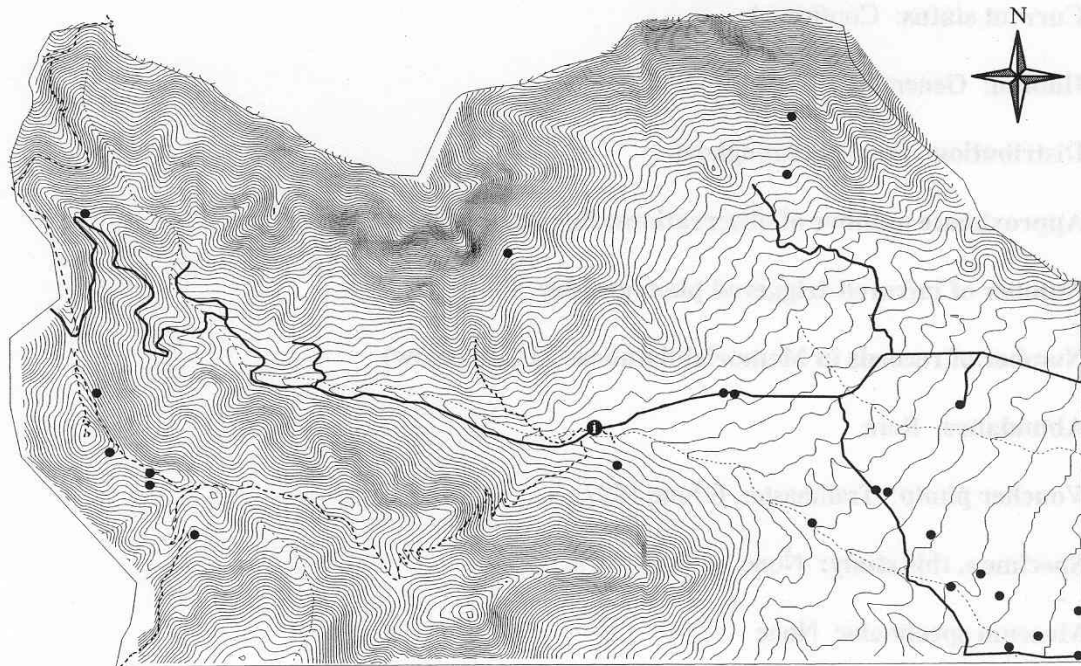
Specimen, this study: DES #76, trap mortality collected by DES, 6 October 1996

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), and not listed as probable

Comments: This species was not observed by Petryszyn and Cockrum (1979), but it currently is one of the most common rodents in the Memorial. It occurs in grasslands at both low and high elevations, as well as grassy riparian areas. There is some evidence that this species has only recently expanded its range into the sky islands of southern Arizona (Davis and Ward 1988, Davis and Sidner 1992). In the Rincon Mountains, the species occupies montane meadows, an ecological niche that is similar to voles (genus *Microtus*) (Davis and Ward 1988).

Yellow-nosed cotton rat *Sigmodon ochrognathus*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family CANIDAE (dogs and foxes)

FERAL DOG
Canis familiaris

Current status: Confirmed

Habitat: Generalist

Distribution: Possible throughout

Approximate number of observations, this study: None

Number of infrared-triggered photographs: 1

Number of records in Memorial database: 1 (see below)

Abundance: Rare

Voucher photo: Trailmaster, 6 June 1997

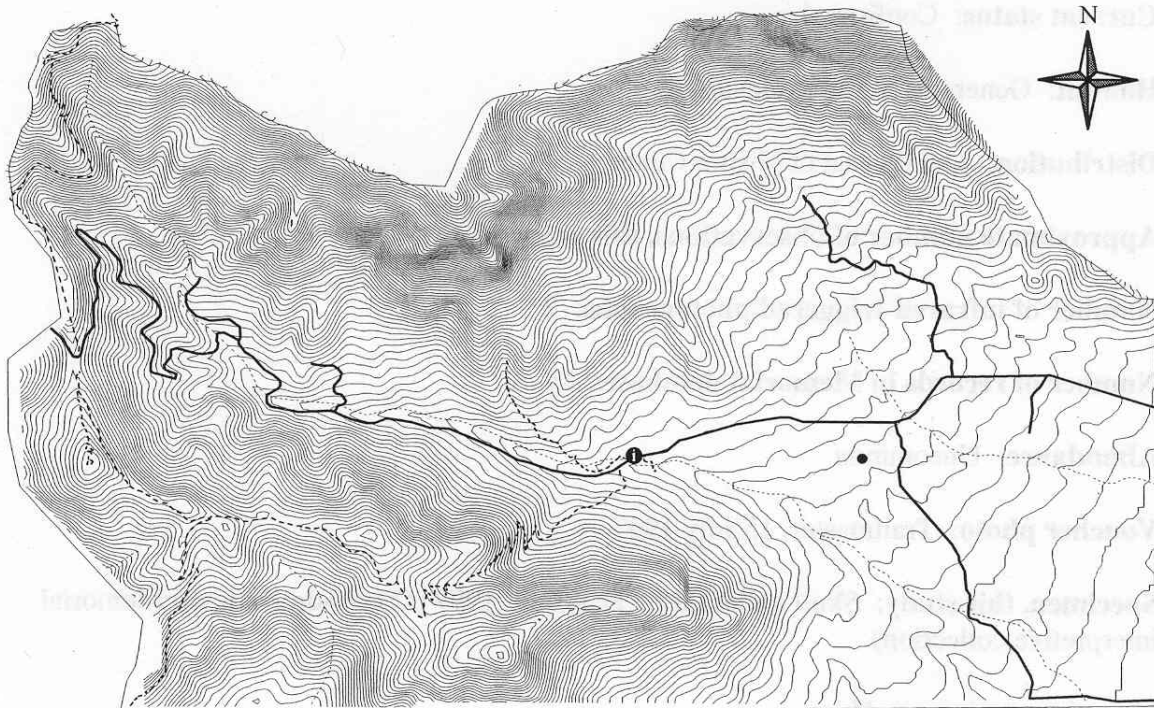
Specimen, this study: None

Museum specimens: None

Historic records: None

Comments: Domestic dogs gone wild are sometimes seen in the Memorial and have been common on nearby ranches during recent years (Henry Ruiz, pers. comm.). We photographed at least one wild dog on the Trailmaster during this study, at the E. Forest Lane seep. There is also one record in the sightings database from 1995, near Joe's Canyon trail, that was reported as a dog or wolf, but recorded by staff as a domestic dog. Dogs were again sighted and photographed in the Memorial during the winter of 1999-2000.

Feral dog *Canis familiaris*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- - - Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family CANIDAE (dogs and foxes)

COYOTE

Canis latrans

Current status: Confirmed

Habitat: Generalist at lower elevations

Distribution: Mainly east of Visitor Center

Approximate number of observations, this study: 3

Number of infrared-triggered photographs: 2

Number of records in Memorial database: 43

Abundance: Uncommon

Voucher photo: Trailmaster, 15 July 1997

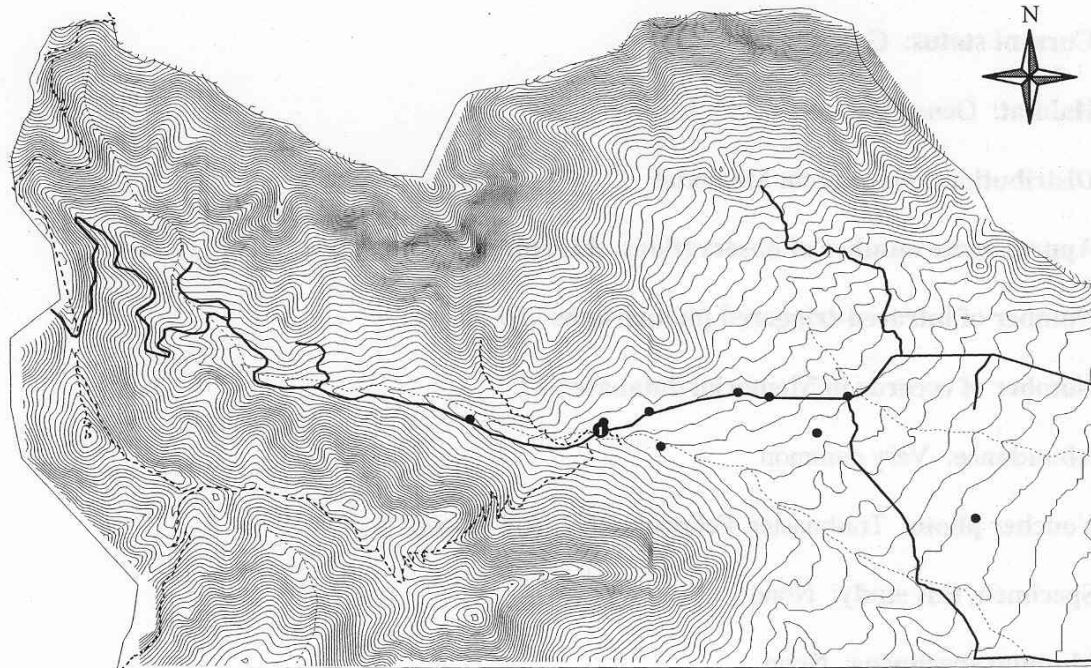
Specimen, this study: Skull collected by Dan Bell, 1997 (Coronado National Memorial interpretive collection)

Museum specimens: None

Historic records: Observed (heard and seen) by Petryszyn and Cockrum (1979) in lower elevation areas of the Memorial

Comments: Coyotes are common at Coronado, but are rarely seen outside of grassland areas. 47 individual sightings are in the wildlife observation database. Nearly all recorded sightings of coyotes are from east of the Visitor Center, although an individual was observed in 1994 approximately 0.8 km (0.5 miles) west of the Visitor Center. We observed few coyotes by sight during this study and Trailmaster photographs were few, but we often heard them calling in the grasslands.

