

# OCCASIONAL PAPERS

## THE MUSEUM

### TEXAS TECH UNIVERSITY

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NUMBER 104

22 SEPTEMBER 1986

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#### POST-PLEISTOCENE MAMMALS OF THE APACHE MOUNTAINS, CULBERSON COUNTY, TEXAS, WITH COMMENTS ON ZOOGEOGRAPHY OF THE TRANS-PECOS FRONT RANGE

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In 1979, Mr. J. M. Fowlkes of Pecos, Texas, showed us a sinkhole-type cave (since named Fowlkes Cave) on his ranch in the Apache Mountains north of the small town of Kent, Texas. Subsequent excavation in the cave yielded a large collection of vertebrate remains from the stratified cave deposits of the lowest chamber, dating from late Pleistocene to modern times. The deeper, yellow calcareous sediments contained remains of some extinct mammals, fossils of extant mammalian species that no longer occur in Texas, as well as species that still occur in the vicinity of the Apache Mountains. The black silts above the yellow calcareous sediments contained abundant remains of the modern mammalian fauna of the region. In order to interpret the chronological succession of mammalian species from Fowlkes Cave, it was necessary to make a comprehensive survey of the modern fauna of the Apache Mountains, because the living mammals of the area had not been studied in detail.

Bailey's (1905) faunal survey of Texas included the Apache Mountains area, but concentrated on the Guadalupe Mountains to the northwest, and the Davis Mountains to the southeast. Later workers likewise collected more intensively in the Davis and Guadalupe mountains (for example, Blair, 1940; Cornely *et al.*, 1979; and Genoways *et al.*, 1979), although Davis and Robertson (1944) did trap mammals for one week just north of Kent (at the

southeastern edge of the Apache Mountains), and Schmidly (1977) reported several species from the area. The higher Guadalupe and Davis mountains possess a varied fauna, including species of montane vertebrates, and seem to have been more attractive to mammal collectors than were the arid, lower, and comparatively barren Delaware and Apache mountains that span the area between the two higher ranges (see Fig. 1).

The Guadalupe-Delaware-Apache-Davis chain of mountains collectively forms the northern part of the Front Range, which extends from the Rocky Mountains of southern New Mexico into Mexico. A more thorough knowledge of the fauna of the Delaware and Apache mountains is critical to the understanding of the distribution of mammals in this chain. The Delawares and Apaches form a bridge between the two higher ranges, and in the late Pleistocene permitted some montane species to reach the Davis Mountains from the north, where they now are isolated by desert. Fossils of such taxa as the wandering shrew, water shrew, chipmunk, marmot, and voles found in Fowlkes Cave show that the nearby land supported a montane fauna along the border of cold-water periglacial streams, draining from the highlands to the north. Glaciers are known to have existed less than 180 kilometers north of the Apache Mountains (Antevs, 1955). This fauna must have reached the Apaches from the Delaware Mountains, and from Fowlkes Cave it still is less than 30 kilometers to pinyon-timbered foothills of the Davis Mountains.

Our survey was designed to sample the small mammals of the Apache mountains and surrounding area, with special efforts to discover if any montane species might yet survive there. We have, for convenience, limited our study area to the roughly triangular region north of Interstate Highway 10 between Kent and Van Horn, bounded by Farm-Market Road 2424 on the northeast and Farm-Market Road 2185 on the northwest, to the point where these Farm-Market roads intersect. Some of the peaks and short ranges within these boundaries are named, but all are collectively termed here as the Apache Mountains (this name sometimes is restricted to the higher parts of the range northeast of Van Horn).

The Apaches scarcely deserve the name "mountains," for they are mostly rugged, barren limestone hills between 4500 and 5000 feet in elevation. The hills stand out prominently from the lowlands of the Culberson Plateau to the east and the Salt Basin to the west. The mountains are uplifted and eroded limestones of Permian age with limited areas of sandstone, siltstone, and shale.

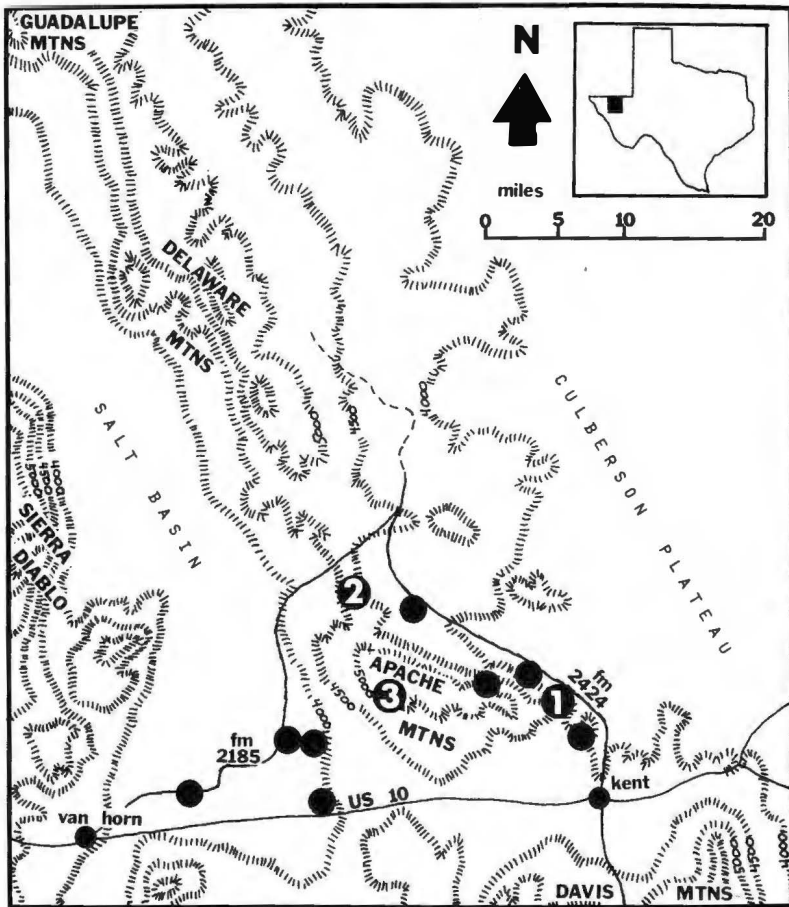


FIG. 1.—Map of the Apache Mountains in Culberson County, Texas, and surrounding topographic features. Circles indicate areas of collecting localities. Numbered circles (1, Fowlkes Ranch; 2, Snyder Ranch; 3, Apache Ranch) denote areas of major collecting efforts.

In most of the area, soils are shallow, and extensive areas of bare limestone are exposed. Along the northeastern and northwestern flanks of the Apaches, the soils are mostly yellowish, calcareous, sandy silts, but to the southwest, north of Interstate 10, there are extensive areas of blown sand and low dunes.

The entire study area is included within the Chihuahuan Desert. Precipitation averages 12 to 14 inches annually. Mean annual temperatures range from 62 to 64 degrees Fahrenheit. No permanent water source exists in the area, and stock tanks that

provide water for livestock and wildlife are few and widely scattered. The land is privately owned and ranches are large, including hundreds of sections. No public roads extend into the mountains, and few private roads extend beyond the fringe of the area.

Collecting in the Apache Mountains area mostly was done by field parties from Midwestern State University, beginning in the spring of 1979, although a few specimens date back to as early as 1961. Restrictions on firearms imposed by landowners limited the means of collecting to small-animal traps and bat nets. Field work was concentrated at the southeast corner of the area on the Fowlkes Ranch. Smaller collections were made at the northern apex on the Snyder Ranch, the east-central parts of the area on the Apache Ranch, and the western corner near Van Horn. Scattered collections were made elsewhere. A total of 563 mammals, most prepared as conventional skins with skulls, is on deposit in the collections of Midwestern State University and The Museum, Texas Tech University.

#### PLANT ASSOCIATIONS

Vegetation of the Apache Mountains area is typical of scrub associations found elsewhere in the Chihuahuan Desert, where succulents and drought-resistant plants predominate. Three major associations occur in the mountains—creosote, mesquite-catclaw, and juniper-sotol (see Table 1). Each has its characteristic mammals, in addition to more generalized species that may occur in more than one association. Additionally, a fairly extensive area of sandy soils and low dunes, dominated by mesquite and yucca, occurs from the southwestern area near Van Horn to the western flanks of the Apaches.

*Cresote association.*—Creosote (*Larrea tridentata*) is the dominant plant of the desert flats, slopes, valley floors, and alluvial fans surrounding the Apache Mountains, where adequate soils exist. This association ends abruptly at slopes and hills where soils become thin. Scattered stands of grasses, cacti, and mesquite (*Prosopis glandulosa*) occur throughout the association. Typical mammals are *Dipodomys merriami*, *D. spectabilis*, *Onychomys torridus*, *Neotoma micropus*, *Peromyscus maniculatus*, and *Lepus californicus*. In less well-drained sites, tarbush (*Flourensia cernua*) replaces creosote. In such areas, especially with somewhat sandy soils, *Peromyscus leucopus* occurs.

TABLE 1.—Major plant associations in the Apache Mountains, Texas.