Coyote *Canis latrans*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- - - Drainage
- △ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family CANIDAE (dogs and foxes)

COMMON GRAY FOX
Urocyon cinereoargenteus

Current status: Confirmed

Habitat: Generalist

Distribution: Throughout Memorial

Approximate number of observations, this study: 12

Number of infrared-triggered photographs: 50

Number of records in Memorial database: 57

Abundance: Very common

Voucher photo: Trailmaster, February 1997 (and others)

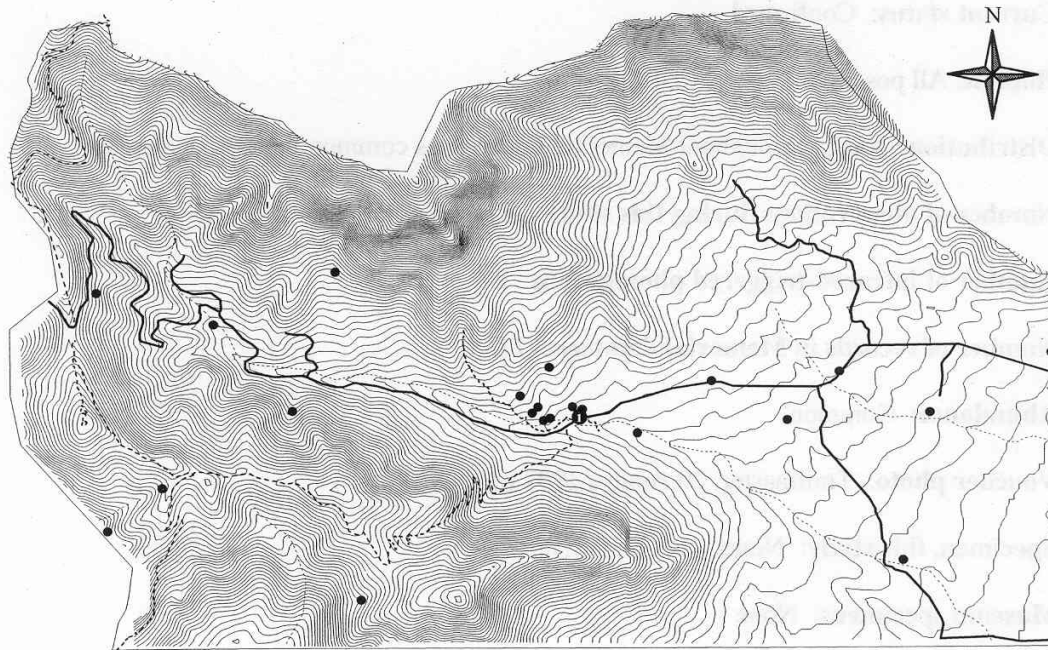
Specimen, this study: None

Museum specimens: None

Historic records: Observed by Charles Lowe, who reported his observation to Petryszyn and Cockrum (1979); they stated that "few in number, gray foxes probably occur throughout the Memorial."

Comments: Common gray foxes were photographed in nearly all infrared photography stations during this study, and were often seen while we were driving on East Montezuma Canyon Road after dark. We consider them to be currently one of the most common carnivores in the Memorial. Gray fox numbers seem to fluctuate in southern Arizona, perhaps in response to cycles of diseases such as distemper and rabies.

Common gray fox *Urocyon cinereoargenteus*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family URSIDAE (bears)

BLACK BEAR

Ursus americanus

Current status: Confirmed

Habitat: All possible

Distribution: Range throughout Memorial, but are less common in grassland areas.

Number of observations during this study: None

Number of infrared-triggered photographs: 27

Number of records in Memorial database: 11

Abundance: Common

Voucher photo: Trailmaster, 20 August 1997 (and others)

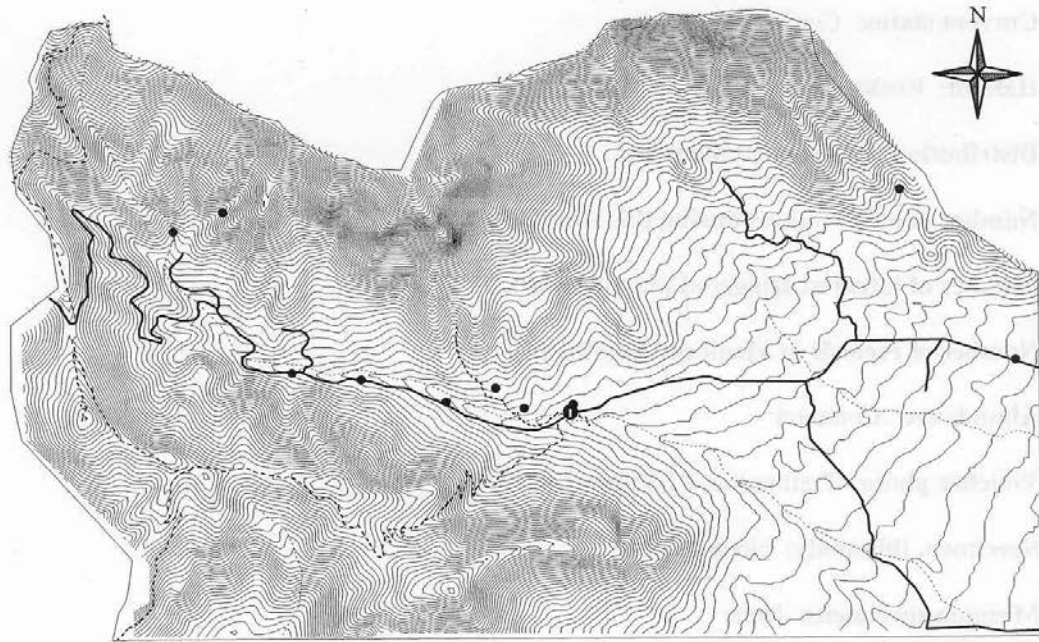
Specimen, this study: None

Museum specimens: None

Historic records: Not observed by Petryszyn and Cockrum (1979), who considered them "probably extinct in the area"

Comments: Black bear have increased in number in southern Arizona in recent years, and now must be considered fairly common in the Memorial. We observed bear scat (large, distinctive piles of manzanita seeds, prickly pear fruit and other food item remains) throughout all areas of the Memorial above 1667 m (5500 feet). Bears were photographed consistently in the Clark-Smith mine area. Black bears in the Memorial are not necessarily black; individuals which are brown or cinnamon colored also occur.

Black bear *Ursus americanus*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- ~ ~ ~ Drainage
- 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family PROCYONIDAE (raccoons and their relatives)

RINGTAIL

Bassariscus astutus

Current status: Confirmed

Habitat: Rocky areas

Distribution: Throughout Memorial

Number of observations during this study: None

Number of infrared-triggered photographs: 93

Number of records in Memorial database: 11

Abundance: Common

Voucher photo: Trailmaster, 21 September 1997

Specimen, this study: None

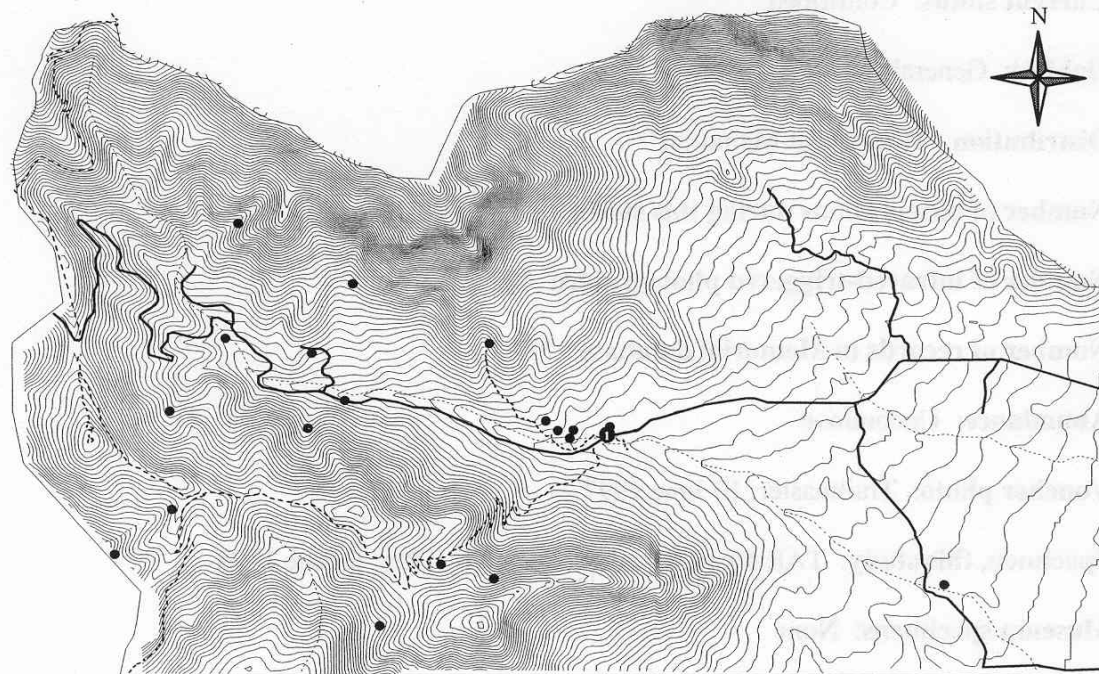
Museum specimens: None

Historic records: Not listed, perhaps inadvertently, by Petryszyn and Cockrum (1979)

Comments: Ringtails occur throughout the Memorial. Although they are rarely seen because of their nocturnal habits, they are probably very common at Coronado and were photographed more often by Trailmaster cameras than any other mammal during our study. Ringtails are rock-dwelling, desert-adapted omnivores, and no doubt much desirable habitat exists for them at the Memorial. They are adept climbers, and can rotate their hind feet at least 180 degrees, which allows them to go up and down steep surfaces easily.

Ringtail

Bassariscus astutus



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family PROCYONIDAE (raccoons and their relatives)

WHITE-NOSED COATI

Nasua narica

Current status: Confirmed

Habitat: Generalist

Distribution: Throughout Memorial

Number of observations during this study: 2

Number of infrared-triggered photographs: 12

Number of records in Memorial database: 357

Abundance: Uncommon

Voucher photo: Trailmaster, 10 June 1997

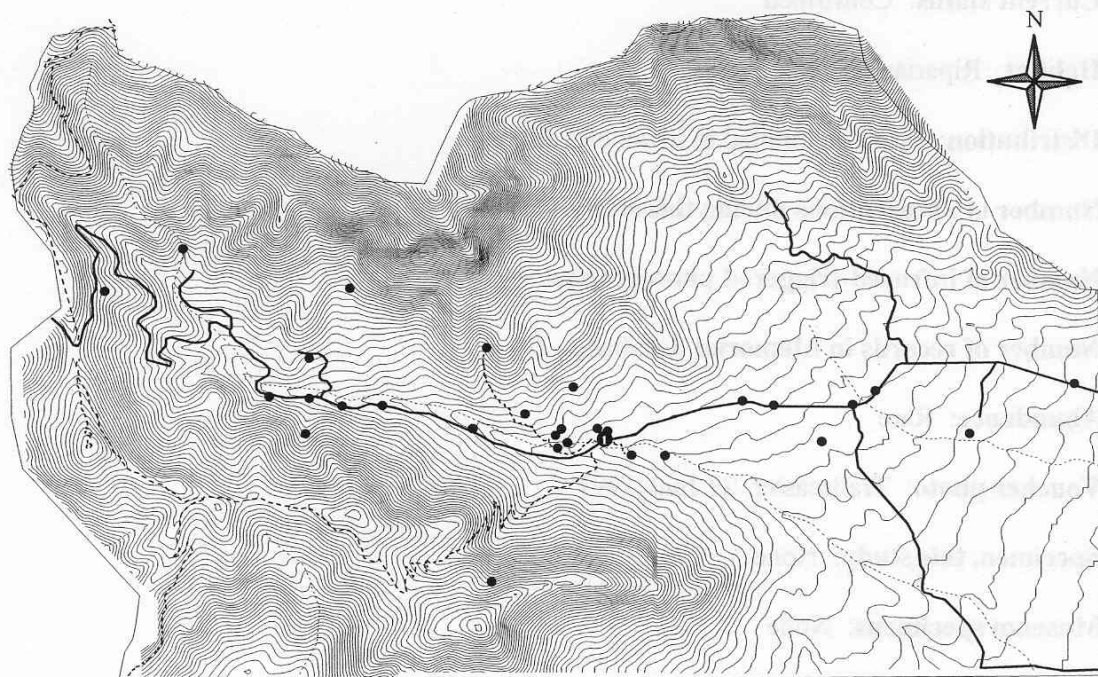
Specimen, this study: TAE #6, skull only collected by DES, 6 June 1998

Museum specimens: None

Historic records: Listed as present by Petryszyn and Cockrum (1979), who did not see any during their study, but remarked that coatis had been common at the Memorial in the past. Risser (1963) noted that coatis were common at Coronado in the 1950's but that none were observed during his study in 1961-62. Coatis were again common during 1970-71 (Gilbert 1973). Bil Gilbert's book *Chulo* (Gilbert 1973) is an interesting and detailed account of the natural history of this species at the Memorial and Chiricahua National Monument.

Comments: The great number (357) of sightings of coatis in the Memorial's wildlife sightings database may be largely attributed to the popular interest in this species. Coatis often travel in large family groups. Of the Coronado sightings, five are of groups of 12 or more. A group of 22 were seen in December 1992, and 24 were seen in March, 1994. We photographed and observed several coatis in this study, including one group of at least three individuals of mixed ages.

White-nosed coati *Nasua narica*



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- ~ Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family PROCYONIDAE (raccoons and their relatives)

COMMON RACCOON

Procyon lotor

Current status: Confirmed

Habitat: Riparian areas

Distribution: Probably limited to lower elevations

Number of observations during this study: None

Number of infrared-triggered photographs: 4

Number of records in Memorial database: 2

Abundance: Rare

Voucher photo: Trailmaster, 27 June 1997

Specimen, this study: None

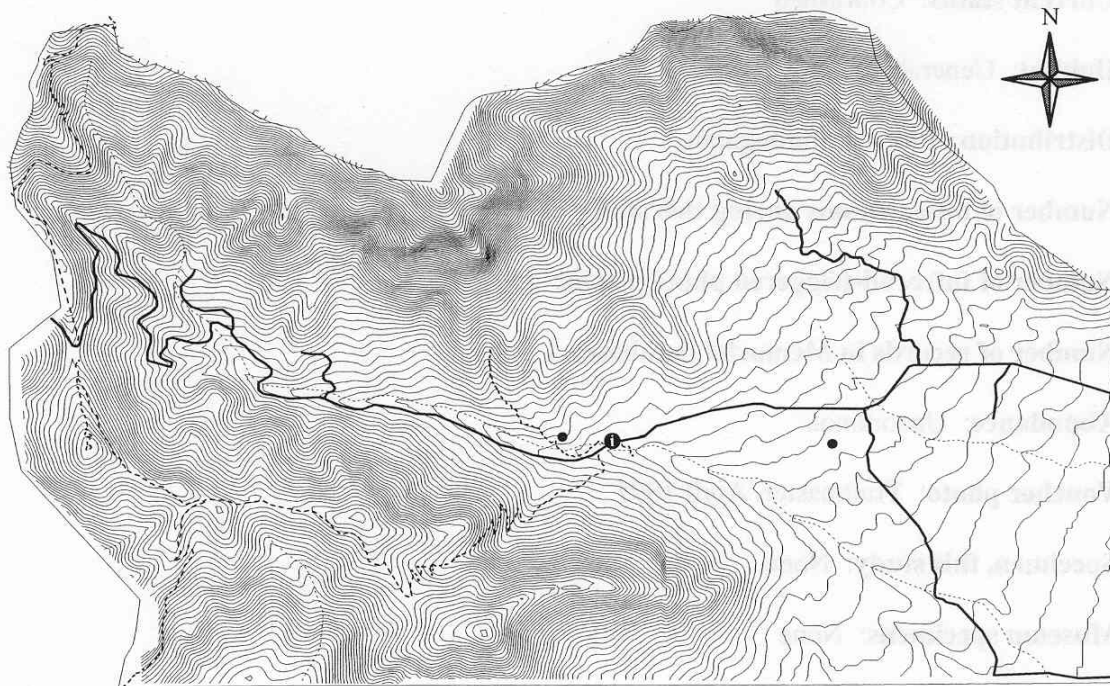
Museum specimens: None

Historic records: Petryszyn and Cockrum (1979) listed raccoons as present, but did not observe any in their study. They stated that raccoons "are transients over most of the Memorial from the riparian community of the San Pedro River."

Comments: Raccoons are probably not common at the Memorial. We did not observe any, but did photograph at least one individual at the seep near the intersection of East Forest Lane and East Montezuma Canyon Road on several occasions. The two records in the Memorial sightings database are from the residence area. Raccoons are riparian obligate species in Arizona, and are seldom found very far from water (Hoffmeister 1986). We suspect they are common along the San Pedro River, and wander into the Memorial from time to time.

Common raccoon

Procyon lotor



0 500 1000 1500 2000 Meters

● Animal Location

① Visitor Center

— Road

- - - Trail

- - - Drainage

— 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family MEPHITIDAE

COMMON HOG-NOSED SKUNK

Conepatus mesoleucus

Current status: Confirmed

Habitat: Generalist

Distribution: Probably throughout

Number of observations during this study: 1

Number of infrared-triggered photographs: 15

Number of records in Memorial database: 1

Abundance: Uncommon

Voucher photo: Trailmaster, April 1997

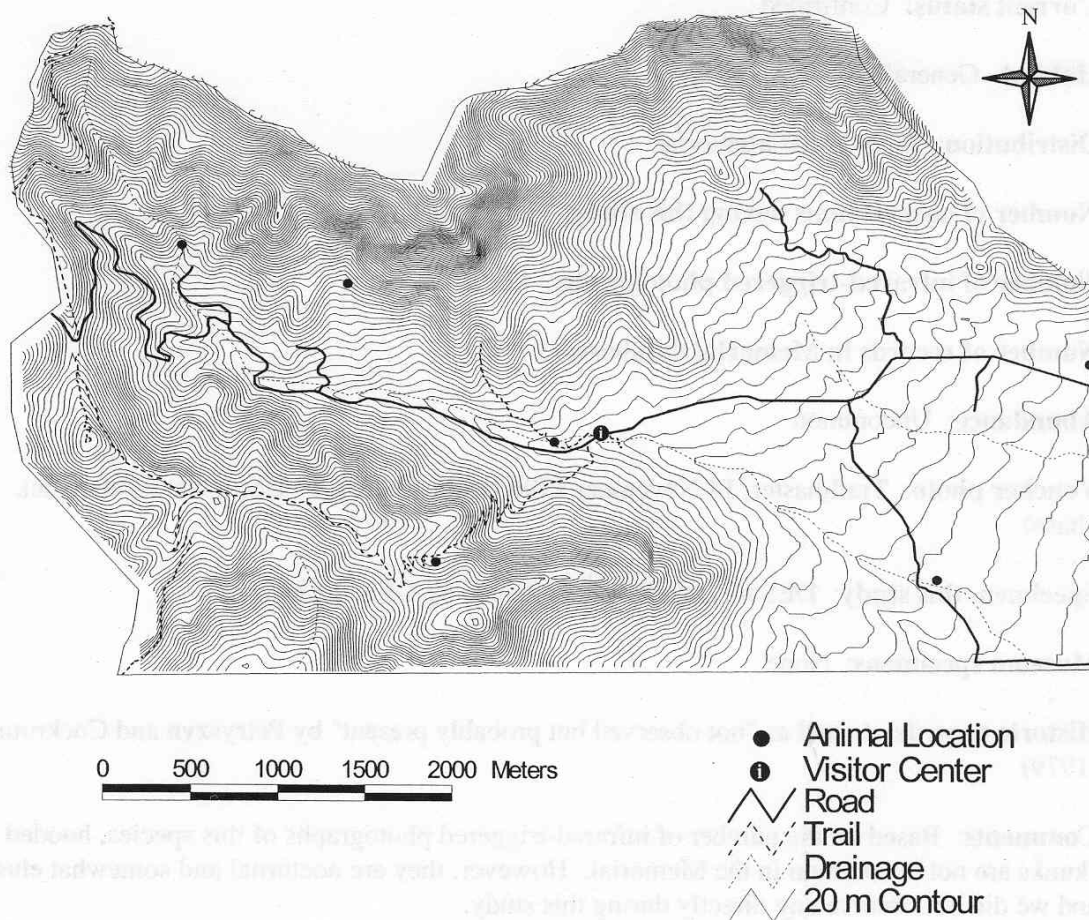
Specimen, this study: None

Museum specimens: None

Historic records: Listed as "not observed but probably present" by Petryszyn and Cockrum (1979)

Comments: We did not observe hog-nosed skunks during this study, but did photograph them at a number of stations. We suspect they are fairly common in the Memorial, but they are almost strictly nocturnal. Common hog-nosed skunks can be confused with hooded skunks, one color phase of which also has an all-white back. However, hog-nosed skunks have an all-white face, while hooded skunks (like striped skunks) always have a narrow white strip down the center of the face.