Dominant	Scattered
Creosote association	
<i>Prosopis glandulosa</i> (mesquite)	<i>Aristida glauca</i> (three-awn)
<i>Larrea tridentata</i> (creosote)	<i>Berberis trifoliolata</i> (algerita)
<i>Xanthocephalum sarothrae</i> (broomweed)	<i>Opuntia leptocaulis</i> (tasajillo)
<i>Flourensia cernua</i> (tarbush)	<i>Opuntia violacea</i> (purple prickly pear)
<i>Koeberlinia spinosa</i> (allthorn)	<i>Opuntia lindheimeri</i> (Texas prickly pear)
<i>Leucophyllum</i> sp.	<i>Erioneuron pulchellum</i> (fluffgrass)
	<i>Croton dioicus</i>
Mesquite-catclaw association	
<i>Prosopis glandulosa</i>	<i>Verbina</i> sp.
<i>Acacia greggi</i> (catclaw)	<i>Nama</i> sp.
<i>Larrea tridentata</i>	<i>Linum lewisi</i> (blue flax)
<i>Flourensia cernua</i>	<i>Argemone</i> sp. (prickly poppy)
<i>Koeberlinia spinosa</i>	<i>Psilostrophe gnaphthalodes</i>
<i>Berberis trifoliolata</i>	(paperflower)
<i>Viguiera stenoloba</i>	<i>Opuntia imbricata</i> (tree cholla)
	<i>Zinnia acerosa</i>
	<i>Yucca elata</i>
	<i>Bernardia obovata</i>
	<i>Ziziphus obtusifolia</i> (lotebush)
	<i>Condalia ericoides</i> (javelina bush)
	<i>Rhus microphylla</i> (desert sumac)
	<i>Rhus virens</i> (evergreen sumac)
	<i>Forestiera augustifolia</i> (desert olive)
	<i>Parthenium incanum</i> (mariola)
	<i>Senecio douglasii</i> var. <i>jamesii</i>
	(groundsel)
Juniper-sotol association	
<i>Juniperus monosperma</i> (one-seeded juniper)	<i>Yucca torreyi</i> (Torrey's yucca)
<i>Dasylirion leiophyllum</i> (sotol)	<i>Mammillaria grahamii</i> (fishhook cactus)
<i>Agave lecheguilla</i> (lecheguilla)	<i>Dalea formosa</i> (feather dalea)
	<i>Viguiera dentata</i>
	<i>Ephedra</i> sp. (Mormon tea)
	<i>Echinocereus triglochidiatus</i>
	<i>Coldenia</i> sp.
	<i>Erioneuron pulchellum</i>
	<i>Zinnia acerosa</i>
	<i>Nerisyrenia camporum</i>
	<i>Selaginella wrightii</i>
	<i>Selaginella lepidophylla</i>
	(resurrection plant)
	<i>Hymenoxys scaposa</i> (bitterweed)
	<i>Castilleja</i> sp.
	<i>Fouquieria splendens</i> (ocotillo)
	<i>Encelia scaposa</i>
	<i>Bothriochloa saccharoides</i>
	(silver beardgrass)
	<i>Mimosa biuncifera</i> (catclaw mimosa)
	<i>Acacia greggi</i> (catclaw)

*Mesquite-catclaw association.*—Along gulleys and dry washes, brushy growth is supported, in addition to heavier stands of grasses. Mesquite and catclaw (*Acacia greggi*) most often dominate this association, although many other plants occur there. The relatively dense cover afforded by such growth supports a number of mammals, particularly those more typical of grassland habitats, including *Reithrodontomys megalotis*, *Peromyscus leucopus*, and *Sigmodon hispidus*. Where soils are friable, *Perognathus hispidus* may occur.

*Juniper-sotol association.*—Juniper (*Juniperus monosperma*) and sotol (*Dasylyrion leiophyllum*) dominate the vegetation of the mountaintops, higher hillsides, and crests of lower hills. However, junipers are scarce to absent in the western and central parts of the Apache Mountains. Where soils are exceedingly shallow, or where bedrock is exposed, lecheguilla (*Agave lecheguilla*) is abundant. *Neotoma albigula* is found throughout this habitat. On the Fowlkes Ranch, where junipers were most common, *Peromyscus pectoralis* is found above 4500 feet in elevation. Below this altitude, and especially in rocky situations, *P. eremicus* occurs. Elsewhere in this association, where junipers are scarce or absent, as occurs throughout areas collected elsewhere on the Apache and Snyder ranches, *P. eremicus* is the common *Peromyscus* and *P. pectoralis* is rarely taken.

#### FOWLKES CAVE

Fowlkes Cave is of the sinkhole type, situated on a steep, rather barren limestone hillside in the juniper-sotol association on the Fowlkes Ranch. For a detailed description of the cave and its Pleistocene fauna, see Dalquest and Stangl (1984a). The surficial silts are soft, black in color, and rich in organic materials. Vertebrate bones are numerous. Bones of bats, ringtails, and some woodrats are probably from individuals that died in the cave. Other remains of Recent origin, and virtually all of the Pleistocene fossils, were brought to the cave by barn owls (Dalquest and Stangl, 1984a). The cave did not serve as a trap for larger species, partly because a ledge near the top of the entrance may have saved some animals from falling into the sinkhole, but principally because the steep, barren slope where the entrance is located is not a place where large mammals would travel, and the cave entrance can be readily detected.

The collection of Recent bones from the cave is biased in that species larger than those a barn owl can overcome and transport

are scarcely represented. The maximum size of a mammal that can be overcome and devoured by a barn owl is speculative, but most remains of cottontail rabbits and the larger woodrat species (*Neotoma micropus*) in the collection are of immature animals, and we presume that barn owls rarely take adults of these species. The few larger species in the collection, such as the ringtail and human, were capable of climbing into the cave for their own purposes. The owls also may prey selectively on preferred species. It is also probable that the cave collection is biased in that remains must have come from within the hunting range of barn owls, a maximum of approximately 10 miles.

The black cave silts, containing the Recent mammalian fauna, vary from two to four feet in depth in the area where we collected. The sediments are soft and bones, especially those of larger size, clearly have sunk through the silts and come to rest on firmer levels, whereas small bones, such as the ribs of mice and snakes, have remained at the level where they originally came to rest. Large pieces of silt, chunks of limestone, and fallen fragments of stalactites made systematic excavation of the black silts unreliable. We consider the materials mixed and unstratified. However, specimens from the surface of the deposit are obviously of late origin and are so labeled. A partly articulated ringtail skeleton, one mummified body and several partly articulated skeletons of *Myotis velifer*, the mummified body of a barn owl, and remains of *Neotoma albigula* were found on the surface. Each of these species is capable of flying or climbing into and out of the cave.

A sample of approximately 500 pounds of the black silts was taken from the cave to the laboratory where it was dried and screen-washed. The concentrate was sorted and identifiable remains, mostly teeth, jaws, and skulls, were preserved. For methods of identification of the materials, see Dalquest and Stangl (1983, 1984a, 1984b).

#### COLLECTING LOCALITIES

Collecting was carried out at several different sites (in addition to Fowlkes Cave), which fall into four main localities as follows:

*Fowlkes Ranch.*—The Fowlkes Ranch is at the southeastern corner of the Apache Mountains triangle. Mr. J. M. Fowlkes has permitted field parties to collect on his property for several years, and the bulk of the specimens reported here come from land under his ownership. All major plant associations are present and

were investigated. Most collecting was done in early spring, when the weather was cool. Perhaps for that reason, bats and sciurids are not well represented in our material.

*Snyder Ranch.*—The Snyder Ranch is located at the northern corner of the Apache Mountains triangle. Mary and George Snyder were most helpful in assisting our work here. Most collecting was accomplished in the juniper-sotol association, especially along cliffs, in talus, on steep hillsides, and along the fringes of washes.

*Apache Ranch.*—Mr. Fred Armstrong of Pecos, Texas, permitted us access to the extensive holdings of the Apache Ranch, which includes the highest and most rugged parts of the Apache Mountains. Collections were made 17 mi. NE Van Horn and 23 mi. ENE Van Horn, near tanks that hold virtually the only open water in the region. Traps were set principally on rocky hillsides at elevations from 3500 to more than 4500 feet, but deeper-soiled canyon bottoms dominated by creosote and tarbush were also sampled. Hillsides were dominated by lecheguilla, sotol, and scattered ocotillo and algerita bushes (*Berberis trifoliolata*).

*West of Kent, east of, and six miles northeast of, Van Horn.*—We trapped along roadsides in the extensive sandy soil and sand dunes that flank the Apache Mountains to the south and southwest. Vegetation consisted of large mesquite, yucca, and sparse grasses and annuals. The mammal population here was low in diversity but rich in numbers.

#### ACCOUNTS OF SPECIES

In the accounts that follow, reference to subspecies follows Schmidly (1977) or Hall (1981) unless otherwise noted. Arrangement of species and use of scientific and vernacular names of species follows Jones *et al.* (1982). We have included accounts only for those mammals of which remains were identified in the Recent silts of Fowlkes Cave or that occur today in the Apache Mountains as here defined. Our principal concerns are with the dynamics of the mammalian fauna, as defined by the present distribution and relative abundance of species in comparison with species identified in the early Recent deposits of Fowlkes Cave. Secondary concerns are ecological distribution and taxonomic status. The lists of specimens examined include first the material from Fowlkes Cave, followed by specimens collected by us from the Apache Mountains area.