Common hog-nosed skunk *Conepatus mesoleucus*



Infraclass Eutheria
Order Carnivora (carnivores)
Family MEPHITIDAE

HOODED SKUNK

Mephitis macroura

Current status: Confirmed

Habitat: Generalist

Distribution: Throughout Memorial

Number of observations during this study: None

Number of infrared-triggered photographs: 11

Number of records in Memorial database: 3

Abundance: Uncommon

Voucher photo: Trailmaster, 14 November 1996 (white phase); 17 December 1996 (black phase)

Specimen, this study: DES #81, skull only collected by DES, 2 May 1997

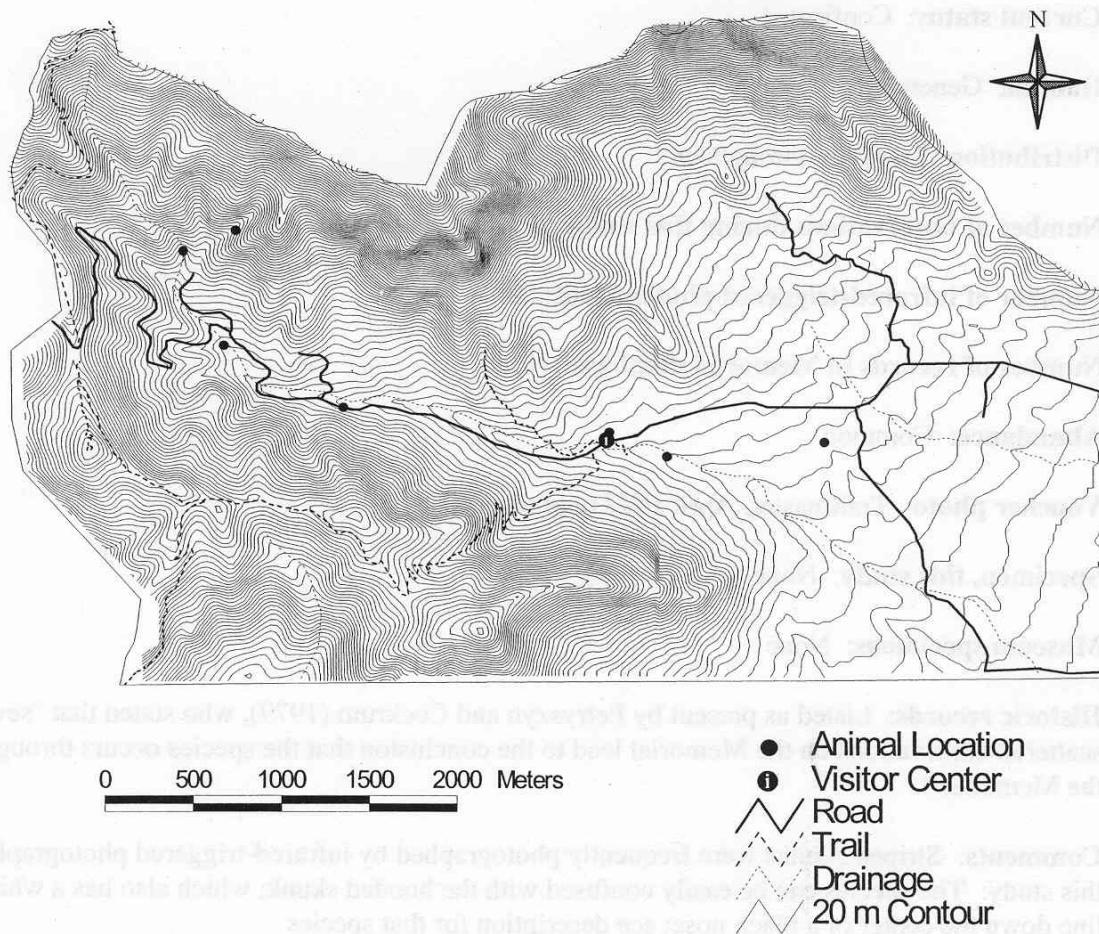
Museum specimens: None

Historic records: Listed as "not observed but probably present" by Petryszyn and Cockrum (1979)

Comments: Based on the number of infrared-triggered photographs of this species, hooded skunks are not uncommon in the Memorial. However, they are nocturnal and somewhat elusive, and we did not observe any directly during this study.

Hooded skunks can be confused with striped skunks, but they lack the black V-shaped wedge of black in the white fur above the tail. However, there is also a color phase of the hooded skunk which is all-black; we photographed one individual of this phase. Hooded skunks can also be confused with hog-nosed skunks; see account for that species.

Hooded skunk *Mephitis macroura*



Infraclass Eutheria
Order Carnivora (carnivores)
Family MEPHITIDAE

STRIPED SKUNK

Mephitis mephitis

Current status: Confirmed

Habitat: Generalist

Distribution: Probably throughout

Number of observations during this study: 4

Number of infrared-triggered photographs: 36

Number of records in Memorial database: None

Abundance: Common

Voucher photo: Trailmaster, April 1997 (and others)

Specimen, this study: None

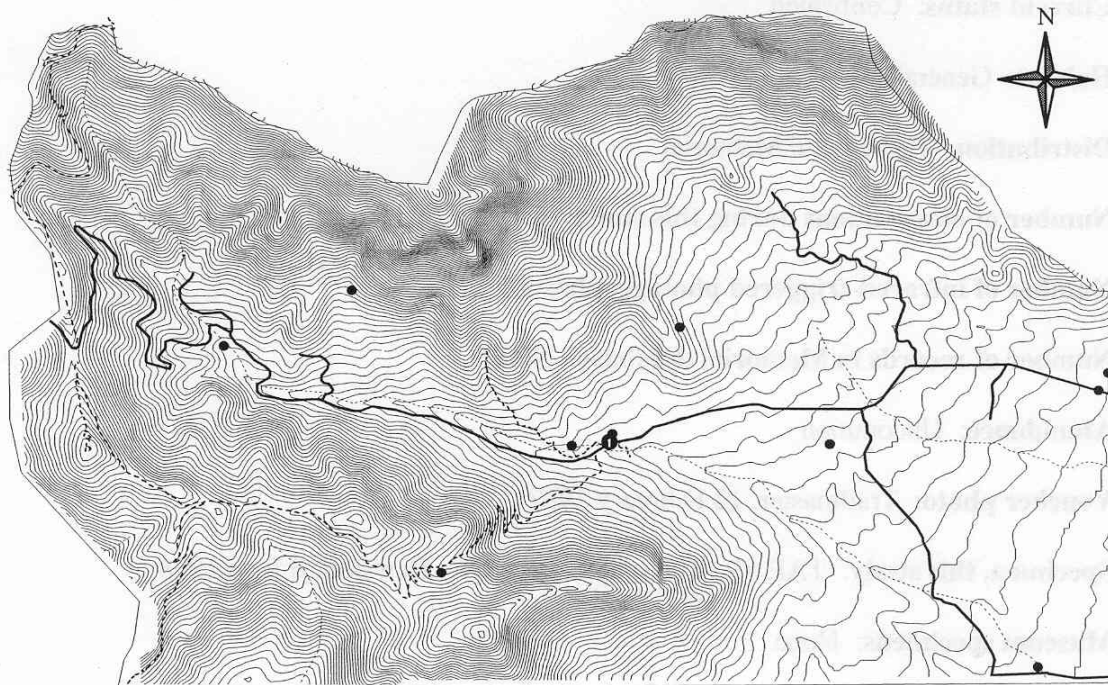
Museum specimens: None

Historic records: Listed as present by Petryszyn and Cockrum (1979), who stated that "several scattered observations on the Memorial lead to the conclusion that the species occurs throughout the Memorial."

Comments: Striped skunks were frequently photographed by infrared-triggered photography in this study. The species can be easily confused with the hooded skunk, which also has a white line down the center of a black nose; see description for that species.

Striped skunk

Mephitis mephitis



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- ~ Drainage
- △ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family MEPHITIDAE

WESTERN SPOTTED SKUNK

Spilogale gracilis

Current status: Confirmed

Habitat: Generalist

Distribution: Throughout Memorial

Number of observations during this study: 1

Number of infrared-triggered photographs: 12

Number of records in Memorial database: None

Abundance: Uncommon

Voucher photo: Trailmaster, 12 February 1997

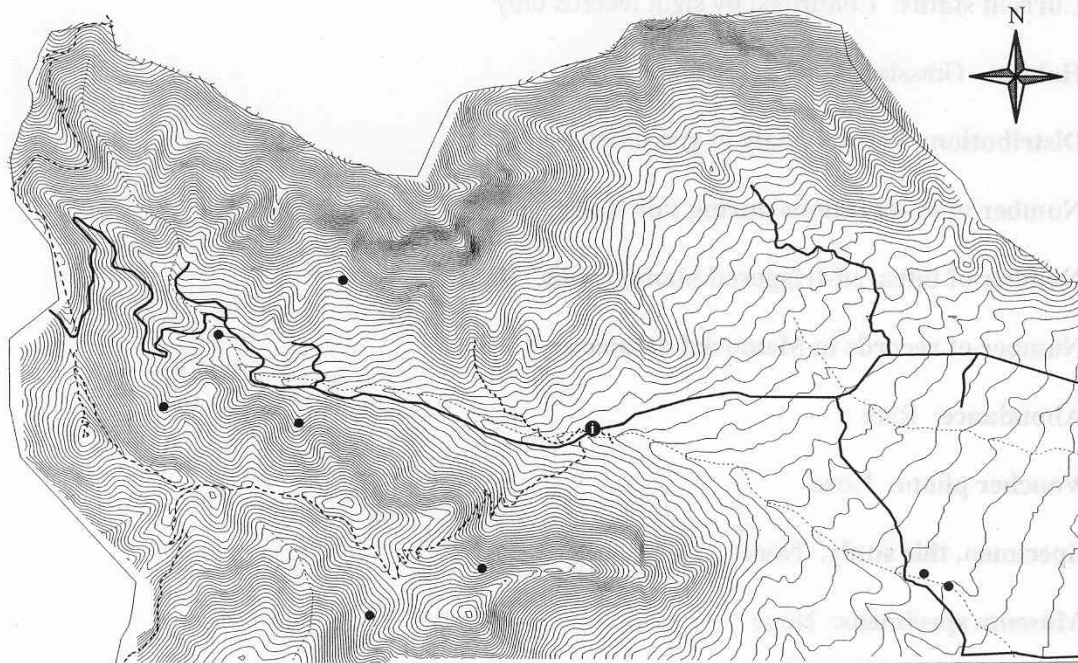
Specimen, this study: TAE #7, skull only collected by Dan Bell, 6 June 1998

Museum specimens: None

Historic records: Listed as present by Petryszyn and Cockrum (1979), who stated that it is seen occasionally by local residents and Memorial personnel. They believed that the species probably occurred in small numbers throughout the Memorial.

Comments: We agree with Petryszyn and Cockrum that spotted skunks probably occur in small numbers throughout the Memorial. This is a small species, approximately the size of a rock or gray squirrel, with a bold pattern of black and white splotches. In one Trailmaster photograph, a spotted skunk and a common gray fox face each other somewhat warily; both individuals visited the same station, baited with sardines, at other times in the evening. Matt Goode (pers. comm.) observed spotted skunks copulating in the residence area during a barking frog survey in August 1996.

Western spotted skunk *Spilogale gracilis*



0 500 1000 1500 2000 Meters

- Animal Location
- ① Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family MUSTELIDAE

AMERICAN BADGER

Taxidea taxus

Current status: Confirmed by sight records only

Habitat: Grasslands and deserts

Distribution: Probably only in grasslands

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: 1

Abundance: Rare

Voucher photo: None

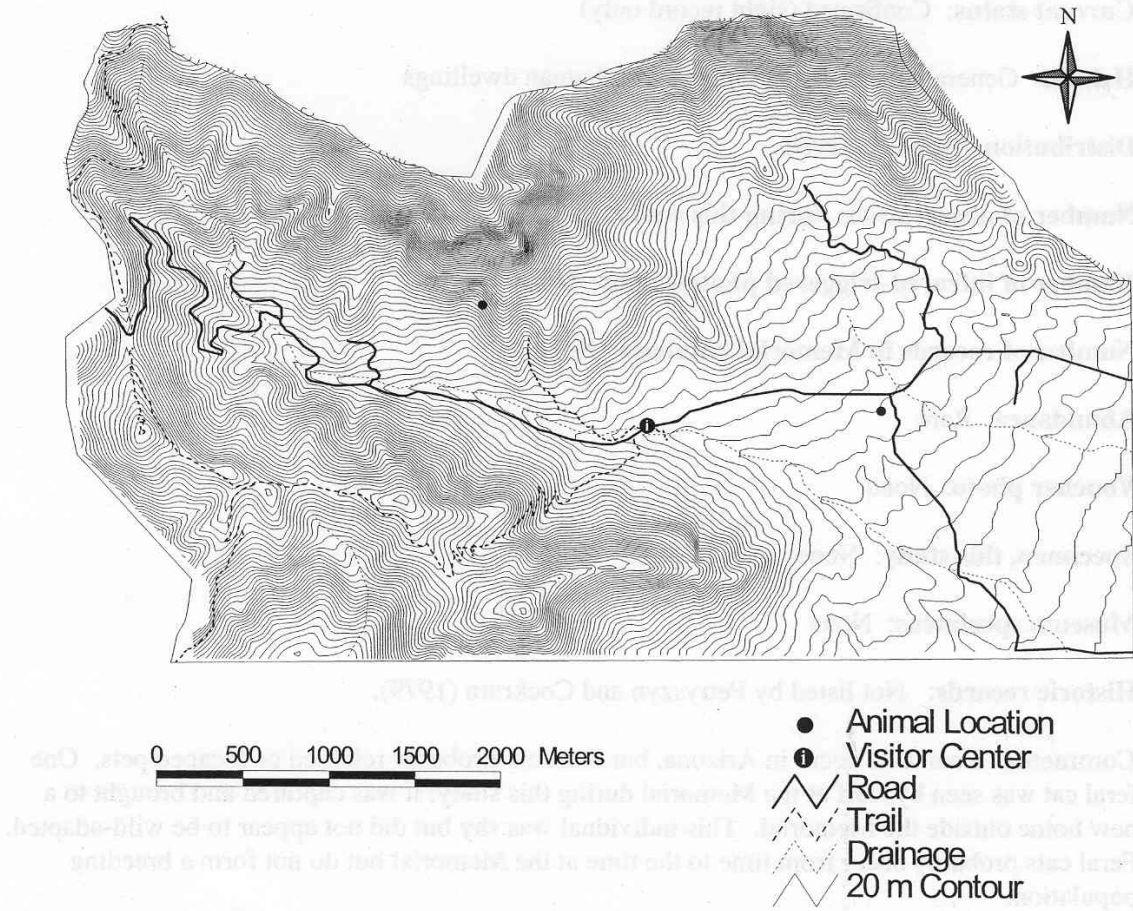
Specimen, this study: None

Museum specimens: None

Historic records: Listed as present by Petryszyn and Cockrum (1979), who stated that "badgers have been reported in the lower reaches of the Memorial in recent years."

Comments: We did not observe any American badgers during this study, nor any diggings that were clearly made by this species. However, badgers are sometimes observed on the Memorial, and may be resident in limited numbers. BNA observed a roadkill on the park road several years ago, but did not collect it. The record in the Coronado sightings database was by Scott Sticha, Coronado National Memorial staff, who observed an individual inside a mine shaft in 1993.

American Badger *Taxidea taxus*



Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE (cats)

FERAL CAT

Felis catus

Current status: Confirmed (sight record only)

Habitat: Generalist, usually associated with human dwellings

Distribution: None observed

Number of observations during this study: 1

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: Rare

Voucher photo: None

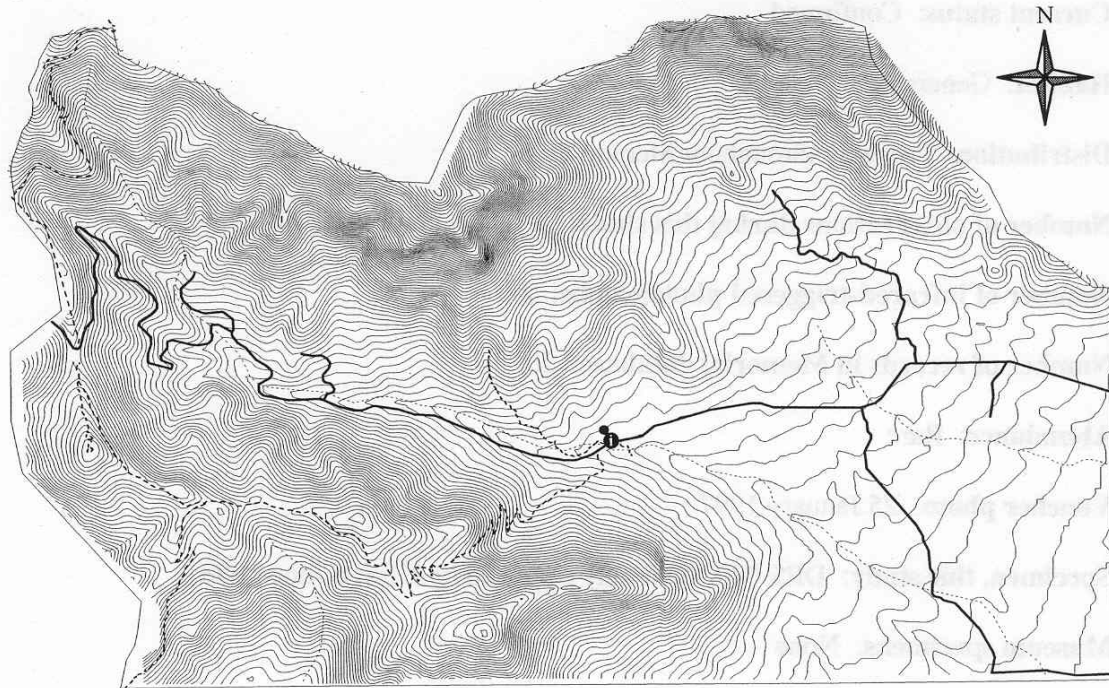
Specimen, this study: None

Museum specimens: None

Historic records: Not listed by Petryszyn and Cockrum (1979).

Comments: Feral cats occur in Arizona, but most are probably released or escaped pets. One feral cat was seen by staff at the Memorial during this study; it was captured and brought to a new home outside the Memorial. This individual was shy but did not appear to be wild-adapted. Feral cats probably occur from time to the time at the Memorial but do not form a breeding population.