*Notiosorex crawfordi crawfordi* (Coues)

## Desert Shrew

The desert shrew is seldom taken by ordinary trapping methods, and we caught none in the Apache Mountains. One was taken under an overturned rock in Jeff Davis County, about 4 mi. S Kent, in mesquite-catclaw association. We overturned many rocks and dead sotol heads and trunks near Fowlkes Cave. A single shrew was routed from under a pile of rocks near the base of a mesquite thicket in the creosote flats 6 mi. NW Kent, but it escaped. Nevertheless, this species probably is comparatively common, and has been since the Pleistocene. Barn owls are known to feed on the desert shrew.

*Specimens examined.*—*Fowlkes Cave*: 22 lower jaws.

*Mormoops megalophylla megalophylla* Peters

## Ghost-faced Bat

One specimen of a ghost-faced bat was taken in a net set across a cattle tank. Mollhagen (1973) recorded this bat from 9 mi. W Valentine, or about 30 mi. SSW of our collection site.

*Specimens examined.*—*Apache Mountains*: 6 mi. N Kent, 1.

*Myotis velifer incautus* (J. A. Allen)

## Cave Myotis

We did not find the cave myotis living in Fowlkes Cave, but the surface of the floor in a side room of the cave was littered with bones, and one mummified bat was found. All of these remains are clearly of late origin. This species is abundant over most of the Trans-Pecos, and we were surprised that none was taken in our nets.

Lower jaws of *Myotis velifer* from the surficial silts of Fowlkes Cave were compared with topotypes of *M. v. incautus* from San Antonio in Bexar County, Texas, and found to be similar in size and structure of teeth. Specimens from Presidio County, 50 miles south of the Apache Mountains, are indistinguishable from Recent bat remains from Fowlkes Cave. However, 27 lower jaws found in the yellow Pleistocene deposits of the cave averaged larger in mandibular size and size of teeth than did those found in the surface silts, and are seemingly referable to the race *M. v. magnimolaris* Choate and Hall (Dalquest and Stangl, 1984b).

*Specimens examined.*—*Fowlkes Cave*: 1 mummy, 33 lower jaws.

*Myotis californicus californicus* (Audubon and Bachman)

## California Myotis

We took single specimens of the California myotis from three separate locales where we set bat nets on warm nights. Crevices in the widely exposed limestone doubtless furnish hiding places for this species, and we suspect that it is abundant during warmer times of the year. The California myotis rarely enters caves, and was not found in Fowlkes Cave. Schmidly (1977) notes that this bat is one of the few known to hibernate in Trans-Pecos Texas. Our earliest date of capture is 14 March.

Our specimens vary from pale reddish-orange above to russet brown, and similar variation is seen in a large series from Presidio County.

*Specimens examined.*—*Apache Mountains*: 6 mi. N Kent, 1; 17 mi. NE Van Horn, 1; 23 mi. ENE Van Horn, 1.

*Pipistrellus hesperus maximus* Hatfield

## Western Pipistrelle

No remains of the western pipistrelle were found in the black silts of Fowlkes Cave. This is not surprising because this small bat rarely enters caves. Pipistrelles appear to hibernate in Trans-Pecos Texas, for we have seen them in Presidio County in late November, hunting in numbers on warm nights. Our earliest record for the Apache Mountains is 14 March, when 10 were taken in a net set across a water tank at 4000 feet in elevation on the Apache Ranch. The following night, at a water tank 3500 feet in elevation, 25 were taken and released. Blair (1940) considered *Pipistrellus hesperus* to be the most commonly encountered bat in the Davis Mountains, and it is certainly the most evident species in the Apache Mountains, if only because it emerges from its daytime retreats so early in the evening.

*Specimens examined.*—*Apache Mountains*: 6 mi. N Kent, 4; 17 mi. NE Van Horn, 5; 23 mi. ENE Van Horn, 7.

*Eptesicus fuscus pallidus* Young

## Big Brown Bat

Occurrence of the big brown bat is widespread in Trans-Pecos Texas, from the hottest deserts to mountain meadows. We took none in our nets, but feel confident that it is present in the Apache Mountains.

*Specimens examined.*—*Fowlkes Cave*: 1 lower jaw.

*Lasiurus cinereus cinereus* (Beauvois)

## Hoary Bat

One hoary bat was taken in a net set over a cattle tank on 11 April 1982, in typical mesquite-catclaw association on the desert. More usual habitat for this species is evergreen forests and higher elevations. The hoary bat usually roosts in trees. Our specimen may have been migrating.

*Specimens examined.*—*Apache Mountains*: 6 mi. N Kent, 1.

*Antrozous pallidus pallidus* (Le Conte)

## Pallid Bat

The pallid bat is a typical desert dweller that often roosts in caves. Two specimens were netted over a cattle tank. A third specimen, a mummified body, was found in a building in Kent, and the owner stated that a sizable population occupied the site in the summer months.

*Specimens examined.*—*Fowlkes Cave*: 3 lower jaws. *Apache Mountains*: Kent, 1; 6 mi. N Kent, 2.

*Tadarida brasiliensis mexicana* (Saussure)

## Brazilian Free-tailed Bat

The absence of the free-tailed bat in both the Pleistocene (Dalquest and Stangl, 1984a) and early Recent sediments of Fowlkes Cave is surprising. This bat is a cave dweller and Fowlkes Cave would seem to be ideal habitat for the species. The only specimens taken were netted over cattle tanks north of Kent. Davis and Robertson (1944) also took specimens just north of Kent.

*Specimens examined.*—*Apache Mountains*: 6 mi. N Kent, 2; 8 mi. N Kent, 1.

*Homo sapiens* Linnaeus

## Man

Several fragmentary bones, all apparently belonging to a single large individual, reveal the presence of early man in Fowlkes Cave. Whether the man climbed, fell, or was thrown into the cave is speculative. We found no evidence that man lived in the cave and no artifacts were recovered. The bones were scattered and lay approximately two feet beneath the surface. Preservation is poor.

*Specimens examined.*—*Fowlkes Cave*: patella, upper M2, thoracic vertebra, proximal and distal ends of femur, phalanges, assorted flat bone fragments.

*Sylvilagus audubonii neomexicanus* Nelson

## Desert Cottontail

Specimens from Fowlkes Cave were referred to *Sylvilagus audubonii* on the basis of size of teeth and jaws, and geographic probability. *S. floridanus* occurs in the Davis and Guadalupe mountains, but only in montane habitat, which has not occurred near Fowlkes Cave since the Pleistocene. None of the usually diagnostic auditory bullae were found in the cave silts. Desert cottontails are common throughout the Apache Mountains, and were often flushed from cover when we set traps. Davis and Robertson (1944) and Schmidly (1977) reported this species from north of Kent.

*Specimens examined.*—*Fowlkes Cave*: 5 palates, 4 lower jaws. *Apache Mountains*: 17 mi. NE Van Horn, 1.

*Lepus californicus texanus* Waterhouse

## Black-tailed Jackrabbit

Jackrabbits were common, but not abundant, throughout the Apache Mountains. Numbers were greater on level or gently sloping ground of the creosote and mesquite-catclaw associations, although droppings were noted at higher elevations, in the juniper-sotol association. Remains of at least three individuals were found in the cave silts. In contrast, remains of a single jackrabbit, only tentatively referred to *Lepus californicus*, were recovered from the 500-pound, bone-rich sample of Pleistocene deposits. This suggests that the jackrabbit may have been absent from the Fowlkes Cave area in the late Pleistocene.

*Specimens examined.*—*Fowlkes Cave*: 3 palates, 2 humeri.

*Ammospermophilus interpres* (Merriam)

## Texas Antelope Squirrel

The antelope squirrel inhabits areas of exposed rock and talus in arid desert. Conditions near Fowlkes Cave and elsewhere in the Apache Mountains area would seem to be ideal habitat for this species but our only records are the sighting of one animal northeast of Kent (east of Farm-Market Road 2424, just outside our area of study), and another on the Apache Ranch, about 15 mi. NE Van Horn. The absence of this diurnal species from Fowlkes Cave is not surprising, for it rarely would be taken by barn owls.

*Spermophilus spilosoma marginatus* Bailey

## Spotted Ground Squirrel

We found the spotted ground squirrel to be uncommon, perhaps because most collecting was carried out in early spring and mostly on soil that was not sandy. However, a specimen from the Snyder Ranch was trapped on a grassy slope at relatively high elevation, where the soil was hard and stony. Davis and Robertson (1944) took four specimens 16 mi. E Van Horn. We did not find the species on the Fowlkes Ranch.

*Specimens examined.*—Apache Mountains: 25 mi. NE Van Horn, 1.

*Spermophilus variegatus grammurus* (Say)

## Rock Squirrel

A single tooth attests to the presence of the rock squirrel at Fowlkes Cave in early Recent times. Davis and Robertson (1944) found the rock squirrel 2 mi. N Kent, but we saw no specimens there. A single animal was sighted on the Apache Ranch, about 15 mi. NE Van Horn.

*Specimens examined.*—Fowlkes Cave: 1 upper M1.

*Cynomys ludovicianus arizonensis* Mearns

## Black-tailed Prairie Dog

To the best of our knowledge, prairie dogs no longer exist in the Apache Mountains area. Davis and Robertson (1944) listed records from near Kent, but these prairie dog towns appear to have been eradicated within the past 20 years. No remains were obtained from the cave silts. The prairie dog is diurnal, too large for a barn owl to overcome, and would not live near the steep hillsides where the cave is located.

*Specimens examined.*—Fowlkes Cave: 1 upper M1.

*Thomomys bottae scotophilus* Davis

## Botta's Pocket Gopher

In the Pleistocene deposits of Fowlkes Cave, *Thomomys* is abundantly represented, whereas the larger *Cratogeomys* is rare. In the Recent silts, remains of the two genera occur in approximately equal numbers. In the modern fauna, *Cratogeomys* is common and *Thomomys* is rare.

Other workers (Davis, 1974; Williams and Baker, 1976) found that in zones of sympatry, *Cratogeomys* seemed to occupy the

deeper soils and *Thomomys* was restricted to the thinner soils and higher elevations. Although we are sure this is generally true, on the Fowlkes Ranch we took one *Thomomys* in deep soils at low elevation beside Farm-Market Road 2424 (a *Cratogeomys* was taken 50 yards away). On the other hand, most traps set for *Thomomys* in supposedly ideal habitat, thin soils among lecheguilla thickets at higher elevations, usually took *Cratogeomys*.

Schmidly (1977) listed nine subspecies of *Thomomys bottae* from Trans-Pecos Texas. The type localities of two of these, *T. b. scotophilus* and *T. b. guadalupensis* Goldman, are relatively near the Apache Mountains. Our specimens from the Apaches are relatively dark in color but we consider three individuals to represent insufficient material to refer the Apache Mountains population to a subspecies. *T. b. scotophilus* comes from the Sierra Diablo Range, which is adjacent to the Apache Mountains to the west and where ecological conditions are similar. The specimen from the Snyder Ranch comes from only 45 km. ENE Bat Cave, the type locality of *T. b. scotophilus*. Record stations for *T. b. guadalupensis* lie farther away, to the north, and the type locality is in montane habitat. We refer our specimens to *T. b. scotophilus* on geographic and ecological grounds.

*Specimens examined.*—*Fowlkes Cave*: 2 skulls, 3 lower jaws. *Apache Mountains*: 6 mi. N Kent, 2; 25 mi. NE Van Horn, 1.

### *Cratogeomys castanops perplanus* Nelson and Goldman

#### Yellow-faced Pocket Gopher

The big yellow-faced pocket gopher is abundant throughout the Apache Mountains area wherever the soil is deep enough to support the animals. Almost all pocket gopher mounds seen may be expected to belong to this species, except at higher elevations where *Thomomys* may occur.

*Specimens examined.*—*Fowlkes Cave*: 2 skulls, 4 palates. *Apache Mountains*: 6 mi. N Kent, 2; 1.5 mi. N Kent, 1; 21 mi. NNE Van Horn, 1; 25 mi. NE Van Horn, 1; 28 mi. NNW Kent, 1; 23 mi. ENE Van Horn, 1.

### *Perognathus flavus silvus* Osgood

#### Silky Pocket Mouse

Remains of the silky pocket mouse are the most common bones found in the Recent silts of Fowlkes Cave. This probably results from both local abundance of individuals and proficiency in capturing them or preferences as prey of the barn owls that

transported their remains to the cave. Fossils of this species are equally numerous in the late Pleistocene sediments.

Specimens were taken on rocky hillsides, creosote flats, and sandy dunes. We found it moderately common but not, during our visits to the area, usually abundant. Specimens were not easily taken with snap traps but readily entered Sherman live traps.

*Specimens examined.*—*Fowlkes Cave*: 478 lower jaws. *Apache Mountains*: 6 mi. N Kent, 8; 9 mi. N Kent, 3; 22.6 km. W Kent, 1; 25 mi. NE Van Horn, 1; 28 mi. NNW Kent, 2; 5 mi. N Kent, 1; 17 mi. NE Van Horn, 1; 23 mi. ENE Van Horn, 1.

### *Perognathus hispidus paradoxus* Merriam

#### Hispid Pocket Mouse

Schmidly (1977) considered *Perognathus hispidus* to be one of the rarest of pocket mice in Trans-Pecos Texas. However, it must have been common in Culberson County in the early Recent, for its remains were abundant in the black silts of Fowlkes Cave. This is a grassland species; perhaps reduction of its grassland habitat in the last century due to grazing of livestock all but eliminated it from the present fauna. One specimen was trapped along a dry wash where patches of tall grass were separated by areas of almost bare, sandy soil dominated by catclaw.

*Specimens examined.*—*Fowlkes Cave*: 32 palates, 192 lower jaws. *Apache Mountains*: 7 mi. N Kent, 1.

### *Perognathus intermedius intermedius* Merriam

#### Rock Pocket Mouse

We found medium-sized pocket mice impossible to identify on the basis of lower jaws only, and these are the fragments most often found in cave deposits. Many lower jaws too large to be *Perognathus flavus* and too small to be *P. hispidus* were recovered from the black silts of Fowlkes Cave, and these might pertain to *P. intermedius*, *P. nelsoni*, or *P. penicillatus*. The capture of a specimen of *P. intermedius* 16 mi. NE McDonald Observatory, Jeff Davis County, well south of Culberson County, makes it unlikely that *P. nelsoni* ever occurred as far north as the Apache Mountains, because these species are almost entirely allopatric. The Apache Mountain area is well within the range of *P. penicillatus*, but to our knowledge, no specimens of this sand-loving species have been taken any closer to the study area than from the Guadalupe Mountains (Genoways *et al.*, 1979; Schmidly, 1977).

We found *P. intermedius* at the Snyder and Apache ranches, but not at the Fowlkes Ranch, where trapping was more intensive. Most specimens were collected on steep, rocky slopes, although one was trapped in a relatively level grassy area surrounded by scattered rocks.

*Specimens examined.*—*Fowlkes Cave*: 108 jaws, tentatively referred. *Apache Mountains*: 25 mi. NE Van Horn, 2; 24 mi. NE Van Horn, 1; 17 mi. NE Van Horn, 2; 23 mi. ENE Van Horn, 2.

### *Perognathus* sp.

#### Pocket Mouse

A single lower jaw from the black silts of Fowlkes Cave is of a pocket mouse larger than *P. intermedius* but seemingly too small to be assigned to *P. hispidus*. There is no overlap in measurements between these two species in breadth of incisor (*P. nelsoni*, *P. penicillatus*, and *P. flavus* have average and extreme measurements less than those for *P. intermedius*) and the maximum length of mandibular tooth row in *P. intermedius* and *P. nelsoni* is markedly less than the minimum for *P. hispidus*. The single jaw from the cave fits into the hiatus between the large and small taxa. Comparisons indicate that it is remarkably similar to the lower jaw of *P. baileyi*, a pocket mouse not known from east of southwestern New Mexico, 250 miles away. This specimen is unidentifiable at this time. No similar jaws were found in the Pleistocene deposits of Fowlkes Cave.

### *Dipodomys ordii ordii* Woodhouse

#### Ord's Kangaroo Rat

Remains of *Dipodomys ordii* are almost three times as common as those of *D. merriami* in the black silts of Fowlkes Cave, and the difference in relative numbers is even more extreme in the Pleistocene deposits of the cave. At present, *D. ordii* is extremely rare on the Fowlkes Ranch. We captured only two specimens, whereas more than 100 specimens of *D. merriami* were saved and many more discarded. Ord's kangaroo rat prefers sandy soils or sand habitat, little of which now exists about Fowlkes Cave. The area must have been more sandy in the past to support such a sizable population of *D. ordii*.

Our specimens from the Fowlkes Ranch were taken in trap lines where numerous *D. merriami* also were captured. In this area, at least, a sparse population of *D. ordii* exists, surrounded by habitat supporting a large population of *D. merriami*. Ord's



kangaroo rat is extremely abundant, however, in sandy soils and dunes along the southwestern flanks of the Apache Mountains. Many more animals were trapped than were prepared as specimens.

*Specimens examined.*—*Fowlkes Cave*: 19 jaws. *Apache Mountains*: 6 mi. N Kent, 2; 17 mi. E Van Horn, 1; 16 mi. NNE Van Horn, 6; 6 mi. NE Van Horn, 10.

### *Dipodomys spectabilis baileyi* Goldman

#### Banner-tailed Kangaroo Rat

The banner-tailed kangaroo rat is well represented in the black cave silts, and it has occupied the area since the Pleistocene. *Dipodomys spectabilis*, being of a larger size, may have been sought out by barn owls in preference to *D. ordii* and *D. merriami*, both of which are small in size. If this was true, specimens of *D. spectabilis* recovered from cave silts may not reflect the relative population that existed in the area. However, differential predation on the two smaller species should not be influenced by size, and their representation in the cave silts should represent relative numbers that lived in the area.

At present, the banner-tailed kangaroo rat is widespread in the area of the Apache Mountains. It occupies the creosote flats and mesquite-catclaw associations, with marked preference for gently sloping, well-drained ground. The conspicuous mounds are common along the western and eastern flanks of the Apaches. This species avoids the sandy soils where *D. ordii* abounds, and steep slopes and barren rocky areas at higher elevations.

*Specimens examined.*—*Fowlkes Cave*: 6 skulls, 23 lower jaws. *Apache Mountains*: 6 mi. N Kent, 10; 9.7 km. N Kent, 1; 20 mi. NE Van Horn, 2; 25 mi. NE Van Horn, 4; 28 mi. NNW Kent, 2; 23 mi. ENE Van Horn, 3.