Feral cat *Felis catus*



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- ~ ~ ~ Drainage
- △ 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE

BOBCAT

Lynx rufus

Current status: Confirmed

Habitat: Generalist

Distribution: Probably throughout Memorial

Number of observations during this study: 1

Number of infrared-triggered photographs: 2

Number of records in Memorial database: 20

Abundance: Rare

Voucher photo: 25 January 1997

Specimen, this study: DES #80, skull only collected by DES, 6 June 1998

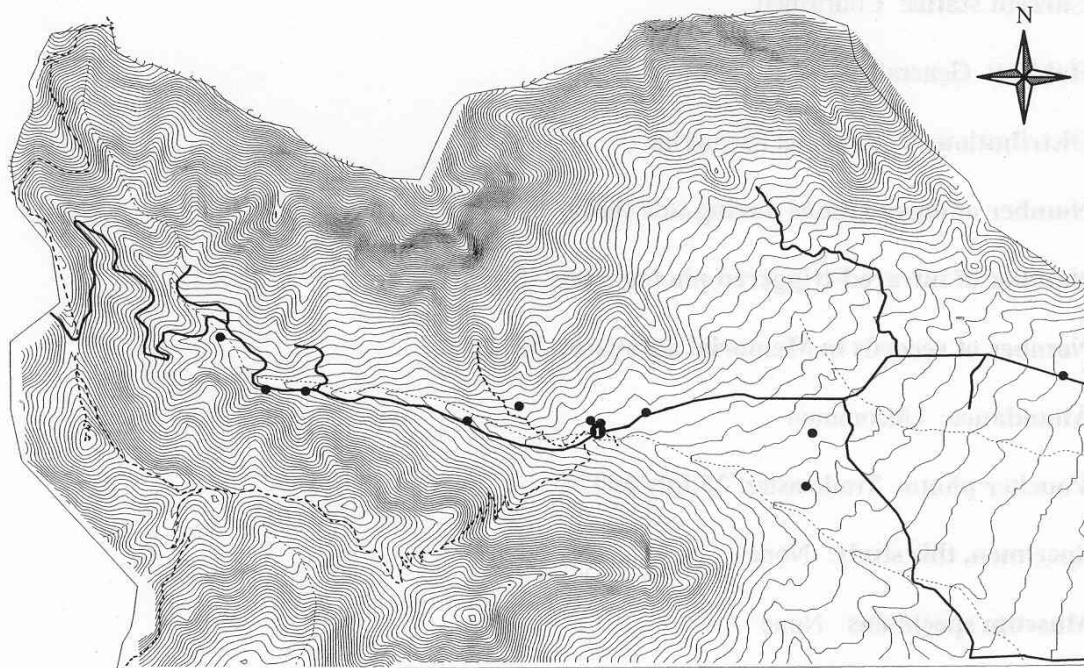
Museum specimens: None

Historic records: Petryszyn and Cockrum (1979) did not observe bobcat, but stated that the species "probably occurs in limited numbers throughout the Memorial."

Comments: Based on photographic and sight records, bobcat do not appear to be common in the Memorial at the present time. While five photographs were taken of mountain lions during this study, only two photos of bobcats were taken. However, it is possible that this species is more cautious than lion and/or are not attracted to cat lures used at the photo stations.

Bobcat

Lynx rufus



0 500 1000 1500 2000 Meters

- Animal Location
- i Visitor Center
- Road
- - - Trail
- - - Drainage
- 20 m Contour

Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE

MOUNTAIN LION

Puma concolor

Current status: Confirmed

Habitat: Generalist

Distribution: Throughout Memorial

Number of observations during this study: 1

Number of infrared-triggered photographs: 5

Number of records in Memorial database: 18

Abundance: Uncommon

Voucher photo: Trailmaster, 25 July 1997

Specimen, this study: None

Museum specimens: None

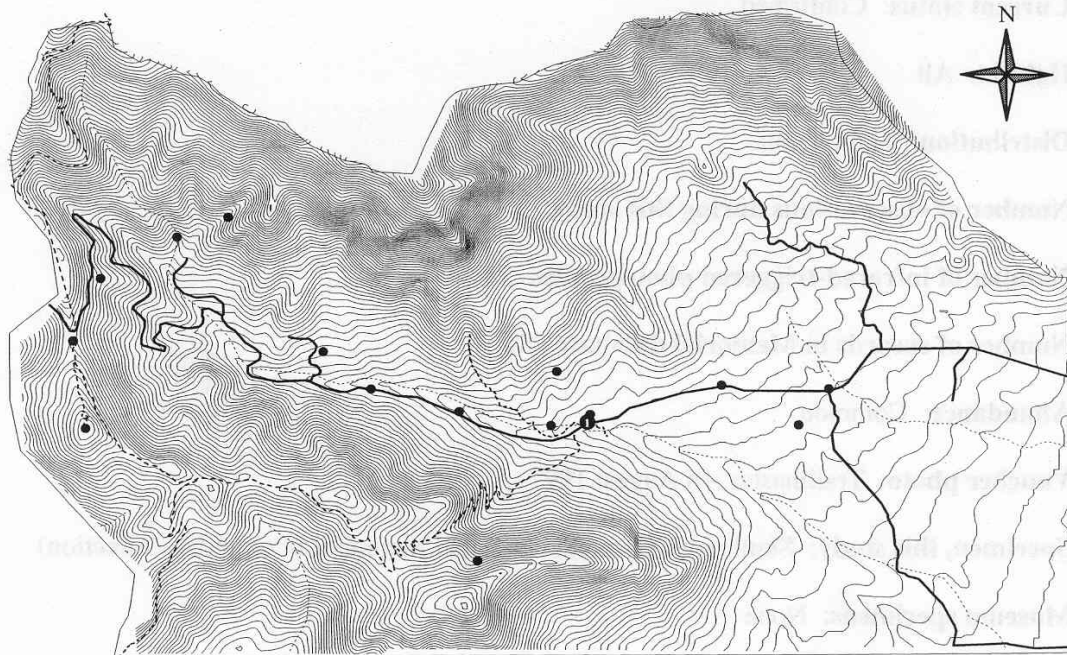
Historic records: Listed as "not observed but probably present" by Petryszyn and Cockrum (1979), who stated that "Most have been eliminated by man."

Comments: We photographed fewer lions than we expected on cameras, perhaps due to camera placement, or perhaps due to low numbers at present. We observed only one individual during this study, but did see scat and other sign on several occasions. However, mountain lions range throughout the Memorial and are seen fairly often, considering their elusive nature.

Mountain lions appear to have a healthy population throughout Arizona and in the Huachucas. Because they are not easily baited, campaigns to exterminate the species were not nearly as successful as with other predators such as wolves and bears (Harley Shaw, pers. comm.).

Mountain lion

Puma concolor



0 500 1000 1500 2000 Meters

- Animal Location
- ⓘ Visitor Center
- Road
- - - Trail
- Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Artiodactyla (even-toed ungulates)
Family TAYASSUIDAE (peccaries)

COLLARED PECCARY

Pecari tajacu

Current status: Confirmed

Habitat: All

Distribution: Throughout

Number of observations during this study: 2

Number of infrared-triggered photographs: 33

Number of records in Memorial database: 84

Abundance: Common

Voucher photo: Trailmaster, 16 August 1997

Specimen, this study: Skull only (Coronado National Memorial interpretive collection)

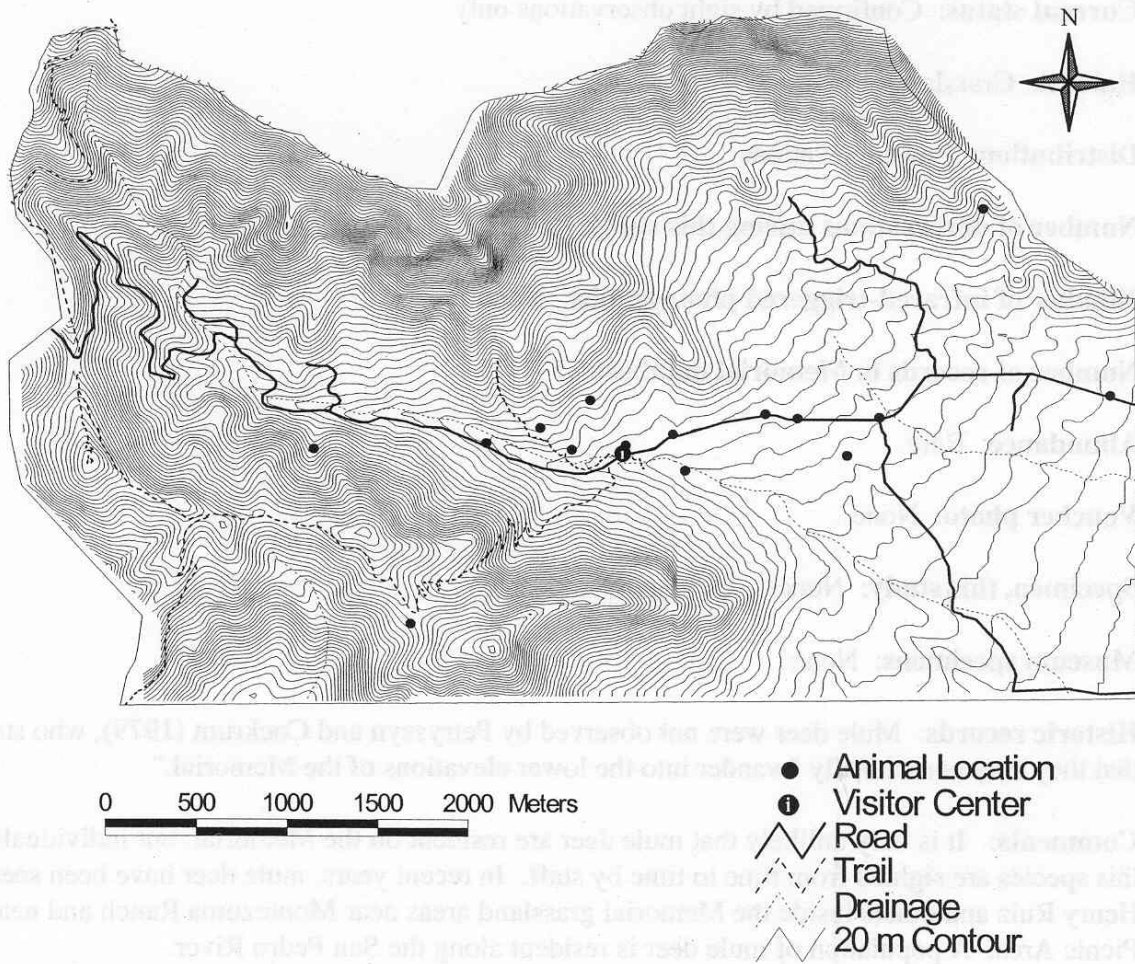
Museum specimens: None

Historic records: Petryszyn and Cockrum (1979) observed 9 individuals in the vicinity of the Clark-Smith mine in 1976 and stated that several are seen by residents in the Memorial area every year.

Comments: Collared peccary (javelina) are probably common throughout the Memorial, though they are not often seen by visitors. We photographed a number of individuals throughout the Memorial. Based on this photographic data and on Memorial sight records, they are probably more common in grassy areas than in woodlands. Javelina appear to use the seep near the gate on East Forest Lane on a regular basis. Memorial sight records include both single individuals and groups of up to seven individuals.