### *Dipodomys merriami ambiguus* Merriam

#### Merriam's Kangaroo Rat

Merriam's kangaroo rat is poorly represented in the cave silts. It is extremely abundant throughout the lower elevations of the Apache Mountains today, inhabiting the sandy soils, where it exists with *D. ordii*, the hard soils of the creosote flats, and the sloping lands of the mesquite-catclaw association. Even on the higher hills, a few specimens were taken in patches of suitable habitat at the bases of steep slopes and along dry washes. These kangaroo rats were taken in almost every trap line. Surprisingly, Davis and Robertson (1944) found the species difficult to trap.

*Specimens examined.*—*Fowlkes Cave*: 7 jaws. *Apache Mountains*: 1 mi. N Kent, 2; 2.25 mi. N Kent, 5; 6 mi. N Kent, 72; 6 mi. NNW Kent, 1; 7 mi. N Kent, 2; 9.7 km. N Kent, 1; 9 mi. N Kent, 10; 9.4 mi. N Kent, 1; 9.5 mi. N Kent, 5; 10 mi. N Kent, 1; 18 mi. NNW Kent, 5; 25.6 km. W Kent, 1; 16 mi. W Kent, 8; 20 mi. NE Van Horn, 1; 21 mi. NE Van Horn, 1; 25 mi. NE Van Horn, 3; 28 mi. NNW Kent, 2; 5 mi. N Kent, 3; 17 mi. NE Van Horn, 3; 23 mi. ENE Van Horn, 25.

### *Reithrodontomys montanus griseus* Bailey

#### Plains Harvest Mouse

The plains harvest mouse is the least common harvest mouse in the black cave silts. It is only represented half as well as the fulvous harvest mouse, and the western harvest mouse is seven times more abundant. At the present time, *R. montanus* is a rare resident near Fowlkes Cave and probably elsewhere in the Apache Mountains at low elevations, whereas the western harvest mouse, *R. megalotis*, is common from the creosote flats of the desert to the coniferous forests of the Guadalupe and Davis mountains. However, the fulvous harvest mouse, *R. fulvescens*, seems no longer to occur in Culberson County. It is extremely rare elsewhere in Trans-Pecos Texas and is known from only a few sites. Both *R. fulvescens* and *R. montanus* are grassland species; the latter seems able to persist in the limited areas of tall, dense grass along dry streambeds but the fulvous harvest mouse apparently cannot.

*Specimens examined.*—*Fowlkes Cave*: 14 jaws. *Apache Mountains*: 7 mi. NNE Kent, 1; 9.4 mi. N Kent, 1; 6 mi. N Kent, 1.

### *Reithrodontomys megalotis megalotis* (Baird)

#### Western Harvest Mouse

Remains of the western harvest mouse are numerous in the cave silts. It is a relatively common species in the Apache Mountains area, found from the sparse vegetation of the creosote flats to the juniper-sotol association. It lives, in the latter habitat, on rocky hillsides and in streamside vegetation. Davis and Robertson (1944) considered this species to be rare in Culberson County.

*Specimens examined.*—*Fowlkes Cave*: 53 lower jaws. *Apache Mountains*: 6 mi. N Kent, 9; 7 mi. NNW Kent, 4; 18 mi. NNW Kent, 2; 16 mi. NNE Van Horn, 2.

*Reithrodontomys fulvescens canus* Benson

## Fulvous Harvest Mouse

The fulvous harvest mouse is fairly well-represented in the cave silts but no longer seems to occur in Culberson County or elsewhere in the northern part of Trans-Pecos Texas.

*Specimens examined.*—*Fowlkes Cave*: 14 lower jaws.

*Peromyscus eremicus eremicus* (Baird)

## Cactus Mouse

Techniques for identification of lower jaws of species of *Peromyscus* in Culberson County are discussed by Dalquest and Stangl (1983). Only well-preserved lower jaws of fairly young animals can be identified with confidence. Of the five species of *Peromyscus* recorded in the cave silts, the cactus mouse is the most variable in characters of the lower jaws and teeth. The skull of *P. eremicus* is readily separated from those of all other species of the genus that occur in the Apache Mountains area (Cornely *et al.*, 1979) by the long, slender processes of the premaxillary bone. These extend posteriorly well past the ends of the nasals. The character can be noted even in the uncleaned skull. In the Apache Mountains, *P. eremicus* is often difficult to separate from *P. pectoralis* by other characters.

The cactus mouse is probably the most common *Peromyscus* in the Apache Mountains area. It avoids creosote flats, although it may be taken along the edges of the flats where yuccas or cacti offer suitable cover. On hillsides, it occurs under cover of rocks and dense vegetation. Crevices in cliffs and thickets of lecheguilla are favored shelters. We also have taken *P. eremicus* at the bases of junipers on hillsides and at the tops of ridges, where junipers are isolated and scattered. If the junipers are large and dense, moderately close together, and at higher elevations of about 4500 feet or more, *P. pectoralis* is usually taken.

*Specimens examined.*—*Fowlkes Cave*: 3 jaws. *Apache Mountains*: 1 mi. N Kent, 1; 6 mi. N Kent, 44; 6 mi. NW Kent, 1; 9 mi. N Kent, 1; 9.4 mi. N Kent, 1; 25 mi. NE Van Horn, 1; 17 mi. NE Van Horn, 8; 23 mi. ENE Van Horn, 18; 8 mi. N Kent, 2.

*Peromyscus maniculatus blandus* Osgood

## Deer Mouse

The deer mouse is abundant in sandy-soil areas of the creosote association, especially where there are scattered clumps of

mesquite or other dense bushes separated by areas of sparsely grassed or barren sand. Such habitat is common just back from the margins of some dry washes and in the extensive areas of sand flanking the Apache Mountains to the southwest. The deer mouse is readily recognized by characters of the lower jaws and teeth. It is rare in the cave silts, perhaps partly because its preferred habitat is some distance from the limestone hills containing the cave.

Davis and Robertson (1944) did not record the deer mouse from the Apache Mountains, although Cornely *et al.* (1979) noted that one of the specimens reported by Davis and Robertson as *P. leucopus* was in fact a *P. maniculatus*.

In the Apache Mountains area, as in the Guadalupe Mountains (Genoways *et al.*, 1979), approximately 20 per cent of the adult deer mice are brownish in color; the remainder are pale gray. Both brownish and gray color phases include young adults to old adults. All subadult mice are gray in color but lack the blackish wash of adults in the gray phase. The occurrence of brownish mice does not seem to be due to intergradation between *P. m. blandus* and *P. m. rufinus*, a large, richly colored race with long ears. We see no suggestion of such intergradation in Texas. If it occurs it must take place farther north. The brown color phase of *P. m. blandus* occurs in mice from Presidio and Ward counties as commonly as in Culberson County, and seems to be typical of the subspecies.

*Specimens examined.*—*Fowlkes Cave*: 2 jaws. *Apache Mountains*: 2.25 mi. N Kent, 4; 5 mi. N Kent, 1; 6 mi. N Kent, 38; 6 mi. W Kent, 1; 9 mi. N Kent, 15; 9.4 mi. N Kent, 1; 9.5 mi. N Kent, 3; 9.7 mi. N Kent, 1; 10 mi. N Kent, 2; 2.7 mi. NNE Kent, 5; 16 mi. W Kent, 5; 6 mi. NE Van Horn, 5; 16 mi. NNE Van Horn, 2; 15 mi. E Van Horn, 1; 17 mi. E Van Horn, 1; 28 mi. NNW Kent, 2; 17 mi. NE Van Horn, 1; 23 mi. ENE Van Horn, 1.

### *Peromyscus leucopus tornillo* Mearns

#### White-footed Mouse

The white-footed mouse is more common in the cave silts than is the deer mouse. In the Apache Mountains area today, both species may be common in their preferred habitats, and less common elsewhere. In less well-drained regions of the creosote association, locally dominated by tarbush, we have found *Peromyscus leucopus* to be the most common rodent. This habitat appears to be less desirable to other species that occur in the creosote association. *P. leucopus* also occurs in mesquite-catclaw growth, where more dense vegetation and sandy soils are

found. The restricted habitats of the white-footed mouse today in the Apache Mountains suggest that it is a remnant from a more humid cycle.

Recently, a major chromosomal subdivision within *Peromyscus leucopus* has been described (Baker *et al.*, 1983). Five specimens from 23 mi. ENE Van Horn were karyotyped, and were found to possess the karyotype described for the southwestern chromosomal race.

*Specimens examined.*—*Fowlkes Cave*: 7 jaws. *Apache Mountains*: 2.25 mi. N Kent, 1; 6 mi. N Kent, 2; 7 mi. NNE Kent, 7; 16 mi. W Kent, 1; 25 mi. NE Van Horn, 1; 28 mi. NNW Kent, 2; 17 mi. NE Van Horn, 2; 23 mi. ENE Van Horn, 5.

### *Peromyscus pectoralis laceianus* Bailey

#### White-ankled Mouse

The white-ankled mouse is not as well represented in the black silts as would be expected. Much of the present-day habitat about and above the cave mouth is inhabited by *Peromyscus pectoralis*. The white-ankled mouse is rarely found away from the comparatively dense cover of juniper trees and bushes, and this restriction may help protect them from the attacks of barn owls.