Collared peccary

Pecari tajacu



Infraclass Eutheria
Order Artiodactyla (even-toed ungulates)
Family CERVIDAE (deer and elk)

MULE DEER

Odocoileus hemionus

Current status: Confirmed by sight observations only

Habitat: Grasslands

Distribution: Lower elevations

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: 5

Abundance: Rare

Voucher photo: None

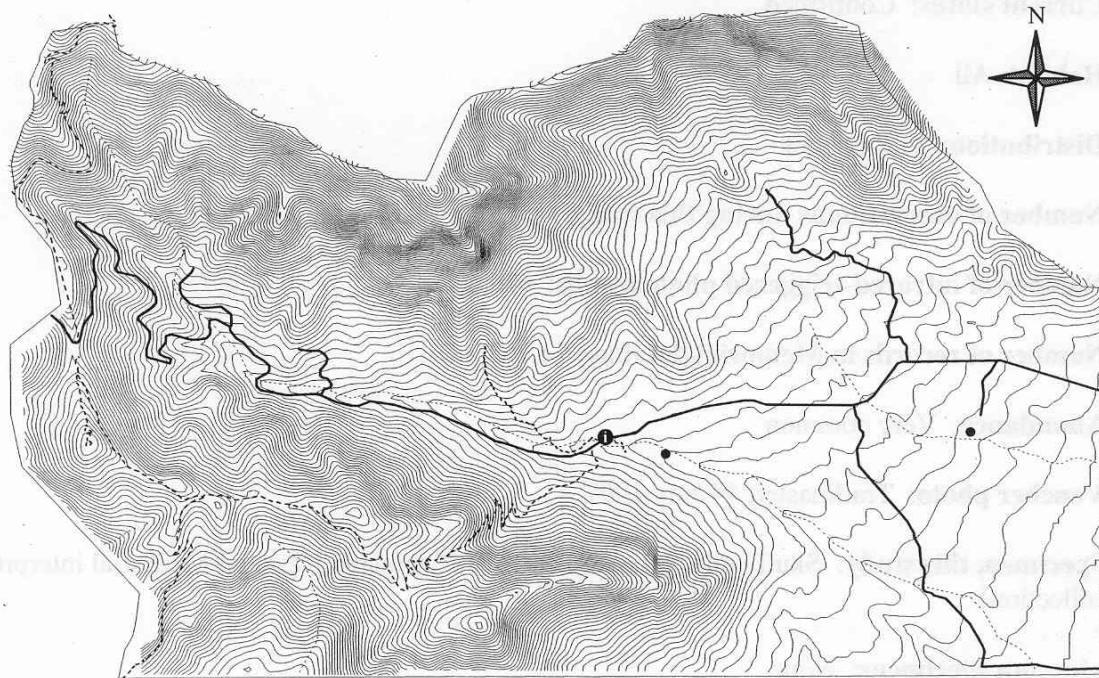
Specimen, this study: None

Museum specimens: None

Historic records: Mule deer were not observed by Petryszyn and Cockrum (1979), who stated that they may occasionally "wander into the lower elevations of the Memorial."

Comments: It is very unlikely that mule deer are resident on the Memorial, but individuals of this species are sighted from time to time by staff. In recent years, mule deer have been seen by Henry Ruiz and others inside the Memorial grassland areas near Montezuma Ranch and near the Picnic Area. A population of mule deer is resident along the San Pedro River.

Mule deer *Odocoileus hemionus*



0 500 1000 1500 2000 Meters

- Animal Location
- ⓞ Visitor Center
- Road
- - - Trail
- /// Drainage
- ~ 20 m Contour

Infraclass Eutheria
Order Artiodactyla (even-toed ungulates)
Family CERVIDAE (deer and elk)

WHITE-TAILED DEER

Odocoileus virginianus

Current status: Confirmed

Habitat: All

Distribution: Throughout

Number of observations during this study: 157

Number of infrared-triggered photographs: 61

Number of records in Memorial database: 1,187

Abundance: Very common

Voucher photo: Trailmaster, 14 July 1997

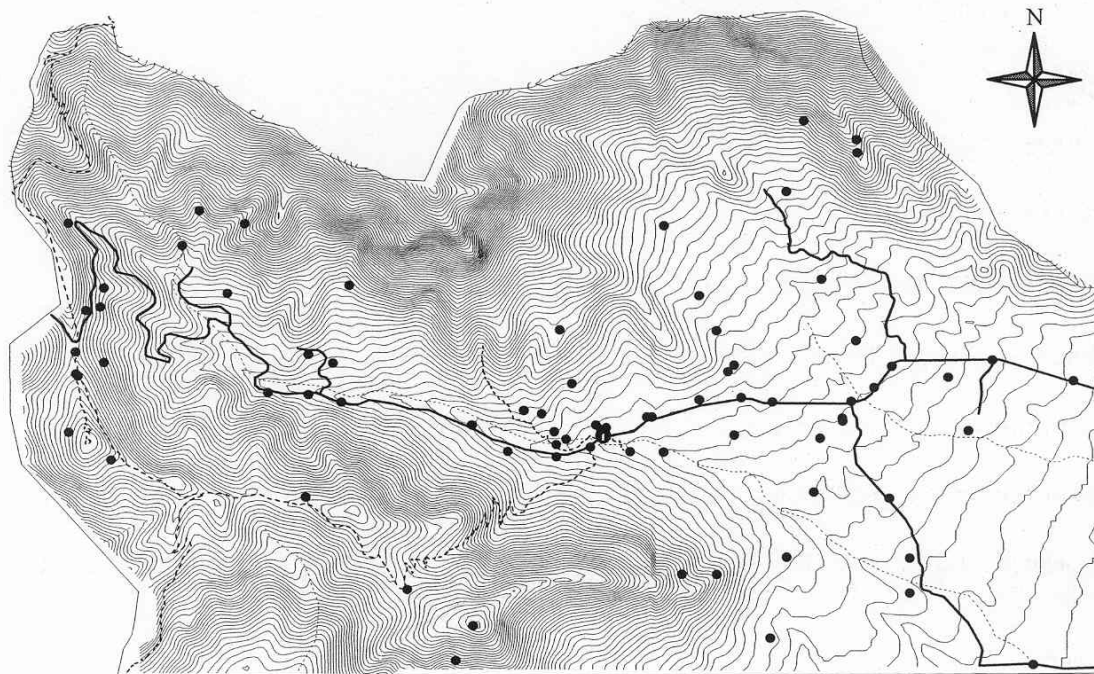
Specimen, this study: Skull collected by DES, 1997 (Coronado National Memorial interpretive collection)

Museum specimens: None

Historic records: Petryszyn and Cockrum (1979) observed individuals of this species throughout the Memorial, stating that "this species prefers higher elevations."

Comments: White-tailed deer are extremely common at Coronado National Memorial, and may be seen during any season in any area of the Memorial. They are by far the most common animal recorded in the sightings database.

White-tailed deer *Odocoileus virginianus*



0 500 1000 1500 2000 Meters

- Animal Location
- i Visitor Center
- Road
- - - Trail
- - - Drainage
- ~ 20 m Contour

**APPENDIX D: ACCOUNTS OF SPECIES OF POTENTIAL OCCURRENCE
AT CORONADO NATIONAL MEMORIAL**

Infraclass Eutheria
Order Insectivora (insectivores)
Family SORICIDAE (shrews)

ARIZONA SHREW

Sorex arizonae

Current status: Not confirmed; probably not present

Habitat: Wet areas, such as spring and streams

Number of observations, this study: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or reported by Petryszyn and Cockrum (1979)

Comments: This species was named by Diersing and Hoffmeister (Hoffmeister 1986), who trapped specimens at high elevations in the Chiricahua, Santa Rita and Huachuca Mountains. The type specimen is from Miller Canyon in the Huachucas, where it was found in a "thicket of horsetail (*Equisetum*) near a spring in dense woodland of oak, walnut, maple, sycamore and some Douglas fir" (Hoffmeister 1986). Arizona shrews have also been found on Fort Huachuca (Hoffmeister 1986). Using Sherman traps, we trapped in wet thickets at the Fern Grotto in the northeast section of the memorial, the tank near Clark-Smith mine, and the "blue waterfall" area north of the residences in an unsuccessful effort to capture this species.

Infraclass Eutheria
Order Lagomorpha (rabbits and kin)
Family LEPORIDAE (rabbits and jackrabbits)

ANTELOPE JACKRABBIT

Lepus alleni

Current status: Not confirmed; probably not present

Habitat: Desert areas

Number of observations, this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or reported by Petryszyn and Cockrum (1979)

Comments: Antelope jackrabbits are primarily desert dwellers, and confined to a small range in south central Arizona. Generally, they are not as associated with grassland as black-tailed jackrabbits, and thus are less likely to occur at Coronado National Memorial. However, specimens have been collected at Fort Huachuca.

Infraclass Eutheria
Order Rodentia (rodents)
Family SCIURIDAE (squirrels)

BLACK-TAILED PRAIRIE DOG

Cynomys ludovicianus

Current status: Not confirmed; probably not present

Habitat: Grasslands

Distribution: None

Number of observations, this study: None

Number of records in Memorial database: None

Abundance: Absent

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Listed as "probably extinct" by Petryszyn and Cockrum (1979)

Comments: Black-tailed prairie dogs were once abundant in the grasslands of southeastern Arizona, including the Sulphur Springs Valley and west to the west side of the Huachucas (Hoffmeister 1986). They were extirpated from the state more than 60 years ago following a concerted effort by ranching interests to eliminate them. However, a colony persisted near Coronado National Memorial as late as 1938, because two animals were collected in that year approximately 9.6 km (6 miles) SE of Fort Huachuca (Hoffmeister 1986).

In Mexico, meanwhile, prairie dogs have survived. In recent years a colony has become established to the south and east of the Memorial, perhaps within 4.8 km (3 miles; Ecological Center of Sonora 1994). It is indeed possible that the species could return naturally to this area in the future. In 2000, an unconfirmed observation of this species in the southeast corner of the Memorial was reported to BNA.

Infraclass Eutheria
Order Rodentia (rodents)
Family SCIURIDAE (squirrels)

ROUND-TAILED GROUND SQUIRREL
Spermophilus tereticaudus

Current status: Not confirmed; probably not present

Habitat: Open desert areas

Distribution: None

Number of observations, this study: None

Number of observations in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or reported by Petryszyn and Cockrum (1979)

Comments: There are few records for this species in Cochise Country, and none that we are aware of from the Huachuca Mountains (Hoffmeister 1986). Hoffmeister extends their range throughout southeastern Arizona, and states that they extend "into Cochise Country along the San Pedro River valley." However, they are principally a desert species. We observed none during this study, and found no anecdotal records for their occurrence at the Memorial.