We found it difficult to separate specimens of *P. pectoralis* from *P. eremicus* in the field. The character of the heel (haired in *P. pectoralis* but naked in *P. eremicus*) is difficult to apply, and distortion in the feet of dried specimens makes it useless. However, the posterior extension of the premaxillaries past the nasals as described by Cornely *et al.* (1979), and the comparatively robust external genitalia exhibited by *P. eremicus*, characteristic of the subgenus *Haplomydomys*, permits certain identification.

Elsewhere in the range of *P. pectoralis*, workers may sometimes have trouble distinguishing this species from darker species such as *P. boylii* and *P. attwateri*. In the Apache Mountains area, however, *P. pectoralis* is so pale, yellowish-brown to olive above, that no such confusion could occur. Instead, it is almost indistinguishable from the pale cactus mouse, *P. eremicus*. Schmidly (1977) referred white-ankled mice from all of Trans-Pecos Texas to the race *P. p. laceianus* Bailey, type locality near Kerrville on the Edwards Plateau of Texas. He noted that mice from the Edwards Plateau were darker than those from Trans-Pecos Texas, but considered size more important as a racial character. We have compared white-ankled mice from the Edwards Plateau with those from the Apache Mountains and find them to be so much darker (dark brown to blackish rather than

yellowish to olive) that we find it difficult to believe that they belong to the same subspecies. We have not studied *P. pectoralis* over all of western Texas and adjacent Mexico, but suspect that the subspecies *P. p. eremicoides* Osgood, placed in the synonymy of *P. p. laceianus*, should be revived.

*Peromyscus pectoralis* is found in close association with junipers in the Apache Mountains, at elevations of approximately 4500 feet and above. Such situations seem mostly to exist on the Fowlkes Ranch and, to a lesser extent, elsewhere along the eastern slopes. At lower elevations where junipers grow, and especially in rocky situations, *P. pectoralis* is replaced by *P. eremicus*. Where junipers are scarce or absent at higher elevations, as occurs on the western slopes and interior parts of the Apache Mountains, *P. eremicus* is the common *Peromyscus*, and *P. pectoralis* is rare. On the Apache Ranch, a single specimen was collected high atop a rocky ridge overlooking the ranch headquarters. This species was similarly scarce on the Snyder Ranch.

*Specimens examined.*—*Fowlkes Cave*: 4 lower jaws. *Apache Mountains*: 6 mi. N Kent, 11; 6 mi. NW Kent, 5; 9.6 mi. N Kent, 1; 10 mi. N Kent, 1; 21 mi. NNE Van Horn, 1; 25 mi. NE Van Horn, 3; 17 mi. NE Van Horn, 1.

### *Peromyscus difficilis nasutus* (J. A. Allen)

#### Rock Mouse

Two lower jaws from the black silts of Fowlkes Cave are referable to the rock mouse. The jaws and teeth are too large, and the teeth too complicated, to belong to any other species. Although the rock mouse lived in the Apache Mountains in early Recent time, it seems absent today. Schmidly (1977) and Genoways *et al.* (1979) found this species to be resident in the higher rocky areas of the Guadalupe Mountains, 50 miles from the northern extent of the Apache Mountains.

*Specimens examined.*—*Fowlkes Cave*: 2 lower jaws.

### *Onychomys torridus torridus* (Coues)

#### Southern Grasshopper Mouse

Grasshopper mice are present throughout the cave deposits, but the species most common in the Pleistocene sediments is *Onychomys leucogaster*, a species not present in the Recent black silts or in Culberson County today.

*Onychomys torridus* is quite common in the Apache Mountains area, particularly at lower elevations. We found them

most common in the creosote association with *Dipodomys merriami* and *D. spectabilis*. A few specimens were trapped on sandy areas, but this species is not as restricted to sand as is *O. leucogaster*.

*Specimens examined.*—*Fowlkes Cave*: 39 jaws. *Apache Mountains*: 1 mi. N Kent, 5; 2.25 mi. N Kent, 2; 6 mi. N Kent, 20; 6 mi. NNW Kent, 1; 9 mi. N Kent, 8; 9.5 mi. N Kent, 2; 9.6 mi. N Kent, 1; 15 mi. N Kent, 3; 6 mi. NE Van Horn, 3; 21 mi. NNE Van Horn, 1; 25 mi. NE Van Horn, 1; 38 mi. NNW Kent, 1; 17 mi. NE Van Horn, 1; 23 mi. ENE Van Horn, 1.

### *Sigmodon hispidus berlandieri* Baird

#### Hispid Cotton Rat

The cotton rat is richly represented in the black cave silts, more so than the present numbers or present amount of suitable habitat would permit. We took several cotton rats in traps set in runways through relatively dense vegetation along a roadside north of Kent and along dry stream beds. However, only two specimens were preserved.

*Specimens examined.*—*Fowlkes Cave*: 32 palates, 190 lower jaws. *Apache Mountains*: 6 mi. N Kent, 1; 16 mi. N Kent, 1.

### *Neotoma micropus canescens* J. A. Allen

#### Southern Plains Woodrat

The large southern plains woodrat is well represented in the cave silts. It must be difficult for a barn owl to overcome an adult of this species; most of the bones are of immature rats.

*Neotoma micropus* is the largest and most prominent of the two kinds of woodrats that occur in the Apache Mountains. It tends to occupy level or gently sloping land, where it constructs stick nests under the cover of yuccas, cacti, or mesquite. Trails are broad and prominent. Some animals were taken from the abandoned mounds of the banner-tailed kangaroo rat. Only a few cactus pads at the mouths of burrow entrances suggested that a woodrat might be occupying the burrow. This species has not been taken outside of the creosote and mesquite-catclaw associations.

*Specimens examined.*—*Fowlkes Cave*: 5 skulls, 7 palates, 7 lower jaws. *Apache Mountains*: 6 mi. N Kent, 3; 9.7 km. N Kent, 1; 9.4 mi. N Kent, 1; 16 mi. W Kent, 3; 20 mi. NE Van Horn, 1; 25 mi. NE Van Horn, 2; 17 mi. NE Van Horn, 1.

*Neotoma albigula albigula* Hartley

## White-throated Woodrat

Although *Neotoma albigula* lives in and near Fowlkes Cave, its remains were less common in the cave silts than were those of the southern plains woodrat. This probably results from the relatively sheltered habitat of this species, whereas the more open habitat occupied by *Neotoma micropus* may make the latter species more susceptible to the attacks of barn owls.

The white-throated woodrat occupies limestone cliffs, ledges, and talus (Cornely, 1979), usually where there are patches of cacti, lecheguilla, or juniper trees. Here it is found in association with *Peromyscus pectoralis* and *P. eremicus*. One can usually determine from habitat and nests whether the southern plains or white-throated species is present at a site. Nests of *Neotoma albigula* are small and usually are partly or completely under cover of rocks and are not prominent. Almost all our specimens of *N. albigula* came from the juniper-sotol association.

*Specimens examined.*—*Fowlkes Cave*: 1 skull, 1 palate, 3 lower jaws, 1 mummified carcass. *Apache Mountains*: 6 mi. N Kent, 9; 6 mi. W Kent, 1; 25 mi. NE Van Horn, 1.

*Canis latrans texensis* Bailey

## Coyote

One coyote tooth was found in the black silts of the cave. No specimens were obtained, but howls were heard on numerous occasions throughout the Apache Mountains area during the evening hours. Davis and Robertson (1944) recorded specimens from 23 mi. N Kent. We sighted a single animal 17 mi. NE Van Horn; it was flushed from its daytime retreat in a heavy stand of mesquite surrounding a dry stock tank.

*Specimens examined.*—*Fowlkes Cave*: 1 lower incisor.

*Vulpes macrotis neomexicana* Merriam

## Kit Fox

No certain evidence of kit foxes was obtained in the area, although Mrs. Snyder told us that the species, known locally as "red fox," are regularly seen while night-driving. An old den site, possibly attributed to kit foxes, was discovered in a large mound of soil in an old quarry about 20 mi. NW Kent. Three circular entrances, measuring about 30 centimeters in diameter, were littered with weathered droppings of a small canid and skeletal



remains of kangaroo rats. Fresh rodent droppings indicated that the burrow system is now inhabited by *Dipodomys spectabilis*.

*Urocyon cinereoargenteus scotti* Mearns

Gray Fox

Gray foxes are not uncommon in rocky areas of the Apache Mountains, according to Mrs. Snyder, and are usually seen while driving at night. However, we found no sign of this species during our investigations in the area.

*Bassariscus astutus flavus* Rhoads

Ringtail

No ringtail remains were found in the cave silts, but the partly articulated skeleton of a specimen was recovered from the cave floor. We also noted tracks and droppings of ringtails in the cave, and presume these agile climbers can enter and leave it at will.

Mr. Fowlkes told us that ringtails are trapped on his ranch for their fur during the legal trapping season.

*Specimens examined.*—*Fowlkes Cave*: 1 skull with lower jaws.

*Mustela frenata neomexicana* (Barber and Cockerell)

Long-tailed Weasel

We found no evidence of weasels in Fowlkes Cave or anywhere in the Apache Mountains area. Davis and Robertson (1944) collected a specimen 1.5 mi. N Kent, the only record from Culberson County. If still present, the long-tailed weasel must be rare.

*Taxidea taxus berlandieri* Baird

Badger

We neither saw nor obtained badgers in the Apache Mountains. Their characteristic diggings were seen, however, 6 mi. N Kent, and 25 mi. NE and 23 mi. ENE Van Horn.

*Felis concolor stanleyana* Goldman

Mountain Lion or Cougar

The mountain lion is responsible for livestock predation on the Apache Ranch, according to Mr. Fred Armstrong and his ranch hands. Sightings are commonly made, and one animal was killed by ranchers about 20 mi. W Van Horn just prior to our collecting

trip in March 1984. However, the carcass was not available for inspection. We have little doubt that mule deer make up the bulk of this carnivore's diet.

*Felis rufus texensis* J. A. Allen

Bobcat

Tracks of bobcat were noted in the dust of a ranch road on the Fowlkes Ranch, and in the dry sand of an arroyo on the Snyder Ranch. Mrs. Snyder told us that one bobcat was responsible for predation on domestic stock near their ranch house.

*Tayassu tajacu angularis* (Cope)

Collared Peccary or Javelina

We saw no javelinas or evidence of their presence in the Apache Mountains area, and no remains were found in Fowlkes Cave. Javelinas were seen about 12 mi. S Kent and are common in the Davis Mountains. One skull was found in a sanitary landfill 1 mi. N Kent. That animal may have died or been killed at the site, perhaps run over by a car, or may have come from elsewhere and been discarded at the site.

*Specimens examined.*—*Apache Mountains:* 1 mi. N Kent, 1.

*Antilocapra americana mexicana* Merriam

Pronghorn

We are not aware of any records of pronghorn in the Apache Mountains area in modern times but the species doubtless occurred there in the past. The pronghorn occupied a good part of Culberson County as late as 1925 (Schmidly, 1977) but now occurs no nearer than the Delaware Mountains, to the north. Pronghorns are abundant in parts of Jeff Davis County, less than 50 miles to the south of the Apache Mountains.

*Ovis canadensis mexicana* Merriam

Bighorn Sheep

Although bighorn sheep do not now occupy the Apache Mountains, they likely did so in the past. Schmidly (1977:205) cited several specimens from the Guadalupe Mountains of Culberson County and a specimen in the United States National Museum from "mts. near Van Horn" that could have come from the Apaches.

*Odocoileus hemionus crooki* (Mearns)

## Mule Deer

Mule deer are common in the Apache Mountains, as evidenced by droppings observed regularly on hillsides and slopes. Sightings near Fowlkes Cave and the Apache Ranch, and a weathered skull from the Apache Ranch, further establish the presence of the species.

*Specimens examined.*—Apache Mountains: 17 mi. ENE Van Horn, 1.

*Odocoileus virginianus carminis* Goldman and Kellogg

## White-tailed Deer

We found no evidence of white-tailed deer during our work in the Apache Mountains but Davis and Robertson (1944) reported positive sight identification of this deer 4 mi. NW Kent. White-tails are abundant in the Davis Mountains, just to the south of the Apache Mountains. Krausman *et al.* (1978) referred the white-tailed deer from central Coahuila northward through the Davis Mountains of Texas to *Odocoileus virginianus carmenis* but did not mention Davis and Robertson's record, cited above. Our reference of Apache Mountains white-tails to *O. v. carmenis* is arbitrary. A resident population, if it still exists in the Apache Mountains, may belong to *O. v. texanus* (Mearns).

## HYPOTHETICAL LIST

The following list includes species that probably now occur, or occurred, in the Apache Mountains area. The bats and carnivores need additional work to substantiate their presence: *Myotis yumanensis*, Yuma Myotis; *Myotis thysanodes*, Fringed Myotis; *Myotis leibii*, Small-footed Myotis; *Plecotus townsendii*, Townsend's Big-eared Bat; *Tadarida macrotis*, Big Free-tailed Bat; *Eumops perotis*, Underwood's Mastiff Bat; *Spermophilus mexicanus*, Mexican Ground Squirrel; *Perognathus penicillatus*, Desert Pocket Mouse; *Erethizon dorsatum*, Porcupine; *Spilogale gracilis*, Western Spotted Skunk; *Mephitis mephitis*, Striped Skunk; *Mephitis macroura*, Hooded Skunk; *Conepatus mesoleucus*, Western Hog-nosed Skunk; *Bison bison*, Bison.

## DISCUSSION

Table 2 shows that nearly all of the mammal species of the modern fauna of the Apache Mountains, other than bats and

TABLE 2.—Representation of species of mammals in the cave silts and modern fauna.

Species	Cave silts	Modern fauna
<i>Notiosorex crawfordi</i>	x	
<i>Mormoops megalophylla</i>		x
<i>Myotis californicus</i>		x
<i>Myotis velifer</i>	x	
<i>Pipistrellus hesperus</i>		x
<i>Eptesicus fuscus</i>	x	
<i>Lasiurus cinereus</i>		x
<i>Antrozous pallidus</i>	x	x
<i>Tadarida brasiliensis</i>		x
<i>Homo sapiens</i>	x	x
<i>Sylvilagus audubonii</i>	x	x
<i>Lepus californicus</i>	x	x
<i>Ammospermophilus interpres</i>		x
<i>Spermophilus spilosoma</i>		x
<i>Spermophilus variegatus</i>	x	x
<i>Cynomys ludovicianus</i>	x	x
<i>Thomomys bottae</i>	x	x
<i>Cratogeomys castanops</i>	x	x
<i>Perognathus flavus</i>	x	x
<i>Perognathus hispidus</i>	x	x
<i>Perognathus intermedius</i>	x	x
<i>Perognathus sp.</i>	x	
<i>Dipodomys ordii</i>	x	x
<i>Dipodomys spectabilis</i>	x	x
<i>Dipodomys merriami</i>	x	x
<i>Reithrodontomys montanus</i>	x	x
<i>Reithrodontomys megalotis</i>	x	x
<i>Reithrodontomys fulvescens</i>	x	
<i>Peromyscus eremicus</i>	x	x
<i>Peromyscus maniculatus</i>	x	x
<i>Peromyscus leucopus</i>	x	x
<i>Peromyscus pectoralis</i>	x	x
<i>Peromyscus difficilis</i>	x	
<i>Onychomys torridus</i>	x	x
<i>Sigmodon hispidus</i>	x	x
<i>Neotoma micropus</i>	x	x
<i>Neotoma albigula</i>	x	x
<i>Canis latrans</i>	x	x
<i>Vulpes macrotis</i>		x
<i>Urocyon cinereoargenteus</i>		x
<i>Bassariscus astutus</i>	x	x
<i>Mustela frenata</i>		x
<i>Taxidea taxus</i>		x
<i>Felis concolor</i>		x
<i>Felis rufus</i>		x
<i>Tayassu tajacu</i>		x
<i>Odocoileus hemionus</i>		x
<i>Odocoileus virginianus</i>		x
<i>Antilocapra americana</i>		x

large mammals, are represented in the cave fauna. The absence of some of the bats from the deposits in the cave is rather difficult to explain. Possibly there are, or were, other caves in the vicinity more attractive to *Tadarida*, for example, than is Fowlkes Cave. Other bats are species not expected to occur in caves. Weasels and various species of ground squirrels are small enough to be taken by barn owls, but are mostly or wholly diurnal, and thus are not active when owls are hunting, and their absence from the cave silts is predictable. The remaining carnivores and ungulates are large taxa and would not be found in the Fowlkes Cave silts except under rather unusual conditions.

No species that occurs or occurred in Culberson County in modern times and is absent from the cave silts is considered by us to be significant as an indicator of climatic change or useful in assessing mammalian distribution dynamics. However, *Reithrodontomys fulvescens* and *Peromyscus difficilis* are present in the cave silts but seemingly absent from the modern fauna, and we do consider these absences significant. We feel that further collecting will show that *Notiosorex crawfordi* is a moderately common species in the Apache Mountains. This shrew is notably difficult to take in traps. Similarly, we feel that *Myotis velifer*, *Eptesicus fuscus*, and other bat species would be taken if more nets were set for bats, especially later in spring or summer.

Significant are the relative numbers of some species in the cave silts as compared with the modern fauna. *Perognathus hispidus* is common in the cave silts but rare in the modern fauna, as is *Dipodomys ordii*, whereas *D. merriami* is abundant in the modern fauna but comparatively rare in the cave silts. *Reithrodontomys montanus* is rare today and relatively common in the cave silts. *Sigmodon hispidus* is present today only in narrow belts along some washes where there is tall grass, but is abundant in the cave silts.

*Reithrodontomys fulvescens*, *R. montanus*, *Perognathus hispidus*, and *Sigmodon hispidus* all prefer grassland habitats. *Dipodomys ordii* is a species that prefers sandy habitat. These taxa have seemingly decreased markedly in numbers since the Pleistocene. Rodents adapted to the creosote flats and mesquite-catclaw habitat, such as *Dipodomys merriami*, seem to have maintained their relative numbers.

The absence of *Peromyscus difficilis* from the modern fauna may be due to the increased aridity or increase in average temperature. In Texas, the rock mouse occupies rocky habitats at high elevation.

We conclude that most of the species of small mammals that lived in the Apache Mountains area since the end of the Pleistocene, other than those species exterminated by man, still occur there. The major evidence of change noted is the reduction of grassland, shown by marked decrease of grassland species.