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

HOUSE MOUSE

Mus musculus

Current status: Not confirmed; probably not present

Habitat: Buildings, dumps, and cultivated fields

Distribution: None observed

Number of individuals trapped during this study: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: House mice are an introduced species from Europe. They may be locally common in cities and in developed areas, and sometimes establish wild populations in Arizona (Hoffmeister 1986). However, they require free water and usually do not persist long outside of the presence of humans. It is possible that house mice occur from time to time in the Memorial, but none were observed during this study.

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

MEXICAN WOODRAT

Neotoma mexicana

Current status: Not confirmed; possibly present

Habitat: High elevation species, inhabits rocky areas

Distribution: None

Number of individuals trapped during this study: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), and not listed as probable

Comments: Mexican woodrats are a potential species for Coronado. They occur in the Huachuca Mountains, but generally at higher elevations and in denser coniferous forests than occur in the Memorial. We trapped at high elevations (near 2424 m (8000 feet)) in the likeliest habitat for this species in the northwest part of the Memorial, but captured only white-throated woodrats.

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

NORTHERN GRASSHOPPER MOUSE

Onychomys leucogaster

Current status: Not confirmed; possibly present

Habitat: Grassland areas with sandy soil.

Distribution: Unknown

Number of individuals trapped during this study: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: University of Illinois (collection number unknown)

Historic records: Not observed or trapped by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: Northern grasshopper mice were not observed during this study or by Petryszyn and Cockrum (1979), but have been captured in Montezuma Canyon (Hoffmeister 1986). This species is similar in appearance to southern grasshopper mouse, but has a tail which is generally shorter than half the length of the body. Despite the large number of trap-nights in grassland areas at the Memorial, we did not capture any individuals of this species.

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

CACTUS MOUSE

Peromyscus eremicus

Current status: Not confirmed; probably not present

Habitat: Desert areas

Distribution: None observed

Number of individuals trapped during this study: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), and not listed as probable

Comments: Cactus mice are primarily desert inhabitants, and are unlikely at Coronado. However, they have been trapped in other areas of the Huachuca Mountains, including on Fort Huachuca (Hoffmeister 1986), and DES and AJK have trapped this species in semi-desert grassland areas of the Santa Rita Mountains.

Infraclass Eutheria
Order Rodentia (rodents)
Family MURIDAE (rats and mice)

PLAINS HARVEST MOUSE

Reithrodontomys montanus

Current status: Not confirmed; probably not present

Habitat: Grasslands

Distribution: None observed

Number of individuals trapped during this study: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), who listed the species as "not observed but probably present"

Comments: Plains harvest mice are very difficult to distinguish from western harvest mice; see comments under that species. Although we made an effort to distinguish these species in the field, we observed none during our study that appeared to be plains harvest mouse. Probably the only way to know with certainty would be to collect a series of specimens. If this species occurs at Coronado it would probably be in the thick grassland in the southeast area of the Memorial.

Infraclass Eutheria
Order Rodentia (rodents)
Family ERITHIZONTIDAE (porcupines)

COMMON PORCUPINE

Erithizon dorsatum

Current status: Unknown

Habitat: Usually woodlands, but sometimes in grassland and desert areas

Distribution: None observed

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed or collected by Petryszyn and Cockrum (1979), who listed it as "not observed but probably present"

Comments: We are not aware of any records of porcupine at Coronado National Memorial, although they may occur in the Memorial from time to time. One record on a wildlife sightings card is from the junction of Arizona Routes 83 and 92 in 1975. The nearest known specimen is from the west gate of Fort Huachuca (Hoffmeister 1986).

Infraclass Eutheria
Order Carnivora (carnivores)
Family CANIDAE (dogs and foxes)

GRAY WOLF

Canis lupus

Current status: Not present; present historically

Habitat: Generalist

Distribution: Not present

Approximate number of observations, this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Listed by Petryszyn and Cockrum (1979) as "probably extinct in the area." One known sighting exists for the Memorial; see below.

Comments: In a report on Coue's deer at Coronado National Memorial, Welles (1959) states that "one wolf was seen in late 1958. Apparently he was in the area for only a day or two and then slipped back down south." Historically, wolves ranged throughout southern Arizona and were probably resident in the Huachuclas. Specimens from near the Memorial includes several from Ft. Huachuca and Parker Canyon Ranch (Hoffmeister 1986). Gray wolves were actively removed by predator control programs, and were probably extinct in southern Arizona by the 1960's. In 1907, 75 were killed in national forests in the Chiricahuas, Santa Ritas, Santa Catalinas, and Dragoons alone (Hoffmeister 1986). An effort by the U.S. Fish and Wildlife Service to reintroduce wolves into east central Arizona began in late 1997.

Infraclass Eutheria
Order Carnivora (carnivores)
Family CANIDAE (dogs and foxes)

KIT FOX

Vulpes macrotis

Current status: Not confirmed; probably not present

Habitat: Desert areas

Distribution: None observed

Approximate number of observations, this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: 1 (see below)

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed, but listed as present by Petryszyn and Cockrum (1979), who stated that the species "is seen periodically by residents of the area. Although essentially a desert dweller, it may occur at times in the Memorial."

Comments: Kit foxes potentially occur at Coronado, but are generally found at lower elevations. As a popular species that is easy to confuse with common gray foxes and young coyotes, the kit fox is often misidentified by non-biologists. There is one sighting record from the Memorial, by a ranger in the residence area in 1986. No description is provided, and we doubt the authenticity of the report. The nearest specimen we are aware of was collected at Fort Huachuca (UA #5312) in 1955. A voucher specimen or photograph would be necessary to confirm this species at Coronado.

Infraclass Eutheria
Order Carnivora (carnivores)
Family URSIDAE (bears)

GRIZZLY BEAR

Ursus arctos

Current status: Not present; possibly present historically

Habitat: All possible

Distribution: Not present

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: Not present

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Not observed by Petryszyn and Cockrum (1979); they noted that grizzly bears probably once ranged across the Memorial, but had been extinct throughout the region for many years.

Comments: Grizzly bears once roamed throughout eastern and northern Arizona, but were exterminated early in this century. The last known grizzly killed in the state was in Greenlee County in 1935 (Hoffmeister 1986). In the Coronado area, one historic record is from the Santa Cruz River bottom just north of Nogales (Hoffmeister 1986).

Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE

JAGUARUNDI

Herpailurus yagouaroundi

Current status: Not confirmed; probably not present

Habitat: Generalist

Distribution: None observed

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Petryszyn and Cockrum (1979) commented that jaguarundi "may have occasionally roamed over the area...but appear to be at least locally extinct."

Comments: Jaguarundis are small, lean cats that bear a slight resemblance to house cats. It is unlikely that they occur in the Memorial. Although there have been many reported sightings, jaguarundis have never been confirmed by photograph or specimen in Arizona or Sonora, Mexico (Girmendonk 1994). Whether they occurred historically in Arizona is not known, but there is no strong evidence that they did (Hoffmeister 1986). The numerous sight records of jaguarundis from Cochise County may represent misidentified animals, escaped or released pets, legitimate sightings of native animals, or some combination of these. Jaguarundis were present in extreme southern Texas at least until recently, and are listed as a federally endangered species. The last confirmed record in the United States was in 1986 (M.E. Tewes, pers. comm.).

Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE

OCELOT

Leopardus pardalis

Current status: Not confirmed; probably occasional

Habitat: Shrubby areas

Distribution: None observed

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Listed as a species that "may have occasionally roamed over the area now occupied by the Memorial but appear to be at least locally extinct" by Petryszyn and Cockrum (1979). Historic records exist (see below).

Comments: Ocelots occurred in southern Arizona in the past, and may still enter the Coronado area from time to time. Czarmony (1995) contains a photograph of an ocelot killed just west of the Memorial in 1964. This individual was taken during a mountain lion hunt guided by Sewell Goodwin. BNA interviewed a hunter who claimed that he had treed a cat that fits the description of an ocelot in the western part of the Memorial during the 1980s. Ocelots are occasionally trapped in southern Arizona (J. Phelps, AGFD, pers. comm.), but the only area of the country where a population is known to occur is in extreme southern Texas, where 50-100 animals persist (M. E. Tewes, pers. comm.).

Infraclass Eutheria
Order Carnivora (carnivores)
Family FELIDAE

JAGUAR

Panthera onca

Current status: Not confirmed; probably occasional

Habitat: Generalist

Distribution: None observed

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Listed as a species that "may have occasionally roamed over the area now occupied by the Memorial but appear to be at least locally extinct" by Petryszyn and Cockrum (1979). One sight record from Coronado National Memorial; see below.

Comments: Jaguars were probably at least temporary residents of southern Arizona in the past, and continue to range into the area at present; two individuals have been photographed in southeastern Arizona since 1996. There is a 1991 sight record of a jaguar from the Memorial that is a Class III sighting ("not considered reliable"; Girmendonk 1994). However, there are a number of both confirmed and reliable sightings from the Nogales area and the Huachuca (Girmendonk 1994). We suspect that jaguars do occur in the Memorial from time to time. We attempted to document this species, as well as ocelot and jaguarundi, using Trailmaster cameras and a variety of visual and scent lures, but were unsuccessful (Swann et al. 1998).

Infraclass Eutheria
Order Artiodactyla (even-toed ungulates)
Family ANTILOCAPRIDAE (Pronghorns)

PRONGHORN

Antilocapra americana

Current status: Not present; may have been present historically

Habitat: Generalist in open areas

Distribution: Not present

Number of observations during this study: None

Number of infrared-triggered photographs: None

Number of records in Memorial database: None

Abundance: None observed

Voucher photo: None

Specimen, this study: None

Museum specimens: None

Historic records: Listed by Petryszyn and Cockrum (1979) as “probably extinct in area”

Comments: Pronghorn were once present in the large river valleys of southeastern Arizona, but were probably never common. Hoffmeister (1986) reports a 1894 account of “12 or fewer pronghorns at the base of the Huachuca Mountains,” which suggests that the species was present in what is now Coronado National Memorial at one time. All pronghorns occurring now in southeastern Arizona are probably the result of reintroductions by the Arizona Game and Fish Department (Hoffmeister 1986).