#### MAMMALS OF THE NORTHERN FRONT RANGE

The Front Range includes, from north to south, the Guadalupe Mountains, Delaware Mountains, Apache Mountains, Davis Mountains, and, farther south, the Santiago and Carmen mountains, in all reaching from New Mexico to the Rio Grande. The Guadalupe Mountains National Park includes more than 76,000 acres of land and habitat from arid creosote flats to pine forest of the high mountains. The mammals of the park have been described in detail by Genoways *et al.* (1979). The Apache Mountains area and its mammals have been described herein. Between the two areas stretch the Delaware Mountains, where little work on the distribution of mammals has been carried out. The Davis Mountains differ from the Apache Mountains and the northern part of the Front Range in that they are composed of volcanic rock, whereas the northern mountains are largely sedimentary, mostly limestone. The higher parts of the Davis Mountains are a montane forest rich in mammals that have attracted mammalogists since Bailey (1905) worked there. The higher, truly montane parts of the Davis Mountains lie in Jeff Davis County, but the range extends as desert mountains, with some higher parts becoming montane woodland, into northern Brewster County. For our purposes, the boundary separating the northern edge of the Davis Mountains from the Apache Mountains is Interstate Highway 10, by coincidence almost the boundary between the northern sedimentary and southern volcanic regions.

Although the mammals of the higher Davis Mountains have been studied and reported on, the mammals of the surrounding lowlands have not. Schmidly (1977) listed records of most species that occur in the desert lowlands surrounding the Davis Mountains, and from the mountains themselves. We have relied on these records and specimens from the collections of Midwestern State University and Texas Tech University for the information in Table 3. Mammals of the Delaware Mountains are not included in the table.

Little significance should be attached to the fact that some bats occurring in the Guadalupe and Davis mountains were not found in the Apache Mountains. Some of these doubtless do occur there, but our collecting trips to the Apache Mountains were made too early in the spring for effective bat netting, and *Myotis volans* may avoid the arid Apache Mountains in favor of the forested highlands to the north and south. Similarly, several carnivores known from the Davis and Guadalupe ranges are not recorded from the Apache Mountains. We had no opportunity to collect carnivores, and historical records for such larger species as the timber wolf and bears are lacking for this area.

The rabbits and rodents show some intriguing distributional patterns. In general, as might be expected, the desert rabbits and rodents that occupy the mountain flanks and surrounding lowlands are found surrounding the entire northern part of the Front Range from central Brewster County to the New Mexico-Texas border. However, there are exceptions. *Spermophilus mexicanus* is found throughout moderate elevations in the Davis Mountains, but has not been reported from the Apache Mountains and the Guadalupe Mountains. *Perognathus penicillatus* is found in the lowlands about the Davis and Guadalupe mountains, but we failed to find it in the Apache Mountains area. *Perognathus intermedius* occurs in the Guadalupe and Apache mountains, but not in the Davis Mountains (one specimen from 15 mi. S Kent in Jeff Davis County is in the extreme northern part of the Davis Mountains as we here define the range). *Perognathus nelsoni* occupies habitat in the Davis Mountains area similar to that occupied by *P. intermedius* farther north. *Reithrodontomys montanus* and *R. fulvescens* have been recorded from the lowlands about the Davis and Apache mountains (in the latter, only from Recent cave silts in Fowlkes Cave), but neither have been found in the Guadalupe Mountains.

In contrast to desert mammals, some species of montane mammals occur in the Guadalupe and Davis mountains, but are absent from the intervening barren ranges. *Myotis volans*, *Sylvilagus floridanus*, *Peromyscus boylii*, and *Neotoma mexicana* are examples.

The yellow-nosed cotton rat, *Sigmodon ochrognathus*, occupies the Davis Mountains, but not the Guadalupe Mountains. A chipmunk (*Eutamias canipes*), a vole (*Microtus mexicanus*), and

TABLE 3.—Mammals of the Front Range, Trans-Pecos Texas, recorded from historical times.

	Guadalupe Mountains	Apache Mountains	Davis Mountains
<i>Notiosorex crawfordi</i>		x	x
<i>Mormoops megalophylla</i>		x	
<i>Myotis yumanensis</i>			x
<i>Myotis velifer</i>	x	x	x
<i>Myotis thysanodes</i>	x		x
<i>Myotis volans</i>	x		x
<i>Myotis californicus</i>	x	x	x
<i>Myotis leibii</i>	x		x
<i>Lasionycteris noctivagans</i>	x		x
<i>Pipistrellus hesperus</i>	x	x	x
<i>Eptesicus fuscus</i>	x	x	x
<i>Lasiurus borealis</i>			x
<i>Lasiurus cinereus</i>	x	x	x
<i>Plecotus townsendii</i>	x		x
<i>Antrozous pallidus</i>	x	x	x
<i>Tadarida brasiliensis</i>	x	x	x
<i>Tadarida macrotis</i>	x		x
<i>Sylvilagus floridanus</i>	x		x
<i>Sylvilagus audubonii</i>	x	x	x
<i>Lepus californicus</i>	x	x	x
<i>Eutamias canipes</i>	x		
<i>Ammospermophilus interpres</i>	x	x	x
<i>Spermophilus mexicanus</i>			x
<i>Spermophilus spilosoma</i>	x	x	x
<i>Spermophilus variegatus</i>	x	x	x
<i>Cynomys ludovicianus</i>	x	x	x
<i>Thomomys bottae</i>	x	x	x
<i>Cratogeomys castanops</i>	x	x	x
<i>Perognathus flavus</i>	x	x	x
<i>Perognathus hispidus</i>	x	x	x
<i>Perognathus penicillatus</i>	x		x
<i>Perognathus intermedius</i>	x	x	
<i>Perognathus nelsoni</i>			x
<i>Dipodomys ordii</i>	x	x	x
<i>Dipodomys spectabilis</i>	x	x	x
<i>Dipodomys merriami</i>	x	x	x
<i>Reithrodontomys montanus</i>		x	x
<i>Reithrodontomys megalotis</i>	x	x	x
<i>Reithrodontomys fulvescens</i>			x
<i>Peromyscus eremicus</i>	x	x	x
<i>Peromyscus maniculatus</i>	x	x	x
<i>Peromyscus leucopus</i>	x	x	x
<i>Peromyscus boylii</i>	x		x
<i>Peromyscus pectoralis</i>	x	x	x
<i>Peromyscus difficilis</i>	x	x	
<i>Peromyscus truei</i>	x		



TABLE 3.—Continued.

<i>Onychomys torridus</i>	x	x	x
<i>Sigmodon hispidus</i>	x	x	x
<i>Sigmodon ochrognathus</i>			x
<i>Neotoma albigula</i>	x	x	x
<i>Neotoma micropus</i>	x	x	x
<i>Neotoma mexicana</i>	x		x
<i>Microtus mexicanus</i>	x		
<i>Erethizon dorsatum</i>	x		x
<i>Canis latrans</i>	x	x	x
<i>Canis lupus</i>	x		x
<i>Vulpes macrotis</i>		x	x
<i>Urocyon cinereoargenteus</i>	x	x	x
<i>Ursus americanus</i>	x		x
<i>Ursus arctos</i>			x
<i>Bassariscus astutus</i>	x	x	x
<i>Procyon lotor</i>	x		x
<i>Mustela frenata</i>	x	x	
<i>Taxidea taxus</i>	x	x	
<i>Spilogale gracilis</i>	x		
<i>Mephitis mephitis</i>	x		x
<i>Conepatus mesoleucus</i>	x		x
<i>Mephitis macroura</i>			x
<i>Felis concolor</i>	x	x	x
<i>Felis rufus</i>	x	x	x
<i>Tayassu tajacu</i>		x	x
<i>Odocoileus hemionus</i>	x	x	x
<i>Odocoileus virginianus</i>	x	x	x
<i>Antilocapra americana</i>	x	x	x
<i>Ovis canadensis</i>	x	x	

two species of *Peromyscus* (*P. truei* and *P. difficilis*) live in the Guadalupe Mountains but not in the Davis Mountains.

The Front Range in Texas shows transition from the mammalian fauna of the Rocky Mountains in the United States to that of the Sierra Madre Oriental of Mexico. Additional work in the intervening mountain ranges should detail this transition more exactly.

#### ACKNOWLEDGMENTS

Numerous individuals have contributed both to the excavation of cave silts, and to the collection and preparation of specimens. In addition to mammalogy and field zoology students from Midwestern State University, we also wish to thank Edward Matelski, Guy Nelson, Gregory Zolnerowich, David Holub, G. James Merchant, Tom McElroy, Holly McElroy, Craig Hood,

Ben Koop, Lynn Robbins, Robert Hollander, Steve Kasper, and David McCullough. Laurie Robbins collected and identified plants in compiling Table 1. For critical readings of the manuscript, we thank Craig Hood, Robert Hollander, J. Knox Jones, Jr., Robert Owen, David Schmidly, and an anonymous reviewer.

Finally, we express our appreciation to the following landowners whose permission to work on their property made this study possible: J. M. Fowlkes, Mr. and Mrs. George Snyder, Fred Armstrong, Cole Armstrong, and Scott Armstrong.

Parts of this study were supported by a Midwestern State University Faculty Grant (to WWD), and grants from the Institute for Museum Research of Texas Tech University (to FBS), and the Theodore Roosevelt Memorial Fund (to FBS).

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ISSN 0149-175X

Texas Tech University Press  
Lubbock, Texas 79409